THE IRON AND STEEL INSTITUTE.

On Friday morning, the 6th inst., the proceedings of the Institute began by Mr. Michael Scott reading a paper

On Hydraulic Machinery for Steel Works.

This paper dealt with balancing and varying the power of hydraulic cranes. The author's thesis may be thus stated. It is well known that direct-acting hydraulic cranes and lifts of the ordinary kind are imperfect in balance and variability of force. The weight of the moving parts is considerable, and loss is incurred by the necessity of raising this weight as well as the load. Secondly, if the lifting power of the crane be invariable, then in raising variable loads power must occasionally be lost. It would therefore appear to be desirable to provide means by which the weight of the moving parts of cranes and lifts should be balanced, and the power should be varied in proportion to the load to be raised. The author next proceeded to glance at the history of what had been done in this direction by the late Col. Clay and others, and he finally explained the system which he had devised. A diagram illustrated his apparatus. Mr. Scott proposes that certain engines or machines be provided which would receive the waste water from the cranes at low pressure and return it at a high pressure. In order to provide for uninterrupted continuous action, there are two machines similar in form and dimensions. Each consists mainly of a hydraulic cylinder and ram, the lower end of which ram is a piston fitting the cylinder, and on the top of each ram rests a weight. Speaking generally, the action of the machines would be as follows:—The waste water from the cranes and lifts being under the pressure due to the weights on their descending rams, on its admission into the cylinder of one machine below the piston, it and the ram would rise. When up to the top of the stroke, the waste water from the cranes would be shut off, and it would be turned on to the other machine, whose piston and ram would likewise ascend. Meantime communication having been opened between the top and bottom of the cylinder of the first machine, and simultaneously between the cylinder and the high-pressure main supplying the cranes and lifts, the piston, so far as the annular space round the ram is concerned, would be in equilibrium, and the counterpoise weight would cause it and the ram to descend, forcing out of the cylinder and into the pressure main a quantity of water equal to the capacity of the cylinder, minus that of the annular space, or, in other words, equal to the displacement of the ram. It will be obvious that the pressure required to raise the ram, acting as it would upon the whole area of the piston, would be less than the pressure under which the water would be expelled when the ram descended, when the surface upon which the pressure would act would be the area of the ram only, and by varying the relative proportions of piston and ram, any difference of pressure might be obtained, and that, so far as the action of the machines is concerned, deducting friction, the power expended in raising the rams would be given out again in their descent in a more concentrated form. Mr. Scott then described in detail the operation of his system in a steel works, and concluded by saying that at a future time he would take up the subject of cranes and other appliances for both the Bessemer and Siemens processes.

The discussion was opened by Mr. Walker, of the firm of Tannett, Walker, and Co. Mr. Walker stated that compound pumping engines were more economical than non-compound pumping engines by 30 per cent., and he set about proving his statement by pointing out that at the East and West India Docks they had one-third of their boilers standing. No one was likely to dispute Mr. Walker's statement, inasmuch as he gave no one the least idea what the duty of either the compound or the non-compound engine was. Mr. Walker left out all the data of any interest to engineers. He then went on to say that no class of men were more rude than forgemen, and that nothing but the roughest appliances would stand the rough treatment of forge hands. Mr. Scott had in his appliances a great many bends and turns and valves, and all these represented a loss of pressure and power. Mr. Charles Markham, of Staveley, argued that Mr. Scott's machinery must fail because it had a couple of pistons. He had himself tried all kinds of pistons, packed with wood, leather, hemp, metallic packing, &c., and he could not get them to stand when the water was in the least dirty.

Mr. Menelaus spoke next and enlivened the discussion by stating that for twenty years he had never gone into a Bessemer converter house without a feeling of bitter vexation when he saw the ingot cranes at work; at last he could bear with them no longer, and got from Mr. Walker certain of his balanced cranes, and he could say that during two months these cranes had been at work he had suffered more annoyance and vexation than in all the twenty years which had preceded. As this statement was the very opposite of what the meeting anticipated, it was received with much amusement. Mr. Menelaus added that both Mr. Scott and Mr. Walker were on the right track; but certainly success had not yet been attained.

The moment Mr. Menelaus sat down Mr. Snelus jumped up to defend Mr. Walker. He stated that he had no fewer than six of his cranes at work, and that they gave every satisfaction. It was true that at first they were very slow in turning, but after some rollers had been put under the jib they worked quite well. Mr. Walker, being, as may be supposed, by no means pleased with Mr. Menelaus's statements, now got up and asked permission to explain that the cranes with which Mr. Menelaus found fault were not designed by him; Mr. Menelaus supplied the drawings and the specifications. This apparently completely turned the tables on Mr. Menelaus, and caused much laughter; but Mr. Menelaus was not to be beaten readily, for *he* begged leave to explain that Mr. Walker's draughtsmen had made out an entirely new design, and the firm had not worked to his drawings at all. This passage of arms over, Sir Henry Bessemer stated that when he designed the original type of crane which vexed the soul of Mr. Menelaus, he did so to get something which would clear the ingots quickly out of the pit. This special crane had peculiar advantages, and though he hoped some one would improve on it, it was not to be very easily done. Mr. Winsor Richards complained that Mr. Scott's apparatus was too complex; when he sat down, Mr. Williams, past president, got up to say a word in defence of the forgemen. Work in a forge was not clean and dainty and white-handed, like that of an engineering draughtsman. If, however, the draughtsmen would deal less in theory, and give the forgemen more scope, they would be less troubled than they were by breakdowns. It was well known in ironworks that it was unsafe to put down "tackle," that is machinery, designed by engineers; and his own practice was to make the best guess he could at what was likely to be strong enough, and when he had made up his mind that it was certainly strong enough to stand anything, he made it four times stronger still, and such machinery never broke down.

Mr. Scott replied generally on the discussion, pointing out that the machine he described would take the place of at least half-a-dozen others. The piston ought to stand very well, as the pressure on it would not exceed 150 lb. per square inch, and as the same water would be used over and over again, he did not see how it could become dirty. A vote of thanks was passed unanimously.

Mr. G. Bower, of St. Neots, then read a paper on

The Preservation and Ornamentation of Iron and Steel Surfaces.

In this paper the author described his own process and that of Professor Barff for protecting iron surfaces from rust by coating them with black magnetic oxide, $Fe_3 O_4$. The process has been fully described in our pages. Mr. Bower, it will be remembered, submits the iron to be coated to hot air in a furnace, while Professor Barff supplies the necessary oxygen by sending into the oven containing the articles to be coated superheated steam. A combination of the two processes is found to be superior to either alone, one doing best for cast and the other for wrought iron; and Mr. Bower, after paying a high compliment to Professor Barff, stated that he had purchased the whole of his patents. He then detailed his more recent progress to success, and exhibited several beautiful specimens.

It was noteworthy that in the discussion which followed, the chemists, many of whom were present, hardly took any part. There was not a dissentient voice, and the discussion possessed little or no interest. It was, in short, quite unworthy of the subject. Sir John Alleyne hoped that it might be found useful in protecting the surface of iron kept in stock, which if it rusted became unsaleable. Mr. J. Head pointed out that its value for protecting iron roofs could hardly be overrated. He cited the case of the new railway station at York, which is now being repainted at a cost of no less than £2000. If it would take the place of galvanising for sheets it would confer a boon on all who had to use sheets for roofing.

Mr. Riley stated that the black oxide being electro positive to bright iron or steel, he wished to know what would occur to bolt or rivet holes drilled in, say, an angle iron after treatment. Mr. Tweedie explained that the holes might be made first and the bar treated subsequently, but even if this was not done little harm would ensue, because the corrosion would not run under the oxide as it would under paint, but was rigidly localised. Professor Barff's son, speaking to the same point, said that iron pipes with a coating inside and out had been specially tested, the oxide being taken off in spots outside. The iron was attacked by sulphate of copper, which ate its way steadily through until it reached the coating on the inside, which it left intact.

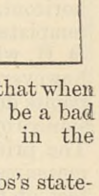
Mr. Bower replied to the whole discussion, answering questions and explaining certain phases of the process more in detail than he had previously done. A vote of thanks was passed, and Mr. Parry then read his paper,

On Hydrogen and Carbonic Oxide in Iron and Steel.

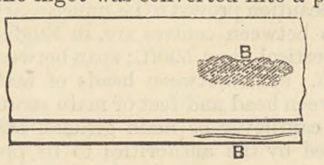
We have very fully and very recently dealt with this subject in our pages, and Mr. Parry went to a large extent over the same ground, discussing all the experiments which have from time to time been made to ascertain the weight of gas contained in iron and steel. The author then went on to describe some of his own experiments made at Ebbw Vale. He heated the metal in tubes kept exhausted; glass failed, and strong porcelain was finally employed. The tubes used were previously heated in vacuo to remove any natural gas which might possibly be present, to the highest heat—nearly sufficient for the fusion of grey iron—the tube would bear. At this temperature it was found impossible to maintain a good vacuum; the metal continued to evolve gas for days, in one instance even after seven days' continuous heating. In the first stage, at a dull red heat gas was evolved freely for about six hours, when it almost ceased. At a bright red it was again rapidly given off for about twelve hours. The iron now appeared nearly exhausted, but an increase of heat had the effect of again starting the flow of gas, and this continued up to the highest heat attainable. The evolution of carbonic oxide, in part, at least, appears to be due—(1) to the reducing action of carbon on the silicious material of which porcelain is composed. Iron wrapped in platinum, and therefore not in contact with silica, gave considerably less carbonic oxide; (2) iron and steel may contain oxide of iron, which is reduced to the metallic state by carbon with a consequent evolution of gas. The evolution of carbonic oxide may be the result of these reactions. Concerning the evolution of hydrogen, to remove all uncertainty arising from possible leakage the author proposes heating the metal enclosed in an exhausted glass globe by means of the electric current derived from a powerful battery, or, better still, a dynamo machine. A bar of metal large enough for subsequent mechanical and chemical tests might thus be treated. With a properly constructed apparatus there would be no errors from leakage due to the possible porosity of the heated tube, thus affording a fair chance of quantitatively determining the hydrogen, &c., evolved. The matter thus volatilised may be examined with the spectroscope with possibly interesting results. One of the conclusions at which the author arrived, was that the temperature at which steel is worked, and the rate at which it is cooled, much affect its physical qualities.

Mr. Snelus began the discussion, and he admitted at the outset, what we have recently and often urged, namely, that the existing knowledge of the chemistry of iron and steel is very imperfect, and he hoped that the physicist and the chemist would combine together to dispel this ignorance. It was well known that steel absorbed gases. Bessemer had found out very early, in the infancy of his process, that steel absorbed CO. Stead and Richards held that it absorbed hydrogen and nitrogen, and not CO; at first he believed that steel absorbed CO, then rejected that belief, but now he was inclined to go back to the old view. He then proceeded to point out that when air was blown through melted steel there must be large volumes of carbonic oxide produced, and it was extremely likely that this would be absorbed in part; and he was quite certain that CO played a very important part in determining the quality of a steel. Oxygen made a steel red short, but carbonic oxide made it cold short, and he classed it with phosphorus. It might be said that the weight of the gas present in any given specimen was too small to have much effect; but they must not forget that as little as ·02 per cent. of phosphorus would prevent a steel from taking a fine cutting edge, and that was the principal reason why the product of the converter failed for cutlery.

Sir Henry Bessemer then described the experiments he had made, no account of which had ever before been published. He had two iron vessels constructed shaped like large flower-pots, and fitted with flanges by which they could be secured together mouth to mouth air-tight. In one of these vessels he placed a 40 lb. crucible containing 12 lb. of pure molten iron obtained by blowing through melted metal with a blow-pipe. The other vessel was then inverted over that containing the crucible, and the two were bolted together air-tight. Secured in what was now the top of the inverted vessel, was a short bit of 2in. pipe, to the end of which was fastened a disc of stout glass; through this what went on inside could be seen. On exhausting the air from the vessels the contents of the crucible rose up and boiled over the edge. A vacuum of about 13 lb. could be got. By re-admitting air, the metal sank, the boiling ceasing. He had the gas drawn off, analysed three times, and each time the result was the same; the gas was carbonic oxide. When Mr. Bessemer had finished, Mr. Stubbs got up, and made an exceedingly startling statement. Mr. Stubbs seems to be a very competent chemist, and spoke with all modesty and to the point. He explained that he had occasion not long since to analyse some borings from a large ingot, and he found that these contained more carbon, sulphur, and phosphorus, almost than the original pig. Surprised by this, he went over his experiment three times, always with the same result. Then he consulted with the manager, got more borings from other places in the ingot, and after numerous experiments arrived at the conclusion that ingots are not homogeneous—that is to say, impurities are not equally distributed through them. His view is that the impurities tend to find their way to that part of the ingot which remains longest fluid, as, for example, at A in sketch.



Thus, for example, drillings taken from a point about 23in. from the bottom of a very large ingot, gave on analysis, carbon, ·92; manganese, ·535; sulphur, ·161; silicon, ·043; and phosphorus, ·261 per cent.; but drillings taken from another point in the same ingot gave carbon, ·37; manganese, ·498; sulphur, ·025; phosphorus, ·096; and silicon, ·006 per cent. The effect of the imperfect distribution of impurities would be that when the ingot was converted into a plate there would be a bad place at B B in the sketch.



To Mr. Stubbs's statement, Mr. Riley lost not a moment in taking vigorous exception. He asserted that the ingot did not remain fluid long enough to permit the elimination of the impurities in the way supposed, asserting that in five minutes after an ingot was cast it could be taken out of the mould and moved. He had made all sorts of analyses, and never with a result like that obtained by Mr. Stubbs. He admitted, however, that it was almost impossible to find out how much manganese was in steel. He held that solidification would set in too soon with an ingot 15in. or 20in. square to prevent elimination. Mr. Smith explained that the ingots which Mr. Stubbs had analysed were 32in. in diameter and 7ft. long. Mr. Riley's experience did not appear to extend to such enormous ingots as this, and after a few words about the Livadia's plates, he sat down. Mr. Cowper explained that planings taken off $\frac{1}{16}$in. thick at a time were sent to the chemist for analysis, and it did seem that in the Livadia's plates the impurities were not evenly distributed.

Mr. Parry replied briefly, and held that absorption of gases was a function of temperature. He suggested that a very valuable experiment might be made by heating steel in vacuo. A vote of thanks having been passed, Mr. Alexander E. Tucker read a paper

On a New Method for the Determination of Oxygen in Iron and Steel.

This paper was a description of a chemical process based on the following proposition:—If an iron or steel containing oxygen be melted in contact with pure charcoal, a removal of oxygen and an absorption of carbon will take place, and if we weigh the iron before and after the experiment, and estimate the carbon before and after the experiment, we have data from which we can estimate the oxygen originally present in the steel.

No discussion followed; indeed, there were not a dozen people present when the paper was read. A vote of thanks was passed to Mr. Tucker; another to the members of the Institution of Civil Engineers for the loan of their hall; and a third to Mr. Smith for the manner in which he had filled the chair, and the meeting was over.

On the whole it was successful, but the attendance was never very large, and on the last day it was very small. We believe that the third day is a mistake. The meetings die out of sheer inanition, and there is always a paper—in this case one by M. Rollet on the Thomas and Gilchrist process—which must be taken as read, for no one will stop to listen to it. A change in this respect might readily be made with a regard for the best interests of the Institution.

PROPOSED NEW BRIDGE OVER THE DOURO.

No. II.

In our impression of the 11th March we gave a brief account of the principal designs submitted by different engineers and contractors for the new bridge over the Douro, between Oporto and Villanova. At the same time we gave a page illustration of the design submitted by Mr. John Dixon, of London, and although not the one selected, it was considered worthy of special remark because of the novelty of the design, which was made with special reference to the work of erection. As we have already stated, the span of the new bridge is 560ft., while the upper roadway is 196·80ft. above mean water-level. A structure of such dimensions and to cross such a river and valley could not be erected by means of scaffolding without enormous cost, so that the method of building out is the only one that can be adopted, rolling out not being applicable for a structure of the form which must be given to a half span of 280ft. The items of Mr. Dixon's general estimate may be here usefully given, and are as follows:—

Preliminary expenses, agency during construction, maintenance for 12 months, interest of guarantee deposit of 5 per cent., bank and finance charges, local fees, &c.	£4,500
Excavation, masonry and concrete in foundations and approaches, construction of roadways and footpaths, flagging and paving...	8,000
Cost of ironwork, ex ship in Oporto, all of quality equal to English Admiralty tests, 3500 tons at £13...	45,500
Cost of erection, painting and finishing, including use and waste of plant, 3500 tons at £4 10s.	15,750
Margin for profit and contingencies	20,790
Total tendered price	£94,540

The main span in this design has considerable originality of design. It may be broadly described as consisting of two huge cantilevers, abutting one against the other at the centre of the span. The principal members of the construction are two large struts or inclined piers A B, F G, which spring obliquely from the banks of the river, and the double cantilever girders D B C, C G H of varying depth. The girders are supported at the point of their greatest depth, nearly midway in their length, on the heads B, G of the two main struts; they meet at C, the crown of the bridge, and their other ends rest on the lofty vertical piers which terminate the approach spans on either side of the river. From the lower booms of these girders are suspended by steel rods the side girders of the lower roadway. The points A, F, B, G, and C are articulated by means of steel pins of large diameter, and the ends D, H of the girders rest on expansion rollers. In this way entire freedom from temperature strains is secured, the only effect of expansion or contraction of the main members of the structure being a rise or fall, unrestrained in any way, of the points B, C, G, and a simultaneous horizontal motion of the points D, H. Means were contemplated for holding down the ends of the girders at D, H, while still permitting free horizontal motion; as, however, the downward pressure on the piers at those points does not become less than 80 tons under any circumstances of loading, that precaution proved to be unnecessary. The principal dimensions between centres are, in English measures, span between vertical piers, 590ft.; span between feet of main struts, 540ft.; span between heads of main struts, 320ft.; height between head and feet of main struts, 148ft.; greatest depth of cantilever or main girders, 48ft. The moving loads required by the authorities to be provided for were—(1) A continuous load on each roadway of 2000 kilos. per metre run = 0·6 ton per foot run; (2) also for both roadways, two four-wheeled vehicles side by side, carrying on each wheel 3000 kilos. = 3 tons nearly, wheel base 3 metres. The latter of the two alternative conditions of loading affects the strength of the subsidiary members of the construction only, that is, the buckled plates and the longitudinal stringers and cross-girders of the two roadways.

The values of wind pressure to be considered were:—270 kilos. per square metre = 55·3 lb. per square foot, when the bridge is not loaded; and 150 kilos. per square metre = 30·7 lb. per square foot, when the bridge is fully loaded.

For a structure of such magnitude the preliminary determination of its own weight, for the purposes of calculation, is evidently a matter of much importance. In the present case, the weight of each platform with its accompanying ironwork being carefully estimated, that of each of the main members was assumed and preliminary calculations then made with the object of more exactly determining the weight at first assumed. The necessary modifications being made on the data so obtained, the final calculations for the stresses in all parts of the structure were proceeded with. The fixed load, as estimated for the purposes of calculation, was made up as follows:—Lower platform with girders, suspension rods, stiffening chains, &c., 1·7 tons per foot; upper platform, 1·1 ton per foot; main girders and bracing, 2·25 tons per foot; total, 5·05 tons per foot. The above total does not include the weight of the main struts. The moving load for the two roadways together, is 2 × 0·6 ton = 1·2 ton per foot; total fixed and moving load, 6·25 tons per foot. The calculations were simplified by dividing the above total into, 5 tons per foot for fixed load, $1\frac{1}{4}$ ton per foot for moving load. The bays or panels of the main girders being 20ft. long between the upper joints, the panel loads for one girder become—$W_1 = \frac{1}{2} \times 20\text{ft.} \times 5$ tons = 50 tons, fixed load; $W_2 = \frac{1}{4} W_1 = 12\frac{1}{2}$ tons moving load.

The simple proportion existing between the two loads makes it only necessary to add one-fourth part to the stresses due to fixed load, in order to obtain those due to fixed load and moving load distributed uniformly over the entire span.

The different cases of loading considered were—(1) Fixed load alone. (2) Fixed load with moving load over the whole length D H. (3) Fixed load with moving load over the half span D C or C H. (4) Fixed load with moving load over the part E K of the span. In the cases of entire or partial distribution of the moving load, it is to be understood that both roadways are similarly loaded. For the cases of moving load over part only, as D E or E C, of one half span, it was easily seen that smaller stresses would occur than for the cases above stated, and they were not further examined.

The stresses on the booms and web of the main girders were determined graphically by means of the now well-known Maxwell diagrams or reciprocal figures. These diagrams we are enabled by the courtesy of Mr. Dixon to place before our readers, and as the structural design of the bridge and the determination of the stresses on the various parts are of great interest to engineers, we propose to follow the diagrams as required for every part of the whole structure as an excellent example of the application of Maxwell's reciprocal figures. These diagrams and the calculations for the bridge were made for Mr. Dixon by Mr. H. Reilly, and the whole performed in such a complete and systematic manner, that special reference should be made to Mr. Reilly's work.

In place of constructing a single diagram for the whole of one girder B D E C, and including all the different forces acting upon it, separate diagrams were drawn for two parts B D E, B C E of the girder; also in the case of B C E separate diagrams were drawn for the vertical loads upon it, and for the vertical and horizontal components of the thrust at C.

1. *Stresses due to Fixed Load.*—The fixed load being symmetrical on both half-spans, the resultant thrust at C due to it is horizontal. The load on the entire girder D C is 15 × 50 tons = 750 tons, and adding 50 tons for the half weight of the main strut, there is obtained a total vertical load of 800 tons acting along a vertical line midway in bay 8 of the girder—that is, 10ft. to the right of D E. Setting off on that line $\overline{m o}$ = 800 tons, from m the point of intersection with it of a horizontal line through C, then joining A m, and drawing $o n$ parallel to C m, the horizontal thrust at C is found to be $\overline{o n}$ = 500 tons. The line $\overline{n m}$ represents the direction and value of the oblique resultant of that horizontal thrust and the vertical load, and this being resolved vertically and in the direction A B, as shown by the dotted triangle of forces, the vertical component is found to be 120 tons, which is the value of the vertical upward reaction at D. The thrust along A B at the head is 830 tons, and by the weight of the strut itself this is increased to nearly 900 tons.

2. *Diagram* 1.—This diagram determines the stress occurring on each member of the part E B C of the girder, due to the single horizontal force of 500 tons acting at C. Its construction is as follows:—Set off on a horizontal line a length representing, to the scale chosen, 500 tons, and from its right and left extremities draw lines parallel to the bars 0 and 0a respectively. These lines are marked + 300, + 280, and the figures represent the compressive stresses in tons on the bars. From their intersection draw a vertical line to meet the horizontal line; its length represents to the same scale the stress, tension of 143 tons, on the short vertical adjoining C. From the upper end of this line draw a line (+ 25) parallel to diagonal bar 1, and meeting a line (+ 218) parallel to bay 1 of the lower boom, drawn from the right extremity of the horizontal line. The construction will now be continued by drawing the vertical line (— 13) parallel to the vertical 1, and in succession diagonal and vertical lines parallel to the diagonal and vertical bars 2, 3, . . 8, the intersection of each pair occurring at the end of the line drawn parallel to the lower boom bay of the same number from the right extremity of the horizontal line. The diagram being completed, the stresses on the separate members can be directly ascertained. Thus on bay 4 of the top boom the stress is + 363 tons; on bay 4 of the bottom boom it is + 108 tons; on diagonal 4, + 40 tons; and on vertical 4, — 23 tons. The stresses are then measured off and tabulated.

3. *Diagram* 2.—This diagram determines the stress occurring on each member of the same part E B C of the girder, due to the load of 50 tons at each upper joint. The condition of E B C under the action of the loads in question is the same as if it were a cantilever fixed at B E and free at its extremity C, and the diagram is drawn for that case. The whole of the load of 50 tons on each bay is not actually carried at the adjacent upper joint, as would seem to be implied, it being in part due to the weight of the lower roadway, which is suspended from the lower joints of the girder. The necessary correction is made, however, by adding a tensile stress of — $\frac{1}{2}$ × 20ft. × 1·7 tons = — 17 tons to the stress existing on each vertical according to the diagram. The diagram is constructed as follows:—Set off on a vertical load line, and to the proper scale, seven loads of 50 tons each, and at the lower end a load of 25 tons, this latter representing the half of the load at C which is carried by E B C. The two short lines (—24) and (+24) are parallel respectively to the diagonal bars 0, 0a; from their intersection the vertical line (+12) is drawn to meet the horizontal line (—21), the two representing the stresses on the short vertical adjoining C and on the bay 1 of the upper boom. The lines (—38), (+51) again are parallel respectively to diagonal 1 and bay 1 of the lower boom, and from their intersection (+71) is drawn parallel to the vertical 1 to meet (—51) parallel to bay 2 of the upper boom. The construction is continued by drawing in succession diagonal and vertical lines parallel to the diagonal and vertical bars 2, 3 . . . 8, the intersection of each pair occurring at the end of the line drawn parallel to the lower boom bay of the same number from the lower end of the load line. The horizontal line drawn through the points of division of the load line represents the stresses occuring on the bays of the upper boom, that on bay 6, for example, being — 508 tons. The diagram being completed, the stresses on the different members are measured off from it and tabulated as for Diagram 1, the correction for the suspended part of the load being then made as before explained.

4. *Diagram* 3.—The purpose of this diagram is the determination of the stresses on the different members of the part E B D of the girder, due to the loads of 50 tons at each upper joint. Apart from the effect of the vertical reaction at D, the condition of E B D is the same as if it were a cantilever fixed at B E and free at its extremity D, and the diagram is drawn for that case. To construct the diagram, set-off on a vertical load line six loads of 50 tons, and at its lower end one of 25 tons, this latter being the half bay load at D. From the lower end of the load line draw the line marked (+147) to (+528) parallel to the straight lower member of the girder, and that marked (+70) parallel to bar 15; draw the two horizontal lines marked (—66), and also the vertical line (+ 50) from the intersection of the lower of the two with (+70), and the line (—79) parallel to the diagonal 14. The construction is continued by drawing in succession vertical and diagonal lines parallel to the vertical and diagonal bars 13, 12, . . . 9, each pair intersecting at the end of the horizontal line representing the stress on the upper boom bay having the same number. The stresses are then measured off and tabulated as before. With the stresses on different bays of the upper and lower booms B D, D E, as obtained from Diagram 3, it is necessary to combine those of the opposite kind due to the upward reaction at D. Taking moments round B and E respectively, the values of the additional stresses are—

$$120 \text{ tons} \times \frac{135\text{ft.}}{48\text{ft.}} = +\ 337 \text{ tons, compression on D E;}$$

$$\text{and } 120 \text{ tons} \times \frac{135\text{ft.}}{45\text{ft.}} = -\ 360 \text{ tons, tension on D B.}$$

The total stress due to fixed load on each member of booms or web for the part E B C, is obtained by the algebraic addition of the stresses on that member given by Diagrams 1 and 2. The stress on each member of the web for the part B D E is given directly by Diagram 3; and that on each member of the booms for the same part, by combining those from Diagram 3 with the figures just given.

5. *Moving Load over the whole Span.*—The total stresses due to fixed and moving load together are for this case obtained very simply by adding one-fourth part to the stress on each member due to fixed load alone.

6. *Moving Load over One-half Span.*—Considering only the moving load on the half span D C, its total amount is 295ft. × $\frac{5}{8}$ ton = 190 tons nearly. The resultant of that load acts in the same vertical line $m o$ as the resultant of the fixed load for the same half span, and the oblique reactions at A and F intersect on that line prolonged at p. The reaction at F necessarily passes through the point of articulation C, since the right half span C H is unloaded, and by construction of the triangle of forces drawn at p, the components of that reaction acting at C are found to be 40 tons and 62 tons respectively vertical and horizontal.

7. *Diagram* 4.—It now becomes necessary to construct a new stress diagram for the part E B C, in order to determine the stress on its members due to the vertical component at C. This diagram is No. 4 on the sheet. It was originally drawn for a vertical component at C of 33 tons, which occurs when the moving load extends from E to C only, but is made available for the present purpose by increasing the values it gives by one-fourth part. The construction is similar to that of Diagram 2, except that 33 tons is the only value set off on the load line, and that all the horizontal lines of that diagram merge into one line drawn from the upper end of the load line. Again, the stresses on the part E B C, due to the horizontal component of 62 tons at C, are evidently obtained sufficiently exactly by taking one-eighth part of those given by Diagram 1 for a similar horizontal force of 500 tons. The resultant stresses in this case, due to fixed and moving load together, are obtained, therefore, for all members of the part E B C, by the algebraic addition of one and an-eighth times the stresses given by Diagram 1, one and a-quarter times those given by Diagram 2, and one and a-quarter times those given by Diagram 4. An alternative series of stresses is obtained for the same part of the girder when the condition of loading is reversed—that is, when the right half span only is loaded—by the algebraic addition of one and an-eighth times the Diagram 1 stresses, the Diagram 2 stresses, and one and a-quarter times the Diagram 4 stresses, with reversed signs. The reversal of sign is due to the fact that the vertical component at C acts downwards on the unloaded girder, and upwards on the loaded girder. For the part E B D, the resultant stresses on all members of the web are, as in the second case, one and a-quarter times the stresses given by Diagram 3. On the members of the booms, the resultant stresses are one and a-quarter times those given by Diagram 3, combined with the stress of opposite kind, and uniform in value, along each boom, due to the upward vertical reaction at D. That reaction is 120 tons + 70 tons = 190 tons, and the additional stresses are—

$$190 \text{ tons} \times \frac{135\text{ft.}}{48\text{ft.}} = +\ 534 \text{ tons, compression on D E;}$$

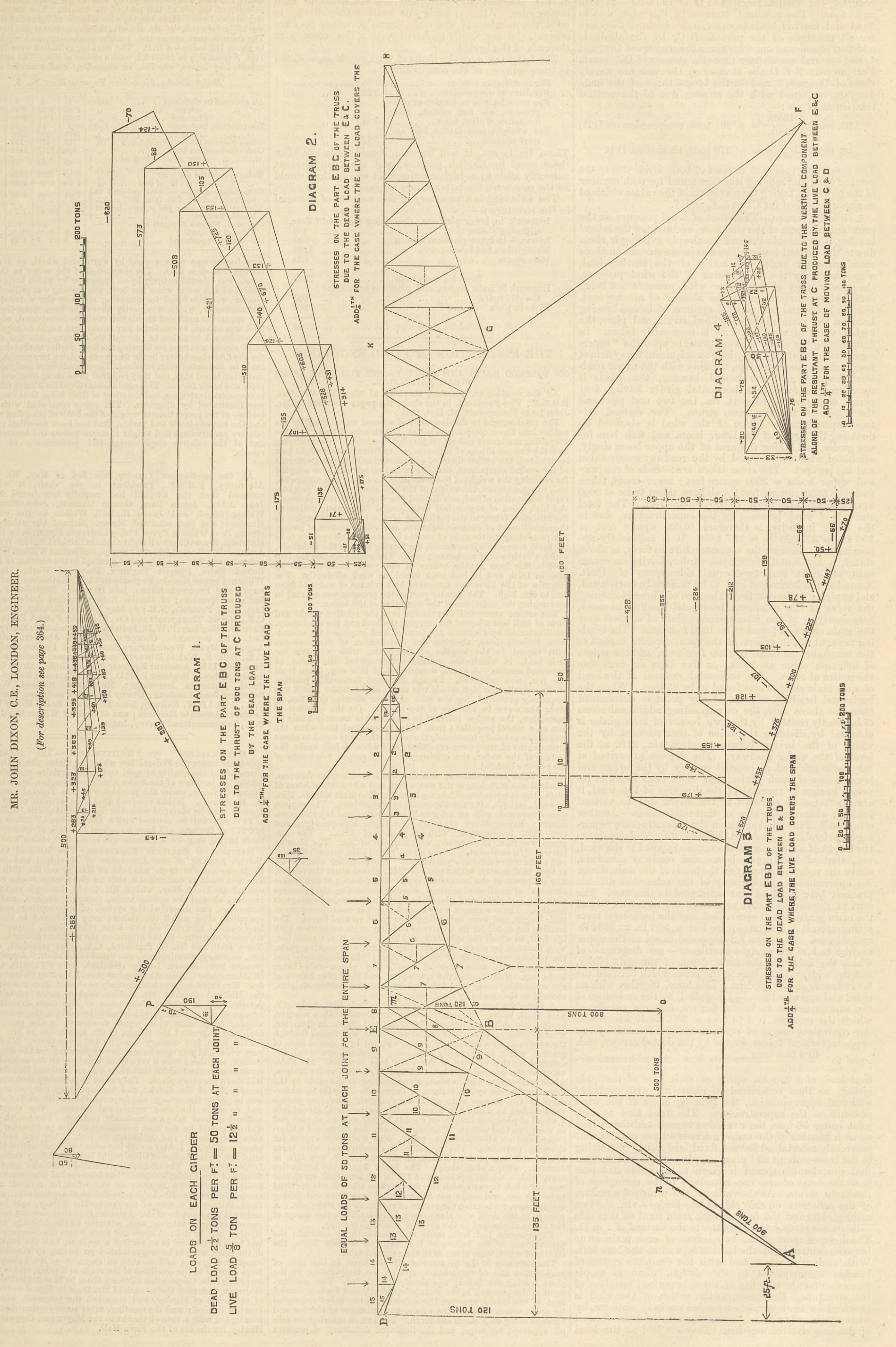
$$\text{and } 190 \text{ tons} \times \frac{135\text{ft.}}{45\text{ft.}} = -\ 570 \text{ tons, tension on D B.}$$

8. *Moving Load between E and K.*—The loading being for this case symmetrical on both sides of the centre, the thrust at C again becomes horizontal. By the construction of a triangle of forces, not shown on the diagram, at a point on the line C m, midway between E and C, the horizontal thrust at C, due to the moving load over E C, is found to be 99 tons, or nearly exactly $\frac{1}{5}$ of the thrust at C, due to the fixed load alone. The vertical component of the oblique reaction at A, this latter being resolved vertically and along A B, is also found to be — 27 tons,

STRAIN DIAGRAMS, PROPOSED BRIDGE OVER THE RIVER DOURO AT OPORTO.

MR. JOHN DIXON, C.E., LONDON, ENGINEER.

(For description see page 364.)



reducing the vertical reaction at D to 120 tons — 27 tons = 93 tons. The resultant stresses in this case, due to fixed and moving loads together, are obtained therefore for all members of the part E B C, by the algebraic addition of one and one-fifth times the stresses of Diagram 1, and one and one-quarter times the stresses of Diagram 2. For the part E B D the stresses on the web are merely those of Diagram 3, and for the booms those of the same diagram, combined with the stresses due to the vertical reaction at D viz:—

$$93 \text{ tons} \times \frac{135\text{ft.}}{48\text{ft.}} = +\ 261 \text{ tons, compression on D E;}$$

$$93 \text{ tons} \times \frac{135\text{ft.}}{45\text{ft.}} = -\ 279 \text{ tons, tension on D B.}$$

The maximum resultant stresses of both kinds due to the vertical fixed and moving loads are found for each member of the girder by taking the maximum of the values obtained as above described for Cases 5, 6, and 7.

9. *Wind Pressure.*—The effect of wind pressure on the principal members of the structure, exclusive of the lateral bracing, is to increase the stresses already existing in them due to the vertical loads. The maximum stresses on those members occur under the action of the moving load, accompanied by the lesser value of the wind pressure, the greater effect of the higher wind pressure not being sufficient to compensate for the absence of moving load. For the horizontal and vertical systems of lateral bracing between the main girders, inclined struts, and piers, the higher value of wind pressure is necessarily taken. In determining the effect of wind pressure upon the "superstructure" of the bridge, by which term is meant the system of four main cantilever girders, together with the upper roadway structure and the lateral bracing, the whole is considered as forming a horizontal girder having four points of horizontal support, viz., the two end piers and the heads of the two main struts. The vertical surface exposed to the action of the wind is obtained by doubling the areas of the lower boom and web bars for one girder, and taking the area of the upper boom singly, combined with that exposed by the roadway construction and the parapet. The areas taken are:—Side of roadway and upper boom = 3600 square feet; lower boom, taken twice = 2800 square feet; web bars, taken twice = 3600 square feet; total area, 10,000 square feet. The total amount of wind pressure on the superstructure, due to the lesser intensity, is therefore 10,000 square feet × 30·7 lb. = 307,000 lb. = 137 tons. It is sufficiently approximate to consider the superstructure to form, as above stated, a horizontal continuous girder, having a centre span of 320ft. and two equal side spans of 135ft. Assuming the horizontal load to be uniformly distributed, and applying to the case the "Theorem of Three Moments," the value of the maximum horizontal bending moment, here occurring at the intermediate points of support over the main struts, is found to be 1640 foot-tons. The bending moment at the centre of the span, opposite in sign to the maximum moment, is 1300 foot-tons, and the points of inflexion occur at 100ft., or five bays on each side the centre of span. The horizontal reaction at the head of each main strut is also found to be 65 tons. When the horizontal bending moment at any point is determined from the above data, the corresponding additional stress to be jointly resisted by the two booms of each girder is obtained by dividing the value of that moment by the width of the bridge between centres, viz., 21ft. at the level of the upper roadway. The stresses so arrived at may be considered as resisted equally by the upper and lower boom of each girder, and since such stress is reversed in sign by reversal of the direction of the wind, it always forms an addition to the stress due to vertical loading, whatever the sign of that latter stress. Another component of the wind action on the superstructure requiring consideration is produced by the twisting tendency due to the height of a large part of the surface exposed to the wind, viz., that of the upper boom and roadway structure, above the points of support on the heads of the main struts. An approximate solution only of the somewhat difficult problem here involved was attempted in this case. The area of the surface above mentioned for each 20ft. bay of the main girder is 120 square feet, and the horizontal force acting upon it is f = 120 square feet × 30·7 lb. = 3684 lb. = 1·64 tons. The force f is supposed to act at the upper or free end of an upright cantilever — see diagram — of which the height is the mean depth of the main girder, and the width at the base is the mean width between the lower booms of the girders. This force, together with an equal and opposite force $-f$ supplied by the resistance of the superstructure to lateral flexure, forms a couple, of which the moment is 1·64 tons × 30ft. = 49·2 foot-tons. An equivalent couple of equal moment is formed by two opposite vertical forces shown by the dotted arrows, each equal to $\frac{49\cdot2 \text{ foot-tons}}{24\text{ft.}} = 2\cdot05$ tons. An additional vertical load of 2·05 tons, acting at each joint of the main girder, is then considered to represent, with probably sufficient approximation, the twisting effect of the wind pressure on the superstructure. The fixed load at each joint being 50 tons, the stress due to such additional load on each member of the main girders is 4·1 per cent. of that previously ascertained for the fixed load alone. Referring to the cross-sections and plans on page 182, it will be seen that considerable spread is given to the whole structure from the level of the upper roadway to the springings of the main struts. As shown there, the principal members of the structure on each side of the bridge—viz., the two main girders and the half of each main strut on that side—lie in one plane, having a batter to the vertical of 1 in 11. The distance apart of the two halves of each main strut between centres is, at the head 28ft., and at the base 55ft. With such dimensions, and with the complete system of bracing contemplated in the design, there is ample guarantee for the stability of these important members of the structure. Resistance to the action of the wind is provided for the lower, or suspended roadway platform, by what are in effect two horizontal parabolic chains formed of flat bars rivetted together. They are laid at the level of the platform structure, and are connected to each cross-girder. After crossing one another they diverge to meet the members of the main struts, to which they are secured, and are finally anchored within the masonry at the ends of the bridge.

The following were the limits of working stress, as stated in the conditions of the competition:—

For cast iron in tension	0·95 tons per sq. in.
For ditto in compression	2·22 ,,
For wrought iron in tension or compression, on net section, after deduction of rivet holes...	3·81 ,,
For wrought iron lattice bars and rivet sections	3·17 ,,

These limits are, it will be seen, considerably less than those usual in English practice, and their employment naturally leads to a higher estimate of weight than would be the case were the latter values taken.

The following is a summary of the weights of material in the structure:—

	Tons.
Ironwork in lower platform, suspension rods and stiffening chains	460
Ironwork in upper platform system	300
Main girders and bracing	1160
Main struts	620
Total for main span	2540
Ironwork in main girders and platform system for the side spans	600
Ditto in piers	360
Total for the bridge	3500

THE INSTITUTION OF CIVIL ENGINEERS.

ON TORPEDO BOATS AND LIGHT YACHTS FOR HIGH SPEED STEAM NAVIGATION.

At the meeting on Tuesday, the 10th of May, Mr. Brunlees, F.R.S.E., Vice-President, in the chair, the paper read was by Mr. John Isaac Thornycroft, M. Inst. C.E.

The total weight or displacement of a vessel was divided by the author into three components:—1st, the structural hull; 2nd the propelling machinery and apparatus; 3rd, the load. In considering how the two conditions of lightness and sufficient power might best be attained, the author directed attention chiefly to the treatment of the second component, and the means which had been adopted for reducing the weight of the propelling machinery and apparatus, and, in consequence, the weight of the hull also. For this purpose, rapid combustion of fuel, sub-divided flue-way, high-steam pressure, and high-speed of engine had been bought into action, following the initiative taken in the perfecting of the locomotive engine as the embodiment of extreme lightness and concentration of power. For promoting the draught of marine boilers, the fan appears to be the most convenient instrument, for forcing air into the stokehole, which was thus kept moderately cool. The author devised the fan-blast in this form for the boilers of the yacht Gitana, built by him in 1876, and it had been found to work efficiently. The pressure of the blast was measured by a column of water of from 3in. to 6in. high. The greater part of the pressure was exerted in overcoming the resistance of the flue-tubes of the boiler.

The author proceeded to examine into the relative weight and form of hull best adapted for carrying the load and the machinery. He illustrated by diagrams the form of hull employed for second-class torpedo boat, showing the distribution of displacement with regard to the lengths of the boats, with a curve for each boat, in which the ordinates represented the areas of immersed section. A curve, constructed in this way, taken from the Iris, was exhibited. Though the most favourable position of the propeller for high speeds was astern of the rudder, yet it was frequently preferred, for the sake of better steering qualities, to place the screw in advance of the rudder. On the question of immersion, the author referred to experiments recently made by him on a model propeller; from which it appeared that when the propeller was totally immersed, the useful effect was equal to about seven-tenths of the power expended; and when it just broke the surface of the water, the efficiency did not exceed five-tenths of the power expended.

The light yacht Gitana, was described in its main features. The hull was 86ft. long at the water line, and a breadth of beam of 10½ft., the extreme breadth being 13ft. 3in. The draft was 1ft. 1½in. forward, and 4ft. aft; the displacement was 29 tons. The engines were compound, with an intermediate receiver, and injection condenser; having three cylinders—one 13½in. high-pressure, and two 15in. low-pressure, with a stroke of 16in. The air-pump was 23in. in diameter, with a stroke of 3in. The blowing fan was 3½ft. in diameter, driven directly from a 5in. steam-cylinder, and made 900 revolutions per minute. The propeller was a screw of 5¼ft. in diameter, with a pitch of 8½ft., placed abaft the rudder. The boiler was of the locomotive type. The framing of the engine consisted of small steel columns, directly connecting the cylinders with the bed-plate, and placed as near to the main bearings as possible. These columns were braced together near the centre of their length, and were only adapted to resist vertical forces. The framing depended for its transverse stability on its connection with the hull, to which the cylinders, and lower ends of the guide bar, were fastened by stays. For securing lightness of moving parts, the pistons were made of wrought steel; the piston-rods and connecting-rods were also of steel, the piston-rods being bored out. The cranks, the crank-pins, and the lower halves of the connecting rods, were balanced by cast iron balance-weights, secured to the cranks by steel bolts.

A first-class torpedo-boat was next described, 87ft. in length, with 10½ft. beam. The engines were compound with a receiver, having two cylinders respectively 12¾in. and 20⅞in. in diameter, with a stroke of 12in. The condensing water was forced through the condenser by a centrifugal pump, assisted by a special form of grating, which by gradually expanding openings, converted the external relative velocity of the water into pressure. The slide-valves of the engines were balanced by being placed under bridges, which were made with recesses corresponding to the ports in the cylinders, as used by Mr. Wilson, of Patricroft. The four packing-rings of the pistons were of Perkins' metal. The feed pumps were worked by a cast iron worm on the engine shaft, geared into a wheel of phosphor-bronze, on a shaft having a crank at each end to work two feed pumps. The engine-room also contained a bilge-pump, and an air-compressing pump, with a separate engine for charging torpedoes. The propeller was constructed with three blades, and was placed forward of the rudder; it was 4½ft. in diameter, with a pitch of 6ft. The boiler was of the locomotive type, with a working pressure of 126 lb. A rose with an ejector was provided, to extinguish the fire in cases when it was required to be put out, and could not be drawn. There were self-closing ashpit-doors, preventing the return of vapour to the stokehole. A passage to the deck was also provided, to facilitate the escape of the steam discharged in the event of a tube giving way.

Experiments had been made at Portsmouth to ascertain the performance of the boilers of the first-class torpedo boats, the results of which were given as in the annexed table.

The influence of the pressure of air employed on the rate of evaporation and of combustion, and on the temperature of the gases leaving the boiler, was clearly manifested. The measurement of the pressure in the stokehole, ashpit, and fire-box showed that of the initial pressure the resistance of the tubes accounted for about seven-tenths of the whole, the resistance of the fire and fire-bars being only about one-tenth. The loss on entering the ashpit appeared too large, and the indicated deficiency of pressure under the bars was perhaps partly due to the comparatively high velocity of the air at this part of its transit. The second-class torpedo boat was 60ft. in length, with a beam of 7¼ft.; the draught was 12½in. forward, and 3ft. 4in. aft; the displacement was 10·6 tons. The engines were compound, surface-condensing, and worked up to about 112 indicated H.P. The working cylinders were 7in. and 11in. respectively in diameter, with a stroke of 8in. The air-pump, actuated by levers, was 7in. in diameter, with a stroke of 2in.

Boiler Trials, First-class Torpedo Boat No. 3.

Air pressure in stokehole	inches	2	3	4	6
,, ash-pit	,,	1·47	2·29	3·26	5·25
,, furnace	,,	1·35	1·87	3·0	4·33
Temperature, feed-water	Fahr.	53·5	57	54	56
,, funnel	,,	1073	1192	1260	1444
Steam pressure (above atmosphere).	lb.	117	117	115	115
Coal consumed per hour	,,	925	1177	1472	1815
,, ,, per square foot of firegrate	,,	49	62	78	96
Water evaporated per hour	,,	6530	7770	9320	10,840
,, ,, per lb. of coal ..	,,	7·06	6·6	6·33	5·97
Evaporation per lb. of coal reduced to equivalent at 212° Fah. from 100°		7·61	7·08	6·81	6·41
Evaporation per hour per square foot of heating surface		10·8	72·9	15·5	18·0
Coal used, Nixon's Navigation.					
Ashes, 9 per cent.		H. M.	H. M.	H. M.	H. M.
Duration of experiment		2 0	2 7	1 39	1 27

Two feed-pumps were worked by worm and wheel, as described for the first-class boat. The circulation of the water in the condenser was effected entirely by an apparatus by which the external motion of the water when the boat was moving was utilised. An ejector was also fitted for removing air from the water-space of the condenser, which was partly above the load water-line. By this apparatus sufficient circulation could be maintained, when the boat was at rest, to condense any steam that might be required to be condensed in order to prevent its escaping into the air. A small engine was used for blowing the fires, similar to that described for the first-class boats; but it was made to drive two pumps, which could be connected when required. These boats were designed to be carried on board ship, and they required to be slung overboard complete and ready for use. This condition involved their being subjected to considerable stresses, and the effect of their being thus suspended was illustrated by diagrams. The paper concluded with three tables—of the proportionate weight of the hulls of sea-going vessels, and the torpedo-boats and yachts, that had been described; of the relative performance and weight of steam-vessels and locomotives; and of the relative displacement and performance of steam-vessels.

