NARROW GAUGE COLONIAL RAILWAYS.

THE relative economy and fitness of a narrow or standard gauge railway for a new or thinly populated country is a question which has been much debated, and as it generally has happened that the advice of engineers on this point has been disregarded, and the gauge has been fixed upon by politicians on the ground of alleged economy, the mere fact of the adoption of the narrow gauge by most of our colonies cannot be said to have definitely settled the question. It remains to be seen whether experience does not bear out the self-evident proposition that, as regards the cost of construction, a narrow gauge railway is more economical than one of standard gauge in a mountainous country, where sharp curves and side cuttings are numerous, and that in fairly level country, the weight of rails and the ruling gradient are the factors of cost rather than the width of the gauge; and in considering this question it should be borne in mind that the width of the loading gauge—that is to say, the actual free channel that must be left clear for the passage of rolling stock through cuttings and bridges, is often as wide or even wider on a 3ft. 6in. gauge than on a 4ft. 8½in. Thus, while the maximum width of rolling stock—which generally obtains over the wings of brake vans—is on most English lines 9ft., this dimension is exceeded by some 7in. or 8in. on some colonial lines. The dimensions of carriages, except in height, correspond closely to those on the standard gauge; on one line at least bogie vehicles 41ft. in length are in use, while those now building by the Great Western Railway at Swindon only measure 46ft. The wagons now made are almost identical in dimensions with those in use here, the tare of medium-sided open wagons being 4 tons instead of 4 tons 10 cwt. to 5 tons 5 cwt., and the nominal capacity 6 tons instead of 7 or 8 tons. Long bogie wagons no less than 28ft. in length, and weighing 11½ tons, are also in use on a 3ft. 6in. gauge. It has been found inconvenient and unprofitable to deal with small trucks which cannot carry a heavy load or bulky articles, while the passengers growl at the small stuffy carriages which are especially uncomfortable in the warm climates in which some of our colonies are situated. This increased size, weight, and carrying capacity of rolling stock on narrow gauge lines, seems to show that to work a railway efficiently much the same appliances are needed all the world over; and that the small reduction in dead weight is due more to the central buffer system and its attendant simplification of framing than to the narrowness of the gauge. The reduced diameter of wheels and the smaller size of journals and axle-boxes effect an additional saving in weight, and are permissible only on account of the slower speed.

In this country, the size, weight, and power of locomotives have gradually increased since the Rocket first ran on the Liverpool and Manchester Railway, and a similar increase is still in progress, both here and in the United States and the Continent; but dealing only with what has taken place in this country, we find that little more than a generation ago, an engine with 15in. by 20in. cylinders and 120 lb. pressure of steam was reckoned powerful. These dimensions have gradually grown to 18in. and 26in. cylinders and 140 lb. pressure, and, roughly speaking, the power delivered on the crank pin has been rather more than doubled. A similar movement has taken place on colonial narrow gauge railways. Engines with 12in. by 18in. cylinders have been superseded in a few years by engines of nearly double the power with 15in. by 20in. or 22in. cylinders. But just as the colonies, as a whole, are progressing faster than the mother-country, so this doubling the power, which has taken thirty odd years in the old country, has been achieved in seven to ten years in the colonies. An increase has also been found necessary in the diameter of the wheels and the thickness of the tires. The 3ft. diameter driving wheels of the usual type of narrow gauge engine made a few years ago have been found too small; the impossibility of balancing the revolving and reciprocating parts on so small a wheel made the engine excessively unsteady at any speed, and the consequent jerks and oscillations loosened the fastenings of the cylinders and framing, slacked the cotters in the connecting and coupling rods, and caused friction and disturbance all round. This has been remedied by the introduction of 3ft. 6in. wheels, and a typical example may be found in the goods engine for the Cape railways which we illustrated in our number for March 30th. The power of this engine is nearly equal to that of the usual type of English goods engine, with 17in. by 24in. cylinders, and 5ft. wheels, which for every pound on the square inch average pressure of steam in the cylinders exerts a pull of 117 lb.; the engine we illustrated has cylinders 15in. by 20in., and 3ft. 6in. wheels, and exerts a pull of 107 lb. The weight, however, in working order is increased to some 34 tons, an amount which is actually in excess of that found sufficient for the main line engines on our two largest English railways; though if the English engines carried water in side tanks, as well as in tenders, this proportion would doubtless be reversed.

As many of the colonial lines are unfenced, an engine must stand the shock of running into cattle without jumping the track; and here a heavy engine, with a long, flexible wheel base, is far safer than a slight, short wheel base engine with overhanging cylinders. The increased cost of repairs in the colonies, where labour is 50 to 66 per cent. more expensive than at home, and all materials have to be imported at an enhanced cost, which tells most severely upon the commonest articles of consumption, such as coal, fire-brick, timber, and pig iron, render it very desirable to make the engines as durable as possible, and this can in general only be accomplished by judicious strengthening and increased bearing and wearing surfaces, which of course involve additional weight. The small crank pins of the early engines soon wore oval, to an extent that is hardly credible to persons conversant only with locomotive practice at home; and the constant renewal of pins and brasses, and repair of rod ends, form a serious item of expense. The whole engine is purposely kept low, and hence all the wearing parts are near the road bed, and consequently are continually smothered in dust, and strike against any ballast which has not been carefully levelled. Cylinder waste water cocks are particularly liable to be struck, and hence inclined cylinders are preferred in some places, though they of course render an engine less steady.

A somewhat similar increase has taken place in the weight of rails. Large systems were laid out on the narrow gauge with 40 lb. rails, iron being used, as steel was then considered unnecessarily durable for the light traffic, and the difference in cost was, moreover, considerable. These rails were soon found to be too light for even small engines weighing but 6 tons per axle, and in many instances are being replaced with steel rails of 60 lb. and even 70 lb. weight per yard. The light iron rails are found to wear rapidly, especially on curves, and as very little wear makes it necessary to take up a 40 lb. rail, a large quantity of almost valueless scrap is soon accumulated, the difference between the price of new and scrap rails being much greater in the colonies than at home.

It therefore appears that on narrow gauge railways the width and weight of the rolling stock, the power and weight of the locomotives, and the weight of the rails—three main items in determining both the first cost of a railway and its power of conveying traffic—have all largely increased; falsifying the confident hope of the early promoters of narrow gauge railways that the dead weight might be greatly reduced, and the use of far lighter rolling stock rendered permissible. On the contrary, in everything except the gauge, narrow gauge railways are approaching to the same weight and dimensions as those in use on the standard gauge lines, and the reasons for this gradual change or development are not far to seek. On any railway a train will cost approximately the same under whatever conditions it is run. For instance, the difference in cost between running a train of empty wagons and one of loaded wagons is small, though the earnings in one case are nil and in the other ample. It is therefore necessary, in order to make a railway pay, to earn as much as possible per train mile, and in practice it is generally found easier to increase the earning per train mile than to decrease the expenses. More powerful engines and more capacious rolling stock enable a larger train load to be carried without materially increasing the cost. On long lengths of single line, such as exist in the colonies, it is difficult to arrange crossing places for a large number of trains. Stations are often fifteen, twenty, and even forty-five miles apart, and at the latter distance, with a speed of fifteen miles per hour, intermediate crossing places must be provided to work even five trains a day each way with any regularity. As the colony grows and traffic increases, it is necessary to increase the number of trains if the old type of engine and rolling stock be retained, and either partially double the line or increase the number of passing places, which must often be situated where there is no traffic. It is not, therefore, surprising that the alternative of improved rolling stock is adopted, conferring, as it does, the additional advantages of increased speed and smaller liability to derailment and breakdown.

As the dimensions of the rolling stock and the clear width of the line have been closely assimilated to that prevailing on the standard gauge, it becomes a question whether it is advisable in future lines to retain the reduced distance between the rails, which seems the one exceptional feature left which distinguishes a narrow gauge railway from one of standard gauge. It certainly appears that in a country of some size, where the amount of traffic is more than sufficient to pay working expenses, and is likely to increase, that the many inconveniences inseparable from narrow gauge, and to which further allusion will be made, render it unsuitable for adoption. In a country where there are already narrow gauge railways, the gauge of any extensions must be largely determined by the question of break of gauge, and in Canada this consideration has told on gauges both broader and narrower than the standard; though the narrow gauge was also found to be costly in repairs and deficient in haulage power. It would therefore seem advisable, in similar cases, to follow the example of Canada, as a comparison between the merits of the standard and narrow gauge presents a very different aspect to that of the battle of the gauges fought by Brunel and Stephenson. There the broad gauge demanded wider embankments, cuttings, bridges, and tunnels, while the size and capacity of the rolling stock was unnecessarily great; and though considered as a purely mechanical question, greater speed could be attained, it was found that the distance between stopping stations, the gradients, and the absence of busy junctions, were factors which, independently of gauge, materially influenced the question of speed. The inferiority of the metre, or the 3ft. 6in. gauge, in point of speed is so marked that it admits of no discussion. The necessity for keeping the centre of gravity within reasonable bounds forbids a larger driving wheel than 4ft. 6in. diameter, and therefore a maximum speed of thirty to thirty-five miles an hour takes the place of fifty-five to sixty. Though this difference is unimportant in a small country where the journey is short, it becomes a grave question when a continent has to be traversed. Here a journey seldom exceeds a length of 400 miles, say a journey from London to Glasgow, and the difference in time possible between the present service at the rate of forty miles an hour, including stoppages, and one on a narrow gauge line at twenty-five miles an hour, would be six hours. This in itself is bad enough, as it would make it impossible to answer letters on the same day; but when we come to deal with larger distances, say, for instance, the projected trans-continental line across Australia, a journey of fifty hours is increased to one of eighty—a loss of over a day. But as a matter of fact we are not aware that a speed of even twenty-five miles an hour, including stoppages, has been regularly attained on any 3ft. 6in. or metre gauge line. Until quite recently the speed of the through mail trains on the South African railways was but fourteen and a-half miles per hour, or slightly slower than the mail steamers.

As has been already stated, a narrow gauge presents few obstacles to the adoption of rolling stock which is satisfactory as regards carrying capacity and strength, and is durable at the slow speeds inherent to a narrow gauge. The adoption of 2ft. 9in. diameter wheels for both carriages and wagons secures uniformity, and though smaller than the 3ft. 6in. and 3ft. wheels in use here for carriages and wagons respectively, the tires and flanges wear well and the journals seldom heat. The centre of the buffers, and therefore the horizontal centre line of the framing, is generally reduced from 3ft. 4in. usual here to 2ft. 9in., and consequently the centre of gravity is lowered some 6in. or 7in., or about half the difference in the gauges, 1ft. 2½in. This, aided by the slightly lower bodies of the carriages, is sufficient to render them perfectly safe in a violent gale of wind. Owing to the greater width of stock in proportion to the gauge the journals are further away from the wheels than on the standard gauge, and an increased cross breaking strain is thus thrown on the axles, which occasionally break in the centre, a rare occurrence at home, where the back of the wheel boss is usually the vulnerable point. The standard gauge is a few inches too narrow for the proper development of the locomotive. The length of the bearings, the width of the fire-box water space, and the diameter of the boiler are all unduly restricted in a large modern engine; and when the available space is further diminished by 25 to 30 per cent., the inconvenience is severely felt. The distance between the backs of tires on the ordinary gauge being 4ft. 5¼in. is diminished to 3ft. 3in. on the 3ft. 6in. gauge; and as the thickness of the main frame, the clearances between it and the wheels and fire-box respectively, and the thickness of the fire-box plates, and width of the water space, can hardly be reduced, it follows that the whole difference of gauge must come out of the internal width of the fire-box, which is thus reduced, say, from 3ft. 4in. to 2ft. 2in., a reduction of 35 per cent. But this is not the worst of the evil, as the fire-grate is so much reduced in width that its area can only be made sufficient by adhering to the length usual on the standard gauge, and if the fire-box is placed between the axles, the wheel base must also be retained. But the long wheel base renders the engine stiff on the sharp curves which the narrow gauge alone is supposed to render possible, and so the fire-grate is sloped and the trailing wheels placed underneath it. This is always an objectionable arrangement, especially when the centre of the boiler has to be kept low, as the fire-box has then so little depth, especially at the back end, that the fire-hole ring and its rivets are constantly burnt, and the cramped and shallow ash-pan soon becomes so full of hot ashes that the fire-bars are heated from both above and below, and consequently bend and burn and need constant renewal, while the small amount of room between the ash-pan and springs renders it difficult to get at either the one or the other. Various plans have been tried for getting over this difficulty. One, which, however, introduces new disadvantages, consists in substituting outside for inside frames, the fire-box can then be made as wide as the distance between the backs of the tires permits, and the ash-pan need only be recessed for the axles, and not for the axle-boxes; which latter, with the springs, are outside, and therefore accessible. The cylinders, however, must be wider apart, and the engine is thus more unsteady, while the outside or clock cranks are, of course, objectionable. It does not, however, appear to be possible to produce on the narrow gauge a powerful locomotive of the ordinary type, which shall be as economical in consumption of fuel and repairs as an engine of the same weight and power on the standard gauge; and this serious disadvantage, coupled with that of reduced speed, must always militate against the usefulness of a narrow gauge railway which aspires to be the main channel of communication in a large and busy colony, and not a mere subsidiary line in an isolated district or island, where the traffic must always be small and the population limited.

THE VENTILATION OF THE ST. GOTHARD TUNNEL.

IN our impression for May 4th we gave particulars of recent investigations on the temperature of the St. Gothard Tunnel. We now proceed to consider the nature of the currents in the tunnel. The change of direction in the current of air passing through the tunnel is of course due to a change in the relative value of the air pressures at the two ends; but the change within the tunnel cannot be exactly synchronous with those outside, and, moreover, the observations are taken over the entire day. This renders the calculation more difficult; but on the whole it appears that a change in the direction of the current took place when the difference between the pressures amounts to 0·008 atmospheres. On the other hand, it is found that in the completed tunnel the current ceases when the excess of pressure falls below 0·003 atmospheres; hence it is calculated that the resistances during the progress of the work in 1881 were five times as great as when the tunnel was completed. This figure agrees fairly well with the figure 4·2 obtained by another method. Starting from this basis, we have to consider what would have been the condition of the ventilation of the tunnel during the year 1881 if it had then been in working order. The results are given in the annexed table B. From this table it appears that the maximum velocity of the air would have been on an average 3·74 metres per second, and the minimum velocity 0·59 metre, eliminating those periods when there was no current whatever. The northern current, having a mean velocity of 2·61 metres, would have prevailed for 191 days, or 52 per cent. of the year; and it is a very favourable circumstance that the period of these northern currents is that of the summer, from May to September. The southern current, having a mean velocity of 2·22 metres, would have prevailed for 87 days, or 24 per cent. of the year. Lastly, the alternating currents would have lasted for the same period, namely, 87 days, and would have had a mean velocity of 1·45 metres when coming from the north, and 1·27 metres when coming from the south. Taking the average results, even during the unfavourable period when alternating currents were frequent, and assuming a southern current with a velocity of 1·27 metres, it appears that the tunnel would have been cleared of smoke in about three hours sixteen minutes. Thus, if the time-table was so arranged that there was a space of three and a-quarter hours between every two trains there would have been no difficulty with regard to ventilation.

Unfortunately, whenever a change takes place in the direction of the current, there must, of course, be a period when the speed is *nil*. This period is more or less short, according as the differences in intensity before and after the change are more or less large. When there is a single change, followed by a steady current in the new direction, this period of no velocity is very short. When, however, there are two or more changes at short intervals, the ventilation becomes difficult; experience confirms this. From the 19th to the 22nd September, 1881, the average velocity of the northern current would have fallen to 0·1 metre in consequence of three successive changes of direction which occurred in that period. Such an event, however, would not take place more than once or twice in each year; but it becomes important to consider how far in such a case the air of the tunnel would be vitiated.

In January, 1882, 248 trains passed through the tunnel; the total amount of coal consumed by these trains was 23,000 kilogs., but of this about 5750 kilogs. only was burnt in the tunnel, or about 0·684 kilog. per ton weight of train. Assuming that ten trains of 400 tons each traversed the tunnel daily, the carbon burnt in it amounted to 2736 kilogs. per day; hence if we assume that for four days consecutively there is absolutely no ventilation in the tunnel, the gases proceeding from 10,944 kilogs. of coal will remain within it. Of this we may take 80 per cent., or 8755 kilogs., as being carbonic acid or carbonic oxide, the other 20 per cent. will be in the form of water, cinders, &c. The analyses of locomotive smoke made of our Parisian Shot Railway show that at a speed of 25 kilos. per hour the composition was about 3 of carbonic acid to 1 of carbonic oxide; thus the 8755 kilogs. mentioned above would furnish 21,065 kilogs. of carbonic acid and 7022 of carbonic oxide, and in doing so would deprive the air in the tunnel of oxygen amounting to 19,332 kilogs. Assuming the pressure inside the tunnel to be 655m. of mercury and the temperature to be 20 per cent. greater, the carbonic acid represented a volume of 13,048 cubic metres, the carbonic oxide a volume of 7044, and the oxygen lost a volume of 16,545 cubic metres. Now the tunnel has a transverse section of 41 square metres and a total length of 15 kilos. It has thus a total containing 615,000 metres; and supposing at the end of four days without any ventilation the air in the tunnel would contain 2·12 per cent. of carbonic acid and 1·14 per cent. of carbonic oxide, whilst its contents of oxygen would have fallen from 20·96 to 18·27 per cent. Now, candles go out in air containing less than 18·5 of oxygen, or with 2 per cent. carbonic acid is still breatheable, but with ½ per cent. of carbonic acid it is unwholesome. It follows then if there was an interruption for four whole days of the natural ventilation, and if the traffic was continued without intermission, the atmosphere would be almost if not quite unsupportable.

This conclusion follows strictly from observations and calculations. It can only prove to be incorrect if the average conditions of the atmosphere at the two ends of the tunnel is found to differ largely from that of the year 1881, or if the effect of the natural ventilation is found to vary largely and other conditions from those under which it has been determined; or lastly, if the quantity of coal burnt is different to that assumed. It must not, however, be forgotten that this state of the air will only exist at the end of the period of four days, such as will scarcely happen once a year. Moreover the local currents formed at the two ends by diffusion by the trains themselves produce a mixing of the air, which considerably improves the condition of things. It is suggested that on days when the ventilation was especially bad one or two of the goods trains might be stopped and not allowed to enter the tunnel. It seems almost absurd to provide a costly artificial system of ventilation, which would not be required more than once a year. Moreover, a practical example of the Mont Sini tunnel, where the amount of coal consumed is much larger, shows that such a provision is not really necessary. The very small effect produced by the introduction of compressed air for the purpose of general ventilation is easily shown; it would be necessary to work all the air pressers at both ends of the tunnels for no less than 200 hours in order to renew once only the air which it contains. Such admissions of compressed air are merely useful for the improvement of the atmosphere at the particular spot where work may be going on at the moment. Such air should be stored up in a large reservoir at the mouth of the tunnel, which should be constantly filled to the pressure such as would give an effective pressure of one atmosphere at the further end of the air pipe.

TABLE A.

Currents of Air in the St. Gothard Tunnel during 1881.

Month.	No. of days observed.	North current.		Alternating current.			South current.	
		Days.	Per cent.	Days.	Per cent.	Mean excess of density.	Days.	Per cent.
January	31	11	35·5	9	29·0	+0·0078 / −0·0133	11	35·5
February	28	6	21·4	8	28·6	+0·0041 / −0·0106	14	50·0
March	31	11	35·5	13	41·9	+0·0083 / −0·0079	7	22·6
April	30	12	40·0	9	30·0	+0·0079 / −0·0029	9	30·0
May	31	13	44·9	11	35·5	+0·0118 / −0·0135	7	22·6
June	30	17	56·7	7	23·3	+0·0095 / −0·0064	6	20·0
July	31	10	32·2	16	51·7	+0·0126 / −0·0061	5	16·1
August	30	18	60·0	9	30·0	+0·0089 / −0·0032	3	10·0
September ..	30	18	60·0	9	30·0	+0·0089 / −0·0043	3	10·0
October	31	15	48·4	11	35·5	+0·0123 / −0·0077	5	16·1
November ..	28	9	32·1	8	28·6	−0·0111 / +0·0043	11	39·3
December.. ..	30	8	26·7	14	46·6	−0·0115	8	26·7
Mean and totals	361	148	41·0	124	34·3	+0·0084 / −0·0078	89	24·7

TABLE B.

Conditions of Ventilation in the Year 1881, *had the Tunnel then been Completed.*

Month.	Northern current.				Alternating currents.					Southern current.			
	Days.	Per cent.	Mean excess of density.	Speed of current.	Days.	Per cent.	Mean excess of density, + = North − = South.	Direction.	Speed of current.	Days.	Per cent.	Mean excess of density.	Speed of current.
				m.					m.				m.
January	11·0	35·5	+0·0091	2·24	8	25·8	+0·0035 / −0·0072	North / South	1·39 / 1·86	12·0	38·7	−0·0193	3·10
February	5·5	19·6	+0·0101	2·29	7	25·0	+0·0020 / −0·0033	North / South	1·08 / 1·23	15·5	55·4	−0·0126	2·49
March	17·0	54·8	+0·0116	2·44	9	29·0	+0·0033 / −0·0040	North / South	1·35 / 1·37	5·0	16·2	−0·0091	2·76
April	15·5	51·7	+0·0138	2·67	7	23·3	+0·0077 / −0·0031	North / South	2·00 / 1·19	7·5	25·0	−0·0091	2·11
May	22·5	72·6	+0·0152	2·85	6	19·3	+0·0015 / −0·0031	North / South	0·94 / 1·19	2·5	8·1	−0·0097	2·18
June	24·0	80·0	+0·0151	2·78	4	13·3	+0·0036 / −0·0028	North / South	1·39 / 1·11	2·0	6·7	−0·0063	1·73
July	25·5	82·2	+0·0137	2·65	3	13·3	+0·0055 / −0·0019	North / South	1·70 / 0·90	2·5	8·1	−0·0070	1·83
August	13·5	64·3	+0·0124	2·53	7	33·3	+0·0037 / +0·0029	North / North	1·41 / 1·27	0·5	2·4	−0·0021	0·94
September	21·0	70·0	+0·0113	2·42	8	26·7	−0·0023 / +0·0046	South / North	1·14 / 1·57	1·0	3·3	−0·0066	1·79
October	21·0	67·7	+0·0152	2·79	8	25·0	−0·0047 / +0·0072	South / North	1·48 / 1·95	2·0	6·5	−0·0108	2·30
November	5·5	18·3	+0·0255	2·59	9	30·0	−0·0026 / +0·0032	South / North	1·08 / 1·32	15·0	51·7	−0·0146	2·69
December	3·0	9·7	+0·0090	2·09	8	25·8	+0·0032 / −0·0040	South	1·37	20·0	64·5	−0·0146	2·69
Total for 355 days	185	52·41	+0·0136	2·61	84	23·7	+0·0041	North	1·45	86	24·2	−0·0107	2·22
Mean for 365 days	191	52·			87	24	−0·0035	South	1·27	87	24		

+ indicates excess on the northern, − on the southern side. The calculations at Airolo are wanting for ten days.

THE ROYAL INSTITUTION.

MR. ROBERT SCOTT ON METEOROLOGY.

ON Friday evening, May 4th, Mr. Robert Scott, of the Meteorological Department, delivered a lecture at the Royal Institution on Meteorology. The lecture was listened to with careful attention, and in the course of it the speaker, while stating the exceptional difficulties of those who have to forecast the weather, said that foreign journals were as free in their criticism about the results as those in England. He began by producing figures to prove that the oft-asserted connection between terrestrial and solar weather has not yet been demonstrated to be a fact; the variations in temperature and in area of sun spots do not, he stated, always agree.

He added that the daily forecasting of the weather had really been forced upon the department by the demand on the part of the public that information as to probable coming weather should be published every day in the newspapers, especially as the same thing is done regularly in America. The public forget that in America the meteorologists have a large area from which to draw their facts; that there they have plenty of funds, and have skilled observers trained in military discipline. In England no reports can be obtained from the ocean to the west of us, as to the state of the weather there; yet from the sea most of our storms come, and it would be well if more could be ascertained about barometrical depressions to the westward of these islands. As regards Europe, it is difficult for meteorologists to agree upon an international code. For instance, inland countries like Austria do not care to insert in a code items about the sea, a subject in which they are little interested.

Forecasting at a distance from the locality interested is difficult, since all information comes to the London office second-hand, and valuable points are often missing through the breaking down of the telegraph in bad weather. No serious attempts at local forecasting are made in any part of Europe, except in one place where it is done under the auspices of a German newspaper. In London the forecasting has to be done for the whole country, since the funds cannot be obtained for local work. The forecasting is adapted as much as possible to the requirements of the district to which it is sent; for instance, the western part of England is mainly a grazing district, and the eastern part mainly a corn district, although this distinction, being a sweeping one, inapplicable to some localities included, is rather arbitrary. Forecasts, moreover, when received should be intelligently interpreted according to the circumstances of each particular locality; for instance, a range of hills running across a district and bringing down rain on one side of the mountains will produce dry weather on the other, yet the forecast is the same for both. The wind, when raised by blowing against the hillsides, is cooled about 1 deg. Fah. for every 300ft. it is tilted; at the same time the air is expanded. These two changes cause its aqueous vapour to condense and fall as rain. On the other side of the range of hills the process is reversed; the wind being condensed and warmed in its downward course is much drier than before. The conditions just described are to be found at Nairn, which is bounded by the Grampians and the hills of Inverness-shire and Ross-shire; the rainfall in Nairn is consequently not more than half that in the upper valleys of the Grampians. Therefore the one forecast sent from London for the whole district requires intelligent local interpretation.

Seventy-five per cent. of the forecasts for the West of Scotland have proved quite successful. Hay harvest forecasting is carried on only for a month or two in summer, the necessary figures and information being sent to about twenty-five gentlemen in various parts of the country, who then temporarily do some local forecasting, with a percentage of success of about 80. Still, as already stated, a great difficulty is want of knowledge as to the weather out at sea to the west. German meteorologists complain that a great impediment to German forecasting is the late arrival of the English telegrams, without which news from the west, nothing can be done. England, however, can get no news from the Atlantic Ocean.

Storm warnings were instituted years ago by Admiral Fitzroy, and are still given under difficulties. The Meteorological Office, to do its work with most efficiency, wants reports from the coast all night long, but cannot have them. Another impediment is that any warning to fishermen must be sent in the daytime, for no port will bear the expense of the lights required for the night service. Then again, warnings sent out from London in the afternoon rarely reach the fishermen's eyes till next morning, since no signals can be hoisted after dark.

In the matter of the trustworthiness of the forecastings and storm warnings, these are generally correct as to the direction and force of the wind, but fail most in foretelling rain quantitatively, in saying whether a small shower or a deluge is to be expected. The great floods in Moravia, for instance, were not foretold. This arises chiefly from ignorance as to conditions prevailing in the upper strata of the atmosphere. Information about these strata can be gained in a fragmentary way by means of balloons, which, however, are useless for regular work. Mountain stations are useful, but not high enough in this country, which, moreover, has but one such station, that on Ben Nevis, 4000ft. high. The observer, during part of the year, ascends the mountain every morning before nine o'clock, but is stopped as the winter comes on. Much time is lost in conveying the news he obtains to the nearest telegraph station. The mechanical method of sending up captive balloons with instruments, the indications of which are recorded below by electricity, does not answer for regular work. For such work instruments should be maintained steadily and permanently at a height of not less than 2000ft. Next come the optical methods, the observation of cirrus clouds, and spectroscopic work. Professor Piazzi Smith has written a beautifully illustrated work on the rainband spectroscope, but his belief in the efficacy of that instrument is not yet accepted as an article of faith by meteorologists at large. If it gives warning of coming rain but two or three hours in advance, it is not of much use; the first cost of a fair rainband spectroscope is two or three guineas, and requires more skill in using than is possessed by some of the meteorological reporters, a portion of whom are ordinary coastguardsmen.

Observations of cirrus clouds are of more importance. The Rev. Clement Ley has spent one-twelfth part of all his waking hours in watching clouds, and in his own locality of Lutterworth he claims to be almost infallible as regards forecasting the weather. His telegrams to the Meteorological Office about coming weather are frequently astonishingly accurate. On the other hand, the method has its drawbacks. For instance, the faculty of cloud observations is incommunicable by books, and great exercise of judgment is necessary before a trustworthy opinion can be deduced and pronounced. Furthermore, the observers must have abundance of leisure. In Europe no trustworthy basis for regular observations of the higher clouds has yet been proposed, and in England cirrus observations alone are available for the extension of meteorological outposts over the Atlantic.

In the course of the lecture Mr. Scott called attention to the following among other tables of figures:—

Temperature of the British Isles compared with Sun Spots, October to March.

Winter.	Mean temperature.	Sun spots.
1876—77	43·7	13
1877—78	43·4	8
1878—79	39·3	3
1879—80	41·4	24
1880—81	40·0	44
1881—82	43·7	64
1882—83	41·8	74

The 6 *p.m. Forecasts*, 1879 *to* 1882.

District.	Complete success.	Partial (more than half) success.	Partial (more than half) failure.	Total failure.	Percentage of success.
Scotland, N.	36	43	16	5	79
,, E.	33	45	16	6	78
,, W.	28	42	21	9	70
England, N.W. ..	31	44	19	6	75
,, N.E. ..	30	44	19	7	74
,, E.	34	44	16	6	78
,, Mid. ..	30	46	18	6	76
,, S.	36	46	13	5	82
,, S.W. ..	32	42	19	7	74
Ireland, N.	32	43	18	7	75
,, S.	33	41	17	9	74
Averages	32	44	17	7	76

THE MIDLAND INSTITUTE OF MINING ENGINEERS.—On Wednesday a meeting of the Midland Institute of Mining, Civil, and Mechanical Engineers was held at the Institute rooms, Barnsley, Mr. Thos. Carrington, president, in the chair. A paper was read by Mr. W. F. Leale, of Leeds, on "The Safe Lighting of Mines." In his paper Mr. Leale reviewed the qualities of the various safety lamps now in use, and gave the preference to the Mueseler over the Davy, Clenny, and Stephenson. He pointed to the Protector Mueseler as a further improvement, and referred to various improvements which he had himself made in lamps. The paper was ordered to be printed in the transactions of the Institute. Reference was also made to the lime process of getting coal, and the question was adjourned for further information.

FIRES IN THEATRES.—The Society of Arts propose to hold a public meeting on Thursday, the 31st instant, at three o'clock, to consider and discuss a report which has been prepared by a committee of that body on the best means of preventing loss of life from fires in theatres and other places of public resort. The report deals principally with the following points:—(*a*) Structural arrangements—including arrangements for heating, and with special reference to exits; (*b*) arrangement and treatment of scenery and accessories; (*c*) arrangement of illuminating appliances, and stage effects involving the use of gas, pyrotechnic compositions, &c.; (*d*) regulations, organisation of fire brigades, &c. Copies of the report can be obtained on application at the offices of the society in John-street, Adelphi. It is announced that persons who are not members of the society can obtain tickets for this meeting by applying to the secretary, at the above address.

LETTERS TO THE EDITOR.

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

STEPHENSON'S LINK MOTION.

SIR,—Since the invention of this practically simple, though theoretically highly complicated reversing and expansion gear, I am not aware that hitherto any good theory about the laws of its movements and particular features has been brought before the public.

The first who wrote a theory of this arrangement of excentrics, rods, and slotted arc of a circle—M. Phillips, a French engineer—made two capital mistakes, which were adopted straight away by several German authors, like Professor G. Zeuner, Gustav Schmidt, Emil Blaha, Otto Grove, J. Weisbach, and Alb. Fliegner. We shall see in a few moments of what kind these errors are, but commence with examining the varieties of construction the Stephenson's link motion is subject to.

FIG. 1

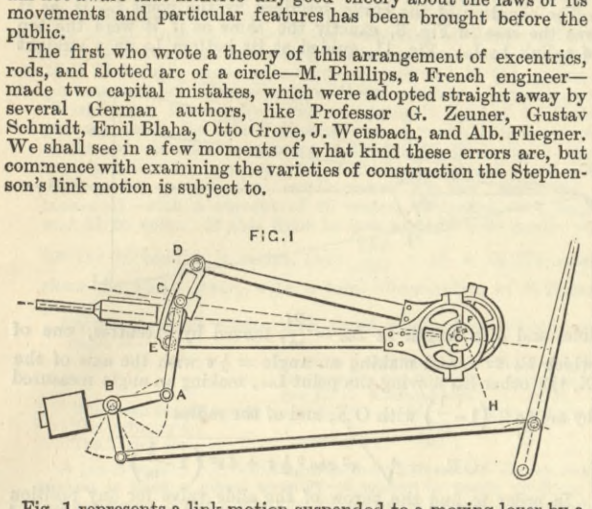
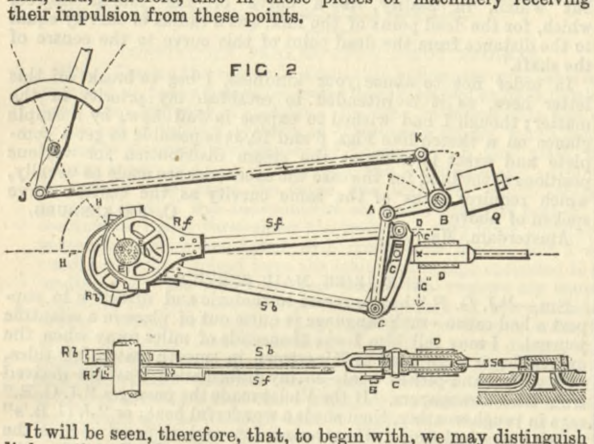


Fig. 1 represents a link motion suspended to a moving lever by a suspension rod which is fixed in the centre of the link, so that if the lever B A remains in its position like the engraving shows it, the centre O of the link is carried by C A through an arc of a circle, the chord of which has to pass through O, the centre of the driving shaft, or nearly so.

The link D E itself is usually bent according to a radius = D F = E G = the length of the excentric rods, which are equal, and the crank is supposed to be in the position O H, so as to divide the angle E between the two excentricities O F and O G into two equal parts. But very often we see the arrangement Fig. 2. Here the link is carried by a suspension rod fixed to its lower end, which circumstance, as we will see afterwards, makes a good deal of difference in the movements executed by the different parts of the link, and, therefore, also in those pieces of machinery receiving their impulsion from these points.

FIG. 2



It will be seen, therefore, that, to begin with, we may distinguish link motions by the two different modes of suspension shown; A, link suspended in its centre, as in Fig. 1; B, link suspended at the top or at the bottom, as in Fig. 2, both being carried by a suspension rod through an arc of a circle, the chord of which passes through O, or nearly so. But each of these two kinds of suspension may be accompanied by other special features. The excentric rods may be found crossing one another, or to be open.

Both our figures 1 and 2 show open excentric rods, but they would have crossed one another if the rod which is now fixed to the top of the link had been lowered to be fixed at the bottom of it, and *vice versâ.* This makes another source of differences in the movement, as we will see in short.

FIG 3

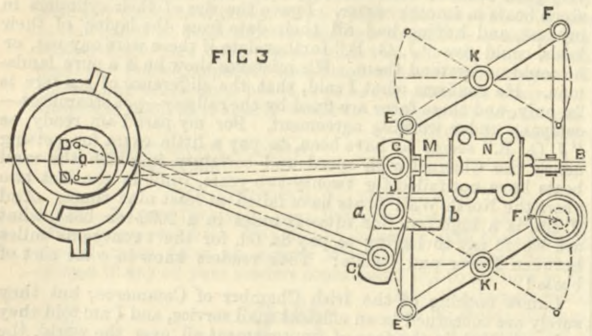
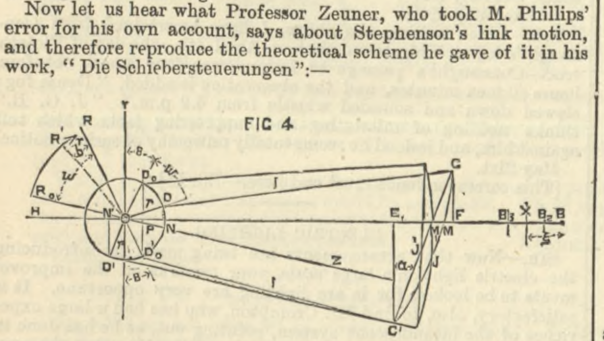


Fig. 3 shows a mode of suspension so as to get the centre of the link guided on a straight line passing through the centre of the driving shaft O. The same might be done for top or bottom of the link. It is called in Germany Landsee's suspension, and is slightly superior to the other method of carrying either centre, top, or bottom of the link through an arc of a circle; but it does not correct the irregularities in the movements of the link when the driving shaft is turning.

Now let us hear what Professor Zeuner, who took M. Phillips' error for his own account, says about Stephenson's link motion, and therefore reproduce the theoretical scheme he gave of it in his work, "Die Schiebersteuerungen":—

FIG 4



"The principal aim of the theoretical examination is to find the relation between a certain angle turned through by the crank when starting from its dead point, and the corresponding way made by the valve, reckoned from its centre of oscillation as origin, at a certain position of the link. . . . . We examine first the case of a link with open rods and excentrics making equal angles with the crank, because this facilitates by its results the examination of crossed excentric rods and unequal angles. . . . . At first, the inclination α of the cord $C\,C^1$ of the link has to be calculated for corresponding values of ω—'the angle turned through by the crank'—and u—'the distance from the centre of the link at which the pin of the slide valve rod is impulsed by the slot in the link.' Then we put the length of the chord of the link $C\,C^1$ as approximately equal to the length of the arcus $C\,C^1$, which we may do, because its radius is always very great. . . . . In the same manner we put the distance between the point M_1 in the chord, and the centre of the chord $J_1 = u = J\,M$. If, now, the crank is in its dead point, the different parts of the arrangement will take the position shown by the thin lines."

Here Professor Zeuner omits to say how he came to this position, because it is not at all the same thing if the link is guided in its centre, or at its top or bottom. The positions will be different in the two cases, and what case Professor Zeuner has in view is not mentioned. Further, the sketch looks as if the chord of the link were perpendicular to O B, which is only the case when the link carried in its centre is lifted with this centre in the line O B. But we go further:—

"If, now, the crank turns through an angle ω, the excentricities, the rods, and the link will occupy the position shown by the thick lines. . . . . Then the point M which moves the valve rod pin will not leave the line O B when taking the suspension rod long enough, because the latter in the adopted position will keep the link on the same, or approximately the same, height during the revolution of the crank shaft."

I observe to Professor Zeuner that the length of the suspension rod has nothing to do with the point M leaving the line O B, or with its remaining in it. According to Professor Zeuner, the arrangement as shown in Fig. 3—Landsee's suspension—ought to prevent completely the point M from leaving the line O B. We will see that even in this case, which renders the suspension rod = ∞—which, I suppose, is sufficiently long—the point M of the link, pushing and pulling the valve rod pin, may leave O B, make a complete revolution of 360 deg., and return to its place.

"Now," says Professor Zeuner, "we project C and C_1 in F and F_1 upon O B, and in the same way D and D^1 by N and N^1 on O B, and determine, first, the angle $F\,C\,C_1 = F_1\,C_1\,C = \alpha$. We have

$$\sin.\ \alpha = \frac{F\,F_1}{C\,C_1} = \frac{O\,F - O\,F_1}{2c},$$

and determine the value:

$$O\,F = O\,N + N\,F = O\,N + \sqrt{D\,C^2 - (C\,F - D\,N)^2} =$$

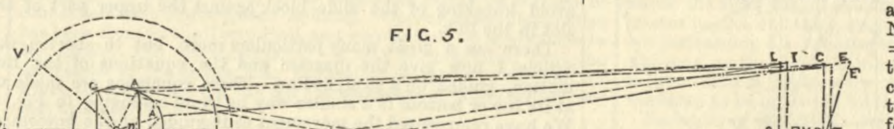
$$r \sin.\ (\delta + \omega) + \sqrt{l^2 - \left\{(c-u)\cos.\ \alpha - r\cos.\ (\delta + \omega)\right\}^2}$$

or approximately, if we say for the *small angle* α that $\cos.\ \alpha = 1$, and neglect the members with l in a higher power when developing into a series the member under the root," &c.

Here I beg to stop Professor Zeuner. If we look at the drawing, it will be easy to see that really the angle α will be small when $C\,C_1$ is great with respect to $D\,D_1$, but will increase very rapidly when $C\,C_1$ decreases. This decrease of $C\,C_1$, which Professor Zeuner recommends several times in his book, has a theoretical as well as practical limit, and this limit is nothing else but the distance $D\,D_1$, *i.e.*, the distance between the two centres of the excentrics. This limit has not been indicated by Professor Zeuner. If $C\,C_1$ becomes equal to $D\,D_1$ it is very easy to see what will happen. $D\,D_1$ becoming a chord in a circle described with a radius = O D, forms a parallelogram with the two rods D C and $D_1\,C_1$, and these four elements cannot produce anything else but parallelograms; the points D and D_1 also C and C_1 acting as hinges, and the curves described by C and C_1 are ellipses. Now it is clear that if $D_0\,D_0$ was the position at one of the dead points of the crank, O p will be its distance from the centre of the shaft to the centre of $D\,D_1$. This point p makes a complete revolution with the shaft, therefore at the other dead point p must be found at the same distance of O, but on the other side; while D_1 D—with D_1 above and D under—will be again perpendicular to O B. Also in this position $D_1\,D\,C\,C_1$ must be a parallelogram, and therefore $C\,C_1$ must have moved towards O for 2 × O p. If we take $C\,C_1 < D\,D_1$ the link motion becomes impossible, because $D\,D_1$, when becoming horizontal, would tear $C\,C_1$ to pieces, or break or bend the rods D C and $D_1\,C_1$.

All these important facts Professor Zeuner overlooks when recommending to make the "link as small as possible," without telling us where the possibility is at an end. The first practical consequence Professor Zeuner derives from his theory is the rule: "The link of Stephenson requires a radius of curvity g = to the length l of the excentric rod." We will see in how far this is right; Professor Zeuner deriving his results from formulæ containing the erroneous suppositions I have shown above, we cannot trust their consequences. Fig. 5.—Let O be the centre of the shaft, O V the crank, O A = O B the excentricities, and ∠ V O A = ∠ V O B; A B will be the revolving chord over the circumference of the circle A B D C. If A E = B F = the length of the excentric rods, and E F the chord of the link, the arrangement is what is called "link motion with open rods." If we disconnect the excentric rods from E and F and connect A with the bottom, and B with the top of the link, they will take the positions A H and B G, and be called, therefore, crossing rods. When turning, in the first case with open rods, the crank through 180 deg., A will have taken the position D and B the position C, whilst E F, after certain oscillations and moving with its centre from T towards Q, takes the position L M, the centre of the link being supposed to be guided in a straight line, as in Landsee's suspension, Fig. 3.

FIG. 5.



When turning, in the second case of crossing rods, the crank through 180 deg., the position of the link which was G H when the crank V was in its first dead point, will have become I K, and its centre S will have moved from S to R. It will be seen that R S, or the throw of the centre of the link with crossing rods, is smaller than Q T, its throw with open rods. It will be understood by the figure that R T = Q S, because the trapezium A B F E is the same as the trapezium C D K I, so that R T = P N. In the same way Q S will be found = P N, because the triangles A a B and G a H are identical with C b D and L b M, so that P N = $a\,b$ = Q S, therefore Q T = R S + 2 S T = R S + 2 Q R. In consequence, if the centre of the link has to move the valve rod, the latter will get the throw Q T, with open, and R S with crossed excentric rods. If the slide valve shall be adjusted so as to give equal lead to the steamports at both the dead points, the centre of oscillation of the link must be at X when X T = Q X or X S = X R. But in this case the cut-off is not the same for the two faces of the piston, nor can the exhaust, with perfectly symmetrical slide valves, commence at the same point of the stroke fore and aft. For this case the steam distribution is wished identical, which requires unequal laps for steam inlet as well as for the exhaust; a point V may be chosen so that with open rods Q U be = to lap + lead at one steam port, and U T = lap + lead at the other steam port. If the compression is raised up to the inlet pressure the lead may be = 0. Let the excentricities O A and O B be called = e, the angle A O B under which they are keyed to the shaft = ϵ, the length of the rods = s, and the length of the link = 2 c, so that c = T E = Q L = S G = R I; further O X = a and O U = a, then we find easily—

$$s^2 = \left(\left\{\begin{matrix} a + X\,T \\ \text{or} \\ a_1 + U\,T \end{matrix}\right\} - e\cos.\ \tfrac{1}{2}\epsilon\right)^2 + \left(c - e\sin.\ \tfrac{1}{2}\epsilon\right)^2,$$

$$\left\{\begin{matrix} a + X\,T \\ \text{or} \\ a_1 + U\,T \end{matrix}\right\} - e\cos.\ \tfrac{1}{2}\epsilon = \sqrt{s^2 - (c - e\sin.\ \tfrac{1}{2}\epsilon)^2}$$

$$X\,T = -a + e\cos.\ \tfrac{1}{2}\epsilon + \sqrt{s^2 - (c - e\sin.\ \tfrac{1}{2}\epsilon)^2}$$

$$U\,T = -a_1 + e\cos.\ \tfrac{1}{2}\epsilon + \sqrt{s^2 - (c - e\sin.\ \tfrac{1}{2}\epsilon)^2}$$

and $s^2 = \left\{\left(\begin{matrix} a_1 - Q\,U \\ \text{or} \\ a - Q\,X \end{matrix}\right) + e\cos.\ \tfrac{1}{2}\epsilon\right\}^2 + (c + e\sin.\ \tfrac{1}{2}\epsilon)^2$; hence,

$$Q\,U = a_1 + e\cos.\ \tfrac{1}{2}\epsilon - \sqrt{s^2 - (c + e\sin.\ \tfrac{1}{2}\epsilon)^2}$$

$Q\,X = a + e\cos.\ \tfrac{1}{2}\epsilon - \sqrt{s^2 - (c + e\sin.\ \tfrac{1}{2}\epsilon)^2}$, so that

$$Q\,U + U\,T = T\,X + Q\,X = Q\,T = 2\,e\cos.\ \tfrac{1}{2}\epsilon + \sqrt{s^2 - (c - e\sin.\ \tfrac{1}{2}\epsilon)^2} - \sqrt{s^2 - (c + e\sin.\ \tfrac{1}{2}\epsilon)^2} \quad . \quad . \quad (1)$$

In the same way we find—

$$R\,S = 2\,e\cos.\ \tfrac{1}{2}\epsilon + \sqrt{s^2 - (c + e\sin.\ \tfrac{1}{2}\epsilon)^2} - \sqrt{s^2 - (c - e\sin.\ \tfrac{1}{2}\epsilon)^2} \quad (2)$$

The value (2) deducted from (1) gives—

$$Q\,T - R\,S = 2\,Q\,R = 2\,S\,T = 2\sqrt{s^2 - (c - e\sin.\ \tfrac{1}{2}\epsilon)^2} - \sqrt{s^2 - (c + e\sin.\ \tfrac{1}{2}\epsilon)^2}$$

or $Q\,R = S\,T = \sqrt{s^2 - (c - e\sin.\ \tfrac{1}{2}\epsilon)^2} - \sqrt{s^2 - (c + e\sin.\ \tfrac{1}{2}\epsilon)^2} \quad (3)$

If the link decreases to its limit value $c = \pm\, e\sin.\ \tfrac{1}{2}\epsilon$, we have Q R = S T = 0, for the case the link makes a complete revolution (360 deg.), and

$Q\,R = S\,T = s - \sqrt{s^2 - 4e^2\sin.^2\ \tfrac{1}{2}\epsilon}$ (4), for the case the link makes half a revolution (180 deg.)

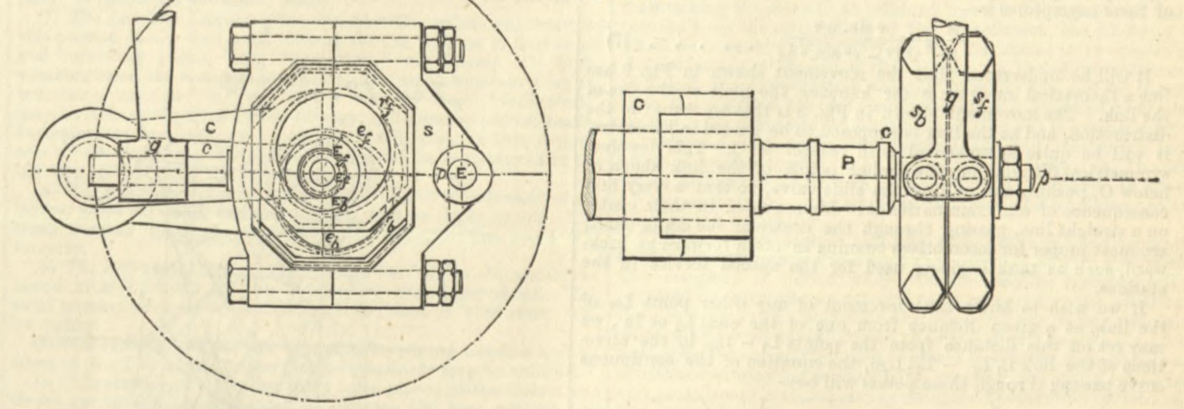
If c is smaller than A N = $e\sin.\ \tfrac{1}{2}\epsilon$, the value of Q R becomes complex, which means, like we said before, that this is not possible. We see also from the formula (3) that Q R = S T = 0 for $e\sin.\ \tfrac{1}{2}\epsilon$ = O, and this condition gave me the idea of inventing "excentres," so as to fulfil it, without making $\epsilon = o$.

Fig. 6 shows the arrangement of this "excentre," specially designed for the purpose of showing the possibility of the execution. The principle is the same as that which is often used in steam pumps, having a slotted central guide between the steam—and pump cylinders to receive the crank of a shaft. In the same way as the position of the piston is in these engines = the projection of the arc of the crank circle turned through by the crank; here the way $p^1\,E^1$ of the excentric rod head E^1 is = $p\,E_f{}^1$ = the projection of any position of the excentre E_f upon the centre line $p\,E^1$, and the revolving motion of E F is converted into a straight one, which for any position is only the cosinus of the angle between the excentricity and the centre line of the crank C. The excentric is supposed to be made for an outside cylinder locomotive, with outside valve gear, worked by a counter crank. e_f and e_b are the forward and backward "excentres," r_f and r_b their rings transformed in octogones, s a pair of slides allowing the rings to move up and down, and g a pair of guides to keep the slide frames s in their position.

If we consider now the link moving forward and backward on the line O X—Fig. 5—its centre T^1 will move on O T just as much as the projection n of the centre N^1 on the same line, so that N n = T T^1 for every position. If, therefore, for a position of the crank V^1 we want to find the position of the link, we operate as follows:—Draw $V^1\,A^1$ = V A = $V^1\,B^1$ and prolongate V^1 O until N^1; make $N^1\,n \perp$ O T, and make $T\,T^1$ = N n. With s = A E as radius, describe from A^1 and B^1 as centre circles, and with c = T E as radius, describe from T^1 as centre, other arcs of circles; the points of intersection E^1 and F^1 will be in the same straight line with T^1, giving the exact position of the link. The construction, however, for every point would be very difficult and troublesome with respect as well to the large drawing as to the difficulty of radius.

I found, therefore another mode, allowing every link motion to be drawn in full size on a relatively small paper. The principle is as follows:—the projections N n of N^1 N, being always the same as $T\,T^1$, and when adopting the "excentre," Fig. 6 Q T becoming = R S = P N, we may carry the movement of the link over to the movement of the excentres A and B, and get the following link motion diagram, Fig. 7.

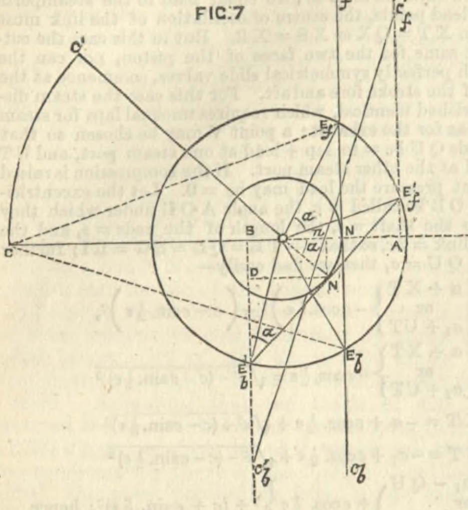
FIG. 6.



Let O be the crank shaft, C the crank, E_f and E_b the forward and backward excentres, and c_f and c_b the position of the link eyes at the dead point C; then to find the positions of the link corresponding to a given position C_1 of the crank, proceed as follows:—Make $C_1\,E^1{}_f = C_1\,E^1{}_b$; draw C_1 O N^1 and $E^1{}_f\,E^1{}_b$, erect $E^1{}_f\,c^1{}_f$ and $E^1{}_b\,c^1{}_b \perp$ C N, make $n\,c^1{}_f = n\,c^1{}_b = N\,c_f$; $c^1{}_f\,c^1{}_b$ will be the required position of the link; and now the equation of the point

c^1_f. Be $\angle E_f O E_b = \epsilon$, $O E_f = O E_b = e$, and $N c_f = l$. Let the crank C be turned through an angle $\alpha = C_1 O C$, then $E_f O E^1_f$ and $N O N^1$ will be also $= \alpha$, and $O N = e \cos \frac{1}{2} \epsilon$, $E_f N = e \sin. \frac{1}{2} \epsilon$. Further is $O n = O N^1 \cos. \alpha = O N \cos. \alpha = e \cos. \frac{1}{2} \epsilon \cos. \alpha$; $n N = e \cos. \frac{1}{2} \epsilon \sin. \alpha$.

FIG. 7



$E^1_b B = E^1_b D + B D = E^1_b N^1 \cos. \alpha + N^1 n = e \sin. \frac{1}{2} \epsilon \cos. \alpha + O N^1 \cos. \alpha = e \sin. \frac{1}{2} \epsilon \cos. \alpha + e \cos. \frac{1}{2} \epsilon \sin. \alpha$ . . . . (1)
$O B = x = e \cos. \frac{1}{2} \epsilon \cos. \alpha - e \sin. \frac{1}{2} \epsilon \sin. \alpha$. Now is $n {c^1_b}^2 = B {c^1_b}^2 + B n^2$, or $l^2 = y^2 + e^2 \sin.^2 \frac{1}{2} \epsilon \sin.^2 \alpha$.

$$\text{Hence } e \sin. \tfrac{1}{2} \epsilon \sin. \alpha = \pm \sqrt{l^2 \; y^2},$$

$$\text{and } \cos. \alpha = \pm \sqrt{1 - \frac{l^2 - y^2}{e^2 \sin^2 \frac{1}{2} \epsilon}}$$

This value substituted in (1) gives:—

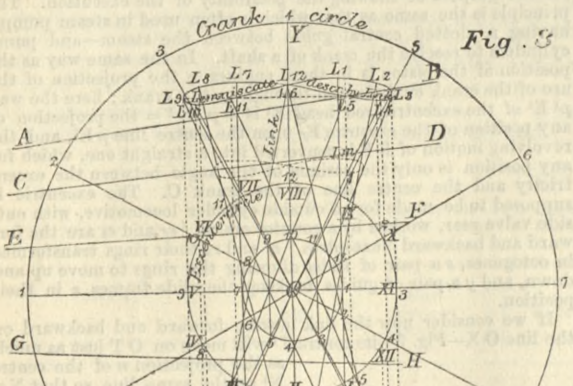
$$x = \pm \text{cotg. } \tfrac{1}{2} \epsilon \sqrt{e^2 \sin.^2 \tfrac{1}{2} \epsilon - l^2 + y^2} \mp \sqrt{l^2 - y^2} \quad . \quad . \quad (2)$$

or $x \pm \sqrt{l^2 - y^2} = \pm \text{cotg. } \frac{1}{2} \epsilon \sqrt{e^2 \sin.^2 \frac{1}{2} \epsilon - l^2 + y^2}$; and after some reduction: $4 x^2 (l^2 - y^2) = \left\{ e^2 \cos.^2 \frac{1}{2} \epsilon - x^2 - \frac{l^2 - y^2}{\sin.^2 \frac{1}{2} \epsilon} \right\}^2$. (3)
which is an equation of the fourth degree, and represents a lemniscate. When taking in (2) $l = e \sin. \frac{1}{2} \epsilon$, we have $x = \pm y \text{ cotg. } \frac{1}{2} \epsilon \mp \sqrt{e^2 \sin.^2 \frac{1}{2} \epsilon - y^2}$, or after reduction,

$$x^2 + \frac{y^2}{\sin.^2 \frac{1}{2} \epsilon} + 2 x y \text{ cotg. } \tfrac{1}{2} \epsilon = e^2 \sin.^2 \tfrac{1}{2} \epsilon \quad . \quad . \quad . \quad (4)$$

which is the equation of two ellipses, the conjugated diameters of which form an angle $= \frac{1}{2} \epsilon$, and are represented by the values $2e$ and $2e \sin. \frac{1}{2} \epsilon$. The figures 8 and 9 show these curves, and the different positions of the link indicated by the same numbers as the corresponding positions of the crank and the excentricities, the Roman figures with L showing the consecutive positions of the bottom end of the link, the Arabic figures with L those of its top.

Fig. 8



It will be seen from Fig. 8 that the moving link has an envelope. The equation of the variable position of the link is easily found to be—

$$\sqrt{\frac{l^2 - e^2 \sin.^2 \frac{1}{2} \epsilon \sin.^2 \alpha}{y}} = \frac{e \sin. \frac{1}{2} \epsilon \sin. \alpha}{x - e \cos. \frac{1}{2} \epsilon \cos. \alpha}, \quad . \quad . \quad (5)$$

hence by differentiation with respect to cos. α, and making use of the method of Bezout or Sylvestre, and of the theory of the determinants, we find for the equation of the envelope—

$$(x^2 + y^2)\,(x^2 e^2 \cos.^2 \tfrac{1}{2} \epsilon - 1) = y^2 l^2 x^2 \text{ cotg.}^2 \tfrac{1}{2} \epsilon, \quad . \quad . \quad (6)$$

which is an equation of the fourth degree, though the form of the curve is very similar to that of a hyperbola. This envelope has two asymptotes, which are the directions of the positions $L_4 E_{iv}$ and $L_{10} L_x$ passing through the centre O of the figure. The equation of these asymptotes is—

$$\frac{x}{y} = \frac{e \sin. \frac{1}{2} \epsilon}{\sqrt{l^2 - e^2 \sin.^2 \frac{1}{2} c}} \quad . \quad . \quad . \quad . \quad . \quad (7)$$

It will be understood that the movement shown in Fig. 9 has but a theoretical importance for knowing the limit of the size of the link. The movement shown in Fig. 8 is that we want for the distribution, and as the link is supposed to be guided in its centre, it will be quite symmetrical with respect to O. This involves symmetrical distributions for similar points of the link above or below O, pushing and pulling the slide valve, so that a very first consequence of our examination is:—Links guided in their centre on a straight line, passing through the centre of the crank shaft, are most proper for locomotives running as often forward as backward, such as tank engines, used for the special service in the stations.

If we wish to know the movement of any other point L_m of the link, at a given distance from one of the ends L_1 or L_I, we may set off this distance from the points $L_1 - L_{12}$, in the directions of the link $L_1 L_I - L_{12} L_{xii}$, the equation of the continuous curve passing through these points will be—

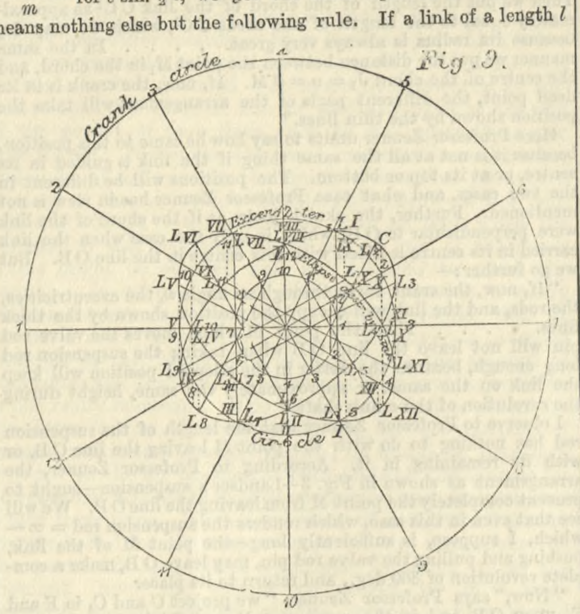
$$x = \pm \text{cotg. } \tfrac{1}{2} \epsilon \sqrt{e^2 \sin.^2 \tfrac{1}{2} \epsilon - l^2 + m^2 y^2} \mp \frac{1}{m} \sqrt{l^2 - m^2 y^2}, \quad (8)$$

$\frac{l}{m}$ being the distance of the examined point from the centre of the link. This equation reduced gives—

$$4 x^2 \left(\frac{l^2}{m^2} - y^2 \right) = \left\{ e^2 \cos.^2 \tfrac{1}{2} \epsilon - x^2 - \left(m^2 \text{cotg.}^2 \tfrac{1}{2} \epsilon + 1 \right) \left(\frac{l^2}{m^2} - y^2 \right)^2 \right\} \quad . \quad . \quad . \quad (9)$$

For $m = 1$ we get the equation (3) again; for $m = \infty$ we have $y = o$, that is the axis of the X. But this equation has another feature. If in equation (3) we substitute $\frac{l}{m}$ for l, and $\frac{e \sin. \frac{1}{2} \epsilon}{m}$ for $e \sin. \frac{1}{2} \epsilon$, we get the same equation as (9), which means nothing else but the following rule. If a link of a length l

Fig. 9.

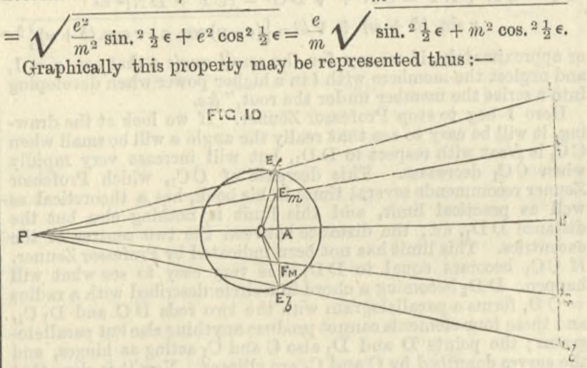


is connected at its ends to excentres e, keyed at a distance $2 e \sin. \frac{1}{2} \epsilon$ from centre to centre, any point at a distance $\frac{l}{m}$ from the centre of the link will be moved in the same way as if it were connected to excentres keyed at a distance $\frac{2 e}{m} \sin. \frac{1}{2} \epsilon$ and of a radius

$$= \sqrt{\frac{e^2}{m^2} \sin.^2 \tfrac{1}{2} \epsilon + e^2 \cos^2 \tfrac{1}{2} \epsilon} = \frac{e}{m} \sqrt{\sin.^2 \tfrac{1}{2} \epsilon + m^2 \cos.^2 \tfrac{1}{2} \epsilon}.$$

Graphically this property may be represented thus:—

FIG. 10



Let O be the crank shaft; ϵ_f and ϵ_b the forward and backward excentrics to a link $L_f L_b$; call $\angle E_f O E_b = \epsilon$; $O E_f = O E_b = e$, and $B L_f = l$. A point L_m of the link moved by this mechanism will be moved exactly in the same way as if the excentres had been E_m and E_m moving a link $L_m L_M$. The reader will understand that if the excentres are made as shown in Fig. 6, the link must be a straight line, because the centres of oscillation of all of the lemniscates fall in a straight line.

The space kindly allowed to me by the editor of this paper for the publication of a summary of this theory being already taken, I cannot develope here the mathematical demonstrations showing which are the best conditions for the construction of link motions, guided in their centre. But it will be seen from the drawing, Fig. 8, that in order to get the full throw of the excentre, the link must be lifted or lowered as much as the distance of O to $L_g - L_3$ and its length, in order to permit the oscillating movements, must be greater than l if the full throw $= 2 \times$ excentricity is required. We find its length in the asymptote position. The distance from O to the intersection of $L_g L_3$ with $O L_4$ is the required length, to avoid knocking of the slide block against the upper part of the slot in the link.

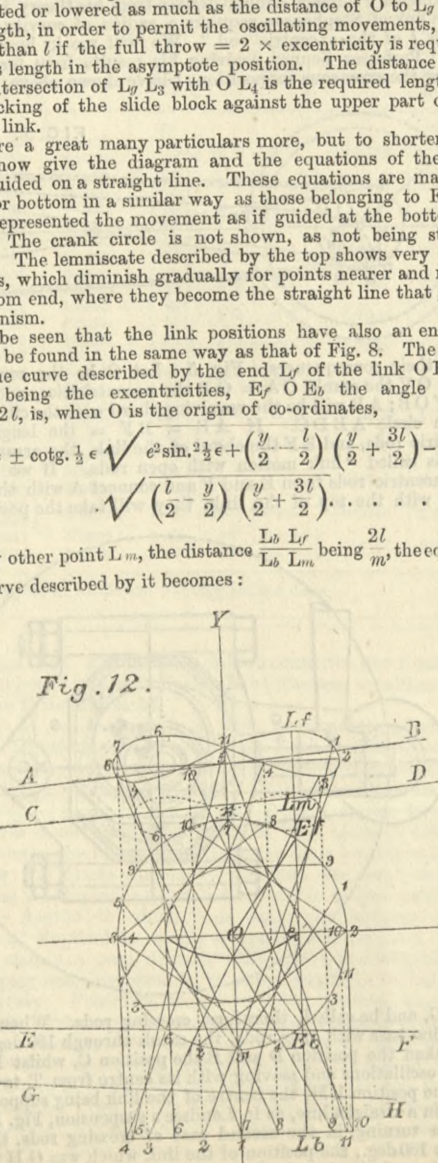
There are a great many particulars more, but to shorten this article I now give the diagram and the equations of the link motion, guided on a straight line. These equations are made up at its top or bottom in a similar way as those belonging to Fig. 8. We have represented the movement as if guided at the bottom of the link. The crank circle is not shown, as not being strictly necessary. The lemniscate described by the top shows very heavy oscillations, which diminish gradually for points nearer and nearer to its bottom end, where they become the straight line that guides the mechanism.

It will be seen that the link positions have also an envelope which can be found in the same way as that of Fig. 8. The equation of the curve described by the end L_f of the link $O E_f$ and $O E_b = e$ being the excentricities, $E_f O E_b$ the angle ϵ, and $L_b L_f = 2l$, is, when O is the origin of co-ordinates,

$$x = \pm \text{cotg. } \tfrac{1}{2} \epsilon \sqrt{e^2 \sin.^2 \tfrac{1}{2} \epsilon + \left(\frac{y}{2} - \frac{l}{2}\right)\left(\frac{y}{2} + \frac{3l}{2}\right)} - \sqrt{\left(\frac{l}{2} - \frac{y}{2}\right)\left(\frac{y}{2} + \frac{3l}{2}\right)} \quad . \quad . \quad . \quad . \quad (10)$$

For any other point L_m, the distance $\frac{L_b L_f}{L_b L_m}$ being $\frac{2l}{m}$, the equation of the curve described by it becomes:

Fig. 12.



$$x = \pm \text{cotg. } \tfrac{1}{2} \epsilon \sqrt{e^2 \sin.^2 \tfrac{1}{2} \epsilon - l^2 + \frac{m^2}{4} y^2} \mp \frac{2 - m}{m} \sqrt{l^2 - \frac{m^2 y^2}{4}} \quad (11)$$

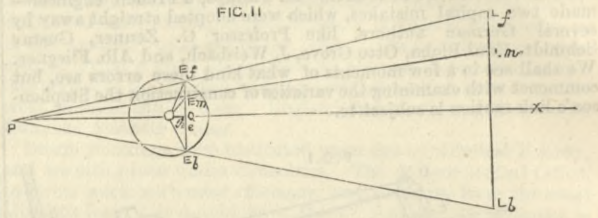
For the centre of the link $m = 2$, and therefore the equation of the curve described by the centre is

$$x = \pm \text{cotg. } \tfrac{1}{2} \epsilon \sqrt{e^2 \sin.^2 \tfrac{1}{2} \epsilon - l^2 + y^2},$$

which represents a hyperbola.

The equation of the curve described by the point L_m is, as it was the case in Fig. 8, exactly the same as if it were the top of a link $L_b L_m$, Fig. 11, guided at its bottom L_b on a straight

FIG. 11



line, and of a length $L_b L_m = \frac{2l}{m}$, moved by excentres, one of which $E_b = e$, and making an angle $= \frac{1}{2} \epsilon$ with the axis of the X, the other E_m moving the point L_m, making an angle measured by arc $tg\, 2 \left(1 - \frac{1}{m}\right)$ with O X, and of the radius

$$O E_m = \sqrt{e^2 \cos.^2 \tfrac{1}{2} \epsilon + 4 e^2 \left(1 - \frac{1}{m}\right)^2}.$$

In order to find the throw of the slide valve for any position of the link, we remember that the axis of the slide valve-rod passes through the centre of the driving shaft, and that, therefore, if we lift or lower the link, the movement of the slide block in the slot of the link will be found in the following way —Figs. 8 and 10:—Draw A B, C D, E F, G H, I K, and L M so as to converge in the centre of the shaft. The distance of this centre to O being constant, the equation of any straight line passing through this centre and a certain point of the axis O Y is known too. These equations, combined with the equation of the envelopes, give the points of intersection as the extremities of the throw, and therefore its value.

If, now, a curve is brought through the centres of these different throws of the slide valves, this curve will be the central curve of the link motion, which Professor Zeuner thinks to be a parabola, but which, in reality, is a curve of the fourth degree, which, for the dead point of the link, has a radius of curvity equal to the distance from the dead point of this curve to the centre of the shaft.

In order not to abuse your kindness, I beg to break off this letter here, as it is intended to establish my priority in the matter; though I had wished to expose in full how, by a simple glance on a sketch like Figs. 8 and 10, it is possible to get a complete and exact idea about the steam distribution for various positions of the link, for the case the excentrics are made as usually, which requires links of the same curvity as the central curve spoken of above.

C. FALKENBURG.

Amsterdam, May 9th.

THE IRISH MAIL SERVICE.

SIR,—"J. G. B." has to resort to rhetoric and invective to support a bad cause—such language is quite out of place in a scientific journal. I may tell him I was thousands of miles away when the express boats were tried to Kingstown in smooth water, fair tides, and with hand-picked coal—so my information was not derived from Irish newspapers. If the Violet made the passages "J. G. B." says in rough weather, then she is a wonderful boat; or "J. G. B.'s" watch keeps bad time. He gives no date and no proof; but as the mail boats' passages are officially recorded for the Post-office, the Connaught's passage that day can be easily ascertained. By "J. G. B.'s" showing, she must have had a head wind and Violet a fair one. As I stated before, on March 29th, in a south-west gale, the mail boat Leinster beat Violet an hour, and Violet was docked next day—leaky from over-driving probably; and Connaught is faster than Leinster. Also on Lily's trial, the Munster, in fine weather, beat her eleven minutes with a dirty bottom. These facts were verified by Post-office officials. Rose and Shamrock are out of it, being short of boiler power. Just three weeks ago Ulster beat Shamrock forty minutes in a moderate easterly gale. I never heard of anyone envying Lily, Violet, &c.; they are very good boats of their class, and nearly as fast as the new Folkestone boats in smooth water. I gave the size of their cylinders in my last, and having had all their data from the laying of their keels, could give "J. G. B." further data if there were any use, or he could understand them. His mistakes show he is a pure landsman. He confirms what I said, that the difference of sea fare is 2s. only, and these fares are fixed by the railway—not steamboat—company under working agreement. For my part I am ready, as "J. G. B." seems to have been, to pay a little extra for getting across the Channel with speed and certainty, in which the mail boats have not failed for twenty-two years, while in the last two years the North Wall boats have failed at least nine times. And if 10s. is a high fare for fifty-six miles in a 2000-ton boat, what are we to say to having to pay 8s. 6d. for the twenty-one miles between Dover and Calais? Your readers know in what sort of boats!

I know nothing of the Irish Chamber of Commerce; but they surely are concerned in an efficient mail service, and I am told they only ask that in the face of improvement all over the world, the new Irish mail boats shall not be inferior to the present, instead of being some 40 per cent. smaller and less powerful. "J. G. B." brought certain grave charges against that body, which, as he fails to substantiate them, may be assumed to be false.

Thanking you, Sir, for your kindness, I hope I shall not again trespass on your space, as I am just leaving Ireland, and in one thing "J. G. B." is right—I care nothing for Violet, Lily, or mail boats, but only for

FAIR PLAY.

Dublin, May 19th.

P.S.—Since writing the above, I have ascertained from Connaught's log at Kingstown, that on April 4th—the day of Violet's trial—Connaught's passage to Ireland was four hours, not four hours sixteen minutes, and the observation is added, "Dense fog; slowed down and sounded whistle from 4.9 p.m." "J. G. B." thinks nothing of misstating and suppressing facts which tell against him, and indeed he seems totally unworthy of serious notice.

May 21st.

[This correspondence must end here.—ED. E.]

ELECTRIC LIGHTING.

SIR,—Now that arrangements are being made for introducing the electric light on a large scale, your remarks on the improvements to be looked for in arc lighting are very opportune. It is satisfactory, also, to find Mr. Crompton, who has had a large experience of the incandescent system, pointing out, as he has done in your issue of the 18th inst., the mistake of thinking that the consumer must elect between the arc and the incandescent systems, instead of having both introduced side by side wherever it can be done profitably. Now, what are the conditions necessary to their profitable introduction together? Generally the character of the current for use by the arc system is different from that required for lighting by incandescence, and therefore, to obtain the highest efficiency from each, the area to be illuminated should be of such a description that the separate leads of each system should be fully used—conditions which cannot be made at will, if at all. Economy and efficiency, therefore, must be looked for in a different direction. I think the solution of the problem will be found—indeed, I may say the solution has been found—in the flexible carbons for use in arc lamps invented by Mr. F. H. Varley. These carbons accommodate themselves to a current of exactly the same kind as is used for incandescence, and so the current can be taken from the same leads without loss in permutation, and the alteration, instead of impairing the efficiency of the arc system, has increased it enormously. Mr. Varley has advanced in a direction directly opposite to that referred to by Mr. Crompton, his aim throughout being to obtain flexibility instead of density and hardness. Early experiments at the Royal Aquarium proved the possibility of obtaining from fifteen to twenty subdivisions per horse-power; later experiments that 15·5 watts produced a light, as measured by the grease-spot photometer, of 69-candle power, or equal to forty-eight subdivisions per horse-power, with an aggregate light of 3·312-candle power; whilst the latest experiments, carried out in the presence of several electrical engineers, with ten of these same candles arranged in series, gave an estimated illumination of from 1500 to 2000-candle power—the candle-power in this case was not measured—with a current of 85 watts, composed of 4 ampères and 21·25 volts. If this light be put at only 1000-candle power for the 10 candles in series, then $\frac{746}{85} \times 10 = 87{\cdot}776$ subdivisions per horse-power, with a total illumination of 8777-candle power.

Comparing these results with those obtained by other systems, have :—

	Sub-divisions per H. P.	Current absorbed per c.p. Volt-ampères.	Total illumination per H. P.
The Swan incandescent ..	10 to 14 ..	3·5 ..	200 to 300 c. p.
The ordinary arc	0 ..	·37 ..	2000 ,,
The Varley arc	87 ..	·085 ..	8777 ,,

A peculiar and very striking characteristic of the Varley flexible carbon is that a given amount of energy in watts produces the same amount of light, whether these watts be composed chiefly of volts or chiefly of ampères, provided the potential be not reduced below sixteen volts.

As these results are so thoroughly in advance of anything that has hitherto been obtained, a considerable amount of incredulity is to be expected, and I should not have ventured to have stated them had not the experiments been made and repeated under strictly test conditions. I may say, too, that I shall be happy to make arrangements to have them again repeated for the satisfaction of any expert who may so desire. The instruments used in these experiments were the Siemens dynamometer for determining the ampères, the Siemens watt meter for the volt-ampères, and the grease-spot photometer for measuring the amount of light.

JOHN RONALD SHEARER, A.C.A.,
One of the Varley Patents Proprietors.

10, Basinghall-street, London, E.C., May 21st.

CONTINUOUS BRAKES UPON PILOT ENGINES.

SIR,—During the recent Whitsuntide holidays several cases have occurred of heavy passenger trains drawn by two engines breaking loose when stopping at stations. In some instances this was due to the use of inferior systems of continuous brakes, which cannot be made to work simultaneously throughout a long train, thus placing a very unequal strain upon the draw-bars and couplings. In several other cases the cause was that the leading or pilot engine "brake" was independent of, and formed no part of, the continuous brake throughout the train. A very large number of passenger engines are fitted with continuous brakes, but a very small proportion indeed have the main brake pipe extended to the leading end; the result is that when two engines are coupled together, the first one cannot form any part of the continuous brake. When two engines are employed to draw a train, the driver of the first must be in the best position to see danger, more especially when the steam from the leading engine blows down and completely obscures the second driver's view; therefore it is very necessary that the leading driver should have full command over, and be instantly able to apply, the whole of the brakes throughout the train. In like manner the "automatic action," or in case of a "stop made by the guard," the brake should be applied upon the leading engine and tender, if not a break-loose is almost certain to follow.

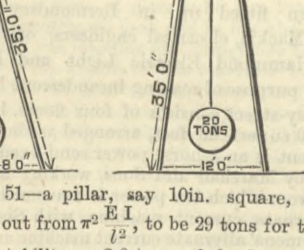
Is it not absurd that when a long express train is drawn by two engines the leading driver has the best view of the road, but the driver of the second engine has the control of the continuous brake? It therefore follows that when the first man sees danger he is powerless, and can only whistle to call the attention of the second driver, who, perhaps, cannot see in consequence of steam and smoke; this, of course, causes a loss of several seconds, which, when running at express speed, means all the difference between danger and safety. All that is required is a few feet of iron pipe and an additional hose pipe at the front of every engine fitted with any continuous brake. The whole brake power would then be in the hands of both drivers, and we should hear much less of broken draw bars upon trains with two engines than we do at present. Some companies have fitted some of their engines with the leading brake pipe, but it is to be regretted the others do not adopt the plan, as it clearly would be a very great advantage.

CLEMENT E. STRETTON.

Saxe Coburg-street, Leicester,
May 22nd.

THE STRENGTH OF SHEAR LEGS.

SIR,—In your 38th vol., page 152, you illustrate shear poles for lifting heavy weights. You do not, however, give the scantling or size of these poles as regards diameter. I should feel much obliged if any of your readers could point out to me how to calculate the necessary size of similar shear poles to carry say 20 tons eight feet clear of feet of poles; the extreme length of poles being say 35ft.



I have looked up several works on the strength of long wooden pillars, but the results from the formulæ are so different that I feel bewildered. Thus to give only two authorities:—Unwin, 1st Edit., page 51—a pillar, say 10in. square, 35ft. long, of pine, will work out from $\pi^2 \frac{E\,I}{l^2}$, to be 29 tons for the greatest load consistent with stability, or 2·9 tons safe load; whereas per Molesworth, 17th Ed., page 67, a pillar 10in. square, 30ft. long, would carry a safe load of 7 tons 3 cwt.

Which is correct? A note of the stresses on the various parts, both compressive and transverse, would be acceptable. Could any one recommend a work on subjects of this sort—one not using more profound formulæ than simple equations?

READER.

Leith, May 22nd.

ELEPHANT BOILERS.

SIR,—We are not prepared to question Messrs. Cater, Walker, and Sons' statement in your issue of the 11th inst., as to the greater evaporative efficiency of their boiler over that of the elephant type, but that is only one—though a very important one—of the points which decides the adoption of any type of boiler.

With regard, however, to the amount of repairs required by each type, our experience causes us to differ very considerably with your correspondents' statement. In the rare cases where pure water is obtainable, either naturally or artificially, we can understand their boiler, and others of the same class, working with the ordinary amount of attention for long periods without repairs. But this is not so in the great majority of cases where the feed-water is far from pure. We find that a well made elephant boiler, under the latter conditions, will work for a long time—from twelve to fifteen years—without repairs of any kind, and this we know is more than can be said of the Cater boiler.

We may mention as other good points in the "old-fashioned" boiler the following:—Extreme safety, small attention and watchfulness being required on the part of the stoker, since so great a latitude may evidently be allowed in the water level with perfect immunity from risk; small diameters and consequently thin plates and more efficient heating surfaces; no stayed surfaces, great accessibility to all parts for cleaning, and small parts for easy and cheap transport.

As in addition to the above they have proved themselves more efficient in evaporation than the usual type of Lancashire boilers, we think that they quite warrant the recommendation which they received in your article.

J. AND E. HALL.

Dartford Ironworks, Dartford, May 23rd.

THE CHANNEL TUNNEL.

SIR,—Referring to a passage in your leading article of the 18th inst., on the subject of the "Channel Tunnel," to the effect that "it is well known that Colonel Beaumont, R.E. . . . . is the inventor of the machinery used to bore it," I beg to forward, for your information, a copy of the specification of my patent No. 4347, dated 25th October, 1880, under which the boring machines are constructed.

THOS. ENGLISH, R.E.

Hawley, near Dartford.

CONTRACTS OPEN.

BOROUGH OF LEEDS ELECTRIC LIGHTING.

THE "Electric Lighting Committee" of the Corporation of Leeds are prepared to receive tenders for lighting by electricity the following places, namely:—In the Town Hall: (1) The Victoria Hall; (2) the Vestibule. In the new municipal buildings: (3) The Vestibule; (4) the General Pay office; (5) the "Gas" and "Water" Clerk's office; (6) the General Reading-room—Library division; (7) the Lending Library; (8) the Reference Library—lower level; (9) the Reference Library—upper level. Outside lighting: (10) In front of the Town Hall. Victoria-square: (11) In Calverley-street.

The committee desire it to be distinctly understood by persons who may be prepared to tender that the positions indicated on the plans for the incandescent lamps and pendants, and the number of lamps mentioned as being considered sufficient to efficiently light the places named, are suggestions only on the part of the committee, and are given with a view to the tenders being prepared upon a common basis. Persons tendering are at liberty to suggest any probable improvement, either as regards the proposed position or number of the lamps, or with reference generally to the proposed scheme of lighting. If any departure is made from the character of the installation, as herein suggested, the tenders should be in an alternative form, namely:—(1) To cover the cost of the lighting as suggested by the committee; and (2) to cover the cost of any alternative scheme of lighting proposed in the tender.

(1) *The Victoria Hall.*—The Victoria Hall in the Town Hall is 130ft. long, 71ft. wide, and 72ft. 3in. high. It is at present lighted by sunlights, containing 800 burners, of No. 3 size. The room is used for public meetings, festivals, concerts, balls, banquets, *soirées*, bazaars, panoramas, and similar purposes. The committee direct attention to the position of the grand organ at the north end of the hall, and to the form and area of the orchestra, which upon special occasions is often occupied by a large body of singers and instrumentalists. This circumstance may suggest the desirability of a slight increase in the quantity of light in the neighbourhood of the orchestra. For the present, the space underneath the gallery will not require to be lighted. Incandescent lamps must be used for the lighting of the Victoria Hall. It is suggested that 500 20-candle power lamps should be employed for this purpose. The lamps may be distributed in such a manner as may be considered most conducive to the brilliant illumination of the hall, and as will best harmonise with its architectural proportions and ornamentation. If it should be proposed to suspend chandeliers or coronæ from the roof of the hall, sufficient and convenient means of doing so is afforded by the character of the double roof. The present sunlights are fitted with raising and lowering gear. The Corporation are in possession of several of the large chandeliers recently hung in the Victoria Hall, the brilliant lustres belonging to which, it has been suggested, might be utilised in connection with the proposed lighting. One of these chandeliers has been fixed in the Town Hall, and may be seen on application to Mr. Linsley, the superintendent. It may be mentioned that the receptacles in the arches near the roof at each side of the hall, to which the main pipes of the ten chandeliers were lately affixed, are still available for use.

(2) *The Vestibule, Town Hall.*—One arc lamp of 1000 estimated candle-power to be suspended from the dome in the Vestibule, and and proper raising and lowering gear provided.

The Municipal Buildings: (3) *The Vestibule.*—One arc lamp of 1000 estimated candle-power to be suspended from the roof, and to be provided with proper raising and lowering gear.

(4) *The General Pay Office* (*Plan No.* 1).—This office will be used for the purpose of receiving rates and rents. Suitable raising and lowering gear to be provided. Four arc lamps of 1000 estimated candle-power to be employed in the lighting of this and the adjoining office.

(5) *The Gas and Water Office* (*Plan No.* 3).—The clerks engaged in the work of the gas and water departments will be located at the five desks in this room, and it is suggested that two of the four arc lamps before referred to will be amply sufficient to light the room. Suitable raising and lowering gear to be provided.

(6) *The General Reading-room* (*Plan No.* 4).—This department must be lighted with incandescent lamps, of which fifty-one may be employed, arranged in such manner as may be considered most likely to produce a successful result.