At the meeting on Tuesday, the 3rd of May, Mr. James Abernethy, F.R.S.E., President, in the chair, it was announced that the Council had recently transferred Messrs John Addy, James Barr, George Garnett, John Standfield, Walker Stead, and James Birdsall Walton to the class of Members; and had admitted Messrs. Richard Carruthers Armstrong, Paul William Byers, Philip Lawrence Foster, John Kaehler Hutchins, Ernest Charles Knight, Outram Faithful Monier-Williams, Arthur James Russell, Charles Stronge, and Robert William Waddell, as Students. The monthly ballot resulted in the election of Messrs. Robert Haire, District Engineer, Board of Works, Dundalk; William Coupar Rennie, Engineer-in-Chief, Kathiawar State Railways; and Frederick Simon, late Executive Engineer, P.W.D., India, as Members; of Messrs. Robert Sanders Anderson, Stud. Inst. C.E., Penicuik, N.B.; Sydney Walker Barnaby, Stud. Inst. C.E., Messrs. Thornycroft and Co., Chiswick; Patrick Paget Dease, Executive Engineer, P.W.D., India; Arthur Scudamore Emery, Stud. Inst. C.E., Sevenoaks; George Smith Hird, Aberdeen; Ambrose Augustus Myall, Westminster; Samuel Hall Parker, Stud. Inst. C.E., Bala, N. Wales; Edward Powell, Swansea; Frederick Reilly, Stud Inst. C.E., Assistant Engineer P.W.D., India; Orton Gastrell Smart, Assistant Engineer P.W.D., British Burmah; Robert Henry Smith, Battersea Ironworks; Maximilian Richard Western, Belvedere-road, Lambeth; Otway Edward Woodhouse, Stud. Inst. C.E., L. and S.W. Railway, Nine Elms; and Ralph Henry Wyrill, Leeds, as Associate Members; and of Andrew Wilson Baird, Capt. R.E., Trigonometrical Survey, India.

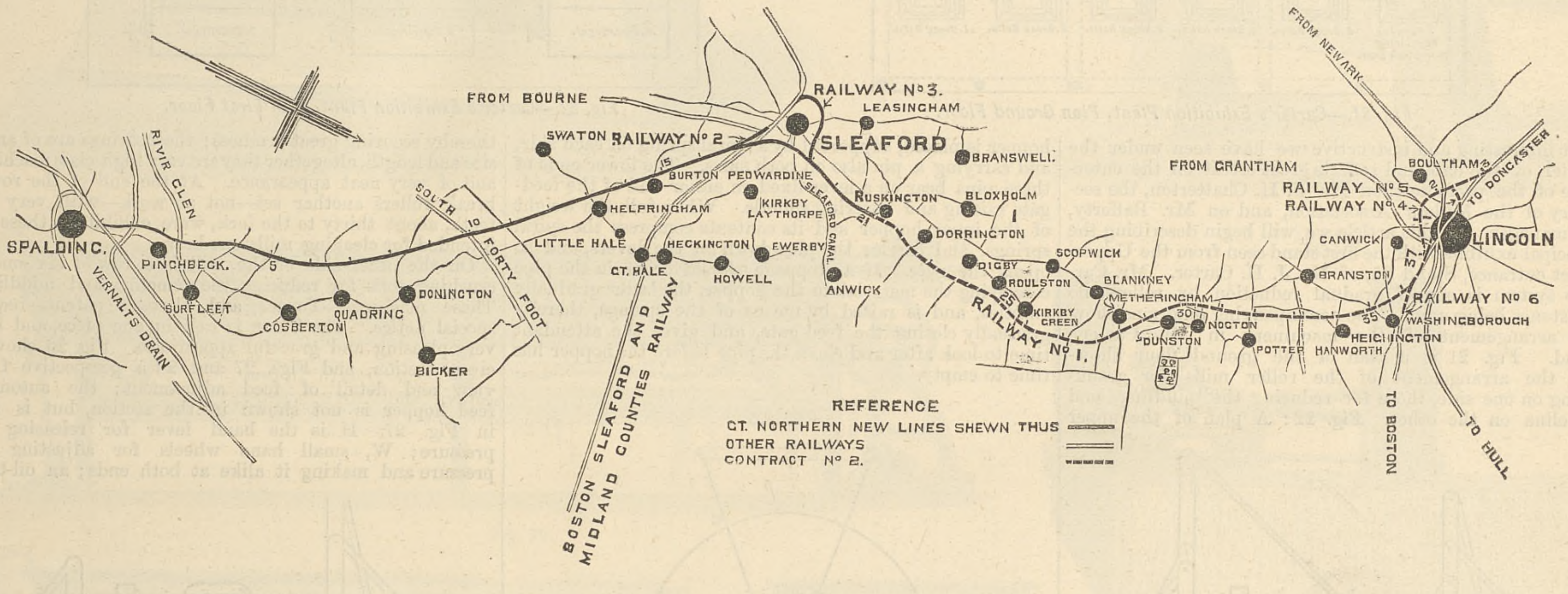
"Hall-marking" in Switzerland. — The Commission appointed under the Federal law which regulates the control and guarantee of the quality of gold and silver articles manufactured within the territory of the Swiss Confederation has lately held its sittings in Berne, under the presidency of the Federal Councillor, M. Ruchonnet. It has resolved that gold articles of 18 carats fineness shall be stamped with the figure of Helvetia, while those of 14 carats shall be marked with a chamois-head. Silver articles of 0·875 of fineness will have a squirrel for mark of quality, while those having only 0·8 of fineness will be marked with a woodcock.

Meeting of Sanitary Engineers.—The Midland Counties district meeting of the Association of Municipal and Sanitary Engineers and Surveyors was held at Hanley on the 13th inst.—The first business comprised a visit to the sewage works recently opened at Trent Hay, where Mr. Lobly, borough engineer at Hanley, showed the sewage tanks, pumping engines, and filtration areas, and described the system of intercepting sewers in operation, after which the visitors were conducted to the storm leap weirs at Etruria Vale and some other places, inspecting the tramway *en route*.—In the afternoon the members assembled at the Town Hall, and Mr. E. Pritchard, C.E., past president, district hon. secretary, Birmingham, was voted to the chair. Among those present were Messrs. Lobley (Hanley), Boys (Walsall), Comber (Kidderminster), Allen (Stratford-on-Avon), Fereday (Wednesbury), &c. Mr. Pritchard was unanimously re-elected hon. secretary for the Midland district. Mr. Lobley read a paper containing a detailed and interesting description of the main draining and sewage works at Hanley, which was followed by a discussion, and a number of question upon points mentioned in the paper. The chairman expressed the thanks of the association to Mr. Lobley for the treat, in a sanitary sense, he had given them. No doubt a very wide field was open in sanitary engineering for the disposal of sewage, and there were a variety of opinions on the subject; but sensible men must admit that there was no hard and fast line to be laid down for every place. They must be guided by the nature and peculiarities of the district, and their primary duty as engineers was to purify the sewage and improve the health of the district, and do it in the most economical manner. The question of utilisation must take a subordinate position. The health of the district should be the first consideration, the purification of the sewage the second, and utilisation the last. They had had in the paper read by Mr. Lobley a very important work submitted to them, although perhaps some of them might not thoroughly endorse Mr. Lobley's system. The chairman proceeded to criticise some of the details of Mr. Lobley's scheme, but bore cordial testimony to the great ability shown in carrying out what he termed a most remarkable work. Mr. Lobley replied to the questions; and Mr. Boys, in moving a vote of thanks to Mr. Lobley, said he fully endorsed the remarks of the chairman that that meeting had been one of very great interest, and, referring to the drainage works at Hanley, said he did not know any town where the sewerage system had been carried out in so perfect a manner, and the inhabitants of the town were to be congratulated on having so excellent and complete a system and so able an engineer as Mr. Lobley. Mr. Boys alluded to the condition of the roads at Hanley, and expressed surprise at the Corporation allowing them to be so neglected. The chairman endorsed the remark of Mr. Boys in regard to the state of the roads of Hanley, and seconded the proposal, which was heartily carried; and the meeting, after some further discussion, terminated with a vote of thanks to the Mayor and Corporation of Hanley for the use of the Town Hall.

THE LINCOLN AND SPALDING RAILWAY.

THOSE interested in the progress of railway Bills through Parliament will remember that an Act for an important line of railway between Spalding and Lincoln was promoted by the Great Northern Railway Company, and passed in 1878, while in the following year a joint committee of this company and of the Great Eastern Railway Company was formed to carry out this railway as modified by the Act promoted by the two companies, and passed in 1879. Of the line of this railway we now give a small plan, and a few particulars of the part in course of construction by the Great Northern Company. The chief towns connected by the line are Spalding, Sleaford, and Lincoln, but a large number of small towns and villages in a large and important agricultural district, hitherto quite unprovided with railway accommodation will be tapped. To the north of Sleaford the farms are chiefly on the heathland, while south of that town they are principally fenland farms. The main object of the line, however, is to secure a shorter and more direct route for the transport of the products of South Yorkshire—chiefly coal—to the Eastern Counties and London by the Great Eastern and Great Northern Railways. The distance saved will be about nine miles, but the time saved will be much more than is represented by this distance, because of the facilities for through traffic, *viâ* Spalding and Peterborough and Spalding and March, in place of running over other lines and through Boston. The part in construction by the Great Northern Railway Company extends from Ruskington, about three miles from Sleaford, to Lincoln, and includes nearly all the heavy work on the whole line.

The heavy work consists chiefly in deep cuttings through, for the most part, greatly shattered limestone. There is, however, a great deal of this rock in a more continuous and slightly shattered condition, and this is being extensively used in the construction of bridge abutments, piers, and filling, and with considerable advantage in point of appearance. The same limestone is also being used for the production of lime for the masonry work. The new line branches off from the loop line from Peterborough to Doncaster, at a point about a quarter of a mile to the north of Spalding station. There are four stations between Spalding and Sleaford, viz., at Pinchbeck, Gosberton, Donington, and Helpringham. It joins the Boston, Sleaford, and Grantham line near the junction of the Bourne and Sleaford branch, a short distance to the east of Sleaford station. The passenger traffic will be carried into and through Sleaford station, and the new line will leave the Boston and Grantham line about two hundred yards to the west of Sleaford station, and thence proceed to the north. An arrangement has been made for carrying heavy traffic through without touching Sleaford, an avoiding line being formed a short distance to the south-east of the junction with the Boston and Grantham branch, this avoiding line passing over that branch by means of a bridge. Some distance to the north of Sleaford the passenger loop will join the new line. There will be seven stations provided between Sleaford and Lincoln, viz., at Ruskington, Digby, Scopwick, Metheringham and Blankney, Nocton, Potterhanworth, and Heighington. Between Spalding and Sleaford the line passes for the most part through a level country, and few works of magnitude are therefore necessary. To the north of Ruskington there is a short cutting, the greatest depth being 22ft. At Digby the line will be on the level, with a level crossing at the station, and between there and Dunston the line will not present any marked features. At Dunston there will be an embankment 20ft. high, with a bridge over the Dunston and Coleby-road. To the north of Dunston station there is about a mile of cutting, the deepest point being 31ft., and involving nearly a quarter of a million cubic yards earthwork. There is no heavy work from that point up to Potterhanworth, but near to Heighington station, which is only about a couple of minutes' walk from the village, there is a very heavy cutting for three-quarters of a mile, chiefly in close limestone, and 42ft. deep at its deepest point. Then for a short distance there is a low bank, which brings us to the Washingborough cutting, close to Heighington Brook. This cutting is nearly a mile and a-quarter in length, its greatest depth is 46ft., and represents over half a million cubic yards of earth. Shortly after leaving the cutting there is a high bank, about 27ft., carrying the line over the Canwick Fen, and passing the Lincoln Sewage Farm, now being completed from the designs of Mr. Mansergh, M.I.C.E. At a point about three-quarters of a mile from a place known as the Cowpaddle at Lincoln, a branch is formed for the passenger traffic, which will join the Lincoln and Grantham branch a little to the south of its junction with the Lincoln and Boston line. As is generally known, there are already several lines crossing in the east of Lincoln, and, owing to the position of the city and the contour of the district, these lines are crossed on the level. The Lincoln residents and authorities, considering that the somewhat heavy traffic of these existing lines already constituted as much obstruction to the common road traffic as could be allowed, urged that the heavy traffic of the new line should pass outside the city by means of an avoiding line. This line was accordingly laid down in the plans, and is that marked No. 4. The passenger traffic, however, passes direct into the existing station by a short connecting line, as shown on the map. This avoiding line will also be used for the heavy traffic from or to the north, and also for the heavy traffic out of Lincoln, by means of the short branch already referred to, and that branch marked No. 5 on the map. The annoyance caused by the almost continual closing of the gates across the High-street of Lincoln, for the passage of heavy goods and mineral trains, will thus be removed. In and near Lincoln are two heavy iron plate girder bridges with lattice parapets, supported on cast iron columns 6ft. in diameter, one bridge carrying the line over what is known as the Sincil Dyke, and the other over the river Witham and over a large flat land drain, between which and the river is a flat always flooded the whole of the wet part of the year. The bridge passing over the river, the drain, and the intervening flat is 280ft. in length, the three chief spans being 70ft. each, and two others 35ft. Most of the cylinders or columns, which are in short lengths bolted together by inside flanges, are sunk through a considerable depth of sand, some of which is running sand, to a compact bed of gravel, but some of them have to be sunk through a considerable depth of unstable peaty soil and mud. The cylinders for the Sincil Dyke bridge have to be put down about 40ft., and all are sunk by means of hand winches and buckets, with one man inside excavating the sand. The cutting edge of the bottom cylinder is made bell-shaped, and stands off about 3in., so as to give the necessary amount of clearance to permit of sinking. When sunk to the necessary depth and loaded with about 40 tons of rails, the cylinders are filled in with cement concrete. In and close to Lincoln there are several wrought iron plate girder bridges supported on very heavy brickwork. The character of the foundations, or rather of the beds upon which these have to be made, necessitates the construction of very heavy abutments in order that the masonry may remain intact even should slight subsidence take place. Over one plate girder bridge the line crosses the High-street of Lincoln in one span of 82ft., resting upon cast iron cylinders as already described.



MAP OF LINCOLN AND SPALDING RAILWAY.

In many places adjoining the line for several miles out of Lincoln the subsoil waters run in underground channels or through the numerous fissures in the shattered upper limestone, and make their appearance as springs, which are constantly removing sand, whenever the Trent rises above a certain level, the head of water and velocity of flow being, it is said, dependent upon and contemporaneous with the rise and height of the water of that river. With such a subsoil it will be understood that great care must be exercised in the construction of bridges and embankments which cross the parts so affected.

A very considerable portion of the heavy cuttings and embankments are already well in hand or nearly completed, and several long stretches of the permanent way already laid. Permanent and contractors' lines now extend to Nocton, so that a run of about ten miles may be made. The embankment and cutting are not equal within long distances, so that a greater length of contractor's line is necessary than is commonly the case, and a considerable break at one part of the line which is advancing towards completion remains to be made up from cuttings now to be made or from adjoining land. The permanent way consists of heavy wood sleepers and steel rails weighing 82 lb. to the yard. The bridges on this part of the line are all ballast covered, the floors being flat plates rivetted to the longitudinal and cross girders, which are all so connected as to form one large piece of framework. Few lines have been constructed with heavier embankments than are here being made; but the excellence of the materials will make it improbable that any trouble will be experienced with them. The ruling gradient of this part of the line is 1 in 400, and it was considered more advisable to make this the maximum than to save first cost and entail in future a constant loss on haulage. A good deal of discussion on this subject took place at the Institution of Civil Engineers in November last, and as a result of this discussion anyone not biassed by previous railway working experience, would be led to the conclusion that gradients considerably in excess of 1 in 400 might be economically worked, and if this be the case a very large sum might have been saved on the Lincoln to Nocton section of this line.

The wood fencing along this line is being made in a somewhat unusual way. The main posts are not morticed, but the rails are spiked to one side and to the intervening verticals, which are driven into the ground. All the parts are creosoted, and it is claimed that the fence constructed in this way is equally as strong as the morticed post fence, while the posts are not so liable to crack and require repairing by side strips. No quickset is planted at the foot of the fence, but in place thereof a lower rail is employed, which effectually prevents sheep or lambs from straying on to the line, and the loss of the quickset fence by sparks setting fire to dry grass is avoided. Although the whole line from Lincoln to Spalding is being constructed by the two railway companies jointly, that from Lincoln to Ruskington is being carried out by the engineer of the Great Northern Railway, Mr. Richard Johnson, M.I.C.E., and the other part of the line by the engineer of the Great Eastern Railway, Mr. A. A. Langley, M.I.C.E. Of the part of the line we have been describing, Mr. Samuel Abbott, M.I.C.E., is the resident engineer, with offices in Lincoln, and Messrs. Baker and Firbank are the contractors. The whole of the stations will be built by Messrs. S. and W. Pattinson, of Ruskington, while the ironwork is being constructed by Messrs. Eastwood and Swingler, of Derby, for the line from Lincoln to Heighington, and by Mr. M. Pitts, of Stanningley, Leeds, for the line from Heighington to Ruskington. Mr. Abbott was resident engineer of the Derbyshire Extension Railway, constructed by the Great Northern Railway, and opened in 1878, and for which he designed the Ilkeston Viaduct, illustrated in our impression of the 19th October, 1877. Some parts of that line run across old coal pits, and provision had to be made that the structures should be as little affected as possible by subsidences. In that respect there is some similarity in the two lines, inasmuch as works of a similarly substantial, if not heavy character, have been necessary. It is expected that the new line will be completed by the middle of next year, and judging by the part already near completion, and the large quantity of plant employed by Messrs. Baker and Firbank, it would seem that their part at least would be completed by that time. A large number of men are at work on the cuttings and embankments, and more are about to be employed as advanced cuttings are opened. The total length of the line is about 44 miles, that of the part being constructed by the Great Northern Railway Company about $20\frac{1}{2}$ miles, the latter involving about 1,255,200 cubic yards of cutting, and about 1,449,800 cubic yards of embankment, the cost being about £12,000 per mile, without stations or rolling stock.

ELASTICITY VIEWED AS POSSIBLY A MODE OF MOTION.

AT the weekly evening meeting of the Royal Institution of Great Britain, Friday, March 4th, 1881, Mr. William Bowman, F.R.S., vice-president, in the chair, Sir William Thompson, LL.D., F.R.S., read a paper on "Elasticity Viewed as Possibly a Mode of Motion." The speaker said: " "A century and a-half ago Daniel Bernouilli shadowed forth the kinetic theory of the elasticity of gases, which has been accepted as truth by Joule, splendidly developed by Clausius and Maxwell, raised from statistics of the swayings of a crowd to observation and measurement of the free path of an individual atom in Tait's and Dewar's explanation of Crookes' grand discovery of the radiometer, and in the vivid realisation of the old Lucretian torrents with which Crookes himself has followed up their explanation of his own earlier experiments; by which, less than two hundred years after its first discovery by Robert Boyle, 'the spring of air' is ascertained to be a mere statistical resultant of myriads of molecular collisions.

"But the molecules or atoms must have elasticity, and this elasticity must be explained by motion before the uncertain sound given forth in the title of the discourse, 'Elasticity Viewed as Possibly a Mode of Motion,' can be raised to the glorious certainty of 'Heat, a Mode of Motion.' "

The speaker referred to spinning-tops, the child's rolling hoop, and the bicycle in rapid motion as cases of stiff, elastic-like firmness produced by motion; and showed experiments with gyrostats in which upright positions, utterly unstable without rotation, were maintained with a firmness and strength and elasticity as might be by bands of steel. A flexible endless chain seemed rigid when caused to run rapidly round a pulley, and when caused to jump off the pulley and let fall to the floor, stood stiffly upright for a time till its motion was lost by impact and friction of its links on the floor.

A limp disc of india-rubber caused to rotate rapidly seemed to acquire the stiffness of a gigantic Rubens' hat-brim. A little wooden ball which when thrust down under still water jumped up again in a moment, remained down as if embedded in jelly when the water was caused to rotate rapidly, and sprung back as if the water had elasticity like that of jelly, when it was struck by a stiff wire pushed down through the centre of the cork by which the glass vessel containing the water was filled. Lastly, large smoke rings discharged from a circular or elliptic aperture in a box were shown, by aid of the electric light, in their progress through the air of the theatre when undisturbed. Each ring was circular, and its motion was steady when the aperture from which it proceeded was circular, and when it was not disturbed by another ring. When one ring was sent obliquely after another the collision or approach to collision sent the two away in greatly changed directions, and each vibrating seemingly like an india-rubber band. When the aperture was elliptic, each undisturbed ring was seen to be in a state of regular vibration from the beginning, and to continue so throughout its course across the lecture room. Here, then, in water and air, was elasticity as of an elastic solid, developed by mere notion. May not the elasticity of every ultimate atom of matter be thus explained? But this kinetic theory of matter is a dream, and can be nothing else, until it can explain chemical affinity, electricity, magnetism, gravitation, and the inertia of masses—that is, crowds of vortices.

Le Sage's theory might easily give an explanation of gravity and of its relation to inertia of masses, on the vortex theory, were it not for the essential aeolotropy of crystals and the seemingly perfect isotropy of gravity. No finger-post pointing towards a way that can possibly lead to a surmounting of this difficulty, or a turning of its flank, has been discovered, or imagined as discoverable. Belief that no other theory of matter is possible is the only ground for anticipating that there is in store for the world another beautiful book to be called "Elasticity, a Mode of Motion."

THE MILLING EXHIBITION.
No. III.

THE importance attached by millers and milling experts to the new milling processes must have been apparent to all who visited the Agricultural Hall last week. The earnestness with which the millers inspected the samples produced by machinery working at the various stands, and the almost entire absence of the usual percentage of loungers was quite a feature of the exhibition. The general appearance of the somewhat dingy hall was like an immense mill under one roof; the whole atmosphere was "floury," and by settling on the gaseliers, &c., made them for once look bright and cheerful by day. We do not think it going too far to say that this exhibition was the most interesting and instructive we have seen under the shelter of the hall, and reflects great credit on the enterprise of the promoters, on Mr. J. H. Chatterton, the secretary of the Millers' Association, and on Mr. Rafferty, the manager. In this article we will begin describing the principal exhibits with the first stand seen from the Upper-street entrance, Stand 25, of Mr. J. H. Carter. Mr. Carter's system is one of gradual reduction by rollers, no millstones being used. The accompanying diagrams show the arrangement of the machinery in Mr. Carter's stand. Fig. 21 is a plan of the ground flour showing the arrangement of the roller mills for granulating on one side, those for reducing the middlings and semolina on the other. Fig. 22: A plan of the upper floor showing the dressing machines and inspirator; Fig. 23 and 24, sections through K L and M N. Mr. Carter's system is completely automatic from the raw wheat to the finished flour; everything being carried by elevators and creepers, attendants only being required to look after the machines. A special feature in this exhibit is Mr. Carter's newly patented automatic feed, applied by him to all the machines at work in his plant, we quote his own words to describe its use:—"Since rollers were first introduced there has been great difficulty in feeding them regularly. As a rule they take their supply from purifiers, which precede them in the operation. In most of the mills of this kingdom the floors are so low that there is little room for a hopper or bin in which a reasonable quantity of semolina, or middlings, can accumulate; and even where the bins are large, they frequently soon become full or empty from the fact of the feed-gate on the roller letting on rather more or less feed than is coming to it. The gate of the narrowest roller is 12in. wide, and only $\frac{1}{32}$in. increased or diminished represents a considerable quantity in the course of an hour's work. If the hopper or bin become empty, the feed runs usually in a thick, narrow stream through the gate, frequently at one end only, the result being that the middlings are not crushed, and the rollers become hot at the part where there is no feed between them. In the case of the hopper filling up, the well-known disagreeable result of a choke of the purifiers follows." The construction is as follows:—Within the usual hopper another light hopper is placed, supported by a spiral spring on each side, and carrying a pin also on both sides. The lower ends of these pins bear on a lever fixed on either end of the feed-gate raising and lowering spindle. When full, the weight of the inner hopper and its contents compress the spiral springs, and carries the pins down on the levers, and so opens the gate. If a stoppage should occur in the pipe conveying the material to the hopper, the latter gradually empties, and is raised by means of the springs, thereby gradually closing the feed-gate, and gives the attendant time to look after and clean the pipe before the hopper has time to empty.

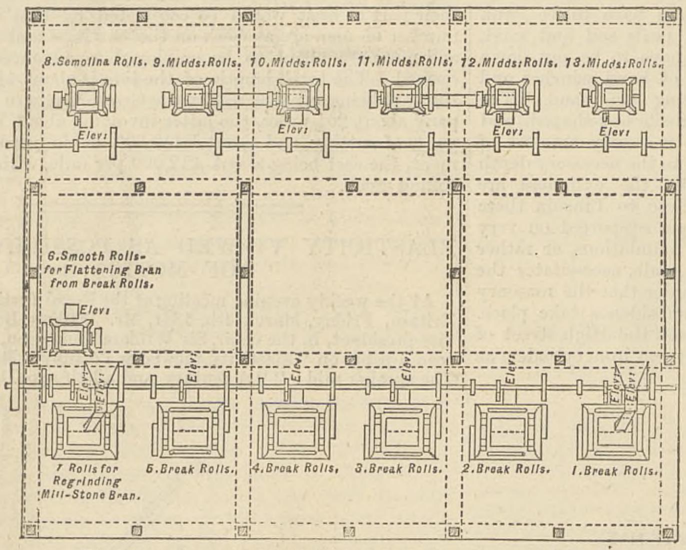


Fig. 21.—Carter's Exhibition Plant, Plan Ground Floor.

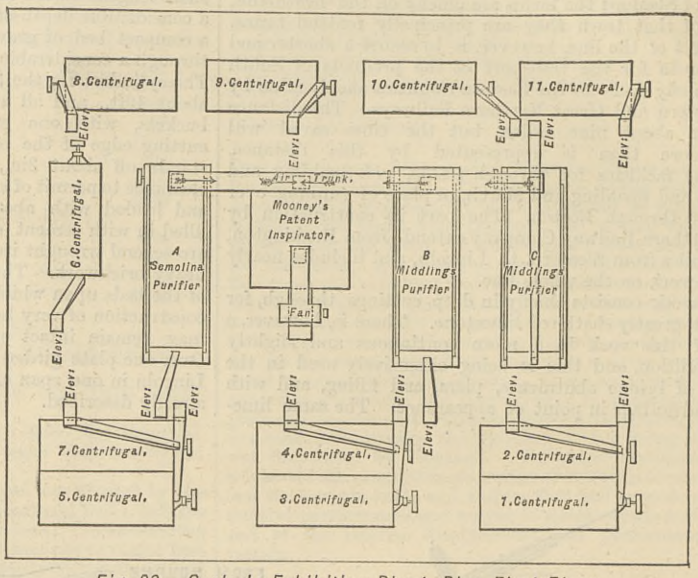


Fig. 22.—Carter's Exhibition Plant, Plan First Floor.

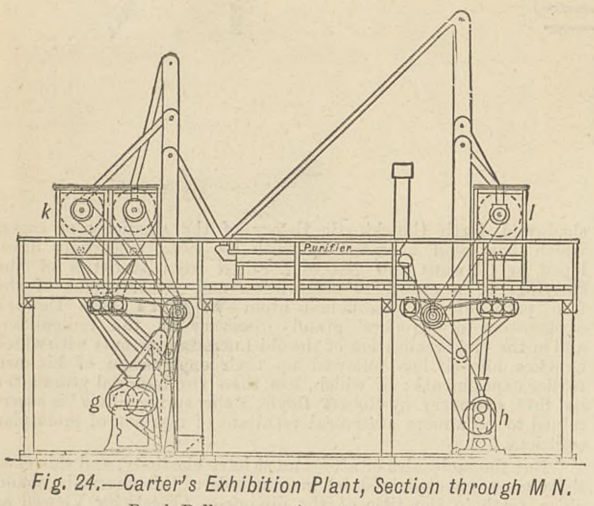


Fig. 24.—Carter's Exhibition Plant, Section through M N.

g—Break Rollers. | *k*—Centrifugal Silks.
h—Middlings Rollers. | *l*—Centrifugal Silk.

FIG. 31

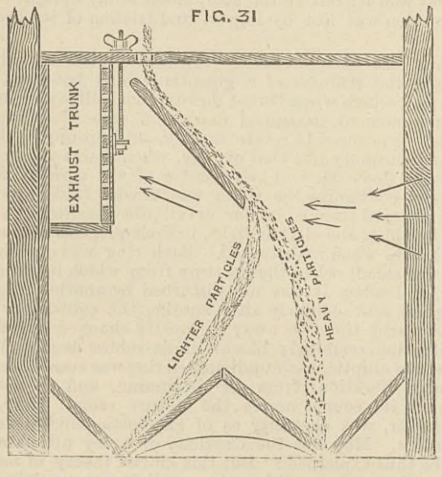
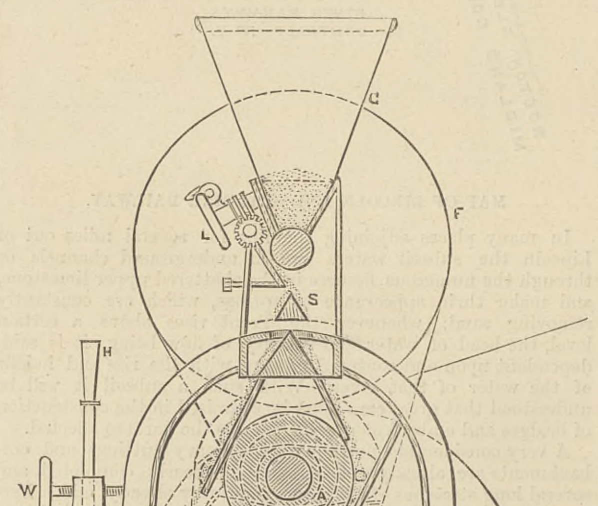


FIG. 26



The granulation is effected by five sets of fluted rollers, Braun's patent, manufactured by the eminent continental firm, Escher, Wyss, and Co. Fig. 25 represents a perspective front view of one of these machines. The rollers are of larger size than usual, with a corresponding increase of output. Mr. Carter estimates that a set of five will treat 35 centals of wheat—about seven quarters—and clean the bran. The result of the first break is to split the wheat in halves lengthwise; the flutes for this purpose are rather coarse, about eight to the inch. Both rollers are driven by independent belts; one roll is run faster than the other to secure a better splitting action, as we explained in the last article. If necessary to alter the differential speed, a cone pulley is fitted to one of the spindles, and a corresponding cone pulley on the shaft from which the rolls are driven. There is no increase of wear in the teeth by running one roll faster than the other; comparing them to millstones; it is known that the bedstone and runner wear equally. The pressure is applied by a lever and weights, and can be taken off at a moment's notice by means of a hand lever and catch. The rolls are of chilled cast iron, and the fluting is most beautifully done; those who know the practical difficulty of dealing with such a hard substance as these rolls are made of will appreciate the excellence of the work. Between the roll bearings there is an adjustable stop to prevent the rolls from coming into actual contact. The second and following break rolls are of the same construction, but the flutes are progressively finer.

The frames of these machines are cast in one piece, thereby securing great firmness; the bearings are of ample size and length, altogether they are very high-class machines, and of very neat appearance. At the end of the row of break rollers another set—not at work—with very fine teeth, about thirty to the inch, were exhibited; these are intended for cleaning millstone bran.

On the other side of the mill is a row of six smooth crushing rolls for reducing the semolina and middlings. These machines—Turner and Carter's patent—require special notice. The frame is cast in one piece, and is of very pleasing and graceful appearance. Fig. 26 shows a cross section, and Figs. 27 and 28 a perspective front view and detail of feed adjustment; the automatic feed hopper is not shown in the section, but is seen in Fig. 27. H is the hand lever for releasing the pressure; W, small hand wheels for adjusting the pressure and making it alike at both ends; an oil-tight case, kept partly full of oil contains and lubricates the cogs of all the wheels; P, the driving pulley; F, the feed roll pulley; G, the outer hopper; the inner hopper is seen in Fig. 27; A, B and C, the three rollers; S the feed splitter.

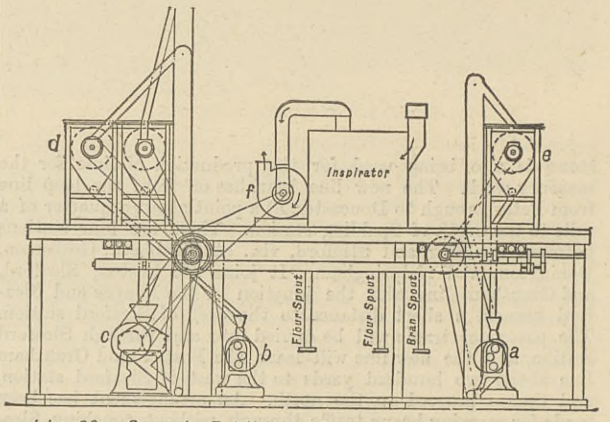
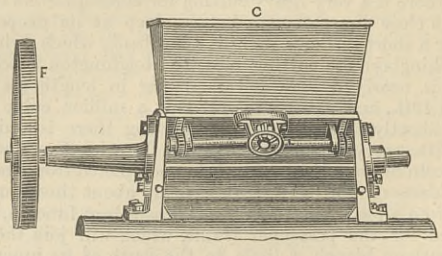


Fig. 23.—Carter's Exhibition Plant, Section through K L.

a—Middlings Rollers. | *c*—Break Rollers. | *e*—Centrifugal Silk.
b—Bran Rollers. | *d*—Centrifugal Silks. | *f*—Inspirator Fan.

The feed passes out of the hopper through the open gate on to an inclined plate, and falls on the edge of a triangular brass bar with a perfectly true and sharp edge; the plate is adjustable so as to regulate the split of the feed to a great nicety. Half the feed passes down by an inclined board and goes between the upper and middle rolls, and thence out by an inclined trough through a hole in each side of the casing Q—Fig. 26—and thence into the spout below and into a creeper trough. The other half falls on to another board under the inclined trough, and thence between the middle and lower rolls to the creeper below, where it meets the first half of the feed. When the automatic hopper is not used the feed is regulated by the small hand wheel L—Figs. 26 and 28. One feed roll gate and adjustment is required. This arrangement of feed is very simple and works well. The arrangement for applying the pressure is also very simple. The outer rolls A C are

FIG. 28



ROLLER MILLS AND DRESSING MACHINES AT THE MILLING EXHIBITION.

Fig. 25.

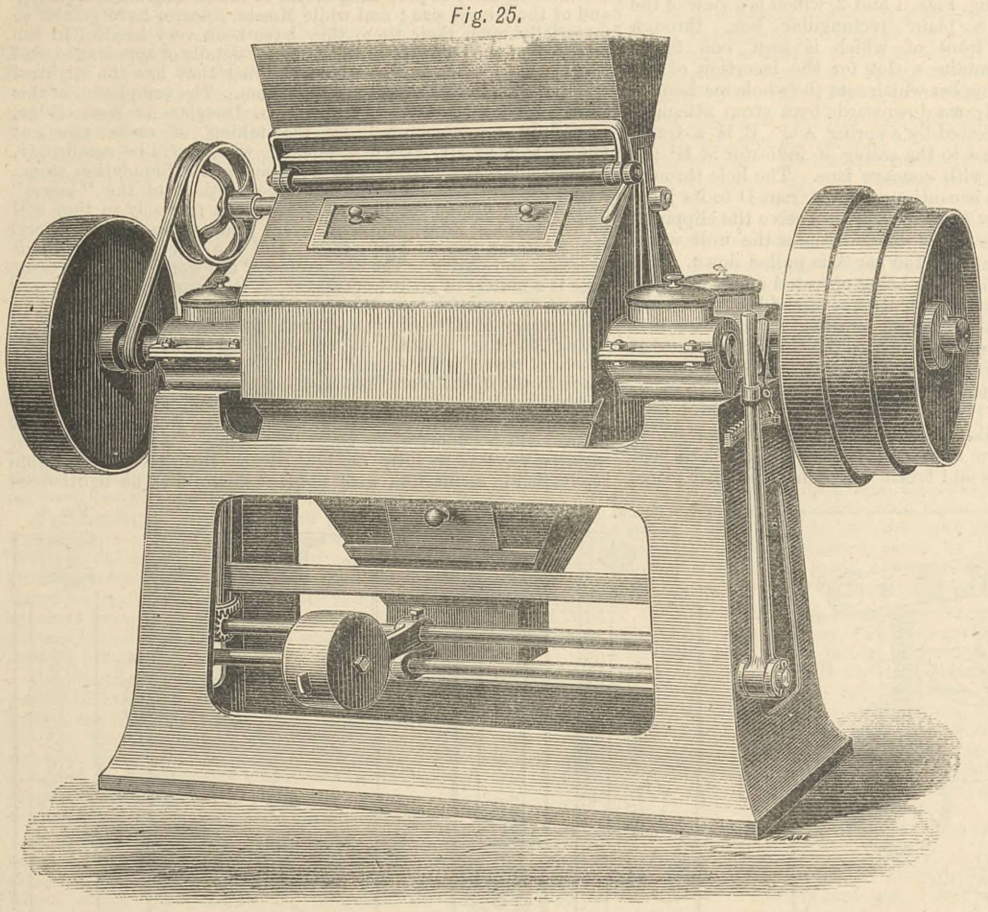


Fig. 27.

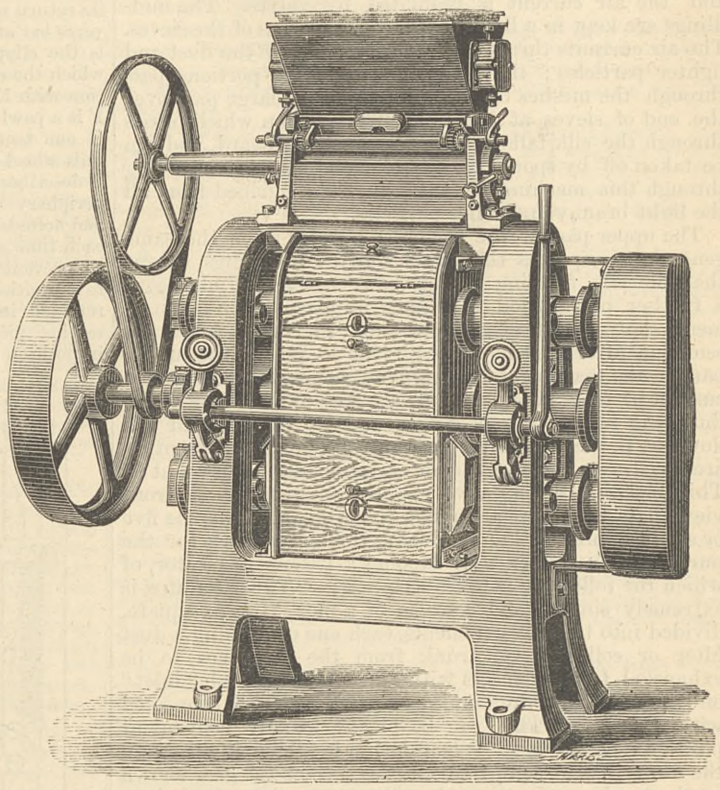


Fig. 30.

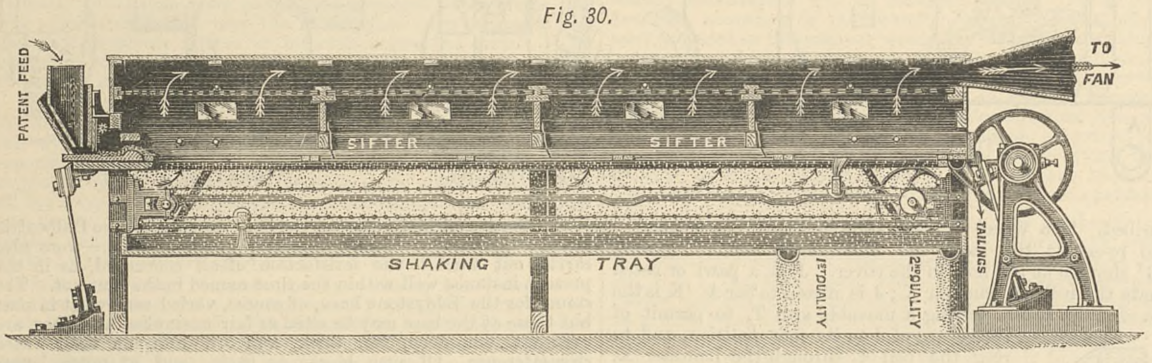


Fig. 33.

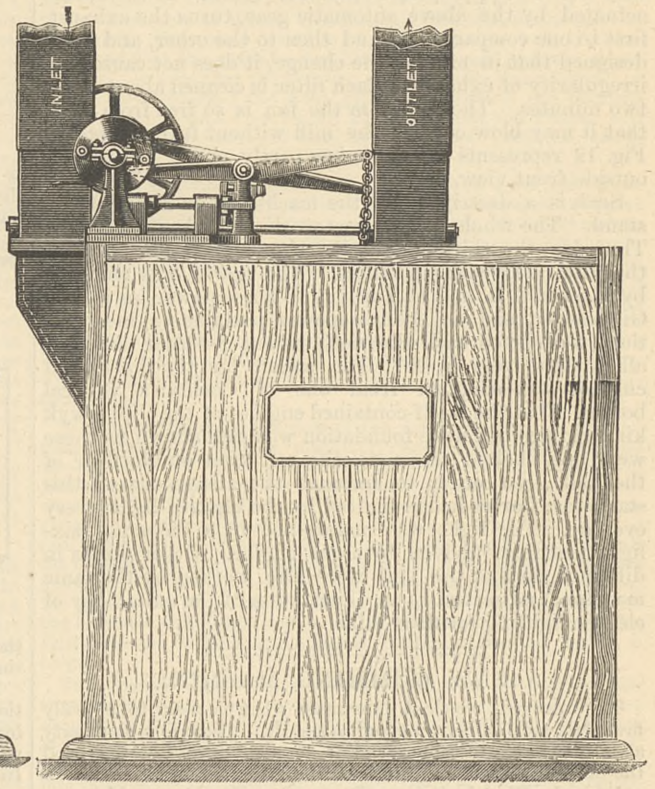
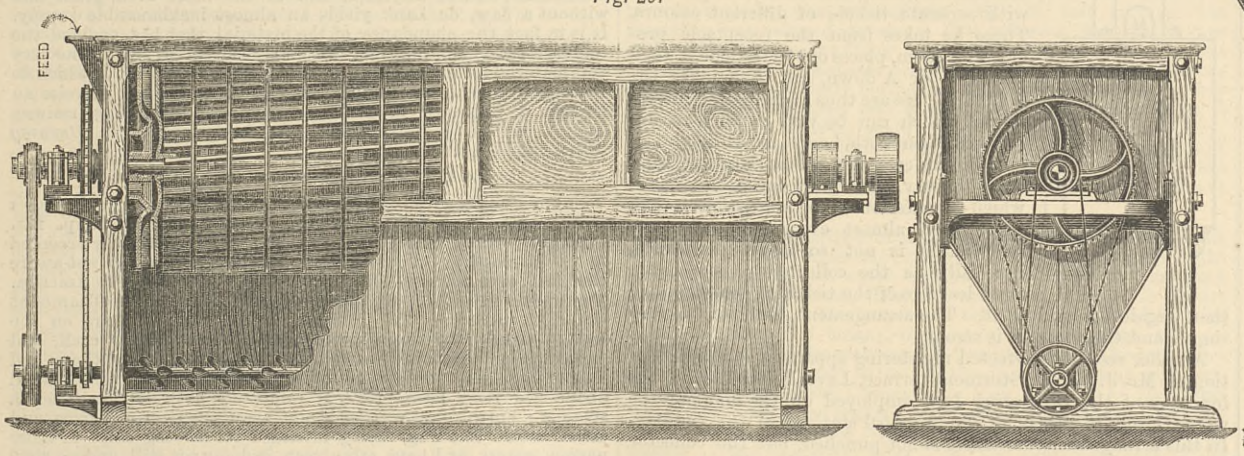


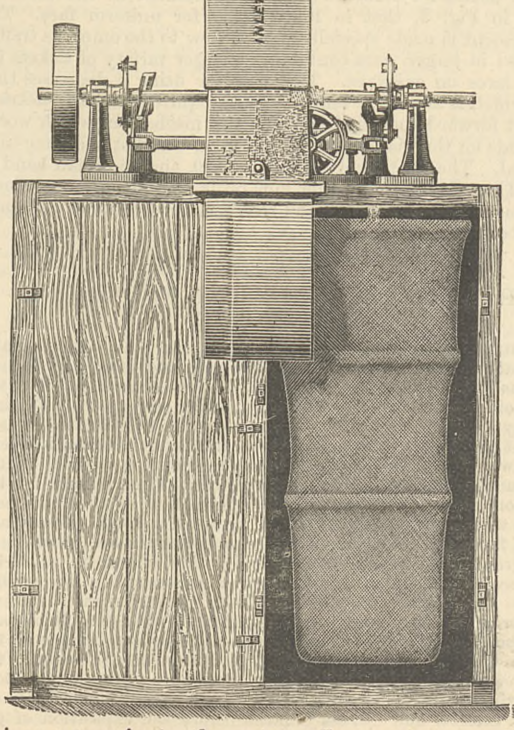
Fig. 29.



placed out of vertical line with the middle roll B, an arrangement found by practice to give a better grip. The middle roll bearings are fixed to the frame, the others are carried on short levers; one end of these levers is carried by an adjustable pin in a lug cast on the frame on each side of the machine. The other ends are joined by a flat spring—there are two of these springs, one for each end of the rolls. To the middle of each of these springs a bar is attached, sliding in an accurately fitting bush fixed to the frame. The outer end of the bars are enlarged and bored to fit a pair of excentrics formed on a spindle extending across the front of the machine; this spindle is also carried in the adjusting lever, which is free to up-and-down motion, but rests against the frame at its lower end, and through the medium of a screw at its upper end also rests against the frame. The handle H is keyed on to the spindle at one end. When the handle is depressed it pulls out the middle of the flat spring, and pulls the two outer rolls against the middle one; when raised it pushes in the middle of the spring and raises the upper roll and depresses the lower one out of contact with the middle roll; by this means the pressure can be released, and put on again at a moment's notice, without altering its initial amount. The hand wheels and screws W W are used to regulate the initial amount of pressure, and to adjust it equally at both ends of the rolls. This arrangement has proved excellent in practice, and gives firm pressure with the slight amount of elasticity necessary. The bearings are very long, and are provided with a continuous flow of oil through them: the oil is passed along to one end of the bearing by a spiral groove in the phosphor bronze bush, flows back by an inclined passage underneath the bush, is raised by a collar, and scraped into the spiral groove again, and so continually floods the journal.