(7) *The Lending Library* (*Plan No.* 5).—The public will resort to this portion of the free public library for the purpose of borrowing and returning books. The "indicators" are frames 4ft. high, standing upon the counters, and show, by a small numbered tablet, whether a book is "in" or "out." One of these "indicators" may be seen at the Free Public Library, in Infirmary-street, Leeds. Incandescent lamps must be used for the lighting of this department. The total number of lamps suggested to be employed in the lighting of this room will be seventy.

(8) *The Reference Library, lower level* (*Plan No.* 6).—Incandescent lamps must be used for the lighting of this department. The total number of lamps proposed to be used in this room will be sixty.

(9) *The Reference Library, upper level* (*Plan No.* 7).—Incandescent lamps must be used for the lighting of this department. The total number of incandescent lamps to be used in this room will be eighty.

Outside lighting.—Four arc lamps to be placed outside and in front of the Town Hall. The present standards may be utilised.

In Calverley-street.—One arc lamp to be placed at the Calverley-street entrance to the Town Hall between the two existing gas standards, which may be utilised for supporting the framework of the lamp.

Engines.—The committee propose, at their own expense, to provide suitable engines and boilers necessary for driving the dynamo machines to be used in connection with any of the tenders they may accept. Each tender must, therefore, contain an estimate of the horse-power required, also a statement of any special matters relating to plant, &c., other than the engines and boilers which the contractor would prefer should be provided by the Corporation in connection with this branch of the tender. The contractor must provide and maintain all necessary belting and countershafting. Any person or company submitting a tender, who may themselves prefer to provide the whole of the plant and machinery necessary for the complete inst llation—including engines and boilers—may propose to do so, but are requested to include such items in a supplemental tender showing the additional estimated cost of providing such engines and boilers, &c.

The power and dynamo station.—The committee propose, at their own cost, to provide, within a distance of 400 yards from, but as near as possible to the Town Hall, a suitable building or place for the engines, boilers, and dynamo machines, and will, in case the committee should provide the engines and boilers, make all necessary foundations for, and properly fix the boilers and engines ready for starting, after which the power will be delivered to the control, care, and maintenance of the contractors. At the end of the term, or on other sooner determination of the contract, the contractor shall re-deliver the engines and boilers to the Corporation in good order and condition, reasonable wear and tear only excepted. The committee will, at their own cost, find and provide the gas, coal, and water for the agreed term, and will also pay all rates and taxes on the station. The contractor must provide the necessary oil, waste, and petty stores.

Dynamo machines.—The tenders must provide for the employment of the Crompton-Bürgin dynamo machines, for both the arc and incandescent lamp lighting.

Conductors and leading wires.—Perfect insulation must be adopted, and each tender must state the character and quality of the conductors, and of the leading and connecting wires to be used.

Regulating apparatus and other fittings.—A list of the regulating apparatus and other electrical fittings must accompany each tender, which must also state the means to be adopted to reduce or extinguish any one or more of the lights in any part or section of the system.

Fire risks.—The tenders must state what means it is proposed to adopt to obviate the risk of fire from overheating; also if it is intended to carry out the requirements of the insurance companies, as contained in the recommendation of the council of the Society of Telegraph Engineers and Electricians, dated June 21st, 1882, in connection with such risks.

Fittings.—A short description of the fittings to be used must accompany each tender, and if it is proposed to use shades with any of the incandescent lamps, it would be desirable to forward a sample shade with the tender. All wires must be carried to the various groups of lamps by means of wood mouldings, to harmonise with the walls and mouldings of the ceilings, &c., so as to cover up and preserve the wires.

Incandescent lamps.—Swan or other approved lamps of not less than 20-candle power must be used. The committee will, however, reserve to themselves the right to accept or require to have employed any other description of incandescent lamp of the same candle power in connection with the proposed installation.

Arc lamps.—The tenders must state if the person or company tendering are prepared to use, in the proposed arc lighting, any of the arc lamps now before the public, should the Corporation desire, for experimental purposes, to make a selection therefrom. It would be desirable also if the tenders contained a list of the arc lamps, any of which might be used in the proposed lighting, together with any suggestions as to their special suitability for either interior or exterior illumination.

Work and labour.—The committee will open such parts of the public highways as may be necessary for receiving the receptacles for the conductors, and after the same have been laid therein will fill up and make good the trench. The committee will not, however, accept any responsibility in connection with the laying of the receptacles or cables, but the same and the necessary joint boxes shall be laid by and at the expense of the contractor. The Corporation will at their own cost supply a sufficient quantity of 3in. iron pipes for containing cables. The contractor shall find and provide—with the exception herein otherwise proposed—all necessary plant and machinery for providing a complete system of electric lighting in the rooms and at the places named, and the whole of the work is to be finished in a workmanlike manner, to the satisfaction of the Electric Lighting Committee of the Corporation.

The working of the plant.—The contractor will be required to place in charge of the installation a competent person or persons to work and carry out the lighting, during the continuance of the contract, the wages of such persons to be separately estimated in the tenders, and to be paid by the Corporation. A weekly return shall be made to the committee and to the contractors of the full and complete details of the cost and working of the installation during the preceding week. The committee will reserve to themselves the right to suspend any workman employed by the contractor in or about the installation in the event of such workman not discharging his duties to the satisfaction of the committee, or who may conduct himself improperly, and to require the contractor to immediately replace the workman so suspended by another workman to be approved by the committee.

Summary of lamps.—Incandescent lamps 20-candle power:—

	Proposed.
1. Victoria Hall	500
6. General Reading-room	51
7. Lending Library	70
8. Reference Library—lower level	60
9. Reference Library—upper level	80
Total	761

Arc lamps—

2. Vestibule, Town Hall	1
3. Vestibule, Municipal Buildings	1
4. General Pay Office .. ,, ...	2
5. Clerk's Office .. .. .. ,, ...	2
In front of Town Hall ,, ...	4
In Calverley-street .. ,, ...	1
Total	11

Maintenance and continuation of contract.—The tenders may be for a period of one or two years, and must be in the following alternative form:—(1) The total amount for carrying out the whole of the electric lighting mentioned in these particulars, and for maintaining the same in an efficient manner for a period of twelve months from the completion of the installation, the whole of the plant and machinery supplied by the contractor to be removed by the contractor at the end of that term. (2) The additional amount at which the Corporation may purchase, at the end of the first year, the whole of the plant and machinery so supplied by the contractor. (3) The total amount for carrying out the same work for a period of two years, the same plant and machinery to be removed by the contractor at the end of the term. (4) The additional amount at which the Corporation may purchase, at the end of the second year, the whole of the plant and machinery so supplied by the contractor.

Tenders.—The Electric Lighting Committee or the Corporation do not bind themselves to accept the lowest or any of the tenders. The company or person whose tender may be accepted will be required to enter into a contract, to be prepared by the solicitor to the Corporation, to complete the whole of the before-mentioned work within two months from the date of the acceptance of the tender by the committee, such contract to contain such clauses and conditions as may be necessary for carrying the same into effect, and particularly a clause empowering the Corporation to determine the contract in the event of the contractor having failed, for a period of one month after the completion of the installation, to have efficiently carried out the terms of the contract during such month; and also a condition for the payment by the contractor to the Corporation of a sum of £10 for each and every day during which default is made in completing the installation after the above-named two months. The Victoria Hall and the Vestibule may be inspected on application to the superintendent, and the interior of the new Municipal Buildings, may be seen on application to the Clerk of the Works. Sealed tenders and specifications, addressed to the chairman of the Electric Lighting Committee, Town Hall, Leeds, and marked "Tender for Electric Lighting," to be delivered at the office of the Town Clerk, Town Hall, Leeds, not later than 5 p.m. on Thursday, the 21st day of June next.

LEACH'S FISH CURING AND COOKING PLANT.

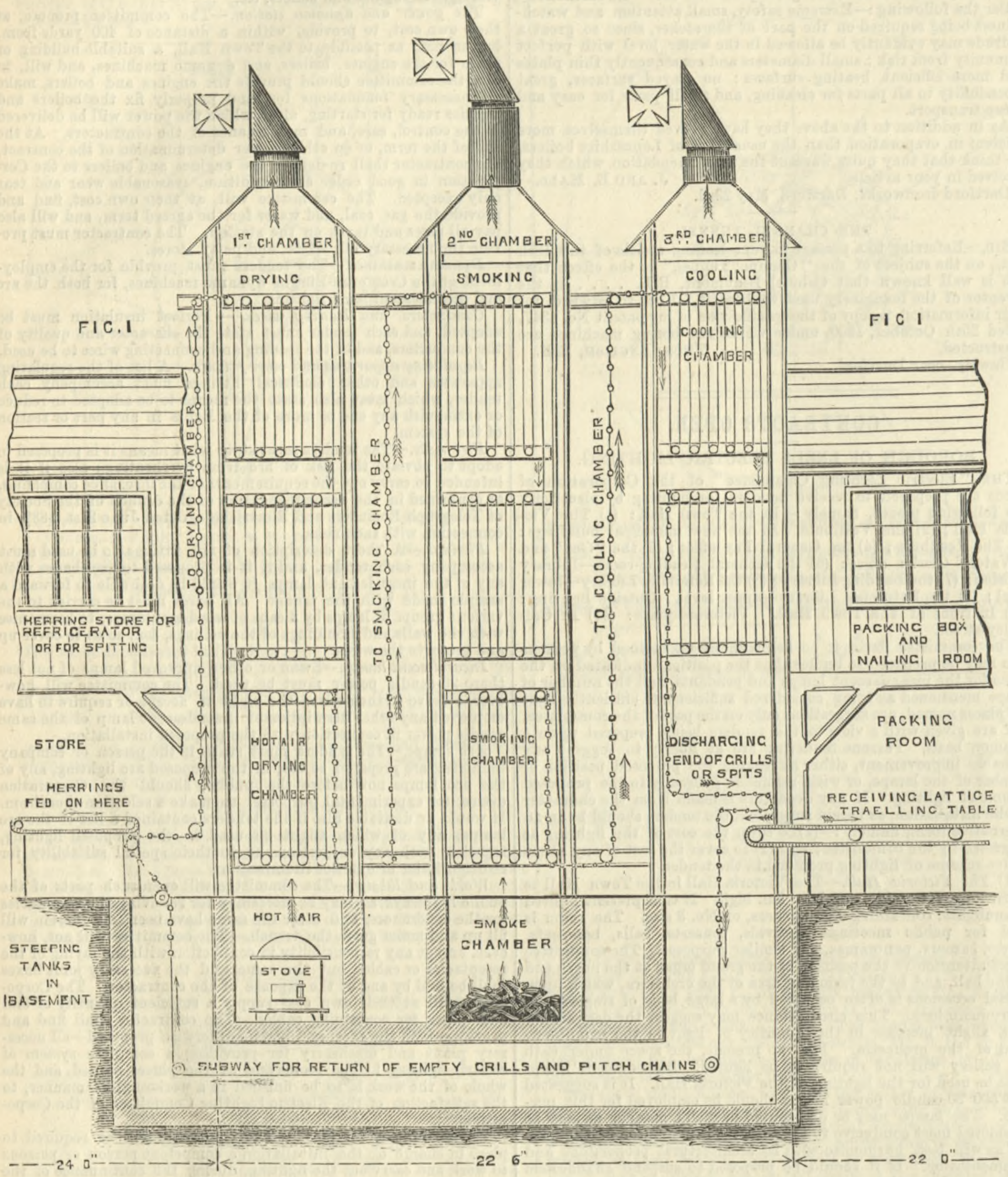
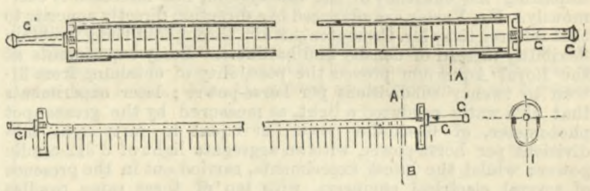


Fig. 3



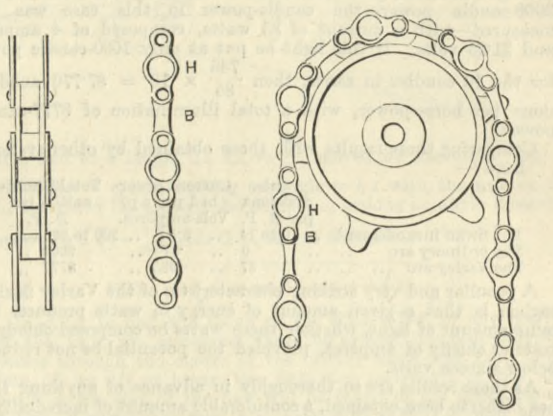
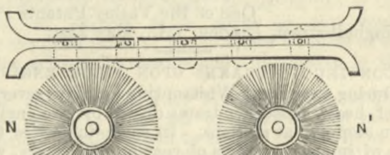


Fig. 2

Fig. 4



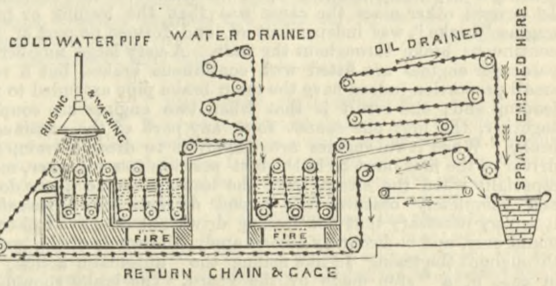


Fig. 5

The facts and figures published in connection with the Fisheries Exhibition will have given people generally some idea of the vastness of the fishery trades, and of the enormous consumption of fish even in London alone. Mr. George Leach, of Hull, has devised the mechanical arrangements we are about to describe, with a view to saving large quantities of fish now lost as manure, and to the more perfect smoking and cooking of all kinds of dried or cured fish. In London alone the quantities cured are enormous. Mr. H. Mayhew in his well-known work "London Labour and the London Poor," has stated that 200,973 tons of fish, wet and dry, were consumed in London during one year; and Mr. Mayhew had gleaned from different quarters that one-half of this enormous weight, or 100,486 tons were herrings. If of this supply of herrings the impression of the trade be consulted, one-third of this quantity were "bloatered" during the year, and this accords with several estimates of practical men. It may be assumed, therefore, that 33,495 tons, or 334,950 barrels of herrings, were bloatered in London. But Mr. Mayhew compiled his estimate for 1850, now thirty-two years ago, and by every authority upon the subject of our sea fisheries published since that time, the supply of fish for consumption in London has immensely increased. But if the quantity of herrings "bloatered" in London at that time was 33,495 tons, or 334,950 barrels, be minimised to 30,000 tons, or 300,000 barrels, a very moderate estimate of the work to be done shows mechanical appliances ought here to have a field.

Like other branches of fishery trades, the changes in the methods of curing have been very few in very many years. In bloatering herrings, as hitherto carried on, the operations are as follows, as described by Mr. Leach:—"The fish after having been prepared and washed in clean water, are threaded or skewered upon sticks or 'spits,' which are usually about ½in. in diameter and 4½ft. long. These spits are passed or threaded through one gill and the mouth of each individual herring, and about twenty-five herrings are threaded or placed upon each spit. The fish are smoked in a special house or chamber, fitted up with a series of open wooden frames extending from floor to roof, and having light transverse beams, technically called 'loves,' placed in them, one above another, at regular distances. The spits are handed up from the basement or smoke-house floor by men or boys who climb up the wooden frames of the smoke-house, and pass each spit with the herrings threaded upon it from the bottom tier to a man stationed at or within hand reach of the uppermost tier. As the frames are placed parallel to each other about 4ft. apart, or a somewhat less distance than the length of a spit, it follows that the man who is within hand reach of the uppermost tier can there rest each end of the spit carrying its complement of herrings upon the parallel 'loves' in adjoining frames, and thus by passing a sufficient number of spits from hand to hand, and from tier to tier, according to the size or extent of the smoke-house, the house may be filled or hung with herrings ready to be dried, smoked, or cured. Sometimes the fires are lighted and the smoke is rising during the time the men are thus filling the smoke-house, and especially so when there is great pressure of business. At such times the condition and temperature of the smoke-house are suffocating, and the occupation most injurious to health. When the fires are in full force it is impossible for any person to remain in the smoke-house for any long period, but even then it is customary for the men to make occasional short stays in the smoke-house in order to examine the condition of the fish placed upon the different tiers, and in some cases to withdraw the spits and replace them upon other tiers either nearer to, or further from, the fire or smoke, according to the state of the fish. This operation is performed after tying a muffler or cloth over the mouth or nostrils of the workmen, so as to filter the smoke or render less noxious the fumes arising from the fires, but in all cases it is a trying and injurious operation." A great deal of hand labour is thus required where mechanical appparatus would not only save it but would secure uniform results. By the machinery devised by Mr. Leach the process would be continuous, the fish handled but once before curing, and then in packing, and there seems to be every reason for thinking that it would give a uniform result, which would be under control. Our engravings show several modifications of the apparatus. Fig. 1 is a longitudinal section showing the general arrangement of a fish-curing house constructed according to Mr. Leach's plans. In the three towers are mounted a series of rollers or spindles with grooved or toothed wheels for carrying the chains, shown at Fig. 2, the links of which are provided with holes H for the reception of the stud spindle ends G of the trough-shaped grills, Fig. 3. The holes H are large enough to permit the passage of the collar G^1 on the ends of the spindle by which the grills are kept in place as the parallel chains carry in them a horizontal position through the building. The grills are mounted so that the weight of the fish keeps them always in the same position. From Fig. 1 it will be seen that the herrings are fed from a table into the grills which are on the chain first passing through the drying chamber. From this chamber they pass into the smoking chamber, the grills being carried up and down, so as to get a sufficient number at one time into the chambers, and for a sufficient time. The grills next pass into the third or cooling chamber, whence they are discharged into a packing room, the whole process being continuous. At a place just above the travelling lattice table in the packing room the grills are caused to turn over by contact of the head with a surface. The herrings are thus emptied from them. At a convenient place the grill heads are caused to pass between two guides, as shown at Fig. 4, by which they are kept from turning under the action of a pair of revolving brushes N N^1, by which the grill is freed from adhering pieces of fish after leaving the travelling table.

At Fig. 4 is shown by diagram an arrangement for washing and cooking or preserving fish. When herrings, and especially small fish, such as sprats, sardines, or "stocker bait," are required to be washed or steeped in either water, liquor, or oil, for the purpose of cleansing, curing, cooking, or preservation for food other than that of drying and smoking, moving cages are employed. The cages are furnished with cylindrical ends and central trunnions similar to the "grills" before described for washing, smoking, or drying herrings. After the cages are filled with fish, they are attached to the chains which are drawn by machinery and passed through baths or troughs containing liquids or oil, either hot or cold, and, if necessary, subsequently dried, smoked, spiced, or flavoured in like manner by the use of chains already described. In illustration of this application, Fig. 5 shows the general arrangement of the apparatus, which may be modified to suit special necessities of the size of the fish, the duration of time of immersion required in the water, oil, fat, or other matter with which it has to be cooked. The inventor has also made arrangements by which small fish, such as pilchards, sprats, and sardines, can be expeditiously and cheaply bloatered, and at cost, weight for weight, about the same as that for herrings or larger fish.

There are other modifications of this apparatus; but we have said enough to show their general character. The curing house, represented by Fig. 1, which was to be exhibited at the International Fisheries Exhibition, is estimated to be equal to an output of seventy-one barrels of bloaters in ten hours' work, or 142 barrels with a night and day shift of workpeople in twenty hours. "Bloatering" by this method, instead of costing, as now, about 1s. 9d. per barrel, will, according to Mr. Leach's estimate, cost only 6d. He also estimates that this house will dry, smoke, and cure 6¼ tons of Finnan haddocks in ten hours, usually costing £1 per ton, in London, for 5s. per ton, or would cure 5 tons of sprats in twenty hours at a cost of less than one-tenth of a penny per lb. It is to be regretted that Mr. Leach has been unable to show the apparatus at work in the Fisheries Exhibition, for it would there attract some of the attention which it undoubtedly deserves.

MANUFACTURE OF ELECTRIC LAMPS.

A factory has been fitted up in Bermondsey-street, by Messrs. Wright and Mackie, electrical engineers, of Gracechurch-street, for the Hammond Electric Light and Power Supply Company, for the purpose of making incandescent lamps. The factory at Bermondsey-street consists of four floors, having a total area of about 4800 superficial feet, arranged as shown on page 339. In the basement is an 8-horse power semi-fixed compound expansive engine, by Marshall and Sons, working at 180 revolutions per minute, from which the power is transmitted to a 300-light Ferranti alternate current machine, with Siemens' exciter, and a 600 volt Siemens' alternate current machine and exciter. The Ferranti machine is employed for lighting the building, heating the carbon filaments during the process of exhaustion, and for general experimental purposes, while the Siemens machine is used in the process which deposits carbon in the pores of the filaments. The ground floor is devoted to a store-room, and the glass-blowing room. In the latter twelve mechanical glass blowers are arranged, driven by power shafting, which also works a series of air compressors for supplying air to the blow-pipe flames, and the necessary high-pressure air for blowing out the bulbs. The machines in this room are manipulated by boys ranging from fourteen to sixteen years of age, who are employed in the various processes of blowing bulbs and sealing in the carbon filaments.

The mechanical glass blower, as may be seen from the drawing, is very similar in construction to a lathe, but is supplied with two headstocks fitted with hollow mandrils and chucks, which hold the glass tube to be shaped. The mandrils revolve synchronously, the one headstock being a fixture and the other capable of traversing the bed by means of a hand-wheel, rack, and pinion. The machine is also supplied with a blow-pipe attached to a sliding saddle and suitable valves actuated by a treadle k for the admission of air to the mandrils. The glass

WRIGHT AND MACKIE'S MACHINERY FOR MAKING INCANDESCENT LAMPS.

FIG. 1.

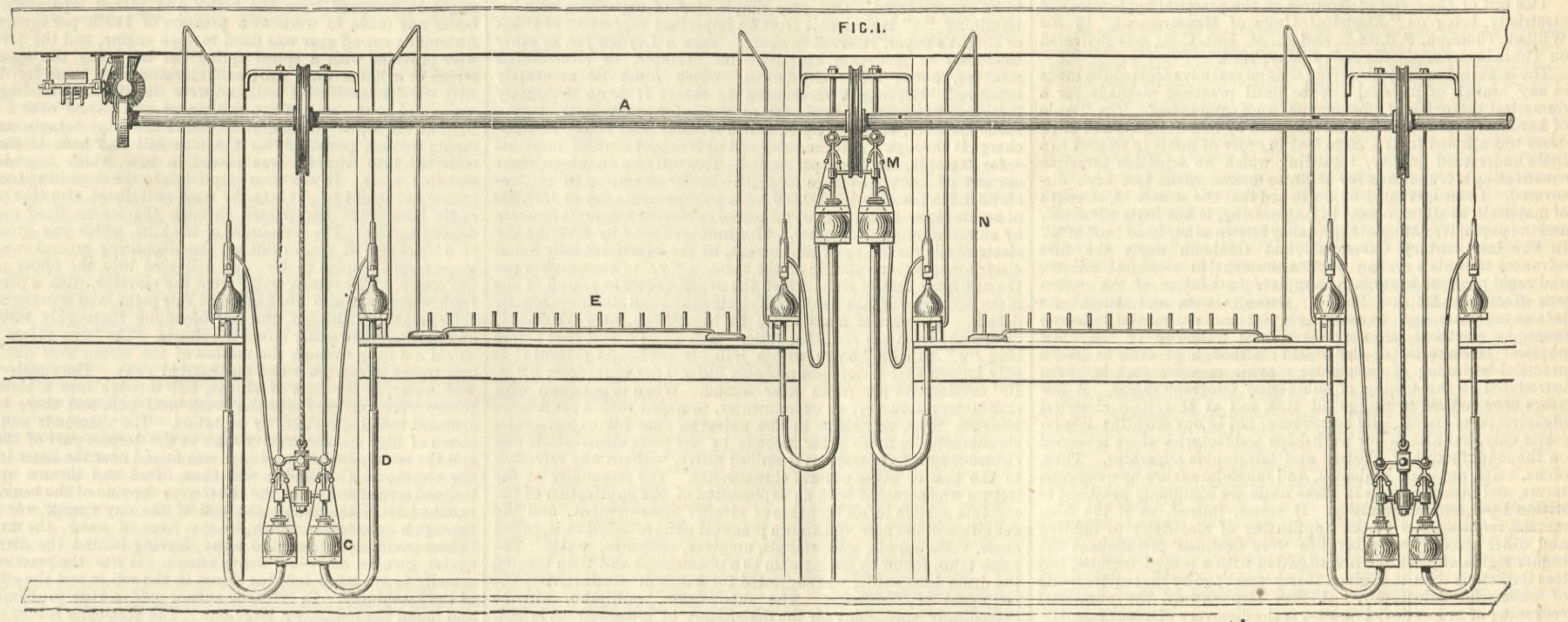
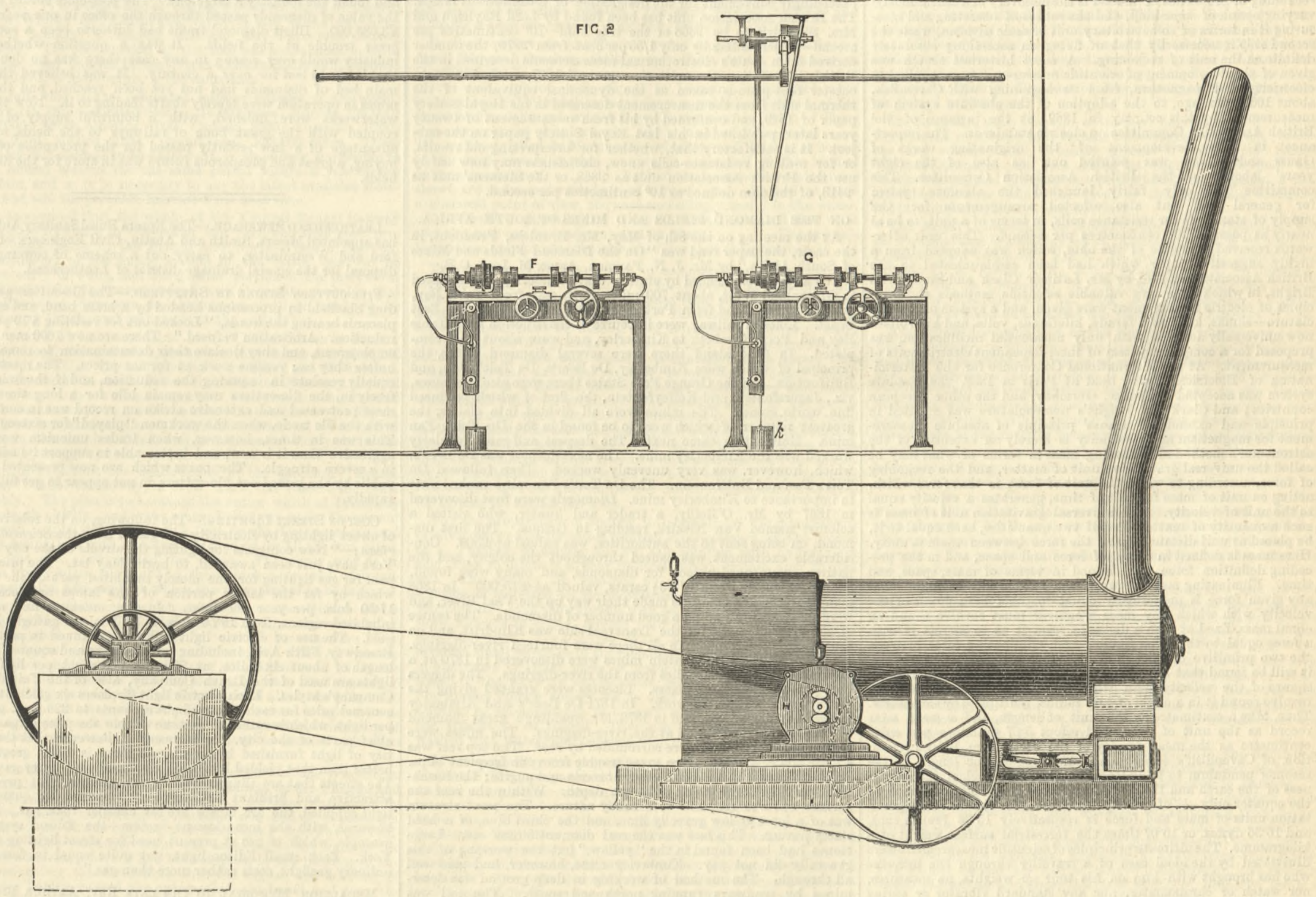


FIG. 2



tube is fixed at G, corresponding to F in the contiguous blower.

The operation of blowing the bulbs is as follows:—The boy takes a piece of glass tube 9in. long and ⅝in. in diameter, and having gripped each end in the chuck provided on the mandrils, starts the machine and brings the flame of the blow-pipe to bear upon the middle of the length of tube, which, being softened, is drawn out into a small tube, thus forming two "pump stems." The flame is then made to play on the original tube between its extreme end and the drawn-out "pump stem." This part being softened, is blown out to the shape required, and the operation is repeated at the other end of the tube, thereby making two bulbs from the single tube. The admission of the air, the direction and force of the blow-pipe, the approach and recession of the mandrils, so as to lengthen or shorten the bulb, are movements all readily controlled by the boy operator, who is able on an average to model from 250 to 300 bulbs complete per diem. By a succession of somewhat similar processes the whole of the glasswork in the incandescent lamp is finished. A boy blows the bulb, a boy fixes the two platinum electrodes by a bead of glass, and a boy inserts the mounted filament into the end of the finished bulb, thus preparing the lamp for pumping and sealing off, which is done upstairs.

The preparation of the filaments is carried on in an upper room. Almost any kind of tough vegetable fibre will serve, the inventor having a special process for densifying and giving it a metallic lustre. The fibre actually employed appears to be a species of grass, not unlike the coarse, wiry specimen which often grows by the seaside. A length of this grass is bent by a boy round a metal mould into the proper helical form. The fibres on their moulds are then gently heated, thereby fixing their shape. The filaments thus formed are afterwards placed in a crucible, filled up with plumbago, from whence they are transferred to a Fletcher furnace, where they are exposed to great heat. This carbonises them, and they are then sent into the mounting room, where they are fixed upon the platinum electrodes which have been prepared for them. The mounting is a secret process, but it mainly consists in sticking the filament ends into the hollow of the small spirals turned on the upper ends of the platinum electrodes, and cementing them with a special cement. The filaments thus mounted are then "flashed" in a special liquid, which forms and deposits carbon in their pores, creating, it is claimed, a dense elastic carbon having a bright metallic lustre.

The proper resistance is first estimated by the light given out by other lamps in circuit with the filaments and checked by a Wheatstone bridge. Thus finished off, the mounted filaments are then taken down to the glass-blowing room, where they are inserted in the bulbs, and sealed by the machines we have described. The lamp is next taken to the pumping room, where there are a series of mechanical mercury pumps, each capable of exhausting twelve lamps at a time. For this work only two men are employed, for by setting the lamps in groups in different stages of exhaustion, one man can attend to the exhaustion of a large number of lamps, sealing off the completed lamps and supplying fresh ones as the pump continues to act of itself. A clear view of the pumps and the exhausting frames is given in the drawings. The mercury reservoirs are raised and lowered automatically by straps from power shafting, and the velocity of movement is adjusted by means of a half-moon pulley, which allows the reservoir to move slowly at the beginning and end of its up and down range. The lamps are attached to spiral springs, which pull them upwards as they are sealed off, and thus facilitate the act of sealing. In the engravings A is the power shafting to which the half-moon pulleys are fixed. M is the carrier for the mercury reservoirs C, lifting them up and letting them down as actuated by a rope connected with the half-moon pulley. D is an india-rubber tube connecting the pump vessel with the mercury reservoir. E are short upright tubes or stems on which the lamps are fixed in order to undergo exhaustion. Fig. 1 shows two of the exhausting frames on an upper floor. Fig. 2 represents the engine and driving machinery in the basement, with two of the glass-blowing machines on the ground floor. H is the Ferranti machine. The engine works up to 30-horse power indicated.

The mercury pump is an improvement devised by Messrs. Wright and Mackie on the ordinary Geisler pump, and obviates the necessity of taking out a stopper to let the air escape. The valves of the air pump are, in fact, automatic also, and thus the entire arrangement is self-acting. The degree of exhaustion can be estimated by the height of the mercury column, and is from one-millionth to one and a-half-millionth of an atmosphere. The whole of the work of the factory is regulated by piecework, and it is stated that by the means described the manufacture of incandescent lamps is very greatly reduced in cost, and the rate of production increased.

It seems remarkable that the primitive practice of blowing glass by the mere aid of human lungs has not long ago been superseded by a directly mechanical method. The progress of electric lighting has at length applied a stimulus which will evidently terminate the rude and unsatisfactory operations of the human glass-blower. The electric light in the incandescent form has created a demand for a species of lamp which makes a heavy call on the resources of the glass-blowing workshops. The time has arrived when machinery is absolutely required to supersede the tedious and clumsy system hitherto adopted, and it is eminently satisfactory to find that inventive genius has already achieved success in this direction. The mechanical glass-blower is also capable of being applied to other processes besides that which we have thus described.

Independently of the glass-blowing invention, the Wright and Mackie lamp is itself a success. The filament is said to be remarkably durable, and capable of bearing a strong current. Experiments which we have seen in proof of this have been satisfactory. The carbon filaments on that occasion were obtained from the leaf-stalks of the cocoa-nut palm.

THE INSTITUTION OF CIVIL ENGINEERS.

ON ELECTRICAL UNITS OF MEASUREMENT.

THE last of the series of lectures on the practical applications of electricity, being on "Electrical Units of Measurement," by Sir William Thomson, F.R.SS.L. and E., M. Inst. C.E., was delivered on Thursday evening, the 3rd of May, 1883.

The lecturer began by observing that no real advance could be made in any branch of physical science until practical methods for a numerical reckoning of phenomena were established. The "scale of hardness" for stones and metals used by mineralogists and engineers was alluded to as a mere test in order of merit in respect to a little understood quality, regarding which no scientific principle constituting a foundation for definite measurement had been discovered. Indeed, it must be confessed that the science of strength of materials, so all important in engineering, is but little advanced, and the part of it relating to the quality known as hardness least of all. In the last century Cavendish and Coulomb made the first advances towards a system of measurement in electrical science, and rapid progress towards a complete foundation of the system was effected by Ampére, Poisson, Green, Gauss, and others. As late as ten years ago, however, regular and systematic measurement in electrical science was almost unknown in the chief physical laboratories of the world; although as early as 1858 a practical beginning of systematic electric measurement had been introduced in the testing of submarine telegraph cables. A few years have sufficed to change all this, and at this time electrical measurements are of daily occurrence, not in our scientific laboratories only, but also in our workshops and factories where is carried on the manufacture of electric and telegraphic apparatus. Thus, ohms, volts, ampères, coulombs, and micro-farads are now common terms, and measurements in these units are commonly practised to within 1 per cent of accuracy. It seems, indeed, as if the commercial requirements of the application of electricity to lighting and other uses of every-day life were destined to influence the higher region of scientific investigation with a second impulse, not less important than that given thirty years ago by the requirements of submarine telegraphy. A first step toward the numerical reckoning of properties of matter is the discovery of a continuously-varying action of some kind, and the means of observing and measuring it in terms of some arbitary unit or scale division, while the second step is necessarily that of fixing on something absolutely definite as the unit of reckoning. A short historical sketch was given of the development of scientific measurement, as applied to electricity and magnetism, from its beginning with Cavendish, about 100 years ago, to the adoption of the absolute system of measurement by this country in 1869, at the instance of the British Association Committee on electric standards. The importance in this development of the originating works of Gauss and Weber was pointed out, as also of the eight years' labours of the British Association Committee. This committee not only fairly launched the absolute system for general use, but also effected arrangements for the supply of standards for resistance coils, in terms of a unit, to be as nearly as possible 10^9 centimetres per second. This unit afterwards received the name of the ohm, which was adopted from a highly suggestive paper which had been communicated to the British Association in 1861 by Mr. Latimer Clark and Sir Charles Bright, in which some very valuable scientific methods and principles of electric measurement were given, and a system of nomenclature—ohmas, kilohmas, farads, kilofarads, volts, and kilovolts—now universally adopted with only unessential modification, was proposed for a complete system of inter-dependent electric units of measurement. At the International Conference for the Determination of Electrical Units, held at Paris in 1882, the absolute system was accepted by France, Germany, and the other European countries; and Clark and Bright's nomenclature was adopted in principle and extended. Gauss' principle of absolute measurement for magnetism and electricity is merely an extension of the astronomer's method of reckoning mass in terms of what may be called the universal gravitation unit of matter, and the reckoning of force, according to which the unit of force is that force which, acting on unit of mass for unit of time, generates a velocity equal to the unit of velocity. The universal gravitation unit of mass is such a quantity of matter, that if two quantities, each equal to it, be placed at unit distance apart, the force between them is unity. Here mass is defined in terms of force and space, and in the preceding definition force was defined in terms of mass, space, and time. Eliminating mass between the two, it will be found that any given force is numerically equal to the fourth power of the velocity with which any mass whatever must revolve round an equal mass, fixed at such a distance from it as to attract it with a force equal to the given force. And, eliminating force between the two primitive definitions of the universal gravitation system, it will be found that any given mass is numerically equal to the square of the velocity with which a free particle must move to revolve round it in a circle of any radius, multiplied by this radius. Thus, take a centimetre as the unit of length, and a mean solar record as the unit of time, and adopt 5·67 grammes per cubic centimetre as the mean density of the earth from Baily's repetition of Cavendish's experiment, and suppose the length of the seconds' pendulum to be 100 centimetres, and neglect the oblateness of the earth and the centrifugal force of its rotation—being at the equator only $\frac{1}{289}$ of gravity—the result for the universal gravitation units of mass and force is respectively 15·36 French tons, and 15·36 dynes, or 15·07 times the terrestrial surface weight of a kilogramme. The ultimate principles of scientific measurement were illustrated by the ideal case of a traveller through the universe who has brought with him on his tour no weights, no measures, nor watch or chronometer, nor any standard vibrator or spring balance, but merely Everitt's units and constants and a complete memory and understanding of its contents, and who desires to make for himself a metrical system agreeing with that which he left behind him on the earth. To recover his centimetre the readiest and most accurate way is to find how many wave lengths of sodium light there are in the distance from bar to bar of a plating which he can engrave for himself on a piece of glass. How easily this is done, supposing the grating once made, was illustrated by a rapid experiment performed in the course of the lecture, without other apparatus than a little piece of glass with 250 fine parallel lines engraved on it by a diamond, and two candles and a measuring tape of unknown divisions of length—only used to measure the ratio of the distance between the candles to the distance of the grating from either. The experiment showed the distance from centre to centre of consecutive bars of the grating to be 32 times the wave length of yellow light. This being remembered to be $5·89 \times 10^{-5}$ of a centimetre, it was concluded that the breadth of the space on which the 250 lines are engraved is $250.32.\ 5·892.\ 10^{-5}$, or ·4726 of a centimetre. According to the instrument maker it is really ·5 of a centimetre. Five minutes spent on the experiment instead of one, and sodium flames behind fine slits instead of open candles blowing about in the air, might easily have given the result within $\frac{1}{2}$ per cent. instead of $4\frac{1}{2}$ per cent. Thus the cosmic traveller can easily recover his centimetre and metre measure. To recover his unit of time is less easy. One way is to go through Foucault's experimental determination of the velocity of light. But he must be imagined as electrically-minded; and he will certainly, therefore, think of "v," the number of electrostatic units in the electro-magnetic unit of electricity; but he will probably see his way better to doing what he wants by making for himself a Siemens' mercury unit—which he can do easily now that he has his centimetre—and finding—by the British Association method, or Lorenz's with Lord Rayleigh's modification, or both—the velocity which measures its resistance in absolute measure. This velocity, as is known from Lord Rayleigh and Mrs. Sidgwick, is 9413 kilometres per mean solar second, and thus he finds, in mean solar seconds, the period of the vibrator, or arbitrary-unit chronometer, which he used in his experiments. Still, even though this method might be chosen as the readiest and most accurate, according to present knowledge of the fundamental data for recovering the mean solar second, the method by "v" is too interesting and too instructive in respect to elimination of properties of matter from our ultimate metrical foundations to be unconsidered. One very simple way of experimentally determining "v" is derivable from an important suggestion of Clark or Bright's paper, referred to above. Take a Leyden jar, or other condenser of moderate capacity—for example, in electrostatic measure, about 1000 centimetres—which must be accurately measured. Arrange a mechanism to charge it to an accurately measured potential of moderate amount—for example, in electrostatic measure, about 10 c.g.s., which is about 3000 volts—and discharge it through a galvanometer coil at frequent regular intervals—for example, ten times per second. This will give an intermittent current of known average strength—in the example, 10^5 electrostatic c.g.s., or about 1/300,000 c.g.s. electro-magnetic, or 1/30,000 of an ampère—which is to be measured in electro-magnetic measure by an ordinary galvanometer. The number found by dividing the electrostatic reckoning of the current, by the experimentally found electro-magnetic reckoning of the same, is "v," in centimetres per the arbitrary unit of time, which the experimenter in search of the mean solar second has used in his electrostatic and electro-magnetic details. The unit of mass which he has chosen, also arbitrarily, disappears from the resulting ratio. It is to be hoped that before long "v" will be known within 1/10 per cent. At present it is only known that it does not probably differ 3 per cent. from $2·9 \times 10^{10}$ centimetres per mean solar second. When it is known with satisfactory accuracy, an experimenter, provided with a centimetre measure, may, anywhere in the universe, rate his experimental chronometer to mean solar seconds by the mere electrostatic and electro-magnetic operations described above, without any reference to the sun or other natural chronometer. The remainder of the lecture was occupied with an explanation of the application of the absolute system in all branches of electric measurement, and the definition of the now well known practical units founded on it, called ohms, volts, farads, micro-farads, ampères, coulombs, watts. The name mho, found by saying ohm to a phonograph and then turning the drum backwards, was suggested for a unit of conductivity, the reciprocal of resistance. The sub-division, millimho, will be exceedingly convenient for the designation of incandescent lamps. The British Association unit has been found by Lord Rayleigh and Mrs. Sidgwick to be ·9868 of the true ohm—10^9 centimetres per second—which differs by only 1/50 per cent. from ·9870, the number derived from Joule's electrothermal measurements described in the British Association Committee's report of 1867, with 772 Manchester foot-pounds taken as the dynamical equivalent of the thermal unit from the measurement described in his Royal Society paper of 1849, and confirmed by his fresh measurement of twenty years later, published in his last Royal Society paper on the subject. It is satisfactory that, whether for interpreting old results, or for making resistance-coils anew, electricians may now safely use the British Association unit as ·9868, or the Siemens' unit as ·9413, of the ohm defined as 10^9 centimetres per second.

ON THE DIAMOND FIELDS AND MINES OF SOUTH AFRICA.

AT the meeting on the 8th of May, Mr. Brunlees, President, in the chair, the paper read was "On the Diamond Fields and Mines of South Africa," by Mr. J. N. Paxman, Assoc. M. Inst. C.E.

The author commenced by stating that Kimberley was situated in Griqualand West, about 700 miles north-east from Table Bay, and 450 miles inland from Port Elizabeth and Natal on the East Coast. Lines of railway were in course of construction from Table Bay and Port Elizabeth to Kimberley, and were about half completed. In Griqualand there were several diamond mines, the principal of which were Kimberley, De Beer's, Du Toit's Pan, and Bultfontein. In the Orange Free States there were also two mines, viz., Jagersfontein and Koffeyfontein, the first of which produced fine white stones. The mines were all divided into claims, the greatest number of which were to be found in the Du Toit's Pan mine. Bultfontein came next. The deepest and most regularly worked was the Kimberley mine. The next deepest was De Beer's, which, however, was very unevenly worked. Then followed Du Toit's Pan and Bultfontein. The Du Toit's Pan mine ranked next in importance to Kimberley mine. Diamonds were first discovered in 1867 by Mr. O'Reilly, a trader and hunter, who visited a colonist named Van Niekirk, residing in Griqua. The first diamond, on being sent to the authorities, was valued at £500. Considerable excitement was caused throughout the colony, and the natives commenced to look for diamonds, and many were found, among which was one of $83\frac{1}{2}$ carats, valued at £15,000. In 1868 many enterprising colonists made their way up the Vaal River, and were successful in finding a good number of diamonds. The centre of the river-diggings on the Transvaal side was Klipdrift, and on the opposite side Pniel. In all there were fourteen river-diggings. Du Toit's Pan and Bultfontein mines were discovered in 1870 at a distance of twenty-four miles from the river-diggings. The diggers took possession of these places. Licences were granted giving the first diggers a right to work. In 1871 De Beer's and Kimberley mines were discovered, and in 1872 Mr. Spalding's great diamond of $282\frac{1}{2}$ carats was found at the river-diggings. The mines were of irregular shape, and were surrounded by reef. The top reef was a loose shale, and had given great trouble from the frequent slips. Below this were strata of trachytic breccia and augite; the formation was then seamy to an unknown depth. Within the reef the surface soil was red, and of a sandy nature. The next stratum was of a loose yellow gravelly lime, and the third blue, of a hard slatey nature. This last was the real diamantiferous soil. Large stones had been found in the "yellow," but the working of this generally did not pay. Kimberley mine, however, had paid well all through. The method of working in deep ground was determined by roadways running north and south. The soil was hauled up to these roadways, and taken to the sorting-tables. The roadways decaying shortly after exposure to the atmosphere, a system of hand windlass was adopted which worked very well for a time, until horsewhims were introduced in 1873. The depth of the mines increasing, horsewhims had to give way to steam engines in 1876. The first diggers treated on an average ten loads per day each party. At the present time the least taken out by any engine when fully employed was 250 loads per day. The cost of working, with present appliances, the first 100ft. in depth, was 3s. 6d. per load; the second 100ft.—mostly blue—5s.; the third 100ft., 8s.; the fourth 100ft., 11s. Through scarcity of water, a system of dry-sorting had to be resorted to for several years, but it was superseded by the introduction of washing machinery, which was now generally employed. At the commencement, through inexperience, many serious mistakes were made. When the first diggers reached the bottom of the red sand, they thought no diamonds would be found in the next stratum. When, however, diamonds were found in the second stratum, the diggers had again to remove the *debris*, and so also when the "blue" was reached. Some of the claims in the Du Toit's Pan and Bultfontein mines were irregular in shape. The other mines, however, had been properly and regularly laid out. One or two shafts had been sunk and connected with the mines by undergound galleries. These galleries were convenient in the case of falls of reef. Labour, at first, was cheap; but from 20s. per month, wages rose to 30s. per week and food. The yellow soil offered no difficulty in working, being loose and broken, but the blue soil required blasting. Several methods were adopted for extracting the soil and carrying it from the mine before steam was introduced. The cost of wood for heating purposes was a serious item, but good coal had now been found at 160 miles from Kimberley, costing £13 per ton; another serious item of expense was the transport over natural roads only, costing from £18 to £30 per ton. The machinery designed by the author for this industry was described. A 16-H.P. direct-acting winding engine was introduced for hauling up loads at the rate of about 1000ft. per minute; and a 25-H.P. geared engine for hauling up heavier loads at the rate of from 600ft. to 700ft. per minute. Water was dear, and water heaters were fitted to each engine, by which 33 per cent. of the water was again used, thus saving one-third. The boilers were of the locomotive type, mostly of steel, to save weight, and thus reduce the cost of transit. The fire-boxes were also made of steel of very soft and ductile quality. A semi-portable engine was made for driving the wash mill. The engine was so arranged that it might be removed from the boiler and placed separately. The boiler was made to work at a pressure of 140 lb. per square inch. Automatic cut-off gear was fixed to each engine, and the governors were provided with a spiral spring for adjusting the speed. A screen or cylinder wash mill and elevator were used for dealing with the diamantiferous soil, and were described. Standing wires were fixed at the back of the machinery and passed over a frame fixed at the top of the mine, the end in the mine being secured to strong wooden posts. After the blue soil had been blasted and collected into trucks it was placed in tubs, which ascended the standing wires. It was then emptied into the depositing box. The yellow soil might be put into the wash mill direct, also that portion of the blue which had passed through the screen fixed over the depositing box. The remainder of the blue, which was spread out to a thickness of 4in. or 6in. on the depositing ground some distance from the mine to dry, was delivered into the upper part of the screen. The return water from the elevator, with a portion of fresh water, was also discharged at this point, and operations were thus greatly facilitated, the soil becoming thoroughly saturated, and passing more easily down the shoots. The large pieces which would not drop through the meshes of the screen were discharged into trucks at the lower end and carried away. The smaller pieces with water, in the form of sludge, fell through into a shoot, and thence were conveyed into the wash mill pan, and there kept in constant rotating motion by agitators. The diamonds and other pieces of high specific gravity sank to the deepest part of the pan, and the remainder of the sludge was forced over the inner ledge to the elevator. The sludge was then lifted and thrown upon an inclined screen and down the shoot over the side of the bank. The residue left in the pan at the end of the day's work was passed through a pulsator, in which, by the force of water, the mud and lighter particles were carried away, leaving behind the diamonds, agates, garnets, and other heavy stones. It was the practice occasionally to put a few inferior stones in the soil to test the efficiency of the machinery. In 1881 the author paid a visit to Kimberley, and found the industry a large one. The post-office return showed the value of diamonds passed through the office in one year to be £3,685,000. Illicit diamond traffic had hitherto been a source of great trouble at the fields. It was a question whether this industry would ever cease; in any case there was no doubt but that it would last for over a century. It was believed that the main bed of diamonds had not yet been reached, and that the mines in operation were merely shafts leading to it. Now that the waterworks were finished, with a bountiful supply of water, coupled with the great boon of railways to the fields, and the advantage of a law recently passed for the prevention of illicit buying, a great and prosperous future was in store for the diamond fields.

LEATHERHEAD SEWERAGE.—The Epsom Rural Sanitary Authority has appointed Messrs. Smith and Austin, Civil Engineers, of Hertford and Westminster, to carry out a scheme of sewerage and disposal for the special drainage district of Leatherhead.

FILE-CUTTERS' STRIKE IN SHEFFIELD.—The file-cutters are parading Sheffield in processions headed by a brass band, and carrying placards bearing the words, "Locked out for resisting a 10 per cent. reduction. Arbitration refused." There are now 1600 men out of employment, and they declare their determination to remain out, unless they can resume work at former prices. The masters are equally resolute in imposing the reduction, and if the funds flow freely in, the file-cutters may remain idle for a long time. The most protracted and extensive strike on record was in connection with the file trade, when the workmen "played" for sixteen weeks. This was in times, however, when trades unionism was more aggressive than it is now, and better able to support its adherents in a severe struggle. The boxes which are now presented to the public by the locked-out file-cutters do not appear to get filled very rapidly.

COST OF STREET LIGHTING.—The following, on the relative costs of street lighting by electricity and gas, is from the *Scientific American*:—"New contracts for lighting the streets of the city of New York have just been awarded, to begin May 1st. The price to be paid for gas lighting for the closely inhabited part of the city, in which by far the larger portion of the lamps are located, is 17·50 dols. per year per light. In the outskirts and sparsely inhabited regions, from 19·50 dols. to 32 dols. per gaslight is to be paid. The use of electric light will be continued in portions of Broadway, Fifth Ave., including certain parks and squares, in all a length of about six miles, at 70 cents per night per light. Arc lights are used of the Brush Company, also of the United States Company's styles. Each electric light displaces six gaslights. The contract price for each electric light amounts to 225 dols. per year per light, which is rather more than double the price of gas in the chief parts of the city. It is conceded, however, that the quantity of light furnished by an electric lamp is much greater and better than that yielded by the six displaced and dingy gas lamps. The streets that are illuminated by the electric light present an attractive and brilliant appearance. Reckoned by quantity of light supplied, the arc lamps are far cheaper than gas. Not so, however, with the incandescent system—the Edison system, for example, which is not at present used for street lighting in New York. Each small Edison light, not quite equal in force to an ordinary gaslight, costs rather more than gas."

MEDALLION MEMORIAL TO THE LATE REV. ARTHUR RIGG.—In accordance with the wish of numerous old pupils who received their early education at the Engineering School at Chester, a permanent memorial has been provided in memory of their old master, whose lamented death we recorded in September, 1880. To carry out this purpose a committee was formed, the chairman being Mr. Percy G. B. Westmacott, President of the Institution of Mechanical Engineers, Mr. Samuel Worssam, Oakley Works, Chelsea, being hon. secretary. A consideration of the subject led to the unanimous conclusion that a marble medallion erected in the College Chapel would be the most suitable form of memorial. The suggestion met with ready assent from the diocesan authorities, and the carrying out of this resolution was most kindly undertaken by Mr. J. S. Westmacott, at whose studio, No. 49, High-street, Pimlico, the finished work can now be seen. We have had an opportunity of seeing the medallion, and can testify as to its beauty as a work of art, while those who knew the Rev. Arthur Rigg personally declare that the likeness is well sustained. Moreover, the eminent sculptor has given a pleasant expression to those strongly-marked features, and the medallion cannot fail to remind his former pupils of how much real kindness lay at the heart of their old master. The head is fully life-size, and looks out from a deeply-recessed background, an arrangement which produces admirable effects of light and shade, and takes away from the cold lifelessness that marble must often convey to the mind; and the half-turned face seems to suggest the act of listening interestedly to the remarks of a friend. Surrounding the circular medallion there is a large rectangular framing of Italian marble relieved with a bold moulding, and this ample field of grey seems well to set off the white marble which it surrounds. Below the medallion is a brass plate, bearing the following inscription:—"This medallion is placed here in memory of the late Rev. Arthur Rigg, M.A., for thirty years principal of this College, from its commencement in 1839, by some of his old pupils of the Science School, attached to the College, as a tribute to the founder of the first English school for technical education and practical engineering.—Percy G. B. Westmacott, M.I.C.E., P.I.M.E., chairman of committee; Samuel Worssam, A.M.I.C.E., M.I.M.E., honorary secretary. April, 1883."

RAILWAY MATTERS.

IT is said that the Torrens Bridge on the Grange Railway, South Australia, has sunk some inches owing to the use of heavy locomotives.

THE railway bridge at Attock is now nearly finished. A locomotive has already passed over it, and it was hoped that it would be opened for traffic on the occasion of the Queen's birthday. The line to Peshawur will then be without a break.

THE viaduct over the Solway Firth is being pushed on rapidly, especially on the English side; but it will be some time before the gap is closed. Both sides will benefit considerably when railway communication is again established.

THE Scarborough and Whitby Railway, which will bring two fashionable watering-places into closer connection, is making rapid progress at the Whitby end. The high level bridge, which will carry the line over the river Esk at Whitby, is being erected.

The well-known firm of locomotive builders, Messrs. Beyer and Peacock, of Manchester, has been formed into a limited company. The shares, which have not been offered to the public, have, it is said, been taken up by the members and leading representatives of the old concern.

THE *Colonies and India* says trains running on February 13th between Waverley and Nukumara, halfway to Wanganui, New Zealand, were brought to a standstill through countless thousands of caterpillars being on the rails. The officials had to sweep and sand the metals before the trains could proceed.

AN accommodation train on the western counties of Nova Scotia Railway was brought to a standstill some time back after much whistling to allow a cow to get off the track. The passengers, who had alighted, resumed their seats and the train its journey, when after a few miles the engine again whistled loud and long. "Now then conductor, caught up that darned old cee-ow again?" was the inquiry of a Yankee passenger.

ARRANGEMENTS are in course of completion for opening the Whitby and Loftus Railway for passenger and general traffic in July next. It is a coast line of railway, fourteen miles in length, between Whitby and Loftus-in-Cleveland, and opens out some beautiful scenery, a mining district, and important fishing industries. The construction of the line was commenced in 1871, but it has been finished by the North-Eastern Railway Company. Mr. Waddell, of Edinburgh, is the contractor.

THE following is the estimated railway mileage of the world, January 1st, 1883:—United States, 113,000 miles; Europe, 109,000; Asia, 8000; South America, 7000; Canada, 8500; Australia, 3200; Africa, 2200; Mexico, 2100. Grand total, 253,000 miles. These figures are not claimed to be exact. It is absolutely impossible to obtain official returns for the same period within a year or two after date, and so it is necessary to use the latest available statement, and add the probable increase since that time.

IT is announced that the whole of the Central Bengal Railway will be open for traffic by the end of the year, and that good progress is being made by the Bengal and North-Western Railway. The earthwork of the entire system of the latter line will be finished early in June, and the greater portion of the brickwork. The *Times* Calcutta correspondent says it is also probable that 140 miles—from Sonepore to Goruckpore—will be ready to be opened next March, and perhaps even the entire line.

THE record of train accidents in the United States in March, given by the *Railroad Gazette*, shows for that month a total of 142 accidents, in which thirteen persons were killed and 137 injured. While the record is much better than that of February, it still makes a very unfavourable comparison with previous months and with the same month in previous years. As compared with March, 1882, there was an increase of forty-three accidents, a decrease of sixteen in the number killed, and an increase of thirty-six in the number of persons injured.

THE Bill to permit the construction of the proposed "Arcade Railway" under Broadway, in New York, has passed the State Assembly. The plan is to excavate the entire width of Broadway to the depth of 20ft., and make a new Broadway under the present one, with ample sidewalks, with four tracks for passenger and freight trains, and with an accessible conduit for all the iron pipes, water, gas, &c., now under the street. The upper road is to rest on iron girders, sustained by brick arches covered with concrete, asphalte, and sand, on which the pavement is to be laid.

INCLUDED in accidents which occurred on the United States railways in March are 47 collisions, in which 5 persons were killed and 30 injured; 84 derailments, in which 5 persons were killed and 105 injured; and 11 other accidents in which 3 persons were killed and 2 injured. Four of the killed and 24 of the injured in the collisions were employés, as were all of the killed and 46 of the injured in the derailments, and all of the killed and injured in the other accidents. The only person killed who was not an employé was a tramp who was stealing a ride, being thus of a class who voluntarily expose themselves to greater risk than passengers.

MR. HOWARD FRY, locomotive superintendent of the West Shore and Buffalo Railway, was killed in an accident on the Chicago and Grand Trunk Railway on the 27th ult. A collision was caused by an extra freight train running into the rear end of a passenger train called the Pacific express, and telescoping the two rear Pullman cars. The passenger train was standing on the track at the place of accident, where it had been stopped by the bursting of the hose connecting the air brakes with the engine, the bursting of the hose having caused the automatic brake to set and stop the train. The jury further found that the conductor of the passenger train did not exercise proper diligence in making sure that his flag man went back in a proper manner and to a proper distance. The freight train was running at a higher rate of speed on the down grade east of the place of the accident than was prudent.

WORK has been resumed on the Hudson river tunnel, on the New York side of the river. The water was pumped from the excavation, and it was found that the brick walls of the tunnel were not injured in the least. Work is going on continuously night and day. One of the engineers engaged in the work says:—"We are making very satisfactory progress. Since the work was suspended, about six months ago, the river bed at the outer end of the tunnel has become more solid. After we get about 30ft. further we shall strike a loamy soil similar to that through which the tunnel on the other side of the river has been dug, and will be able to push the work much faster. We are now making progress at the rate of about 2ft. or 3ft. a day." The *Railway Review* says the tunnels on the New Jersey side of the river have been kept free of water as far out as the air-lock in each tunnel. Work has not yet been resumed on the New Jersey shore.

IN the Cottran locomotive the driving axle, and those coupled with it, are provided with two pairs of wheels—one pair of the diameter best suited to the ordinary requirements of the road and the traffic, and the other pair—generally placed outside the larger—of a much smaller diameter, for running on supplementary rails when mounting heavy gradients. Thus, with a uniform number of piston strokes, and therefore revolutions of the wheels, the speed of the engine is reduced, with a corresponding gain of power, when there is harder work to be performed. This is not new as a proposal, and there are practical objections, such as obstacles lodging in the space between the inner and the outer rails, and capable of throwing the train off the track by contact with the clearing irons. Again, as the inner rails are necessarily lower than the outer, there is increased difficulty in forming level crossings; but this objection is of less weight than the former, as level crossings are a fruitful source of accident, and are being abolished by the Board of Trade wherever possible. The supplementary rails require to be laid very accurately, and tapered off at each end, so as to avoid any shock to the train when entering upon and leaving them.

NOTES AND MEMORANDA.

A GOOD paste for labels, suitable for bottles, may be made by soaking glue in strong vinegar, then heat to boiling and add flour. This is very adhesive, and will not decompose when kept in wide-mouthed bottles.

THE annual rate of mortality in London from all causes, which in the two preceding weeks had been equal to 19·8 and 21·8 per 1000, declined last week to 20·2. In greater London 3066 births and 1900 death were registered, equal to annual rates of 32·1 and 19·9 per 1000 of the population.

THE annual rate of mortality last week in twenty-eight great towns of England and Wales averaged 21·3 per 1000, or 20·96 per hour, of their aggregate population, which is estimated at 8,620,975 persons in the middle of this year. The six healthiest places were Bolton, Bristol, Leicester, Huddersfield, Brighton and Halifax. In London 2407 births and 1530 deaths, or 9·1 per hour were registered.

A WRITER in an American contemporary says:—"I discovered many years ago that wood could be made to last longer than iron in the ground, but thought the process so simple that it was not well to make a stir about it. Posts of any wood can be prepared for less than two cents apiece. This is the recipe:—Take boiled linseed oil and stir in pulverised coal to the consistency of paint. Put a coat of this over the timber, and there is not a man that will live to see it rot.

SIR G. B. AIRY, F.R.S., late Astronomer Royal, has recently published in the *Proceedings of the Royal Society* an analysis of observations on the temperature of the Thames, extending over many years. On the average of thirty-three years the temperature of the river—51·7 deg.—is higher than that of the air at the Royal Observatory—50·2 deg—by 1½ deg. During the seven months, May to November, this difference averages 2·0 deg.; and during the winter, December to April, only 0·7 deg. On the average of the thirty-three years July gives the highest monthly mean river temperature—65·7 deg.—and January the lowest—39·4 deg. The average for June, 1846, was 73·1 deg. The highest temperature recorded seems to be 77·0 deg. on June 21st, 1846; but that does not seem to be quite reliable. The next highest reading, and probably a true one, was on July 20th, 1859—75·4 deg.

IN their report on the Thames water supply to London during April, Messrs. Crookes, Odling, and Tidy, while objecting to Dr. Frankland's reports, say:—"We accept as the expression of our own opinion with regard to 'moving organisms' what is stated in the following extracts from a published lecture of Dr. Frankland's, delivered at the Royal Institution in 1861:—'These organisms consist of animalculæ, and animals of a larger size. . . . The water supplied to Manchester, which is well known to be one of the best waters in this country, is quite full of this kind of animals in summer. . . . . . Both of the specimens which I have shown are to be met with in good waters. . . . . Looked at from a chemical point of view, they are exceedingly useful in the water. . . . . From a physiological point of view, I do not know what sort of a case can be made out against them. . . . . . The animals themselves cannot pass through the filter, but their ova can.'"

THE product which is known in commerce under the name of argentine, and which is employed for printing upon cloths and paper, is a tin moss or sponge, obtained from the precipitation of a solution of chloride of tin by zinc. The solution, strongly acidulated at first, must be diluted until it contains 60 litres of water (15·85 gals.) for 150 grammes of the tin salt. The sponge must be collected with care and without compression in a sieve, then washed in water, and dried by heat. It may then be finally brayed with water in a mortar, passed through a hair sieve, and mixed with starch paste for printing. The small quantity of the sponge which remains upon the sieve is dissolved in a mixture of equal parts of chlorhydric acid and water, and added to the tin solution. The same water may be used from ten to thirteen times. The chloride of zinc in solution may be evaporated and used for soldering, or for cleansing objects which are to be tinned. The *Chronique Industrielle* says the gray tin powder can be economically employed for tinning all metals but lead.

FOR the preparation of spongy tin suitable for the manufacture of silver paper and for calico printing it is necessary, by the process of F. Puscher, to acidify the tin salt solution with hydrochloric acid, then to dilute it so that 10 litres liquid contain only 25 grm. salt. The spongy tin obtained by immersing zinc rods in the solution is collected on sieves washed with water, and dried by warming it. It is then ground with water, washed through a hair sieve, allowed to settle, ground with a certain quantity of starch paste and used. The *Journal of the Society of Chemical Industry* says the small particles of tin remaining on the sieve are dissolved in a mixture of equal parts of water and hydrochloric acid and added to the next tin salt solution instead of hydrochloric acid. For tinning metals spongy tin is used with a saturated aqueous solution of sal-ammoniac to a pasty consistency, and painted on the articles to be tinned. They are then heated for a minute, washed with water, and polished with chalk.

IN investigating the properties of pure aluminium Dr. J. W. Mallett, F.R.S., prepared the pure metal by converting the commercial aluminium—containing 96·89 Al, 1·84 Fe, 1·27 Si, and a trace of copper—into the bromide, by treatment with bromine. More than 2 kilos. of this bromide were purified by a careful fractional distillation, the temperature being strictly regulated, and the operation being repeated until the product was perfectly colourless, and dissolved in water without leaving any perceptible impurity. The reduction of the metal was, of course, accomplished with great difficulty and considerable loss, by heating with sodium in a crucible, which was made from a pure mixture of alumina and sodium aluminate. The large globules of aluminium thus obtained were remelted before the blowpipe on a bed of clay, then laid a short time in hydrochloric acid, well washed with water and dried. Aluminium purified in this way is considerably whiter than the commercial metal, being nearly tin white in colour, without any tinge of blue. The lustre of the fresh-cut surface is stronger than that of tin. The pure metal is far softer and more malleable than the commercial product. The specific gravity at 4 deg., compared with water at the same temperature, is 2·583. The specific heat is 0·2253, for temperatures between 0 deg. and 100 deg. This figure, multiplied into an atomic weight, gives the atomic heat 6·09.

A PAPER "On the Production of Ammonia from the Nitrogen of Minerals" was read by Mr. G. Beilby at a recent meeting of the Chemical Society. The author gave the results obtained by distilling two shales, one a typical oil shale from Midlothian, the second a coal shale from Ayrshire. These shales were distilled (1) by the usual process of distilling at a low red heat; (2) at a low red heat in a current of steam; (3) at a low red heat in a current of steam, the residual coke being afterwards subjected to the prolonged action of steam at such a temperature that the whole or a large part of the carbon being consumed by the steam, the nitrogen is liberated as ammonia. The soda lime process was used for the determination of the nitrogen. The results are given in pounds of N per ton. No. 1 shale gave with the first process 2·70 lb. of N as NH_3 in the watery distillate and 1·20 lb. in the coke. The nitrogen combined with carbon amounted to 8·88 lb. in the coke. By using the second process all the ammonia in the coke came over in the distillate, and 3·9 lb. of N as NH_3 were found in the watery distillate, the N combined with carbon remaining untouched. In the third process, however, the N as NH_3 in the watery distillate amounted to 12·0 lb., the N combined amounted to only 0·78 lb. Similar results were obtained with No. 2 shale. In the third process the carbon, steam, and temperature should be so adjusted that the re-action is $C + 2H_2O = CO_2 + 2H_2$. Dr. Armstrong, the author, stated that the above improved process—No. 3—of distillation was very successful commercially, the results being startling; in one case a coal shale which furnished only 18 lb. of ammonium sulphate per ton now yielded from 75 to 98 lb.

MISCELLANEA.

THE Edison Company has applied for powers to light the interiors of buildings in a central district of Brussels.

IT is reported that a company has been formed in Iowa for the purpose of manufacturing sporting shot from iron. It is stated that recent trials which have been made with the shot have proved it to be fully equal, and in some respects superior to the lead shot.

THE Normandy, one of the new fast paddle steamers now working between Newhaven and Dieppe in connection with the London and Paris day tidal service, accomplished the passage on Wednesday from Dieppe to Newhaven in 3 hours and 47 minutes.

THE Chester Town Council is considering a scheme for the abolition of the River Dee tolls. The bridge across the Dee opens direct communication with Eaton Hall and Hawarden Castle. At present a 9d. toll is charged. The Duke of Westminster has offered to contribute £10,000 towards the abolition of the tolls, one-third of the entire sum required.

AN extensive bed of superior red marl, 64 yards deep, has been recently discovered at Ruabon, and with it Messrs. Monk and Newell, Liverpool, are commencing the manufacture of terra-cotta, &c., upon a large scale forthwith, the manager of the Penybout Works, "the originator of Ruabon—deep red—terra-cotta," undertaking the practical management of the works.

AT the last monthly meeting of the Meteorological Society, Mr. G. M. Whipple, F.R.A.S., read a paper on the reduction of Meteorological and other similar observations, and the possibility of employing a method, suggested by a consideration of the highly ingenious system of composite portraiture, invented by Mr. Francis Galton, F.R.S., and utilised in his anthropological studies.

ON the 21st inst. Messrs. Earle's Shipbuilding and Engineering Company, Limited, launched from their yard at Hull a fine twin-screw passenger and cargo steamer, named the Ipswich, for the Great Eastern Railway Company's service between Harwich and Rotterdam. This vessel is to be the same in all respects as the Norwich, built by Earle's Company, recently launched and now nearly completed.

AT the International Electrical Exhibition of Vienna, 1883, the Italian Minister of Public Works will exhibit apparatus employed by the Telegraph Administration, and the Danish Navy Minister will exhibit inventions in the department of torpedoes. Like Russia, the Wirtemberg Government has now appointed a representative, namely, Dr. Dietrich, Professor of Electrotechnics at the Polytechnic School in Stuttgart.

ON Saturday, near Lincoln, a traction engine, on commencing the descent of a steep hill, became unmanageable through breakage and swung round, crushing against a wall a man named William Simpson, who was acting as flagman. The wall was knocked down, and Simpson was precipitated into a garden a considerable distance below the level of the road, and sustained frightful injuries, from which he died.

THE Royal Commission on Metropolitan Sewage Discharge met on Tuesday and Wednesday, at 8, Richmond-terrace, Whitehall. Present: Lord Bramwell, F.R.S., in the chair; Sir John Coode; Colonel C. B. Ewart, C.B., R.E.; Professor A. W. Williamson, F.R.S.; Dr. de Chaumont, F.R.S.; Dr. Stevenson; Mr. James Abernethy, F.R.S.E.; Dr. W. Pole, F.R.S., secretary. Further evidence was given on behalf of the Metropolitan Board of Works.

ALL articles for exhibition at the Southern Exposition at Louisville, Kentucky, to which we recently referred, are to be admitted without the payment of duty, or of customs fees or charges, under such regulations as the Secretary of the Treasury shall prescribe: Provided that all such articles as shall be sold in the United States, or withdrawn for consumption therein, at any time after such importation, shall be subject to the duties, if any, imposed on like articles by the revenue laws in force at the date of importation.

COLONEL COLTON, commanding the Quebec Citadel, successfully broke the ice gorge on the St. Lawrence River the week before last, by means of gunpowder explosions. The gorge extended for several miles along the river, being jammed at the narrows until it was some 35ft. thick. Here several shafts were bored and filled with charges of 300 lb. each, which were exploded by electricity. This treatment loosened the ice, and the tide is now clearing the harbour. The possibility of opening Montreal port earlier hereafter has thus been demonstrated.

CONSULAR statistics as to the trade of Birmingham and district with the United States, for the first quarter of the year, just issued, show that from Birmingham alone guns and materials were sent to the value of 139,106 dols.; hardware, cuttlery, steel, and iron, 191,107 dols.; and glass, porcelain, &c., 50,801 dols. The value of the total exports from Birmingham was 736,058 dols. The Wolverhampton exports amounted to 98,216 dols., of which 60,692 dols. was for cotton, tees, &c., and 27,661 dols. for iron sheets, roofing, &c. The whole of the exports for Birmingham and the district amounted to 1,127,752 dols., or an increase over the first quarter of last year of 8807 dols.

A PAMPHLET entitled "The Explosives Act, 1875, and the Orders in Council of 20th April, 1883, their Prejudicial Effect on Mining and Quarrying, and the Encouragement they give to Fenians," is being published by A. P. Blundell and Co. It contains some interesting information, and amongst other things gives figures showing the enormous difference in the loss of life and destruction caused by the explosion of a barrel of gunpowder at Clerkenwell in 1867, and by the dynamite explosion at the Foreign-office lately. The former caused the loss of twelve lives directly, of numerous babies indirectly, and about £20,000 worth of property, while a hundred or two pounds repaired the Foreign-office.

ACCORDING to a telegram received in London on Wednesday, Mr. Oscar Dickson's Greenland expedition, under the command of Baron Nordenskjöld, is now sailing in the Sofia, 180 tons, 65-horse power, drawing 10ft., and of 11 knots speed, navigated by Captain Nilsson and a crew of thirteen men. With Baron Nordenskjöld are Dr. Nathorst, geologist; Dr. Berlin, doctor and botanist; Dr. Forsstrand, zoologist; Dr. Hamberg, hydrographer; Herr Kolthoff, zoologist; Herr Kjellström, typographer and photographer; two Laplanders, two Norwegian icemasters, and one harpooner. There is on board a complete scientific equipment and fourteen months' provisions for subsistence on the inland ice. Eight or nine picked men accompany Baron Nordenskjöld. Count Stromfeldt, botanist; Dr. Arpi, archæologist and philologist; and Herr Flink, mineralogist, will disembark on the coast of Iceland for the purposes of study and collection.

THE report of the Committee on Solar Physics recommends:—(1) That the existing information regarding sun spots be collected and published. (2) That steps be taken to obtain sun pictures from existing observatories, so as to secure a daily record of the sun for the future. (3) That these pictures be reduced on a uniform system, with the co-operation of the Astronomer Royal. (4) That the system of spectroscopic observations of the sun and their reduction at present employed at South Kensington be continued. (5) That communications be opened with observatories where spectroscopic work would be likely to be prosecuted under good climatic conditions, suggesting simultaneous observations on a definite plan for a limited period, say for three years. (6) That steps be taken, in concert with foreign Governments, to secure the observation of the phenomena of all total solar eclipses as far as possible. (7) That the experiments necessary to obtain improved instruments to record the intensity of solar radiation be continued, and that measures be taken to secure continuous observations with such instruments in suitable localities. (8) That communications be entered into with the Meteorological Council, with the view of concerting a plan for investigating with sufficient thoroughness the nature and extent of the supposed relations between solar variability and the meteorology of the earth. (9) That communications be entered into with the Kew Committee of the Royal Society, with the view of furthering some concerted scheme for utilising the records of self-recording magnetographs.

NEW WATERWORKS, BRADFORD, WILTS.

MR. HENRY ROBINSON, M.I.C.E., WESTMINSTER, ENGINEER.

(*For description see page 406.*)

FIG. 1. FRONT ELEVATION

FIG. 2. PLAN

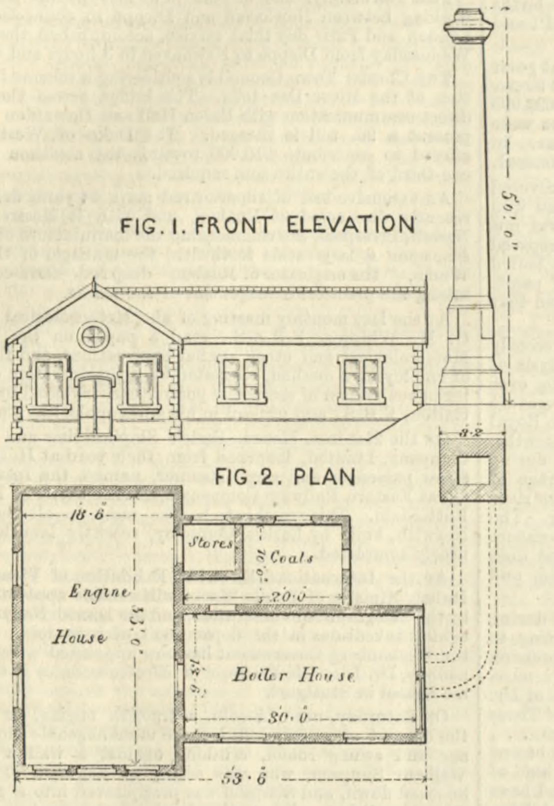


FIG. 3. GROUND PLAN

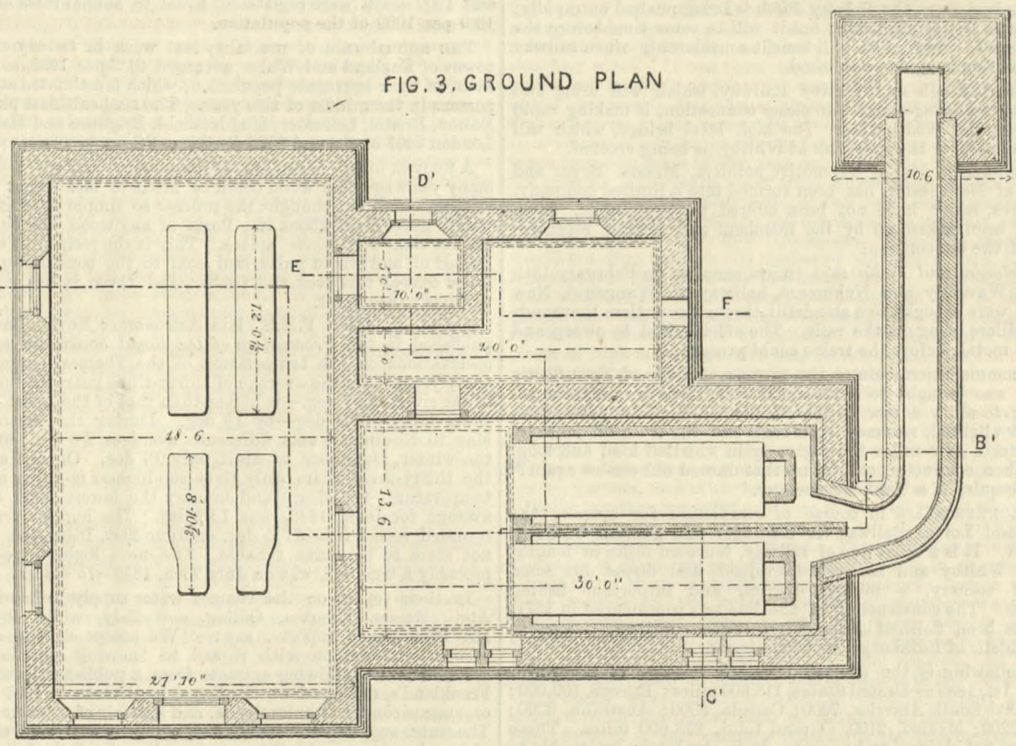


FIG. 4. SECTION ON LINES A.B. A'B'.

FIG. 6.

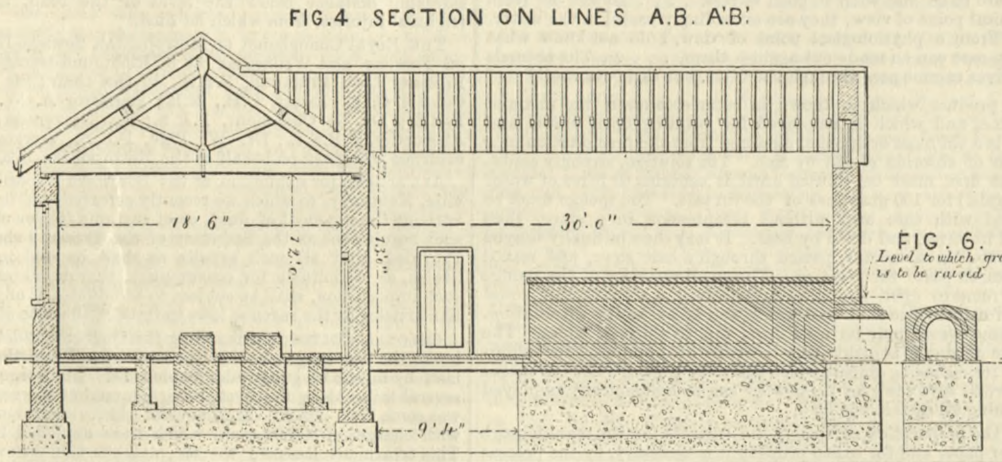


FIG. 5. SECTION ON LINES C.D. C'D'.

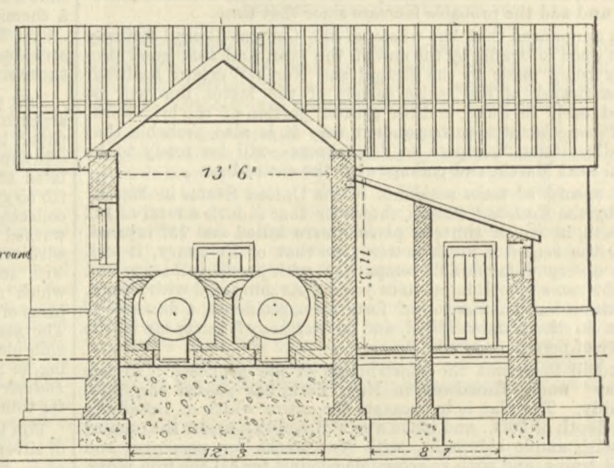


FIG. 7. CROSS SECTION E.F

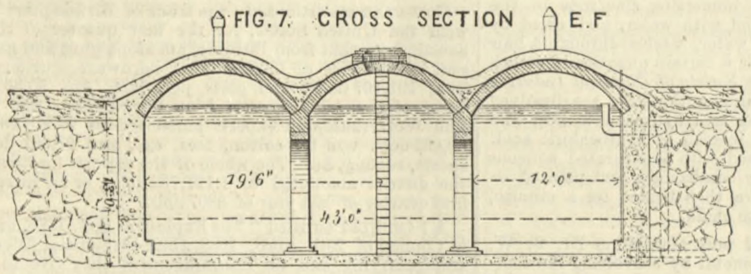
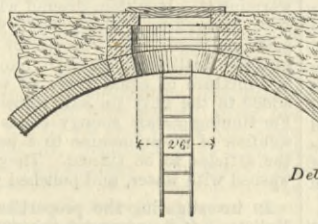


FIG. 8. SECTION K.L.



SECTION I.J.

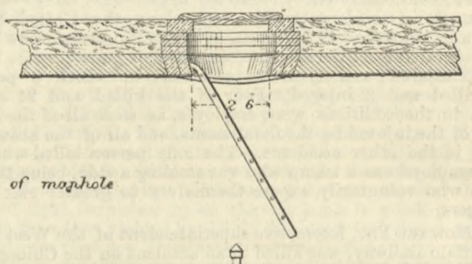


FIG. 10. LONGITUDINAL SECTION A.B

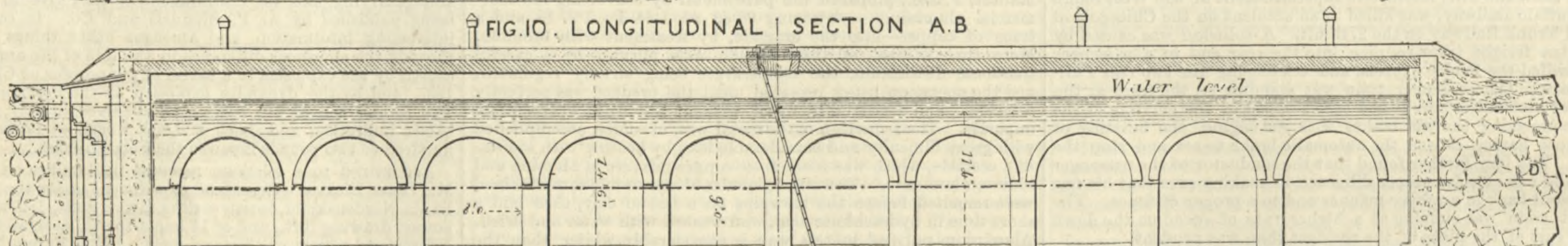
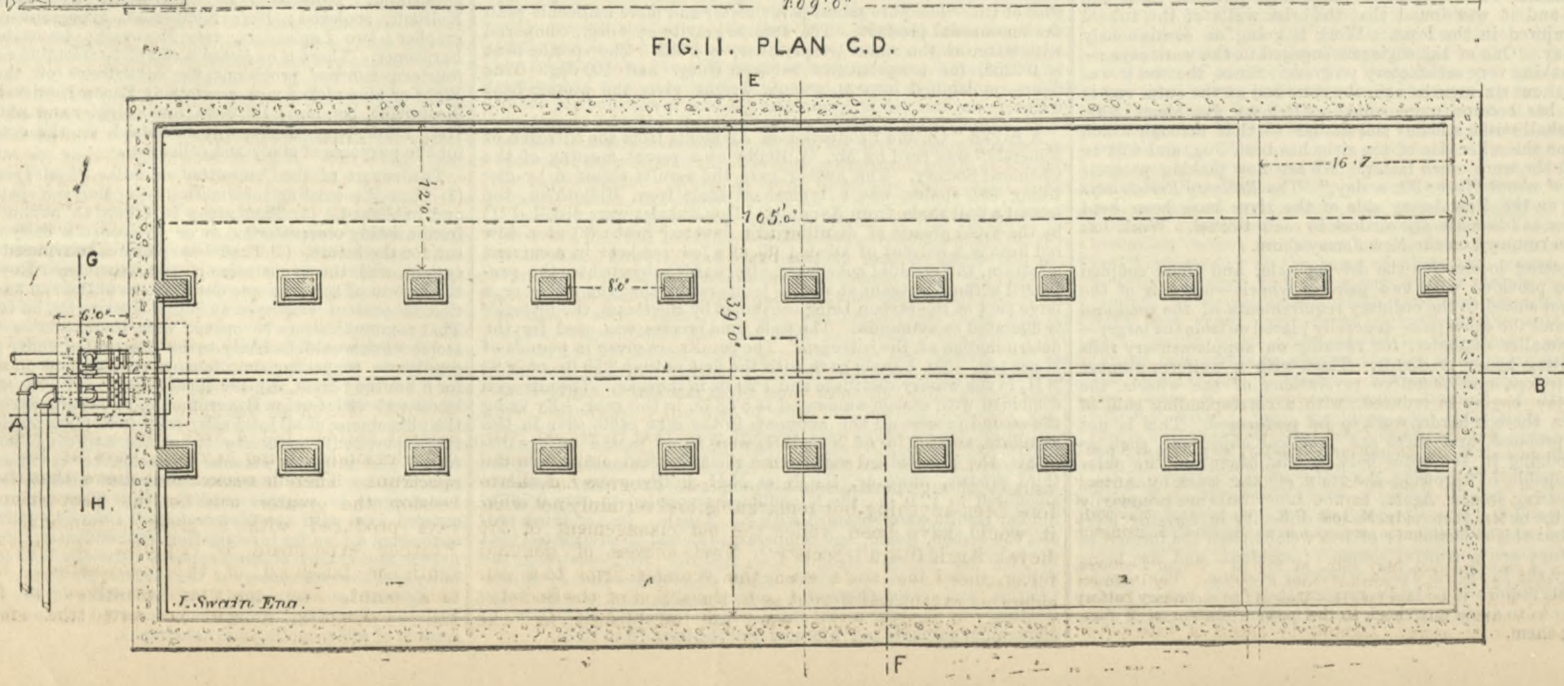


FIG. 11. PLAN C.D.