These machines are manufactured by Messrs. Turner, of Ipswich, and are in every respect of high-class workmanship and material. The gearing, as before mentioned, is contained in an oil case, and is in some of the machines of the "Chevron" type much used now in this class of machinery. The middle roll is driven at about 120 revolutions per minute, the outer rolls running at a higher speed. On this floor is a seventh pair of rolls for flattening the bran; also a four-roll mill of Esher, Wyss, and Co.'s make, and a two-roll mill of Turner and Carter's—neither of these were at work. The lower part of the elevators were also visible on this floor, and under the upper floor the worms for conveying the dressed products from the dressing machines above. The elevators are bucket and chain elevators with Ewart's patent chain. On the upper floor were eleven centrifugals of Mr. Carter's design, those dressing from the breaks covered with wire, those dressing the crushed middlings with silk; the construction of these machines is shown partly in section, and with the silk covering removed, in Fig. 29. The outer cylinder has cast iron ends held together by ten longitudinal bars stiffened by transverse hoops of light, half round iron. This is covered with silk or wire cloth, and revolves slowly, about thirty revolutions per minute. Within this outer cylinder, beaters carried on cast iron discs revolve rapidly say about 130 revolutions per minute; these beaters have a twist, shown in the diagram. The middlings are put in through a hopper at one end, and are received by a flat disc brush, rubbing lightly against the inner end of the outer reel. The brush revolves with the inner beater spindle, and acts as a detacheur or dismembrator. The revolving beaters then stir up the material into a cloud, and thrust it against the inner surface of the silk, the heavy particles being thrown with greater centrifugal force, and more directly than the lighter particles of the same size. The separation of the dust is first effected through the fine wire at the feeding end of the machine, the larger particles pass on to the lower end of the reel where the silk or wire is coarser. Here the centrifugal action sends the good middlings through; the lighter particles strike against the silk and do not go through, but pass out at the tail end of the machine. This description holds good for the centrifugals used for the finer dressing. The tailings of the first break machines, consisting of broken pieces of corn and bran, pass on to the next breaks. This description of the centrifugal action

Fig. 32.



sounds perhaps somewhat speculative, but in practice what has been described actually takes place.

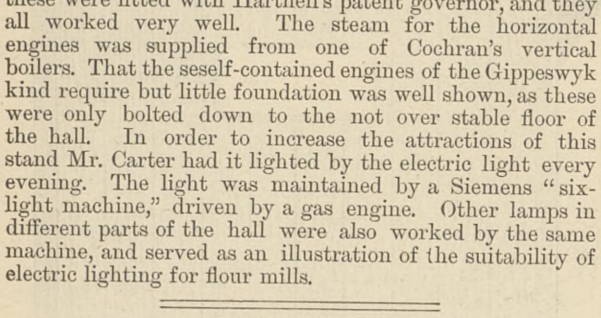
A further separation of the light particles is effected by the purifiers. Of these there were three—one for purifying semolina, the others, one for purifying good middlings, the other for tailings. Fig. 30 shows a longitudinal section of one of the latter. The middlings are fed in the inner hopper, and pass to reciprocating sieves covered with silk. An exhaust fan is in connection with the upper chamber and the air current is regulated by valves. The middlings are kept in a lively state by the motion of the sieves. The air currents through the silk draw away the dust and lighter particles; the heavy and valuable portions pass through the meshes of the silk; those too large pass over the end of sieves at the tail. The portion which passes through the silk falls on to a reciprocating board, and can be taken off by spouts at different points. After passing through this machine, the middlings are purified from all the light branny and other particles.

The upper part of the semolina purifier is on the same general principle as that used for the middlings, except that the silk forming the sieves is coarser. Underneath a further purification is effected by means of an arrangement shown in transverse section, Fig. 31. Here the semolina after passing through the sieves in the upper part of the machine falls down an inclined board, and a current of air is taken through the stream of falling semolina; the light portions are carried by the air and fall down at B, the heavier portions by their greater momentum are not drawn aside by the air currents and fall down at A. This machine effects a very clean separation. In front view these chambers are about 3in. wide, and may be five or six in number. For producing the air currents for the purifiers, Mr. Carter uses Mooney's patent inspirator, of which the following is his description:—"The apparatus is extremely simple, and consists of a box, 7ft. 6in. square, divided into two compartments, each one containing a dust filter or collector. A trunk from the machines to be exhausted from, connects with the trunk marked "inlet" on engraving, and the trunk marked "outlet" is connected with the fan. This can be placed at any convenient position near the box. When the fan is exhausting through the filter in one compartment, the automatic gear shown on the top is causing the other filter to be violently shaken, and thus relieved of the dust adhering to it. The latter falls into a hopper prepared for it below. A valve, also actuated by the above automatic gear, turns the exhaust, first to one compartment and then to the other, and is so designed that in making the change, it does not cause any irregularity of exhaust. Each filter is cleaned about every two minutes. The air from the fan is so free from dust, that it may blow outside the mill without fear of waste." Fig. 12 represents an end view partly open; Fig. 13, an outside front view.

Such is a description of the machinery on Mr. Carter's stand. The whole system was working well, especially on Thursday, the third day of the show, when his mill ran the whole day without a hitch. The power was supplied by Messrs. E. R. and F. Turner's 10-horse power horizontal Gippeswyk, and an 8-horse power portable engine. All these were fitted with Hartnell's patent governor, and they all worked very well. The steam for the horizontal engines was supplied from one of Cochran's vertical boilers. That the seself-contained engines of the Gippeswyk kind require but little foundation was well shown, as these were only bolted down to the not over stable floor of the hall. In order to increase the attractions of this stand Mr. Carter had it lighted by the electric light every evening. The light was maintained by a Siemens "six-light machine," driven by a gas engine. Other lamps in different parts of the hall were also worked by the same machine, and served as an illustration of the suitability of electric lighting for flour mills.

A SAW GUMMING MACHINE.

THE annexed woodcut illustrates what is next to a really first-class tool, namely, a good makeshift. There is a simplicity about it which will recommend it to many practical men, and the range in size of saw which can be gummed by it is almost unlimited. We take it from the *American Machinist*, which says of it:—"The accompanying engraving has come into our possession from some mysterious source. We do not know who the manufacturer is, nor where he is located, but the machine seems to possess some degree of merit. It consists of a strong



cast iron bracket bolted to a table. From this bracket a cast iron crane is suspended carrying a shaft. The shaft is driven by a belt upon a pulley, shown upon one end, and an emery wheel is placed upon the opposite end. Stops are provided, permitting a sufficient swinging motion of the crane to allow the emery wheel to do its work of grinding out the teeth of large saws. The saw is placed upon the table as shown, and the operator moves the shaft and emery wheel by means of the handle attached to the end of the shaft. The movement of the crane at the pivot is so slight that there is no danger of the belt running off."

FARE REGISTERING AND TICKET PUNCHING APPARATUS.

THE increase in the number of public street conveyances during the past few years, and the difficulty which many of the conductors of these and omnibuses find in permanently believing the old adage anent honesty, have led to the invention of a number of registering ticket punches. The registering ball punch, with operating handles like those of pincers, has met with great favour from tramway companies, and is, perhaps, the most readily used of all those brought out. Another form has recently been brought out by Mr. A. Soul, of 17, Holborn, which we illustrate by the accompanying engraving, Figs. 1 and 2, which is a view of the interior. The case is a plain rectangular box, through glazed openings, in the front of which is seen one figure of each dial, and it also contains a slot for the insertion of the ticket. A is the main moving bar which sets the whole mechanism in motion upon its being drawn downwards by a strap attached, its return motion being effected by a spring A^1. B is a transverse bar attached to A, and to the casing of indicator at B^1; C is the clipper, or punch, with concave face. The hole through which the clipper C works is continued down from D to its junction with E, which is a box or receptacle to receive the clippings. F is a pawl attached to the bar B which actuates the unit wheel G one tooth or unit each time the bar A is pulled down. The unit wheel G has ten teeth, which being operated on by the pawl F describes a complete circle in ten strokes of the bar A. In the periphery of G is fixed a projecting tooth G^2 which gears into and actuates on a corresponding recess on the circumference of H each time a complete revolution is made by G. G has a pawl P to prevent its slipping back on the return of the pawl F to its first position. The wheel H registers the tens. The wheel H is retained in working position by means of a lever with pin or ratchet piece R, as shown at Fig. 1. H and I are both kept in position by such springs and levers with pins or ratchet pieces

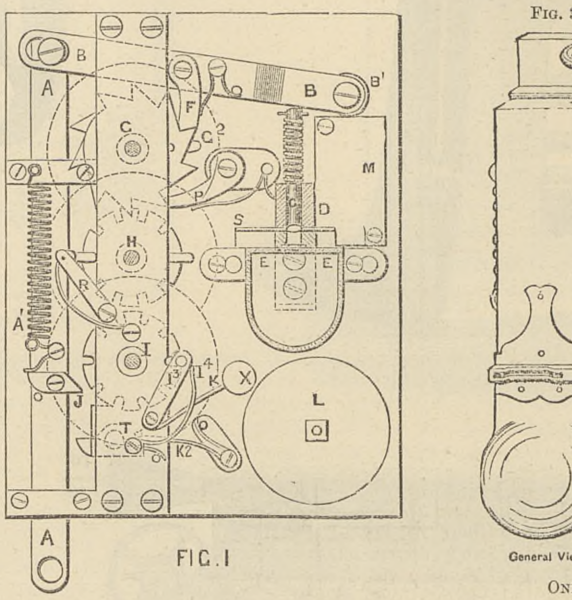
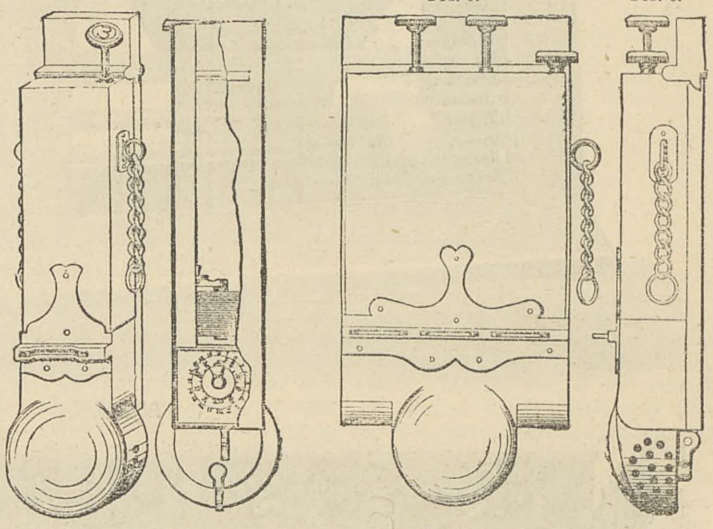


FIG. I

Fig. 3. Fig. 4. Fig. 5. Fig. 6.



General View. Back View—Cover partially broken away.

ONE FARE APPARATUS.

Front View. Side View.

THREE FARE APPARATUS.

as described. The wheel G is not thus provided, but is fixed so that to re-set it the main bar A must be set in motion until G^1 shows 0 at the hole in the cover. J is a pawl or catch to actuate the bell and hammer X; J is affixed to bar A. K is the lever to ring the bell L, having a movable arm T, to permit of the return of J to its first position, and to ring the bell L through the hammer X. The collector using the machine is provided with separate tickets of different colours. These he takes from the receptacle provided for them, places one in the slot S, then pulls the bar A down, and then takes the ticket. There are thus three distinct movements, which can be very rapidly accomplished when both hands are at liberty, as in tramway cars, but when only one hand is at liberty, as on the London omnibus—which is inferior as to convenience than those used almost everywhere else—the registration is not so easily performed, especially as the collector or conductor must leave go of the ticket to punch it, and then regain his hold of it. The arrangement, however, is very simple and the machine is strong.

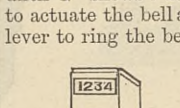


FIG. 2.

Another recently-perfected registering apparatus is the invention of Mr. J. Bailey, Stormont-terrace, Lavender-hill, S.W., the inventor of the registering lock employed on the doors of the water closets of nearly all the principal stations in the country. In this arrangement the ticket is not punched, but the collector cannot issue one without its issue being recorded. The arrangement is shown in the above engravings, from which it will be seen that on the top of the case there is in Fig. 3 one stop, and in Fig. 5 three stops. These must be depressed before a ticket can be issued, and two tickets cannot be issued at one time. Three sorts of tickets for different fares are contained in the machine shown in Fig. 3, that in Fig. 1 being for uniform fare. The arrangement is made specially with a view to the omnibus traffic, and also in larger sizes containing a larger variety of tickets for excess fares on railways. The collector using it depresses that knob which is above the kind of ticket required, and the ticket is brought forward and the bell rung, the mechanism which works the hands on the dial, as shown in Fig. 4, being at the same time operated. The long hand marks up to 20, and the small hand to 400. The advantage of this apparatus is that only two operations have to be performed, and that a ticket cannot be got until it has been registered.

THE COMPLETION OF THE EDDYSTONE LIGHTHOUSE.

WITHIN another month or so—much earlier than was originally anticipated—the actual building of the new Eddystone Lighthouse, so far as the masonry is concerned, will be completed, and the work of furnishing it with the lighting apparatus will then speedily begin. The whole of the stonework of the lighthouse is in fact not merely constructed but in the hands of the actual builders, whose work consists in conveying the already prepared blocks to the reef, and fitting them in their places there. The contract for the provision of the stone and for the construction of the lighthouse was, it will be remembered, taken by Messrs. Hugh Shearer and Co., of 21, Great George-street, Westminster, the owners of the de Lank granite quarries, near Wadebridge, and of granite quarrying rights away to Rough Tor, over an area of something like twenty square miles. The stones have been wrought in a yard at Wadebridge, where every one of the 2200 of which the lighthouse is composed—they weigh in all 6000 tons—has been brought to the precise dimensions required and fitted to a hair's breadth, the whole of the structure being built up section by section preparatory to its shipment. This work has now been brought to a close by Messrs. Shearer and Co. six months before the expiration of the time allotted in their contract, and the last stone of the outward curve of the top gallery was dropped into its place in the presence of Mr. Douglass, the engineer of the work, who heartily congratulated Mr. Shearer upon the style in which the contract had been executed. The de Lank quarries had been specially selected for their capacity of producing blocks of the finest grain and quality and of the largest size; and while Messrs. Shearer have gained so materially upon their time, they have been very heedful in the selection of the stone, even in the minor details of appearance, and there is not a block in the whole building that has the slightest speck of discoloration from top to bottom. The completion of this great undertaking, and the visit of Mr. Douglass to Wadebridge, was duly commemorated by the taking of some excellent photographs by Mr. Yeo, of Plymouth, who, it will be recollected, photographed the ceremony at the laying of the foundation stone. These photographs show the last two sections of the "house" built up in place on the quay at Wadebridge precisely as they will be fitted on the Eddystone Reef, every detail beautifully perfect, the joints as fine as knife edges, and the colour of marvellous evenness and purity. The completion of the work by the present date is a matter of great importance, as it saves very much more time in the erection than the six months gained on the contract, in consequence of the early period of the season, which will enable the fitting of the lantern, to be proceeded with almost at once. Much, of course, will depend upon the progress which has been made in the metal work and in the construction of the lighting apparatus; but the probability now is that the new light will send forth its saving rays at least twelve months before the earliest period which a short time since was thought possible. Messrs. Shearer have now fully established for themselves an enviable reputation in connection with lighthouse work. The lighthouses of the Great and Little Basses, Ceylon—executed at the Dalbeattie granite quarries of Messrs. Shearer, Field, and Co.—were also carried out much to the satisfaction of all concerned, as in the present instance well within the time named in the contract. The stones for the Eddystone have, of course, varied somewhat in size, but those at the base may be cited as fair examples, and they are each 6ft. 6in. deep, 2ft. thick, and 3ft. 10in. on their outer circumference. Of such blocks as these, and of much larger dimensions, and of the finest and of the most even grain and without a flaw, de Lank yields an almost inexhaustible supply. It is in fact the abundance of the material that has enabled the construction to be proceeded with at such speed. Only the very best material is chosen for works of this kind. The way, in which de Lank has thus been brought into prominence will exercise an important influence upon the project for extending railway communication to Padstow and Wadebridge.—*Western Morning News*, 6th May, 1881.

EARLY STEAMSHIPS.—The following extract is from Mr. Froude's recently-published "Reminiscences of Carlyle," Vol. I., p. 128. It gives a version different from that which is generally accepted of the introduction of steamships. For instance, we are not aware that Bell ever assisted Miller, or that he ever went to America. There is no record of experiments by Miller upon the Thames at the date named:—"At Greenock I first saw steamers on the water; queer little dumpy things with a red sail to each, and legible name, 'Defiance,' and such like, bobbing about there, and making continual passages to Glasgow as their business. Not till about two years later—1819, if I mistake not—did Forth see a steamer; Forth's first was far bigger than the Greenock ones, and called itself 'The Tug,' being intended for towing ships in those narrow waters, as I have often seen it doing; it still, and no rival or congener, till—in 1825—Leith, spurred on by one Bain, a kind of scientific half-pay master R.N., got up a large finely appointed steamer, or pair of steamers for London; which so successful were they, all ports then set to imitating. London alone still held back for a good few years; London was notably shy of the steamship, great as are its doings now in that line. An old friend of mine, the late Mr. Strachey,* has told me that in his school days he at one time—early in the Nineties, I should quess, say 1793—used to see, in crossing Westminster Bridge, a little model steamship paddling to and fro between there and Blackfriars Bridge, with steam funnel, paddle wheels, and the other outfit, exhibiting and recommending itself to London and whatever scientific or other spirit of marine adventure London might have. London entirely dead to the phenomenon which had to duck under and dive across the Atlantic before London saw it again, when a new generation had risen. The real inventor of steamships, I have learned credibly elsewhere, the make and proprietor of that fruitless model on the Thames, was Mr. Miller, Laird of Dalswinton, in Dumfriesshire—Poet Burns' landlord—who spent his life and his estate in that adventure, and is not now to be heard of in those parts; having had to sell Dalswinton and die quasi-bankrupt—and I should think broken-hearted—after that completing of his painful invention, and finding London and mankind dead to it. Miller's assistant and work-hand for many years was John Bell, a joiner in the neighbouring village of Thornhill. Miller being ruined, Bell was out of work and connection, emigrated to New York, and there speaking much of his old master, and glorious unheeded invention well known to Bell in all its outlines or details, at length found one Fulton to listen to him; and by 'Fulton and Bell"—about 1809—an actual packet steamer was got launched, and, lucratively plying on the Hudson River, became the miracle of Yankee-land, and gradually of all lands. These, I believe, are essentially the facts. Old Robert McQueen of Thornhill, Strachey of the India House, and many other bits of good testimony and indication, once far apart, curiously coalescing and corresponding for me. And as, possibly enough, the story is not now known in whole to anybody but myself, it may go in here as a digression—*à propos* of those brisk little Greenock steamers which I first saw, and still so vividly remember; little 'Defiance,' &c., saucily bounding about with their red sails in the sun, on this my tour with Irving."

* Late Charles Buller's uncle, Somersetshire, gentleman, ex-Indian, died in 1831, an examiner in the India House; colleague of John S. Mill and his father there.

RAILWAY MATTERS.

THE New South Wales National Debt is £15,000,000. Her railways, as one asset, are alone said to be worth £12,000,000.

THE New South Wales Government are constructing tramways as feeders to the railways in two or three of the populous districts of the colony.

A PAPER on the "Electric Railway and the Transmission of Power by Electricity," was read on Wednesday evening before the Society of Arts by Mr. Alexander Siemens.

AT the date of departure of recent mail, traffic on the central line of railway of Queensland was stopped on March 30th, as the Dawson Bridge was 10ft. under water.

ACCORDING to official returns, sixty-nine men were killed and 225 wounded on the St. Gothard Railway in the course of 1880. Of these, twenty-two were killed in the great tunnel. These accidents have arisen for the most part from falls of rock and premature explosions of dynamite.

THE endless cable system of working street cars, which has been in use in San Francisco for a number of years, will soon be introduced on the South Side street railways in Chicago. There are four cable lines in San Francisco, and it is said that cars run eight miles an hour, up hill or down. This is much better time than is usually made with horses, while the travelling is safer.

IN the debate on the New South Wales Government railway schemes the estimate of £1,430,000 for the railway from Goulburn to Cooma was agreed to without a division, as was the proposal of £80,000 for a double line from the Murray to the Albury Extension, including one-half the cost of the bridge. The estimate of £518,000 for the line from Narrandera to Jerilderie was strongly opposed, but was ultimately carried.

A LENGTHENED discussion took place at the Johnstone Town Council last week as to the power of the Glasgow and South-Western Railway to close up the canal route to Glasgow. The meeting strongly deprecated the shutting up of the water way unless an equivalent be given to the people of Johnstone. Several speakers gave statistics as to the high tariff rates charged, and showed that during the last ten years the rates had been raised at least 45 per cent.

THE electric railway built by Messrs. Siemens and Halske, between Lichterfelde and the Cadettenhaus, about six miles from Berlin, has been tried with most successful results. A trial was made on the 12th inst., with a simple tram-car, with one electro-dynamic machine. The gauge is one metre. The greatest speed obtained on a distance of about one and a-half mile was eighteen English miles an hour. A far greater speed could be obtained, but is not allowed by the German police authorities.

AN attempt to wreck the up 6.39 p.m. passenger train was made on Tuesday night on the London and South-Western line between Guildford and Woking. The engine encountered an obstruction which nearly threw it off the line, and the carriages were so violently jolted that some passengers screamed out in alarm. It was afterwards found, says the *Times*, that some miscreant had placed large pieces of iron at intervals across the metals. The police, of course, are endeavouring to trace the delinquent, but they never find the fiends that do these things.

A BRISBANE telegram, dated the 11th inst, says :—"Mr. Watson's party for the survey of the projected trans-continental railway, arrived at Point Parker on the 4th inst. Mr. Watson reports favourably on the proposed route for the railway line inspected by the expedition. The party drove a four-horse wagon all the way, and passed through the worst time of the year, after and during serious floods. Timber was found to be scarce, but ballast plentiful. The high ground runs right down to Point Parker, where there is a good site for a town and a safe harbour."

AFTER some delay, the new passenger station for Waterloo on the Southport line of the Lancashire and Yorkshire Railway, Liverpool, has been completed. The new station is on the south-east side of the venerable shed which has done duty for a station for many years, and it is as cleanly and compact as the old station is dilapidated and dirty. The aim of both architect and the engineer appears to have been to produce a station which should be at once ornamental and useful, and architecturally a feature in the neighbourhood in which it is placed, and in this aim the *Liverpool and Bootle Times* thinks they have succeeded admirably.

THE reasons given by United States track repairers for stopping trains are sometimes amusing. The *Railroad Gazette* quotes some. An Erie engineer was told recently, upon being stopped, that, "De track videns oud, und de track videns in; de bolds is oud und de spikes is oud, und you got to go slow on dat section." Another, on being asked what was the matter with him, said, "Phat's the matter wid me? Phat's the matter wid you? Go to h—l, and don't pass the min beyont till the boss bickons at you." Another said, "They are putting in iron down where Murphy had the potaty patch last summer." Another said, "The min are putting in a broken rail down forninst the sand bank."

THE Panama ship railroad has been anticipated in Florida, though the line transports only fishing boats, and is worked by mules; still the principle is the same. The *Pensacola Gazette* says :—"There is really a railroad on Santa Rosa Island, complete in all its parts, except that the rolling stock is operated without steam. This road traverses the island from the vicinity of Mary Esther post-office to the Gulf coast, and was built by the Pensacola Ice Company in the interest of their fish business. It has long been a custom with the fishermen to bring over their fish from the Gulf to the Sound in tubs, but they were never before able to enter the harbour with their boats without doubling the western pass. The cars on the railroad, however, accommodate the boats as well as the tubs. And thus we keep pace with the age."

THE scheme for constructing a railway across the Continent of Australia is again attracting attention. Years ago Mr. R. D. Ross urged a scheme for interesting English capitalists in such an undertaking by making large grants of land in alternate blocks along the line. This scheme is now revived, and Mr. J. G. Pitcher, accountant of the English and Scottish Chartered Bank, who is about to visit England, is the bearer of a prospectus of a proposed company to carry out this undertaking on the basis of land grants. The nominal capital is six millions, in 12,000 shares of £500 each. The scheme, says a correspondent of *India and the Colonies*, rather captivates us by its magnitude; but a by no means inconsiderable portion of the community are determinedly opposed to the scheme, preferring that the Government should carry on the trunk line as funds permit, and get all the benefit of opening up the interior.

THE collision which occurred on the 26th February, at High Peak junction, on the Derby and Manchester section of the Midland Railway, when the 3.30 p.m. down express from London to Manchester and Liverpool came into collision with the brake van of a down mineral train from Ambergate to Manchester, was very destructive of rolling stock. In the express train, which consisted of engine and tender fitted with a steam brake, third-class brake carriage, two horse-boxes, bogie composite, Pullman car, bogie composite, brake-van, bogie composite, and brake-van, nine vehicles in all, all except the horse-boxes fitted with Saunders' automatic vacuum brake, applicable from the engine by the same handle as the steam brake, the engine had its buffer beam broken, left buffer knocked off, left framing and foot-plate damaged, left brake-rod broken, and received other minor damage; the tender had its left axle boxes damaged; the sides, steps, and axle-boxes of all the vehicles were more or less damaged, and also the brake gearing of one of the bogie composite carriages and of the Pullman car. The body of the mineral train brake-van was broken up, and one pair of wheels of the wagon next it was knocked off the rails, and the draw-bar of this wagon was broken. In concluding his report on this accident, Major-General Hutchinson says there is good reason to believe that it would not have taken place had the safety points been worked by rod instead of by wire.

NOTES AND MEMORANDA.

IT has been estimated, we do not know upon what data, that, in 1878, on the 270,000 miles of railroad, there were at work 105,000 locomotives, of an aggregate 30,000,000 horse power, while the total number of engines amounted to 46,000,000 horse power.

A NEW invention consists, it is said, in the application of light-giving materials to printing ink, by which print becomes luminous in the dark, so that in future it will be possible to read without the assistance of candle or lamp. A new daily paper, it is said, will soon be started in Turin, upon which luminous ink will be used.

MR. LEWIS T. WRIGHT has continued his experiments on the determination of the value of combustible gas recently referred to in this column. He has lately measured the lengths of a coal gas flame burning in air and burning in nitrous oxide (N^2O). The flame length was 1·3 in length in air and 0·5 in length in the nitrous oxide. The relation 5 : 13, Mr. Lewis says, is in accordance with the law he previously enunciated.

A MANUFACTURER whose business requires the use of large amounts of fine emery, affirms, says the *National Car Builder*, that he has obtained good results from the use of ashes as a substitute for the finer grades. He saturates the ashes with water, the liquid being poured off after standing an hour or two, then poured off again, and so until he obtains several grades, down to a substitute for emery flour. When dried, the deposit cuts readily and leaves a satisfactory surface.

THE operation of making holes in glass and porcelain is often a troublesome and unsatisfactory one. The firm of Richter and Co., in Chemnitz, have found a way of so impregnating thin German silver discs, 15 mm. to 25 mm. diameter, with diamond, that when fitted to a quickly rotating tool, these cut through glass or porcelain in a few seconds, or effect any desired carving with great accuracy. With cylinders made on the same principle, round holes can be quickly made, the wear, even after much use, is, says the *Scientific American*, hardly perceptible.

AT a recent meeting of the New York Academy of Sciences Dr. Trimble, of New Jersey, exhibited specimens of marine shells and marble which were deeply perforated by the larva of certain ephemera. The marble had been bored in every direction to the depth of from 2in. to 3in., and thus honeycombed with slender passages, plugged at the entrance with a closely cemented deposit. In their flying state the ephemera—commonly called May flies or day flies—live but a few hours. The larvæ live in water for a year or more, and, according to Dr. Trimble, secrete an acid which enables them to bore into limestone, passing through their first transformation in the closed burrows. These are probably insects of the genus pholas, plentiful in some parts of the Dorset coasts.

IF crushed maize, rice, barley, or other unmalted grain, be exposed to a temperature of about 160 deg. Fah. under a pressure of say four or five atmospheres, it will be found that nearly all the starchy constituents will be rendered soluble. It is however, doubtful, according to the *Country Brewers' Gazette*, whether a wort prepared in this manner would be suitable for making beer, because the soluble products are scarcely such as will undergo a normal fermentation under the influence of yeast; but by the subsequent addition of some malt extract at suitable temperatures, there ought to be no difficulty in producing from it a wort of suitable composition. The raw grain should, of course, prior to mashing, have been submitted to a process of kiln drying, by which its raw flavour is removed and an agreeable one imparted, on account of the development of certain empyreumatio products.

IN a report to the Norton Union Sanitary Authority on the ventilation of sewers, Mr. G. B. Nichols, after briefly describing the principal methods of ventilation, quotes Mr. Robert Rawlinson, C.B.: "In Leeds some years ago the sewers were not ventilated, and the rate of mortality was high. Their engineer had since done what ought to be done generally; he had not only ventilated all the main sewers, but he had untrapped every gully. The result was, there were 20,000 gullies which had no traps, and the combined area was equal to something over 3300 square feet always open to the atmosphere. By the last returns, the mortality was reduced to about 19·9, whereas last year it was 25·5. If there was one thing more difficult than another, it was to induce people to ventilate the sewers and drains. There were towns which persistently bottled up their sewers, because if they made one opening they said it stank so abominably—and so it did—that they shut it up again, instead of opening twenty, fifty, or a hundred others. He had recently reported on Dublin, which had 400 ventilators on their main sewer, whilst he ascertained that to make them safe they ought to have 2800. This question was at the root of sanitary improvement."

A GENTLEMAN recently returned from Australia believes that the arid plain which occupies the centre of that island-continent might be amply supplied with water and converted into rich farm land by a very simply process. His idea are communicated to *Nature* by Mr. F. T. Mott. He founds his belief upon observed facts in the three sciences of botany, physiography, and geology, thus :—(1) Gum-trees and the mallee scrub flourish there. The gum-trees grow to a great size, and withstand the drought of many summers. They must have water; whence do they obtain it? (2) Rivers which flow toward the centre from the mountain ranges along the coasts have no apparent outlet into the sea, but are lost in the desert. What becomes of them? (3) The underlying rock of the central plain is an almost horizontal bed of tertiary sandstone. The conclusion is that the sandstone is saturated with water, and forms an immense reservoir, from which existing trees draw their supplies by deep tap-roots, and that by sinking wells in the desert this water could easily be reached. The author of this theory, wishing only to confer a public benefit, desires to bring it under the notice of scientific men, that it may be either turned to account or shown to be erroneous. If there is even a remote possibility of its truth, it would seem worth while for one or more of the colonial Governments to have borings made in order to test it.

A CORRESPONDENT has sent a letter on the storage of electric force to the *Times*, from which we may quote the following :—A short time ago your able Paris correspondent announced the discovery by M. Camille Faure of the practical means of storing electric energy and rendering it portable, so as to be applied to many purposes hitherto considered, if not impossible, extremely difficult. The public *séance* at the Société d'Encouragement pour l'Industrie, which was presided over by the *doyen* of the French Academy of Science, M. J. B. Dumas, and at which were present some eminent English scientific men, proved that M. Faure's discovery was no mere laboratory experiment, but substantially one of great practical utility, based on that of Mr. G. Plante. On Monday, the 9th inst., in Paris, a Faure battery, or *pile secondaire*, was charged with electricity direct from the ordinary Grove battery and in my presence. It may be more economically done from a Gramme or Siemens machine. The receptacle consisted of four Faure batteries, each about 5in. diameter and 10in. high, forming a cylindrical leaden vessel, and containing alternate sheets of metallic lead and minium wrapped in felt and rolled into a spiral wetted with acidulated water, and the whole placed in a square wooden box, measuring about one cubic foot and weighing some 75 lb. This was protected by a loose wooden cover, through which the electrodes—in lead—protruded, and were flattened down for convenience of transport. This box of "electric energy" was handed to me by M. Faure, at my request, with the object of submitting it for examination and measurement to Sir William Thomson at the University of Glasgow. In about 72 hours from the time of charging in Paris, the writer presented to Sir William Thomson M. Faure's rare offering of a "box of electricity," intact and potent, holding by measurement within that small space power equivalent to nearly one million of foot-pounds. It is now being submitted to a series of tests and measurements, the results of which will shortly be made public through the proper channels.

MISCELLANEA.

THE *American Manufacturer* says China's mercantile marine compares very fovourably with Great Britain's, the tonnage of the former being 4,100,000, and of the latter, 6,115,638.

THE Porth Curnow Lisbon cable, which was some time since picked up in 2000 fathoms of water and repaired, has been again broken and picked up in 1900 fathoms, and repaired by the s.s. Chiltern.

A VERY interesting and highly instructive lecture on the recent progress in the manufacture and application of steel was delivered before the Society of Arts on the 12th inst. by Professor A. K. Huntington, of King's College, London.

A LANDSLIP occurred on Monday morning at Innsteads, near Bacup-on-the-Hill, where the fatal landslip took place a short time ago. Several tons of soil suddenly fell from the summit, but no one was injured. The hill has been gradually giving way for some time.

THE tower of the very old St. Lawrence Church, Ipswich, has long shown signs of destructive decay, and according to the *Ipswich Journal*, some of the brickwork of the tower fell on the 6th inst. into the St. Lawrence-lane, which runs past it. The old tower will probably have to be taken down, as it is unsafe to pass it.

A REUTER'S telegram of the 13th inst. from Cincinnati says :—"A discovery has been announced before the Cincinnati Scientific Society of a process for fusing and moulding iridium, which has hitherto been deemed impossible. A bar of this metal which was used as a substitute for the negative carbon in an electric lamp burned sixty hours without loss of weight or change of form."

A MEETING attended by merchants and tradesmen of Adelaide was held on March 24th, to consider a proposal to hold an exhibition in Adelaide. The undertaking was at the meeting looked upon with little favour, as it was considered to be merely a monetary speculation of Messrs. Joubert and Twopenny. The action of the Government in assisting the movement was condemned.

EARLY on Tuesday morning the steamship Queen of the Bay, bound from Penzance to Scilly, broke her shaft during strong weather off the Rundle Stone. Sails were hoisted with all speed, the crew being assisted by twenty fishermen who were on board. This was done only in time to prevent a disaster, for the head of the steamer was got round so close to the Rundle Stone that the buoy marking its proximity was touched.

AN interesting series of steam fire engine competitive trials were concluded at Karlskrona, in Sweden, on Monday, the 2nd inst. These trials had been adjourned to give the Ljusne Company, of Sweden, time to repair their boiler which had failed. The competitive engines were one by the Swedish Company above referred to, being a copy of the Gould—American—engine, one by Merryweather and Sons, and two by Shand, Mason, and Co. The report of the jury has not yet reached England.

SOME comment has taken place upon an announcement made in the *Ironmonger* that the basic process, as recently put into operation at the works of Messrs. Wendel and Schneider, has not proved successful. The reason is said to be that white pig iron is there used, and that this contains too little manganese and too much sulphur. It adds that the question of cost is also found difficult of satisfactory solution; and that generally speaking the opinions expressed some time since by Mr. Hampton, Herr von Tunner, and M. Pourcel, have not yet been upset by the practical results obtained.

WE have received a copy of a book published by Messrs. Dean and Son, London, which is a list of the export merchant shippers of London, Manchester, Liverpool, Birmingham, Wolverhampton, Walsall, Leeds, Bradford, Sheffield, Glasgow, Greenock, Edinburgh, Leith, Hull, Stockton-on-Tees, Newcastle-on-Tyne, Middlesbrough, West Hartlepool, Gateshead, Sunderland, North and South Shields, Bristol, and Cardiff. It thus comprises the chief exporting centres, and gives their respective trading ports, and the class of goods the merchants customarily ship. It contains a list of warehousemen and manufacturers, alphabetically arranged, together with a statistical directory and guide, index to places of shipments, &c.

WE are informed that in view of the International Congress of manufacturers of engines, machinery, and finished products, and the exhibition of these, which will be held at Liège during the *fêtes* commemorative of the foundation of the kingdom of Belgium on the 24th, 25th, and 26th of July, the Minister of Finance has given orders that all goods sent to and from the Exhibition will be free of duty. The Minister of Public Works has ordered that all the objects sent to the Exhibition, and which are returned to the exhibitor, shall be returned carriage free, thus practically reducing the carriage by 50 per cent. All correspondence on the subject of the Congress and Exhibition is to be addressed, le Président des Entrepreneurs de Travaux Publics et Civils, rue Dartois, No. 15, à Liége.

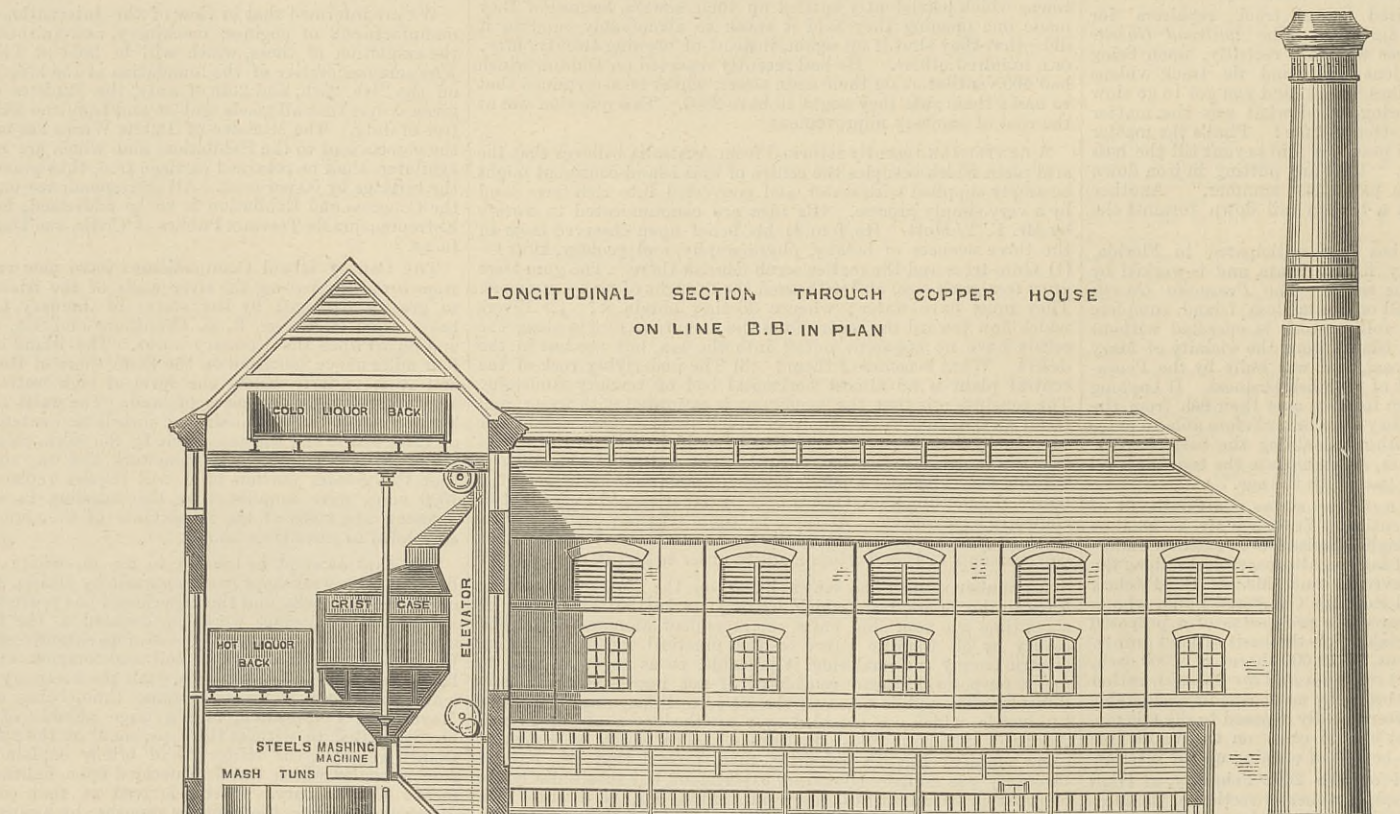
THE Canvey Island Commissioners have now resolved to take steps towards repairing the river walls of the island, which were so greatly damaged by the storm of January 18th, and they have called in Messrs. R. B. Grantham and Son, C.E., to survey and report upon the necessary works. The island is situate about four miles above Southend on the Essex shore of the river Thames, and it is entirely below the level of high water. In ordinary seasons it is a fertile piece of land. The walls facing the river Thames under the commissioners' jurisdiction extend over a length of three miles, and the gaps made by the storm measured one and a-half miles in length. The stonework also was so much injured that the greater portion of it will require replacement. About 1500 acres were inundated by the bursting in of the tide in January, and many of the inhabitants of the various farms were compelled to leave their homes.

THE first attempt in Lincoln to use electricity as a means of lighting large workshops has been made by Messrs. Robey and Co., of the Globe Works, and the experiment has proved an unqualified success. The spacious workshop devoted to the fitters, turners, and erectors—which, in consequence of its extensive galleries, offered the greatest obstacles to the full and complete utilisation of the light—was the first dealt with. All the necessary arrangements, which had been in progress some time, being completed, the Mayor and Corporation, and a large number of citizens, were kindly invited to witness the experiment on the 8th inst. Mr. F. Clench received the visitors, and briefly explained the circumstances under which the firm decided upon lighting the works by means of electricity. Having arrived at that conclusion, they determined during the summer months, by means of a machine and lamps of 32,000-candle gross power—sixteen lamps of 2000-candle power each—to conduct such experiments as would enable them to commence lighting the works comfortably in the winter. Mr. J. Richardson then gave an explanation of the principles of electric lighting and the Brush system, which is that used. He said: "Taking the quantity of gas we previously consumed as our basis, reckoning it at the reduced price of 2s. 8d. per 1000ft., we find that, after making a full allowance for interest on capital outlay, depreciation, working expenses, and carbons, that the electric light is slightly cheaper than gas for the same number of hours; but the new light has the very great advantage that it gives full and brilliant illumination of the whole shop, instead of the very partial lighting, with intervals of obscurity, which we get with gas." In the fitting shop, thirteen electric lamps replaced 325 gas jets. The great workshop was brilliantly illuminated, and even in the corners most distant from the rows of lamps, the workmen, it is said, were able to pursue their labours as easily as in the brightest sunlight. Here and there shadows were necessarily cast; but the positions of the lamps had been so arranged that this inconvenience was scarcely felt.

NEW BREWERY, DORCHESTER.

MESSRS. SCAMELL AND COLYER, ENGINEERS, AND MR. CRICKMAY, ARCHITECT.

(*For description see page 375.*)



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MEETINGS NEXT WEEK.

THE INSTITUTION OF CIVIL ENGINEERS.—Tuesday, May 24th, at 8 p.m.: Paper to be discussed, "On Torpedo Boats and Light Yachts for High-Speed Steam Navigation," by Mr. John I. Thornycroft, M. Inst. C.E.; and paper to be read, "The Production of Paraffine and Paraffine Oil," by Mr. Richard Henry Brunton, M. Inst. C.E.

SOCIETY OF TELEGRAPH ENGINEERS AND ELECTRICIANS.—Thursday, May 26th: Council meeting at 7 p.m., ordinary general meeting at 8 p.m.: "On the Construction and Working of a Military Field Telegraph," based upon experience gained during the campaigns in Afghanistan in 1878-'79-80, by P. V. Luke, C.I.E., Superintendent, Field Telegraphs, Northern Afghanistan Field Force.

THE ENGINEER.

MAY 20, 1881.

THE FORTH BRIDGE.

SIXTEEN years ago Parliamentary powers were sought and obtained by the North British Railway Company to construct a bridge across the Firth of Tay, and a bridge across the Firth of Forth, for the purpose of "securing for the North British, Great Northern, North-Eastern, and Midland Railways a fair share of the through traffic between England and the North of Scotland hitherto practically monopolised by the London and North-Western and Caledonian Railways." In the present session powers are being sought to reconstruct the blown down Tay Bridge, and to abandon the Forth Bridge. The history of the former bridge will be fresh in our readers' memory, but that of the latter is, in many respects, of so remarkable a character as to deserve the special consideration of engineers. The bridge authorised in 1865, though a bold and even reckless undertaking in its way, was an entirely different structure, and on a different site, from that now sought to be abandoned. Sir Thomas Bouch's first intention was to cross the Forth at a point five miles above Queensferry, by a bridge 11,755ft. in length, inclusive of four spans of 500ft. each, across the deep water channel. Borings at this place showed that the bed of the Forth, for a depth of at least 120ft.—or, in other words, for a practically unlimited depth—consisted of soft silt, incapable of sustaining without serious settlement one-tenth of the load usually imposed on bridge piers. In the evidence before the Parliamentary Committee it was stated that an experimental disc, 4ft. in area, had sunk 1ft. 2½in. into the silt when loaded with four tons, whilst with the very ordinary pressure of six tons per square foot the settlement had been no less than 7ft. 7in. It is sufficient evidence of the recklessness which characterised the design to state that Sir Thomas Bouch proposed, on a foundation of this kind, to erect a continuous girder bridge—a type of construction which, above all others, requires immovable piers, since a settlement of an inch or two may increase the strains fully 20 per cent., and larger settlements a correspondingly greater percentage. However, the Act was obtained, and in the following year an experimental pier was commenced. This consisted of a platform of timber, 80ft. by 60ft. by 7ft. high, bolted together, and floated out, with an iron caisson, 50ft. by 36ft., attached to its upper surface, within which the brick pier was to be built. Sundry amateur contrivances for attaining uniform settlement were adopted, and the idea was that when sunk, and loaded with 10,000 tons of pig iron, the timber platform would be squeezed down some 10ft. into the silt, and would then form a fit support for a continuous girder superstructure imposing a pressure of 15 cwt. per square foot on the foundation. Happily the financial embarrassments of the North British Railway Company led to the abandonment of the undertaking in 1867, and English engineers were spared the odium of what must almost necessarily have proved an engineering failure as conspicuous as that of its companion structure, the notorious Tay Bridge. The latter work was, indeed, abandoned the same session; but the powers were subsequently revived, as were those of the Forth Bridge—if the term revival may be applied to a different bridge on a different site.