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

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

H. K.—*The Landore Siemens Steel Company. Landore, South Wales.*

VULCAN.—*There is no such Institution in Scotland so far as we are aware.*

SEAMAN (Cronstadt).—*Mr. Juvet's address is Canajoharie, Montgomery Co., New York, U.S.A.*

W. B. (Hart's hill).—*You cannot use anything better than hot water for warming the church. Box's treatise "On Heat," costing about* 6s*, will supply you with most of the information you will need. For the rest we shall be happy to supply you with information on doubtful points.*

SIGNALS.—*Nothing, however good, which would require a radical change in the system of signalling on our railways has the least chance of being adopted. The responsibility entailed by making such a change and getting men to unlearn one system—if we may use the words—and learn another would be too great to be incurred by any set of railway officials.*

N. W. M. (Rampore).—(1) *The expression given is obviously very rough. No account is taken of the length of barrel. It would not apply to rifles at all.* (2) *The work increases with the length of barrel without limit. Practically the barrel is curtailed by considerations of convenience. The new* 100-*ton breech-loading gun fired at Spezia is* 27·5 *calibres long. Krupp has fired a* 3·4*in.*—8·7 *cm.—gun* 50 *calibres long. Speaking generally, the same laws apply to rifled guns and small-arms.* (3) *Destructive effect is proportional to "stored-up work" or "energy" on striking, that is* $\frac{W v^2}{2 g}$, *where* W *is the weight, v the striking velocity, and g the force of gravity. The actual calculation of remaining velocities is too long to give here. The subject is treated of with examples and tables in the new "Test-book of Gunnery," by Capt. Mackinlay, R.A., printed for cadets by the Government Stationery-office. The initial velocities of the Martini rifle bullet* ·45 *bore and Mauser bullet* ·435, *are* 1353*ft. and* 1526*ft. The velocities at* 200 *yards are* 1074*ft. and* 1142*ft. The Mauser bullet is* 382 *grs., the Martini* 480 *grs.*

PARKER'S PARALLEL VICE.

(*To the Editor of The Engineer.*)

SIR,—Can any of your readers give me the name and address of the makers of Parker's patent parallel vices? W. R.

London, May 18th.

PACKING PEAT.

(*To the Editor of The Engineer.*)

SIR,—Can any of your readers give me the address of makers of machines for cutting and packing turf or bog for stable litter? C. D.

Belfast, May 21st.

ALUMINIUM BRONZE.

(*To the Editor of The Engineer.*)

SIR,—Can any reader tell me the proportions of the metals for making aluminium bronze, also the flux, and the amount of it used for a given quantity? V.

Glasgow, May 23rd.

IRRIGATION OR SANITARY WORKS IN PROGRESS.

(*To the Editor of The Engineer.*)

SIR,—I should be obliged if any reader could give me information on the following subject:—I wish to find some works, such as irrigation or sanitary works, or some large construction, suitable for a practical course, in a healthy and pleasant neighbourhood, by the sea, and preferably in Scotland. TAFFY.

Staines, May 8th.

NAMES ON CART WHEEL BUSHES.

(*To the Editor of The Engineer.*)

SIR,—Could any of your numerous readers give me any information as to the best method of putting the maker's name on cart wheel bushes which are cast vertically? I have tried stamping after the pattern is drawn, but find the name does not come out well, as the letters generally clog. I should also like the name of any firm who makes letters or stamps for this purpose. Perhaps some Glasgow reader might give this information, as the manufacture of bushes is largely carried on there.

Ireland, May 22nd. INQUIRER.

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Advertisements cannot be Inserted unless Delivered before Six o'clock on Thursday Evening in each Week.

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

MEETINGS NEXT WEEK.

THE INSTITUTION OF CIVIL ENGINEERS.—Tuesday, May 29th, at 8 p.m.: Papers to be discussed—"The Edinburgh Waterworks," by Mr. Alexr. Leslie, M. Inst. C E. "The Waterworks of Port Elizabeth, South Africa," by Mr. John George Gamble, M. Inst. C.E. "The Water Supply of Peterborough," by Mr. John Addy, M. Inst. C.E. Wednesday, May 30th, from 9 to 12 p.m.: The President's *conversazione* at the South Kensington Museum.

SOCIETY OF ARTS.—Monday, May 28th, at 8 p.m.: Cantor Lectures, "Secondary Batteries and the Electrical Storage of Power," by Professor Oliver J. Lodge, M.A., D.Sc. Lecture II.—Uses of the secondary battery in practice. Laboratory purposes. Motive power. Action as a regulator. Transmission of energy. Lighting by means of water-power. Locomotion on land. Marine locomotion. Efficiency of motors driven by batteries. Tuesday, May 29th, at 8 p.m.: Foreign and Colonial Section, "Queensland: its Progress and Resources," by Mr. Arthur J. Stanesby. Mr. W. T. McCulloch Torrens, M P., will preside. Wednesday, May 30th, at 8 p.m.: Twenty-third ordinary meeting, "The Relative Claims of Etching and Engraving to Rank as Fine Arts," by Mr. F. Seymour Haden, F.R.C.S. Sir Rutherford Alcock, K.C.B., will preside. Thursday, May 31st, at 3 p.m.: "Prevention of Fires." Public meeting to consider the question of the prevention of fires in theatres. The report of the Society's Committee on that subject will be presented for discussion. Sir William Siemens, F.R.S., chairman of the Council, will preside.

THE ENGINEER.

MAY 25, 1883.

PUBLIC TRIALS OF AGRICULTURAL MACHINERY.

A POLICY has of late years been adopted by some of the older firms of agricultural engineers, the wisdom of which may be questioned, not only as it affects the well-being of those firms and the makers of agricultural machinery generally, but as it influences the development of a very important branch of engineering and those who are its patrons. The last-mentioned have perhaps the most cause for concern as to the tendency of this policy; but there are many others who have little less reason for urging that they are working under an unsatisfactory influence in the management of the affairs of the national society which in former years did so much to place English agriculturists and agricultural machinery manufacturers in the highest position.

Until less than ten years ago the Royal Agricultural Society of England held a position, chiefly owing to its systematic yearly trials, which caused it to be regarded by all the world as the index of progress in the construction of all the implements and machinery required by the farmer. Its sphere was the encouragement of the combination of practice with science or science with practice, and it fulfilled its duties. The functions of the position which it arrogated to itself were carried out, and with the result that development in the design and construction of the tools of agriculture made remarkable advances. Of the stimulating effect of the Society's yearly trials the records of invention and improvement between the years 1840 and 1870 give ample testimony, while during the past few years progress has been very slow, and real novelty almost *nil*. Individual firms have brought out many improvements in design and workmanship, but none have been strides such as those which were formerly the result of a vigorous competition for the first prize offered by a great national society. It is not that there is no room for great strides or for novelties and really valuable improvements, for several in an undeveloped state may be pointed to now; valuable things which no maker looks upon as claiming any more than that desultory attention which is given to things which are rarely finished, because the stimulus of a competitive trial and its resulting fame all over the agricultural world have no existence. The adoption of the idea that things are good enough, and that the ideal of the agricultural engineer is to be able to go on manufacturing farm machinery as a Birmingham manufacturer makes pots and pans year in and year out, condemning all changes and competitive trials as expensive nuisances, may at first sight appear to be the proper policy for the well-known firms who have by the aid of competitive trials reached world-wide fame, and now wish them discontinued because they interrupt the lifeless uniformity of repetition manufacture; but it is very questionable whether this is not a policy just as suicidal for the older firms as injurious to the younger firms which the policy is supposed to keep in the background. It pays well for a time, but in the long run no firm can afford to live upon its reputation. In mechanical engineering, change is so constant, and the means of placing improvements before the public are now so extensive, that young firms quickly acquire public recognition; and a proof that the policy of resting upon laurels of victories won in days gone by does not pay, is found in the very rapid growth of some of the younger firms, and the slow growth of some of the older firms. It is well known that the influx of business which followed gaining a first prize of the Royal Agricultural Society in competitive trials, years ago, was enormous; and though the cost of the experimental work which preceded the trials was often very great, it was as nothing compared with the value of the business which followed a first or second prize.

The policy to which we have referred has, however, sufficiently prevailed to have had a retrogressive effect on the working of the Royal Agricultural Society. For several years competitive trials have been discountenanced, few competition prizes offered, and remarkable improvements have gradually grown correspondingly fewer. The last engine trials were at Cardiff, in 1872. Thrashing machines have received no trials worthy the name since the same date; steam cultivation has received no such encouragement as in former days, and the trials at Carlisle in 1880 have not been followed by the stimulus of a proffered prize, as it should have been after what was brought forward then. Reaping machines have been made the subject of competition with the most profitable result to the winner of the first prizes; profits which are, however, to a great extent shared by this country, to which his success brings trade and money from abroad where it would otherwise have remained. Generally, however, the annual meetings of the Society have altogether lacked the enthusiastic interest which they formerly excited; and the development of agricultural engines and machinery has been left to individual manufacturers, encouraged only by the expectation of that increased business which the introduction of a useful improvement usually, though perhaps slowly, ensures. Progress has, therefore, been anything but remarkable, and certainly not what it would have been under the old management of the Royal Agricultural Society. New sources of demand for engines have made even the younger firms to a considerable extent indifferent as to the action of the Society; but the Society's trials were not established for the benefit solely of the manufacturers. They were especially promoted with a view to improvement for the advantage of agriculture; but the Society has fallen back from its position as leader, and to the disadvantage of trade in agricultural engineering, to say nothing of the loss to agriculturists. Whatever may be the feelings of the greater number of manufacturers with respect to competitive trials, there can be no doubt of their fostering value; and many engineering firms that are now indifferent to them would clamour for trials if trade were less brisk. Even under present conditions, however, it is well known that not a few firms are complaining of the policy adopted by the Society as one which is most detrimental to the interests of the Society and to home and foreign trade; unfair to manufacturers generally, though especially favourable to a few, and one which calls for action on the part of the Society as a whole. When it is asked why are there no trials, for instance, of steam engines, the answer given is usually that it is the result of the present constitution of the Council of the Society. It certainly is not because the steam engine at Cardiff was perfection, and that nothing has been done since to place an economical simple engine in the hands of the farmer. The high results of the Cardiff engines were obtained by means of more or less complicated mechanism and special boilers, which everyone knows never find their way on to the farm. The duty obtained by a racing engine is not necessarily any indication of the economy obtainable by the common commercial engine made by the maker of the racer; and this fact alone is sufficient ground for demanding trials of modern engines, and especially of the compound engine, which promises to give, with simple mechanism, an engine of less weight and equal in economy to the elaborate engines tested at Cardiff. It is, however, quite unnecessary to mention the different implements in which improvements have been made or are much required, and which should receive special attention on the part of the Society if it is to remain the representative institution of those interested in agriculture generally. If the Society is to be looked upon as waning in influence and vigour, and unlikely to return to a full sense of its duties, it becomes a matter of some importance for the large number of agricultural engineers and others, who know the high value of well-conducted and complete public trials, to consider the advisability of forming themselves into a body for the purpose of carrying on the work so well begun by the Agricultural Society. It is a great pity that a Society which has occupied a position of such national importance, and has conferred such great benefits on the agricultural community generally, should lose its influence and be unable to carry on the work which was so well appreciated all over the world. It is not, however, simply a want of funds which has caused the Society as represented by its Council to fall from its high position. Reform is needed, and that reform in the Council. It is impossible for the affairs of a prize-awarding Society to be carried on in the interests of those it represents while its Council is largely composed of members themselves interested in the awards that should be made. Without mincing matters, it may at once be said that there are too many members of engineering firms on the Council, and so long as engineers who might be advantageously or disadvantageously affected by the encouragement by trial of improvements in agricultural machinery take a prominent part in the management of the Society's work, that work cannot be fairly or properly done. Some engineers on the Council there should be, but they should not be makers of agricultural machinery. It remains to be seen whether the Society as a body will wake up to a proper comprehension of its duties with respect to the composition of its Council, or whether it will be necessary, in the interests of agriculture and of agricultural engineers, to form a new body to carry on the work which the the old Society would, under proper management, be the most competent to do.

ELECTRIC LIGHTING.

MR. CROMPTON'S letter, published in our last impression, is a valuable contribution to the momentary literature of electricity. It so happens that what is true of electricity to-day may not be true to-morrow, and that advances are daily made into the regions of the apparently impossible. But the letter in question tells us what has been most recently effected in incandescent lighting, and calls attention to the want most felt at the moment by electricians. It will not have failed to strike our readers that Mr. Crompton's large experience does not lead him to desire any great improvement in lamps, or dynamos, or engines. He wants better carbons; that is to say, for incandescent lamps, carbons with a yet higher resistance than has yet been got, and for arc lighting an altogether better material. It is well that electricians of experience should say plainly what they want in order that they may be supplied. We have already pointed out that high resistance in incandescent lamps is desirable. Mr. Crompton admits this, but he wants it for a reason different from ours. Mr. Swan has already succeeded, it appears, in making filaments with a resistance of 360 ohms, requiring a current with an electro-motive force of 160 volts to work them. The advantage claimed by Mr. Crompton is that an enormous reduction can be effected by the use of such lamps, as compared with those of lower resistance, in the weight of the wires required to transmit the current. This we have, of course, foreseen and admitted; but we venture to go further, and say that it is possible that a still further advantage may be gained. It is known, for example, that of all the light rays given out by the incandescent carbon, but a very small percentage are visible, the remainder being invisible rays at the end of the spectrum. There is reason to believe that the higher the tension the greater will be the proportion of visible rays produced with a given expenditure of power. Further experiment is required to demonstrate the truth or falsehood of this proposition. But waiving this point, and confining ourselves to Mr. Crompton's statement, it will be seen that such lamps as

Mr. Swan has recently made go a long way to render the orders of the Board of Trade obsolete. It will be remembered that 200 volts is practically the maximum tension which will be allowed by law; but it is by no means impossible that lamps will be made requiring 300 volts to work them, and it is quite clear that even 160 volt lamps cannot be worked at all in series with only a 200 volt current. Up to the present it has been found eminently convenient to work three or four incandescent lamps in series; but to do this in future will demand lamps of low resistance. To make what we wish to convey clear to those of our readers who are not versed in electricity, we may explain that when lamps are worked in series a given current passes successively through two or more lamps, each of which will take up a portion of the energy in the current, leaving the quantity unaltered. Thus, if we have three lamps, each with a resistance of 50 volts, set one after the other, we must have a total energy of 150 volts to overcome the resistance. Let us suppose that we have a given quantity of water available with a head of 150 lb., and that we have three water pressure engines. The first works against a resistance of 50 lb. on the square inch, and delivers its water to the second, also working against a resistance of 50 lb., and so on. It is clear that the water in the first engine will virtually lose head equivalent to 50 lb., and the pressure in the second will only be 100 lb. In this engine, again, 50 lb. will be lost, and the water will be delivered to the third with a vertical head equivalent to only 50 lb., while from the last engine it will flow away without any head at all. For the water substitute electricity. For the pressure in pounds or head in feet substitute electro-motive force in volts; and for the water pressure engines substitute electric lamps, and the illustration is complete. When working in multiple arc, we have a case similar to that which would be presented if we used three water pressure engines side by side, all fed at once from the same main, in which the water exerted a pressure of 50 lb. on the square inch. The water would be delivered from each engine without any pressure. A moment's thought will show that to get the same power three times as much water must be used at one-third of the pressure, and that three mains would be needed instead of one. With water, if the pressure were obtained by head, the whole quantity of main would be the same, because the vertical height would be 300ft., say, in one case, and 100ft. in the other; but with electricity the extra force would be obtained by using finer wire and more of it in the dynamo; but the saving in conductors would be greater by far than the loss on dynamo wire. Very considerable inconvenience and much expense will be incurred if three incandescent lights at least cannot be worked in series; and so great is the advantage gained from high tension that we may say that one firm has now in hand a dynamo to give 45 ampères with an electro-motive force of 1200 volts, which is far in excess of anything yet used in practice. We have no doubt that the statutory limitation to 200 volts will be withdrawn; but the fact that the necessity for its repeal should already be announced, points strongly to the fact that electrical discovery and improvement are travelling at a tremendous pace. The impossible of to-day is the obsolete of to-morrow.

Concerning arc lighting we do not quite agree with Mr. Crompton. Had he made himself familiar with the working of the Brockie lamp last winter at the Crystal Palace he would not have said that all lamps were on a dead level of flickering uniformity. Mr. Brockie, at all events, managed to get hold of carbons which did not flicker. Furthermore Mr. Crompton ought to be aware that any fairly good carbon can be used either so as to flicker and make a noise, or to give a perfectly silent and steady light. The conditions are quite easy of attainment. At pleasure the carbons can be made to "roar" and flicker, or to burn, as we have said, in perfect silence and without a twinkle. To maintain this condition requires, we admit, a very sensitive lamp; but the means of attaining the required end are, we should suppose, well known to an electrician of Mr. Crompton's experience. It is impossible to describe on paper how the desirable end is obtained, but we may say that, so far as our experience goes, it has very little to do with the length of the arc, so long as there are no "mushrooms" on the carbons, and the dimensions of these last are properly proportioned to each other. Of course good carbons are needed. Siemens' soft-cored carbons will burn in almost perfect silence, and without flickering. They give a beautiful white, mellow light, but they are too expensive, both in first cost and because of the rate at which they burn, for general use. There is plenty of rubbish in the shape of carbons in the market, and this ought to be rigorously excluded. Unfortunately competition is already beginning to work mischief, and companies which should know better buy carbons which are bad because they are cheap. Mr. Shearer's letter, which will be found in another page, contains news too good we fear to be true. The so-called flexible carbons are simply charred cord or lamp wick. We do not know the precise details of manufacture, but the general principle is obvious. The cord is soaked in sugar, glucose, or some other carbonaceous matter, and heated in retorts. No doubt it can be burned to give a brilliant light, but our correspondent is quite silent concerning the enormous rate at which it is consumed. We have to deal with a bundle of small filaments, offering a large surface for oxidation. No lamp has yet been devised to burn these flexible carbons, and it will be seen that the problem of constructing such a lamp with a very rapid, continuous, variable, feed is one of great difficulty.

At present a lull has fallen on the sea of electrical speculation. It is well known that certain companies must go down before electric lighting can be put on a satisfactory commercial basis. The time is not far distant, however, when the stage will be cleared, and the curtain will rise on a new act. There is a great future before electric lighting, but electric lighting must in the first place find its own level. Extravagant speculations have been indulged in, and these were certain to be disappointed. Electricity has to compete with a powerful rival in gas, whereas gas had practically no rival at all. To ask a town which has already incurred an expense of fifty or a hundred thousand pounds on gasworks, &c., to shut up the gasworks and expend another large sum on putting down electrical plant, is to expect a great deal. It must be first shown that very important pecuniary advantage will accrue to the town. This is the main factor in the whole affair, and for this reason we insist that no pains should be spared to reduce the first cost and the power needed. Electric lighting got long since out of the experimental stage; it is time now that effort should be made to perfect it commercially.

WATER-GAS.

MR. SUTHERLAND'S paper read last week before the Iron and Steel Institute serves to recall attention to a very old invention—an invention so full of promise that large sums have been spent on its development by sanguine capitalists, while it has served as a medium in the United States for more than one swindling transaction. It does not follow by any means that because an invention has been misused and misunderstood for a quarter of a century or more, it should be a completely worthless thing; and it may even be admitted that there is enough in the water-gas idea to entitle it to respectful consideration. Indeed, there is some reason to believe that, properly carried out, the process of making water-gas may be found useful if not profitable; and we propose to explain here what water-gas is, what are the uses to which it may be applied, and to indicate the position which the manufacture at present holds.

Water, as is well known, consists of hydrogen and oxygen combined, in the proportion of two of the former to one of the latter. The gases have a great affinity for each other, and readily combine if, when mixed in the proper proportions, a light is applied to them. If, however, the mixture be highly heated throughout, no combination will take place. The precise point at which this result takes place, known as the temperature of dissociation, has not been certainly determined. It is between 3000 and 4000 deg. Fah. There is reason to believe that the more highly the gases are heated, below this point, the less is the affinity which they have for each other. At temperatures of about 2000 deg. the affinity of oxygen for carbon is much greater than its affinity for hydrogen. If, therefore, a current of steam is passed through a coke fire, the steam will be decomposed, the oxygen will fly to the coke, and hydrogen will be set free. Now, hydrogen is the most powerful heating agent we have. It is more than four times as effective as carbon, for while 1 lb. of the latter will evolve heat enough to convert 15 lb. of water from and at 212 deg. into steam, 1 lb. of hydrogen under the same conditions will evaporate 64·2 lb. of water. Nine pounds of steam contain 8 lb. of oxygen and 1 lb. of hydrogen; so that for each pound of steam decomposed we can obtain gas enough to evaporate $\frac{64 \cdot 2}{9} = 7 \cdot 13$ lb. of water. Bearing these facts in mind, we are in a position to arrive at the value of the process in a commercial sense. It must not be forgotten, however, that the hydrogen is useless as a lighting agent. Now, to make a pound of steam will require, with ordinary boilers working with cold feed-water, say, one-eighth of a pound of coal; but the hydrogen in each pound of steam would evaporate, as we have seen, 7·13 lb. of water. Consequently, a pound of coal will produce hydrogen—"water-gas"—enough to make $7 \cdot 13 \times 8 = 57 \cdot 04$ lb. of steam; and, so far, the economy of the process appears to be enormous. When, however, we examine what goes on in the generator, or dissociator, we find that the whole of the economy disappears. In a word, as much heat is expended in separating the two gases as they can subsequently give out again by recombining. The oxygen supplied by the steam is sufficient in amount to burn $\frac{8}{2 \cdot 66} = 3$ lb. of carbon to carbonic acid, with an evolution of as much heat as would evaporate 15 lb. of water but as a matter of fact it is found to be in practice as in theory quite impossible to make the process continuous. The passage of the steam through the white-hot coke cools this last down with great rapidity. In practice the cupola is urged by a fan for about 15 minutes; then the steam is turned on for 5 minutes, and so on. The production of hydrogen to be used as fuel in this way must be extremely expensive. The work done in dissociation cannot be performed without some loss of fuel beyond that theoretically necessary, and the hydrogen cannot be recombined—burned—so as to give out its full effect. Loss and waste of energy attend every step in the process, and hitherto for this reason all attempts to use water gas alone as fuel have been failures.

In the Siemens gas furnace, air is admitted to coal or coke sufficient to produce an imperfect combustion. Each pound of coal is supplied with about 6 lb. of air, and the result is 2·33 lb. of carbonic oxide, C O, mixed with 4·7 lb. of nitrogen, which has no effect of any kind, save to act as a diluent, and reduce the heating power of a given volume of the mixture. The nitrogen, of course, finds its way in with the oxygen in the form of atmospheric air. If, however, we send in steam only, the oxygen of the steam will combine with the coke, and each pound of this will produce 2·33 lb. of C O; and we shall thus have a mixture of hydrogen and C O quite free, or nearly so, from nitrogen. The precise proportion of the two will vary in practice, as will readily be understood by those who have had much to do with furnaces. But the gaseous mixture thus produced is an admirable fuel for many purposes, and is possibly on the whole not much more expensive than the gas made in the Siemens producer—at least we are given to understand that it is not; and it certainly enables small coal, which would otherwise be totally useless, to be made available for producing an extremely clean and intense heat, as explained by Mr. Sutherland. In the United States a determined effort has recently been made by a Dr. Holland to utilise the system in propelling locomotives. The descriptions which have reached us of the Holland furnace are not so clear as we would wish, but it is easy to understand the general features of the arrangement as fitted to a shunting engine on the New York, Lake Erie, and Western Railroad. An iron retort is placed in the fire-box, and kept at a very high temperature. Into this retort is poured heavy petroleum oil, drop by drop. The heat instantly converts this into gas, presumably a rather dense hydrocarbon. Steam is passed into the retort also. Its oxygen is seized by the carbon, and the result is a mixture of C O and H, which can afterwards be burned in jets in the fire-box. It is claimed that no contraction of the blast pipe is necessary, and so no back pressure is set up; that no sparks are emitted, and that so clear is the flame a white handkerchief may be held over the chimney without being blackened—all which we can well believe. The heat can be regulated at will; the fire can be started in five minutes and put out at once. The fire doors are never opened, and the evil of contraction due to rushes of cold air is quite avoided. We understand that the locomotive "Dr. Holland," above referred to, has been used in working regular passenger trains as well as in shunting operations for more than twelve months with perfect success. It may at first sight seem that we have here our old friend the petroleum furnace in a new guise, but there are, we think, substantial differences between the two. It remains, of course, to be seen whether the Holland system will bear the test of constant hard work.

Our readers are now, we hope, in a position to form their own opinions concerning the value of water-gas as fuel. The essential feature in the whole process, the fact never to be lost sight of, is, that the value of the gas as a heating agent must be less than that of the fuel expended in producing it. Thus in Mr. Holland's engine, absolutely nothing is gained by sending steam into the retort save that the hydro-carbon gas is so much further enriched with hydrogen that it can readily be burned without the evolution of smoke or the deposit of soot, which would otherwise be an extremely difficult operation.

THE PRESERVATION OF MEAT BY CARBONIC ACID.

SINCE 1874, when Professor Kolbe, of Leipzig, first published his results on the antiseptic action of salicylic acid, he has made many efforts to apply this acid to the preservation of meat, but he has invariably found that after the lapse of a few days an unpleasant flavour has been developed, which is not that of putridity. If putrid changes be noticed it is a sign that salicylic acid is in insufficient quantity, for where it has turned putrid the meat is found to be no longer acid, but alkaline. This leads to the assumption that meat is protected from change by acids, even by gases of that kind; and in fact it was noticed that beef—from 2 to 5 kilogs. being taken—when placed in an earthen vessel and loosely covered with a wooden cover was long preserved from putridity if the bottom of the vessel contained some hydrochloric acid, nitric acid, or aqueous sulphurous acid. The meat, however, no longer had the taste of fresh meat, but of such as had long lain in ice. Experiments were therefore made with carbonic acid, and these proved highly successful. The meat was placed in a cylinder of metal plate, and suspended from a rod which crossed the upper part and the lower part. A small tube serves to admit a current of carbonic acid from a Kipp's apparatus. The lid, which rested in a circular trough of glycerine, was traversed by a similar tube in its centre, and both tubes could be closed with india-rubber tubing and screw taps as soon as sufficient carbonic acid gas had traversed the apparatus. At the end of seven, fourteen, and twenty-one days it was found that the meat was still quite good, and the soup prepared from it was in every respect excellent. At the end of the fourth or fifth week the meat thus preserved in the gas was still quite free from all putridity; but the broth prepared from it no longer tasted so well as fresh bouillon. The experiments were not extended over a longer time. Carbonic acid is thus shown to be an excellent means of preserving beef from putridity, and of causing it to retain its good taste for several weeks. Mutton does not preserve so well. In eight days it had become putrid; and veal is by no means so well preserved as beef. The comportment of beef inan atmosphere of carbonic acid, to which carbonic oxide has been added, is curious. A number of cylinders were filled in the usual way with such a mixture and opened at the end of two or three weeks; in each case the flesh had the smell and taste of pure good meat, but it was not of the grey colour which meat preserved in carbonic acid gas gradually takes, but appeared in the interior, as well as on the outside, of a bright flesh-red colour, and on the surface here and there there were white round masses of fungoid growth of the size of a 20-pfenning piece, which were removed with the slightest rubbing. The flesh lying just below these was found to have the same bright red colour as that already described. Meat which had been for three weeks in such a gas mixture gave a broth which, in good taste and freshness, could hardly be distinguished from freshly-made bouillon; and the boiled meats could not be distinguished either in appearance or taste. The property of carbonic acid to preserve meat suggests a use for the large supplies of this gas evolved from the earth in many localities. And it is as interesting to determine in how far the gas could be of service as an antiseptic during surgical operations.

SOLAR SPECTROSCOPY DURING THE RECENT ECLIPSE.

AT a recent meeting of the Royal Society Dr. Schuster gave an illustrated description of the arrangements made for obtaining photographs of the eclipse of the sun last May in Egypt, and some of the results achieved by Captain Abney, F.R.S. The general appearance of the corona seemed to the naked eye of Dr. Schuster not to have been strikingly different to that of the two previous eclipses, either in brilliancy or extension; but the photographs revealed very essential differences. Sometime observations were made at the first and last contact, and the length of the eclipse was measured to be 74 seconds. Three photographs of the corona itself with different times of exposure, viz., 3 seconds, 11 seconds, and 23 seconds, showed a gradual increase in the extension of the corona. Care had been taken to fix, by means of a wire stretched across the camera, the position of the corona, and it was believed that the orientation was accurate within probably a quarter of a degree. The photographs showed the prominences very well, and confirmed the distinction which had been drawn between the inner and outer corona. The shape of the corona was very irregular. In addition to the long equatorial rifts, short but sharp rifts appeared near the sun's poles. At times of great solar activity these rifts were not seen, nor was there any symmetry whatever in the general outline of the corona. During the present eclipse the photographic impression of one of the rifts reached to a distance of 1·4 solar diameters away from the sun's limb. As regarded form and general appearance of the streamers, two points deserved especial notice. One was the remarkable curvature of some of the coronal rays. The rays seemed in many cases to start almost tangentially from the sun's limb; sometimes these were wider near the sun's limb, contracting as their distance increased; some of the rifts, however, spread out in a fan-like fashion. The second point to be noticed was the transparency of the streamers; in two instances at least there could be traced structural details through the luminous streamers. The position of a comet which appeared during totality could be accurately fixed by means of the photograph. Some interesting results were obtained by means of the prismatic camera. The strongest impression of the prominences was obtained in the ring corresponding to the calcium lines H and K. The hydrogen lines $H\alpha$ (C) $H\beta$ (F) $H\gamma$ (near G) and $H\delta$ all appeared in the strongest prominence; one prominence was especially rich in violet light, and showed $H\gamma$ and $H\alpha$ stronger than two adjacent prominences, which in their turn showed a greater intensity of $H\beta$. This could be explained by supposing that the first-mentioned prominence was hotter than the other—an explanation which was confirmed by the fact that it showed a great number of lines reaching far into the ultra-violet. The line (λ = 5875) known generally by the name of D^3 was also represented in prominence, and a very weak impression of one prominence corresponding to a wave length 5315 (K 1474) could be seen. One of the prominences showed two lines in the infra-red; one of them corresponding very likely to λ = 8240, the other was beyond the limit of the normal spectrum published. The yellow ring was much fainter than the green one, but more uniformly distributed round the surface of the sun. An instantaneous photograph taken about five seconds after the end of totality showed the prominence still, and also at the cusps short extensions corresponding to the hydrogen lines, and due, no doubt, to the higher parts of the chromospheric layer. The photograph taken with the spectroscopic camera showed close to the sun a strong continuous spectrum reaching from F to a place beyond λ 3490 in the ultra-violet. Traces of the continuous spectrum in the region near G could be seen up a height of 1·47 solar radii on the southern side of the solar disc, and to a height of ·9 of a solar radius on the northern side. A strong prominence which was cut by the slit gave a complicated spectrum. The calcium lines, and especially the lines H and K, stood out prominently. Then, as might be expected, all the broader lines were represented, including those of the ultra violet. Some unknown lines brought up the total number of lines photographed to 29. About 30 of the coronal lines have been measured. Two prominence lines in the ultra-red have been discovered, and it has been proved that the green line of the corona was a line specially belonging to the corona. Twenty-nine lines of the prominence have been photographed, and the great importance which the metal calcium plays in solar eruptions has been emphasised. As regards the corona, it was pointed out that only one line had hitherto been well determined and accepted as a true corona line, though one or two more had been suspected. Tacchini determined the position of four true corona lines in the red. The English have been enabled to photograph and measure about thirty additional lines; thus it can be seen how an eclipse of only seventy seconds' duration can be made to yield important information.

LOCOMOTIVE ENGINE DIAGRAMS.

IT is well known to those who have given the subject attention that in quick running engines the pressure on the crank pin is not expressed by that on the piston. At the beginning of the stroke the pressure is greatest, but the piston, connecting rod, &c., undergoing acceleration, absorbs energy, and the crank pin does not experience the full effect of the steam. During the latter half of the stroke the steam is falling rapidly in pressure, but the piston-rod and connecting rod are moving at a reduced speed, and therefore restoring energy, so that the pressure on the crank pin is kept up. Furthermore, we have to consider the effect of compression. Our contemporary, the *Railroad Gazette*, sums up a sensible article on valve gear for locomotives, after dealing with these questions, in the following words:—"The problems, then, which are presented to our readers are—(1) What kind of an indicator diagram should we have when the engine is working most effectively with expansion? (2) What kind of a diagram will best fulfil these conditions and also use steam most economically; and (3) How can we secure the most uniform rotative effect on the cranks when working steam full stroke or nearly so?" We shall be glad to see these questions discussed in our correspondence columns. It may be well to explain that by the words "most effectively" in the first query, our contemporary refers to the fact that there are certain grades and speeds at which an engine will do most work on a given consumption of fuel, but these need not be the conditions under which least fuel is burned per horse per hour. Thus, for example, a locomotive might be most economical per horse-power when indicating but 100-horse power, but it would then run but very small trains at slow speeds, which would not at all answer the purposes of its owners. The questions are ingeniously framed, and we commend them to the attention of our readers.

BASIC BESSEMER STEEL.

WE understand that plates made in the Bessemer converter by the Thomas-Gilchrist process at Witkowitz, in Moravia, were recently sent to the Austrian Lloyd's Registry, at the request of that authority, to be tested as to their suitability or otherwise for boilermaking and shipbuilding purposes; and that when they had been exhaustively tried, they were pronounced to have stood very satisfactorily all the tests required by the Lloyd's committee. Such a result should be encouraging to those steelmakers who are preparing to make by this process plates for use in British boiler and ship yards. Authentic returns of the production of basic steel by the seventeen firms who are making it show that the annual outturn is at the rate of 558,800 tons. In the six months ending with March the precise tonnage was 279,400. It was made to the extent of 57,911 tons by the one firm in England; 5962 tons by the two firms in France; 12,786 tons by the one firm in Belgium; 152,479 tons by the nine firms in Germany; 37,476 tons by the three firms in Austria; and 12,786 tons by the one firm in Russia. The make by Messrs. Bolckow, Vaughan, and Co.—the one English firm at present working a basic plant—is, it will be seen, at the rate of 9651 tons per month. This is considerably over three times the average make per month by individual German firms, and the German firms, the foregoing returns show, are not only the largest producers of this class of steel in the aggregate, but also the largest producers, per individual firm, of all the continental firms who have adopted the system.

COAL FOR WATER PUMPING.

A STATEMENT of the water pumped and the coal consumed in doing the work of pumping has been compiled by the Stockton and Middlesbrough Water Board. It appears from that statement that in the seven weeks from the commencement of the Board's year there were pumped 440,686,000 gallons of water, for which over 836 tons of coal were used, or about 4·25 lb. of coal per thousand gallons of water. In the corresponding period of 1882 there were pumped 420,680,000 gallons, at an expenditure of over 814 tons of coals, or about 4·49 lb. of coal per thousand gallons. Another table shows that over the same period the actual cost of engine expenses and filtration was ·294d. per thousand gallons—an amount that is considerably less than that paid for that service a few years ago. It is evident that this latter amount must vary from time to time with the price of coals; but that in the former comparison, it is the regularity of the work, the class of coal, and other details that could make the expenditure of coal less than that of a previous period for a similar kind and extent of work. We have previously given in THE ENGINEER extracts from the records of this Board showing valuable points in the details of working. It would be well if these could be extended, and if we could have similar details from other works it would greatly aid in the decision of the question as to what kind of coals is the best for use in water pumping, and what is the maximum work that may be extracted from a given quantity of coal.

LITERATURE.

The Practical Steam Engineer's Guide on the design, construction, and management of American stationary, portable, and steam fire engines, steam pumps, boilers, injectors, indicators, governors, pistons and rings, safety valves and steam gauges For the use of engineers, firemen, and steam users. By EMORY EDWARDS. Philadelphia, Con.: Bird and Co. London: Sampson, Low and Co. 1882. 8vo. 420 pp.

PRACTICAL: The word is so often used to cover a multitude of sins and shortcomings that suspicion arises immediately one sees it used in this connection. "Practical steam engineers" is, however, in this case explained as meaning those who *run* steam engines, pumps, and so on, the word "engineer" being used in America where we should use "driver." With this explanation, the purpose of the book may be easily gathered. It is intended to give engine-drivers and others of the artisan, or steam-using classes, an intelligent idea of what goes on in a steam engine or pump, and why they are made as they are. For this purpose algebraic formulæ are dispensed with, and questions such as the value of expansion, mean and terminal pressures, explained by the use of written rules and simple arithmetic. This method of treating the subject is always attended with some difficulty, and the author of this book shows that it is not an easy thing to talk down to the level of those he addresses. The philosophy of the working of the steam engine is rather mixed up with mechanics, and such questions as "latent heat" are treated with too much brevity and not sufficient accuracy. The meaning of specific heat is explained out of sight by reference to specific gravities.

Oliver Evans, an American, is credited with the invention of the high-pressure steam engine, for which he is said to have applied to the Pennsylvanian Legislature in 1786 for a patent, but was refused. The drawing given of an engine made by him in 1800 is very much like one of Trevithick's early engines; but the Cornish inventor is not supposed to have hit upon the use of high pressure steam until 1796, though he seems to have really made engines of this class before 1800, and was thus before Evans. The steam engine is explained by reference to perspective and sectional views of American engines, many of which are very good, the greater part of the text being descriptive pure and simple of the engines by different makers, many of whose names appear in the engravings. The first engraving given is intended to make clear the working of a condensing beam engine, but it is one of the worst engravings in the book.

As an illustration of the want of accuracy in the book, it may be mentioned that in explaining latent heat the author says that the total heat in a pound of steam at atmospheric pressure is 212 deg. sensible heat, and about 1000 deg. of latent heat, the sum of the sensible and latent heats being about 1212 deg. for all pressures; and after explaining that as the sensible heat increases so the latent decreases, he, when speaking of high-pressure boilers later on, gives the total heat of 30 lb. steam as 1190, and of 120 lb. steam as 1218. These things are not as free from error as they should be for the "practical" man, who will be very angry when, reading about boilers, he finds nothing about the means of assigning their dimensions, though there is a good deal about what is of importance. For instance, under the head of capacity, in the description of the Babcock and Wilcox boiler, so much used in the States, after reading under the head of "capacity," he finds a paragraph beginning, "The cubical capacity of this boiler," and thinks—oh, here it is—but he reads on, and finds, as follows—"per horse-power is equal to that of the best practice in tubular boilers of the ordinary construction." Under the head of "horse-power of boilers" nothing is given which would enable a man to find out the horse-power of any boiler. Under "boiler efficiency" the practical man is told that the rate of combustion should not exceed 0·3 lb. of coal per square foot of heating surface, except where quantity of steam is of more importance than economy—economy, in this case, being presumably obtained by reducing the quantity to zero. A chapter is given on safety valves, but there is almost nothing in it which will make the "practical engineer" a bit the wiser than before he reads it, for it is very much like descriptions from safety valve makers' catalogues. The book is really very annoying. It takes its readers round the nuts, but never shows him how to crack one.

THE EARLY HISTORY OF CREWE LOCOMOTIVES.

WE have been favoured, says the *Crewe Guardian*, by Mr. Allan, of Scarborough, formerly principal mechanical engineer of the London and North-Western Railway—Northern Division—with the following interesting communication on the subject of the early history of locomotive engines, and more particularly those manufactured in Crewe. We have to express regret that through inadvertence we were led in our account of the opening of the New Foundry to attribute to another engineer what appears to be due to our present correspondent. Mr. Allan, in a note, writes:—"I have been in bad health for a month, and unable to supply you with my promised note. I am now in better health, at seventy-three years, and manage to give the details from memoranda in my possession connected with young Crewe." The following is Mr. Allan's communication:—

"My attention has been called to the *Guardian* and supplement of May 20th, 1882, on the opening of the extension works at Crewe. Amongst the illustrations in the supplement there is one of a locomotive engine, which is named 'One of Mr. Trevithick's engines built soon after the opening of Crewe Works in 1843.' This is the first time I have seen Mr. Trevithick's name associated with the straight axle design of locomotive of the above date or earlier, as illustrated in your supplement. As it might lead your readers into the error of supposing that Mr. Trevithick designed the engine of 1840 or 1843, or had claimed to have designed it, I shall be glad to give you a few links in the early history of the locomotive and some authorities for the same.