The present Forth Bridge scheme, as authorised by the Act of 1873, provides for the construction of a bridge at a narrower and deeper part of the Firth than the original crossing. At low water the width of channel is but 4000ft., and the island of Inchgarvie conveniently divides this width into two channels capable of being spanned by a bridge having two openings of 1600ft. each with a central pier several hundred feet in width on the island. No intermediate piers are commercially practicable, the depth of water being about 200ft. between the island and the shore on either side, and clearly foundations in that great depth, though not beyond the power of engineering appliances, would involve more cost than the alternative of a large span bridge. It is hardly necessary to remark that previous to this scheme a railway bridge with spans of 1600ft. had never been even contemplated; and the leap from the 460ft. spans of the Britannia and Saltash bridges—the largest hitherto constructed—was so enormous that the parliamentary inquiry into the merits of the proposed design would, it might reasonably have been supposed, have been exhaustive and complete. So far from this being the case, the preamble of the Bill for the construction of this, the largest railway bridge ever contemplated, was declared proved, incredible to relate, before a single question of an engineering character respecting the design of the bridge, the mode of its erection, or the strains upon it when completed, had been addressed to the engineer, either in his examination in chief or in cross-examination! Twenty-three questions in all were put to Sir Thomas Bouch, and these had reference chiefly to the history of the undertaking and its utility. In fact the committee apparently neither understood the design, nor cared to understand it, but simply passed the preamble on the strength of a report by Sir John Hawkshaw and other eminent engineers, which Sir Thomas Bouch handed in with the remark that "the directors had not any want of confidence in myself, I believe, but they thought it better in order to satisfy the public, to have the opinion of men of the greatest eminence in the profession." As most engineers are agreed now that the bridge designed by Sir Thomas Bouch would have proved an unsatisfactory structure, and as the grounds of the present application to Parliament for powers to abandon it are that the modification required to make the bridge a satisfactory structure would involve an enormous increase in the cost, it will be instructive to glance at the report above referred to, and to note the great change that the fall of the Tay Bridge has wrought in engineers' opinions.

Sir John Hawkshaw and his colleagues reported that they had considered the design with respect to its suitability as a structure for carrying railway traffic, the practicability of its construction, and the sufficiency of the estimate. They had investigated the strains to which the various parts of the bridge would be subject from passing loads, from changes of temperature, and from storms of wind, in connection with which they had had the advantage of examining the anemometer records of Greenwich Observatory and receiving the explanations of the Astronomer Royal. They were satisfied that the bridge when completed upon the designs, dimensions, and materials submitted to them, would be found quite sufficient, not only for the safety of the ordinary traffic, but also to meet the strains due to extreme gales of wind. In other words, they were satisfied that a rolling load of 600 tons was enough to provide for on the 1600ft. span, that a strain of 10 tons per square inch was not too much to impose upon the steel chains, and that a pressure of 10 lb. per square foot was that corresponding to "an extreme gale of wind." The Astronomer Royal was solely responsible for the latter figure, but so completely had the matter passed from his memory that in the Tay Bridge Inquiry he observed, "All calculations for the strength of a proposed structure, and especially for the spread of the bases of the piers, should be based upon the assumption of a pressure of 120 lb. per square foot;" and when Mr. Bidder asked him if he had not been consulted upon the Forth Bridge, he replied, "Not with regard to pressure, I think." Nor did he remember having given the smaller figure of 10 lb. until his own report of 1873 was placed in his hands. The difference between the Astronomer Royal's 10 lb. in the report of 1873, and the 120 lb. in his evidence of 1880, very fairly illustrates the difference in the spirit with which an average engineer would approach the consideration of the design for the biggest and most exposed bridge in the world before and after the fall of the Tay Bridge. Public opinion, the Board of Trade, and personal conviction would alike impel him to go to the opposite extreme as regards wind-pressure, and to assume a pressure as much above the possible maximum as the 10 lb. was below it. Further, the feeling of timidity and caution thus engendered would lead him to provide for a greater rolling load and lower strains than in the instance of the original design. All these points have, it is understood, been considered in the amended designs for the Forth Bridge recently prepared by Mr. Harrison, Mr. Barlow, and Mr. Fowler, on behalf of the three east coast companies to which they are respectively consulting engineers.

This reference to a new board of consulting engineers was made in consequence of the application of the Forth Bridge Company to Parliament this session for powers to abandon the undertaking. It was desired by the east coast companies interested in the work, and guarantors of it, to ascertain what would be the character and cost of the modifications necessary to make the bridge, as originally designed and contracted for, a satisfactory work. We have already fully illustrated and described in THE ENGINEER for Oct. 17th and 24th, 1879, the original bridge as designed by Sir Thomas Bouch, and contracted for by Messrs. Arrol and Messrs. Vickers for the sum of £1,156,000; hence it will be unnecessary to do more than remind our readers that the two main openings of 1600ft. were to be spanned by suspension chains and stiffening girders, the former of unusually great deflection, and the latter of exceptional stiffness. A characteristic feature of the design was the unparalleled loftiness of the towers, these being no less than 665ft. in height from base to summit. Lateral stiffness was provided for by making the superstructure about 100ft. in width, and the two lines of rail were not laid centrally but near the edges of the superstructure. The towers or piers were to be founded upon 50ft. cylinders filled with concrete, and consisted chiefly of columns of small diameter braced together. To construct the piers in masonry or brickwork up to platform level, to provide for a rolling load of 1600 tons upon each line instead of 600 tons, and a wind-pressure of 56 lb. per square foot instead of 10 lb., and to limit the strain upon the chains to 8 tons instead of 10 tons per square inch, would involve an increased cost of from £600,000 to £700,000, and it may readily be conceived that this might be financially impossible, and that if no other solution of this problem could be attained it might be necessary to abandon the bridge. The most important function of the consulting engineers was therefore to consider the feasibility of attaining a cheaper mode of construction for this long span railway bridge than that of a suspension bridge with stiffening girder. It was quite possible, and even natural, that Sir Thomas Bouch should have taken it for granted that no other type was worth investigation when this span was so enormous. In the discussion at the Institution of Civil Engineers on suspension bridges in 1867, it was generally agreed that for anything above 1000ft. in span girders were out of the question, and a suspension bridge must be adopted; but it is not difficult to show that the latter might prove an inferior structure as regards stiffness and offer no economical advantage over some other types of construction.

A suspension bridge with stiffening girders, such as the original Forth Bridge, is no novelty in engineering, and the temptation to erect such a structure for railway traffic must often have proved almost irresistible during the fifty years that railways have been in progress. Engineers have, nevertheless, consistently foregone the advantages which the system frequently offers as regards facility of erection and otherwise, and have adopted works more expensive, but not suffering from the same want of rigidity. They have probably been led to this conclusion, not from the results of theoretical investigation, but from observing the behaviour of ordinary suspension bridges under light road traffic. Theoretical considerations might lead to the inference that where the rolling load was light in comparison to the dead load, and the calculated deflection insignificant, a rigid bridge would be secured; but practice amply proves that this is not so, but that a perfectly disproportionate amount of vibration and tremour accompanies and follows the passage of a rolling load across the bridge. Thus the step of a single person on the platform of the 140ft. span suspension bridge in St. James's Park causes a distinct tremour through the structure, and a visible lateral oscillation of the chains, although the ratio of "live" to "dead" load in this case would be only 1 to 1000, and there is a deep stiffening girder. What the tremour would be with a ratio of 1 to 3, and a speed of twenty miles an hour, as contemplated in the instance of the Forth Bridge, it would be difficult to foretell. A bridge on the basis of the original design, but of the proper strength, would thus be both a costly and an imperfect structure. It is well known that Mr. Barlow has given great attention to the subject of large suspension bridges, and it is understood that he found no difficulty in effecting a considerable saving in cost, combined with increased rigidity in a design for a braced chain suspension bridge of singular novelty and merit, worked out by himself for the joint consideration of the engineers. It is equally well-known that Mr. Fowler is opposed to the suspension principle for high-speed railway traffic, and it is understood that he submitted for consideration a design for a continuous girder bridge, which had been worked out by himself and Mr. Baker, and by which a still greater saving was effected and rigidity obtained. A continuous girder bridge, with two spans of 1730ft. each, must necessarily present some novel features. In the present case the points of contrary flexure are fixed at about 600ft. from the piers: the depth of girder is 330ft. at the piers, and 55ft. at the centre, with a camber of 130ft. in the bottom member; the width of superstructure is about 100ft. at the piers and 30ft. at the centre, and the compression members generally are steel tubes varying from 5ft. to 12ft. in diameter. The Forth Bridge Company and the North British, Great Northern, Midland, and North-Eastern Companies have thus all the facts before them as to the practicability and cost of a bridge which would satisfy the requirements of the public and the Board of Trade, and it remains with them to decide whether the abandonment Bill, which has passed the Commons unopposed, shall be proceeded with this session, or at all.

LOW TEMPERATURE HEAT ENGINES.

THE American press is devoting just now some attention to Mr. Gamgee's scheme for obtaining motive power from ammonia, and many, if not all, the articles which have been written on the subject are interesting; while not a few are very amusing. With the utterances of the non-scientific press we need not concern ourselves; but we feel some surprise that technical journals of standing and repute in the United States have failed to understand what it is that Mr. Gamgee proposes to do; and prophecy his failure on assumed facts which have no existence. Thus we find our usually competent contemporary, the *Scientific American*, publishing in one impression alone, that for May 14th, no fewer than three articles on the subject, every one of which curiously and ingeniously misses the whole point and essence of the very important issues raised by Professor Gamgee. Whether the zero motor will or will not ultimately succeed we do not concern ourselves to say. Before it can be placed in the market, no doubt either Mr. Gamgee, or someone else, will have to overcome enormous difficulties; but what they are the American press has failed to find out. Thus the *Scientific American* writes: "The latest candidate for immortal honours is Professor John Gamgee, of London, now residing in Washington, for he claims to have found out how to prevent a large part of that celebrated 90 per cent. loss which has hitherto been incidental to the use of steam for dynamical purposes." Now, so far as we are aware, Professor Gamgee has made no claim of the kind. Again, after giving an extract from Professor Gamgee's patent specification, our contemporary goes on: "Gamgee's theory would fail with steam or air. A motor vapour during its expansion is a useful source of power, but after it has expanded it is wholly unusable. It may be brought again to the expanding or condensed condition, but if the cost of restoration be computed, not the smallest fraction of gain can be discerned. Gamgee's motor could make one stroke, but never another of its own accord. Think of a steam engine which exhausts directly into its own boiler!"

Apart altogether from Professor Gamgee and the zero motor, the question whether it is or is not possible to construct an engine which shall operate between such low limits of temperature that the natural heat of surrounding bodies, such as the air, will suffice to supply the power required, is one of enormous importance, and by no means to be dismissed flippantly or without due consideration. The *Scientific American* leads public opinion on such topics in the United States, and it should handle with great care subjects with which few scientific men, and hardly any engineers, have made themselves familiar. Had due caution been observed by our contemporary, he would not have confounded a perfect gas like air with steam, and he would have seen that to "think of a steam engine exhausting into its own boiler" would have been sheer waste of time, as the zero engine will not exhaust into its own boiler; it will use a vapour or steam, just as the steam engine does, and this vapour is to be condensed, and restored to the boiler in a liquid state, just as the water of condensation is pumped in again by a steam engine. The analogy between the two machines is, as we have pointed out in a previous impression, perfect so far, and the ammonia engine will work as well and as certainly as the steam engine—in theory—if only it is possible to liquefy the ammonia. The opponents of the scheme have completely missed the fact that the turning point of the whole is the liquefaction of the ammonia. If this can be effected altogether, or even in large part, in the way Professor Gamgee proposes, the practical difficulties being overcome, the zero engine will be a success. If liquefaction cannot be brought about, then will the engine be a failure, and we may devote our attention entirely to the consideration of this single point—the possibility of liquefying ammonia in the way proposed by Mr. Gamgee, for none other is available. Mr. Gamgee proposes to expand his gas behind a piston until it is so far cooled down that it liquefies. Can this be done?

It is more than probable that all so-called permanent gases are simply the superheated vapours of solids. The first step in their production was, we may say, the thawing or liquefaction of the solids; the next was the boiling away of the liquid into gas; and the third was the superheating of that gas. Let it be remembered that absolute zero is 461 deg. below the zero of Fahrenheit thermometer, and that the true temperature of air at 62 deg. is 523 deg. Let us suppose, for the sake of illustration, that solid oxygen exists at 3 deg. absolute, that it becomes liquid at 5 deg., and boils at 10 deg.; then at 523 deg. it will be superheated by no less than 513 deg., and before it is possible to condense it or make any other radical change in it, we must get rid of the superheat. The superheat all gone, we can begin to abstract latent heat, and the instant this takes place liquefaction must commence. Now there are apparently as many boiling points in nature as there are forms of matter, and what is a condition of extreme superheat for one substance in the condition of vapour, may be far below the boiling point of another substance. Thus, for example, while ammonia vapour is superheated at atmospheric pressure and 60 deg., steam is not superheated under the same conditions of pressure at less than 213 deg. But the superheat of ammonia at 62 deg. is very small as compared with that of hydrogen or oxygen at the same temperature, and this fact must be carefully borne in mind. Ammonia must be regarded not as a permanent gas like oxygen, but as a steam like the vapour of water. The necessity for making this distinction will be perceived in a moment. Anyone might propose the use of common air, let us say, in an engine in the way that Mr. Gamgee suggests the use of ammonia; but no practical amount of expansion would secure the liquefaction of the oxygen and nitrogen. Simply because their store of superheat is so enormous, that before it could be all used up, a final pressure would have been reached almost infinitely small. It may be taken as proved that a permanent gas cannot be liquefied in practice in the performance of work. If ammonia be a permanent gas and not a steam, then the zero motor must be a failure.

Let us turn now to the steam engine. In that machine steam is always liquefied at each stroke, not by external cold, not by radiation or conduction, or loss through the metal in any way, but simply by the conversion of a portion of its latent heat into work. The precise details of the process are not fully understood; but it is quite certain that liquefaction does take place, and it can only be prevented by superheating the steam. The store of superheat is first drawn upon and converted into work; and if there is enough of it the steam will only be cooled instead of being liquefied. In other words, it will act as though it were a gas; and Rankine for this reason very properly treats of the superheated vapour of water under the title "Steam Gas." It must be carefully borne in mind in this connection that the liquefaction of the steam is *not* due to expansion; it is due to the performance of work during expansion. If steam is suffered to expand without doing work it becomes slightly superheated in a way explained by Rankine, and familiar no doubt to most of his readers. The quantity of steam liquefied will bear an exact proportion to the quantity of work done by the steam. Thus, for every horse-power exerted in one hour, there must be abstracted from the steam developing that power 2564 units, and assuming that each pound of steam can give up 1000 such units in falling to the temperature which exists at the moment the exhaust port opens, then it follows that 2·564 lb. of steam will be condensed per horse per hour in the cylinder in the performance of work. Let us suppose that the engine withdraws from the boiler 20 lb. of steam per horse per hour. Let the water of condensation be separated from the steam and pumped back separately into the boiler—theoretically there is no difficulty in doing this—the volume of this water is so small that the work done on it in pumping it back into the boiler may be neglected. Let the steam be recompressed to boiler pressure and forced back also. Now, the work done in compressing the steam and returning it to the boiler will be less than that done by the steam in leaving the boiler and expanding, in the same proportion that its volume is less. Twenty pounds of steam at, say, 100 lb. absolute occupy 86·6 cubic feet, while 20 — 2·564 = 17·436 lb., as the weight of the steam left after deducting the water of condensation. The volume of this steam will be but 75·5 cubic feet. Thus for every 86-horse power total done by the engine, 75-horse power in round numbers would be expended in restoring to the boiler the steam not condensed in the performance of work, leaving as a balance available for producing useful effect about 10-horse power. Here, then, it will be seen that in theory it is quite practicable to work a steam engine, which shall depend for its operation on the condensation effected by the conversion of latent heat into water. But such an engine must work between limits of temperature higher than that of surrounding bodies, and consequently coal or other fuel must be used to convert water into steam.

In the ammonia engine we have a precisely similar cycle, the only difference being that the range of temperature exists between much lower limits, and it is, therefore, possible to dispense with fuel. But the conditions are only identical in the two cases in so far as ammonia is a non-superheated steam. We may, we think, safely assume that at such pressures and temperatures as Mr. Gamgee proposes to work, it would be very slightly superheated, if at all; that is to say, it would not be in the condition of a gas. Dr. Siemens, for example, has shown that although steam, when the barometer stands at 30in., is superheated at all temperatures above 212, yet that it does not attain the condition of a gas at a lower temperature than 230 deg. If this be so, then during the performance of work a portion of the ammonia will of necessity be liquefied—if we think proper, we may say that this liquefaction will be produced by the cold due to expansion—and the amount of condensation may be expressed in terms of the coefficient of expansion. The quantity liquefied will depend on the latent and specific heats of the ammonia. It is stated that the latent heat of liquid ammonia is 900 deg., or very nearly that of steam. We are not quite clear what this statement conveys, it may mean that 900 times as much heat as would raise one pound of ammonia 1 deg. would evaporate the whole of it, or it may mean that 900 times as much heat as would raise one pound of *water* 1 deg. are required; which is a very different thing. We have consulted all the available authorities without being able to clear up this point. Indeed, the experiments made on liquid ammonia, with a view to determine its thermo-dynamic characteristics, have been very few. If its latent heat really be nearly that of water, then it will be almost impossible to make a useful engine on Gamgee's system, because the quantity of gas to be pumped back into the boiler must be large as compared with the quantity of liquid. If, however, the latent heat be small, then the engine may, practical difficulties being overcome, be a success. For example, let us suppose that the latent heat of ammonia steam is 500 deg., and that 20 lb. of it are used to develope 1-horse power, then of that power, neglecting the energy expended in pumping the liquid ammonia back to the generator, about 20 per cent. would be available for the performance of useful work.

We have endeavoured to make the broad principles involved intelligible to our readers, in order to remove misapprehension; but it must be clearly understood that until further information of a quite trustworthy character is available concerning the properties of ammonia, it would be rash to pronounce any opinion either for or against Mr. Gamgee's engine. If ammonia be a true gas, then the zero motor is both theoretically and practically an impossibility. If it be not a true gas but a steam, then the zero motor is theoretically possible; and the smaller the latent heat of the ammonia the greater the chances of its success. It is stated that in ice machines working with ammonia the gas is actually liquefied. This can only be because the ammonia is a steam and does work in expanding. If liquefaction takes place it is a strong argument in Professor Gamgee's favour. But even though ammonia should fail, it remains to be seen whether other liquids may not be made to give the required results. The thing wanted is a liquid with a low boiling point, a high vapour pressure, and little latent heat. Ammonia supplies the first two conditions perfectly; it is more than doubtful if it fulfils the last, and not the least of the practical difficulties Mr. Gamgee will have to surmount will lie in dealing with so corrosive a fluid as concentrated liquid ammonia. If something more innocuous could be got so much the better. Ether appears to very nearly meet the required conditions; at 212 deg. it has a pressure of 96 lb. on the square inch, and its latent heat is according to Rankine 143 deg., and according to Clark only 175 deg. As a result, liquefaction will readily take place during the performance of work by expansion. The volume of ether steam is comparatively small, and this would detract from the power of the engine. While the volume of water steam at 96 lb. is 4·51 cubic feet per pound, each cubic foot of ether steam weighs as nearly as possible the same. This would be a matter of secondary importance. Finally, we wish it to be clearly understood that we in no sense or way endorse Mr. Gamgee's views. We pronounce no opinion as to whether his engine will or will not work. We handle his proposal on the broadest possible basis, and we have endeavoured to show under what conditions it is and is not possible to construct an engine working at low temperatures. Concerning practical difficulties, it is enough to say that we believe they would be very great. As to the details of Mr. Gamgee's machine we are almost wholly ignorant, and for the present we wish to remain so. Furthermore, we have made no attempt to state with minute scientific accuracy the thermo-dynamic laws involved. Such a statement must be copious to be satisfactory, and would be at once out of place here and competent to defeat the very object we have had in view, namely, making the principles involved in Mr. Gamgee's proposals intelligible to our contemporaries at the other side of the Atlantic, who appear, to use one of their own expressive idioms, to have "got mixed" about the zero motor.

ELECTRICAL RAILROADS.

The vision of the ubiquity of electricity was only beginning to dawn upon the minds of men, when Sir Thomas Browne wrote, "Nor by electrick bodies do I conceive only such as take up shavings, straws, and light bodies, in which number the ancients onely placed jet and amber; but such as conveniently placed unto their objects, attract all bodies palpable whatsoever." It is certain, however, that in these later days the science of electricity has forced itself into the front rank, and its applications are being daily more and more widely extended. Just as there are sure indications well understood by politicians, showing when questions have entered the domain of practical politics, so there are as certain signs of the time when scientific experiments enter the domain of practical engineering. In the summer of 1879, Messrs. Siemens and Halske exhibited at the Berlin Exhibition an experimental electrical railway, and similar apparatus was also to be seen last year at Dusseldorf and at Brussels, and now at the Crystal Palace. This experimental railway has undergone a good deal of criticism, but so successful has it been, that the firm above-mentioned, proposed to the authorities at Berlin the construction of an elevated railroad to be worked on this system. This proposal estimated for the construction of a line about 6¼ miles long, at a first cost of £72,500, and an annual cost with 200 trains running per day of £9720. This proposal was not carried out, "partly because the inhabitants objected to having people looking into their first floor windows, and partly because the Emperor did not wish to see the 'Linden,' which this electric railway was to cross, disfigured." On Wednesday last at the Society of Arts, Mr. Alexander Siemens, in a paper read before the Society, gave some interesting details of the proposed line. "Along the kerbstones of the street, iron columns formed by two channel irons were to be erected about eleven yards apart, carrying wooden sleepers on the top, which in their turn support longitudinal girders." Wooden struts keep the girders apart and insulate them from each other. "The clear height from the level of the street is about 14ft. 6in., and the depth of the girder about 16in. Steel rails are laid on the top of the girders, and the girder and rail on the one side serve as the conductor from the primary machine, and the other rail and girder form the return wire, reducing the electrical resistance of the line to a very low figure."

Although the construction of the railroad was not permitted, one was sanctioned on the ground level between the Military Academy and Lichterfelde, about one and a-half miles long. This line has been constructed, and at present is working satisfactorily. The authorities, with the crass stupidity so well understood by those who have any contact with red-tapeism, have classed this railroad as a one-horse tramway, and thus limited the speed. "The permanent way has been constructed in exactly the same way as that of railways. Wooden sleepers and steel rails are employed, the rails being connected, in addition to the usual fish-plates, by short straps of iron, bent in the shape of a bridge, so as to admit the adjustment of the rails to different temperatures, and to reduce at the same time the electrical resistance. As the currents are low tension currents, it was not necessary to provide further insulation, and no difficulty is experienced in using one rail as the positive, and the other as the negative conductor." A little explanation will perhaps be necessary here. In working an electrical railway it is proposed to have a central station, where a stationary engine drives stationary dynamo-electric machines. The current obtained from these stationary electric machines is led by thick wires to one rail of the road. The current passes from the rail through the wheel in contact with the rail to another dynamo machine carried, say, underneath the carriage. The armature of this secondary machine is caused to rotate by the current, and the motion is communicated by bands or otherwise to the wheels of the carriage, the electric current passing from the secondary machine to the second rail through the wheel in contact with it, and so completing the circuit. From this brief explanation it will be seen that the insulation of the various parts must be fairly perfect, or the leakage of the current will be enormous, and the result wanted will not be obtained. Hence the one rail must be insulated from the other; the wheel through which the current passes to the secondary machine must be insulated from the wheel through which the current passes from the machine, and so on. No doubt it is easy to get good insulation under certain conditions. If the rails are under shelter and in a dry situation there is no difficulty. Suppose, however, the condition to be similar to that which frequently happens on many of our lines, when water stands between the rails, or even covers both rails. Could an electric line then work? The normal atmospheric condition of England is vastly different from that of some continental countries. Here moisture is the order of the day, there moisture is the exception and not the rule. It may be that the ingenuity of engineers will point a way to the solution of the difficulty. Indeed, we believe that Prof. Ayrton and Perry are already in a position to experiment in this direction, and hope to show us a way whereby this difficulty of insulation can be avoided. Another suggestion worthy of consideration is the use of secondary batteries. M. Faure is stated to have made a great improvement upon Plante's secondary battery, and to be able to store up a very considerable charge in a small space. It is proposed to charge such a battery, and use the charge for driving the dynamo-machine fixed to the carriage. The idea is as yet no doubt somewhere among the clouds, but we are accustomed to see such ideas rapidly turn to realities, that no one would be surprised to hear of its trial. Some of the advantages offered by electrical railroads are not very clear from purely theoretical considerations, and can hardly be demonstrated till the system has been worked for a considerable time on a large scale. Its economy is a matter of theory, but the lack of half consumed carbon, of steam, point to a sphere of usefulness in such places as the underground railway, where ventilation is very difficult and yet of great importance.

DRILLING IN MINES BY MACHINERY.

It appears that the system of drilling by machinery in the Cleveland iron mines is being increasingly adopted. Many years ago an old-fashioned rotary drill was introduced, but after trial its use was abandoned; but the more recent introduction of the percussion drill is followed by results so satisfactory that in several mines the system is being adopted, and at a recent government inquiry it was stated that last year about a quarter of a million tons of ironstone were wrought from machine-drilled parts of the mines. It is true that against an output of over six million tons this is very small, but for a method introduced comparatively recently, it must be acknowledged to be a large proportion. Almost invariably the machine drills that are in use in the Cleveland mines are worked by compressed air; and they are at work in three or four of the mines of the three chief ironstone-producing firms in the Cleveland district. As yet it is impossible to state the average production, but it may be said that one of the firms who have over six machines at work has averaged about fifty tons per machine per shift of eight hours, and that on one or two occasions at least one hundred tons per shift have been produced by each of the machines. As there are now over a score of these machines at work in the mines, it is evident that the production must with continuous use be very largely increased. At the same time it is said that the use of the machine drill lessens some of the evils which are complained of by the enforced use of cartridges for blasting in certain cases, and it is evident that if that favourable working that is now known be continued, there will be a considerable tendency towards an increased use of machine drills in the Cleveland mines. When it is stated that the average output—so far as it is established—of the machine drills is about ten times that of the average output of the individual miner, it will be seen that after the payment of the interest on the cost of the machine and of its working, there must remain a substantial balance to the owner's credit. So far as can be anticipated, it is not probable that the use of these machines will at the present time lessen the labour needed in the Cleveland mines, and it may be said that at the present time the output of ironstone is almost at its maximum. It is expected, too, that the use of Cleveland iron by the basic process in the steel manufacture will give a considerable impetus to that production in an early future, and it may be that that anticipated increase will give the additional demand that is needed for the enlarged production of the machines to be taken up. As yet no statistics of the exact cost of the mode of working are obtainable, so that the two methods cannot be compared; but the general belief is that the use so spoken of will rather tend to further lessen the cost of production of ironstone in Cleveland. In the methods of working, in the explosives used, and in the forms that the latter are put into for use, there is just at the present time a good deal of experiment being made in the Cleveland district, and as that district is the largest of our sources of ironstone, these experiments will be watched with interest.

RAILWAY RATES IN SOUTH STAFFORDSHIRE.

The ironmasters of South Staffordshire have had their case, so far as it relates to the carriage of minerals and of pig iron, brought before the Railway Committee. They were represented by Mr. Alfred Hickman, the proprietor of the Spring Vale furnaces. The committee had notified their inability to hear more than two witnesses from that part of the kingdom—an ironmaster and the chairman of the Wolverhampton Chamber of Commerce to present the case of the hardware manufacturers. Mr. Hickman, with his thirty years' experience, was well qualified to speak upon the branch of trade with which he is associated; and it is the branch for which most has to be said from the ironmasters' point of view. Mr. Hickman contended that for short distances the railway companies in his district were charging in excess of the authorised rate; but he said that it was the explanation of the companies that if they charged in excess in some cases they were within their maximum in others. The witness cited the delivery of coal and ironstone from the pits to the furnaces, and the delivery of pigs from the blast furnaces to the mills and forges. The companies charge 9s. 3d. per ton for minerals from Durham to his siding at Deepfields, near Wolverhampton, a distance of 260 miles; and he held that a halfpenny per ton per mile would be a fair charge for the carrying of coal and ironstone. At present the charge made for the carriage of ironstone from Chatterley, in North Staffordshire, to Deepfields, a distance of less than forty miles, is 3s. 10d., or, including wagon hire, 4s. 6d. per ton. For coal, the maximum authorised rate over the Stour Valley was 1d. per mile; but from Round Oak, to Deepfields, a distance of six miles, the charge, including wagon hire, was 1s. 10d. per ton. Pig iron was charged 2s. 11d. instead of 1s, 2d. for a distance of something over seven miles, from Deepfields to Brittell-lane; and from Deepfields to Dudley, over the North-Western, a distance of four miles two chains, the charge made was 2s. 6d., whereas the authorised rate was 7d. Citing an instance of the irregular charges made by the companies in carrying even from long distances, the witness showed that they claimed 9s. 2d. a ton from Dowlais in South Wales to Wolverhampton, but charged 10d. less if they took it to Bloomfield, the next station beyond Wolverhampton. He advocated an extension of the powers of the Railway Commissioners, whose decisions should be final; and he was in favour of the Board of Trade taking proceedings against railway companies in the case of illegal or unauthorised charges.

LITERATURE.

Old Ireland Improved and Made New Ireland. By John P. Doyle, C.E., late Executive Engineer Public Works Department, India. London: William Ridgway. 1881.

Mr. Doyle tells us plainly that he is an Irishman, and that he lived in the sister isle for many years. Then he went to India, and on his return visited Ireland, and was struck by what he saw. Thereupon, like many others, he set about devising a remedy for her misfortunes, and the book before us is the result of his deliberations. It is a scheme for carrying out a great system of public works, which are to make his native land prosperous, happy, and peaceful. He proposes the construction of a system of narrow—3ft.—gauge railways; the formation of farm and parish roads; the drainage and reclamation of waste land; the arterial drainage of arable land; the purchase of the interest of the Irish companies in their railways and canals; the improvement of Irish harbours, and the construction of fishery piers. The cost of the whole he estimates at £159,953,058; but he adds that it "may he written down as amounting in round numbers to £160,000,000." So far as we can gather the whole of this vast sum is to be obtained from Great Britain, and is to be spent within about ten years. We have not the slightest doubt that the expenditure of £16,000,000 annually in Ireland for ten years would do the island in one sense a great deal of good; but when we have conceded this we have granted all that we are diposed to admit. It is enough to mention the sum to show that Mr. Doyle's scheme is but a dream; and we much doubt that it was worth while to write and publish an octavo volume of 275 pages to advocate it. Indeed, we have seldom noticed a more thoughtless work. Our author continually and impulsively jumps at conclusions; and at times we are tempted to doubt that he really knows anything about Ireland or the Irish. He fails altogether to convince, because he never gives a logical reason for any one of his statements, which reason will bear the test of examination from a practical point of view. We might cite numerous examples of this; one or two will suffice.

Mr. Doyle holds that Ireland ought to be permeated by narrow gauge railways which are to cost in round numbers £11,000,000; and he favours narrow gauge lines because he has had to aid in constructing the narrow gauge system of India. Now if he had kept his eyes open to passing events, he would have discovered that the narrow gauge Indian system is a complete failure; that the adoption of the metre gauge was a great blunder; and that before long the whole of the work will have to be done over again, the road being re-laid to the wide gauge. It is quite improbable that narrow gauge roads would be more successful in Ireland than they are in India. Let us, however, suppose that his great railway system was carried out. What then? Mr. Doyle does not know. His assumption is that great quantities of produce and manure, and large numbers of passengers could be carried by the railways. It is not quite clear where the produce is to be carried to; the manure, we are informed, would be required for the land reclaimed on the tops of mountains and in bogs. Such statements are the result of reckless thinking, or of a total ignorance of the conditions of agriculture. Corn and cattle drift to the large towns, and thence to the various sea ports by rail, as it is; and the coupling up of unimportant villages with the large towns by railway could effect no good purpose whatever. If Mr. Doyle will consult any of the directors of the Waterford and Central Railway of Ireland, or of the Waterford and Limerick lines, for example, they will tell him that the traffic carried between the small villages and the towns is of no practical value whatever. The country people do not use the railways which exist, and giving them more would be waste of energy and material. Again, the farmyard manure, on the carriage of which he lays great stress, is not a commodity carried by rail. No farmer will sell it off his land. In the large towns manure is made, which finds a ready sale at prices which totally prohibit its use by farmers living at any distance. It is all bought up by market gardeners and dairymen living close to the towns. We are willing to admit that in certain cases railways might be made with advantage to a district, but they would certainly not pay any profit to their owners. In others, steam-worked tramways on the high roads would prove of service; but to concede this much is not to concede that Mr. Doyle is right, or that his railway schemes are sound.

Turning to the reclamation of the waste lands of Ireland, we find a far more hopeful subject. But Mr. Doyle succeeds in proving that the reclamation of bog, at least, is quite out of the question. This is, of course, not what he intended to do; but it is impossible to read his figures without drawing conclusions totally the reverse of those which he wishes his readers to draw. His estimate of the cost of reclaiming bog land is £25 13s. 7½d.—may we say £26—an acre. A great deal of bog land has been reclaimed in Ireland, especially under the Labouchere Drainage Act. We do not hesitate to say that not one acre of such reclaimed land ever was, or ever will be, worth £26; we doubt if 1000 acres could be found worth £10 for purely agricultural purposes. To spend £26 and obtain in return £10, cannot be considered a sound financial investment. Mr. Doyle should have cited figures to prove that the land reclaimed from bog is really worth the cost of reclamation. A very little inquiry would have sufficed to convince him that he is mistaken, but he seems to have made no inquiries and jumped at conclusions. He has, moreover, entirely overlooked the enormous engineering difficulties which stand in the way of draining the great central bogs of Ireland, one of the most important consisting in the extremely low level and dead flatness of huge tracts of land, which render it next to impossible to unwater them effectually. It may be well to explain here that the rivers and streams lie low enough to prevent such tracts as the great bog of Allan—which runs in a wide belt almost from Dublin to the Shannon—from becoming lakes, yet that they are not low enough to carry away thorough drainage water. In many cases peat bogs are 30ft. or 40ft. deep. It would be impossible to drain them to the bottom. The immediate effect of draining a peat bog is to cause its subsidence; a fall of 5ft. or 6ft. is not an unfamiliar circumstance, and this fall may lead to the surface flooding of the drained land. With such things Mr. Doyle does not concern himself. With an expenditure of £26 an acre, he is satisfied that he can convert black and red peat bogs into smiling arable farms.

Mr. Doyle furthermore holds that a great mistake has been made by devoting so much land in Ireland to pasturage and so little to tillage. This is not an engineering question, and we shall not dwell on it; but we may explain to Mr. Doyle that farmers who have grown corn have given up growing it because grass pays better. If Mr. Doyle will make inquiries in Ireland, he will find that partly as a result of the qualities of the climate, partly because of foreign competition, an acre of grass will produce beef and mutton which will be worth more than the wheat, oats, or barley which could be grown upon it. Wheat rises in price, and beef and mutton fall, the acreage under grass diminishes, and *vice versâ*.

Mr. Doyle holds that as the Irish canals do not pay a profit, the Government ought to get them cheap. He values them at £593,550. What he has to say concerning the harbours of Ireland possesses little interest. It is far too vague and deficient in accuracy.

If we might venture to give Mr. Doyle advice, we would urge him, if he has the time, to visit Ireland, and spend a year in travelling from place to place collecting statistics and acquiring information. If he had done this in the first instance, he would have written a very different book from that before us. A good treatise on the same subject is much wanted; and such a treatise can only be written by a competent and experienced engineer, who, if he does not possess what we may term local information, must be assisted by some one who does. We are quite at one with Mr. Doyle that money could be expended with great advantage to the United Kingdom in carrying out public works in Ireland; but it is probable that about £10,000,000 is the maximum sum that could thus be expended with advantage. More railways are not wanted, and would do no good. Those in existence are not worked to one-fourth of their capacity, and every attempt to provide feeders, in the shape of branches, has proved a disastrous failure. In some cases branch lines have been shut up, not because they did not pay, but because no one used them. We could name one somewhat important branch, a link between two principal main lines. Over this link ran three trains each way every day, and the average number of passengers of all classes in each train was six. Goods traffic in proportion. How and on what £10,000,000 could be spent to the best advantage on Irish public works is a very large and important question. We may return to it at another time. We certainly should not advise any part of it to be devoted to the construction of narrow gauge railways to the tops of mountains, or the reclamation of utter bog, while land which is not bog might be unwatered and otherwise improved, and made to pay for its improvement. When we say that not the least Utopian of Mr. Doyle's ideas is, that "the Government" should spend £160,000,000 within the next ten years on public works in Ireland, we have perhaps said enough to give our readers a fair idea of the value of the book he has written.

NEW BREWERY, DORCHESTER.

On page 372 we give a perspective view and a transverse section of a brewery constructed at Dorchester for Messrs. Eldridge, Pope, and Co., from the designs and under the superintendence of Mr. G. R. Crickmay, architect, Weymouth, and Messrs. Scamell and Colyer, brewery engineers and architects, Westminster. A plan of this brewery, with description, will be given in our next impression.

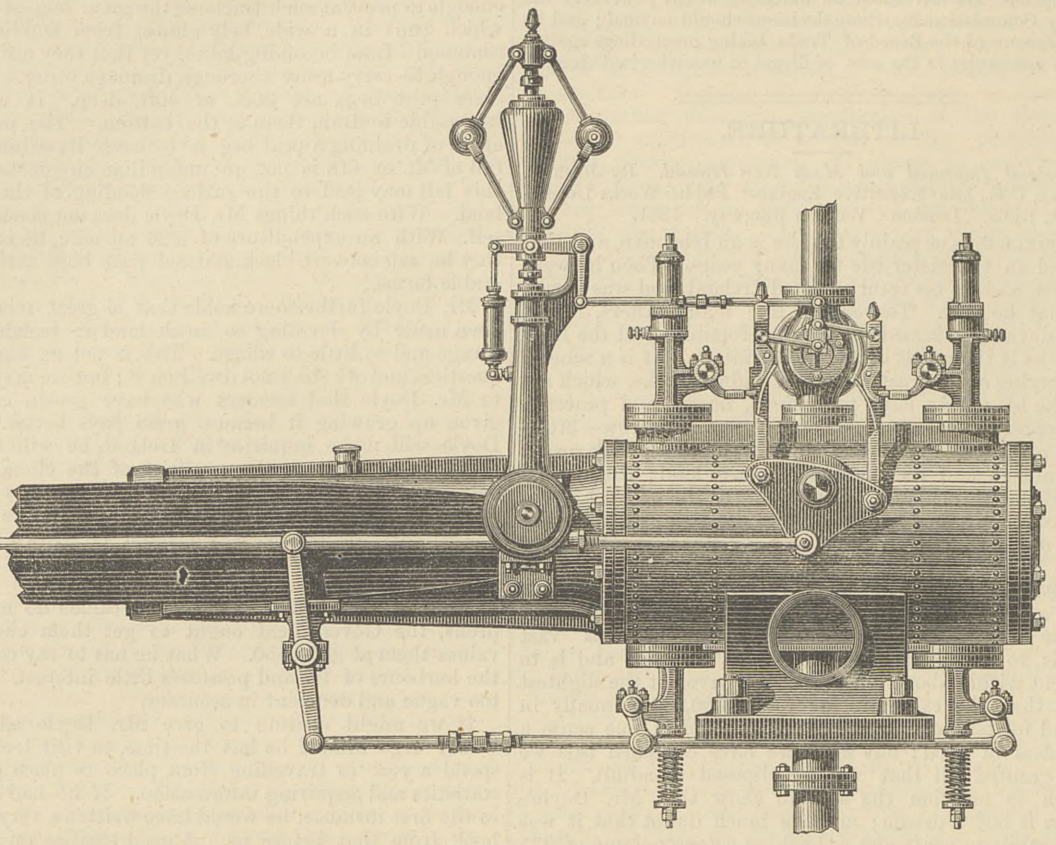
Naval Engineer Appointment.—The following appointment has been made at the Admiralty:—John Pitt, engineer, to the Excellent, temporarily, as additional, for the Medway, vice John Smith, retired.

Bilbao Ores.—A company is in course of formation under the title of "The Anglo-Bilbao Steel Ore Company," for the purpose of acquiring and working haematite iron ore quarries and mines situated at Bilbao. These ores are so largely used for steel-making by the modern processes that the ores are termed steel ores by the promoters.

South Kensington Museum.—Visitors during the week ending May 14th, 1881:—On Monday, Tuesday, and Saturday, free, from 10 a.m to 10 p.m., Museum, 9919; mercantile marine, building materials, and other collections, 3105. On Wednesday, Thursday, and Friday, admission 6d., from 10 a.m. till 6 p.m., Museum, 3636; mercantile marine, building materials, and other collections, 425. Total, 17,085. Average of corresponding week in former years, 14,214. Total from the opening of the Museum, 19,950,416.

A Year of Lifeboat Work.—The lifeboats of the National Lifeboat Institution were the means of saving 577 lives during the past year from wrecked or endangered vessels, most of them under perilous circumstances when ordinary boats could not with safety have been employed. The total number of lifeboat launches during the year was 245; lives saved, 577; and vessels saved, 27. In addition to those lifeboat services, 120 lives were saved from shipwreck by shoreboats and other means, making a total of 697 lives preserved in 1880, for which honorary or pecuniary rewards were made by the Institution. There were voted last year one gold, six silver medals and clasps, fifteen votes of thanks inscribed on vellum, and £4287 in cash, for saving these lives. Last year, 430 lives were also saved by means of the rocket apparatus belonging to the Board of Trade, which is so efficiently worked by the Coastguard and the Rocket Volunteer Brigades. The number of lives saved since the establishment of the Institution to the end of the year 1880, either by its lifeboats or by special exertions for which it has granted rewards, is 27,603. In view of facts like these the Lifeboat Institution cannot fail to maintain its hold on the support of the British public.

ZIMMERMANN'S VALVE GEAR.



VISITORS to the Paris International Exhibition of 1878 will remember an engine exhibited by Messrs. Lecointe and Villette, or, as this engineering firm is now known, by the Société Anonymé de Constructions Mécaniques of St. Quentin, France. This engine we illustrated in our last impression. It is fitted with the valve gear patented by M. Albert Zimmermann, C.E., of Marchiennes, and of this valve gear the annexed engravings afford a very good illustration. It will be seen that this valve gear works with four valves, the two admission valves being arranged on the top, whilst the two exhaust valves are placed at the bottom of the cylinder in the style adopted by many continental engineers. Spring pressure is used to bring back the four valves on their seats, so that we meet here with what is generally technically termed "positive opening and negative shutting of the valves." One excentric serves to work all the four valves, and accordingly the range of expansion is limited to about two-fifths of the stroke. From our engraving, it will be seen that two rods, placed at the side of the cylinder, are moved to and rods are placed under governor control by the lever combination clearly shown in Fig. 4, and hence their relative position to the steel nibbed levers is determined by the governor, and thus contact or disengagement between the two will be prolonged or curtailed according as the governor balls are low or outwardly extended. In this manner an automatic variable expansion gear is obtained by two independent motions being given to the trigger rods by the wrist plate and by the governor, and the practical working of this valve gear may be gleaned from the following remarks, which report the trial of one of these engines under the direction of M. L. Pinrger—Professor at the Polytechnic College of Aix-la-Chapelle—at the woollen mills of Mr. J. F. Mayer, of Eupen:—Working at a boiler pressure of 6 atmospheres, the fly-wheel was run at 51 revolutions per minute with the steam in the cylinder jacket. As the stroke was 3ft. 7¼in. the mean piston speed was a little over 6ft. per second. The cylinder diameter was 19·69in. and as the piston rod—3·35in. in diameter—extended through the two cylinder covers, the effective

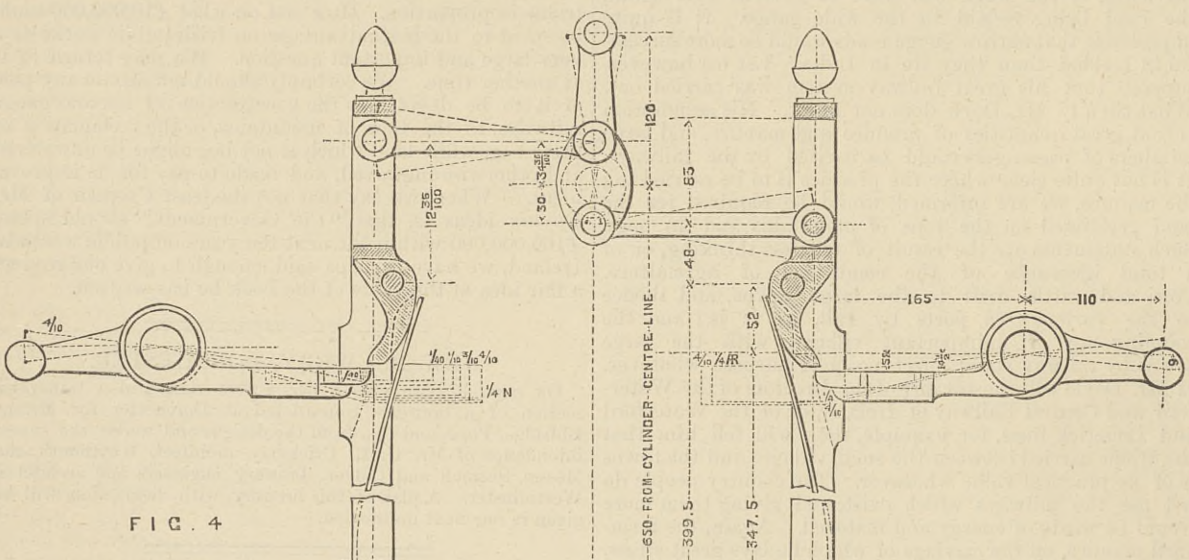


FIG. 4

fro by the excentric rod; the topmost of these two causes a wrist-plate to rock, which in its turn actuates the two admission valves, whereas the exhaust valves are worked from the bottom rod by the intervention of two bell cranks.

The castings of the inlet valve-chest covers are so combined with the ordinary spring dash pots as to form a bearing for a pivot shaft. As before stated, the valves are kept on their seatings, *i.e.*, closed, through the pressure of the springs in the dash pots, so that the work of opening these valves is confined to moving their valve spindles against the springs, and in the case of the admission valves, this is done by mounting steel nibbed levers on the forementioned pivot shafts and allowing one end of each to catch against its valve spindle. The wrist plate imparts an alternate up-and-down motion to two rods, each furnished with a trigger, which, when between certain positions, trips up against the other end of the steel nibbed bell cranks, and so carrying the steel nibs down with them in this downward motion, cause the respective valves to be opened. At a certain time the triggers become disengaged from the steel nibbed bell cranks, when the pressure from the dash pot springs closes the admission valves again, and so on. It should be observed that this disengagement only ensues during the downward stroke of the trigger rods, and the trigger itself reclines on a spring blade. These trigger-carrying steam surface on the piston amounted to 2·05 square feet. Under one of Prony's brakes the engine was worked at 100-horse power,* and a number of diagrams were then taken under these conditions with a Richard's indicator. Fifteen of these diagrams were taken at each cylinder end, and in order to secure greater accuracy the diagram areas were measured by an Amsler planimeter. These thirty diagrams resulted in showing the following mean values:—Duration of steam admission period = 19·86 per cent. of the piston stroke; absolute pressure during the admission = 5·76 atmospheres; ditto at end of cut-off = 1·025 atmosphere; back pressure in the cylinder = 0·16 atmosphere; pressure in the condenser = 0·118 atmosphere. The mean effective steam pressure on the square centimetre of the piston = 2·5175 Kilos.; consequently Prof. L. Pinrger calculates the indicated horse-power of the engine, whilst maintaining a brake power of 100-horse power, to

$$= \frac{2·5175 \times 1906·75 \times 1·785 \dagger}{75} = 114·3\text{-horse power,}$$

and the useful effect of the engine is therefore $\frac{100}{114·3} = 0·875$ or 87½ per cent.

Taking into consideration the clearance spaces, the consumption of steam answering to a brake power of 100-horse-power, is put down at 1870 lb. per hour. Allowing 110 lb. of loss for the condensation of steam in the cylinder and pipes, we obtain a total consumption of 1980 lb. of steam, or of 19·8 lb., per brake horse-power per hour. Assuming that under the conditions stated, 1 lb. of coal produces 8 lb. of steam, the consumption of fuel per brake horse-power per hour amounts to 2·45 lb., or as the French horse-power roughly stated = 0·99 British horse-power, the hourly consumption of fuel, expressed in corresponding English equivalents = 2·47 lb. of coal.

The temperature of the condenser water — feed — was 16·5 deg, Centigrade, which on its delivery was raised to 37·5 deg. Centigrade. The temperature thus rose by 21 deg. Centigrade, and the quantity of water Q used for the condenser $= P\frac{600}{21} = P \times 2857$ kilos., that is to say, every pound of steam required 28·57 lb. of feed-water to condense it.

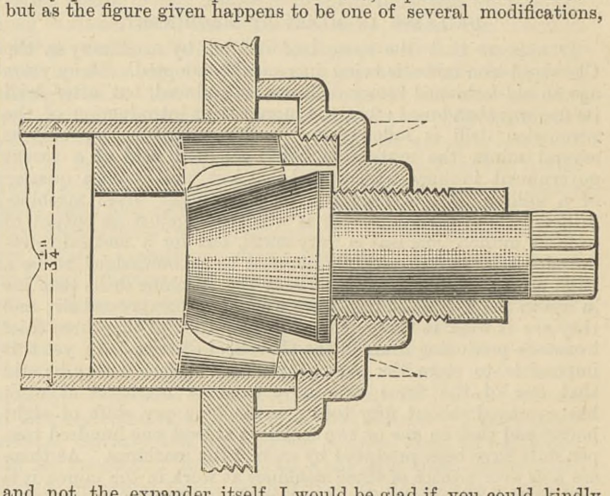
The engine in question was next run idle, and the results obtained showed that the resistance due to increased friction at the forementioned 100-horse power, amounted to about 7-horse power, so that taken altogether the report of this trial must be considered satisfactory.

LETTERS TO THE EDITOR.

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

THORBURN'S TUBE EXPANDER.

SIR,—In your last week's ENGINEER you have given an engraving of my patent tube expander—No. 3737, September 14th, 1880—but as the figure given happens to be one of several modifications,



and not the expander itself, I would be glad if you could kindly find space to correct the same. I herewith send a tracing of the apparatus. W. THORBURN.

16, Union-street, Luton, Beds, May 10th.

THE CORROSION OF IRON AND STEEL.

SIR,—It is much to be hoped that Mr. Parker's most valuable paper will not be suffered to go undiscussed as it deserves. The whole subject is one of wonderful importance to steel makers and shipbuilders, and cannot with propriety be left where it is.

Mr. Parker's paper is good so far as it goes, but it has the defect that it only deals with one branch of the subject. Given iron and steel with all galvanic influences excluded as far as possible, which will last the longer? This is no doubt an interesting question, but it is not *the* question. What I want, as a shipowner, to know is, given the ordinary conditions under which iron and steel are employed in ships and boilers, which will last the longer?

About twelve months ago Mr. Parker or Mr. Milton, I forget which, showed me some pieces cut from boiler tubes, which were pitted and perforated with holes into which I could put a lead pencil, and all this mischief had been done in a new boiler during one voyage to the United States and back. Here was corrosion with a vengeance. Now I maintain that under the insulating conditions of Mr. Parker's experiment, nothing like this destruction could have been caused to either iron or steel

Has Mr. Parker ever seen a steel furnace crown pitted all over in less than two months' service? I have not the least doubt he can put his finger on many such cases; and he is familiar with the same thing in iron? Perhaps.

Now the next experiment wanted is the building of bits of ships, four or five square feet of skin with angle iron, &c. Let them be submerged in different parts of the world for twelve months, let them be of iron and steel, and we shall be able to obtain from them a great deal of useful information. Mr. Parker's experiments do not represent the conditions under which iron and steel are used in practice; hence they are for practical purposes of very little value. Mr. Parker might just as well have locked up his discs in a drawer for twelve months, and at the end taken them out and reported them.

May I suggest that he should now get another lot of discs, and deal with them just as before, omitting the glass tubes and insulating arrangements. Black discs and bright discs may be tried both separately and together; some of those put in the sea to have a coating of slush after the usual practice with short voyage ships His report on this trial would be very valuable. SHIPOWNER.

London, May 17th.

HIGH-SPEED LOCOMOTIVES.

SIR,—With reference to the two letters in your last issue criticising Mr. Pearce's suggestions, it is with great pleasure that we find your correspondents glad to catch a ray of light on so important a subject. If, then, they will condescend to follow me for a few minutes, I will do my utmost to enable them to attain their end. First, with regard to Mr. Cleminson's statements, I should like to ask him whether Mr. Stroudley's engines, which "are *in propria persona* with Mr. Pearce's No. 1," have cylinders 20in. diameter, or whether they have a heating surface of 1720 square feet, to say nothing of such minor details as framing, radial axle-boxes, &c. Again, I should like ask him, with reference to Mr. Stride's locomotives, the same questions as regards cylinders and heating surface, and whether he thinks that since the time the latter engines were designed, radial axle-boxes might not have been made more effectually to answer the purposes for which they were originally intended. Secondly, Mr. Wilson does not appear to have noticed that Mr. Pearce's engines are designed to meet the difficulties which the narrow gauge presents, and that their cylinders are more than 12½in. or even than 16in. in diameter. I need scarcely say that I think Mr. Pearce's designs deserving of some attention to their internal arrangements, and not merely to their external

* French equivalents.

† These numerical values again refer to the French equivalents, as 2·5175 represents the pressure in kilogrammes on the square centimetre of piston area; 1906·75 expresses the net piston area exposed to the steam, answering to our 2·05 square feet; 1·785 = mean piston speed in metres and lastly, 75, referring to the French horse-power = 75 kilogramme-metres per second.

appearance. Even though Mr. Pearce may have erred in following the unquestionably fine outlines of Mr. Stroudley's engines, it is evident that he has not intended to depart far from the ordinary type.

C. N. G.

May 11th.

HIGH-SPEED LOCOMOTIVES.

SIR,—I have only within the last day or two had an opportunity of examining Mr. Pearce's designs. If he will go over my letter again and make the requisite calculations he will see that neither of his engines could do the work. They would lack adhesion. The work cannot be done with a four coupled engine; with your permission I will return to the subject in a week or two, meanwhile perhaps Mr. Pearce will amend his designs.

Swindon, May 17th. RUNNING BOARD.

COLD AIR MACHINES.

SIR,—I do not wish to trouble you with my opinions about cold air machines, but referring to an article in THE ENGINEER of the 13th May describing one, I find it stated that it is a new thing for cold air machines to be run at 120 revolutions. In reference to this, I am enabled to state that the machines of the Bell-Coleman Company have been frequently run at this, and even 150 revolutions, when of the small size of the machine of Mr. Lightfoot described in your article.

The Bell-Coleman Company has just put on board the s.s. Cuzco, of the Orient Company, the most powerful machine yet afloat, capable of circulating 60,000 cubic feet of air per hour at 50 deg. to 80 deg. below zero; and have also in hand machines for the Hudson Bay Company, the Guion Line, the Cunard Line, and the Peninsular and Oriental Line, and others, all of which I should not have the least hesitation in running at upwards of 100 revolutions, and the smaller ones at 150 revolutions.

Amongst the hundreds of indicator cards taken with our machines I have never seen any signs of the difficulty about air suction valves, referred to in this article. Mr. Lightfoot's machine is said to have been invented to do away with the nuisance of snow produced by other cold air machines. This was a failing of machines made between 1869 and the date of the Bell-Coleman patents, but certainly the Bell-Coleman Company during the last two or three years has never had any trouble from this cause. The one greaser or attendant who watches our machines at sea finds no difficulty whatever in keeping—without any other assistance—all ports or pipes clear, and I am not aware that in the hundreds of voyages made by our machines, and the carrying of cargo to the extent of fully £2,000,000 sterling, that any injury whatever has occurred to the cargo from stoppages by accumulation of snow, not even in Indian waters.

J. J. COLEMAN.

Glasgow, May 15th.

SEA VIEW PIER.

SIR,—My attention has been called to a slight inaccuracy in the very kind notice of my work by your correspondent, Mr. Edwin W. de Rusett, in your last week's issue. The deck is kyanised, as stated, but not the piles. They are creosoted, and the standards are pitch pine; all the kyanised, creosoted, and pitch pine timber being from the well-known works of Messrs. Armstrong, Addison, and Co., timber merchants and preservers, of this port. I may add that the steel cables were manufactured by Messrs. Glaholm and Robson, and the iron hangers, rollers, &c., by Mr. Tomkinson, both firms of Sunderland. FRANK CAWS, Engineer.

Sunderland, May 17th.

THE EDUCATION OF ENGINEERS.

SIR,—Your very interesting leading article in your number of the 25th of March, on "Engineers by Act of Parliament," has suggested to me the present letter on the education of engineers. I hope this subject will prove interesting to many of your readers.

Having resided in France the greater part of my life, I know something about the working of a law similar to that which Mr. Badgerow proposes to the Legislative Assembly of the province of Ontario. There is no absolute law in France on this subject, but engineers are, as a rule, considered as competent men if they hold a diploma delivered by the Board of Trade of that country, or by any other administration or department which belongs to the State. What are called Government engineers there are those who are appointed and paid by the Government. The others obtain merely a diploma from this one, and generally occupy situations in private companies. This class of engineers are called civil engineers—ingénieurs civils. The former class comprises all the services over which the State has a control, viz., mines, highways, bridges, navy, &c. The latter class comprises the great majority of mechanical engineers, and all those who follow any branch of engineering not connected with the Government. The first sort of engineers are recruited from the Polytechnic School. The first thirty pupils who leave this great school with success are allowed to choose amongst Government vacancies any situation they like. As they are only very good mathematicians, they will have to go into a special school of application for three years, at the end of which they are third-class engineers, and afterwards may rise according to their abilities. This state of things has been criticised already in your columns some years since. It is very difficult to see what good a man can be to the profession when he has been educated after this fashion. Many of them were known to me, and did not know what branch they should like to follow, or be professors of mathematics. Complaints have often been heard against these gentlemen for the carelessness with which they accomplish their duties. However, out of the great number of engineers we have, some have acquired some renown. But most of the time, those gentlemen who have not been in the office of a civil engineer—I mean one like an English civil engineer—are only good scientists, and disdainfully look upon office work, which they entirely leave to a subaltern. The situation is not very lucrative—the name does more than anything else. I fail to see the good of that great number of years spent in learning *in extenso* sciences, the quarter of the knowledge of which only comes in daily application. Not everybody is apt to solve a transcendental equation; but many of those who cannot do so here understand sufficiently all that is required about erecting and designing a bridge.

Turning now to the second class of engineers, we find the same state of things. Too often all the examinations are the result of a *coterie*. L'Ecole Centrale des Arts et Métiers supplies every year eighty to one hundred engineers to the private engineering enterprises. The first diplomas are always sure to get good berths, and a good prospect for the future; but many have deceived the hopes they had given in the beginning, whilst some of the others have done well, and been fully appreciated. There are divers opinions as to the merits of such scholars. I knew a great manufacturer who had one of them, but had soon to dismiss him for incompetency. This manufacturer then took, to replace him, an artisan, with whom he has ever since been satisfied. I have often met with young men deeply interested in engineering studies, but who could never force the doors of the Ecole Centrale. Why? Because mathematics were the weak point with them, and considered as a *sine quâ non* condition of admission thereto. Yet they knew as much as many civil engineers in this country. Moreover, some of the young men are very often the sons of engineers or manufacturers, and have most of the time acquired some practical knowledge in the shops of their fathers. Many of the candidates to the Ecole Centrale choose the career of an engineer because it sounds nice to be called an "Ingénieur," especially in French ears; but how many know before entering the school, something of the trade they wish to follow? Very few alas! Some are very ignorant of the action and parts of a steam engine. For practical knowledge it is useless to think about it. I have seen workmen murmur at their engineers; for the workmen know better than the engineers, and the latter did not want "to be wrong" when they were. As they have not spent some two or three years in the shops, they know nothing of the nature of the relations which should exist between master and working men, and this experience cannot be acquired anywhere else. Many of our veteran engineers who hold a good reputation as practical men have not been so fortunate as to go to the above school—for it did not get very much known till 1857, when the directors handed it to the State. They merely came from Chalons, where there is a school for the technical and practical training of foremen. But that will not do now.

Before concluding let me speak a little of what is done in England. I admit that Mr. Badgerow's Bill is devoid of practical sense, but the argument you have set forth in the beginning of your article is a very good plea for the necessity of having diplomas for engineers. Are not these employed in scheming and making works of any sort upon which the safety of the public is dependent? Such a Bill should not have a restrospective effect. Why I am a partisan of engineers by examination is that the actual education of an engineer renders difficult to thousands the means of getting known. It is customary that the young man should be apprenticed for some five or six years to the profession, by paying a certain sum; he is often sure to be an engineer. We have seen many of these who have chosen that profession just as some French people do. The day they work in the shops, if often that is called work; instead of employing their leisure time in acquiring some theoretical knowledge, they concentrate it on some amusements which bear no relation to engineering. Thousands of young men now, not born in fortunate positions of life, on the contrary, do their utmost to succeed, but they cannot become engineers; they sometimes become, but after long years. There is a slight difference between the French and English notions of what an engineer is really to be, but it matters little. I have often been disheartened at this state of things. Masters consecrated a good deal of time and made a deal of fuss about well-paying apprentices. I was often struck by the ignorance of some mechanical engineers of the principles and sciences which are intimately connected with mechanical engineering. You will admit easily that some theory is indispensable; he who has not acquired any theoretical knowledge will find it—and now more than ever—difficult to compete with foreign nations. Theory and practice are closely united; a man who possesses only one of them will not go far, but the theoretical engineer will sooner fail, and there are many examples of this sort of thing, which too often brings not only one man but a whole firm to ruin.

We in France go too far one way, and the English go certainly also too far in the extreme. Many men of fame have sprung from either country and have done good service to the engineering trade, but if we examine their manner of education we shall see that they neglected nothing to succeed, both in theoretical and practical attainments. Merit should be rewarded; it is not right that those who are rich should pass before the industrious who strive to make their way in the world under difficulties of restricted pecuniary means. To succeed in any trade, the love of that particular trade is required. In connection with engineering some practical good sense is wanted joined to some sound theoretical principles. To-day nobody can complain of the difficulty of acquiring them. Many good books have been published for their diffusion. It is also useless that the young engineer should pass through all the shops; he should confine himself more to the erecting shops—that will not prevent him knowing something of what is done in the other departments. A long stage should be done in the drawing-office. The examination would only turn upon theoretical knowledge, but nobody should be admitted who has not been in connection with some works. We can easily do away with that heap of useless knowledge the head of a French engineering student has to be stuffed with, for a quarter only is useful, and of the three-quarters remaining something has to be unlearnt, and the rest is soon forgotten—a thing we know too well.

The Board of Trade would alone have the right to grant diplomas to successful candidates. Candidates must be successful in both practical and theoretical knowledge—not in one alone. They should always be apprentices in that particular line they intend to follow.

I dare say there exist in England schools which combine the study of practice in workshop with the private study of theory. In Rouen, France, there has also been established a similar school in order to remedy the want of practical knowledge of the Ecole Centrale de Paris. But in this last school, candidates are not admitted by examinations I think, but only if they have the degree B.Ec. Such examinations, if they became general, would be a great stimulus to young engineers, and keep away a lot of incompetent men who encumber the profession and spoil the trade.

Nottingham. E. GOBERT.

LOCOMOTIVE ENGINE BRASSES.

SIR,—In my letter of the 25th ult. I endeavoured to deal in a general way with the uniform or all-round mixture of all axle brasses, as laid down in Mr. Wright's specifications—a system, judging from the information which I have obtained from time to time, too commonly practiced, either by direct instruction from or an undoubted acquiescence on the part of locomotive superintendents or mechanical engineers connected with English railways. In a like manner I purpose, with your permission, to deal with one or two other matters.

It is stipulated that the same alloy—copper five, and tin one part—shall be used in the connecting rods, both for small and large end brasses. Large end to be recessed for the reception of white metal. Now, Sir, with all due deference to Mr. Wright, or any other professional gentleman who may feel disposed to differ with me upon this matter, my respectful contention is that this alloy is too hard, and especially for the large kinds. Let it be remembered that in small end brasses there is little more to be done than to bear the thrust of the piston rods to and fro in transmitting the motive power to the crank, and that almost in a direct line. In large end brasses, in addition to this, we find that the circular motion and throw of the crank in the transmission of power have to be provided for. Small end brasses are necessarily small, and flanges where used are thin, and are, therefore, frequently broken either from the cause of slackness arising from wear, or in consequence of the strain produced when travelling over sharp heavy curves. There can be but little doubt as to a like tendency to breakage in the large end brasses, but, perhaps, in a modified degree, as the brasses are much larger and therefore stronger. The common practice with large end connecting rod brasses is to fit them close, face to face; or, in other words, without leaving any draw. Often is it found that rods have not been taken down for closing from the time of leaving the repairing shop until their return thereto. Especially is this the case with an engine working from a remote station. Hence is it necessary to make the best possible provisions for keeping an engine easy but accurate in all its bearings during the fifteen or eighteen months to run down the tires before going into shops for repairs. As the slackness in journal and other bearings becomes greater, so does the danger to breakage of large end brasses or crank axle increase. The latter is a most important item when it is remembered that from £100 to £130 is the required amount for a renewal. It, therefore, becomes a matter of first importance to adopt every precaution which human skill and foresight can devise in the prevention of accidents of this character, the evil results of which are not always confined locally to the large ends and crank axle, but often extend to cylinders and covers. It may be said that is all very nice in theory, but what is the best way to meet the difficulty? Simply this—by providing both axle and motion bearings with brasses composed of such alloys as practice and constant care and investigation may have proved to be the most suitable for each particular purpose. I may here state that I have a very intimate acquaintance with a goodly number of engines—both passenger and goods—not one of which has so much as required a single large end brass for more than a dozen years past, and why? Because the system herein indicated has been duly appreciated and vigorously applied. The practice of filling large end connecting rod brasses with white metal is, undoubtedly, the best, provided the metal be a good one.

In glancing over Mr. Wright's specification which now lies before me, I see that he has really adopted for his coupling rod bushes that which I have advocated both in this and my previous letter, viz., to keep well within the line of probable breakage in all bearings which are supplemented with white metal on the bearing surface. Respecting coupling rods he says, "bushes of solid brass lined with white metal."

Allow me, Sir, to say that this is a subject upon which I have felt strongly for a very long time, and am anxious to see it ventilated in a thoroughly good spirit by your readers connected with the profession of locomotive engineering. FOUNDRYMAN.

May 16th.

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

(*From our own Correspondent.*)

SOME good finished iron orders have been this week received by mill and forge proprietors in South Staffordshire on account of New Zealand, and the orders have had to be executed with more than customary promptitude, for the stocks have been allowed to run down to a very low point. The prospects of that colony are greatly improved; and the iron needed, embraces most of the kinds made hereabouts.

For export and for home use alike the demand has improved somewhat upon the week. But buyers insist upon placing their orders at very low figures—figures that can be accepted only upon the principle that most standing charges go on the same whether the works are kept on wholly or in part.

Marked bar orders cannot be placed under £7, onwards to £7 12s. 6d. But there are few establishments of this class doing more than half-work. Medium bars are easy to buy from £6 10s. down to £6, and common bars are procurable at a minimum of from £5 17s. 6d. to £5 15s. per ton. Angles are from 2s. 6d. to 5s. more than bars in all but the high-class sorts, in which the ratio of advance is greater. Angles are somewhat more inquired for than has lately been usual, and girder plates show signs of improving demand. But boiler plates are difficult to sell, either of the £8 10s. or of the £8 quality.

Stamping sheets find full employment for the leading mills, at varying rates, and the proportion of the highest qualities made from open-hearth steel ingots is steadily increasing. Sheets for galvanising and for working-up are in growing demand; but, taken altogether, the mills are scarcely so well employed as at the close of last year. For singles makers to-day—Thursday—in Birmingham and yesterday in Wolverhampton, asked £7 10s.; but in a mixed order, with doubles and trebles, singles were to be had from several firms at £7 5s. There was a fair London inquiry for sheets for export to South America, to India and the East generally, and to the West Indies. For these orders there was much competition, and the quotations of Staffordshire firms had to meet those of other districts. The prices which are being taken for orders in 50-ton lots of sheets of 10 w.g. upwards may be inferred from the fact that a quotation at £7 2s. 6d. delivered in London was too high; and yet that quotation would have to be subject to a payment by the maker of nearly 20s. per ton in carriage and commission. Thus the sheets at works would have been under £6 5s. per ton. There was also a demand for common sheets capable of being stamped into the small shovels which usually accompany low-priced American stoves.

Strips for tube making and hoops for baling are in more than average request. Baling hoops are in growing demand, made from steel. To meet the requirement in that respect there is a larger outturn of puddled steel. One firm last week made fifty tons in their forge. The practicability of using lighter hoops to secure the same strength as that obtained with heavier hoops of iron is making the steel hoops popular alike for baling wool and cotton.

The pig iron trade keeps in a languid state. Sales are difficult to make, whether to the mill and forge or to the engineers for foundry use. Common qualities, in which cinder is largely used, were to be had to-day in Birmingham and yesterday in Wolverhampton at as low as £1 15s., from which figures prices rose up to £2 2s., according to the quantity of mine used in the original mixture. Part-mine pigs were to be had at from £2 15s. down to £2 5s. All-mine pigs were quoted at £3 2s. 6d. by some firms, whose quotation a fortnight ago was £3 5s., and some of the firms who at that time held out for £3 2s. were not wholly disinclined to take £3 in respect of good sales. Derbyshire pigs were plentifully offered at £2 5s., and there were a few sales at £2 2s 6d. Northampton iron was to be had at from £2 5s. to £2 2s. 6d. Hematite pigs were led off by the Tredegar brand, for which £3 7s. 6d. was firmly demanded. A quality hardly inferior to that of Tredegar was obtainable in a few purchases at £3 5s. A third quality, made, also, in a third district, might have been had at between £3 5s. and £3. Consumers are generally well supplied, and they manifested a reluctance to buy in advance, expressing a conviction that owing to the heavy stocks about the country, prices must rule lower.

To-day a meeting is being held at the offices in Birmingham of Messrs. Carter and Carter, accountants, of the shareholders of the Willenhall Furnaces Company, Limited. The directors find it impossible at the prevailing low rates to make at a profit, and as recently there have been some losses, they see no alternative but the voluntary winding up of the concern, which consists of three blast furnaces at Willenhall, and some mines there. For a few months past the working of the furnaces has been stopped.

Wrought iron tubes, mainly for gas and water purposes, are leaving all the principal works in large bulk for the Continent, South America, the Antipodes, the Indian empire, and South Africa. The home demand is not of great importance just now. Some contracts lately offered in this district have been secured by Glasgow makers, who have under uoted Staffordshire producers. To lessen, if possible, the existing competition, an effort is once more being made to form an association in the tube trade.

The constructive ironwork in hand is likely to receive augmentation in the small railway bridge department, some railway companies being still engaged in replacing timber with iron structures of this class. A new gasometer work is being placed.

Glazed iron roofing tiles, made upon the American principle by a Wolverhampton branch of an American firm, are going out to our colonies. Enamelled sign and name and advertising plates, encased in cast iron frames, are in growing demand for corporations and large manufacturing firms.

Wagon, cart, and carriage springs and axles are in steady demand from the Cape and Natal, Australia, New Zealand, and a few other distant markets. A little improvement marks the home orders, and numbers of the manufacturers are fully employed.

Coal is without improvement; but the prices of the best sorts remain strong at the lately declared drop.

Mining operations at the Blackley Hall Colliery, near Oldbury, have this week been suspended and most of the men discharged, the workings not having yielded coal, or sufficient indications of its existence to justify the managers in pursuing the search for the present. A meeting of the directors will, it is understood, shortly be held to decide what shall be done in the matter. A large amount of money has been expended on the undertaking, an exceptionally fine working plant having been laid down.

Of the colliers on strike in North Staffordshire, 3000 in the district of Longton returned to work on Monday morning at a 10 per cent. reduction in wages. At the Berry Hill Colliery, near Hanley, and at the great Fenton Colliery, near Stoke-on-Trent, notices for a similar reduction which expired on Saturday have been suspended for fourteen days by the employers, in the hope hat a better trade may at the end of that time admit of the withdrawal of the notices.

A meeting of representatives of ironworkers was held on Monday at Wednesbury, to consider the proposals of the masters in lieu of the terms of the Employers' Liability Act, but only 14 out of 130 works in the district were represented. It was agreed, after some conversation, that with such an inadequate representation it would be unsafe to attempt to decide the question, and the meeting was adjourned *sine die.*

NOTES FROM LANCASHIRE.

(*From our own Correspondent.*)

Manchester.—In the iron trade of this district business for the present appears to be almost paralysed, owing in some measure on the one hand to a real absence of any large requirements on the part of consumers, and on the other to the generally entertained belief that values have not yet touched their lowest point, which not only checks any operations on the part of speculators, but actuates the few buyers who are in want of iron in holding back from week to week with the view of securing the best possible terms. Consequently when anything is done it is mostly in small hand-to-mouth parcels to cover pressing requirements, business being in quite as depressed a condition as at any period during 1879, and there is also a strong conviction that prices will have to recede to as low figures as then prevailed.

Lancashire makers of pig iron have made a few small sales during the week at prices averaging about 44s. for forge and 45s. for foundry, less $2\frac{1}{2}$ delivered equal to Manchester, but the new orders coming in represent nothing like in bulk those which are being rapidly worked off, and the deliveries on account of which have, up to the present, chiefly kept the furnaces going. There is naturally, therefore, not a little anxiety with regard to the future, and to secure orders local makers would be open to special offers at under the prices I have quoted above.

In outside brands transactions have been very limited, and as a rule prices are lower. Some makers are not disposed to go below late rates, but sellers have been offering at 6d. per ton under what they were asking last week, whilst cheap lots are being pressed upon the market by needy holders, and where business is done it is difficult to ascertain what prices have really been taken. Nominally quotations for delivery equal to Manchester range from 43s. 6d. to 45s. less $2\frac{1}{2}$ for Lincolnshire and Derbyshire irons, and about 45s. 3d. net cash for g.m.b. Middlesbrough, but the actual prices where iron is sold are in most cases under these figures.

Manufactured iron maintains rather a better position in the market than the raw material. A few local makers are still kept tolerably well employed on old specifications, but there are very few new inquiries of importance, and good orders for early delivery could be placed at low figures. For ordinary bars delivered into the Manchester district the average prices remain at about £5 12s. 6d. to £5 15s. per ton; hoops are to be bought at £6 2s. 6d. to £6 5s.; common plates, £6 15s. to £6 17s. 6d.; and sheets, £7 10s. to £7 12s. 6d. per ton.

The reports which I hear from founders, engineers, tool makers, and machinists throughout the district continue almost without exception of a very unsatisfactory character. But little new work appears to be coming in, and this is competed for at extremely low figures.

It is rumoured that one of the largest machine-making firms in this district who do an extensive foreign trade contemplate the erection of works in Russia, to which they will send out their own men, in order to manufacture there, free from the heavy import duties now levied, the machinery for their Russian customers.

The introduction of cast steel for all descriptions of engineering work is, amongst other things, rapidly driving cast iron out of the market for various classes of spur gearing, and to meet the competition of Sheffield manufacturers, who are making strenuous efforts to secure the Lancashire trade, particularly in the large sizes, wheelwrights in this district are laying themselves out to produce heavier steel castings than they have hitherto been able to turn out. In this direction, Messrs. Peter Rothwell, Jackson and Co., of Manchester, one of the principal firms in the district, and well known for the production of exceptionally large cast iron wheels, are now laying down plant for turning out crucible steel castings for spur-gearing up to, I believe, 20 tons in weight, which will enable them to produce much heavier wheels than any that are at present being sent out of the Sheffield district.

I hear that the Lancashire and Yorkshire Railway Company has decided upon the erection at Fleetwood of a grain elevator on the American principle, with the view of affording every facility at the above port for the reception of grain from the United States. In order that the company might be enabled to avail itself of all the recent improvements, a special commissioner was sent to the United States, where he has inspected all the most approved appliances for the elevation of grain from ship-board into warehouses, and I understand that the company's engineer is now engaged upon plans and specifications for a large warehouse and elevator.

The same company, I also hear, is considering the advisability of replacing their present first-class carriages on their line between Manchester and Southport with new cars on the Pullman principle.

A clock recorder for indicating the fluctuations of the water in the reservoirs is being constructed by Messrs. Bailey and Co., of Salford, for the Canterbury Waterworks. This recorder is similar in construction, although not so large, as the one already erected at the Sheffield Waterworks, and consists of an autographic recorder with a revolving diagram, indicating for each day a rise and fall of 20ft. on a scale of 1in. to the foot, actuated by an eight-day clock movement.

A dull tone prevails throughout the coal trade of this district, and stocks are accumulating with short time in operation at a large number of the collieries. The better classes of round naturally only move off slowly owing to the season of the year, but the market is further weakened by the present very limited demand for the common sorts for iron making and manufacturing purposes, in consequence of which common coal is a complete drug. There is not the pressure in the market for engine fuel which was anticipated. Burgy continues plentiful, whilst the recent stoppage of a number of chemical works in the district, with the small inquiry for brick-making purposes, is throwing a considerable quantity of slack upon the market, and prices are scarcely so stiff as they were. Prices all round, in fact, may be said to be easier, and at the pit mouth average about as under:—Best coal, 8s. 6d. to 9s.; seconds, 6s. 9d. to 7s. 3d.; common coal, 5s. 3d. to 5s. 9d.; burgy, 4s. 6d. to 5s.; and good slack, 3s. 9d. to 4s. 3d. per ton.

In the shipping trade there is still an absence of any general activity, and low prices are quoted to secure cargoes.

Barrow.—I cannot say that the hematite market has yet shown any disposition towards a renewed activity, or even to a better position than that of the past few weeks. Inquiries from foreign and home consumers are being fairly made; but there is a listless feeling in the hematite market, which is anything but healthy or re-assuring. My inquiries within the past few days have given me opinion that the output must ere long be reduced a little more than it is at present. Indeed, a feeling is beginning to manifest itself in this direction. The prices of forge and Bessemer qualities remain at much the same figures. No. 1 Bessemer is changing hands at 58s. 6d. per ton, No. 2 at 57s., and No. 3 at 55s. 6d., all at makers' works. No. 3 quality of forge iron is selling at 57s. per ton. Low prices are also ruling in the steel department. The mills are well employed, but this is on account of old contracts. A pretty large tonnage of this metal is going into delivery, but this is chiefly on home account, the deliveries to American and Continental buyers not being large. Shipbuilders have not contracted for much new work lately, but they are still very busy on orders booked some time since. The demand for iron ore is not quite so brisk as it was. Orders booked some time since, however, will maintain a considerable output. Coal and coke in fair inquiry. Shipping only moderate.

THE SHEFFIELD DISTRICT.

(*From our own Correspondent.*)

There is no improvement whatever in the coal trade, except in gas coal, which appears to be advancing in value. All other sorts are very low and in languid demand. Since my last letter I see it stated that the Shaw Hope Silkstone Colliery, near Barnsley, has been shut down, throwing a considerable number of men out of employment. Other collieries are said to be so poorly employed that similar steps are expected.

The action of the Manchester, Sheffield, and Lincolnshire Railway Company in increasing the tonnage rate for coke and ironstone is causing a good deal of dissatisfaction. Though the advance is not very great, it is stated to form a serious obstacle to the trade, most of the coke made in South Yorkshire being sent to North Lincolnshire. The Frodingham Iron Company is damping down one of its furnaces.

There is no change in the armour plate, steel rail, boiler and ship plate trades since my last letter. All these departments are very busy.

A very brisk business is reported in wire for cable and telephone purposes, and agricultural implements are in improved demand. There has been a clearing out of stocks which have accumulated during the winter. A good business is anticipated during the forthcoming season. Sheep shears are largely called for.

The Parkgate Iron Company, Limited, has issued its seventeenth annual report. The directors state that during the past financial year the company derived considerable advantage from the contracts that had been previously made during the temporary excitement which prevailed in the iron trade. At the present time the prices of pig and finished iron are extremely low, and although, unlike other companies in the neighbourhood, they report a moderate demand for finished iron, the margin of profit is admitted to be very small. In consequence of the substitution of steel for iron rails, and the improbability of the rail mill ever being again required for the purposes for which it was established, the directors have considered it advisable to appropriate £5000 out of revenue in reduction of the cost at which this mill stands in the books. After providing for bad debts and all other charges, the net profit made during the year is £14,996, which, added to the sum of £795 brought forward from last year, makes an available profit for distribution of £15,791, out of which an interim dividend has been paid amounting to £4858. It is proposed to pay a further dividend of £3 5s. per share on 2990 shares, making a total dividend of $7\frac{1}{2}$ per cent. for the year, and to carry forward £1215 to next year's account. This report is regarded in the district as exceedingly satisfactory.

A failure of some magnitude is reported in the Sheffield iron trade, a liquidation petition having been filed last Friday by William John Roseby, Tinsley Blast Furnaces, Tinsley, Doncaster, and Frodingham, ironmaster and merchant, and coke, coal, and ironstone merchant, also a partner in the Mid-Lincoln Coal Company, of Lincoln. The liabilities amount to £100,000. The assets, the value of which has not yet been ascertained, are considerable. The failure is attributed to severe losses in trade, in consequence of the prolonged depressions.

At Barnsley, on Monday, the magistrates adjudicated upon a number of summonses against the miners on strike at Ryhill Main Colliery for compensation, they having shut a colliery down and caused it to be idle. Fifteen horses and over 100 railway wagons were thus unemployed, and seven boats have left the colliery unloaded; 15s. compensation was claimed from each man. Defendants were ordered to pay 10s. each compensation, and costs.

Messrs. Spear and Jackson, Etna Works, have been awarded by the commissioners of the Melbourne Exhibition, the "First Order of Merit," in addition to a gold medal for special excellence in quality and finish of their exhibit of saws, files, and edge tools.

THE NORTH OF ENGLAND.

(*From our own Correspondent.*)

There is no alteration yet to report in the general downward tendency of the Cleveland iron market. Production, considerably in excess of consumption and distribution, still goes on steadily and unrelentingly. Stocks and stores still increase day by day. Outside capitalists who, in the earlier months of the present and the latter months of last year, were ready and even greedily anxious to exchange their ready money for pig iron warrants, are now finding out that they made a great mistake. Their investments have been thoroughly bad. The 1s. 6d. per ton premium they paid for their warrant fees, and representing the cost of putting into and taking out of store, is now worth only 9d. Their rent of one penny per ton per month is absolutely lost, and their interest of 2d. per ton per month has also totally disappeared. Not only so, but their principal sum of, say, 40s. per ton has dwindled down to 37s. 3d. Under these disappointing circumstances it is not to be wondered at that many warrant holders are quite sick of their fluctuating property; so many that they are largely becoming sellers, and so contributing to help forward the evil they seek to fly from. The general verdict is that some furnaces, at least a dozen, must be blown out somewhere. The Scotch ironmasters say they will not stop, and their Cleveland competitors think the obligation lies with the smelters of other districts. The prevailing idea is that out-lying and ill-situated works will have to give way in whatever district they may be situated, and that before very long, unless something unforeseen speedily occurs to increase the demand largely. In the meantime it is to be noted that during the week it has been announced that one furnace in Lincolnshire and three in Staffordshire are likely to be put out. All this will tend to throw on to the market a quantity of material and a number of workmen, and so lower the cost of production for others. No. 3 g.m.b. pig iron may now be bought at 36s. 6d. per ton delivered at Middlesbrough, and little or nothing extra is expected for delivery up to the end of September. Forge iron is about 9d. per ton less, and warrants 9d. per ton more.

Shipments continue very poor, the usual daily average of 3000 tons being by no means maintained. According to present appearances it will be strange if the total for the month reaches 60,000 tons. The increase in Connal's stores during the week is 1194 tons, raising the total to 171,048 tons at Middlesbrough, and 557,328 tons at their Glasgow store.

In manufactured iron much more steadiness prevails. The order-books of the makers have quite as much upon them as was the case three months ago, but of course the average price is much lower. The only reason, indeed, for any weakness there may be in shipbuilding material is the tendency to fall in pig iron. Buyers, when they observe this, generally keep back their orders, in expectation of a corresponding fall in finished iron; and this holding back, extensively practiced, produces the desired effect. There is no doubt but that East coast shipbuilders must now be making enormous profits. They filled their yards with work for many months ahead, at prices based on £6 15s. for plates and £5 15s. for bars and angles. Now they have the opportunity to purchase such portions of their requirements as they may still need for £6 2s. 6d. for plates, and £5 7s. 6d. for bars and angles. The difference is a clear addition to their profits. Ironfounders are a little more active, but not sufficiently to allow of any rise in price. The coal market is decidedly flat, in sympathy with pig iron. In the common kinds of coal used for puddling, there is, indeed, a fall of about 3d. per ton. Best screened coal is, however, still able to maintain previous prices.

Considering how largely the time of the members of the Iron and Steel Institute has of late been taken up at their meetings by papers upon the wonders of basic and other steel, and how enthusiastically its merits have been set forth by those interested in it, it is almost refreshing to find that it is possible that here and there a crotchety individual exists with sceptical tendencies in the matter. We have no doubt this healthy scepticism will lead to further discussion, and that here, as elsewhere, the fittest will ultimately survive.

A serious fire occurred on Monday night at the shipbuilding yard of Messrs. Wigham, Richardson, and Co., Walker-on-Tyne. Sheds, storehouses, machinery, stores, and other property were destroyed to an estimated value of £10,000. The yard contains several hydrants, which were soon brought into requisition, but unfortunately the pressure of water was not sufficient to be of much use. Various fire-engines also arrived, but here again difficulties occurred. The tide was dead low at the time, and the water in the channel of the river was distant and difficult of access in proportion. The whole amount will be covered, it is said, by insurance, and as there are other sheds and other machinery available, the work of the yard will not be stopped.

NOTES FROM SCOTLAND.

(*From our own Correspondent.*)

The pig iron trade does not yet show any improvement. This week the market has on some days been quite stagnant, and on others, when any movement has taken place, it has generally been in a downward direction, so that quotations have declined again since last report. In the course of the week fully 3000 tons have been added to the stock in Messrs. Connal and Co.'s Glasgow stores, bringing it up to 557,727. The magnitude of this reserve will be all the more striking if it is noted that at the same period last year the stock aggregated 442,073 tons; in 1879, 261,549; in 1878, 174,987; in 1877, 136,676, and in 1876, 63,194 tons. These figures will, no doubt, to some extent, be affected by the comparative amounts in makers' hands, of which no reliable account is supplied, except at the close of each year. But allowing for this, the increase is so remarkable, that the wonder is how prices have for so long been maintained at the rates of the past few weeks. Possibly the explanation may be that the warrant business is now spread over more and stronger orders. This week sales have been difficult to effect, even at quotations below those officially reported. So far as can be seen there is hardly any likelihood of an upward turn, or even a healthy steadiness in the market, until prices have gone to a lower level still. The past week's shipments were 10,568 tons against 9416 in the preceding week, and 13,123 in the corresponding week of 1880. The total shipments to date are 190,360, compared with 302,020 tons in the corresponding period of last year. They are 6000 tons less than in 1879, but 40,000 tons more then in 1878, which was the smallest of the dull years of the past decade. In the Cleveland imports of pigs, on the other hand, there is a total increase to date of 22,137 tons, and last week's arrivals amounted to 4260 tons.

In the warrant market, business was done on Friday forenoon at from 45s. 9d. to 45s. $10\frac{1}{2}$d. cash, and 46s. fourteen days, the afternoon quotations being 45s. 9d. to 45s. $9\frac{1}{2}$d. cash, and 45s. $10\frac{1}{2}$d. to 45s. 11d. one month. On Monday morning transactions were effected to 45s. 10d. cash, and 45s. $11\frac{1}{2}$d. one month; and in the afternoon at from 45s. 9d. to 45s. $9\frac{1}{2}$d. cash, and 45s. 10d. to 45s. $10\frac{1}{2}$d. one month. The market was stagnant on Tuesday at about 45s. 8d. cash and 45s. 9d$\frac{1}{2}$. one month. On Wednesday transactions were effected down to 45s. 5d. cash, recovering 1d. at the close. To-day—Thursday—the market was quiet, with the business at 45s. to 44s. cash and 40s. to 44s. one month.

The prices of makers' iron tend downwards, and the following quotations are about 6d. below those of last week:—Gartsherrie, f.o.b., at Glasgow, per ton, No. 1, 56s. 6d.; No. 3, 48s. 6d.; Coltness, 56s. 6d. and 48s. 6d.; Langloan, 57s. and 49s.; Summerlee, 55s. 6d. and 48s. 6d.; Calder, 56s. 6d. and 48s.; Carnbroe, 52s. and 47s.; Clyde 47s. 6d. and 45; Monkland, Quarter, and Govan, 47s. and 45s. each; Shotts, at Leith, 57s. and 50s.; Carron, at Grangemouth, 52s. 6d.—specially selected, 56s. and 51s. 6d.; Kinneil, at Bo'ness, 47s. 6d. and 45s. 6d.; Glengarnock, at Androssan, 52s. and 47s. 6d.; Eglinton, 47s. and 45s.; Dalmellington, 47s. and 45s.

There is a fair amount of work in the manufactured ironworks generally, those engaged on contracts for shipbuilding being still very busy. One or two qualities of bars are quoted at a little less money this week. Steel boiler plates are given at £11 15s.; ship plates, £11; and angles, £10; iron bars, £5 15s. to £6 5s.; boiler plates, £7 10s. to £8; £6 15s. to £7; angles, £5 15s. to £6 5s.

The smelters at the Steel Company of Scotland's Works, near Glasgow, struck work on Monday for an advance of 10 per cent. in their wages, which had been refused by the manager after the men had given the usual notice.

There is a good business doing in coals, the shipments being larger than they were at this time last year, and the inland consumption fair for the season. It is many years since the miners have given so little trouble to their employers, and in consequence they are putting out a large quantity of coals and earning steady, if not very large, wages. For the first time since the last strike a meeting of the miners was held a few days ago at Motherwell, and addressed by some of their old leaders, who alleged that before the break-up of the Union they had 1s. 6d. per day more than now, although they were now putting out eight tons a day in place of three. It was alleged that the Acts of Parliament passed in recent years for the amelioration of the miners' condition were set aside by rules which the men would not dare refuse to sign. An agitation is hardly likely to be awakened among the west country miners at this juncture. In the eastern mining counties, the shipping trade is improving, this being especially the case in Fifeshire, where the shipments at some of the ports are nearly double what they were at the same date last year.

Among the past week's launches on the Clyde is the Rome, a fine screw vessel, of 430ft. in length, 5100 tons, and 5000 indicated horse-power, built by Messrs. Caird and Co., of Greenock, for the Peninsular and Oriental Steam Navigation Company. Her engines will have four cylinders, two of 44in. and two of 82in. diameter, and the stroke will be 5ft. She will have six boilers with thirty furnaces, and will accommodate 147 first and fifty second-class passengers.

WALES AND ADJOINING COUNTIES.

(*From our own Correspondent.*)

A large number of hands have been already paid off at Cyfarthfa; the whole of the horses are in the market, and the process of blowing out the furnaces has begun. It is, however, known that by new arrangements a good number of the men will have places found in the collieries and about the alterations until the steel-works are completed. To what extent the alterations will go is unknown yet, and they are most probably still under consideration. One thing is certain, that the change will be an elaborate one, and such as to give Cyfarthfa a position amongst the first-class steelworks of the kingdom. Glancing through the iron and coal district, I can see unmistakeably that both in iron and coal there will be considerable transformations worked in the present year. Briton Ferry, to wit, is one place where a change is threatened. If iron can be worked more cheaply at one place than another, and freightage and fuel arrangements less, this is the place. Previously worked by Evans and Davey, and since by Townsend, Wood, and Co., with Mr. Davey as manager, no one doubted the prosperity of the concern, and I am still inclined to the opinion that a reduction of wages may be the sole object in view for the announcement made of discontinuance of all contracts.

The special advantages of the works are so considerable that a stoppage may be regarded as most unlikely.

Bookers Works, Pentyrch, Cardiff, form another item of consideration. These, collieries and all, will be formed into so many lots and sold at the Royal Hotel, Cardiff, shortly. The figures realised will depend very much upon what condition the tin-plate trade may be in at the time of sale. At present it is a little firmer. Twelve works are idle in the district, and about fourteen mills at the other works. The average prices obtained for coke plate may be taken as 17s., and the number of stoppages may be regarded as certain to operate favourably at that price.

Including Cyfarthfa, it will be seen that the iron trade of Wales is undergoing a metamorphosis, and in coal the changes on the carpet are almost as great. In June next, at the Llancaiach and Gellygaer collieries, all the plant, wagons, and materials, engines, &c., will be sold. Also at the end of May, at Lebanus Colliery, Blackwood, all will be sold—machinery, plant, &c.; and in tin-plate, as stated, there are enough concerns idle to make one apprehensive of serious breakdowns, if not total collapses of once flourishing industries.

With all this there is yet a degree of prosperity prevailing, consequent on the excellent condition of the coal trade. The shipment from Wales last week was close upon 150,000 tons, of which Cardiff alone sent 111,000 tons, and the quantities sent by coast-wise and land were very large. In the neighbourhood of Swansea the iron and steel trade is not brisk, and the coast trade of April compared with April of previous year shows a falling off of 36,000 tons. This month, however, promises to make amends, and the opinion held in safe quarters is that the falling off is only due to exceptional causes.

The progress made at the new docks is not sufficiently great, as seen from the pier, to justify the promise of completion by October. Still the work is in able hands, and with good weather a large stride may be made. The severe winter must have told considerably as a drawback.

The vigorous administration of affairs at the Bute Dock, Cardiff, by Mr. W. T. Lewis, is beginning to bear fruit. The work is now more effectually done at a quarter of the cost. The Augean needed an energetic broom. The President of Marseilles port was at the docks this week, and spoke in high terms of the arrangement. In his opinion "there is a great future before Cardiff."