"My experience of the locomotive engine begins at Messrs. Stephenson's, Newcastle, in 1832, where the 'Rocket' had been succeeded by the 'Planet' type, then building. In 1834 Messrs. Forester, of Liverpool, put their first locomotive on the Liverpool and Manchester Railway, which had my attention for some time. The same year I went to Ireland with the first locomotives for the earliest Irish Railway—the Dublin and Kingstown—having charge of them during a year's maintenance contract. Returning to Messrs. Forester's, I had charge of the locomotives built there till 1840. In February, 1840, I was appointed assistant superintendent of the locomotive department of the Grand Junction Railway, under Mr. Buddicom. There were fifty-six locomotives, all of the crank axle 'Planet' class, by various makers. Of these, two only were goods engines, coupled on the four front wheels. Both were in the shop for new gab motion valve gear—Buddicom's. (See Clark's 'History of the Locomotive,' page 23.)

"Your readers will hardly credit the fact that the goods traffic from Liverpool and Manchester to Birmingham and London was then taken by one small passenger engine from each place, *i.e.*, about 900 to 1000 tons per week.

"Very short experience of the locomotives on the Grand Junction Railway induced me to attempt a design in which the quick moving parts should be more in view and easier of access, and by which the expense of crank axles and much connected therewith might be reduced. Crank axles then were formidable items. The drawings of this design were submitted to Mr. Buddicom, and to McLocke, engineer-in-chief to the Grand Junction Railway, and permission was obtained for the expenditure to make the experiment on three engines, having fair boilers, but requiring new frames, new valve motions, and crank axles. These three engines, Æolus, Sunbeam, and Tartarus, with 5ft. 6in. driving wheels, then valued at £239 each, were reconstructed to my design. The Æolus, at work at the end of 1840, was valued at £1300, and in 1841 had run 26,000 miles.

"In 1842 Mr. Joseph Locke, C.E., contracted with Messrs. Allcard, Buddicom, and Co., to supply locomotive power for the Paris and Rouen Railway, where the same design of locomotives were introduced. In 1842 the first goods engines were constructed at Crewe, on the same general lines, but with the four hind wheels coupled. These continued to be made up to 1854. Some of them were arranged with side tanks. Probably the first so arranged.

"At the first opening of the Crewe Works in 1843, Mr. Locke at the banquet gave the toast of the "Locomotive Department," and spoke of the success of the straight axle engine, associating my name alone with it. In 1846 to 1849 larger locomotives came into use. The 'long boiler' class by Messrs. Stephenson, and by Mr. T. R. Crampton, both made with driving wheels behind the travelling ones. Drawings of the 'Crampton' engine were examined by Mr. Trevithick and myself at Crewe; and at a meeting of the Locomotive Committee in Liverpool, Mr. Hardman Earle and Mr. Henry Booth being on the committee, the subject was fully discussed; and I was instructed to build one 'Crampton' engine, with 7ft. driving wheels behind the fire-box, and to modify the parts I had mentioned in the description. They instructed Mr. Trevithick also to build one on the design he favoured, with low boiler under the driving axle. I was further authorised to construct one on my own design, but with the same size of driving wheels and cylinders as the 'Crampton' engine. The result was the 'Courier'—Crampton; the 'Cornwall'—Trevithick; and the "Velocipede"—Allan.

"In 1857 Mr. Ramsbottom succeeded Mr. Trevithick at Crewe, and introduced good and useful engines of the large size, including those of the 'Lady of the Lake' class; goods engines; six wheels coupled, four hind wheels coupled; the 'shunting' class; also a 'narrow gauge' class for the works. He also put a new boiler on the 'Cornwall,' placing it above the driving axle, thus changing the original of Mr. Trevithick's engine into my design. When Mr. Ramsbottom went to Crewe he would find many of the 1843 to 1853 class of engines; and in 1876, when the 2000th engine built at Crewe was celebrated, there would be some of the same design. But not any of these ever bore Mr. Trevithick's name.

"At the above celebration I observed that a patented invention of mine was in use at Crewe, and spoken well of in the *Guardian's* report at the time, but it was placed amongst the improvements of another. Engineers have seen it printed in several languages under its proper title of Allan's straight link motion. I refer your intelligent readers to Mr. D. K. Clark's practical book 'Railway Machinery' in which they will find a history of the locomotive engine from 1830 to 1854. Also its physiology and anatomy with each step of progress reported to date and in working scale drawings. Mr. Clark had the assistance and patronage of the principal engineers at the time, and the best sources of information were open to him by the Messrs. Stephensons, Joseph Locke, Daniel Gooch, of the Great Western Railway, John V. Gooch, of the London and South-Western Railway, and many others. In his visits to Crewe he was furnished with statistics of working of locomotives, and copies of drawings for his book as on engraved plates 21, 22, 23, 29, and 52. On one occasion when at Crewe before 1850 Mr. Clark required to know in whose name the straight axle, Crewe engine, with all its details, should appear in his history. Mr. Trevithick at once agreed that my name should be attached to the general design and to all the details, making no claim to the same then or at any other time. At page 15 in the 'History of the Locomotive,' Mr. Clark writes: 'Mr. Allan, of the Crewe Works of the Grand Junction Railway, suggested the removal of the cylinders to the outside, which suggestion carried with it simplified machinery, a straight axle on two bearings, instead of a crank axle on four bearings, allowed the boiler to be lowered—the boiler ceasing to be a superstructure to build on and draw by—reduced the size of crank pins, block crossheads, and lengthening connecting rods by half a crank, allowed lighter connecting rods, and four slide bars instead of eight, as on all other engines.' At page 15, 'The standard engine now—in 1851—is not substantially different, in general arrangement, to that first adopted by Mr. Locke in 1840. Having found it to succeed to his satisfaction on the Grand Junction Railway, he adopted the same class of engines for the London and South-Western Railway, and for the Paris and Rouen Railway in 1843.' In the index, page 330, Mr. Clark writes: 'Cylinders outside. Reintroduction of in Locomotives by Locke; arrangement by Allan.' At engraved plate 29: 'Passenger Locomotive by Alexander Allan for the London and North-Western Railway.' Plate 21: 'Goods Locomotive by Alexander Allan, Crewe, for the London and North-Western Railway, Northern Division.' Plates 22 and 23: 'Allan's Locomotive, Crewe.' On diagram, Plates 6, 7, and 9: 'Allan, Crewe.' At page 321, and on Plate 58, is illustrated my invention of a floating turntable, a trial of which was sanctioned by the directors in 1850. Mr. D. K. Clark's 'Railway Machinery' was published in parts extending over some years; any error in attaching my name to the Crewe locomotives of 1840 to 1854 has never been questioned at any time. I was also recognised by minute of the Locomotive Committee principal mechanical engineer of the Northern Division. There will still be some of the old hands at Crewe who have not quite forgotten the early history of the locomotives there, when we and it were young."

HIGH TENSION GRAMME DYNAMO ELECTRIC MACHINE.

THE BRITISH ELECTRIC LIGHT AND POWER COMPANY, ENGINEERS.

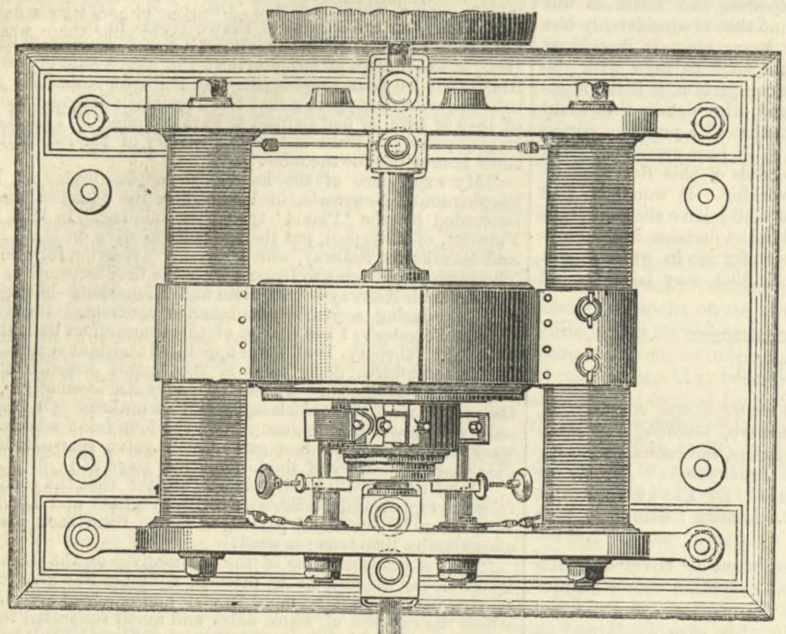


FIG. 1. PLAN

FIG. 2. SECTION

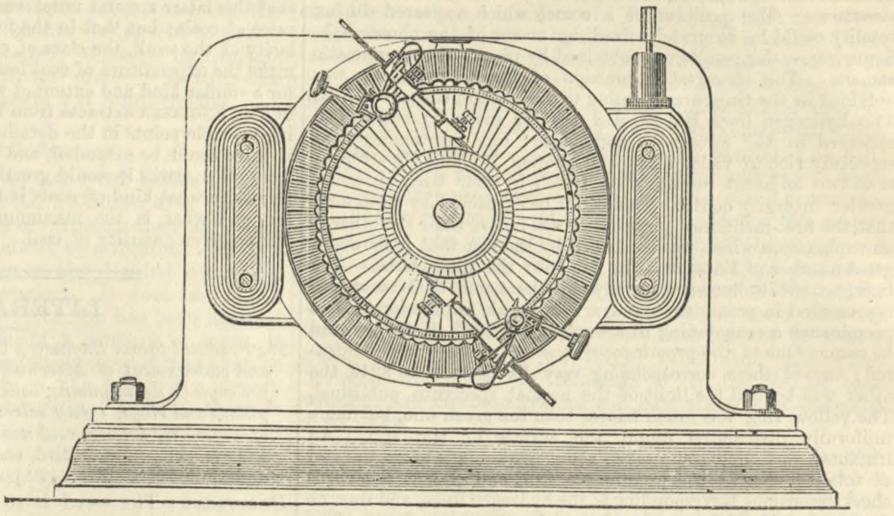


FIG. 3. ELEVATION

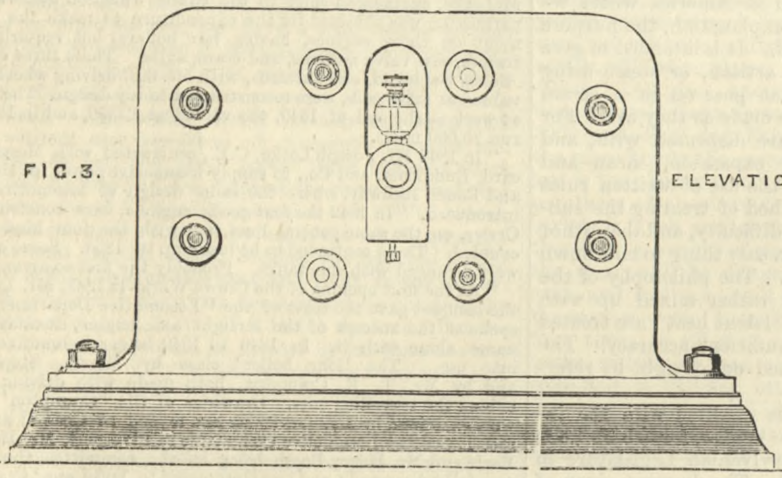
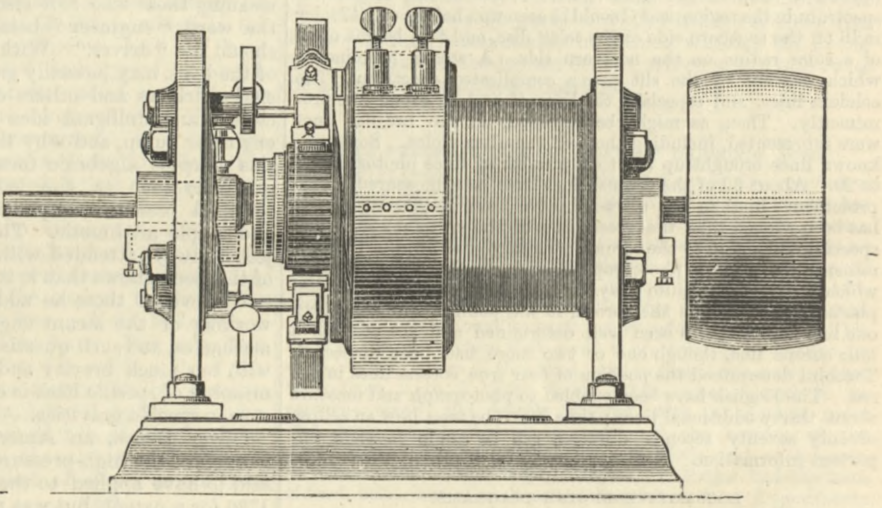
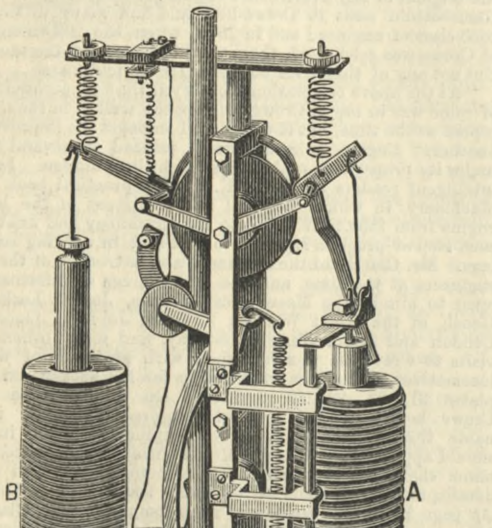


FIG. 4. END VIEW



THE WERDERMANN EXHIBIT AT THE CRYSTAL PALACE.

Mr. Werdermann exhibited until recently at the Crystal Palace an installation of fifteen arc lamps, actuated by Gramme machines, driven by a 25-horse power semi-portable engine by Messrs. Robey and Co., of Lincoln. The dynamos are of the Gramme type. It is well known that dynamos are now designed with some thought for the work which it is proposed they should do, and hence, while the type may remain the same, the design may be modified by a different arrangement of field magnets, by using thicker wire in order to reduce



resistance, and so on. We take this opportunity of illustrating a Gramme machine, introduced by the British Electric Light Company, which has, so far as we know, not been illustrated previously, instead of the well-known E Gramme, as used at the Palace. The modifications will easily be seen from the diagram. The lamp used is the invention of Mr. Lea. The lamp looks a little complicated, but it seems to feed regularly and to give a fairly steady light. The current passes from the upper to the lower carbon, and thence through the solenoid of thick wire A, having a resistance of about $\frac{1}{17}$ ohm to the negative terminal T. The current through A causes the core of the solenoid to be pulled down, and connected to the core is a gripping lever, which brakes the disc C, turning it, and thus raising the upper carbon holder and striking the arc. The gripping lever is lifted from the disc when the core is fully down by a bent arm striking a pin. The action of the core releases the pawl and ratchet at D, leaving the spring at D free to act on the jockey rollers, which clutch and guide the holder. B is a solenoid wound with smaller wire in two sections, each section having a resistance of about 250 ohms. The sections can be brought in circuit separately. This coil is in a shunt circuit. As the arc becomes longer its resistance increases, and so does the current through B. The core of B is drawn down and a feed toe acts on C, slightly rotating it and lowering the upper carbon. Should this feed be too great, the second section of B is brought into the circuit, thus doubling its resistance and proportionally decreasing the current and the action of the coil on the core. A cut-out arrangement is actuated by the spring D. Under certain circumstances the upper carbon holder falls below the highest pulley, the pulley is left free to be pulled over further, and connected to it is a long bent arm, which comes into contact with a continuation of terminal T, and in fact joins both terminals by a resistance less than that of a corresponding piece of leading wire.

In a series of experiments carried out at the Crystal Palace, on Saturday, 27th April, we obtained the following results: The field magnets of a reserve E Gramme were used as a resistance in the circuit of one of the exciters. The carbons of the lamps were by Siemens, of Berlin, the upper carbon having a diameter of 12 mm., the lower of 20 mm., both having soft cores, the rate of burning was given as 6 : 1. Altogether, between twenty and thirty tests were made, but it will be sufficient if we give the average figures derived from the tests of one of the lamps in the central transept. The lamp was selected by us at random, the mean of eight readings showing that C = 18·039 ampères; E = 48·25 volts; R = 2·7 ohms.; and the average horse-power absorbed by the lamps was 1·17. No photometric measurements were taken, but the light was estimated at 2500 candles. Taking this average horse-power, the fifteen lamps would require 15 × 1·17 = 17·55-horse power. Indicator diagrams were taken by a colleague as nearly as possible at the moment when certain electrical tests were taken; the average of the diagrams gives 42-horse power. The friction diagram, *i.e.*, for shafting and machines with brushes up, was about 7-horse power. Adding this to 17·55, we get 24·55-horse power accounted for in the lamps, and by friction, leaving some 17 or 18-horse power used elsewhere. It is difficult to say exactly where this loss occurred if the Gramme machine is as efficient as it is generally presumed to be.

THE PURIFICATION OF FEED-WATER.

In the examination of the properties of water with a view to its use for supplying boilers, it has been suggested that due attention should be given to its influence upon the boiler metal and its liability to form solid deposits. The injury which boiler metal receives in such cases differs essentially in its nature from that which is produced on the external surface of the boiler by the action of the sulphurous acid and superfluous oxygen in the smoke gases, together with the presence of damp. The internal surfaces of boilers, on the other hand, suffer from the oxygen and carbonic acid in the water, which is in contact with them. The simultaneous presence of chloride of magnesium tends to intensify the noxious influence of the oxygen. It is, of course, well known that free acids, metallic salts of acid reaction, and fatty substances, should not be found in water used for the purpose indicated.

This theory has recently been propounded in detail by Dr. Fischer in the official organ of the German Boiler Inspecting Association, and he quotes an instance in which considerable froth was found to be produced when the water was heated. An examination of the spring water and condensed water used failed to establish traces of any importance either of magnesia or fatty substances. There was a scarcity of matters capable of forming incrustation, but a somewhat large quantity of organic substances was discovered, which were easily oxidised, and to which the frothing was attributed. At last it was found that the spring from which part of the water supply was obtained was in the vicinity of a cesspool, whence the organic substances must have been derived.

It is remarked that incrustations are caused by the presence in the feed-water of sulphate and carbonate of lime, and carbonate of magnesium. The following methods have from time to time been adopted for obviating these injurious effects by appliances within the boiler itself:—(1) By electricity and zinc linings. Dr. Fischer expresses himself unfavourably as to the efficacy of these systems. (2) By slime-catching appliances and boiler linings. These appliances serve to remove the froth or scum and remove the liability of the slime to be burnt into the fire-plate. They cannot, it is remarked, prevent the formation of solid incrustations. (3) Shreds of metal, clay, &c. Various description of powders—such as powdered heavy spar and talc—are referred to, but they are considered by Dr. Fischer to be more or less injurious in their operation. (4) Greasing or tarring the sides of the boiler, the importance of which, it is remarked, scarcely requires detailed proof. (5) Tanning materials, which have been used since 1839, although attempts have lately been made to introduce the application of this principle as a novelty. (6) Precipitations in the boiler. Various chemical compositions have been patented for carrying out this principle.

In conclusion, Dr. Fischer remarks that all the methods referred to are ineffective, if not positively injurious. Under the most favourable circumstances they give powdery deposits, which are apt to be quite as troublesome as solid crusts. A caution is given against the use of specifics for preventing incrustations, which, it is remarked, are often introduced by speculators, to sell to credulous boiler owners.

For the purification of feed-water—which is specially necessary with tubular boilers—it is recommended that any measures with that intention should be taken before the water enters the boiler. Whether milk of lime, soda, or other methods are used, is a question dependent upon an analysis of the feed-water itself for its definite solution.

WATER SUPPLY OF SMALL TOWNS.

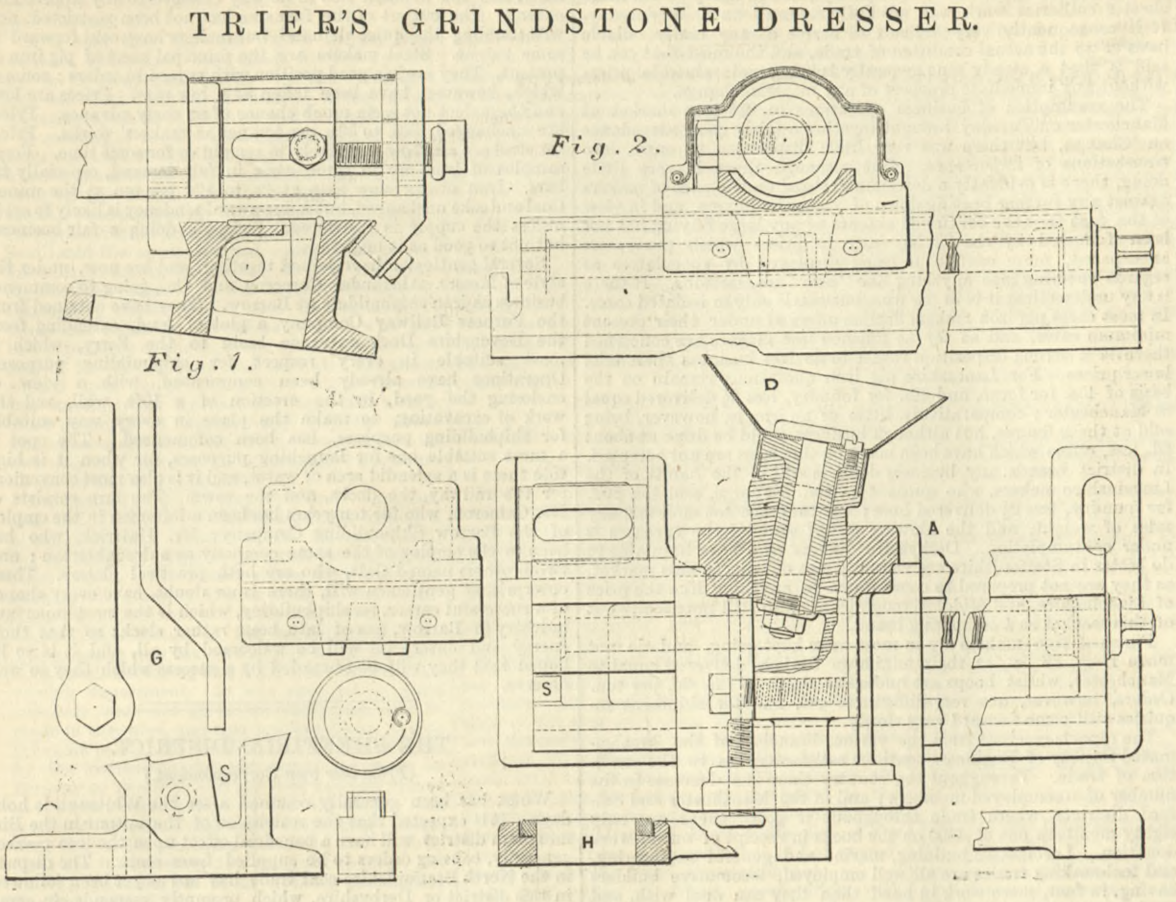
BRADFORD (WILTS) WATERWORKS.

On page 402 we publish a page of engravings illustrative of the new waterworks constructed at Bradford (Wilts) by Mr. Henry Robinson, M.I.C.E., Westminster. In another impression we shall give further illustrations with a description of the works.

The Reform Club and Electric Lighting.—We hear that the library and dining-room of the Reform Club have been lighted by electricity, furnished by the dynamo machine patented by Lord Elphinstone and Mr. C. W. Vincent, to a number of incandescent lamps. We are also informed that it is in contemplation to light the Royal Institution by this system.

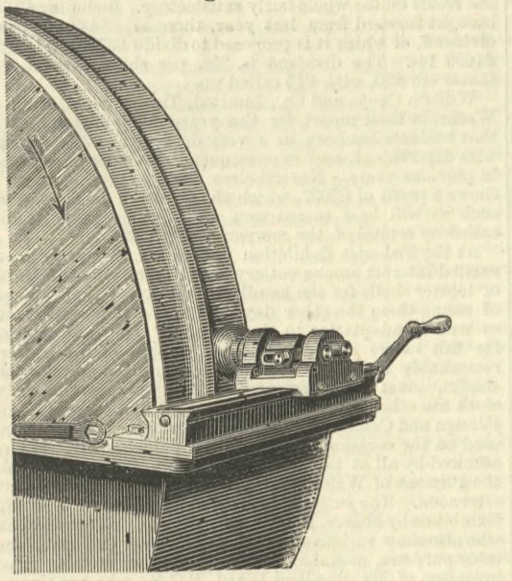
South Kensington Museum.—Visitors during the week ending May 19th, 1883:—On Monday, Tuesday, and Saturday, free, from 10 a.m. to 10 p.m., Museum, 33,791; mercantile marine, Indian section, and other collections, 18,017. On Wednesday, Thursday, and Friday, free, from 10 a.m. to 6 p.m., Museum, 5155; mercantile marine, Indian section, and other collections, 5981. Total, 62,944. Average of corresponding week in former years, 50,198. Total from the opening of the Museum, 22,034,292.

TRIER'S GRINDSTONE DRESSER.



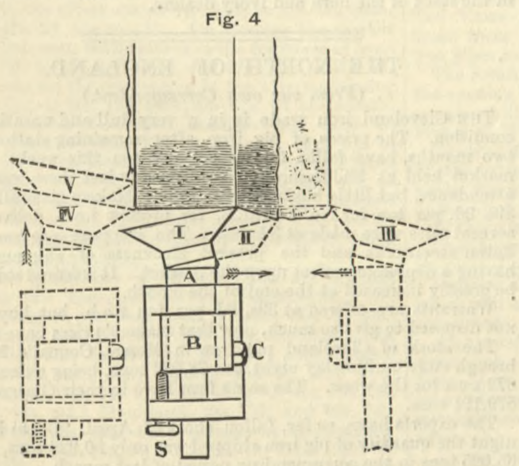
THE accompanying engravings show the form of the grindstone dresser, an application of the revolving discs of Trier's stone-dressing and cutting machine, as now made by Messrs. Brunton and Trier, Westminster. It will be seen to consist of an inclined bed-plate with a sliding rest carrying the revolving cutter-head and spindle. The cutter-head is simply a saucer stamped from thin soft sheet steel. The construction of the apparatus is so clearly shown by Figs. 1, 2, and 3, and the details, that it is only necessary to say a little with respect to Fig. 4, which is a diagram showing the slide tool-holder rest in three positions,

Fig. 3



acting on the periphery of a grindstone. The stone must revolve in the same direction as for ordinary turning, and it is of importance that the line of the axis of the cutter-bar should, if prolonged, pass a little below the centre of the stone. This can, of course, be adjusted by means of wedges under the feet of the bed. In working the dresser it is necessary to slacken the screw C, push forward the cutter-bar till the cutter D takes the required cut, tighten the screw S, and then the screw C, and work the cutter about half-way across the stone at the rate of about $\frac{1}{20}$in. for each revolution of the stone. When

Fig. 4

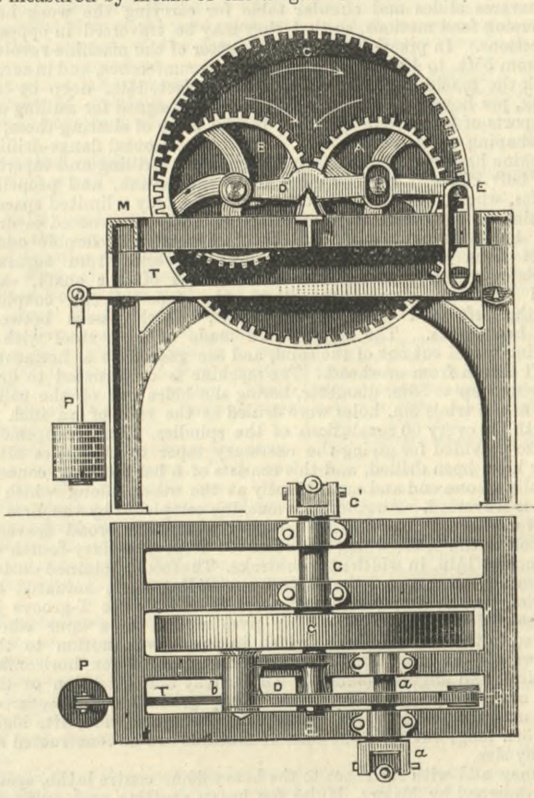


arrived in position 1, the screw S must be slackened to allow the cutter to run gradually out of cut into position 2; this is done to prevent plucking where the cuts meet—then the cutter is run to the other side of the stone, and turned over into position 3, the screw S tightened, and the face finished. For dressing the edges, B is fixed on the other side of the bar in position 4, 5, as shown in Fig. 4. The cutter bar is set in the collar B by the set clip C, and spanner G.

The stone-dresser was exhibited at the recent Building Exhibition, and there attracted much attention.

RAFFARD'S TRANSMISSION DYNAMOMETER.

THE annexed engravings represent a new transmission dynamometer, recently described in the *Scientific American.* The motor acts directly upon the axle of the wheel A, in the direction shown by the arrow, and this wheel carries along the intermediate one B, which transmits motion to the inner toothed wheel C. The latter is connected with the tool to be experimented upon by the axle c, and the Cardan joint c'. The axles a' and c' revolve in bearings fixed to the frame M, but the axle of the wheel B revolves in a bush which is carried by a beam whose fixed axis passes exactly through the contact of the primitive circumferences of the wheels A and B. The result of this is, that the momentum of the force exerted by the wheel A upon B is null with respect to the edge of the knife-blade upon which the beam oscillates, and that consequently such force has no tendency to move the beam in one direction more than in another. The beam, then, is only influenced by the resistance that the wheel C offers to the motion of the wheel B; and it is such resistance that, by a system of levers in a ratio of 1 to 10, is measured by means of the weight P.



In order to simplify calculations the primitive circumference of the wheel C is made equal to 3 metres. The formula of the work then becomes very simple: $T = \frac{P \times 10 \times 3 \times n}{60} = \frac{P\,n}{2}$, in which T is the work per second, P the weight situated at the extremity of the lever system, and n the number of revolutions per minute.

It should be remarked that this dynamometer will permit of obtaining results that are not very far short of the truth; since, save the friction of the wheel C, all the friction of the apparatus is external to the measurement. Now, the force which acts on the wheel C, being transmitted in a direction opposite the gravity, the friction due to the weight of this wheel need not be taken into account. There only remains the friction of the teeth; but it is well known that wheels with inner teeth, especially when they are governed by a relatively large pinion, occasion very little friction. If the causes of error of this new dynamometer be compared with those that exist in the White apparatus employed in the United States, it will be found that they are about four to five less. By substituting a spring for the weight P, any kind of a totaliser may be applied to the new apparatus.

PHOTOGRAPHIC ACTION STUDIED SPECTROSCOPICALLY.

AT a meeting of the Chemical Society, May 17th, a lecture on this subject was delivered by Capt. W. de W. Abney. The lecturer said that he wished all chemists to become photographers, for photography occupied the border land between chemistry and physics. The days had been long past when black fingers were a necessary concomitant of photography; at the present time there was a vast number of amateur photographers, but there were but few who studied the scientific aspect of photography. By most experimenters it was looked upon as a servant to be abused rather than used, and the majority were content with working by rule-of thumb. The lecturer was firmly impressed with the fact that photographic action is interatomic. He had already shown in a previous paper that throughout the absorption spectra of a series of organic compounds, the absorption due to hydrogen could be recognised. Something of the same kind seems to occur in inorganic chemistry. Probably the first photographic action with which most chemists become acquainted is the blackening of chloride of silver by light. Now if this salt be perfectly dry and perfectly free from organic matter, &c., it will not blacken when exposed to light. Two tubes were exhibited, both of which had been exposed for some time to the action of light. In one the chloride was quite white, in the second the chloride, which was moist, had blackened. The action of developers was then discussed. A picture on iodide of silver paper, which had been previously exposed, was developed before the meeting with gallic acid and solution of silver nitrate. The action of the light is to liberate free iodine, and the developer precipitates metallic silver to form the image. The number of particles acted on by the light must be extremely small. The image can be washed off with nitric acid, and a fresh picture taken on the same film. A second image was developed with citrate and oxalate of iron; in this case the metallic silver must have been obtained from the film itself. Some other experiments were shown proving the truth of this statement. Development is not a chemical but a physical action. It was found on photographing the solar spectrum that the amounts of energy in different parts were very varied and irregularly distributed; recourse was had to the positive pole of the electric arc light. The incandescent light had not sufficient energy, but the positive pole furnishes a spectrum which has sufficient energy, and is much more uniform than the solar spectrum. For producing the spectrum everyone would probably first choose the diffraction grating, but it was found that a perfect grating did not exist, and one grating differed so much from another, owing to minute differences in the ruling, that eventually a glass prism was adopted, as the grating could not be relied on for quantitative work. Films of chloride, bromide, and iodide of silver were successively interposed in the beam of the electric lamp, and it was shown that the chloride partially cut off the violet end of the spectrum, the iodide absorbed the whole of the violet, but the bromide cut off part of the blue, as well as the violet. An image of the spectrum was then thrown on films containing respectively silver chloride, bromide, and iodide, and the plates were developed with ferrous oxalate. It was seen that with the chloride but a small portion of the spectrum had acted on the silver salt, and that with the bromide a very much larger image was obtained. The action of sensitisers was next considered. The part played by a sensitiser is the taking up of the chloride, bromide, or iodine set free by the action of light. To demonstrate this action an image was thrown on to a sensitive plate, and during the exposure a streak was made across the plate with a solution of sodium sulphite; on developing, a black stripe indicated the position of the sodium sulphite, this salt having rendered the silver salt in its vicinity more sensitive. A sensitiser is useless unless it be close to the salt on which it is to act; so all sensitisers are more or less hygroscopic, or they may act in solution or as vapour. Almost any organic compound acts as a sensitiser. The lecturer then gave instances of coloured sensitisers, and photographs of the spectrum were taken on films coloured with cyanin blue and with cosin. The plates were developed, and the relation between the portion of the spectrum photographed and the portion absorbed by these pigments demonstrated. Thus cyanin blue absorbs the yellow, and the photograph of the spectrum on the film coloured with cyanin blue exhibits a band in the yellow where the absorption had been previously seen. It is very remarkable that one salt of silver may act as a sensitiser to another salt of silver. Thus a film containing bromioxide of silver photographs much more of the spectrum than films containing the one bromide and the other iodide. It is easy to destroy the results of photographic action. If a film during exposure be washed with any oxidising agent, as potassium, permanganate, or bichromate, dilute nitric acid, peroxide of hydrogen, &c., the image is completely effaced. Thus, if plates which are foggy from accidental exposure be dipped in dilute bichromate of potash and well washed they are restored to their original condition. This bleaching effect was demonstrated by throwing a picture on a sensitive plate, and during exposure making a streak with bichromate solution across the plate. On developing this streak was seen to be white. A sensitive plate after exposure to light was soaked in dilute nitric acid containing one drop of acid in 8 oz. of water and then exposed to the spectrum; the tendency of the nitric acid was to oxidise; at the violet end, where the reducing power of the light was at its maximum this tendency was overcome, but the red end was perfectly white. A method of obtaining a reversed image was demonstrated. A sheet of iodised paper was exposed to light, then immersed in potassium bromide solution; a picture was then thrown on it, on developing it was found to be reversed. An instructive experiment was also shown of an easy means of preventing the bad results of over exposure. An extremely sensitive dry plate was soaked in sodium sulphite solution and exposed for sixty seconds to a bright spectrum. On developing a good picture came out not in the least reversed. So a picture cannot be reversed if some substance is present in the film having a great affinity for oxygen. A beam of light was transmitted through films of the three varieties of silver bromide; the ordinary variety was orange, the film used in the gelatin dry plates a sort of French grey, the film used for photographing the ultra-red portion of the spectrum green. In conclusion, the lecturer said he had endeavoured to point out to the chemists present some of the pitfalls which beset the practice of photography.

The President, in proposing a hearty vote of thanks to Capt. Abney, said that all must feel that they had had a great scientific treat. Most chemists had dabbled in photography, and must have felt how many points required investigation. He hoped that Captain Abney would continue his researches, and he was sure that no one was more able to carry them out to a successful issue. A vote of thanks was passed by the crowded meeting with acclamation, and the Society adjourned to June 7th, when a ballot for the election of Fellows will be held and the following papers read:—"Laboratory Notes," by Dr. Gladstone and Mr. Tribe: (1) "On the Action of Light and Heat, on Cane, and Invert Sugar;" (2) "On Hydroxylamin;" (3) "Recovery of Iodine from Organic Iodide Residues;" (4) "A Residual Phenomenon of the Electrolysis of Oil of Vitriol;" (5) "On an Alleged Test for Alcohol;" (6) "Reaction of the Copper Zinc Couple on Nitric Oxide;" (7) "On the Reducing Action of Spongy Lead."

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

(*From our own Correspondent.*)

THE sudden appearance of hot weather has this week necessitated the abandonment of some of the turns at the mills and forges, for the men have found it impossible to go on. But it is not expected that the interruption will be continuous, and in the present state of the demand it is rather welcomed than otherwise. The demand is without improvement on the week.

Makers, however, find less fault with the extent of buyers' operations than with the unprofitableness of existing prices. That competition should be so keen is matter for regret, but the avoidance of it in times like these seems well nigh impossible. Amongst thoughtful men Mr. Goschen's explanation of the present low values is finding more belief than hitherto.

Bars are in considerable sale for local consumption, and the Colonies and other export markets are also buying fairly, but production keeps in excess of demand. Marked sorts remain at £8 2s. 6d. to £7 10s.; second-class sorts are £7 to £6 15s.; and common sorts range from the last-named figure down to even £5 17s. 6d.

Hoop and strip makers continue to give as good an account as anybody. At these works the mills are running steadily. I refer more particularly to medium and common qualities. £6 15s. is being obtained for bedstead strips, whilst common hoops are £6 12s. 6d. to £6 10s.

Plate makers on 'Change this—Thursday—afternoon were unable to report very favourably. Girder and other engineering sorts are in better inquiry than boiler descriptions. For the former prices ranged from £8 10s. to £9, and for the latter £9 to £9 10s. and £10.

Sheets for working up and galvanising purposes keep languid at £7 10s. to £7 12s. 6d. for singles, £8 for doubles, and £9 to £9 5s. for lattens. Galvanisers speak rather more cheerfully. They note with much satisfaction the steady improvement in the New South Wales market.

Messrs. Morewood and Co., of the Lion Galvanising Works, Birmingham, quote galvanised sheets of 18 and 20 w.g., 6ft. to 8ft., as:—Red Star brand, £12 10s.; Red Diamond, £12 15s.; and Lion, £13. Sheets of 24 g. are £1 per ton additional as to each brand; of 26 g., £3 additional; and of 28 g., £5 additional. Close annealed and cold rolled galvanised tinned flat sheets of Lion brand are £20 for 18 and 20 g., £22 for 24 g., £24 for 26 g., and £26 for 28 g. Similar sheets, but of the Anchor brand, including ½-ton felt-lined cases, are quoted £18 10s., £20 10s., £22, and £24, according to gauge. Flat sheets of the Woodford Crown brand are £16, £18, £19 10s., and £21 10s., according to gauge. The market understands, however, that for large orders of some of the commoner qualities, the firm would take less money than these quotations. The firm's patent tiles, 3ft. by 2ft. of the Red Star brand, are quoted: £14 per ton for 24 g., £16 for 26 g., and £18 for 28 g. Tiles of the Lion brand are 10s. per ton additional.

The easier rates which pig makers, both native and distant, are quite ready to accept, fail to induce buyers to enter the market. Forty-six furnaces, it is estimated, are now blowing in this district, but the make is not all going into consumption, and stocks in producers' hands are consequently growing. All-mine hot blast pigs are 62s. 6d. to 65s., part mines 50s. to 45s., and common 40s. to 39s., less 2½ per cent. Derbyshire pigs are 47s. delivered into this district, Wigan pigs 48s. 6d. nominal, and Northampton's 45s. upwards.

This—Thursday—afternoon the coal trade held a meeting in Birmingham, the miners' representatives being also present to receive the award of Mr. Haden Corser in the wages dispute. Mr. Corser awards that as all the masters have not followed the lead of Lord Dudley in dropping coal 1s. per ton, the old rate of wages shall continue in force until the expiration of the Birmingham agreement on August 1st. A resolution was passed accepting the award. It was further determined that the new Conciliation Board now being formed should consist of twelve masters and twelve representative men.

Results no less satisfactory than those which are attending the employment of the Bicheroux gas furnace in connection with puddling and heating furnaces in Belgium—to which reference was made by the president of the Iron and Steel Institute at the recent meeting of that body—are following upon its employment in this district. In this country the process goes by the name of the Casson-Bicheroux, since it was only by the application of the hot blast arrangements of Mr. R. Smith Casson, general manager at Round Oak Works of the Earl of Dudley, that the process was made applicable to English coal. The Casson-Bicheroux furnace is now working most successfully at the Round Oak Works, at Messrs. Morewood and Co.'s, Woodford-street Ironworks, at Messrs. John Russell and Co.'s, Walsall, as well as at the works near Wakefield of the Harbury Junction Iron Company. An important saving is effected in the quantity and the price of fuel consumed, and the quantity and quality of the yields is also increased.

Heavy rolls for ironworks, largely for laying down in the sheet mills, are in active demand, and engineers and ironfounders who have a high repute for this class of work report themselves busy. In this connection I may mention Messrs. Thomas Perry and Son, of the Highfield Works, Bilston, some of whose rolls are going abroad, as well as being in brisk demand for home use. The heavy pinions which this firm have lately begun to manufacture with cast iron helical teeth are steadily winning their way into favour amongst machinery users.

The Cape, West Indian, and Brazilian mails have been delivered this week. Financial difficulties in the Cape still stand in the way of orders from that market, and the orders from West Indies and Brazil would have been more numerous had the condition of the coffee market at date been more satisfactory. Monte Video and adjacent South American markets are taking galvanised iron.

Perhaps it is not generally known that a handsome service of silver plate, richly gilt, to the value of 600 guineas, has been presented to Mr. Hugh Mason, M.P., by the shareholders in the Nantyglo and Blaina Ironworks Company, for his services to the company since 1874. It is the work of Messrs. Elkington.

Mr. E. B. Martin, chief engineer to the Midland Steam Boiler Insurance Company, addressed the North Staffordshire Mining Institute, on Monday, on "The Explosion of Boilers and other Vessels," illustrating his statements by diagrams, models, and practical experiments. Mr. Martin's paper was similar to that which he has lately read before two or three of the North of England Institutes.

The North Staffordshire colliers allege that they are getting the best of the dispute with the masters. They state that several firms have this week withdrawn the notice for a reduction. But it is estimated that there are still 7500 hands playing, and these are appealing to other districts for money to continue the struggle. A few colliers are benefitting materially, as the demand consequent on the strike enables three shifts to be made every twenty-four hours.