The total iron and steel shipped from Cardiff and Newport, Mon., last week was slightly over 10,000 tons.

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.

10th May, 1880.

2026. Separator, H. E. Kratz.—(*M. Deal, U.S.*)
2027. Rink, H. Langsford, Islington, London.
2028. Waterproof Canvas, G. and W. Good, Yeovil.
2029. Detecting Fraudulent Alterations in Cheques, &c., R. Murray, Southwark.
2030. Colouring Matters, J. A. Dixon.—(*C. Rumpff, Elberfeld, Germany.*)
2031. Pressing Horn, D. Stewart, Aberdeen.
2032. Calf Skins, L. A. Groth.—(*P. Bernard, Italy.*)
2033. Sole Plates, &c., M. and R. Slack, Bollington.
2034. Automatic Fog Signal, H. Whiteherd, Bucknall, and T. Dodd, Winsford.
2035. Iridium, W. P. Thompson.—(*J. Holland, U.S.*)
2036. Ticket Apparatus, J. J. Mielecki, London.
2037. Drying, &c., H. J. Haddan.—(*E. H. Potter, U.S.*)
2038. Electric Lighting, H. J. Haddan.—(*R. J. Gulcher, Bielitz-Biala, Austria.*)
2039. Binding Cut Crops, G. A. Walker, Sutton.
2040. Artificial Stone, P. Jensen.—(*E. J. Erichsen, Copenhagen, Denmark.*)
2041. Controlling Electric Currents, L. M. de B. y O'Lawlor, London.
2042. Root-cutting Machines, J. Hornsby and J. Money, Grantham.
2043. Conveying Heat, &c., W. T. Whiteman.—(*J. Newton, New York, U.S.*)
2044. Firegrates, W. Clapham, Leeds.
2045. Burning Liquid Hydrocarbon, W. R. Lake.—(*R. Lighthall, Brooklyn, U.S.*)
2046. Fastener for Boots, J. Abrahamson, London.
2047. Removing Hair from Skins, J. Blumm, London.
2048. Making Joints, M. Benson.—(*A. H. Fancher, U.S.*)

11th May, 1881.

2049. Velocipede, G. M. E. Jones, Cambridge.
2050. Tram Rails, W. Sterling, Rusholme.
2051. Hats, J. H. Neave, Macclesfield.
2052. Tube Connections, H. F. Baker, Smethwick.
2053. Patterns, J. H. Noad, Essex.
2054. Brakes, H. H. Duke, Westbury.
2055. Looms, E. Wilson, Preston.
2056. Driving Tacks, W. Lake.—(*G. J. Capewell, U.S.*)
2057. Magnetic Comb, J. Richards.—(*H. Drake, U.S.*)
2058. Petroleum, S. Pitt.—(*P. Dittmar, Russia.*)
2059. Producing Designs, A. Guattari, London.
2060. Window-cleaning Chair, A. M. Clark.—(*A Dormitzer, New York.*)

12th May, 1881.

2061. Producing Animal Charcoal, D. Fife, Barnes.
2062. Stretching Fabrics, S. Hallam, Manchester.
2063. Tank, H. Kirkhouse, Penarth, and H. W. Lewis, Treherbert.
2064. Cone Gearings, S. H. Saxby, East Clevedon.
2065. Pianofortes, G. W. von Nawrocki.—(*G. Neuhaus, Kalkar, Germany.*)
2066. Carburetting Air, W. P. Thompson.—(*M. F. Chavée, Namur.*)
2067. Lawn Tennis Bats, W. P. Thompson.—(*R. Gordon, Hanzadah, British Burmah.*)
2068. Engines, J. McFerran and W. Rennie, Ireland.
2069. Expansion Gear, C. Pieper.—(*W. Poell, Saxony.*)
2070. Stoppering Bottles, J. Broadbridge, Manchester.
2071. Corking Machines, A. Weir, Belfast.
2072. Date Fruit, T. F. Henley, London.
2073. Indicating the Presence of Fire-damp, H. J. Haddan.—(*L. Somzee, Brussels.*)
2074. Packing, W. T. Whiteman.—(*Defalque and Co., Brussels.*)
2075. Power Hammers, J. Patterson, London.
3076. Transmitting Motion, J. F. Haskins, London.
2077. Axle-boxes, G. E. Vaughan.—(*H. Cristin, Paris.*)
2078. Air-testing Instruments, F. H. F. Engel.—(*W. Klinkerfues, Germany.*)
2079. Electric Lamps, C. H. Gimingham, London.
2080. Oxygen, &c., A. M. Clark.—(*N. Hélouis, Paris.*)
2081. Fluid Meters, B. D. Healey, Blackburn.
2082. Syphonic Apparatus, H. E. Cooper, London.
2083. Motive-power Engines, J. Robson, Birmingham.

13th May, 1881.

2084. Capstans, B. C. Scott, Chester-terrace, London.
2085. Projections, S and J. Chandler, London.
2086. Steam Pumps, F. Pearn, S. Pearn, and T. Addyman, West Gorton, Manchester.
2087. Regulating Taps, &c., G. Osborn, Brighton.
2088. Conveying Intelligence, J. Baker, London.
2089. Velvets, J. Newton and J. E. Harrison, Oldham.
2090. Locking Bottle Moulds, W. Arthur and R. W. Smith, Fitzwilliam Quay, Dublin.
2091. Illuminating Gas, J. Keith, Edinburgh.
2092. Harvesting Machines, J. Miller, Edinburgh.
2093. Corn Mills, A. E. F. Chattaway, Wixford.
2094. Tuck-pointing Walls, W. N. Bundy, Whittlesea.
2095. Spinning Fibres, S. Tweedale, Accrington.
2096. Supplying Gum to Paper, J. J. Allen, Halifax.
2097. Substitute for Coffee, R. Hall, Lindley.
2098. Dobbies, &c., J. Garstang, Burnley.
2099. Self-warping Mechanism, S. Cook, sen., and S. Cook, jun., Bury.
2100. Locks, &c., A. A. Bedford, Clapham.
2101. Securing Railway Chairs, W. Nevill, Ferryside.
2102. Terne Plates, D. Leyshon, Penclawdd.
2103. Printing Ink, C. T. Bastand, Camberwell.
2104. Bottles, F. S. S. Darby, Wandsworth.
2105. Embossed Fabrics, F. C. Jeune, London.
2106. Rock Tunnelling, H. N. Penrice, Hatfield.

14th May, 1881.

2107. Chromographic Printing, H. J. Haddan.—(*W. H. Forbes, Boston, U.S.*)
2108. Cotton Pile Plushes, W. Irlam, Eccles.
2109. Controlling the Speed of Steam Engines, H. Linley, Salford.
2110. Vacuum Pans, A. Watt, Liverpool.
2111. Cropping Machines, W. W. Urquhart and J. Lindsay, Dundee.
2112. Flannel, W. Schofield, Rochdale.
2113. Soda, E. Solvay, Brussels.
2114. Filtering, W. Spence.—(*C. Piefke, Berlin.*)
2115. Curling, &c., Hair, J. Careless, Birmingham.
2116. Travelling Cabinet, W. M. Cochrane, London.
2117. Apparatus having a Gelatinous Surface, J. H. Noad, East Ham.
2118. Mandril, C. Croissand and P. P. Huré, Paris.
2119. Securing Knobs, A. W. Pocock, Wandsworth.
2120. Thrashing Machines, F. Wirth.—(*P. Mayfarth and Co., Frankfort-on-the-Maine, Germany.*)
2121. Screw Propellers, W. R. Lake.—(*J. Root, U.S.*)

16th May, 1881.

2122. Gas Motor Engines, J. Dougill, Manchester.
2123. Driving Belts, D. Williams, North Wales.
2124. Hydraulic Caps, F. Wirth.—(*N. Franz and F. Westmeyer, Germany.*)
2125. Steering, &c., Vessels, A. Figge, London.
2126. Renovating, &c., the Polish of Wood, &c., C. D. Abel.—(*E. Schultz, Berlin.*)
2127. Life-preserving Garment, F. W. Brewster, Westminster.
2128. Steering, A. B. Brown and W. King, Edinburgh.
2129. Safety Valve, W. Lake.—(*A. Pleichl, Vienna.*)
2130. Steering, W. Morgan-Brown.—(*H. Lindemann, Germamy.*)
2131. Stoves, F. H. F. Engel.—(*H. Kock, Hamburg.*)
2132. Crane, J. Hurst, Brighton.
2133. Pumps, W. Lake.—(*W. and J. Jacobs, Holland.*)
2134. Cutting Cylindrical Cores, J. Gazeley, U.S.

Inventions Protected for Six Months on deposit of Complete Specifications.

1984. Cutting Open Tin Cases, H. Knight, Ryde, Isle of Wight.—*7th May*, 1881.
1988. Spinning Carded Wool, &c., A. Munzinger, Olten, Switzerland.—*7th May*, 1881.
1995. Breaking Stones, &c., W. R. Lake, Southampton-buildings, London.—A communication from P. W. Gates, Chicago, U.S.—*7th May*, 1881.
2001. Waterproof Casing for Cartridges, H. A. Bonneville, Cannon-street, London.—A communication from A. A. Biennait, Paris.—*9th May*, 1881.
2011. Car Wheels, E. L. Taylor, Philadelphia, U.S.—*9th May*, 1881.
2023. Regulator Gas Burners, H. Zwanziger, Vienna.—A communication from J. Janky, J. Rimanoczy, and C. Rimanoczy, Vienna.—*9th May*, 1881.
2045. Burning Liquid Hydrocarbon, W. R. Lake, Southampton-buildings, London.—A communication from R. Lighthall, Brooklyn, U.S.—*10th May*, 1881.
2048. Making Joints, M. Benson, Chancery-lane, London.—A communication from A. H. Fancher, Brooklyn, U.S.—*10th May*, 1881.
2081. Hydraulic Pumps, B. D. Healek, Blackburn.—*12th May*, 1881.

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

1881. Puddling Iron, &c., A. P. Price, London.—*10th May*, 1878.
1883. Working Up Shearings, J. H. Rogers, Llanelly.—*10th May*, 1878.
1899. Solid Lye, A. C. Henderson, London.—*11th May*, 1868.
1910. Feather Fabric, M. Brewster, Edinburgh.—*13th May*, 1878.
1905. Preparing Cotton, &c., J. Greenwood and J. Thornely, Stockport.—*11th May*, 1878.
1918. Reproducing Plans, F. Wirth, Frankfort-on-the-Maine.—*13th May*, 1878.
1943. Silicate Cotton Cloth, W. Brown, jun., Cookstown, Ireland.—*15th May*, 1878.
2109. Looms, G. A. M. Malleval, Tarare, France.—*27th May*, 1878.
1907. Hydrocarbon Stoves, D. P. Wright, Birmingham.—*11th May*, 1878.
1961. Hydraulic Gantry, M. Atock, Dublin.—*16th May*, 1878.
1913. Thrashing Machines, R. R. Holben, Barton.—*13th May*, 1878.
1928. Crushing Bones, T. Archer, jun., Dunston.—*14th May*, 1878.
1960. Breech-loading Fire-arms, A. M. Clark, London.—*15th May*, 1878.
2034. Presses for Graining Leather, A. M. Clark, London.—*21st May*, 1878.
2858. Breaking Hides, A. M. Clark, London.—*17th July*, 1878.
2145. Metallic Cases, H. W. Herbst, London.—*29th May*, 1878.
1944. Boring Rocks, G. Forsyth, Lancaster, and E. Barnes, Ulverston.—*15th May*, 1878.
1950. Spinning, &c., W. Stannard, Leek.—*15th May*, 1878.
2004. Chaff-cutting Machines, S. Edwards, Salford.—*18th May*, 1878.
2031. Printers' Quoins, W. R. Lake, London.—*21st May*, 1878.
2188. Weavers' Harness, W. R. Lake, London.—*31st May*, 1878.
2365. Signal Cartridges, W. Morgan-Brown, London.—*14th June*, 1878.

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

1662. Refining Lead, G. Luce, Marseille, France.—*11th May*, 1874.
1676. Forging Metals, A. M. Clark, London.—*11th May*, 1874.
1696. Sawing Stone, &c., R. Cox, Weymouth.—*13th May*, 1874.

Notices of Intention to Proceed with Applications.

Last day for filing opposition, 3rd June, 1881.

4847. Obtaining Oil from Petroleum, W. R. Lake.—Com. from J. E. Borne.—*22nd November*, 1880
5449. Fog Signalling, W. B. Barker, Southampton-buildings, London.—*28th December*, 1880.
101. Furnaces, &c., J. Lart, London.—A communication from C. W. Doten, U.S.—*8th January*, 1881.
105. Mop Wringer, J. Whittingham, Willaston, Nantwich.—*8th January*, 1881.
110. Perforating Jacquard Cards, T. G. Lomas, Withington.—*10th January*, 1881.
111. Preventing Ships Sinking, R. G. Sayers, Hunter-street, London.—*10th January*, 1881.
113. Twisting, &c., Yarns, J. Farrar, Halifax.—*10th January*, 1881.
116. Carding Engines, P. L. Klein and G. Hundt, Dusseldorf, Prussia.—*10th January*, 1881.
121. Furnaces, W. P. Thompson, High Holborn, London.—Com. from J. McAuley.—*11th January*, 1881.
139. Relieving Strains on Ropes, C. Mace, Sunderland.—*12th January*, 1881.
150. Propelling, &c., Carriages, R. C. Nicholl, Streatham.—*12th January*, 1881.
167. Packing, C. A. Maynard, Clement's-lane, London.—Com. from F. Walton.—*13th January*, 1881.
171. Furnace Bars, C. Whitfield, Newcastle-on-Tyne.—*13th January*, 1881.
188. Sewing Machines, J. C. Mewburn, London.—Com. from E. Antoine.—*14th January*, 1881.
191. Looms, J. Northrop, Millhome Shed, near Skipton.—*14th January*, 1881.
195. Close Stoves, H. Doulton and W. P. Rix, Lambeth.—*14th January*, 1881.
197. Treating Saccharine Liquids, W. R. Lake, London.—Com. from G. B. Boomer.—*14th January*, 1881.
208. Preparing, &c., Fabrics, R. W. Morrell, Bradford, and J. Shaw, Wakefield.—*15th January*, 1881.
209. Candles and Tapers, E. G. Brewer, London.—Com. from F. M. Joly.—*15th January*, 1881.
281. Crushing, &c., Substances, P. Pfleiderer, London.—Com. from C. Meinecke.—*22nd January*, 1881.
282. Velocipedes, E. R. Settle, Trafalgar-square, London.—*22nd January*, 1881.
295. Refrigerating, J. Gwynne, Hammersmith.—*22nd January*, 1881.
307. Preventing Water Freezing in Water Pipes, J. Rule, Dublin.—*24th January*, 1881.
459. Distributing Manure, H. A. Bonneville, London.—Com. from L. A. Couteau.—*3rd February*, 1881.
492. Safety, &c., Lamp, V. Ragosine, Russia.—A communication from F. von Kordig.—*5th February*, 1881.
514. Driving Small Machines, L. Boye and E. Müller, Saxony.—*7th February*, 1881.
564. Injectors, W. L. Wise, Westminster.—Com. from H. Cuau.—*9th February*, 1881.
571. Ventilating, &c., H. Mestern, Berlin.—*10th February*, 1881.
806. Purifying, &c., Coal Gas, G. A. Northcote, London.—*25th February*, 1881.
884. Marine Engine Governor, J. G. Tongue, London.—Com. from W. Würdemann.—*2nd March*, 1881.
955. Indicating, the Pressure &c., of Steam, L. Boye and E. Müller, Saxony.—*5th March*, 1881.
1056. Artificial Flowers, W. Spence, London.—Com. from W. Hagelberg.—*11th March*, 1881.
1268. Stoppers for Bottles, N. Thompson, Southampton-buildings, London.—*22nd March*, 1881.
1525. Fastenings for Boots, &c., W. R. Lake, London.—Com. from T. L. Jacobs.—*7th April*, 1881.
1582. Holding Hanks of Wool, W. Graham, Monk Bretton.—*11th April*, 1881.
1627. Carpets and Rugs, G. O. Holloway, Kidderminster.—*13th April*, 1881.
1639. Nitro-benzole, J. Deucker, Manchester.—*14th April*, 1881.
1751. Actinometres, &c., F. Hurter, Widnes.—*23rd April*, 1881.
1768. Magnesia, &c., H. Wedekind, London.—A communication from H. Hauenschild.—*23rd April*, 1881.
1912. Burnishing Heels of Boots, W. R. Lake, London.—Com. from Z. Beaudry, U. Beliveau, T. L. Hoitt, H. L. Brown, and J. Peck.—*3rd May*, 1881.
1913. Perforated Cylinders, &c., W. R. Lake.—Com. from A. Reeve.—*3rd May*, 1881.
1914. Giving Information, W. R. Lake, London.—Com. from E. S. Boynton.—*3rd May*, 1881.
1944. Pneumatic Refrigerating Machines, M. J. Klein, New York.—*4th May*, 1881.
1955. Rotary Engines, H. Thibalt and T. Hawkins, San Francisco, U.S.—*5th May*, 1881.
1984. Opening Tin Cases, H. Knight, Ryde, Isle of Wight.—*7th May*, 1881.
2001. Insulating, &c., Casing, H. A. Bonneville, London.—Com. from A. A. Biennait.—*9th May*, 1881.
2011. Car Wheels, E. L. Taylor, Philadelphia, U.S.—*9th May*, 1881.

Last day for filing opposition, 7th June, 1881.

127. Revolving Shutters, J. Stones and E. Phillips, Ulverston, and T. Kirby, Barrow-in-Furness.—*11th January*, 1881.
134. Tool Holders, J. M. Bibbins, High Holborn, London.—*12th January*, 1881.
135. Stone-breaking Machines, W. Taylor, Leicester.—*12th January*, 1881.
137. Plugs of Urinals, J. Reffitt and W. Irwin, Leeds.—*12th January*, 1881.
141. Kilns, J. Briggs, Clitheroe.—*12th January*, 1881.
147. Securing the Contents of Bottles, J. Betjemann, London.—*12th January*, 1881.
151. Microscopes, F. H. Wenham, New Bond-street, London.—*12th January*, 1881.
152. Electric Batteries, J. A. Lund, Cornhill, London.—*12th January*, 1881.
155. Tools for Cutting Grass, &c., I. Whitehouse, Bridgtown.—*12th January*, 1881.
159. Checking Money Dropped into Tills, S. Fynn, Limehouse.—*13th January*, 1881.
162. Ventilating Buildings, T. Rowan, Ryde, Isle of Wight.—*13th January*, 1881.
166. Stoppers for Bottles, J. Wilkinson, Swinton.—*13th January*, 1881.
169. Planing, &c., Wood, G. Richards, Manchester.—*13th January*, 1881.
176. Hand Stamps, G. K. Cooke and E. Hurles, London.—Com. from E. Gumbs.—*13th January*, 1881.
183. Fastening, &c., Carriage Doors, A. Ross and S. Palmer, Larne, Ireland.—*14th January*, 1881.
198. Sheaf-binding, &c., E. G. C. Bomford, Fladbury, & H. J. H. King, Newmarket.—*15th January*, 1881.
200. Conveying, &c., Power by Electricity, J. Imray, London.—A communication from G. E. Cabanellas.—*15th January*, 1881.
205. Condensing Apparatus, T. J. Rayner, Chancery-lane, London.—*15th January*, 1881.
211. Sizing, &c., Wool, C. Anderson, Osborne-terrace, Leeds.—*15th January*, 1881.
239. Preserving Ground Coffee, C. Pieper, Berlin.—Com. from A. von Hofmann.—*20th January*, 1881.
243. Water-closet Cisterns, J. Shanks, Barrhead.—*20th January*, 1881.
253. Electric Currents, C. G. Gumpel, Leicester-square, London.—*20th January*, 1881.
390. Respirators, E. Rinzi and A. A. Berthier, London.—*28th January*, 1881.
427. Shoes of Horses, R. Ingram, Store-street, London.—*1st February*, 1881.
618. Applying Motive-power, W. H. J. Grout, Watson-street, London.—*14th February*, 1881.
717. Fastener for Doors, J. Woodward, Wolverhampton.—*19th February*, 1881.
869. Lifts or Hoists, D. Edwards, Cardiff.—*1st March*, 1881.
972. Tricycles, C. G. Hawkins, Leyton-road, Essex.—*7th March*, 1881.
1209. Umbrella Frames, G. Neu, King-square, London.—*19th March*, 1881.
1214. Holding Pictures, R. Sherwin and G. Evans, Worcester.—*19th March*, 1881.
1352. Regulating Fanlights, W. Leggott, Bradford.—*26th March*, 1881.
1532. Agricultural Edge Tools, W. Morgans, Bristol, and M. G. Morgans, Mells.—*7th April*, 1881.
1660. Boiler Furnaces, A. W. L. Reddie, London.—Com. from W. Duryea.—*14th April*, 1881.
1731. Sulphate of Alumina, A. A. Croll, Coleman-street, London.—*21st April*, 1881.
1773. Sighting Rifles, R. Morris, Lewisham.—*25th April*, 1881.
1783. Measuring Electric Currents, E. G. Brewer, London.—Com. from T. A. Edison.—*25th April*, 1881.
1802. Electric Lights, &c., P. Jensen, London.—Com. from T. A. Edison.—*26th April*, 1881.
1808. Utilising Liquid, &c., Hydrocarbon as Fuel, W. R. Lake, London.—A communicaiion from J. W. Houchin and J. R. Houchin.—*26th April*, 1881.
1836. Hardware, F. C. Glaser, Berlin.—A communication from C. Haegele.—*28th April*, 1881.
1847. Extracting Copper, W. W. Hughes, Bayswater, London.—*28th April*, 1881.
1995. Breaking Stones, &c., W. R. Lake, London.—Com. from P. W. Gates.—*7th May*, 1881.

Patents Sealed.

(*List of Letters Patent which passed the Great Seal on the 13th May*, 1881.)

4584. Railway Brakes, W. P. Thompson, High Holborn, London.—*9th November*, 1880.
4703. Twisting, &c., Machines, J. E. Heppenstall, Milnsbridge.—*15th November*, 1880.
4707. Velocipedes, E. Burstow, Queen-street, London.—*16th November*, 1880.
4708. Sounding Ships' Wells, R. Jones and J. Jones, Rhyl.—*16th November*, 1880.
4713. Braces, G. W. von Nawrocki, Berlin.—*16th November*, 1880.
4714. Concrete Buildings, J. M. Tall, Dulwich.—*16th November*, 1880.
4716. Autographic Printing, E. Edwards, London.—*16th November*, 1880.
4726. Pugging Mills, R. R. Gubbins, New Cross.—*16th November*, 1880.
4730. Safety Valves, C. Stuart, Fenny Stratford.—*17th November*, 1880.
4731. Steam Valves, C. Stuart, Fenny Stratford.—*17th November*, 1880.
4732. Forcing Sausage Meat into Skins, T. Williams and W. Sangster, London.—*17th November*, 1880.
4735. Syphons and Traps, D. Brown, Huddersfield.—*17th November*, 1880.
4736. Weighing Devices, B. J. B. Mills, London.—*17th November*, 1880.
4748. Vessels for Oil, A. C. Wells and R. Wallwork, Manchester.—*18th November*, 1880.
4755. Electric Lamps, J. A. Berly, Peckham Rye, and D. Hulett, London.—*18th November*, 1880.
4757. Tram-car Engines, J. Hall, Manchester.—*18th November*, 1880.
4759. Supplying Furnaces with Fuel, J. Proctor, Burnley.—*18th November*, 1880.
4761. Domestic Grates, &c., H. Thompson, Islington.—*18th November*, 1880.
4793. Buttons, T. Fairley, Birmingham.—*19th November*, 1880.
4803. Ornamental Printing, J. Macleod, Renton.—*20th November*, 1880.
4846. Colouring Matters, O. N. Witt, Mulhausen, Germany.—*22nd November*, 1880.
4864. Dressing Millstones, P. Jensen, London.—*23rd November*, 1880.
4879. Hoisting Machines, J. B. Handyside, Glasgow.—*24th November*, 1880.
4913. Lavatory Valves, F. E. Tompson, Wolverhampton.—*25th November*, 1880.
4938. Gas Stove, W. Wyman, Gloucester.—*27th November*, 1880.
4971. Pliers for Cutting Wire, J. T. Neighbour, London.—*29th November*, 1880.
5058. Artificial Tallow, M. de la Vega, New York, U.S.—*4th December*, 1880.
5060. Refrigerating Apparatus, A. S. Haslam, Derby.—*4th December*, 1880.
5065. Metallic Plates, &c., B. Bloomer, Stourbridge.—*4th December*, 1880.
5066. Sugar, M. de la Vega and L. D'Oliveira, New York, U.S.—*4th December*, 1880.
5295. Window Sashes, W. Phillips, Leeds.—*17th December*, 1880.
5315. Tacks, &c., E. P. Alexander, London.—*18th December*, 1880.
5319. Alphabet or Code System, A. M. Clark, London.—*18th December*, 1880.
5471. Gas Motor Engines, R. Hutchinson, London.—*29th December*, 1880.
300. Working Railway Points, G. Edwards, Cheltenham.—*22nd January*, 1881.
375. Bankers' Cheques, A. Dufré and O. Hehner, London.—*27th January*, 1881.
409. Drying Coffee, &c., J. Gordon, London.—*31st January*, 1881.
536. Chimney-piece Coverings, &c., R. H. Gudgeon, Winchester.—*8th February*, 1881.
704. Corks for Bottles, &c., F. Des Vœux, Southampton-buildings, London.—*18th February*, 1881.
739. Marking the Ground for Lawn Tennis, &c., F. H. Ayres, London.—*21st February*, 1881.
896. Refining Camphor, W. H. Atkinson, Camberwell-road, London.—*2nd March*, 1881.
990. Framing for Writing Slates, E. J. J. Dixon, Bangor.—*8th March*, 1881.
1013. Ornamental Pottery Ware, C. Westwood and R. A. Windmill, Brierley-hill.—*9th March*, 1881.
1017. Furnaces, A. M. Clark, London.—*9th March*, 1881.
1058. Pneumatic Brake Apparatus, F. W. Eames, Leeds.—*11th March*, 1881.
1161. Purification of Alkaline Solutions, E. Carey, H. Gaskell, jun., and F. Hurtor, Widnes.—*17th March*, 1881.

(*List of Letters Patent which passed the Great Seal on the 17th May*, 1881.)

4752. Cutting, &c., Stone, J. Holgate, Burnley.—*18th November*, 1880.
4756. Spring Mattrices, J. B. Rowcliffe, Glossop.—*18th November*, 1880.
4766. Locks, &c., T. E. Julien, Kennington Park-road, London.—*18th November*, 1880.
4769. Roller, &c., C. Herbert, Edinburgh.—*19th November*, 1880.
4774. Signalling, M. C. Denne, Eastbourne, and T. J. Denne, Red Hill.—*19th November*, 1880.
4777. Slicing Machines, A. C. Herts, Bloomsbury, London.—*19th November*, 1880.
4786. Teapots, W. H. Andrew, Sheffield.—*19th November*, 1880.
4794. Boxes, &c., W. R. Lake, Southampton-buildings, London.—*19th November*, 1880.
4796. Permanent Way, A. Fairlie, King William-street, London.—*19th November*, 1880.
4798. Rolling, &c., Wire, R. A. Hill, Sheffield, and H. B. Barlow, Manchester.—*20th November*, 1880.
4800. Propellers, E. G. Brewer, Chancery-lane, London.—*20th November*, 1880.
4805. Cords, J. and W. Schofield and J. E. Bentley, Littleborough.—*20th November*, 1880.
4806. Pumping Valves, W. Stainton, Liverpool-street, London.—*20th November*, 1880.
4810. Revolving Frame for Umbrellas, E. Edmonds, Fleet-street, London.—*20th November*, 1880.
4811. Grinding, R. R. Gubbins, New-cross, London.—*20th November*, 1880.
4812. Coupling, &c., Carriages, F. Barnes, Tylehurst, Reading.—*20th November*, 1880.
4815. Pressing, &c., Fabrics, G. H. Nussey and W. B. Leachman, Leeds.—*20th November*, 1880.
4818. Sharpening Pencils, W. R. Lake, Southampton-buildings, London.—*20th November*, 1880.
4822. Generator, A. C. Henderson, Southampton-buildings, London.—*22nd November*, 1880.
4826. Heels for Boots, S. H. Hodges, Street.—*22nd November*, 1880.
4830. Bouquet Holders, F Wirth, Frankfort-on-the-Maine, Germany.—*22nd November*, 1880.
4832. Wooden Pavements, E. Young, High-street, Steyning.—*22nd November*, 1880.
4833. Detecting, &c., Gas in Mines, E. H. T. Liveing, Cavendish-square, London.—*22nd November*, 1880.
4834. Door Furniture, J. Brownrigg, Windermere.—*22nd November*, 1880.
4836. Sewing Machines, C. Necker and R Horstmann, Berlin.—*22nd November*, 1880.
4845. Furnaces, &c., W. R. Lake, Southampton-building, London.—*22nd November*, 1880.

4861. FILTERING WATER, C. G. Pfander, St. Andrew's-hill, London.—*23rd November*, 1880.
4869. SULPHATE OF SODA, &c., J. Hargreaves and T. Robinson, Widnes.—*24th November*, 1880.
4902. LOOMS, J. Lyall, New York, U.S.—*25th November*, 1880.
4914. ELECTRIC LIGHT, W. L. Wise, Whitehall-place, Westminster.—*25th November*, 1880.
4921. LUBRICATING SHAFTING, T. Monk and J. Anderton, Blackburn.—*26th November*, 1880.
4925. UMBRELLA &c., RIBS, T. Warwick, Aston, near Birmingham.—*26th November*, 1880.
4947. CHARCOAL BOX-IRONS, T. B. Salter, West Bromwich, and G. Asher, Balsall Heath.—*27th November*, 1880.
4966. COLOURING MATTERS, F. Wirth, Frankfort-on-the-Maine, Germany.—*29th November*, 1880.
4975. WASHING MACHINES, J. Mitchell, Newcastle-on-Tyne.—*30th November*, 1880.
4977 HYDRAULIC PRESSES, J. Watson, Gloucester-crescent, London.—*30th November*, 1880.
4979. CIRCULAR SAWS, H. J. Haddan, Strand, London.—*30th November*, 1880.
4988. ELECTRIC LAMPS, H. W. Hedges, Queen Anne's-gate, Westminster.—*30th November*, 1880.
5062. ENGINES, J. J. Miller and G. J. Tupp, Hammersmith, London.—*4th December*, 1880.
5063. BOTTLING LIQUIDS, F. Foster and S. Barnett, sen., Hoxton, London.—*4th December*, 1880.
5089. SECURING ARTIFICIAL TEETH, C. G. Whiting, Coventry.—*7th December*, 1880.
5219. GAS MOTOR ENGINES, A. Fiddes, Bristol.—*13th December*, 1880.
5254. CONSTRUCTING THE FOUNDATIONS OF SUBMERGED, &c., STRUCTURES, F. W. Reeves, South Kensington, London.—*15th December*, 1880.
449. VALVES, R. Schram, Strand, London.—*2nd February*, 1881.
539. ELECTRIC LAMPS, E. G. Brewer, Chancery-lane, London.—*8th February*, 1881.
562. CARBON BURNERS, P. Jensen, Chancery-lane, London.—*9th February*, 1881.
610. PAVING FLOORS, &c., P. Stuart, Edinburgh.—*12th February*, 1881.
626. HANDLES OF SCISSORS, A. J. Boult, High Holborn, London.—*14th February*, 1881.
655. ARMOURED VESSELS, &c., J. H. Johnson, Lincoln's-inn-fields, London.—*15th February*, 1881.
748. DRYING PRINTED, &c., SHEETS, B. J. B. Mills, London.—*22nd February*, 1881.
768. CONNECTING THE ENDS OF CARBON TO CONDUCTING WIRES IN ELECTRIC LAMPS, E. G. Brewer, Chancery-lane, London.—*23rd February*, 1881.
792. ELECTRIC LAMPS, P. Jensen, London.—*24th February*, 1881.
847. TREATMENT OF QUARTZ, W. E. Gedge, London.—*28th February*, 1881.
876. CLEANING BOTTLES, W. R. Lake, London.—*1st March*, 1881.
1020. SEWING MACHINES, J. B. Robertson, Lurgan, Ireland.—*9th March*, 1881.
1062. STEAM, &c., STEERING APPARATUS, W. R. Cooper and J. Taylor, Sunderland.—*11th March*, 1881.
1093. GOVERNORS, A. M. Clark, London.—*14th March*, 1881.
1094. RAPID TELEGRAPHY, B. J. B. Mills, London.—*14th March*, 1881.
1119. TELEGRAPHY, S. Pitt, Sutton.—*15th March*, 1881.
1125. BOTTLES, H. Codd, King William-street, London.—*15th March*, 1881.
1129. FURNACES, W. P. Thompson, High Holborn, London.—*16th March*, 1881.
1144. REFRIGERATORS, H. J. Haddan, Strand, London.—*16th March*, 1881.
1169. SADDLES FOR BICYCLES, W. R. Lake, London.—*17th March*, 1881.
1173. ABSORBING PULVERISED MATERIALS, A. W. L. Reddie, London.—*17th March*, 1881.
1175. BREAKING PIG IRON, W. R. Lake, London.—*17th March*, 1881.
1179. HELICAL SPRINGS, L. Sterne, Westminster.—*18th March*, 1881.
1379. ROLLS, H. J. Haddan, Strand, London.—*29th March*, 1881.

List of Specifications published during the week ending May 14th 1881.

3058, 6d.; 3147, 6d.; 3224, 6d.; 3225, 6d.; 3463, 6d.; 3499, 6d.; 3510, 6d.; 3600, 6d.; 3319, 6d.; 3704, 2d.; 3747, 2d.; 3765, 1s. 2d.; 3801, 6d.; 3805, 6d.; 3810, 8d.; 3813, 2d.; 3828, 2d.; 3860, 4d.; 3885, 1s. 4d.; 3891, 6d.; 3902, 6d.; 3905, 6d.; 3916, 6d.; 3937, 6d.; 3938, 6d.; 3946, 6d.; 3947, 6d.; 3948, 6d.; 3952, 8d.; 3958, 6d.; 3964, 10d.; 3971, 10d.; 3972, 6d.; 3973, 6d.; 3978, 1s. 8d.; 3980, 6d.; 3983, 6d.; 3987, 6d.; 3988, 6d.; 3989, 6d.; 3991, 6d.; 3996, 8d.; 3999, 10d.; 4003, 6d.; 4006, 6d.; 4007, 6d.; 4012, 6d.; 4013, 8d.; 4016, 6d.; 4017, 6d.; 4018, 6d.; 4020, 4d.; 4025, 6d.; 4027, 6d.; 4032, 6d.; 4033, 6d.; 4038, 6d.; 4041, 6d.; 4047, 6d.; 4051, 6d.; 4056, 8d.; 4061, 10d.; 4062, 6d.; 4065, 6d.; 4066, 6d.; 4070, 6d.; 4075, 6d.; 4079, 6d.; 4080, 6d.; 4081, 6d.; 4085, 4d.; 4090, 4d.; 4097, 10d.; 4100, 6d.; 4101, 4d.; 4117, 2d.; 4118, 2d.; 4119, 6d.; 4120, 2d.; 4123, 2d.; 4125, 4d.; 4126, 6d.; 4128, 4d.; 4129, 6d.; 4135, 6d.; 4139, 2d.; 4141, 2d.; 4145, 6d.; 4147, 2d.; 4149, 6d.; 4154, 4d.; 4156, 2d.; 4157, 2d.; 5158, 2d.; 5159, 4d.; 4162, 6d.; 4163, 2d.: 4164, 6d.; 4170, 4d.; 4172, 2d.; 4173, 6d.; 4174, 2d.; 4175, 6d.; 4179, 6d.; 4180, 4d.; 4183, 2d.; 4186, 6d.; 4187, 2d.; 4188, 8d.; 4189, 2d.; 4192, 4d.; 4194, 2d.; 4195, 2d.; 4200, 4d.; 4201, 2d.; 4204, 6d.; 4207, 2d.; 4210, 6d.; 4211, 2d.; 4214, 2d.; 4215, 2d.; 4216, 6d.; 4217, 2d.; 4218, 2d.; 4220, 2d.; 4221, 2d.; 4222, 4d.; 4223, 2d.; 4228, 2d.; 4229, 2d.; 4239, 4d.; 4241, 2d.; 4253, 4d.; 4254, 4d.; 4262, 6d.; 4303, 4d.; 4406, 6d.; 202, 6d.; 563, 4d.; 641, 6d.; 676, 4d.

_ 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.*

3058. PERMANENT WAY OF PORTABLE RAILWAYS, &c., *J. Cleminson.—Dated 24th July*, 1880. 6d.

The sleepers are of metal, and at one end is fixed a plate or stop having one end turned upwards, so as to allow the flange of the rail to pass under it and be gripped. The other end of the plate or stop is bent downwards, such part projecting beyond the sleeper and having a hole formed in it. Through the sleepers is formed an elongated hole, and the rails are secured by bolts having the form of a hook at one end and screwed at the other, the hook passing through the hole in the sleeper, and the screwed end passing through the hole in the plate or stop and receiving a nut.

3147. HAND POWER MOTOR, *S. P. Wilding.—Dated 30th July*, 1880.—*(A communication from P. Carrera.)* 6d.

The motor consists of two wheels, between which is a crank fixed to one wheel, but revolving loosely in the hub of the other. The crank has two loose sleeves to be grasped by the rider, and suspended from it where it enters the hubs is a bent bar having in the middle an upright socket. The carriage consists of an axle joining two small wheels and carrying a bent bar through eyes in which the axle passes. The bar is of a curvilinear form, so that the weight of the rider presses it outwards, such pressure being resisted by springs. Another bar terminating in a hook drops into the socket upon the hanging bar of the motor, thus connecting the two.

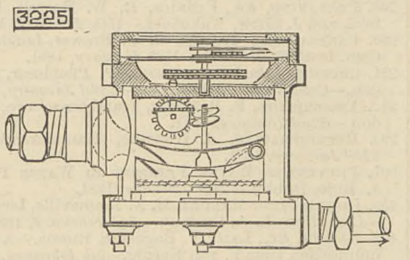
3224. STOP WATCHES, *L. A. Groth.—Dated 6th August*, 1880.—*(A communication from H. A. Lugrin and P. Nordman.)* 6d.

The timing attachment is thrown in and out of gear with the watch movement of two toothed wheels and an intermediate transmitting double bevelled pinion. One wheel is applied to the arbor of the fourth wheel, and the other to a tubular arbor passing through the hollow arbor of the minute hand and carrying a quarter second hand. The arbor of the split quarter second hand passes through the arbor of the quarter second hand, which has a lifting lever and spring to throw the toothed wheel in or out of gear. The minute hand arbor has a stop disc and also a sleeve-shaped arbor carrying a split minute hand, a spring lever arm bearing on the stop whenever the quarter second hand is started. A transmitting gear wheel is placed loosely on the arbor of the third wheel and provided with a clutch device, by which it can be locked to or balanced from the third wheel arbor.

3225. METER FOR WATER, &c., *L. A. Groth.—Dated 6th August*, 1880.—*(A communication from C. Berhaut and H. Ducenne.)* 6d.

This consists, First, in the employment of a semi-circular horizontal injector of special construction, receiving the water from the inlet and discharging it

[3225]



upon the blades of a horizontal turbine; and Secondly, of a special arrangement of toothed wheels worked by a worm set in motion by the turbine, and moving index hands or dials in relation to the number of the indicating apparatus. The drawing represents partly in section a complete meter, constructed according to one arrangement.

3463. COAL PICKS OR HACKS, *A. R. and H. Strachan and R. Oliver.—Dated 26th August*, 1880. 6d.

The points of the head are made separate from the body, to which they are attached by mortices and tenons, and the body is secured to the extremity of a shaft, the whole forming the pick or hack. When the points are damaged they may be easily replaced.

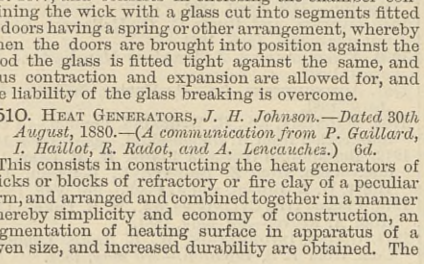
3499. LAMPS, &c., *W. C. Hughes.—Dated 28th August*, 1880. 6d.

This relates to improvements on patent No. 3386, A.D. 1877, and consists in enclosing the chamber containing the wick with a glass cut into segments fitted in doors having a spring or other arrangement, whereby when the doors are brought into position against the hood the glass is fitted tight against the same, and thus contraction and expansion are allowed for, and the liability of the glass breaking is overcome.

3510. HEAT GENERATORS, *J. H. Johnson.—Dated 30th August*, 1880.—*(A communication from P. Gaillard, I. Haillot, R. Radot, and A. Lencauchez.)* 6d.

This consists in constructing the heat generators of bricks or blocks of refractory or fire clay of a peculiar form, and arranged and combined together in a manner whereby simplicity and economy of construction, an augmentation of heating surface in apparatus of a given size, and increased durability are obtained. The

[3510]



regenerator is constructed of blocks of fire-proof material A provided with four equal rectangular holes, and formed on two sides with horizontal projections or ledges; these blocks are superposed or built up in rows at a certain distance apart upon a horizontal partition M formed of plates of refractory material or cast iron perforated with corresponding holes, in such a manner that the holes of the blocks form a series of vertical passages or channels.

3600. PIANOFORTES, *G. Gautier.—Dated 4th September*, 1880. 6d.

This consists in constructing iron frames of pianofortes so that the usual scale of keys and hammer rail can be used, obviating the usual break in keys and hammer rail.

3619. MEASURING ANGLES AT BILLIARDS, *J. F. Armistead.—Dated 6th September*, 1880. 6d.

A cylindrical block is marked on the side with numbers of degrees in a semicircle. The block has a fixed and a movable pointer, the latter being prolonged and projecting over a card graduated like the block. In this pointer are two openings, one near the centre, to enable the player to see the centre of the object ball when it is against the block, and the other to show the figures on the card when the angle to be measured is less than 90 deg., and nearer to the operator.

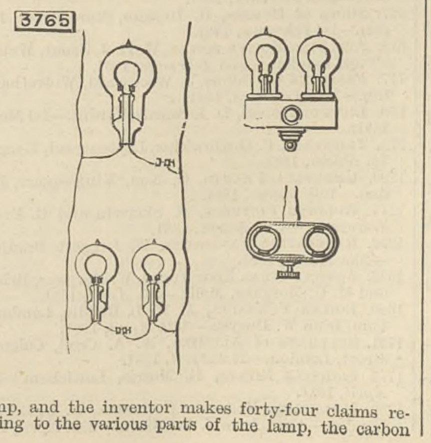
3704. SCREW PROPELLERS, *C. Jones.—Dated 11th September*, 1880.—*(Void.)* 2d.

This consists in forming each blade of the propeller in two or more lengths bolted together, so that should the tip of one be broken, it could be replaced with dry-docking the vessel.

3765. IMPROVEMENTS IN ELECTRIC LAMPS AND IN CARBONS, OR INCANDESCING CONDUCTORS THEREFOR, &c., *G. E. G. Brewer.—Dated September 16th*, 1880.—*(A communication from T. A. Edison.)* 1s. 2d.

This invention relates to the well-known Edison

[3765]



lamp, and the inventor makes forty-four claims relating to the various parts of the lamp, the carbon therein and the methods of preparing the carbon. The fibre of the grass, called "monkey bast," from South America, is stated to be preferred. This fibre, or other vegetable fibre, is carbonised. The lamp is on the incandescent system, and is exhausted of air while the carbon is at a high temperature. The figures show some ways of arranging the lamps in the circuits and the connections.

3747. BOTTLES FOR AERATED LIQUORS, *H. Codd.—Dated 15th September*, 1880.—*(Void.)* 2d.

This relates to forming the necks of bottles fitted with disc stoppers, with inclines so shaped that the disc cannot turn over or escape from its place, but when the bottle is refilled and inverted, the disc is guided back to its place and falls to its seat.

3801. BOOTS, *E. Barnes.—Dated 18th September*, 1880. 6d.

So as to enclose the leg of the wearer to a considerable height without being inconveniently tight and rigid at the upper part, the leather at the back and sides of the boot is extended, while the front is fitted with a flap to be secured by studs or buttons.

3805. SOUTH-WESTER OR SAILOR'S HAT, *J. Christie.—Dated 20th September*, 1880. 6d.

The crown is made of four equal sized pieces of a spherical triangular form. To the lower edge of the crown are joined two pieces of a wedge form, the narrow ends of which are joined at back, and the broad ends reaching to the front, so as to cover the cheeks and pass under the chin. In the broad front ends are strings to tie them together. A brim or shade is attached to the front of the crown, and to the bottom edge of the part covering the back of the head is secured a broad collar to button over in front.

3810. RECORDING NUMBER OF PERSONS ENTERING AND TIME OCCUPIED BY THEM IN CABS, &c., *J. J. Seubich.—Dated 20th September*, 1880. 8d.

The pressure of the passengers on the seats is utilised to cause the marking of a record on a strip of paper containing equidistant lines, and which is revolved at a given speed by clockwork.

3813. EXTRACTING GOLD AND OTHER METALS FROM SILICEOUS, ALUMINOUS AND OTHER SUBSTANCES, *J. P. Dunker.—Dated 20th September*, 1880.—*(Void.)* 2d.

The siliceous or aluminous substance is smelted with a flux consisting principally of soda ash or potash, or a mixture thereof, and with charcoal or other carbonaceous matter, and when the substances are in a molten state metallic zinc and copper are added, with a view of causing a development of electricity, whereby the gold or other metal is brought to the metallic state, and may be purified in the ordinary way.

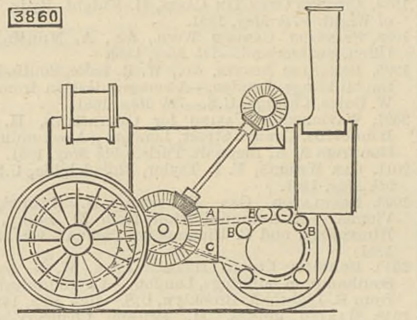
3828. STEAM AND HYDRAULIC MOTORS, *T. O'Hara.—Dated 21st September*, 1880.—*(Void.)* 2d.

The cylinder is made to reciprocate over the pistons and to communicate its motion to a crank shaft, through a connecting rod.

3860. STEERING AND DRIVING ARRANGEMENTS FOR TRACTION ENGINES, &c., *J. Whittingham.—Dated 23rd September*, 1880. 4d.

Instead of the turntable at present employed in engines and vehicles, a frame A is fixed under the fore part of the engine or vehicle, in which frame are placed three or more grooved revolving pulleys B. These

[3860]

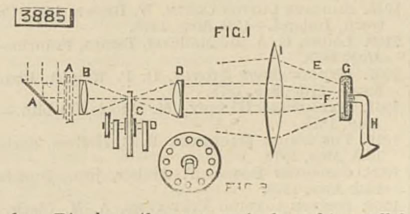


pulleys support and keep in its place an outer ring of a universal joint. This outer ring is either a toothed wheel or a pitch chain wheel, and is driven either by a pitch chain C or gearing from the main shaft.