The iron trade of North Staffordshire is being seriously inconvenienced by the strike, for it is impossible to get all the needed supplies of raw materials. In the interests of trade it is much to be hoped that some settlement will soon be arrived at. The demand for manufactured iron is not active at date. The hoop makers are about the best off, some of them being quite busy on export account. Bars are dull, and although the makers of tank and girder and boiler plates are not doing much at the moment, yet prospects are better in this branch than in some other departments. Actual selling prices all round are low.

The present quotations of Messrs. Robert Heath and Son, Stoke-on-Trent, are, delivered at Liverpool, R. H. crown or R. D. crown bars, £7 per ton; ditto best bars, £7 10s.; R. H. angles and tees, £7 10s.; best ditto, £8; plates, £8 10s.; best plates, £9; double-best ditto, £10; treble best ditto, £12; Ravensdale hoops, £7 15s.; and Ravensdale sheets, £8 5s. Kinnersley and Co., Kidsgrove, quote: Crown bars, £6 7s. 6d.; angles, £6 17s. 6d.; tees, £7 7s. 6d.; best crown bars, £6 17s. 6d.; best angles, £7 7s. 6d.; and best tees, £7 17s. 6d. Crown plates are £7 17s. 6d., and best boiler plates £8 5s. per ton for ordinary sizes. These prices include delivery f.o.s. at Liverpool.

NOTES FROM LANCASHIRE.

(*From our own Correspondent.*)

Manchester.—Both in the iron and the coal trades of this district business during the past week has been only slowly recovering from the disorganising effects of the holidays, and at many of the Manchester collieries work was not fully resumed until Wednesday. It is consequently very difficult to arrive at any really reliable basis as to the actual condition of trade, and the most that can be said is that a steady tone generally is being maintained in prices without any immediate prospect of any material change.

The resumption of business operations in the iron market at Manchester on Tuesday brought together a fairly good attendance on 'Change, but there was very little disposition to enter into transactions of importance. But although there is very little doing, there is evidently a determined stand on the part of makers against any further beating down of values by buyers, and in view of the fact that the continued absence of any large buying has not been followed by the giving way in prices which purchasers anticipated, more caution is being displayed by speculators as regards entering into anything like "bear" transactions. If there is any underselling it is in pig iron, but this is only in isolated cases. In most cases pig iron makers decline offers at under their present minimum rates, and so far as finished iron makers are concerned there is a strong disposition rather to do less business than take lower prices. For Lancashire pig iron quotations remain on the basis of 45s. for forge, and 46s. for foundry, less 2½ delivered equal to Manchester; comparatively little or no iron is, however, being sold at these figures, but although business could be done at about 6d. less, offers which have been made on this basis are not accepted. In district brands any business doing is still in the hands of the Lincolnshire makers, who quote 44s. 10d. for forge, and 45s. 10d. for foundry, less 2½ delivered here; but they are not effecting any sales of weight, and the blowing out of some of the furnaces is under contemplation. Derbyshire makers who have been able to do better in Staffordshire are virtually not offering in this market, as they are not prepared to come down to anything like the price of Lincolnshire, and Middlesbrough iron is also still practically out of this market as a competing brand.

Finished iron makers are in most cases kept going, and do not move from £6 5s., as their minimum for bars delivered equal to Manchester, whilst hoops are quoted at about £6 12s. 6d. per ton. Orders, however, are very difficult to get, and for shipment inquiries still come forward very slowly.

The reports received from the various branches of the Amalgamated Society of Engineers continue satisfactory as to the condition of trade. Throughout the country there is a decrease in the number of unemployed members; and in the Manchester and Salford districts, where trade throughout is good, there are only eighty members out of 4500 on the books in receipt of out-of-work donation. Locomotive building, marine and general engineering, and tool-making trades are all well employed, locomotive builders having, in fact, more work in hand than they can deal with, and the large shops are kept on overtime. The machine-making trade, although not so brisk as other branches, shows improvement.

I have previously referred to the disturbing indications in the labour market with regard to wages questions, and I may add that the Manchester and Salford Trades' Council have before them a number of applications for assistance in connection with disputes in various branches of trades. Amongst these the strike of the file-cutters of Sheffield has been taken up, and I hear that the men are receiving the warm support of the unionists in this district.

A visitor to the Salford Ordsal Toolworks of Messrs. W. Hulse and Co. will generally find some improvement in machine tools being developed of sufficient interest to attract attention, and the firm have just completed one or two tools of new design, to which I may briefly refer. These include a new vertical milling or circular cutting machine, in which the special feature introduced is that the bearing for the spindle which holds the circular cutter follows with the cutter, so that it always keeps its grip upon the tool. This is effected by employing a spindle with conical bearings, held in a vertical square slide, which is carried by arms on the main frame made to correspond, and through which the square slide is moved vertically. In this slide the spindle is readily adjustable, so that all play arising from wear is avoided, and greater certainty of action is given to the cutting tool. The transverse slides and circular table for carrying the work have reversing feed motions, so that they may be traversed in opposite directions. In practice the circular cutter of the machine revolves at from 35ft. to 40ft. per minute on its circumference, and in actual work the machine will remove 41 lineal feet, 1½in. deep by ½in. thick, per hour. The machine is specially designed for milling out the ports of locomotive cylinders in the place of slotting them, or for shaping out general work. A duplex horizontal flange-drilling machine has also been specially designed for drilling and tapering the bolt holes in the couplings of marine, crank, and propeller shafts, where, as in the case of crank shafts, only a limited space is obtainable for work. This machine, which is constructed to drill two holes simultaneously and to operate upon a double crank shaft from 120-horse power upwards, works from separate headstocks on opposite sides of the axis of the shaft, each drill working simultaneously on the face of the coupling to the left and right of the shaft, which passes between the headstocks. The spindles are made of cast steel with a driving wheel cut out of the solid, and are geared to a horizontal shaft driven from overhead. The machine is constructed to drill couplings up to 36in. diameter, boring the holes out of the solid, and in the trials 3in. holes were drilled at the rate of an inch in length for every 60 revolutions of the spindles. An arrangement is also provided for giving the necessary taper to the holes after they have been drilled, and this consists of a bar working concentrically at one end and excentrically at the other, along which a tool is traversed. Another new machine completed by the firm is one for planing general work with an automatic broad traverse motion to the tools, which can be varied from the sixty-fourth of an inch to 1½in. in width at each stroke. The feed is obtained during the return traverse of the table by a sliding rack, actuated by special, though simply-arranged, stops fitted into the T-groove in the side of the table. The rack gives motion to a spur wheel geared to the vertical shaft, which in turn gives motion to the screws of the cross slide, and to tools arranged for horizontal, vertical, and angular planing. The extent and direction of the feed are readily adjustable, and a steady gradual action secured. The machine just completed is to plane about 4ft. wide, 4ft. high, and 3ft. long, but the same class of machine can be constructed up to any size.

I may add with reference to the heavy 40in. centre lathe, specially designed by Messrs. Hulse for heavy shafting and ordnance work, and of which at the time of its completion I gave a short description, that the lathe has now been in work at Sheffield for several months and has given very good results. I was shown samples of the cuttings taken off tough crucible cast steel forgings which were certainly evidence of extraordinary work, and Messrs. Hulse informed me that the machine was regularly taking cuts varying from 1in. to 1⅝in. in depth, at the rate of ¼in. thick per revolution from steel shafts 28in. in diameter, with several tools simultaneously in action, and the shafts weighing 25 to 30 tons each.

In the coal trade orders are as yet coming forward only irregularly after the holidays, and do not afford any legitimate indication as to the actual state of the market. Prices, however, are generally fairly steady, and the leading Manchester colliery firms have no intention of making any alteration in their quoted rates with the close of the month. At the pit mouth prices remain about as under:—Best coal, 9s. to 9s. 6d.; seconds, 7s. to 7s. 6d.; common house fire coal, 6s. to 6s. 6d.; steam and forge coal, 5s. 6d. to 5s. 9d.; burgy, 4s. 9d. to 5s.; and good slack, 3s. 9d. to 4s. 3d. per ton.

Shipping has been rather better, but is still only moderate generally, and steam coal is offered at 7s. to 7s. 6d. per ton delivered at the Garston Docks or the high level, Liverpool.

Nothing has yet been definitely decided with regard to the proposed reduction of colliers' wages in West Lancashire.

Barrow.—The hematite pig iron market is still in a very quiet state, and the demand has in no way changed to any appreciable extent. The output of the furnaces has not been restricted, notwithstanding the quiet demand, but makers have sold forward to some extent. Steel makers are the principal users of pig iron at present. They are in a good position with regard to orders; some of which, however, have been taken at a low rate. Prices are low, and there does not seem much chance of an early advance. Prices are unchanged, 50s. to 52s. per ton net at makers' works. Prices for steel are also low and likely to remain so for some time. Forge samples of iron are in some cases in fair demand, especially tin bars. Iron ore in slow sale at 9s. to 12s. per ton at the mines. Coal and coke unchanged, but a downward tendency is likely to set in unless the supply is restricted. Shipping doing a fair business, but not so good as it might be.

Several gentlemen have joined together, and are now, under the style of Messrs. Alexander Cameron and Co., going to commence business as iron shipbuilders at Barrow. They have obtained from the Furness Railway Company a plot of land, extending from the Devonshire Dock entrance basin to the Ferry, which is most suitable in every respect for shipbuilding purposes. Operations have already been commenced, with a view of enclosing the yard, by the erection of a 10ft. wall, and the work of excavating, to make the place in every way suitable for shipbuilding purposes, has been commenced. The spot is a most suitable one for launching purposes, for when it is high tide there is a splendid area of water, and it is also most convenient for the railway, the docks, and the town. The firm consists of Mr. Cameron, who for ten years has been a loftsman in the employ of the Barrow Shipbuilding Company; Mr. Hattrick, who has been in the employ of the same company as a draughtsman; and two brothers named Galt, who are both practical platers. These enterprising gentlemen will, there is no doubt, have every chance of a successful career, for shipbuilding, which is the most important industry in Barrow, has of late been rather slack; so that their energy and enterprise will be welcomed by all, and it is to be hoped that they will be rewarded by a success which they so well deserve.

THE SHEFFIELD DISTRICT.

(*From our own Correspondent.*)

WORK has been generally resumed after the Whitsuntide holidays. It is expected that the restriction of the output in the Birmingham district will have a beneficial effect upon the iron market generally, causing orders to be supplied from stock. The dispute in the North Staffordshire coal trade has not as yet been followed in this district or Derbyshire, which promptly responds, in some form, to any movement in Staffordshire. The continued fine weather has so quickly affected the coal trade that the supply is again in excess of the demand, and it is not likely we shall hear much of any demand for restricted output by the miners for some time. It will be hard work for them to retain the 10 per cent. advance they secured last year. The iron market remains very languid. Staffordshire bars even are unmoved, in spite of the colliers' strike. Marked bars are at £7 10s. and £8 2s. 6d.; and unmarked iron, £6 to £6 10s.

The Hallamshire Steel and File company's report is acceptable as giving some indication of the course of business, in several branches of which it is difficult to get any idea in the concrete. The directors state that although some departments have suffered through the prevailing depression, they trust that the shareholders will consider the result on the whole fairly satisfactory. Including £1661 19s. 6d. brought forward from last year, there is £5443 14s. available for dividend, of which it is proposed to divide £3750, and carry forward £1693 14s. The dividend is 25s. per share for the year. The shares are £20, with £15 called up.

William Coope and Co., Limited, Tinsley Steel, Iron, and Wire Works, in their report for the year ending March 31st last, state that business has been in a very depressed state, especially in the wire department, and in consequence the sales have been less than in previous years. Nevertheless the result of the year's working shows a profit of £2037, which the directors deem satisfactory, and such as will bear comparison with former years' trading. The called-up capital of the company is £106,425.

At the Fisheries Exhibition in London, a novelty in cutlery has excited interest among cutlery manufacturers. It is the utilisation of lobster shells for the handles of cutlery. I had an opportunity of seeing them the other day, and was struck with their beauty, as well as adaptation to the purpose. They are especially suited for fish eaters and carvers, and a case of fish cutlery looked remarkably handsome. The bright red handles, with varying shades, must have presented a pretty appearance on the white cloth the other day when the Prince of Wales gave a lunch to the Foreign and Colonial Special Commissioners. The new cutlery was used on the occasion, and made "a palpable hit," not only being admired by all at table, but being very favourably spoken of by the Princess of Wales, who visited the Royal Pavilion later in the afternoon. The cutlery is now exhibited near the entrance to the Exhibition by Messrs. Rowland, Ward, and Co., practical naturalists, who also show various adaptations of lobster and oyster shells for all table purposes, mounted in silver and other metals. They are the invention of Mr. Rowland Ward, F.G.S., who has also adapted in a practical and attractive form fish skin, dogs' hides, sharks' jaws, whales' vertebræ, teeth, crocodile head and teeth, turtle and tortoise shells, all of which are illustrated in very novel and elegant designs. Lobster shells are also utilised in salad bowls, breakfast cruets, spirit stands, and almost every domestic purpose for which electro-plate, China, and glass are at present used. Oyster shells are similarly treated, according to the size and quality of the material dealt with. The hint is an important one for cutlery manufacturers in these days, when ivory is so scarce that it threatens to become extinct. Probably we may soon see oyster and lobster shells valuable articles of commerce, and included in the stock of the horn and ivory dealers.

THE NORTH OF ENGLAND.

(*From our own Correspondent.*)

THE Cleveland iron trade is in a very dull and unsatisfactory condition. The prices of pig iron, after remaining stationary for two months, have fallen 3d. to 6d. per ton this week. At the market held at Middlesbrough on Tuesday last there was a good attendance, but little business was done. Makers generally asked 39s. 9d. per ton for No. 3 G.M.B. for prompt f.o.b. delivery, but several sales were made at 3d. less. The stoppage *pro tem.* of the Eston steelworks and the present slackness of shipments are having a depressing effect upon the market. It is feared stocks will be greatly increased at the end of the month.

Warrants are offered at 39s. 6d. per ton f.o.b., but buyers are not disposed to give so much, now that makers' prices have fallen.

The stock of Cleveland pig iron in Messrs. Connal's Middlesbrough store on Monday night was 78,032 tons, being a decrease of 672 tons for the week. The same firm have in their Glasgow store 579,191 tons.

The exports have, so far, fallen short of April. Up to Monday night the quantity of pig iron shipped was only 50,926 tons, against 65,025 tons in the corresponding period of last month.

Very few orders for finished iron have lately been given out. Specifications against existing contracts are, however, more plentiful, shipbuilders requiring increased supplies now that fine weather has set in. On Tuesday prices were as follows:—Ship plates, £6 2s. 6d. to £6 7s. 6d.; shipbuilding angles, £5 12s. 6d. to £5 15s.; and common bars, £5 17s. 6d. to £6, all cash 10th, less 2½ per cent., free on rails at makers' works. Puddled bars have been sold at £3 12s. 6d. per ton net on trucks.

The whole of the boilers, engines, fixed machinery, and plant on the freehold part of the Eston Grange Ironworks, near Middlesbrough, were sold by auction on Wednesday the 16th inst., and realised good prices. The site has not yet been disposed of.

It is said that the Spa Wood Mines, near Guisbro', which have been closed for three years, are to be re-opened shortly by the Weardale Iron and Coal Company, Limited. When in full operation upwards of 200 men will be employed.

A meeting of the Cleveland Institution of Engineers was held at Middlesbrough on Monday last, when in the absence of the president Mr. J. Head occupied the chair. Mr. A. S. Savill, of Manchester, read a paper on "The Exhaust Injector: Its Application at Ironworks and Collieries." Mr. Savill said the apparatus was constructed to utilise exhaust steam, for feeding boilers, and heating the feed-water. It was extensively used in Lancashire, South Wales, and Cumberland, in mines and collieries. Members present who had had experience of the injector, spoke most favourably of it. A prolonged and animated discussion ensued upon the principles upon which depends the startling, but indisputable fact, that a sufficient quantity of steam, only slightly above atmospheric pressure, can force many times its own weight of water into a boiler against a pressure of say 70 lb. per square inch.

On Saturday last Messrs. Bolckow, Vaughan, and Co., Limited, of Middlesbrough, issued a notice giving the decision of the directors as to the reduction of wages to be made at the Eston Steel Works. The notice states that a general advance was given of 12½ per cent. in the manufacturing department and 5 per cent. in the engineering department, in the beginning of 1880. The company now ask a reduction of 10 per cent. in the manufacturing and 5 per cent. in the engineering department. In any case where these advances were not given no alterations will be made in the rates, and this number forms a considerable part of the total. The workmen affected by the reductions did not return to work on Monday or Tuesday, and say they are determined not to start again except at the old rates. The works are therefore idle again this week. Meantime the men are holding meetings, and deputations are interviewing the general manager, Mr. E. W. Richards, but so far nothing satisfactory has been settled.

The agitation amongst the workmen employed at the Tyneside Engine Works is now almost ended, the men having in almost every instance obtained the advances they asked for. Messrs. Clark and Sons' workmen, who were out on strike, made a satisfactory arrangement with their masters on Wednesday, the 16th inst. The skilled hands, including the machine men, are to have an advance of 2s. 3d. per week, and the strikers 1s. 1½d. per week. Similar advances are being conceded to the men at the other engineering shops.

The Employers' Liability Act case, known as Heske *v.* Samuelson, is not ended yet. It will be remembered that a labourer employed at the blast furnaces of Messrs. B. Samuelson and Co., Middlesbrough, was killed by a piece of coke falling on to his head from an ascending lift. An action was brought for compensation to the widow at the Stockton County-court. Judge Turner gave a verdict for defendants, with costs, on the ground that their appliances had not been proved to be out of order. In the Queen's Bench Division of the High Courts of Justice a motion was made on Tuesday last for a rule *nisi* for a new trial, on the ground that the above decision was wrong. It was contended that the lift in question was unsafe owing to faulty design, and that the defendants were as clearly liable for the consequences of this as they would admittedly have been for allowing it to fall into bad repair. A rule *nisi* was granted.

NOTES FROM SCOTLAND.

(*From our own Correspondent.*)

THE Glasgow pig iron market has been depressed this week, so far as regards the business in warrants, which have been gradually declining for several days. Holders were induced to sell pretty extensively at the beginning of the week, and prices declined on Tuesday to 46s. 9½d. per ton. Shipments have been fairly good; but merchants speak with apprehension as to the future of the foreign business in pig iron, judging from the nature of the orders that are now coming to hand. The home inquiry is upon a satisfactory scale. Stocks in Messrs. Connal and Co.'s stores are being reduced to a much less extent than formerly, the past week's decrease having been only between 400 and 500 tons. Another furnace has been put in at the Monkland Ironworks, making 117 now in operation, as against 109 at the corresponding date last year.

Business was done in the warrant market on Friday forenoon at from 47s. 5d. to 47s. 4d. cash, and in the afternoon at 47s. 3½d. to 47s. 3d. cash, and 47s. 5d. one month. On Monday the market was flat, with transactions in the forenoon at from 47s. 3d. to 47s. 1½d. cash, and 47s. 4½d. to 47s. 4d. one month, the quotations in the afternoon being 47s. 1½d. to 46s. 11d. cash, and 47s. 1d. one month. On Tuesday forenoon business was done at 46s. 10½d. to 46s. 9½d. cash, and 47s. 1d. to 46s. 11½d. one month, the afternoon market being steady at 46s. 10d. to 46s. 10½d. cash, and 47s. to 47s. 0½d. one month. On Wednesday business was done at 46s. 10½d. cash, and 47s. one month. The market was closed to-day (Thursday), being the Queen's birthday.

The quotations of makers' iron are slightly lower this week, as follows:—Gartsherrie, f.o.b. at Glasgow, per ton, No. 1, 59s., No. 3, 54s.; Coltness, 62s. 6d. and 54s. 6d.; Langloan, 63s. and 54s. 6d.; Summerlee, 60s. and 51s.; Chapelhall, 59s. and 54s.; Calder, 60s. 6d. and 51s.; Carnbroe, 54s. 6d. and 49s. 6d.; Clyde, 50s. 9d. and 48s. 9d.; Monkland, 48s. 9d. and 46s. 6d.; Quarter, 48s. and 46s.; Govan, at Broomielaw 48s. 6d. and 46s. 3d.; Shotts, at Leith, 62s. 6d. and 56s.; Carron, at Grangemouth, 50s.—specially selected, 57s. 6d.—and 48s.; Kinneil, at Bo'ness, 48s. and 47s.; Glengarnock, at Ardrossan, 54s. 6d. and 48s. 3d.; Eglinton, 48s. 6d. and 46s.; Dalmellington, 49s. 6d. and 48s. 6d.

The demand for Middlesbrough iron in Scotland is well maintained, and the shipments to date exhibit an increase of 1390 tons.

The malleable iron and engineering trades are busy, without any change in values. Messrs. Merry and Cuninghame are about to erect works for the manufacture of steel in connection with their Glengarnock Ironworks, and operations with that view have already been commenced. It is highly probable that ere long most of the iron companies will be in a position to undertake steel orders as well, this being the direction in which matters are at present tending.

There is a good business doing in coals, although the shipments are, as a whole, not quite so large as they were in the preceding week. About 21,000 tons were despatched from Glasgow, including the quantities for the use of steamers. There is no quotable change in prices.

The coalmasters of Fife and Clackmannan have intimated to the representatives of the colliers that they decline to give an advance of 6d. per day on the present rate of wages. As their reasons for the refusal, the employers state that the demand as regards both inland and export sales has fallen off greatly within the last two weeks, and that the prices obtained are not sufficiently remunerative.

WALES & ADJOINING COUNTIES.

(*From our own Correspondent.*)

THE extraordinary vigour of the Welsh coal trade is well maintained, and this week the prospects are as good as at any time during the year. One large coalowner tells me that compared with '73 he has doubled his output, and it was not a small one in '73. Books are so full that colliery proprietors are beginning to hesitate as to accepting for long deliveries, and should this continue we shall not be far from an advance.

I am sorry to note, however, that in the existing good times, when collieries are well off, accidents rare, and provident fund looking up, signs of the ever disturbing spirit begin to manifest themselves. I do not refer to the present strike at Plymouth collieries, which is a purely local evil, but to the movement amongst the Rhondda men to send a representative to the Manchester Congress, and support the motions of Messrs. Broadhurst and Burt. The aim of the Congress is, I hear, to formulate a bill of amendments against the Mines Regulation Act.

In furtherance of Welsh co-operation with Manchester antagonism to existing order and good trade, a meeting has been held in the Rhondda Valley, when it was decided to send a Welsh representative who should support the amendments suggested. Various minor grievances were pointed out in the Act, the most particular being the time for examination of collieries by the fireman; and it was contended that if this could be altered, they would better avoid explosions, as if a fireman can only go in and examine a pit six hours before the men go to work, it is possible, in fact highly probable, for sufficient gas to again accumulate and cause an explosion. Against this amendment no one could seriously raise an objection; but the meeting went on to discuss the Employers' Limited Liability Act, and it was resolved to support Mr. Burt in taking away the power of an employer to contract himself out of the Act.

It is well known that a great effort has been made in Wales to further the most friendly relations between masters and men, and that by agreement these contracts have been entered into and the masters in return have given great material support to the Miners' Provident Fund. This action aims a vital blow at the good relations existing and at the prospect of the fund, and should certainly not be encouraged.

The exports of coal for last week showed a great contrast on account of holidays. This week collieries and docks have been at their busiest in all directions.

Patent fuel is rather slack, and this has told unfavourably against small steam coal, which is duller than usual.

The Rhondda Valley and Swansea Bay Bill is now on its trial, the object being to gain an addition of line of 4¼ miles in length. Under the Bill of last year, when the railway of the promoters got to Briton Ferry, their traffic had to be taken by the Great Western by Neath and Landore to get to Swansea. By the proposed line 87,000 train-miles would be saved in a year, which meant £27,000 in money. A severe contest is expected. The Neath Corporation, Neath Harbour, and Great Western Railway are strongly represented.

The iron and steel trades are about the same. Home orders are moderately good, Taff and Great Western requirements this year being large. Over 5000 tons of iron and steel were sent away last week from Newport and Swansea.

I note that Messrs. Spittle and Co., Newport, have carried off the contract for 3000 tons of 24in. diameter cast iron pipes, 12ft. long, for the Swansea Corporation.

The Cardiff Corporation have gone in for the Taff Vawn scheme of water supply. This will mean most extensive reservoirs, and a series of iron pipes extending nearly thirty miles in length.

The Swansea New Dock returns show that since the opening shipbuilding has increased 25 per cent. as against 21 per cent. before the opening by the Prince of Wales.

The tin-plate trade, after showing a slight change for the better, is again dull. One of the stopped works was put up for sale a few days ago—Pontardulais—but no buyer came forward; a clear proof that there is not much faith in the revival.

Dowlais men continue to resist the reduction in tin-plate department.

Garnant and Red Moor works have been started, which will add 3200 boxes to the weekly make of the district.

An absurd rumour was current in Cardiff this week that a stoppage had taken place at the new Bute Dock. It appears that a slight fall had taken place of the sides, causing the works to be stopped temporarily. All is now in full drive again.

I may add, as a certain fact, that prior to the passing of the Barry Dock Bill, the Marquis of Bute's advisers were counselled to abandon the new dock in the event of the Barry promoters getting their Bill.

As a filling for open or porous burr stones, the *American Miller* gives the following: Powder equal parts of burr, rock alum, and rock salt; add enough molasses to make it into a thin batter, boil for about ten minutes, and pour into the cavities while warm.

THE PATENT JOURNAL.

Condensed from the Journal of the Commissioners of Patents.

*** *It has come to our notice that some applicants of the Patent-office Sales Department, for Patent Specifications, have caused much unnecessary trouble and annoyance, both to themselves and to the Patent-office officials, by giving the number of the page of* THE ENGINEER *at which the Specification they require is referred to, instead of giving the proper number of the Specification. The mistake has been made by looking at* THE ENGINEER *Index, and giving the numbers there found, which only refer to the pages, in place of turning to those pages and finding the numbers of the Specification.*

Applications for Letters Patent.

*** When patents have been "communicated," the name and address of the communicating party are printed in italics.

15th May, 1883.

2432. Carding Engines, G. and E. Ashworth, Manchester.
2433. Draining Land, E. Edwards and J. Williams, Cardiff.
2434. Producing Electricity, E. L. Voice, London.
2435. Treating Phosphatic Slags, &c., C. Pieper.—(*C. Scheibler, Berlin.*)
2436. Winnowing Machines, H. J. Haddan.—(*H. Schmid, Budapest.*)
2437. Differential Gearing, F. Wynne, London.
2438. Incandescent Electric Lamps, H. J. Guest, U.S.
2439. Dressing Types, G. S. Eaton, Brooklyn.
2440. Reproducing at a Distance the Facsimile of Written Characters, A. T. Collier, Wadebridge.
2441. Lace, &c., F. E. Büsche, Schwelm.
2442. Plates for Secondary Batteries, W. Hochhausen, New York.
2443. Ribbed Wire, C. A. T. Rollason, Birmingham.
2444. Locks for Windows, H. Charteris, London.
2445. Controlling Supply of Gas, S. Hyams, Guernsey.
2446. Feeding Calves, W. Osborn, Trull.
2447. Hydraulic Pumping Apparatus, J. Moore, San Francisco.
2448. Electric Light Buoys, E. C. Thomas, London.
2449. Ringing Bells, E. Edwards.—(*R. Latowski, Silesia.*)

16th May, 1883.

2450. Carding Engines, W. Tatham, Rochdale.
2451. Callipers, St. J. V. Day.—(*A. Nimmo, Bristol.*)
2452. Railway Couplings, G. F. Belling, Little Ilford.
2453. Storing Compressed Air, W. Ross, Peckham.
2454. Spring Mattresses, G. A. Billington, Wallasey.
2455. Primary Galvanic Batteries, G. André, Dorking.
2456. Refining Soap, J. Longmore, Liverpool.
2457. Looms, A. J. Boult.—(*M. Baltus, Rouen.*)
2458. Metallic Packing, A. Spagl, Munich.
2459. Domestic Fire-escape, T. Hale, Claydon.
2460. Utilising the Force of Wind, E. Roy, London.
2461. Perforating, &c., Paper, W. R. Lake.—(*S. Wheeler, Albany.*)
2462. Illuminating Gas, W. R. Lake.—(*E. J. Frost, Philadelphia.*)

17th May, 1883.

2463. Breech-loading Ordnance, H. J. Smith and W. A. F. Blakeney, Glasgow.
2464. Gas Stoves, J. Adams, Glasgow.
2565. Gridirons, J. Adams, Glasgow.
2466. Model Race-course Game, T. Borham, London.
2467. Gumming Apparatus, C. Pieper.—(*J. E. Parmentier, Plettenberg.*)
2468. Wool-washing Apparatus, &c., J. Imray.—(*La Société Bock-Wulveryck frères, Paris.*)
2469. Separating Alkalies, J. Lane, Elland, and D. V. Steuart, Manchester.
2470. Neckties, W. T. Whiteman.—(*J. M. Jack and C. H. Anderson, Montreal.*)
2471. Ever-pointed Pencil Cases, &c., W. Wiley, Birmingham.
2472. Extinguishing Fires, G. W. von Nawrocki.—(*C. J. Monch, Gotha.*)
2473. Insulating Electrical Conductors, A. J. Boult.—(*J. G. Sanderson, New York.*)
2474. Pressing Veneers, E. G. Brewer.—(*R. Goff, Newfoundland.*)
2475. Window Sashes, A. Rudolph, San Francisco.
2476. Tramway Wheels, R. C. Mansell, Highgate.
2477. Uniting Knit Fabrics, J. H. Johnson.—(*W. Pearson, Linwood, and J. W. Hepworth, Philadelphia.*)
2478. Stays, F. H. F. Engel.—(*E. and G. Lerch and J. Meyer, Ottensen.*)
2479. Treating Galvanisers' Flux, &c., H. Kenyon, Altrincham.
2480. Working Sight Bars for Guns, C. H. Murray, Newcastle-upon-Tyne.
2481. Substitutes for Ivory, F. Greening, Southall.
2482. Electro-motive Engine, A. Brown, London.
2483. Utilising Liquid Fuel for Furnaces, &c., H. H. Lake.—(*T. Urquhart, Borisoglebsk.*)

18th May, 1883.

2484. Jacquards, &c., W. Davenport and W. Crossley, Failsworth.
2485. Tramway Engines, T. Hunt, Manchester.
2486. Indigo, W. Brookes.—(*T. Holliday, Houlme.*)
2487. Oil Cans, L. A. Walters, London, and J. Bradbury, Braintree.
2488. Sewing Machines, H. J. Allison.—(*C. Wuterich, New York.*)
2489. Electric Current Meters, W. Murray and H. M. Capner, London.
2490. Looms, W. Tristram and W. Westhead, Bolton.
2491. Expansion Valve Gear, W. E. Rich, London.
2492. Gas Motor Engines, G. G. Picking and W. Hopkins, London.
2493. Measuring Electricity, J. Andrews, Glasgow.
2494. Multiple Cylinder Engines, P. Brotherhood, Lambeth.
2495. Photographic Paper, J. Imray.—(*C. Cross and A. Vergeraud, Paris.*)
2496. Textile Fabrics, W. Lake.—(*L. Chaux, Paris.*)
2497. Covers for Books, S. S. Tuckerman, Kinver.
2498. Non-conducting Coverings, A. J. Boult.—(*G. Kelly, Chicago.*)
2499. Insulating Electrical Wires, W. A. Phillips, London.

19th May, 1883.

2500. Ambulance Carriages, R. A. Westhorp, London.
2501. Combined Steam and Hot Air Engine, W. Turnbull, New Hampton.
2502. Sulphite of Lime, R. Powell, Liverpool.
2503. Delivering Consecutively Tickets to Persons Riding in Vehicles, J. M. Black, London.
2504. Iron and Steel, T. Griffiths, Abergavenny.
2505. Horseshoes, T. Allen, Bradford.
2506. Extracting Iron from Solutions Containing the Same, G. W. von Nawrocki.—(*Loewig and Co., Goldschmieden.*)
2507. Chimney Pieces, A. Diss, West Bergholt.
2508. Gaiters, C. M. A. G. du Mont, Paris.
2509. Balanced Slide Valves, J. W. Hall, London.
2510. Spinning Spindles, A. M. Clark.—(*A. R. Sherman, Pawtucket, U.S.*)
2511. Obtaining Motive Power, A. Vacherot, Sutton.
2512. Stoppers for Bottles, A. B. Vanes, Uitenhage.
2513. French Horns, M. Bauer.—(*E. Heidrich, Breslau.*)
2514. Bessemer Steel, A. Davy, Sheffield.
2515. Carriage Wheel Tires, H. Townsend, London.
2516. Door Locks, J. Holden, Swindon.

21st May, 1883.

2517. Gas Engines, W. Haigh and J. Nuttall, Oldham.
2518. Compound Steam Engines, &c., C. Pieper.—(*E. Ongley, Memel, and Proell and Scharowsky, Dresden.*)
2519. Ammonia Salt, G. Chapman, Glasgow.
2520. Tramway Coupling, W. Vaux, Bradford.
2521. Coal Derricks, A. Lewsley.—(*W. Ludlow, U.S.*)
2522. Cowls for Chimneys, A. Snelling, Clapham.
2523. Extinguishing Fires, T. von Trotha.—(*V. Schlippe, Russia.*)
2524. Laundry Blue, M. H. and T. L. Hargreaves, Hull, and J. E. Hargreaves, Freshwater.
2525. Water-slide Gasaliers, W. Soutter, jun., and T. Edkins, Birmingham.
2526. Blasting Rock, H. N. Penrice, near Norwich.
2527. Amalgamating Gold and Silver from their Ores, E. D. Chester, Surbiton.
2528. Holders for Electric Lamps, A. Swan, Gateshead.
2529. Ships' Davits, H. McCollin, Limehouse.
2530. Embroidering Machines, W. L. Wise.—(*F. Martini and Co., Frauenfeld.*)
2531. Types, F. Wirth.—(*J. M. Hepburn, Germany.*)
2532. Washing Machines, H. Lake.—(*K. Wlk, Graz.*)
2533. Rotary Brushes, H. H. Räuber, Stuttgart.
2534. Pumps, F. H. Engel.—(*C. Zimmerman, Germany.*)
2535. Artificial Stone, F. H. F. Engel.—(*E. Murjahn, Hamburg.*)
2536. Beer Casks, J. Watts, Birmingham.

Invention Protected for Six Months on Deposit of Complete Specification.

2475. Window Sashes, A. Rudolph, San Francisco.—*17th May*, 1883.

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

1986. Wire Cards, G. and E. Ashworth, Manchester.—*14th May*, 1880.
2004. Reaping Machines, A. McGregor, Leigh.—*15th May*, 1880.
2718. Sugarcane Crushing Machinery, G. Buchanan and W. A. Keay, London.—*2nd July*, 1880.
2058. Hydraulic Machinery, B. Walker and J. F. A. Pflaum, Leeds.—*20th May*, 1880.
2160. Panels and Mouldings, F. Walton, Twickenham.—*27th May*, 1880.
3187. Self-acting Temples for Looms, W. Chetham, Salford.—*17th May*, 1880.
2035. Steam Boilers, G. Sinclair, Leith.—*19th May*, 1880.
2054. Fireplaces, H. Withington, London.—*20th May*, 1880.
2146. Railway Rails, H. J. Haddan, London.—*26th May*, 1880.
2205. Corsets, E. P. Alexander, London.—*31st May*, 1880.
4262. Extracting Oil from Wool, T. J. Mulling, London.—*18th May*, 1880.
2064. Heating Water, J. Wright, Tipton.—*21st May*, 1880.
2041. Trimming the Soles of Boots, W. R. Lake, London.—*19th May*, 1880.
2127. Rolls, J. T. King, Liverpool.—*25th May*, 1880.
2135. Enriching Gas, J. Livesey, London.—*25th May*, 1880.
2344. Gas-motor Engines, H. Robinson, Manchester.—*10th June*, 1880.

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

2073. Furnaces, J. MacTear, Glasgow.—*17th May*, 1876.
2080. Purification of Sewage, G. Bischof, London.—*17th May*, 1876.
2348. Cleaning the Bottoms of Ships when Afloat, E. Paine, Liverpool.—*5th June*, 1876.

Notices of Intention to Proceed with Applications.

(*Last day for filing opposition*, *8th June*, 1883.)

207. Drawing Corks from Bottles, F. H. F. Engel, Hamburg.—A communication from E. Berlien.—*13th January*, 1883.
212. Letting Down Carriage Windows, C. T. Cheetham, Bradford.—*13th January*, 1883.
222. Grinding, &c., Corn, W. L. Wise, London.—A communication from A. Mariotte, A. Mariotte, and E. Boffy.—*15th January*, 1883.
230. Damp-proof Socks, R. J. Baggaley, Nottingham.—*15th January*, 1883.
231. Stamping, &c., Machines, N. Wilson and T. Hinds, London.—*15th January*, 1883.
238. Water-closets, H. H. Lake, London.—A communication from J. Bennor.—*15th January*, 1883.
241. Reducing Metallic Ores, S. H. Emmens, London.—*15th January*, 1883.
270. Stamping Letters, &c., A. Hoster, London.—*17th January*, 1883.
294. Hydraulic Pumping Machinery, W. Donaldson, Ambleside.—*18th January*, 1883.
334. Hansoms, H. Brockelbank, London.—*20th January*, 1883.
340. Coke Ovens, R. H. Brandon, Paris.—A communication from E. Franzen.—*20th January*, 1883.
350. Bascules or See-saws, H. J. T. Piercy, Birmingham.—*22nd January*, 1883.
405. Insulators, P. R. de F. d'Humy, London.—*25th January*, 1883.
421. Railway Signals, J. H. Cureton, London.—*25th January*, 1883.
522. Desiccated Egg, H. J. Allison, London.—Com. from P. Cooper & C. A. La Mont.—*31st January*, 1883.
541. Coaling Steamships, S. Plimsoll, London.—*1st February*, 1883.
592. Galvanic Batteries, P. R. de F. d'Humy, London.—*3rd February*, 1883.
690. Ordnance, W. L. Wise, London.—A communication from C. T. M. V. de Bange.—*7th February*, 1883.
748. Bichromates of Potash, &c., J. H. Johnson, London.—A communication from O., A., and A. Neuhaus.—*10th February*, 1883.
753. Sawing, &c., Stone, J. H. Johnson, London.—A communication from G. Westinghouse, jun.—*10th February*, 1883.
1697. Alcohol, J. H. Loder, Leiden, Holland.—*4th April*, 1883.
1749. Filtering, C. H. Haubold, Chemnitz, Germany.—*6th April*, 1883.
1837. Railway Signalling, W. Lawson, Dumfries, and T. Forrest, Glasgow.—*11th April*, 1883.
1964. Producing Yellow Dye, G. A. Bang, Leeds.—A com. from G. A., E., and R. Dahl.—*18th April*, 1883.
1989. Sewing Machines, J. Fox, London.—*19th April*, 1883.

(*Last day for filing opposition*, *12th June*, 1883.)

31. Thill Couplings, &c., D. Green, Cincinnati, U.S.—*2nd January*, 1883.
245. Anti-fouling Composition, J. H. Barry, London.—*16th January*, 1883.
257. Filtering Saccharine Solutions, E. P. Alexander, London.—A communication from P. Casamajor.—*16th January*, 1883.
273. Stoppering Bottles, J. Sceats, Norbiton.—*17th January*, 1883.
280. Bricks, &c., J. H. Starling, Erith, and E. A. May, Belvedere.—*17th January*, 1883.
282. Voltaic Batteries, M. R. Ward, London.—*17th January*, 1883.
286. Thrashing Machines, J. H. Johnson, London.—Com. from J. Montandon, jun.—*17th January*, 1883.
304. Furnaces, J. Mackenzie, Stockton-on-Tees.—*18th January*, 1883.
310. Crushing, &c., Cement, H. H. Lake, London.—A com. from C. Jouffray.—*18th January*, 1883.
312. Type Writers, J. J. Raggett, Aston.—*18th January*, 1883.
318. Hurricane Lanterns, H. J. Haddan, London.—A com. from A. Schindler.—*19th January*, 1883.
320. Boiler Furnaces, B. Harlow, Macclesfield.—*19th January*, 1883.
321. Switch for Increasing Electric Current, F. Mori, Leeds.—*19th January*, 1883.
322. Electric Arc Lamps, F. Mori, Leeds.—*19th January*, 1883.
335. Distilling Coal Shale, B. P. Walker, Birmingham, and J. A. B. Bennett, King's Heath.—*20th January*, 1883.
376. Utilising Refuse of Glassworks, W. D. Herman, St. Helens.—*23rd January*, 1883.