3885. IMPROVEMENTS IN TELEPHONIC APPARATUS AND IN THE METHOD OF AND THE APPARATUS FOR TRANSMITTING ARTICULATE AND OTHER SOUNDS, *W. Morgan-Brown.—Dated 25th September*, 1880.—*(A communication from A. Graham Bell.)* 1s. 4d.

Fig. 1 shows the inventor's transmitting and receiving photophonic apparatus for the production of a musical sound. A ray from the sun is reflected from a plane mirror A into a lens B, which brings it to a focus as shown. The passage of the rays at a certain point is interrupted by a perforated disc C (see Fig. 2). As C is rotated the rays pass intermittingly through the holes in it, after which they are projected on to

[3885]

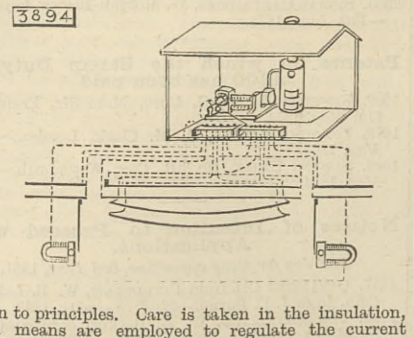


the lens D^1 where they are again brought parallel, and thence pass to the receiver E, a thin disc of india-rubber F in case G; this disc will be affected by the intermittent beams falling on it so as to produce sound-waves, which are conducted to the ear of the listener by a flexible tube H. A condensing instrument, shown as a lens I, is preferably used to concentrate the rays on F. By varying the velocity of C the rapidity of interruption of the beam is equally varied, and consequently the pitch of the sound. In this form the motion which causes the interruptions is continuously in the same direction.

3894. ELECTRO-MAGNETIC RAILROADS, *G. P. Jensen.—Dated 25th September*, 1880.—*(A communication from T. A. Edison.)* 1s. 6d.

The invention relates more to a number of details

[3894]



than to principles. Care is taken in the insulation, and means are employed to regulate the current used. There is a central station, insulated rails in sections, switches, and means of shunting as shown in drawing.

3891. TREATING AND SHAPING SUGAR, *A. and J. D. Scott and T. R. Ogilvie.—Dated 25th September*, 1880. 6d.

This relates to apparatus for forming sugar in small squares or in sticks which can be subdivided for table use, and it consists in shaping the sugar in compound moulds of the required form.

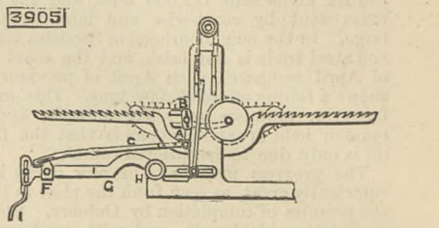
3902. STAMPING LETTERS, *C. Pieper.—Dated 27th September*, 1880.—*(A communication from W. Löffelhardt.)* 6d.

This relates to a machine for stamping letters and post cards with the date and place of reception and delivery, and the cancelling of the stamps, and it consists of two rollers one over the other, the upper one having grasping fingers of india-rubber to pull the letters one at a time between the rollers, when it is stamped by the printing dies.

3905. LOOMS, *P. and J. Banks and W. Slater.—Dated 27th September*, 1880. 6d.

This relates to the "dobby" of looms, and consists in actuating the barrels which work the pegged lags or cards by means of a bar C fitted on the lower end of the bell-crank lever A which acts on the barrel B, such bar being adjusted by screws so as to alter its throw. The other end of the bar has a slot in which works a

[3905]



bowl carried by the bracket F connected to the end of lever G on the rocking shaft H which works the healds. The lever G is actuated by a connecting rod I, the lower end of which is attached to a crank on the tappet shaft of the loom. A modification shows the arrangement for working "dobbys" known as "Bullough's."

3916. PENCIL CASES, *J. Maclenahan.—Dated 27th September*, 1880. 6d.

The case is circular and contains a >-shaped spring clip, into which the pencil is inserted, such clip having one projection, which enters a recess in the pencil, and another which abuts against the case to prevent it being forced inwards by the pressure on the point in writing.

3937. PORTABLE AND TRACTION ENGINES FOR ROUNDABOUTS, *F. Savage.—Dated 28th September*, 1880. 6d.

This relates to a special arrangement of gear to transmit the motion of the crank shaft of the engine situated over the fire-box to the toothed ring to which the roundabout arms are attached.

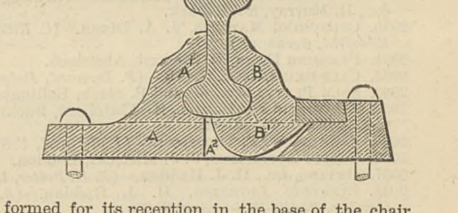
3938. MAGAZINE OF CARTRIDGES FOR ATTACHMENT TO FIRE-ARMS, *C. A. McEvoy and G. W. Fosbery.—Dated 28th September*, 1880. 6d.

As applied to a Martini-Henry rifle, the magazine is made to extend above the line of the axis of the barrel, in which case the cartridges being placed one above the other, descend by their own weight into the position required, from which they are released and carried into the chamber by pressure upon a stud attached to the side or rear end of the apparatus.

3946. RAILWAY CHAIRS, *W. C. Wood.—Dated 29th September*, 1880. 6d.

The chair is constructed in two parts. The First part consists of the base A, which has one of the jaws A^1 formed on or attached thereto; and the Second portion is composed of the other jaw B, which is loose or separate. On the lower part of the loose jaw is a projection or flange B^1 which fits into a recess or slot

[3946]

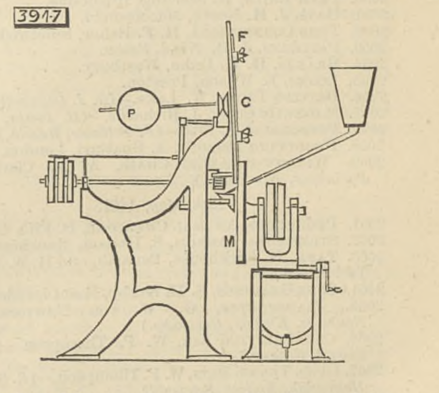


A^2 formed for its reception in the base of the chair, and when in that position it rests transversely beneath the rails, a small portion or shoulder also extending beyond the outer side of the loose jaw flush with the upper surface of the base. On the upper side of that end of the latter which is next to the loose jaw is a projection so arranged or formed as to leave a wedge-shaped or tapered recess between the same and the side of the jaw when the latter is in position.

3947. BEVELLING GLASS, *W. H. Beck.—Dated 29th September*, 1880.—*(A communication from A. Krieger.)* 6d.

This relates to machinery for replacing hand labour in bevelling glass, and it consists in clamping the glass G to the frame F, which is fitted with an adjustable weight P, by means of which the glass is inclined to the proper angle and pressed against the grinding wheel M, which is caused to revolve, the glass moving

[3947]



slowly to and fro longitudinally, while the revolving cast iron grinding plate roughly grinds the bevel with grit. A grinding stone, and finally a wood disc covered with felt, are substituted for the plate M, so as to finish and polish the bevel.

3948. TARGETS, *L. J. Crossley.—Dated 29th September*, 1880. 6d.

This relates to so constructing the target that it will register in any desired place the part of the target struck. The target is made in separate parts—one for the "bull," one for the "centre," and one for the "outer"—and to each part is attached a suitable instrument, such as a microphone. Each instrument is connected to a relay, which itself is so connected with a corresponding indicator as to cause the latter to fall when the part of the target to which it is connected is struck.

3952. CHARGING AND CAPPING CARTRIDGE SHELLS OR TUBES, &c., *W. R. Lake.—Dated 20th September*, 1880.—*(A communication from S. Marelli.)* 8d.

This relates to machinery for automatically charging cartridge shells with powder, ball, and wads, and for fixing the cap or priming, the whole being effected so that when the shells have passed through the machinery they issue therefrom as complete cartridges; moreover, each cartridge is tested before being delivered, and certain faults corrected, all the imperfect cartridges being delivered to a separate receptacle. When the materials are not properly supplied to the shells the machinery is automatically and immediately stopped.

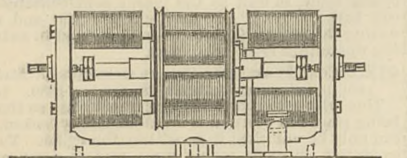
3958. MEASURING THICKNESSES OF OBJECTS, *J. Milner.—Dated 30th September*, 1880. 6*d*.

Two bars are connected together so as to be capable of receiving parallel motion to and from or upon each other. These bars have parallel gauging faces, between which the object to be measured is introduced. One bar carries a scale, and the other bar presents a line, either the scale or the line, or both, being inclined at any desired angle to the gauging faces, so that as these faces are moved towards or from each other, the line and scale cross each other at points nearer to or further from the zero of the scale.

3971. IMPROVEMENTS IN DYNAMO-ELECTRIC AND MAGNETO-ELECTRIC MACHINES, *A. M. Clark.—Dated September 30th*, 1880.—(*A communication from A. Niaudet and E. Reynier, of Paris.*)—(*Not proceeded with.*)

This invention relates to improvements in the original Niaudet machines, which are shortly as follows: The fixed magnet, instead of being perpendicular to the axis of rotation of the coils, is in line with it. The ends of the core of the coils are con-

3971.



nected by thin circles of iron, or a thin iron ring may be placed on the poles of the fixed magnet or magnets. The collector instead of being constructed of radial bars with intervening spaces, is composed of metallic segments fixed on a disc of wood or other insulator, and insulated from one another, but close together. The figure shows the machine with two metal rings as described above.

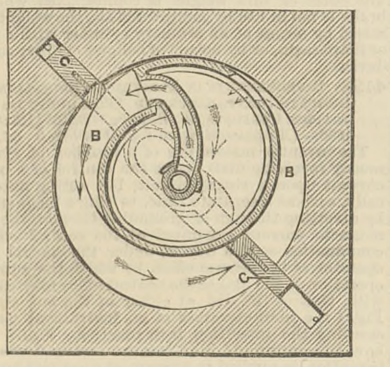
3972. HEATING AIR, *T. Ivory.—Dated 1st October*, 1880. 6*d*.

This relates to stoves in which the external air is heated by projections formed outside the stove, and it consists in arranging over the burning fuel a large number of metal rods, the ends of which project outside the stove.

3973. ROTARY ENGINES, *T. Ivory.—Dated 1st October*, 1880. 6*d*.

This consists in the combination in rotary engines of an inner revolving part B, constructed with a rigid slider or sliders C, carrying abutments, both of which constantly bear against the periphery of the revolving part, and so form between themselves and

3973



the said revolving part of the outer casing two spaces or chambers, each of which spaces or chambers is alternately a space or chamber into which the motive agent enters to propel the engine, and alternately a space or chamber from which the exhaust escapes.

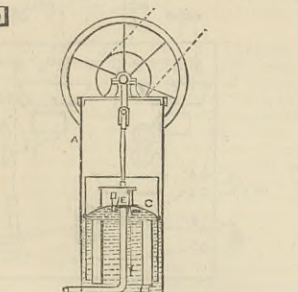
3978. BORING, CHANNELLING, CUTTING, OR DRESSING STONE, &c., *J. A. McKean.—Dated 1st October*, 1880. 1*s*. 8*d*.

A rock drill is employed having a traversing or travelling motion, such motion being either in a rectilinear or circular direction, according to the nature of the work.

3980. MOTORS, *P. Jensen.—Dated 1st October*, 1880.—(*A communication from E. J. Hahn.*) 6*d*.

The law that a solid liquid or fluid body lighter than a fluid in which it is generated or into which it is introduced, will rise therein, is utilised to raise a bell, or to propel a wheel, or a bucket elevator. The draw-

3980



ing shows an arrangement for utilising steam which is generated in the boiler A, and acts on the bell C connected to a crank shaft, which as the bell rises and falls is caused to revolve. When the bell is at the top of its stroke a valve E is opened and allows the steam to escape, when the bell again descends.

3983. ADJUSTABLE RISING AND FALLING FURNITURE, *J. Horton.—Dated 1st October*, 1880. 6*d*.

In the lower part of furniture to be raised or lowered is a reservoir of water, from which rises a tube, in which fits a piston forming the centre of the furniture. At the bottom of the tube is a valve opening inwards, and at the side and near the lower end is a passage from the tube to the reservoir, such passage being fitted with a tap worked by a crank and lever, by foot or hand. On raising the stool or other article the water opens the valve and follows the piston, by reason of the atmospheric pressure and sustaining it at any height it may be left. To lower it the tap is turned, when the water runs back into the reservoir until the pressure is taken off the lever.

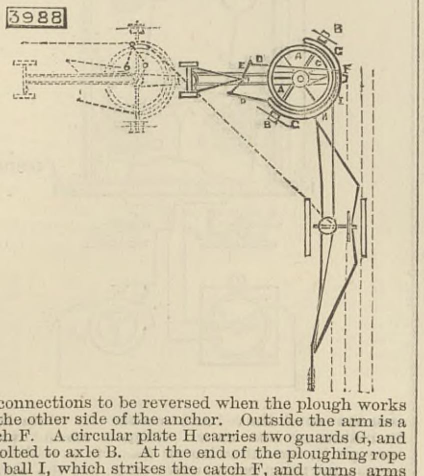
3987. LAMPS, *C. W. Torr.—Dated 1st October*, 1880. 6*d*.

This refers to lamps for burning volatile oils, which have a storage oil reservoir in the body of the lamp to contain sufficient oil for several days' consumption, the oil being fed to a cup in which the wicks dip, and it consists in making the lamp body of a hollow cylinder open at top, and having a partition which forms two chambers, the top one forming the dipping cup, and the lower one the reservoir, the bottom of which is at a higher level than the bottom of the body. At one side of the body is a hollow cylinder, in which a weight piston works loosely, the top of the cylinder projecting into the dipping cup. The piston is raised by a cord wound on a pulley.

3988. STEAM CULTIVATION, *D. Greig and T. Benstead.—Dated 1st October*, 1880. 6*d*.

This relates to causing the anchor to travel forward at the proper moment, and consists in so arranging the anchor that when desired to remain at rest the axle of its disc wheel may be placed parallel to the diagonal strain of the hauling rope, whilst when it has to advance the axle is turned at right angles to the direction in which the anchor should move along the headland. For this purpose the main pulley is carried by a frame on wheels with discs as usual. The main axle B is centred, so as to turn from 90 deg. to 45 deg. of inclination to the centre line of the anchor. An arm C also turns independently round the main centre, and is connected with axle B by two rods D and the beam E, the arm being formed so as to allow

3988

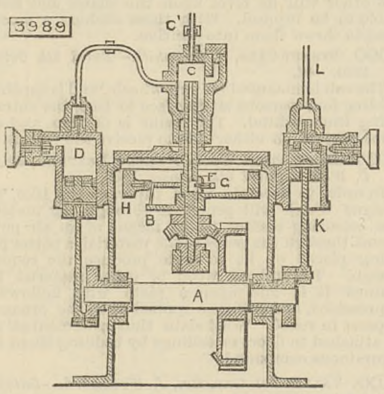


its connections to be reversed when the plough works on the other side of the anchor. Outside the arm is a catch F. A circular plate H carries two guards G, and is bolted to axle B. At the end of the ploughing rope is a ball I, which strikes the catch F, and turns arms C round the main centre, such movement being transmitted by the rods D and beam E to the axle B. As the arm C is moved forward the catch F slips under the guard G and closes over the ball I, which it holds tightly, so as to turn the axle back when the engine is reversed.

3989. APPARATUS FOR INDICATING AND DIRECTING BY SIGNAL THE SPEED OF ENGINES, &c., *B. Tower.—Dated 2nd October*, 1880. 6*d*.

The object is to ascertain by an indicator and to direct by signal the speed of engines or other moving machinery at points distant from the engines or machines themselves. A shaft A driven from the engine shaft at any desired relative speed drives a vertical spindle B, the upper part of which is tubular, and extends through a stuffing-box into an air chamber C. The shaft A by means of a crank works a small air compressing pump D, which forces air into the chamber C. This chamber communicates with a pressure gauge. The tubular part of the vertical spindle has a lateral hole covered by a valve F, against which bears a stud projecting from a yoke G which is mounted on radial arms, and has at its end a weight

3989



H which revolves with the yoke and spindle. The centrifugal force of this revolving weight presses the valve F against its seat with force depending on the velocity of revolution. This force determines the pressure of the air in the pipe C^1, and this pressure read on the gauges indicates the speed of revolution of the spindle B, and consequently of the main shaft. For the speed signalling apparatus, the shaft A by means of another crank works an air-compressing pump K similar to D, which forces air into a pipe L. This pipe leads to a valve-box having an aperture covered by a valve similar to F, which is pressed against its seat by a spring. The air pipe L has branches communicating with two pressure gauges having indices moving over dials graduated to indicate speeds.

3991. KITCHEN RANGES, *A. MacPhail.—Dated 2nd October*, 1880. 6*d*.

This relates to improvements whereby fuel is economised, the smoke consumed, and a larger amount of radiated heat obtained than from ordinary kitchen ranges. The grate is of circular form, the bars radiating from the centre, and projecting entirely forward from the body of the range containing the flues, ovens, and boilers. The ash pan has a hopper projecting downwards, and fitted with a slide to regulate the draught. The grate is fitted with a hinged blower, preferably in the form of three double parts like folding doors, and which, when shut, entirely enclose the grate. The entrance to the flues is surrounded with a series of small bars, outside which is placed wire gauze or netting for the purpose of consuming the smoke.

3996. SKATES, *P. Everitt.—Dated 2nd October*, 1880. 8*d*.

This relates to securing the skate firmly to the foot and consists in a toe strap to receive the point of the boot, which, when tightly laced to suit the wearer, may be further tightened by turning a cam piece or other simple means. The heel of the boot is secured by gripping it between a fixed jaw with teeth and a sliding heel piece. The blade of the skate is fitted near its opposite ends with short platforms or tread plates instead of having a continuous sole plate.

3999. TAKING IN, STOPPING, AND STOWING WIRE AND OTHER ROPE CABLES, &c., *J. Taylor.—Dated 2nd October*, 1880. 10*d*.

This relates, First, to an arrangement of sheaves, shown in the drawing, for taking in steel or iron wire, such sheaves also being capable of acting as cable stoppers and as riding or mooring bits, and are applicable also as deck bits, windlasses and capstans; and it consists of a duplex system of sheaves carried on spindles, the tops of which are carried up and form mooring or fastening bits. The sheaves are driven by a worm. The mooring or fastening bits may be fitted with friction or dead clutches, which drive the sheaves mounted loose on the spindles, such clutches being brought into action by a screw nut, the horns of which bear on the friction clutch. The invention also relates to means for handing wire rope when taking in slack or paying out, and consists of a pair of rollers covered with india-rubber and caused to

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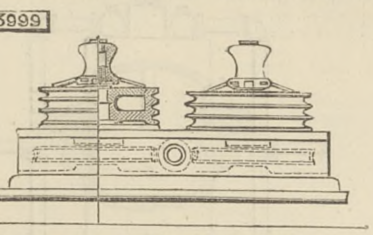

revolve, one roller capable of being lifted or opened out from the other, so as to receive, lock in, or release the rope to be handed or stowed away. A Third part of the invention relates to stowing the cable on a revolving crinoline and drum guard in the cable locker.

4003. REVOLVING HEELS FOR BOOTS AND SHOES, *W. Brown and W. Peover.—Dated 2nd October*, 1880. 6*d*.

The revolving portion of the heel is capable of being turned without the use of a screw-driver or other tool, is formed solid across the wearing surface, and is capable of being fixed firmly without exposing the adjusting and fixing devices to wet and dirt. For this purpose the revolving portion is made to take into a screw thread formed in the other part of the heel, the two parts having to be unscrewed before they can be adjusted.

4006. WASTE WATER PREVENTERS AND VALVE COCKS, *F. J. Henderson.—Dated 2nd October*, 1880. 6*d*.

This relates to means for simplifying and cheapening the construction and cost of manufacture of valves having a so-called sucker connection with the spindle or other actuating part, that is, valves in which the valve proper has, for instance, a cupped or dished part

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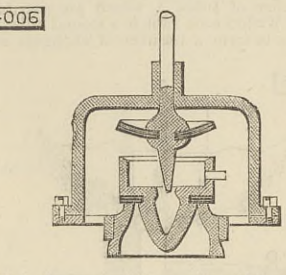
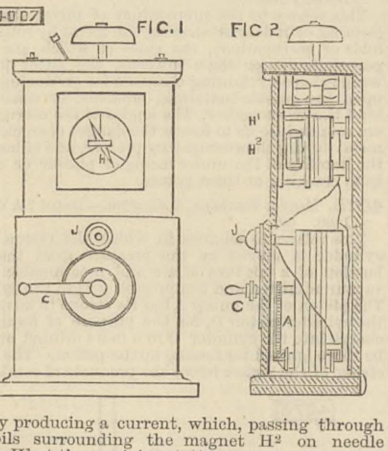


with a flat rim, on which a disc of india-rubber, leather, or other flexible or elastic material can seat itself, such disc carrying the valve spindle, rod, cord, chain or wire for actuating it. The drawing is a vertical section of an enclosed valve constructed according to the invention, and placed in the bottom of a cistern.

4007. IMPROVEMENTS IN MAGNETO-ELECTRIC APPARATUS FOR RAILWAY SIGNALLING, *G. Zanni.—Dated 2nd October*, 1880. 6*d*.

Figs. 1 and 2 are front and end elevations respectively of the apparatus. For producing the magneto-electric current the inventor makes use of an apparatus patented by him on the 13th of November, 1877. The invention is specially applicable to the block system, and operates as follows:—Two stations, each having one of the apparatuses, are connected in circuit; when it is desired to give a signal the electric bell and indicator at the sending station are cut out by pushing in switch J, the crank G is then turned and rotates an armature in the field of the permanent magnet A,

4007



thereby producing a current, which, passing through the coils surrounding the magnet H^2 on needle spindle H^1 at the receiving station, causes said magnet and needle to rock in a direction according to the polarity of the current, and indicator being suitably arranged, the required signal is given. As soon as the signal is given and J released, the sending apparatus is ready to receive signals. To prevent accidental displacement of the needle after it has been adjusted to "line clear" or otherwise, the inventor makes the upwardly extending arm of H^2 of greater weight than the lower arm; he thus dispenses with any current in the line wire to retain the needle in position.

4012. VELOCIPEDES, *W. R. Lake.—Dated 2nd October*, 1880.—(*A communication from G. W. Pressey.*) 6*d*.

This consists in an arrangement to enable the rider to sit nearly over the centre of the hind wheel; further in setting back the turning rod of the steering wheel from the fork. A spring bearing is placed between the boss at the front of the bone and fork of the front wheel. A clutch mechanism is used to rotate the wheels and is covered in by a casing. The surfaces of the hubs on which the straps of the treadle are wound are of scroll form, so as to increase the power as the straps are unwound.

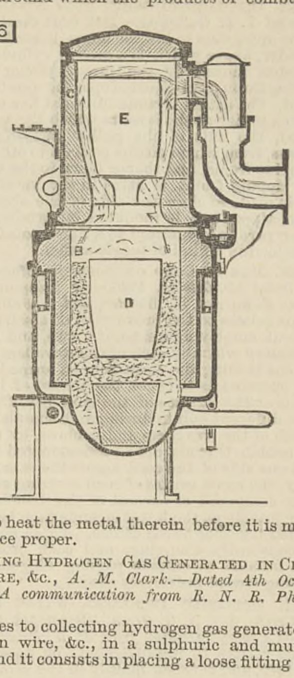
4013. LAVATORIES, &c., *E. W. De Russett, F. P. and E. J. Preston, and J. T. Prestige.—Dated 2nd October*, 1880. 8*d*.

This relates to the construction of lavatories so as to economise space, promote cleanliness, and effect economy in first cost and in use of water. The water reservoir, wash basin, and slop container are enclosed in a case with any suitable fittings. The supply tank is placed above the basin, and is, when not in use, turned upwards, but when in use projects beyond the case. The slop container is pivotted so as to empty itself into a spout or pipe. The supply tank is fitted with a vessel to measure out the supply of water for each wash.

4016. FURNACES FOR MELTING BRASS, &c., *J. Fletcher.—Dated 4th October*, 1880. 6*d*.

This relates to improvements on patent No. 441, A.D. 1877, in which the furnace proper is suspended in a casing, the blast being introduced into a space surrounding the furnace, and the products of combustion conveyed from an opening at the upper end of the furnace to a chimney, and it consists in utilising a portion of the waste heat which escapes from the upper part of the furnace, and also in expediting the process of melting. B is the furnace containing the crucible D, and above it is a heating chamber C, containing a crucible E, around which the products of combustion

4016

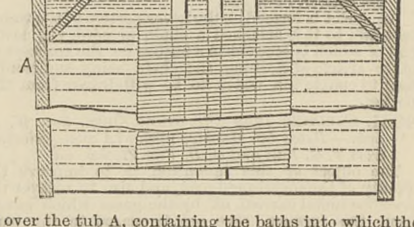


pass so as to heat the metal therein before it is melted in the furnace proper.

4017. SAVING HYDROGEN GAS GENERATED IN CLEANING WIRE, &c., *A. M. Clark.—Dated 4th October*, 1880.—(*A communication from R. N. R. Phelps.*) 6*d*.

This relates to collecting hydrogen gas generated in cleaning iron wire, &c., in a sulphuric and muriatic acid bath, and it consists in placing a loose fitting cover

4017



D over the tub A, containing the baths into which the cover dips, its upper end having a pipe E which conveys the gas to a suitable purifier.

4018. EXERCISING APPARATUS, *J. M. Smith.—Dated 4th October*, 1880. 6*d*.

This consists of a wheel supported on a suitable frame and driven by means of cranks worked by the feet, so as to obtain the same exercise as in velocipede riding.

4020. WOOL COMBING MACHINERY, *J. Heaton.—Dated 4th October*, 1880. 4*d*.

This relates to the fallers employed in the square motion machine, and the object is to lessen the quantity of "robbins," and thereby produce more top, and also, in a great measure, dispense with the necessity of picking fallers. This is effected by inserting within each row of pins a blade or bar connected together at both ends. These blades have a rising and falling motion imparted to them.

4025. ATTACHMENTS FOR SEWING MACHINES, *G. Browning.—Dated 4th October*, 1880. 6*d*.

This relates, First, to an embroidering attachment whereby one, two, or more threads are embroidered together and sewn down on the cloth. The drawing shows an arrangement for embroidering two threads, and it consists of a face cam A, with a groove on its face, in which work rollers secured to the arms D carrying the threads. A bar G slides in guides and is connected at its upper end to the needle bar H. The bar G carries a pawl which takes into teeth on the cam A. The embroidery threads are led from the bobbins through tension pads and through eyes at the

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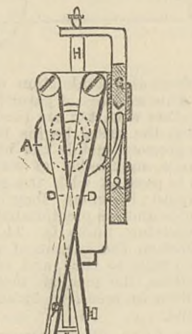


ends of the arms D, which at their lower parts cross each other. From these eyes the threads pass under the pressure foot I, so that while the ordinary stitch is being formed the arms D are caused to cross and thus form the embroidery, which is secured by the ordinary stitch. The invention further relates to an improved arrangement for driving the kilter by means of a cam having a groove in which a roller attached to the kilter lever works.

4027. CHECKING WASTE OF WATER, *B. J. B. Mills.—Dated 4th October*, 1880.—(*A communication from E. E. Furney.*) 6*d*.

This relates to a device to be used in connection with a hydrant or discharge water pipe to stop the water discharge after it has run a certain time. According to one form it consists of a cylinder through which the water passes, and which contains a cylindrical cup forming a gravitating valve to stop the water, and which has in the bottom a ball valve of less specific gravity than the water, so that the water will tend to keep on its seat. In the valve cup is an automatic valve of greater specific gravity than water, and which fits the interior of the cup. When the water is flowing the valve is gradually raised, and on reaching its seat closes the eduction port and stops the flow until the hydrant is closed, when the pressure being equalised above and below the valve it subsides.

4032. FIRE-ESCAPES, *W. Spence.—Dated 5th October*, 1880.—(*A communication from E. Kamin, H. Egberts, and Kraas, and Co.*) 6*d*.

This relates to fire-escapes to be applied to window sills, and consists of a girth to be placed round the waist and fastened to a rope wound on a drum, the rapidity of the descent being checked by stops on the drum coming in contact with reversing stops fixed on guides, and further fitting a toothed segment to the spindle, with which gears a pinion, whose movement is regulated by a volute spring and a pair of governor balls applied to the axis of the pinion.

4033. Discharging Ashes from Steamboats, *J. J. and T. L. Galloway.—Dated 5th October, 1880.* 6d.

The apparatus to lift the ashes bucket consists of a cylinder, above which is a second cylinder, on which a piston moved by the motor piston acts on air passing through an adjusted opening so as to regulate the speed. The action is communicated to a chain passing up to a pulley at the level to which the ashes are to be raised, the axis of the pulley carrying two other pulleys, from which chains pass up to other pulleys on a tipping frame, and thence down to the ashes bucket. The tipping frame is fitted in the ventilating shaft, and is made to close the side of the shaft, excepting when tipped; it is mounted on trunnions, and its upper part is connected to a fixed point by a pair of links having a kind of toggle action.

4038. Making Cord or Rope, *W. Morgan-Brown.—Dated 5th October, 1880.—(A communication from C. E. Barnes, W. Webster, and P. Butler.)* 6d.

This relates to the production of a solid woven rope without employing a separate core, and it consists of machinery whereby each of the travellers carrying the bobbins holding the threads to be formed into a cord is so operated as to cause the thread of its bobbin to appear at the surface of the cord being woven at but three different points during each complete revolution of each of the travellers and bobbins, by which means the bobbin threads are so concatenated as to extend from one side of the cord across the same almost centrally, the exact centre of such crossing of the threads being composed of several of the bobbin strands of other travellers, the latter strands then being partially twisted together at the centre. These centre strands are constantly changing, and each crossing strand from outside to outside passing diagonally across a crossing strand previously made.

4041. Obtaining Increased Water Supply for Cities, &c., *N. G. Green.—Dated 5th October, 1880.—(A communication from N. W. Green.)* 6d.

This relates to improvements on patent No. 3470, A.D. 1879, and consists mainly in the arrangements of the connecting pipes in combination with the series of driven wells, the perforated portions of which enter the stratum of water under the town, and so form an outlet for the body of water as it is drawn off by pumps. The connections are arranged so as to provide for the required flow of water through the several wells towards the pumps in the most regular manner and with the least amount of friction in its passage through the pipes. It further consists in improvements in the machinery employed.

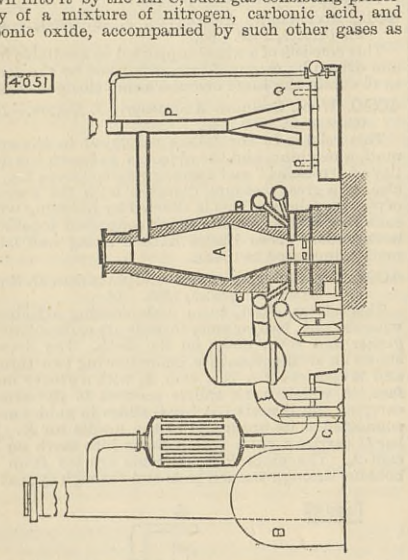
4047. Watch Protectors, *T. Wainwright.—Dated 5th October, 1880.* 6d.

An eyelet is formed on the lower portion of the watch case and to it is attached a chain or cord, the lower end of which is secured to a button on the trousers or other article of clothing, the chain being sufficiently long to enable the watch to be withdrawn from the pocket.

4051. Smelting Iron and other Ores, &c., *W. R. Lake.—Dated 5th October, 1880.—(A communication from T. G. Hall and G. H. Van Vleck.)* 6d.

The object of this invention is to improve the quality of the metal produced, and also to recover the precious metal carried off by the gases which escape from the furnace. The ore is placed in the blast furnace A together with the fuel and flux, and gas is blown into it by the fan C, such gas consisting principally of a mixture of nitrogen, carbonic acid, and carbonic oxide, accompanied by such other gases as

4051



will result from the combustion of the fuel in the furnace B. This mixture of gases is injected into the furnace, together with the air blast, at or below the point at which the metal begins to fuse. When the ore contains precious metals the high degree of heat in the furnace sublimates or vaporises them and causes them to pass off with the gases into the condensing column P, where they meet a descending shower of water and are precipitated and carried down into the receiving tanks Q. The heavier metallic particles collect on the bottom of the tanks and are removed from time to time, and smelted down with lead in crucibles, the precious metal being obtained from the bullion so produced by cupellation or other suitable means.

4056. White Lead, *W. Thompson.—Dated 6th October, 1880.* 8d.

This relates to improvements on patent No. 4142, A.D. 1877, and consists in preparing metallic lead by casting or stamping so as to present a large surface, which is then cleaned with acetic acid and water and placed in a converting chamber, where it is acted upon by suitable gases and converted into white lead. This chamber is heated to from 80 deg. to 120 deg. Fah. by steam pipes laid in a trough formed in the bottom of the chamber, and containing acetic acid and water, the vapours from which pass into the chamber and act upon the lead and forming a coating of hydrated sub-oxide and hydrated sub-acetate of lead. The process is then continued with the combined action of carbonic acid gas until the lead is converted into white lead.

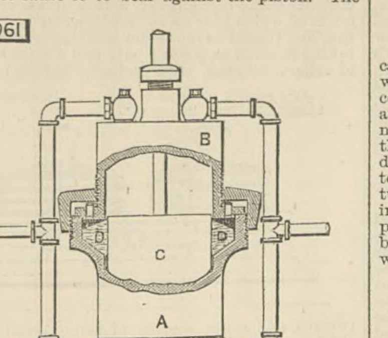
4062. Treating Diamondiferous Earth, *J. Richardson.—Dated 6th October, 1880.* 6d.

This relates to machinery for treating diamondiferous earth, and separating and sorting the diamonds found therein, and it consists of a casing with a large hopper-shaped mouth into which the earth is tipped. In this hopper is a coarse grating between which the soil falls to be acted upon by a series of knives set at an angle on a revolving shaft, and which pulverise and disintegrate the soil, and at the same time mix it into a pulp with water introduced at the hopper end of the machine. The pulp then passes through a fine grating and the stone is ejected by a screw blade. After the soil has been acted upon by any known machine to separate the mud from it and discharge it in the form of small stones mixed with diamonds, it is passed into a sorting machine, where it passes through a series of sieves, each smaller in size and of greater fineness than the preceding one.

4061. Pumps, &c., *W. R. Lake.—Dated 6th October, 1880.—(A communication from P. E. Jay.)* 10d.

This relates to improved pumping apparatus and means for operating the same. The pump cylinder is composed of two parts A and B secured together as shown, and containing the piston C, which is slightly less in diameter than the bore of the cylinder, one part A of which is provided with suitable packing D, adjusted by means of a metallic ring actuated by a ball so as to cause it to bear against the piston. The

4061



driving mechanism consists in the employment of weights attached to a fly-wheel so as to produce steadiness and uniformity of movement.

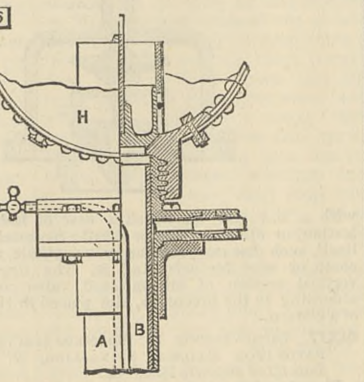
4065. Refrigerating Apparatus, *T. B. Lightfoot.—Dated 6th October, 1880.* 6d.

This relates to means for preventing the deposition of moisture in the form of ice and snow, causing obstruction of pipes and passages and also affecting the chamber in which the cold air is employed. Instead of allowing the compressed and cooled air to expand to its full extent in one cylinder, there are two or more cylinders of different sizes in which it expands by stages, suitable passages being introduced between the successive cylinders in which moisture is deposited in liquid form and is run off.

4066. Steam Generators, *P. de Wrady and K. Okouneff.—Dated 6th October, 1880.* 6d.

This relates to a generator in which only a thin stream of water is presented to the heating surface, and it consists in suspending from a steam chamber H a number of tubes A which are situated in the furnace. Within each tube is a second tube B, corrugated so as to form a number of channels communi-

4066



cating at top with an annular space, into which the water is forced, and passing down the channels is converted into steam, and enters through openings in the bottom of the inner tube to the interior thereof, whence it passes up to the steam chamber. The channels are preferably made of gradually increasing depth to allow for the conversion of the water into steam.

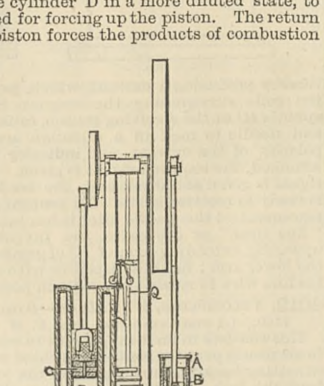
4070. Tie and Core Metal, &c., *G. M. Edwards.—Dated 7th October, 1880.—(A communication from T. Hyatt.)* 6d.

This relates to the preparation of metal sheets for forming cylinders by shaping the metal by rollers into folds or corrugations, the sides of which are either perpendicular or slope inwards, the latter forming wedge-shaped retaining channels for producing a bite upon the plastic materials, enamels, or concrete, to bind the two together. The angles of the corrugations are rounded, so as to lessen the danger of cracking the metal during the corrugating process, and of lessening the liability of the under facing of plaster or cement from cracking at these points.

4075. Motor Engines, *S. Clayton.—Dated 7th October, 1880.* 6d.

This relates to engines in which the piston of the cylinder is moved by the pressure from the combustion of a mixture of air and inflammable gas or vapour admitted and compressed within the cylinder. The piston of the pump A has its stroke in advance of the cylinder piston D, for the purpose of forcing the charge into the cylinder D in a more diluted state, to be there ignited for forcing up the piston. The return stroke of the piston forces the products of combustion

4075



out through the exhaust E. A mushroom valve F prevents the return of the charge to the pump, and it is made with skewed wings, which causes the valve to revolve, so as to keep the valve clean. The valve for firing the charge is of special construction, and is actuated by a cam on shaft Q. The supply of gas is regulated by the governor, and when the engine exceeds its speed the compression is taken from the cylinder by causing the exhaust valve to open.

4079. Dyeing Skins and Leather, *L. Lepine, Son, and P. H. Roelants.—Dated 7th October, 1880.* 6d.

This relates to means for stretching and firmly holding leather while colouring or ornamenting them. A semi-cylindrical piece is supported on a stand and covered first with woollen cloth, then a thin sheet of metal, and finally a sheet of sticking plaster. The skin is laid on the plaster which prevents it shifting, and stencil plates of any required design are held down on it by wires, the ends of which are rolled round shafts by which they can be tightened. The skin is then dyed through the stencil plates in any desired colours by means of brushes.

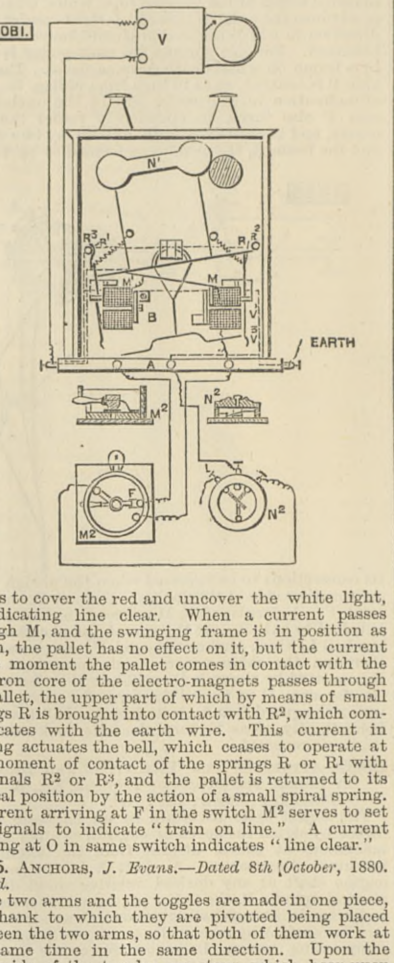
4080. Syringes, &c., *J. Davol.—Dated 7th October, 1880.* 6d.

This consists of a wooden syringe coated on both surfaces with enamel, the fittings such as injection tubes, spray tubes, and coupling being also similarly coated, whereby they are preserved from the action of water and acids.

4081. Electric Signal Apparatus for Railway Purposes, *W. R. Lake.—Dated 7th October, 1880.—(A communication from A. Lemaire and E. Lebrun, of Paris.)* 6d.

Fig. 1 shows the apparatus in elevation, with outer casing removed, connected with pusher switch N², two-way switch M², and electric bell V. The apparatus consists of a board A, carrying terminals as shown, and supporting vertical board B, on which are mounted two electro-magnets M and M¹ for operating the swinging frame N, suspended as shown, carrying double screen N¹ with discs as shown. The impulse to the swinging frame is imparted by the impact of armature V¹ on the end of N² when the pallets are under the influence of a current. Thus, when the parts are in the position shown, and a current passes through M, V¹ being attracted, will, by its other end V², strike N², which will bring the swinging frame into such a posi-

4081



tion as to cover the red and uncover the white light, so indicating line clear. When a current passes through M, and the swinging frame is in position as shown, the pallet has no effect on it, but the current at the moment the pallet comes in contact with the soft iron core of the electro-magnets passes through the pallet, the upper part of which by means of small springs R is brought into contact with R², which communicates with the earth wire. This current in passing actuates the bell, which ceases to operate at the moment of contact of the springs R or R¹ with terminals R² or R³, and the pallet is returned to its vertical position by the action of a small spiral spring. A current arriving at F in the switch M² serves to set the signals to indicate "train on line." A current arriving at O in same switch indicates "line clear."

4085. Anchors, *J. Evans.—Dated 8th October, 1880.* 4d.

The two arms and the toggles are made in one piece, the shank to which they are pivotted being placed between the two arms, so that both of them work at the same time in the same direction. Upon the underside of the toggles are stops, which bear upon shoulders upon the shank, and take the strain when the anchor is in use. The outer edge of the toggles is curved, so that the one will prevent the arms falling back and enable them to grip, and at the same time the other will lie level upon the shank and not be liable to be injured. With these anchors a stock is used to throw them into position.

4090. Street Cabs, *T. Greenhill.—Dated 8th October, 1880.* 4d.

The cab is mounted on two wheels, and is capable of holding four persons sitting face to face, the entrance being from behind. The frame is of iron, and axle arms project on either side to receive the wheels.

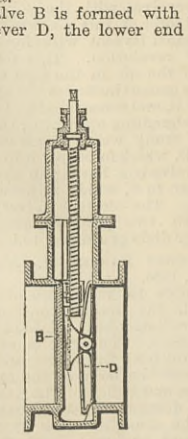
4097. Decorating Wood, Marble, Leather, &c., *H. C. Webb.—Dated 8th October, 1880.* 10d.

In order to decorate wood paper, or the like, with designs which will penetrate through the material, the colouring matter is, by means of an air pump, forced through the pores of the material, a patter plate being placed on it, so as to produce the required design. To emboss wood or other material thus stained it is laid upon a plate with hollows or depressions, and pressure applied until the ornament appears in relief. Wood slabs thus ornamented may be attached to floors or ceilings by bedding them in a bituminous compound.

4100. Valves for Gas, &c., *J. Woodward.—Dated 9th October, 1880.* 6d.

The back of the valve B is formed with a bracket, which supports a lever D, the lower end of which,

4100



when the valve is closed, comes in contact with an incline, so as to force the valve well on to its seating.

4101. Securing Corks in Bottles, *H. T. Lufkin.—Dated 9th October, 1880.* 4d.

A pin passes through a hole on one side of the bottle neck, and passes in a transverse direction through the cork, its lower end if desired entering a slight notch or recess formed in the inside of the neck.

4117. Steam Boiler and other Furnaces, *R. W. Perkins and J. F. Flannery.—Dated 11th October, 1880.—(Not proceeded with.)* 2d.

The object of the invention is to effect perfect combustion and a rapid generation of steam. The carburetted gases evolved are caused to flow into a close chamber, into which a current of air is impelled, preferably by a steam jet, and mixing with it effects its complete combustion, the escape of the gases being retarded by obstructing them in their course to the outlet.

4118. Colouring Matters for Dyeing and Printing, &c., *J. A. Dixon.—Dated 11th October, 1880.—(Not proceeded with.)* 2d.

The nature and object of this invention is the production of colouring matters suitable for dyeing and printing, and belonging to the class of so-called azo-colouring matters, by forming an azo-coupled compound.

4119. Brims and Bands of Hats, *H. J. Haddan.—Dated 11th October, 1880.—(A communication from J. Peters and L. Wiegand.)* 6d.

This consists of a moulded hat brim and band combined, containing an elastic zone of graduated thickness, contiguous to and embracing the angle formed by the brim and band, a stiffened outer rim, and a surface adapted for adhesion to the side crown of a hat body.

4120. Measuring Tapes, &c., *H. J. Haddan.—Dated 11th October, 1880.—(A communication from Knauth and Co.)—(Not proceeded with.)* 2d.

The tape is made of woven fabric coated with india-rubber, on which the divisions are marked. The case is made of vulcanite or hard india-rubber.

4123. Tanning, *W. Nicholson.—Dated 11th October, 1880.—(Not proceeded with.)* 2d.

The hide is washed clean and dried, and then placed in a bath containing 15 or more per cent. of phosphoric acid; it is then covered on both sides with a super-alkaline soap which contains free ammonia and wood naphtha, remaining covered for some hours in an atmosphere not exceeding 100 deg. Fah. The hide is then unhaired, washed, and worked in the ordinary way, being partially dry; it is then treated with a double sulphate of alumina and manganese at a temperature of 65 deg. Fah. After some hours the hide is treated with a solution of hydrochlorate of ammonia and allowed another rest, being again washed and dried. The tanning is effected by oxalate of ammonia, formic acid, or maybe oxalic and hydrocyanic acids, as well as the tannic acid contained in oak bark, volonia, &c.; also succinic acid and milk during the process (spirits of wine is used in extracting the tannin from bark, &c.).

4125. Coal Plates for Cellar Openings, *J. Mathewson and G. Tidey.—Dated 11th October, 1880.* 4d.

This relates to constructing the coal plate so that on being placed in position it is automatically locked, and can only be unlocked from within the cellar. To the cover two or more spring arms project downwards, each arm having on it a ratchet tooth which catches under a shoulder in the fixed frame.

4126. Water-closets, *D. T. Bostel.—Dated 11th October, 1880.* 6d.

This relates to improvements on patent No. 1412, A.D., 1877, in which the basin is cleansed by a flush of water driving its contents over a lip, whence it passes by a channel into a vertical trunk. This trunk is closed at top by a removable cover and terminates at the bottom in the U trap of the closet. This trunk is adapted to receive a piston, by means of which the drain if it becomes stopped can be forced. This trunk is arranged at the front of the basin, the lip also being at the front while the flushing water is admitted at the back. The water drives the contents of the basin over the lip, and a very short channel then delivers it into the forcing trunk. The flushing water is admitted through a spout like an arm passing out from the back of the basin with an easy curve, so that the water sweeps with its velocity unchecked over the bottom of the basin. A small quantity of water is admitted by the scroll forming the upper edge of the closet basin to remove any soil out of the reach of the main flush.

4128. Railway Brake Apparatus, *W. R. Lake.—Dated 11th October, 1880.—(A communication from E. Schrabetz.)—(Not proceeded with.)* 2d.

Gravity is employed to produce the requisite pressure by means of a weight applied to each vehicle. The effect of this weight is counteracted when the brake is not in use by compressed air, the weight being raised by means of an ordinary cylinder with a piston or diaphragm, or by means of bellows or other suitable device.

4129. Improvements in Electrical Signalling and Indicating Apparatus for Telephonic or Telegraphic Purposes, *W. R. Lake.—Dated 11th October, 1880.—(A communication from F. Blake.)* 6d.

The inventor makes use of a number of synchronously revolving dials under the control of a battery current upon a single circuit, but acting automatically, each at a separate time, to ring a magnetic bell by diverting through or grounding through the bell a magneto current generated at the central office, in combination with a device, under the control of the operator at the central office, by which the automatic operation of the dial at the central office may coincide with that of the dial at either of the out stations. Fig. 1 is a front elevation of an instrument used for carrying the invention into practice. Fig. 2 shows how the circuit and branches are arranged when the invention is applied to a group of a central and two out stations, and the magneto bell is to be rung by

4129

FIG. 1.

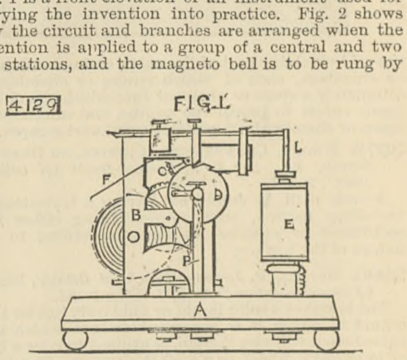
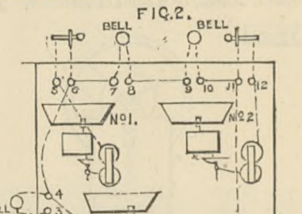


FIG. 2.



diverting a magneto current through it. In Fig. 1 A is a wooden table, B a brass frame for clockwork C, operated by a coiled spring, D is a disc on a shaft revolved by the clockwork, F a governing fan, E an electro-magnet. An armature is rigidly secured to a weighted bell-crank lever L, secured to a post P rocking on a pin inserted in an arm. L carries a catch which takes into a notch in the periphery of D, and also carries a weight sufficiently heavy to lift the armature when not attracted by the electro-magnet. D is of metal, and has a slot which is filled with a hard india-rubber plug. P is a brass post bearing a metallic shaft carrying a pointer, which is an electrode, and is furnished with a platinum point, at all times in contact with the disc, the plug coming in contact with it at each revolution of the dial. Each station is provided with a magneto-bell connected with a magneto-electric machine on the main line, the central station being furnished with a battery as indicated, and a key, the spring arm of which in its normal condition is in contact with plate 13, Fig. 2, but when depressed, with plate 14. Each station is provided with screw caps numbered 1 to 12, connected as shown in figure

4135. Breech-loading Ordnance, *W. Morgan-Brown.—Dated 12th October, 1880.—(A communication from S. M. Richardson.)* 6d.

This relates to mechanism for easily and quickly operating the breech-piece, and consists in the combination with the breech-piece and its carrying arms of excentrics and mechanism to actuate them at the proper time to move the breech-piece longitudinally, also of a stud and cam to cause the breech-piece to be swung laterally away from the breech of the gun; further a sliding extractor.

4139. STAYS AND CORSETS, *F. C. Nutter.—Dated 12th October*, 1880.—(*Not proceeded with.*) 2d.
This consists in constructing and applying to the bones a clip or flattened tube of suitable metal so as to strengthen the bones at that part where they are subject to the greatest strain.

4141. COMBINED BELL AND WHISTLE, *J. Cheshire.—Dated 12th October*, 1880.—(*Not proceeded with.*) 2d.
This consists in fitting to one end of a push rod a pair of lazy-tongs, which have hammers for striking the interior of a bell. The other end of the push rod is fitted with a knob to actuate the mechanism. A spring forces the rod back and causes the bell to strike again on the return stroke. A ball of india-rubber is also compressed and causes air to rush through a whistle, which is thus sounded.

4145. WATCHES, CLOCKS, &c., *M. Cross.—Dated 12th October*, 1880. 6d.
The watch cases are designed so that the watch may be wound, regulated, and the hands set, all from the back, and without exposing the works, and is accomplished by forming a small door in the case; this may be secured by a catch, and opened with the thumb nail, or by a spring, and thrown open by pressing a knob or projection upon the case in the ordinary manner, except that it is preferred to place a knob on the side of the case instead of upon the pendant.

4147. FLOAT GAUGES, *A. Nicholls.—Dated 12th October*, 1880.—(*Not proceeded with.*) 2d.
This consists in making metallic air chambers of various sizes, shapes, and dimensions, so as to give sufficient buoyancy to support a rule or rod, that the indicating of the quantities in the vats, fermenting squares, and other similar vessels may be taken thereby.

4149. LAMPS, &c., *G. W. von Nawrocki.—Dated 12th October*, 1880.—(*A communication from E. Köhler.*) 6d.
A cylindrical compartment is filled with sponge up to a sieve, above which is placed some wadding, on which the wick rests. The sponge is soaked with a combustible volatile carburet of hydrogen. The lighting apparatus consists of a slider, in which is a turntable case constructed on the well-known percussion principle, by the application of a paper strip with lighting surfaces attached thereto at regular intervals.

4154. PRINTERS' QUOINS, *H. J. Haddan.—Dated 13th October*, 1880.—(*A communication from J. Young.*) 4d.
This relates to a quoin composed of two pieces, consisting of a box and rock bar. The box is made of a slightly tapering wedge form, its upper end and lower sides being parallel. Two recesses are formed in the upper and lower sides of the box of suitable form to admit a pinion key to freely revolve in the same, and in proper working contact with the teeth on the inner face of the said wedge rock bar.

4156. GLOBE HOLDERS FOR GAS-BURNERS, &c., *F. Jones.—Dated 13th October*, 1880.—(*Not proceeded with.*) 2d.
To one of the radial arms of the holder a slotted crank lever is applied, the slot passing over and working on a pivot in the arm, which is inclined, so that when the globe is placed on the holder, and the lower end of the lever will be brought against the inside lower edge of the globe, so as to hold the same in position, the slot being on the arm on which it pivots.

4157. INSTRUMENT FOR ASCERTAINING AND INDICATING AT ONE OPERATION THE DENSITY, PRESSURE, AND TEMPERATURE OF STEAM, *C. Boye.—Dated 13th October*, 1880.—(*Not proceeded with.*) 4d.
A vertical cylinder is fitted with a piston and piston rod and connected to the boiler or to the steam engine; the said cylinder is in communication with two other cylinders, in one of which is placed a manometer or steam gauge for measuring the pressure of the steam, and in the other cylinder is placed a thermometer for ascertaining the temperature of the steam.

4158. COLLECTING HYDROGEN GENERATED IN CLEANING IRON WIRE, PLATES, &c., *A. M. Clark.—Dated 13th October*, 1880.—(*A communication from R. N. R. Phelps.*)—(*Not proceeded with.*) 2d.
To remove the scale from iron wire it is plunged into a dilute sulphuric or muriatic acid, whereby hydrogen is generated, to collect which the vat containing the bath is fitted with a loose cover, the lower edge of which dips into the bath, while the upper part is fitted with a tube to carry off the hydrogen, which may be mixed with evaporating gasoline or other hydrocarbon in the making of illuminating gas.

4159. STEAM GAS MOTOR, *C. Kesseler.—Dated 13th October*, 1880.—(*A communication from O. Henniges.*)—(*Not proceeded with.*) 4d.
This relates to improvements upon the Siemens steam gas motor, with burning flame in the cylinder, in which motor a cut-off valve is arranged by which the admission of steam to the working cylinder can be cut off or regulated. This valve is omitted, and for it is substituted a valve (which is placed upon the steam pipe which conducts the steam to the distributing slide) which automatically opens when the steam pressure in the chamber is greater than the pressure of the gases in the working cylinder, and closes when the pressure of the gases is greater than that of the steam.

4162. DYEING YARN, &c., *J. Chadwick and J. H. Mather.—Dated 13th October*, 1880. 6d.
This consists in the application of steam to fix the colour on piece goods and yarns while in the wet stage in the following manner:—The piece goods are passed through a padding machine supplied with the necessary mordants and colouring matters, thence through a box in which are rollers to convey it evenly, and between each pair of rollers are perforated pipes, from which steam issues and acts upon the goods, thereby fixing the mordants and colouring matters.

4163. HARMONIUMS, &c., *S. Crokaert.—Dated 13th October*, 1880.—(*Not proceeded with.*) 2d.
This consists in combining a harmonium or other similar reed instrument with ordinary cottage pianofortes, in the casing of the same with the least possible alteration to the general appearance of the piano. The reed pan is placed close under the keys of the piano, the levers or pallets of the harmonium being operated by means of adjustable screws or pins carried by the underside of the piano keys.

4164. GLAZING SURFACES FOR HORTICULTURAL, RAILWAY, AND OTHER PURPOSES, *W. H. and D. Thompson.—Dated 13th October*, 1880. 6d.
This consists in the use, in glazing without putty or other plastic materials, of perforated diamond-shaped panes or plates, secured through these perforations by self-tightening screw or other equivalent holders, pins, or catches, furnished with elastic washers or cushioning rings, and clipping or otherwise resting upon or against bevelled wedge-shaped laths or bearers.

4170. CARPENTERS' OR JOINERS' PLANES, *W. R. Lake.—Dated 13th October*, 1880.—(*A communication from P. Brunet and V. Brossier.*) 4d.
The plane has only one iron, which is provided with a double bevelled edge at the cutting end. The wood block has two apertures extending through it, one designed to receive the shaving and the other the plane iron and the wooden wedge to hold it in place. The iron is made at its extremity with double inclined or bevelled edges, and the cutting blade is let into the iron centrally and extends a suitable distance along it in an upward direction, the edge of the blade being bevelled to correspond with the edges of the plane iron.

4172. APPARATUS FOR OBTAINING INFUSIONS OF TEA, &c., *C. J. Simms.—Dated 13th October*, 1880.—(*Not proceeded with.*) 2d.
The apparatus consists of discs of perforated metal or wire netting hinged two and two together, and having on opposite edges to the hinges rods or bars, one of which is attached to the edge of one of the discs opposite to the hinge, and serves as a supporting rod, upon which a sleeve or runner is free to run, and the other disc has a corresponding rod, arm, or nose-piece provided thereon, over which the said sleeve or runner will, when the apparatus is charged, be passed to retain the parts together. The apparatus, according to this, is made as a broad-bowled spoon, with a second bowl hinged at the point, so that both bowls will, when the apparatus is charged, lie edge to edge and enclose the material, such as tea, and the rod will be formed as a handle.

4173. FIRE-LIGHTERS, *J. F. Wiles.—Dated 13th October*, 1880. 6d.
A cube block of wood is bored with holes through it in various directions, and is dipped into paraffin and resin or other inflammable materials. Previous to dipping the blocks, shavings or other ignitable material is placed in the holes.

4174. PORTABLE SEATS, STOOLS, OR CHAIRS, *J. E. Mouland.—Dated 14th October*, 1880.—(*Not proceeded with.*) 2d.
This relates to that class of seat having cross legs pivotted to the seat in pairs, and which are folded by the pivots of one pair sliding in slots in the other. The seat is secured by pins to the frame of a slightly tapering form, that is, the bars forming it are larger on their upper surface. To these bars the two pairs of cross legs are pivotted. On each bar of one of these legs is a pin sliding in slots cut in the two bars of the other leg. The two bars of the unslotted legs are strengthened by braces and transverse bars. The slotted bars of the other leg have also two transverse bars just above and below the slots to prevent the leg splitting. These bars also act as stops to prevent the stool being carried beyond the plane in which it is folded, and to serve as a stop to take the strain when in use off the pivots and the upper walls of the slots.

4175. BOLT MAKING MACHINES, *S. Gallie.—Dated 14th October*, 1880. 6d.
This relates to machines in which an upsetting hammer or die, together with side hammers, form the head of the bolt, and it consists in combining with such hammers apparatus for raising the bolt from its holder, while being acted on by the side hammers. A rotating table, with a series of bolt holders, receives

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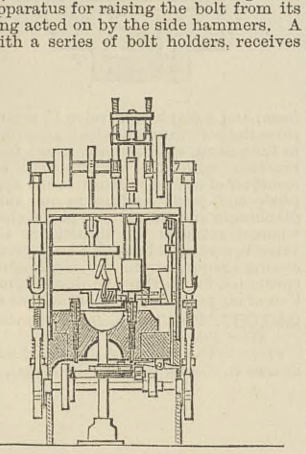

an intermittent motion by suitable gear. The bolt holders are made free to swivel and have taper grooves, through which the side hammers act on the bolt head. The table or bolt holders, or both, are adjustable.

4179. WASHING ROOTS, &c., *W. Griffiths.—Dated 14th October*, 1880. 6d.
This relates to the application and use of a rotary drum and reticulated or perforated convoluted passage of wirework or suitable material, provided with feed and discharge openings in the periphery and centre of the drum, respectively in combination with a water tank and inclined feed and delivery shoots.

4180. BRACE-ENDS, *A. S. Taylor.—Dated 14th October*, 1880. 4d.
This consists in the insertion of a metal bush between the bottom bar of the buckle or slide and the leather or other loop, whether the same be made of a piece of metal simply bent round the bar in the shape of a tube, or with one end (or both ends) elongated and perforated, so that the rivet or eyelet which fastens the leather or other loop passes also through the end (or ends) of the plate and firmly secures the same.

4183. OIL-CANS, &c., *G. T. Harrison.—Dated 14th October*, 1880.—(*Not proceeded with.*) 2d.
The body of the can may be of ordinary construction. The lid is hinged by preference, so that it moves in wards when being opened, and when closed forms a perfectly tight cover for the opening or mouth of the vessel, preventing the escape of liquid. The stop valve in the spout and the lid are so coupled together that they may be opened together, being actuated by a valve spindle, and also closed simultaneously when pressure is taken off a spindle actuated in preference by a flat spring or springs.

4186. ROAD LOCOMOTIVES AND TRACTION ENGINES, *J. Marshall.—Dated 14th October*, 1880. 6d.
This relates to an arrangement for altering the speed, and also for throwing the crank shaft out of gear with the main axle when required to drive machinery from the fly-wheel. On the crank shaft A are two pinions E and F of different diameters, and on the countershaft B are two wheels G and H, and also a broad pinion J. By means of the lever R shaft

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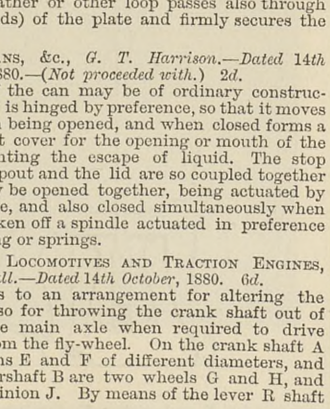

B can be shifted, so as to bring either G or H in gear with E and F respectively, the pinion J being broad enough to still remain in gear with the wheel M. In the intermediate position both G and H are out of gear, and the main axle, therefore, is not driven.

4187. LOOMS FOR WEAVING, *W. H. Hacking and E. Grube.—Dated 15th October*, 1880.—(*Not proceeded with.*) 2d.
The object is to impart to "fast reed" looms, all or some of the advantages possessed by "loose reed" looms. To this end the warp is arranged to be slackened when the shuttle fails to enter the box. As the sley approaches the cloth a finger or feeler feels for the shuttle. This finger is in connection with a tongue, which during the ordinary working of the loom clears the end of a catch or trigger which sustains a lever; the back rest for the warp is hinged or mounted to swivel or yield at times, so as to slacken the warp. The aforesaid lever is connected by a link with a lever arm upon the back rest. When the shuttle fails to enter the box the end of the tongue is lowered and strikes the catch, whereby the lever is released and the back rest swivels, thereby slackening the warp.

4188. LOCKS, *H. K. Bromhead.—Dated 15th October*, 1880. 8d.
The horizontal bar forming the latch of the lock is attached to the upper end of a weighted lever whose lower end is centred towards the lower innermost corner of the lock casing, or the weighted lever may be centred at a higher point within the lock casing. A double armed follower, through which the handle for operating the latch passes, is arranged so that the under part of the weighted lever shall rest upon the straight surface formed by the upper side of the two arms of the follower. The follower is provided with two arms for the purpose of enabling the weight to be lifted and the latch drawn in by turning the handle for operating them either in the right-hand or left-hand direction.

4189. TAPS, *M. Rodgers.—Dated 15th October*, 1880.—(*Not proceeded with.*) 2d.
The tap made according to this invention consists of the portion which is to be inserted into the cask or vessel containing the liquid, and which may be constructed in any suitable manner, the projecting part being of a tubular shape and either parallel or tapered and closed at the front end; a hole for the escape of the liquid is made at some short distance from the closed end, and an outer tube, having by preference a lining of cork or other suitable material, but without such lining if desirable, is made to fit and slide over the projecting part so as to cover or uncover the beforementioned hole, and thus allow or stop the escape of the fluid.

4192. IMPROVEMENTS IN THE METHOD OF AND LAMPS FOR USING THE ELECTRIC LIGHT ON LOCOMOTIVE ENGINES, *G. P. Harding.—Dated 15th October*, 1880. 4d.
The inventor places the lamp on the fore part of the chimney, and uses reflectors to throw the light forward. He places his generator upon bearings attached to the framework of either the engine or tender, and connects its driving pulley by a pulley, which, by means of gearing keyed or connected with the axles of the engine or tender, will drive the generator at a suitable speed; or he attaches to the engine or tender a small auxiliary engine, so that when the locomotive is stationary the light may still be kept going. The object is to light the track for a long distance ahead.

4194. ARRANGING AND PUTTING UP NEEDLES, &c., *J. W. Hayes.—Dated 15th October*, 1880.—(*Not proceeded with.*) 2d.
A folding case or wrapper is employed formed of suitable material and constructed so that it may fold into a number of flaps or leaves, each flap or leaf serving to receive a packet of needles, which may be permanently fixed thereto or be removable.

4195. TRICYCLES, &c., *G. Illston.—Dated 15th October*, 1880.—(*Not proceeded with.*) 2d.
This has reference to those parts of tricycles and other velocipedes by which the motion of the treadle axle is communicated to the driving wheels, and the object is to effect the transmission of the motion of the treadle axle equally to the two driving wheels when the tricycle or velocipede is moving in a right line; and to permit the driving wheels rotating at different speeds when the tricycle or velocipede is travelling in a curve.

4200. EXPLOSIVE COMPOUNDS, *P. M. Justice.—Dated 15th October*, 1880.—(*A communication from H. Prudhomme.*) 4d.
The powder is prepared from the following substances: Nitrates, 60 to 70 per cent. by weight; organic matter, 10 to 15 per cent.; dissolved sulphates, about 5 per cent.; sulphur, 10 to 15 per cent.; charcoal or resin, about 5 per cent.

4201. BURNERS FOR PETROLEUM GAS, *P. Jensen.—Dated 15th October*, 1880.—(*A communication from C. von Szekrenyessy and J. Stern.*)—(*Not proceeded with.*) 2d.
The petroleum is by a tap admitted to a pipe containing copper shavings; it then passes into a knee piece or elbow, which is heated directly by a small petroleum gas jet placed beneath it, and protected by a rim against draught; the passage through the upright end of the elbow tapers off to a very narrow throat.

4204. EMBROIDERY APPARATUS FOR SEWING MACHINES, *W. R. Lake.—Dated 15th October*, 1880.—(*A communication from O. Sellick.*) 6d.
This consists in the combination of a bracket adapted to be attached to the presser bar of a sewing machine, and having the presser foot secured thereto, with the traveller adapted to be connected with the needle bar of the sewing machine, the spiral bar, the looper, the loop detainer, and the mechanism whereby the looper and the loop detainer are operated.

4207. FOLDING TABLES, *G. R. McKenzie.—Dated 15th October*, 1880.—(*Not proceeded with.*) 2d.
In small folding tables, having on each side of the central part of the table a flap, which can fold downwards on a hinge joint, is supported the table when the flaps are folded down upon four legs. Two of the legs are fixed to the central part of the table below two opposite or diagonal corners, and below the two other corners are two movable legs, fixed to a wooden arm or support, which can turn on a vertical pivot below the centre of a central part of the table.

4210. SAFETY FASTENER FOR GUNS, *H. A. Silver and W. Fletcher.—Dated 15th October*, 1880. 6d.
This relates to an improved construction of safety fastener with automatic double action for the strikers, tumblers, or the triggers of sporting and other guns. The lever A is pivotted to the strap C of the breech D of the arm, and when in the normal position it, under the action of the spring E, acts upon the kinked

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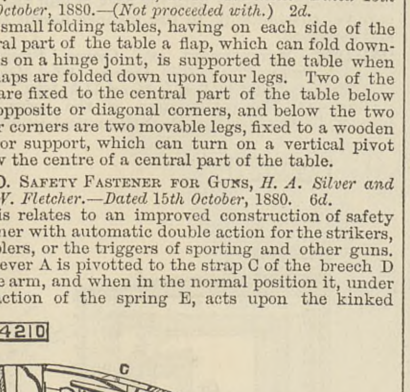


portion F of the lever B, and throws the end G over and upon the trigger H, to prevent it being pulled. By depressing the end I of the lever A the lever B is moved back away from over the trigger. The inner end K of lever A is bent at right angles, and is situated in the path of the striker or tumbler L, which on being raised to be set, lifts that end of lever A and becomes locked behind it, the end K acting as a stop to any accidental movement of the striker, should it become released.

4211. BUNDLING PRESSES, *J. Bennie.—Dated 16th October*, 1880.—(*Not proceeded with.*) 2d.
The press consists of a vertical framing having a horizontal table or platform projecting preferably from both sides of it. On the table or platform rails or guides are formed or laid, and on these rails or guides, one, or by preference two, boxes are placed, the same being rendered capable of moving outwards and inwards on the rails by mounting them on carrying wheels or rollers. On the upper part or head of the frame a box or receptacle is fixed, to contain the balls of twine, wherewith to tie up the bundles of yarn or the like after the same have been compressed, and to enable twine to be passed under and round the bundle. A series of vertical slots are made in the ends of each bundling box.

4214. CARRIAGE DOORS, &c., *H. J. Haddan.—Dated 16th October*, 1880.—(*A communication from C. D. C. Bruhs and H. Pollack.*)—(*Not proceeded with.*) 2d.
The object is to prevent the fingers of careless persons from being clipped by shutting the doors of railway carriages or other doors, and consists in the application of two movable guard plates placed vertically along the sides of the door opening, and so connected with the door and with each other that they cover the sides of the door opening when the door is open, but are turned outside by shutting the door, thereby removing any finger from the door before it can be clipped by the door.

4215. WATCH KEYS, *J. West.—Dated 16th October*, 1880.—(*Not proceeded with.*) 2d.
This consists in fitting into the interior of the pipe of the watch or other key a plug or peg which fits closely therein, and the outer end of which is flush (or nearly so) with the end of the pipe or tube of the key for the purpose of preventing the admission of dust or other extraneous matter into the pipe of the key.

4216. TURNING OVER LEAVES OF BOOKS, &c., *W. Rigg.—Dated 16th October*, 1880. 6d.
A corner or angle is cut off, or a small excision is made from the edge of each sheet or leaf for the purpose of facilitating the turning over of the leaves.

4217. "CLOTH OILS" FOR WOOLLEN OR FELTED FABRICS, *J. Swallow.—Dated 16th October*, 1880. 2d.
The composition is used in blending wool, mungo, and other fibrous materials, and consists of 40 gallons olive oil, 12 lb. lard, 30 lb. Irish moss, 40 lb. crystal borax, 1 oz. hay saffron, and ½ lb. sulphate of potassium.

4218. MEASURING CONTENTS IN EARTHWORKS, *J. Imray.—Dated 16th October*, 1880.—(*A communication from J. Conale.*)—(*Not proceeded with.*) 2d.
A rectangular plate has along each side and one end a groove to receive a slide, the edges of the groove being graduated with equal divisions, and the slides graduated with verniers. At one end of the plate are two other slides, which can be clamped to two graduated guides perpendicular to the grooves. A straight rule is pivotted to one of the end slides, and other rules are pivotted to the end and lateral slides.

4220. OBTAINING MOTIVE POWER, *H. G. Hosmer.—Dated 16th October*, 1880.—(*Not proceeded with.*) 2d.
A ring is secured in a vertical position, and carries a series of permanent magnets of varying strengths, and also a series of armatures placed in juxtaposition to the magnets. On an axis passing through the ring is a wheel carrying a series of hollow armatures containing a core on which wire is coiled, and are arranged so as to come into action successively.

4221. ROPES AND BANDS FOR DRIVING MACHINERY, *J. H. Scott.—Dated 16th October*, 1880.—(*Not proceeded with.*) 2d.
This consists in using metallic wire in combination with the fibrous material.

4222. TREATING COFFEE, *E. G. Brewer.—Dated 16th October*, 1880.—(*A communication from P. Pesier.*) 4d.
Cakes or tablets are made of pulverised coffee and sugar mixed, and solidified by pressure.

4223. SAFETY ALARM APPARATUS FOR STEAM BOILERS, *E. de Pass.—Dated 15th October*, 1880.—(*A communication from L. A. Guibert.*)—(*Not proceeded with.*) 2d.
On the boiler a box is fixed vertically and divided into two compartments by a flexible diaphragm, one connected with the steam space, and the other with water space. To the centre of the diaphragm is connected the stem of a valve, which serves to operate a whistle mounted on the lid of the box.

4228. TREATMENT OF VULCANISED FIBRE FOR PRODUCING SHUTTLES, BOBBINS, &c., *J. C. Leigh.—Dated 16th October*, 1880. 2d.
Vulcanised fibre is cut, pressed, bent, or otherwise shaped to the form required, or the unvulcanised fibre may be pressed into moulds, and then vulcanised.

4229. MOTOR ENGINES, *M. Pratt.—Dated 16th October*, 1880.—(*Not proceeded with.*) 2d.
This relates to single-acting engines in which the steam acts only on one side of the piston, and it has for its object the shortening of the port with the use of an ordinary reciprocating slide valve.

4239. EXTINGUISHING AND PREVENTING FIRE, *M. Windsperger and A. Schaedler.—Dated 18th October*, 1880. 4d.
This relates to a liquid for extinguishing fire, and consisting of 25 gallons water, 15 lb. common salt, 1¼ lb. alum in powder, 28 lb. silicate of sodium, and ½ lb. red chalk.

4241. STICKS FOR UMBRELLAS AND SUNSHADES, *C. D. Abel.—Dated 18th October*, 1880.—(*A communication from Messrs. Baumgarten and Mensendieck.*) 2d.
The stick consists of a metal tube round which twine is wound and coated with glue, after which a thin veneer of ebonite is applied to it.

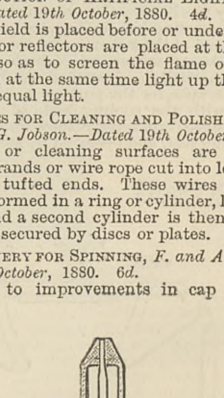
4253. MOUNTING CONSOLIDATED EMERY WHEELS, *R. Luke.—Dated 19th October*, 1880. 4d.
This relates to means for preventing the grinding compound or material from flying off under the action of centrifugal force, and consists of rings enveloped in hempcord and secured between the driving plates and the grinding wheel, which are both grooved so as to allow each ring to lie partly within the driving plate and partly within the grinding wheel.

4254. DISTRIBUTION OF ARTIFICIAL LIGHT, *W. A. S. Benson.—Dated 19th October*, 1880. 4d.
An opaque shield is placed before or under the light, and a reflector or reflectors are placed at the back or over the light, so as to screen the flame of the light from sight, and at the same time light up the room by a diffused and equal light.

4262. BRUSHES FOR CLEANING AND POLISHING METAL SURFACES, *G. Jobson.—Dated 19th October*, 1880. 6d.
The bristles or cleaning surfaces are formed of twisted wire strands or wire rope cut into lengths and folded, leaving tufted ends. These wires are passed through holes formed in a ring or cylinder, leaving the bend inside, and a second cylinder is then placed in the former and secured by discs or plates.

4406. MACHINERY FOR SPINNING, *F. and A. Craven.—Dated 28th October*, 1880. 6d.
This relates to improvements in cap spinning,

4406



whereby a shorter nip is obtained, and which allows of starting the frame at a greatly accelerated speed, with out having an increase of ends coming down, and also allowing an increase of speed in spinning without any extra waste, and producing softer spun yarns, or with less number of turns to the inch than hitherto. This is effected by substituting for the old form of cap a cap having its top part E of just sufficient diameter to allow the spool G a free action therein, while its lower part C is of larger diameter, so as to take in the yarn as it is wound on the spool. The top of the cap is conical, and can be made to work higher up towards the top board of the frame, thereby giving a shorter nip than with the ordinary cap.

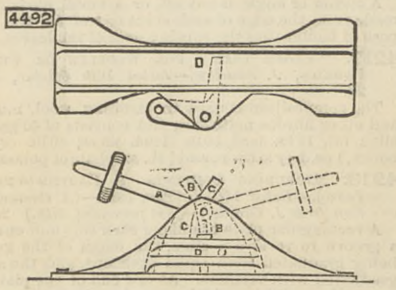
4303. CONVERTING NITROGENOUS ORGANIC SUBSTANCES, *T. Morgan.—Dated 21st October*, 1880.—(*A communication from J. Mayaud.*) 4d.

About 200 lb. of woollen rags is placed in a boiler with 100 lb. sulphuric acid, and made to boil. It is then saturated with phosphate of lime, and after being agitated is removed, when it solidifies. When pulverised it may be used to prevent the fermentation of urine and fæcal matters, and also for disinfecting the same when fermentation has taken place.

4492. SWITCH-BOXES, *R. C. Rapier. — Dated 3rd November*, 1880.—(*Complete.*) 4d.

This relates to switch-boxes having turnover levers and weight. The lever A is so arranged that in one position the limb B is thrust by the weight against one side of the arm of the bell crank D which actuates

4492

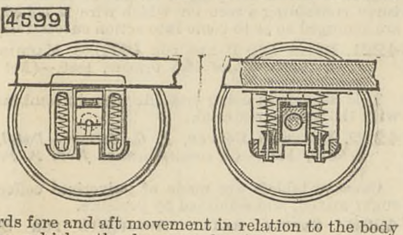


the switches, and in the other position the limb C of the T-shaped head of the lever is thrust against the other side of the arm of the bell crank and pushes it in the opposite direction.

4599. RAILWAY VEHICLES, *W. R. Lake.—Dated 9th November*, 1880.—(*A communication from E. R. Esmond and H. C. Van Vechten.*) 6d.

This consists in a railway vehicle of a laterally swinging saddle piece suspended from the top of the axle-box, which is made rigid by a suitable frame as

4599



regards fore and aft movement in relation to the body of the vehicle, the lower ends of the sides of the saddle piece being provided with projections on which rest the supporting springs of the said body.

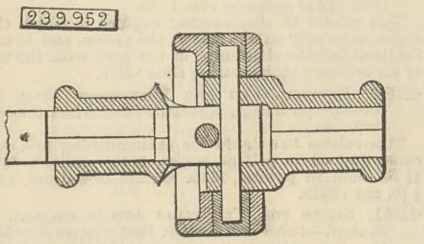
SELECTED AMERICAN PATENTS.

From the United States' Patent Office Official Gazette.

239,952. UNIVERSAL JOINT COUPLING, *Matthew Harvey, Rockford, Ill.—Filed March 1st*, 1881.

Claim.—(1) A coupling ring in one piece having a smooth exterior and provided with removable bearings, substantially as and for the purpose hereinbefore set forth. (2) The combination, with a coupling ring, of removable chilled or hard metal bearings, substantially as and for the purpose hereinbefore set forth. (3) The

239.952

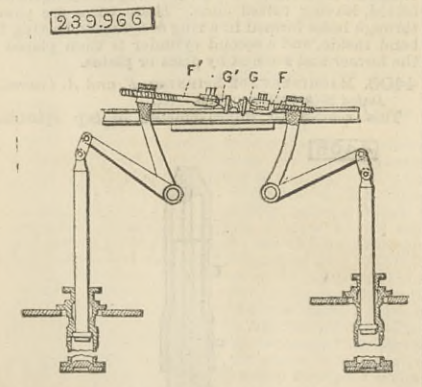


combination, with the removable bearings, of removable coupling pins, substantially as and for the purpose hereinbefore set forth. (4) The combination, with the coupling ring, substantially as herein described, of coupling heads connected therewith by means of removable coupling pins having removable bearings, substantially as and for the purpose hereinbefore set forth.

239,966. APPARATUS FOR BENDING AND STRAIGHTENING HOT RAILS, *Henry C. Kriete, Chicago, Ill.—Filed January 10th*, 1881.

Claim.—(1) In apparatus for bending hot rails, for the purpose set forth, the combination, with the cooling bed, of the two opposite sets of presser plates, operated by mechanical power, and rising and falling through the cooling bed, said plates pressing upon the base and head of the hot rail, and the rail being bent by the combined movement of both sets of presser plates, substantially as described. (2) In apparatus for bending hot rails, for the purpose set forth, the combination, with the cooling bed, of two oscillating shafts, arranged transversely below and across the rails of the cooling bed, and operated by mechanical power,

239.966

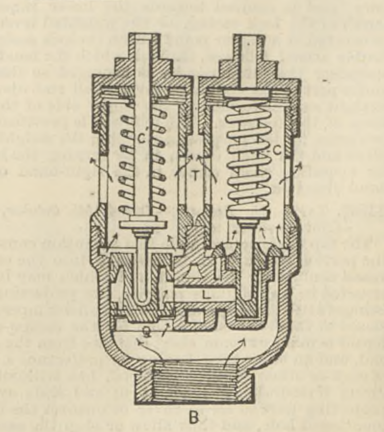


push arms secured to such shafts, push bars carried by said arms and having presser plates, substantially as described and shown. (3) In apparatus for bending hot rails, the two sets of push arms F F¹, having adjustable presser plates G G¹, substantially as described and shown. (4) In apparatus for bending hot rails, the two sets of push arms F F¹, having adjustable presser plates G G¹ connected therewith by ball-and-socket joints, substantially as described and shown. (5) In apparatus for bending hot rails, the combination, with the cooling bed, of the two shafts D D¹, connected by rocker arms directly with working pistons, the push arms, push bars, and presser plates, substantially as described and shown.

239,985. SAFETY VALVE, *Frank B. Scovill, Boston.—Mass.—Filed November 9th*, 1880.

Claim.—(1) The valve E, constructed with a piston or disc H, fitting in chamber I, and provided with interior and exterior bearing surfaces and openings S, substantially as and for the purpose specified. (2)

239.985

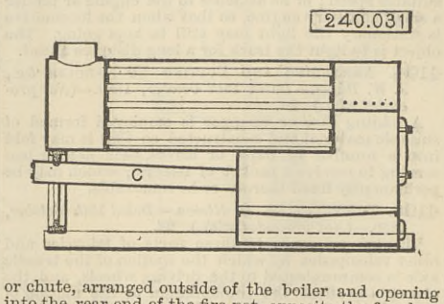


In a safety valve, the combination of the auxiliary valve M, the passage L, extending from a point between the seat P of the auxiliary valve M and its disc N above to the chamber I, containing the piston H and the main valve E, substantially as and for the purpose set forth.

240,031. STRAW BURNING FURNACE, *Walter J. F. Liddell, Charlotte, N.C.—Filed January 13th*, 1881.

Claim.—The combination, with the furnace having the usual fire door, of the straw burning attachment

240.031

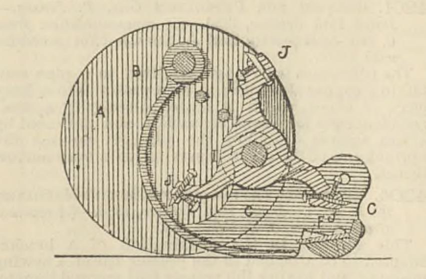


or chute, arranged outside of the boiler and opening into the rear end of the fire pot, opposite the fire door below said boiler, substantially as and for the purpose described.

240,034. CUTTING APPARATUS FOR LAWN OR OTHER MOWERS, *Elwood W. Macguire, Richmond, Ind.—Filed January 24th*, 1881.

Claim.—In a cutting apparatus for lawn and other mowers, the combination, with the bed knife F, of a revolving shaft carrying a series of spiders having slotted heads or jaws J, solid blades or cutters arranged in said slotted head or jaws, set screws pass-

240.034

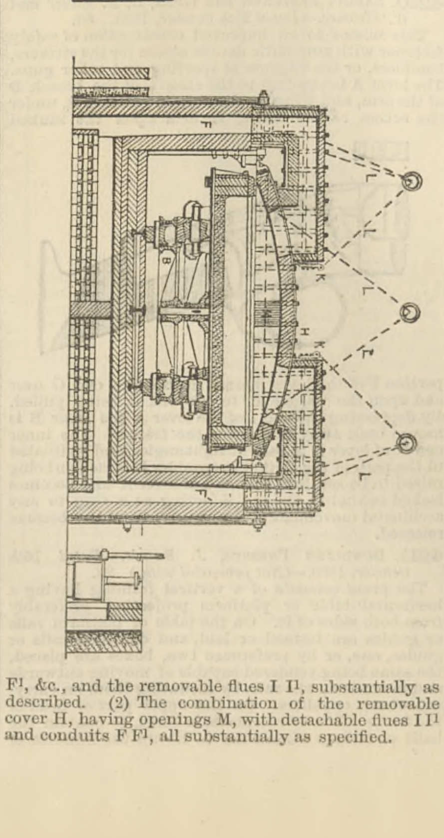


ing transversely through one portion of said slotted heads or jaws and pressing said blades against the other portions thereof, for securing the blades in position, and adjusting screws L, passing through the back side of the portion forming said slotted heads or jaws, and engaging with the back of said blades or cutters, substantially in the manner herein shown and described.

240,037. METALLURGIC AND OTHER FURNACES, *Chas. Pernot, Rive de Gier, France.—Filed May 14th*, 1880.—*Patented in France March 11th*, 1880.

Claim.—(1) The combination of the cover of a furnace, having openings M, with vertical conduits F

240.037

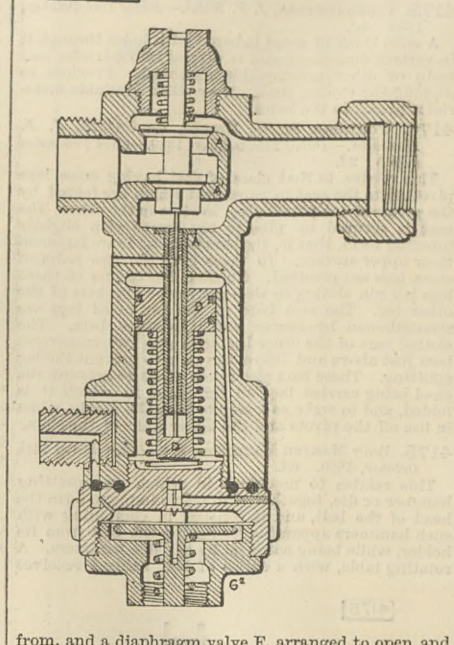


F¹, &c., and the removable flues I I¹, substantially as described. (2) The combination of the removable cover H, having openings M, with detachable flues I I¹ and conduits F F¹, all substantially as specified.

240,062. FLUID PRESSURE REGULATOR FOR AUTOMATIC BRAKES, *George Westinghouse, jun., Pittsburg, Pa.—Filed March 9th*, 1881.

Claim.—(1) A piston subject to fluid pressure on one side and a spring pressure on the other, in combination with a throttle or shut-off valve arranged to open and close the steam flow to the engine, and a diaphragm and valve arranged to regulate the admission of fluid pressure to the piston, substantially as set forth. (2) In combination with a fluid pressure generator, auxiliary reservoir, and brake cylinder of an automatic brake apparatus, a regulating piston, throttle, diaphragm, and valve, arranged for conjoint action, substantially as set forth. (3) In combination with piston D, actuated by variations in fluid pressure applied thereto, a balanced valve A A¹, actuated there-

240.062

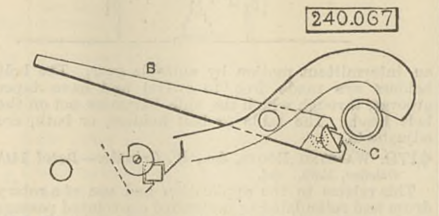


from, and a diaphragm valve F, arranged to open and close the port through which air pressure is admitted to the piston, substantially as set forth. (4) In combination with the continuously charged pipe or reservoir of a fluid pressure brake apparatus, a line of pipes and ports leading to one side of a movable diaphragm and thence to a piston chamber, the piston whereof actuates the throttle or shut-off valve, a valve V, arranged in such line of ports for opening and closing the same from the diaphragm motion, and a spring G², for moving the diaphragm on the diminution of air pressure, substantially as set forth.

240,067. PIPE TONGS, *Deloss Worden, Oil City, Pa.—Filed February 16th*, 1881.

Claim.—The bite tong B, formed with the chamber or seat B, closed, or partially closed, at one end, and

240.067

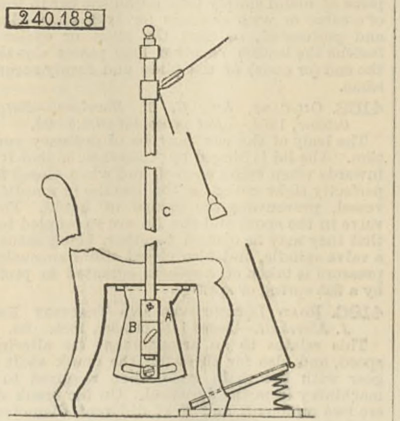


with the narrow opening or slot C across the diagonal face E, in combination with the removable bite C and the recessed button D, substantially as shown and described.

240,188. FAN ATTACHMENT, *William A. Roos, New York, N.Y.—Filed February 10th*, 1881.

Claim.—The combination of the bracket A, having socket B, the staff C, carrying arm C, the roller D,

240.188

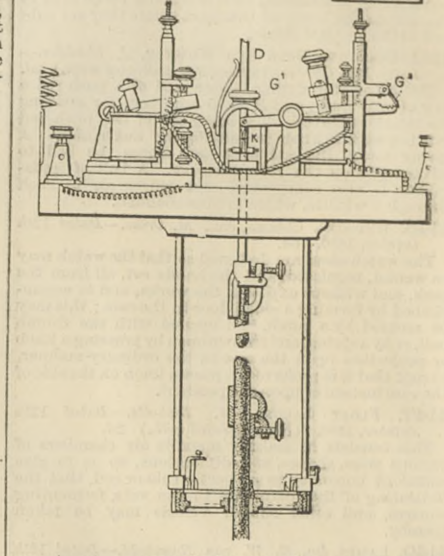


carrying fan E and spring F, the cord G, and the spring supported treadle H, to adapt the whole to be applied to a chair and used as described.

240,210. ELECTRIC LAMP, *Edward Weston, Newark, N.J.—Filed July 8th*, 1879.

Claim.—(1) An electro-magnet and an armature the opposed parts of which are respectively in the form of a cone and of a hollow cylinder, the armature having a range of motion permitting the cone to enter the hollow cylinder when the armature yields to the attraction of the magnet, substantially as and for the purpose described. (2) An electro-magnet having a longitudinally hollow core, in combination with a conically-pointed movable armature having a range of motion permitting its conical point to enter the tubular pole of the magnet, substantially as and for the purpose described. (3) In combination with an electro-magnet provided with a hollow core and a conically pointed movable armature, an adjusting device by means of which the range of movement of the lever to which the armature is attached may be adjusted, substantially as described. (4) In an electric lamp, the combination of a main circuit of small resistance, which includes the carbons and the principal coil surrounding the electro-magnet, with a derived circuit of large resistance, which includes a coil wound differentially upon the electro-magnet, and a circuit closer adapted to close the derived circuit whenever the resistance in the main circuit is increased to a prescribed amount by the too great separation of the carbons, substantially as and for the purpose set forth. (5) In an electric lamp, the combination of the carbons with a differential magnet the two oppositely wound coils of which are respectively included in the main circuit, which includes the carbons, and in a derived circuit whereby the distribution of the current in the two circuits is automatically dependent upon the progress of the combustion of the carbons, substantially as described. (6) In an electric lamp in which the force of gravity tends to diminish the distance between the points of the carbons, a lever to which at one end a movable carbon is suspended and upon which at the other end an armature is affixed, in combination with an electro-magnet, the opposed parts of the armature and magnet being respectively conical and tubular, whereby the

240.210



armature has a prescribed range of movement in the magnetic field, during the whole of which there is no material variation in the amount of attractive force exerted upon it by the magnet, substantially as and for the purpose set forth. (7) The clamp K, composed of the pivotted clamping jaws, respectively linked to the forked end of the rocking armature lever, in combination with the vertical sliding rod D, as and for the purpose set forth. (8) The clamp K, composed of the pivotted jaws, the armature lever, and links connecting the same, in combination with a stop adapted to disengage the jaws from the movable carbon-holder when the same has been dropped to the desired point. (9) The combination, in an electric lamp, of the vertical sliding carbon holder D, the clamp K, the forked armature lever G, to which the clamp is linked, and an electro-magnet the coils of which are included in the circuit which supplies the lamp, substantially as described. (10) The armature lever G and the upper carbon-holder and clamp in combination with the pawl G³ for holding up the end of the lever carrying the clamp, substantially as set forth.

CONTENTS.

THE ENGINEER, May 20th, 1881.

IT is said that in the Bradford U.S. oil field, 14,000 ft. of sucker rods are consumed daily to prepare for pumping wells that have ceased to flow.

THE trade and navigation reports of India for the year ending the 31st of March give the following figures :—Grand total, imports, 62.08.40.213 rupees, against 52.82.13.980 of the previous year; grand total, exports, 75.98.13.480 rupees, against 69.24.75.106 rupees. The number of steamers and sailing vessels employed in the foreign trade which entered Indian ports during the year under review was 4006, aggregating 2,512,965 tons, while 5116 vessels, aggregating 3,152,660 tons, cleared. The figures for the previous twelve months were—entered, 3910 vessels, of 2,264,023 tons; cleared, 5086 vessels, of 2,796,623 tons. The coasting trade also shows a considerable, although less marked, increase.