395. RAILWAYS, P. Jensen, London.—A communication from F. H. Danchell.—*24th January*, 1883.
423. FELT HATS, C. Vero and J. Everitt, Atherstone.—*25th January*, 1883.
440. VELOCIPEDES, W. T. Shaw, Surbiton, and W. Sydenham, London —*26th January*, 1883.
471. REVOLVING FLAT CARDING ENGINES, J. M. Hetherington, Manchester.—*29th January*, 1883.
483. OIL PRESSING, F. Wirth, Frankfort-on-the-Main.—A com. from R. Traumann.—*29th January*, 1883.
590. FURNACES, J. P. Cotiart, Havana.—*3rd February*, 1883.
612. FURNACES, &c., D. Caddick, Middlesbrough.—*6th February*, 1883.
693. TAKING LEVELS, F. Low, London.—A communication from A. T. Fraser.—*8th February*, 1883.
699. MOULDS for ARTICLES of GLASS, A. Swann, Gateshead.—*8th February*, 1883.
768. FASTENING of ARMOUR PLATES, L. W. Broadwell, London.—*12th February*, 1883.
771. SCREWS, H. H. Lake, London.—A communication from the Harvey Screw Co —*12th February*, 1883.
780. POTATO STEAMER, C. P. Bower, London.—*13th February*, 1883.
865. METALLIC DOWELS, W. D. Player, Birmingham.—*16th February*, 1883.
941. UNINFLAMMABLE PRODUCTS, A. M. Clark, London.—A com. from G. Meyer.—*20th February*, 1883.
952. HORSESHOES, J. Ferris, Athlone.—*21st February*, 1883.
1004. TREATMENT of VEGETABLE FIBROUS SUBSTANCES, C. Court, London.—*24th February*, 1883.
1215. BREECH-LOADING FIRE-ARMS, G. Macaulay-Cruikshank, Glasgow.—A communication from M. V. Kacer and W. J. Kriz.—*7th March*, 1883.
1257. MECHANICAL TELEGRAPHS, W. Chadburn, Liverpool.—*9th March*, 1883.
1500. RING SPINNING FRAMES, J. Monks, W. Monks, and W. J. Redman, Bacup —*22nd March*, 1883.
1730 COVERING IRON, &c., with LEAD, W. H. Spence, London.—A com. from E. Möhlau.—*6th April*, 1883.
1759. PRODUCING, &c., ELECTRIC LIGHT, T. Wiesendanger, London.—*7th April*, 1883.
1812. ELECTRIC LAMPS, H. Edmunds, jun., New York.—*10th April*, 1883.
1818. STEERING VESSELS, J. Philp and W. Forrester, Liverpool.—*10th April*, 1883.
1894. PAVEMENT, W. Berry and P. Stuart, Edinburgh.—*14th April*, 1883.
2004. FINISHING WOVEN FABRICS, J. Smith, Thornliebank.—*20th April*, 1883.
2006. FRICTION CLUTCHES, H. Simon, Manchester.—A communication from the Berlin-Anhaltische-Maschinenbau-Actien Gesellschaft.—*20th April*, 1883.
2022. LEVER CORK-SCREWS, R. Dolberg, Rostock, Germany.—Com. from C. F. Wienke.—*20th April*, 1883.
2026. BOOTS and SHOES, J. Leighton, Netherfield.—*21st April*, 1883.
2038. GENERATING ELECTRIC CURRENTS, Sir W. Thomson, Glasgow.—*21st April*, 1883.
2048. IMPROVED MOORING, E. C. G. Thomas, London.—*23rd April*, 1883.
2049. AUTOMATIC DREDGER, E. C. G. Thomas, London.—*23rd April*, 1883.
2063. FURNACES, D. Jones, London.—*24th April*, 1883.
2068. SWINGING, &c., BERTHS, P. M. Justice, London.—A communication from A. P. Bickmore and E. B. Pendleton.—*24th April*, 1883.
2077. VEHICLES, E Newman, Burnham.—*24th April*, 1883
2102. EXTRACTING OILS, J. Imray, London.—A communication from I. A. Bang and C. A. Sanguinette.—*25th April*, 1883.
2139. EXPLOSIVE COMPOUNDS, E. Turpin, Paris.—*27th April*, 1883.
2144. FINISHING, &c., TEXTILE FABRICS, W. P. Thompson, Liverpool. — A communication from D. C. Sumner.—*27th April*, 1883.
2145 SEWING MACHINES, A. J. Boult, London.—A communication from J. H. Whitney.—*27th April*, 1883.
2176. STOPPERING BOTTLES, R. J. Sankey, South Hill, near Ashford.—*30th April*, 1883.
2178. BUTTONS, W. Willeringhaus, London —A communication from C. Umbeck.—*30th April*, 1883.
2341. VULCANISING GUMS, H. H. Lake, London.—A communication from A. C. Eddy.—*8th May*. 1883.
2475. WINDOW SASHES, A. Rudolph, San Francisco, U S.—*17th May*, 1883.

Patents Sealed.

(*List of Letters Patent which passed the Great Seal on the 18th May*, 1883.)

5393. JOINTS of DRAINAGE PIPES, W. N. Hutchinson, Wellesbourne —*13th November*, 1882.
5442. EXTRACTING SALT from FLUIDS, J. Maynes, Manchester.—*15th November*, 1882.
5510 GAS MOTOR ENGINES, J. Maynes, Manchester.—*20th November*, 1882.
5545. UTILISING BYE PRODUCTS of SODA, &c., J. Mactear, Glasgow.—*22nd November*, 1882.
5548. IMPROVING the APPEARANCE of DIAMONDS, &c , J. C. Mewburn, London.—*22nd November*, 1882.
5555. BOILER FLUES, &c., G. W. Dyson, Bolton.—*22nd November*, 1882.
5558 FOUNTAIN PENHOLDERS, A Osborn, Birmingham.—*22nd November*, 1882.
5562 LAMPS and their BURNERS, H. Salsbury, London.—*22nd November*, 1882.
5563. PROPELLING ROW BOATS, W. J. Sage, London.—*22nd November*, 1882.
5580. CARBONS, &c., W. Cunliffe, London. — *23rd November*, 1882.
5582. NAVES of WHEELS, S. Andrews, Cardiff.—*23rd November*, 1882.
5595. CANDLE MOULDING MACHINES, E. Cowles, Hounslow.—*24th November*, 1882.
5599 TRICYCLES, &c., H. J. Hissett, Plymouth.—*24th November*, 1882.
5619. FILLING, &c., BOTTLES, J. Phillips, London.—*27th November*, 1882.
5626. METAL CISTERNS, H. Sutcliffe, Halifax.—*27th November*, 1882.
5663. COMMUNICATING between PASSENGERS, GUARD, and ENGINE DRIVER, W. Sharp, Rastrick.—*28th November*, 1882.
5665. TWISTED RIBS for GUN BARRELS, W. James, Birmingham.—*28th November*, 1882.
5672. REGULATING APPARATUS for ENGINES, A. Budenberg, Manchester.—*29th November*, 1882.
5680. CONSTRUCTING the STEPS of STAIRS, H. Doulton, London.—*29th November*, 1882.
5745. FIRE-ESCAPES, H. J. Allison, London.—*2nd December*, 1882.
5761. REFRIGERATING APPARATUS, W. R. Lake, London.—*2nd December*, 1882.
5796. ELECTRIC LAMPS, W. R. Lake, London.—*5th December*, 1882.
5833. SPRING MOTORS for SEWING MACHINES, A. M. Clark, London.—*9th December*, 1882.
5918. DYNAMO-ELECTRIC MACHINES, H. H. Lake, London.—*12th December*, 1882.
6039. MOSAIC FLOOR CLOTHS, F. Walton, Twickenham.—*18th December*, 1882.
597. DIRECT-ACTING HYDRAULIC MACHINES, R. H. Tweddell, London, and J. Platt and J. Fielding, Gloucester.—*3rd February*, 1883.
703. GROOVED TIRES, W. H. Carmont, Manchester.—*8th February*, 1883.
986. SPOOL WINDING MACHINES, P. H. Marriott and J. Hall, Stockport.—*23rd February*, 1883.
1019. OPERATING ELECTRICAL GENERATORS, T. J. Handford, London.—*24th February*, 1883.
1119. DECORATING WOOD, H. Saunders and S. Comber, Brighton.—*1st March*, 1883.

(*List of Letters Patent which passed the Great Seal on the 22nd May*, 1883.)

5571. PROTECTING SHIPS from the EFFECTS of COLLISION, W. Beverley, Aberdeen, and G. A. MacLaverty, Glasgow.—*23rd November*, 1882.
5578. BOBBINS and SPOOLS, L. Heppenstall, jun., Milnsbridge.—*23rd November*, 1882.
5591. TREATING VEGETABLE MATTER, G. and J. E. Tolson, Dewsbury.—*24th November*, 1882.
5603. TENTERING, &c., MECHANISM, J. Ashworth, Rochdale —*25th November*, 1882.
5606. TAKING SOUNDINGS, F. Sutcliffe, Liverpool.—*25th November*, 1882.
5608. LOOMS for WEAVING, G. Keighley, Burnley.—*25th November*, 1882.
5610. BLOCK SIGNALLING, F. Swift, West Drayton, and A. J. M. Reade, Slough.—*25th November*, 1882.
5611. REGULATING the FLOW of LIQUIDS, P. J Catterall and E. Birch, Manchester.—*25th November*, 1882.
5621. PREVENTING INJURIES to BOILERS, A. J. Smith, London.—*27th November*, 1882.
5625. TELEPHONIC APPARATUS, J. B. Spence, London, and J. E. Chaster, Southport.—*27th November*, 1882.
5630. PILED FABRICS, J. Holt, Bolton.—*27th November*, 1882.
5631. DYNAMO-ELECTRIC MACHINES, C. A. McEvoy and J. Mathieson, London.—*27th November*, 1882.
5638. CULTIVATING LAND, W. Fisken, Stamfordham, and S. S. Robson, Sunderland.—*27th November*, 1882.
5641. STAYS or CORSETS, W. Rosenthal, London.—*27th November*, 1882.
5653. LOOM PICKERS, H. Tetlow, Miles Platting, and J. Holding, Lower Broughton.—*28th November*, 1882.
5716. WAGONS, &c., W. P. Wilson, Brockley.—*30th November*, 1882.
5790. CONDENSING STEAM, A. W. L. Reddie, London.—*5th December*, 1882.
5795. SASH FASTENINGS, J. Whitehouse and S. Peacock, Birmingham.—*5th December*, 1882.
5810. TREATMENT of SPOIL HEAPS, L. H. Armour, Gateshead-on-Tyne.—*6th December*, 1882.
5824. TRAMWAY CARS, E. C. Wickes and F. E. B. Beaumont, London.—*6th December*, 1882.
5853. VELOCIPEDES, W. R. Pidgeon, Putney Hill.—*8th December*, 1882.
5914. OXIDISING TEXTILE FABRICS, C. D. Abel, London.—*11th December*, 1882.
5923. SEA-GOING VESSELS, J. H. Johnson, London.—*12th December*, 1882.
5937. DISPLAYING ADVERTISEMENTS, W. R. Lake, London.—*12th December*, 1882.
5948. WEDGES, &c., G. Guthrie, Sunderland.—*13th December*, 1882.
6027. LATCHING BOLTS of LOCKS, J. Woodward, Wolverhampton.—*18th December*, 1882.
56. MEASURING ELECTRIC CURRENTS, St. G. L. Fox, London.—*4th January*, 1883.
104. SHOES and BOOTS, H. J. Haddan, London.—*8th January*, 1883.
235. ROLLERS for MANGLING MACHINES, C. L. Jackson, Bolton.—*15th January*, 1883.
761. MANUFACTURE of LACE, G. Bentley, Nottingham.—*12th Febuary*, 1883.
806. KNITTED LOOPED FABRICS, H. Kiddier, Nottingham —*14th February*, 1883.
916. GASES for HEATING PURPOSES, W. Arthur, London.—*20th February*, 1883
1022. ELECTRICAL RAILWAYS, T. J. Handford, London.—*24th February*, 1883.
1043. TREATMENT of METALLIC ORES, W. J. Tanner, London.—*27th February*, 1883.
1091. SUPPLYING LUBRICANT, S. Kershaw, Manchester, and J. Bromilow, Heywood.—*28th February*, 1883.
1093. PREPARING INSULATED WIRES, H. E. Newton, London.—*28th February*, 1883.
1112. FERROCYANIDES, G. de Vigne, Lille, France.—*1st March*, 1883.
1187. FEED MOTION of CIRCULAR SAWING MACHINES, T. N. Robinson, Rochdale.—*6th March*, 1883.
1203. FILES, TAPS, DIES, &c , H. H. Lake, London.—*6th March*, 1883.
1357. THERMO-ELECTRICAL GENERATORS, R. H. Brandon, Paris.—*14th March*, 1883.
1608. FORMING GELATINO-BROMIDE FILM PAPER, R. H. Brandon, Paris.—*30th March*, 1883.

List of Specifications published during the week ending May 19th, 1883.

3974, 4d.; 4024, 6d.; 4034, 2s. 10d.; 4343, 4d.; 4548, 10d.; 4558, 2d.; 4566, 6d.; 4583, 8d.; 4584, 6d.; 4585, 10d.; 4592, 6d.; 4594, 4d ; 4595, 2d.; 4596, 6d ; 4598, 6d.; 4599, 2d.; 4601. 6d.; 4603, 6d.; 4609, 8d.; 4623, 4d ; 4625, 6d.; 4627, 2d.; 4632, 6d.; 4635, 6d ; 4636, 4d.; 4640, 2d.; 4642, 2d.; 4645, 6d.; 4646, 10d.; 4647, 6d.; 4648, 2d.; 4650, 6d.; 4652, 2d.; 4653, 10d ; 4654, 2d.; 4656, 2d.; 4657, 6d ; 4658, 6d.; 4659, 8d.; 4660, 4d.; 4661, 2d.; 4663, 2d ; 4664, 2d.; 4667, 6d.; 6668, 6d.; 4639, 8d.; 4670, 2d.; 4671, 2d.; 4676, 6d.; 4683, 6d.; 4684, 2d.; 4686, 6d.; 4687, 6d.; 4689, 2d.; 4690, 6d.; 4692, 6d.; 4701, 4d.; 4703, 6d.; 4705, 6d.; 4706, 6d ; 4708, 2d.; 4720, 6d.; 4731, 6d.; 4832, 6d.; 5030, 4d.; 5691, 6d.

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

ABSTRACTS OF SPECIFICATIONS.

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

3974. DYNAMO-ELECTRIC MACHINES, *J. E. T. Woods, Peckham Rye.—19th August*, 1882.—(*Not proceeded with.*) 4*d*.

This relates to various improvements in the construction of dynamos.

4024. BOTTLE STOPPERS, *I. Lippman, Berlin.—22nd August*, 1882. 6*d*.

This relates partly to stoppers with screw threads to engage with corresponding threads in the neck of the bottle, and it consists in making the body of the stopper of a hard unyielding material, and covering it with a thin mantle of tin or similar metal. It further consists in forming such stoppers with valves for the purpose of charging the bottles.

4343. CHRONOGRAPH, *A. M. Clark, London.—12th September*, 1882.—(*A communication from P. R. Moreau, Geneva.*)—(*Not proceeded with.*) 4*d*.

This consists in the use of a bent lever acted upon by turning the bow of the case up or down, so as to control the movement of heart wheels on the pointer spindles, the movement of such pointers being arrested after a certain time by means of a stop lever.

4535. DYNAMO-ELECTRIC MACHINES, *F. C. Glaser, Berlin.—23rd September*, 1882.—(*A communication from C. Zipernowsky and M. Deri, Budapest, Austria.*) 10*d*.

This relates to an alternate current machine which is so constructed as to excite its own magnets; it is also self-regulating, and the currents are led off from fixed contact screws in place of commutators.

4548. MECHANISM FOR TRANSPORTING GOODS AND PASSENGERS BY THE AID OF ELECTRICITY, &c., *F. Jenkin, C.E, Edinburgh.—23rd September*, 1882. 10*d*.

This relates to means for preventing vehicles or trains propelled by means of electricity according to the system described in the inventor's patent No. 1830, 1882, from colliding, and for preserving a certain interval between each. The inventor claims the use of fixed insulated block wires or conductors divided into sections and regulating the intervals between the trains by operating electrically upon mechanism on the following train to stop or retard it when the interval becomes too small, and causing it to be driven again as soon as the interval is sufficient; also the use, with trains propelled by electric currents transmitted to them by stationary conductors, of leading and trailing connections on the train and fixed insulated sectional block wires or conductors, so arranged that when the interval between the trains becomes too small a portion of the current passes through the block wire and connections and brings into operation apparatus on the following train, by which it is stopped or retarded, &c.

4555. DYNAMO ELECTRIC ENGINES, *A. Lalance and M. Bauer, Paris.—25th September*, 1882.—(*Not proceeded with.*) 4*d*.

This relates to a machine in which the inventors have endeavoured to augment the magnetic field as much as possible by extending the poles, and bringing the induced and inducing coils as near together as possible.

4558. APPARATUS FOR DIVIDING AND TREATING DOUGH TO FORM LOAVES, *R. Abercromby, Glasgow.—25th September*, 1882.—(*Not proceeded with.*) 2*d*.

The dough is placed in a hopper and a screw forces it through a narrow outlet and between rollers, from whence it passes in a thick band on to a travelling apron, where fences or guides turn and fold over the sides, after which it again passes through rollers. The band of dough is then delivered to a second band and fed forward intermittently, a knife cutting off the desired quantity at each forward movement, the divided portions being delivered to a table with recesses, into each of which one portion is compressed so as to form a loaf.

4561. SECONDARY BATTERIES, *F. C. Hills, Deptford.—25th September*, 1882.—(*Void.*) 2*d*.

This relates to the use of molten lead poured from a height into water, whereby it becomes finely divided, for the plates of secondary batteries.

4566. GOVERNING APPARATUS FOR STEAM ENGINES, *B. Fowler and W. Daniel, Leeds.—25th September*, 1882. 6*d*.

A small governor is employed and controls the admission of steam to an auxiliary cylinder, which in turn operates upon the valve gear of the engine. A is the steam cylinder, to which steam is admitted from the boiler, B is the slide valve spindle, and C the expansion valve spindle. The latter carries a pinion gearing with a toothed arc upon a lever pivotted at X. F is the small cylinder, the piston-rod of which

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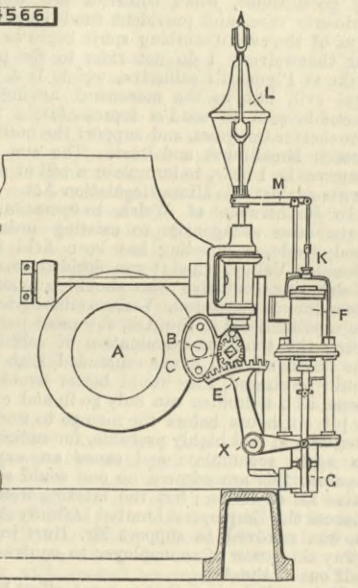

is connected with lever E; G is a cataract cylinder, the piston of which is on the same rod as that working in cylinder F, and it serves to render gradual the change of position of the latter. The same piston-rod also actuates a rod connected with a movable valve face, which varies its position with the piston. A valve works on the movable face and admits steam to cylinder F, its spindle K being connected by levers M to the slider of governor L.

4567. APPARATUS FOR OBTAINING MECHANICAL EFFECT BY ELECTRICAL ENERGY, *E. L. Voice, Torrington-square.—26th September*, 1882. 6*d*.

The object of this invention is to avoid counter electro-motive force in motors. The inventor constructs his machines with armatures, consisting of radial or segmental bars mounted on an axis and rotating through or in fixed hollow bobbins. Commutators are dispensed with.

4573. PORTABLE ELECTRICAL APPARATUS FOR LIGHTING GAS FLAMES, *J. Imray, Chancery-lane.—26th September*, 1882.—(*A communication from E. Arnould, Paris.*)—(*Not proceeded with.*) 2*d*.

Platinum wire is attached to a portable apparatus and connected with a battery, so arranged that in certain positions of the apparatus the battery sends a current through the platinum, rendering it incandescent, whilst in other positions the battery is not in action.

4580. DECOMPOSING ALLOYS BY ELECTROLYSIS AND DIALYSIS, *W. R. Lake, Southampton-buildings.—26th September*, 1882.—(*A communication from H. R. Cassel, New York.*) 6*d*.

This relates to a means whereby the anode solution may be perfectly separated from the cathode solution. In carrying out this invention the anodes and cathodes are separated by any suitable colloidal substance in the form of cells placed in the vat, or as fixed partitions therein. Wood is found to be the best substance for these dialysing cells or partitions.

4583. ROTARY PUMPS AND BLOWERS, *M. Benson, London.—27th September*, 1882.—(*A communication from F. M. Roots, Connersville, U.S.*) 8*d*.

This relates to improvements on patent No. 4158, A.D. 1881, the object being to produce pistons capable of sustaining a heavy pressure with the least possible friction between the abutting parts, and to insure perfect contact between the abutments during their entire revolution. It consists in the formation of the abutting surfaces in arcs of circles, the radii of which are equal to two-thirds of the difference between the diameter of the pitch and inscribed circles.

4584. BUCKLES FOR BRACES, &c., *J. B. Brooks and F. R. Baker, Birmingham.—27th September*, 1882. 6*d*.

The body is formed so as to permit the web of the brace to pass between the front and back plate, and at each side of the latter are ears, between which a spring plate slides, such plate having teeth to enter the web.

4585. APPARATUS FOR AERIAL AND MARINE NAVIGATION, &c., *B. W. Maughan and S. D. Waddy, London.—27th September*, 1882. 10*d*.

This relates to the use of propeller blades and vanes or wings, the surfaces of which consist of two or more planes inclined relatively to each other, such blades being jointed together and provided with a series of projections, cavities, apertures, or grooves so arranged as to present inclined surfaces to the action of the fluid for the purpose of feathering or adjusting the blades.

4592. VENTILATING APPLIANCES FOR SOIL PIPES, &c., *H. Blair, Glasgow.—27th September*, 1882. 6*d*.

This consists in the arrangement in a soil pipe or waste discharge pipe of ventilating appliances, consisting of two lengths of piping fitting into each other, in or between which an air inlet or grating is formed.

4594. LAMPS, *W. L. Wise, London.—27th September*, 1882.—(*A communication from F. Bernards, Paris.*) 4*d*.

The wick is caused to pass through a thin metallic capsule fitting the top of the lamp body, which contains sponge saturated with oil or essence. The upper part of the capsule terminates in a lip, which serves to obviate the necessity of frequent regulation of the wick and to insure sure and rapid lighting.

4595. FAST AND LOOSE PULLEYS, *T. B. Sharp, Smethwick.—27th September*, 1882.—(*Not proceeded with.* 2*d*.

The fast pulley is of larger diameter than the loose pulley, and between them is mounted a conical pulley.

4596. APPARATUS FOR MEASURING AND REGULATING ELECTRIC CURRENTS, *S. Z. de Ferranti, Shepherd's Bush, and A. Thompson, Russell-square.—27th September*, 1882. 6*d*.

To measure alternating currents the inventors use an induction coil, through the primary wire of which the current to be measured is passed; the terminals of the secondary coil are connected to two electrodes immersed in water slightly acidulated. The gas generated by the decomposition of water by the two electrodes is proportional to the current in the secondary coil, which is also proportional to that in the primary. The gas is measured in a special apparatus devised by the inventors and described in this patent.

4598. UTILISING HEAT AS A MOTOR THROUGH THE MEDIUM OF ELASTIC FLUIDS, *H. Gruson and R. Handrick, Germany.—27th September*, 1882. 6*d*.

An injector is used for forcing back into a receiver vapour which has been used for driving a motor. A

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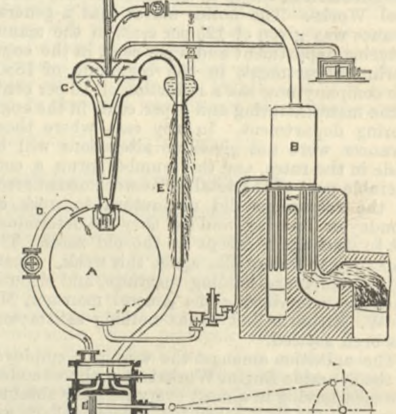

is the receiver holding vapour for driving the motor; B a boiler for generating vapour for operating injector C. The vapour passes by pipe D to the motor, and the exhaust vapour is conveyed by pipe E to the injector, which forces it back into the receiver.

4599. SECONDARY OR STORAGE BATTERIES, *W. Clark, Chancery-lane.—27th September*, 1882.—(*A communication from N. de Kabath, Paris.*)—(*Not proceeded with.*) 2*d*.

The inventor constructs his batteries of plates of perforated pure lead, between which are placed layers of spongy lead; the whole are then subjected to pressure.

4601. APPARATUS FOR FACILITATING THE USE OF CABLES FOR HAULING TRAMWAY VEHICLES, &c., *W. R. Lake, London.—27th September*, 1882.—(*A communication from S. H. Ferrie, Guthrie, U.S.*) 6*d*.

This consists mainly in forming cross ties with the main tube; in providing such tube with enlargements or pockets so that anti-friction wheels may be used with a small tube; in providing the horizontal bearing wheels with a device for retaining the cable in position; in providing the main tube at the pockets or near the vertical bearing wheels with inclines for lifting the gripper or easing it over the vertical bearing wheels; in providing the tube with a side pipe or passage for conveying water around the box.

4603. SPINNING RINGS, *B. J. B. Mills, London.—28th September*, 1882 —(*A communication from J. Schütt and J. Warnholtz, Germany.*) 6*d*.

The object is to furnish a spinning ring which will allow the formation of cops on bobbins of large or small diameter. The spindle with its bobbin revolves inside a sleeve journalled in the ring rail, and revolving in the same direction, but a little faster than the spindle. A light ring rests on an angular projection of the sleeve, and revolves with it. This ring has on its top, vertically under the circumference of the race of the sleeve, a yarn eye, a wire loop, a short horizontal tube, two holes in the top rim of the ring, or any equivalent contrivance through which the yarn passes to the bobbin. Above the top of the ring a stop plate is adjustably arranged.

4607. OBTAINING EXTRACT OR SOLUBLE PORTION FROM TANNING MATERIALS, &c., *H. Hutchings, Warrington.—28th September*, 1882. 6*d*.

This consists in digesting tanning material in water, and at the same time causing both the water and tanning material to surge to and fro by means of oscillating apparatus.

4609. APPARATUS FOR RAISING, LOWERING, AND DIRECTING PORTABLE RIVETTING MACHINES, &c., *R. H. Tweddell, Westminster, and J. Fielding, Gloucester.—28th September*, 1882. 8*d*.

From the frame of the machine projects a trunnion A with its axis nearly in a line passing through the

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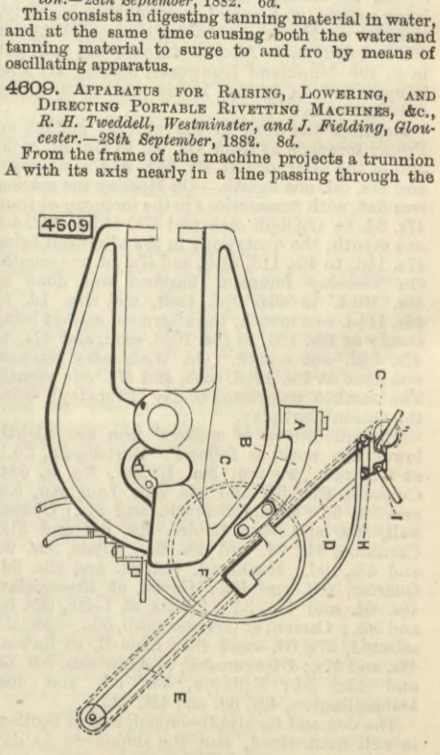


centre of gravity, and to it is fitted a bent radial arm B with a bearing for a pin C at its end, the axis of such pin also being nearly in a line passing through the centre of gravity, and is inclined at nearly 45 deg. to the axis of trunnion A. The pin C is a trunnion of hydraulic cylinder D, the plunger E of which carries a pulley for the chain F that passes round guide pulley mounted on end of cylinder D, and extends up to point of suspension. The cylinder has a valve-box H with supply and discharge valves, which can be worked by cords attached to the valve levers I I, so as to subject the lever to or relieve it from hydraulic pressure, and thereby raise or lower the machine.

4608. APPARATUS FOR OBTAINING ARTIFICIAL LIGHT, *J. Mayer, London.—28th September*, 1882. 6*d*.
Oxygen and hydrogen gas are directed and their combustion effected upon a body of marble instead of lime, suitable means being provided for regulating the supply of gas thereto.

4611. APPARATUS FOR BOILING WORT, &c., *D. W. Hamper and E. Harper, Sowerby Bridge, Yorkshire.—28th September*, 1882.—(*Not proceeded with.*) 2*d*.
This relates to the use of a novel form of fountain apparatus to facilitate the boiling of wort and other liquids, and ensure their automatic constant stirring, and thereby prevent settling and burning.

4612. PREPARATION OF FININGS FOR WINES AND MALT LIQUORS, *W. Hamper and E. Harper, Sowerby Bridge, Yorkshire.—28th September*, 1882.—(*Not proceeded with.*) 2*d*.
This relates to apparatus for producing finings free from lumps, and in which the liquid is submitted to the action of revolving cutters and stirrers.

4613. FEEDING WOOL TO CARDING MACHINES, &c., *R. Tatham, Rochdale.—28th September*, 1882.—(*Not proceeded with.*) 2*d*.
This relates to the use of brushes for removing fibrous material, dirt, burrs, or grease from the teeth of travelling bands used to feed wool to carding engines.

4614. CLIPS FOR SECURING TIRES ON WHEELS, *T. R. Baker, Birmingham.—28th September*, 1882.—(*Not proceeded with.*) 2*d*.
The clip is in the form of an open jointed ring, the ends of which are turned inwards. The clip is passed over the felloe from inside, the open joint coming to the front and allowing the rubber tire to present a free running surface.

4615. SEWING MACHINES, *C. P. Evans, Birmingham.—28th September*, 1882.—(*Not proceeded with.*) 2*d*.
The object is to make two or more rows of stitching simultaneously, and it consists in mounting two or more needles on one needle bar, so that the distances apart may be regulated as desired.

4617. BULLET-PROOF SHIELDS FOR GUNS FOR PROTECTION OF GUNNERS, *J. B. Parkin, Woolwich.—28th September*, 1882.—(*Not proceeded with.*) 2*d*.
A series of steel blades are mounted on bars fixed to the gun carriage, with interstices between them, such blades being capable of being set to any required angle.

4618. FIRE-GRATES OR STOVES, *E. Whillier, London.—28th September*, 1882. 6*d*.
Flues are formed at each side of the stove and lead into a combustion chamber at the back, so that the heated air entering the latter will cause a more perfect combustion of the smoke. The grate is made reversible, so that fresh fuel may be turned to the bottom.

4619. STAYS OR CORSETS, *R. A. Young and R. Neilson, Bristol.—28th September*, 1882. 6*d*.
This consists in forming stays or corsets of a duplex fabric composed of two distinct and superimposed sets of "bones" combined and secured by lines of stitching.

4620. SAFES OR BOXES FOR VALUABLES, *H. Harris, Northampton.—28th September*, 1882.—(*Not proceeded with.*) 2*d*.
The case is of cast steel, in one piece, with the angles all rounded off, and its outer surface is polished or burnished.

4621. SLIDE VALVE, EXPANSION, AND REVERSING MECHANISM FOR ENGINES, *W. R. Lake, London.—28th September*, 1882.—(*A communication from N. A. Bonnefond, Paris.*) 6*d*.
The slide valves are arranged in the form of pistons to diminish the resistance caused by friction, and the rod of the admission slide valves is operated by releasing mechanism, which produces a rapid movement of these valves for the admission. This releasing mechanism is combined with an ordinary slide link permitting of changing the direction of working and not varying the expansion.

4622. TOBACCO PIPES, *J. E. Quirk, Jersey.—28th September*, 1882.—(*Not proceeded with.*) 2*d*.
An intermediate chamber is arranged between the bowl and the mouthpiece and is filled with tobacco, through which the smoke is caused to pass, and is thus purified and cooled.

4623. PREPARATION OF ANIMAL VACCINE, *E. T. Darke, Charing Cross.—28th September*, 1882. 4*d*.
This relates to the method of removing the pustules from animals, and then cutting them up as small as possible and diluting with distilled water and rectified glycerine, triturating them a long time and passing them through a metallic cloth filter. The liquid is then mixed with rectified glycerine to form an emulsion, or with glycerised starch to form a salve.

4624. ROLLING MILLS, *W. R. Lake, London.—28th September*, 1882.—(*A communication from G. Erkenzweig, Germany.*) 6*d*.
This relates to the production of rods or other pieces of iron and steel of small size, by means of a rolling train of two or more pairs of rolls placed laterally to each other, a hollow guide travelling in a curved line from a point opposite the delivering groove to a point in front of the receiving groove, and having a part hinged thereto arranged to be automatically locked and released, and by means of which the end of the rod to be conducted is retained in the bore of the guide until the latter has arrived at the end of its course.

4625. SECONDARY BATTERIES, *St. George Lane-Fox, Queen Anne's-gate.—28th September*, 1882. 6*d*.
This relates to improvements in Planté's battery. The inventor forms his plates of alternate strips of lead and sand or asbestos paper. Several of these are subjected to pressure to form one plate. All the lead strips are connected together, and the whole then immersed in dilute sulphuric acid.

4626. GOVERNORS FOR REGULATING THE SPEED OF ENGINES, &c., *P. B. Elwell, Wolverhampton.—28th September*, 1882.—(*Not proceeded with.*) 2*d*.
The mechanism employed consists of an arrangement of clock pendulum and escapement; a band connecting a pulley on the engine shaft with a pulley on the escapement; a weight connected to a running pulley acting in a loop of the band, and tending to keep it taut; a connection between the running pulley and the regulating valve; and a band tightener.

4627. CIGARETTES, *O. W. T. Barnsdale, Nottingham.—29th September*, 1882.—(*Not proceeded with.*) 2*d*.
This relates to the method of cutting cigarette papers so as to form the mouthpiece.

4628. BORING AND TAPPING HOLES IN BOILER PLATES, &c., *R. Davidson, Glasgow.—29th September*, 1882.—(*Not proceeded with.*) 2*d*.
One form of apparatus for effecting this object consists of a pinion and spur wheel held in bearings in a pair of plates bolted together, and which are formed with or have jointed to them a long arm, the other end of which is held to prevent the plates turning. The pinion is turned by a handle, and the wheel has a central hole to receive the tool.

4630. HUTCHES OR WAGONS, *W. Cook, Glasgow.—29th September*, 1882.—(*Not proceeded with.*) 2*d*.
This consists in forming the buffers of hutches or wagons preferably from one length of steel placed across each end, and formed with an outward bend at the centre. The plates forming the ends of the body of the hutches or wagons are formed with corrugations to strengthen them.

4629. TRICYCLES OR VELOCIPEDES, *A. Gibbs, Birmingham.—29th September*, 1882. 6*d*.
This relates to a case or covering to be attached to the frame of the velocipede, and serving to protect the rider from wet or dirt.

4632. FURNACES FOR STEAM BOILERS, *J. W. Couchman, Tottenham.—29th September*, 1882. 6*d*.
This consists mainly of a distilling chamber, open at one end and on the edges of the sides, bottom and top of which is a pipe to direct the outflow of air across the open end.

4634. STEAM BOILER FURNACES, *A. G. Fenn, London.—29th September*, 1882.—(*Not proceeded with.*) 2*d*.
This relates to an automatic rocking movement of the bars of furnaces, and is specially applicable to those described in patent No. 1122, A.D. 1874. The bearing bar is suspended from one of the fire-bars by a lug and pin at the end farthest from the rocking bar. The near end of the bearing bar rests on a rack segment on the rocking shaft. A reciprocating bar is carried on supports at the foot of the boiler seating, and to it are connected the ends of the levers, which rock the shaft under the grate, such bar being actuated by an excentric on a countershaft driven by any suitable means.

4635. STOPPERS FOR BOTTLES, JARS, &c., *N. Thompson, Brooklyn, U.S.—29th September*, 1882. 6*d*.
The stopper is formed with a hollow cap lined with cork, and which passes over the neck of the bottle. In the cap are two or more spring catches, which take under a flange formed round the bottle or jar.

4636. BISMUTH BRONZE OR METALLIC ALLOY, *J. Webster, Warwick.—29th September*, 1882. 4*d*.
The object is to produce a metallic alloy suitable for use in sea water and other purposes. For use in sea water the alloy consists of 1 part bismuth and 16 parts tin, which are melted and well amalgamated; 69 parts copper, 21 parts spelter, and 9 parts nickel are then mixed with 1 part of the alloy of bismuth and tin, the whole being melted and amalgamated, and then run into moulds.

4637. STEERING GEAR, *E. J. Harland, G. W. Wolff, W. H. Wilson, and W. J. Pirrié, Queen's Island, Ireland.—29th September*, 1882. 8*d*.
This consists in applying springs to the arms, spokes, or other part of the steering tiller, yoke, or quadrant, so that there will be an elastic medium between the rudder head and steering chains, ropes, or rods, which will permit the latter to be always kept equally tight, and yet allow the rudder head to yield to severe shocks.

4638. STEAM GENERATORS AND FURNACES THEREFOR, *W. P. Thompson, Liverpool.—29th September*, 1882.—(*A communication from MM. Monsanto, B. Odio, and F. Perozo, New York.*) 8*d*.
Above the grate surface and furnace proper a supply of air is introduced in a sub-divided condition through slots, so as to effect a perfect combustion of the gases. The heating surface is formed of a nest of concentric coils forming a series of frustra of cones, or pyramids resting on a plate above the grates. They are covered above by a baffle plate, and are set within a conical shell forming a large chamber for the combustion of the fuel.

4639. UMBRELLAS AND PARASOLS, *W. Pickin, Birmingham.—29th September*, 1882.—(*Not proceeded with.*) 2*d*.
This consists in forming transparent parts in the covers of umbrellas and parasols.

4640. APPARATUS FOR PLAYING A GAME OF CHANCE AND SKILL, *J. H. Johnson, London.—29th September*, 1882.—(*A communication from H. Rovel, Paris.*) (*Not proceeded with.*) 2*d*.
A fort or receptacle is elevated in the centre of a platform and balls are thrown into it by suitable discharging apparatus arranged at the sides.

4642. PARALLEL RULERS, *C. R. Baillie-Hamilton, Kent.—29th September*, 1882.—(*Not proceeded with.*) 2*d*.
The object is to convert the lateral motion of parallel rulers into a vertical motion so as to allow lines of equal length to be drawn without shifting the ruler; and, Secondly, to impart greater steadiness and certainty to the action of the ruler.

4643. CONVERTING RECIPROCATING AND ROTARY MOTION, *W. R. Lake, London.—29th September*, 1882.—(*A communication from J. J. Larroque, Paris.*)—(*Not proceeded with.*) 4*d*.
This consists essentially in a piston-rod terminated by a guide frame in which a roller is free to move, and serves as a crank pin, a slot being formed in a frame to receive at the end of the outward and inward strokes of the piston the shaft to which rotary motion is to be imparted.

4644. PURIFICATION OF COAL GAS AND OBTAINING AMMONIA THEREFROM, *C. F. Claus, London.—29th September*, 1882. 8*d*.
This relates to improvements on patent No. 2838, A.D. 1881, and consists in using a number of Woolf's bottles or towers so that the larger quantity of purified gas liquor circulating through them will do away with the necessity for external cooling for the purpose of condensing the vapours from the still. The still is in the form of a coke tower, into the bottom of which superheated steam is passed while the liquor enters at top. The ammonia in a gaseous form is caused to pass through large drying condensing chambers before being admitted to coal gas. Other improvements are described.

4645. ELECTRIC METERS, *S. D. Mott, New York, and Pimlico.—29th September*, 1882. 6*d*.
This relates to a device whereby an index pointer is made to indicate on a graduated scale the quantity of electricity passing through a conductor. According to one arrangement the pointer is moved by the extension or contraction of a metallic spiral having considerable electrical resistance, such as platinum or iridio platinum. The passage of a current increases the temperature of the spiral. A spring is provided to cause it to return to zero when the current ceases to pass.

4646. ELECTRIC METERS, *S. D. Mott, New York.—29th September*, 1882. 10*d*.
This relates to apparatus for measuring the quantity of electricity passing through any conductor. According to one arrangement the inventor employs an escapement, a pendulum, and escape wheel in connection with a train of registering wheelwork. The bob of this pendulum is caused to vary its position in the rod, according to the current passing—that is, when a large current is passing it will be raised, and the pendulum will beat faster, when a small current is passing the opposite will take place.

4647. FASTENERS FOR SHIPS' SIDE LIGHTS, MANHOLE DOORS, &c., *R. C. Thompson, Sunderland.—29th September*, 1882. 6*d*.
A wedge-shaped bolt or cotter is inserted in a cleat rivetted to the hatch coamings when used for a hatch tarpaulin, and in the case of a manhole cover rivetted or bolted near the edge of the hole.

4648. CYLINDER GLASS STYLOGRAPHS, *H. L. Callendar, Essex.—30th September*, 1882.—(*Not proceeded with.*) 2*d*.
A glass tube is drawn to a capillary point, the end being broken off and smoothed and the opening reduced. Above the point a constriction is made so as to regulate the flow of ink from the point.

4650. MUSICAL INSTRUMENTS, *T. Machell, Glasgow.—30th September*, 1882. 6*d*.
The sound producers consist of bars of steel bent to the form of tuning forks, which are connected to the bridge of a sound box by a piece of spring steel. Hammers of lead covered with felt or rubber are caused to strike the forks when actuated from a keyboard, the action of which is arranged below the keys.

4652. APPLIANCES FOR SECURING WINDOWS AND DOORS, *T. Young and G. C. Wood, Sheffield.—30th September*, 1882.—(*Not proceeded with.*) 2*d*.
A two-armed catch or lever projects outwards from a bracket, and is arranged so as to be forced back while the window is being closed, but which moves out automatically and secures the window as soon as the window is closed. A modification is described for use in a horizontal position.

4653. APPARATUS FOR CHECKING OR INDICATING THE PERIODICAL ARRIVAL AND DEPARTURE OF EMPLOYES, *W. B. Llewellin, Bristol.—30th September*, 1882. 10*d*.
This relates to improvements on patent No. 2472, A.D. 1881, and it consists in providing the checking apparatus with a shoot to enable checks to be passed into the machine from another apartment. Further to inclining the bottom of the check box so as to cause the checks to roll towards the circumference, and hinging the bottom, so that the checks can pass into a lower compartment. Several other improvements are described including clockwork mechanism to actuate the moving parts of the checking apparatus at desired intervals.

4654. FOLDING KNIVES, SPOONS, AND FORKS, *L. Hager, Germany.—30th September*, 1882.—(*Not proceeded with.*) 2*d*.
The blade of the knife or the fork or spoon is pivotted to two half handles so that it may be enclosed by the latter.

4655. METALLIC STAIRCASES, *R. Hudson, Gildersome, Yorks.—30th September*, 1882. 6*d*.
This relates to the general construction of the staircases entirely of metal.

4656. APPARATUS FOR DIGGING, *F. Proctor, Stevenage, Herts.—30th September*, 1882.—(*Not proceeded with.*) 2*d*.
This relates to the general construction of digging apparatus in which the ground is turned over by forks, actuated through suitable levers connected with cranks on a shaft driven from the wheel axle by suitable gearing.

4657. BRAKES OR DRAGS FOR CARRIAGES, &c., *H. Downie, Corstorphine, N.B.—30th September*, 1882. 6*d*.
The brake blocks are formed with the usual rubbing and wearing surfaces attached to a thin metal plate, so fitted to the holder of the brake mechanism as to adjust itself readily to the carriage wheel, and is capable of being easily removed and replaced when worn out.

4658. PURIFICATION OF ALCOHOL, *A. J. Boult, London.—30th September*, 1882.—(*A communication from G. Fleury, France.*) 6*d*.
The spirit is combined under pressure with carbonic acid gas, and then led to a tank where the gas is liberated from the spirit, carrying with it the fusel oil.

4659. TREATMENT OF SEWAGE, *J. Young, Kelly, N.B.—30th September*, 1882. 8*d*.
This relates to improvements on patent No. 3562, A.D. 1882, and consists in expelling the ammonia and gaseous bodies from sewage by admitting thereinto steam, or steam and air, whilst a partial vacuum is maintained in the apparatus. Special apparatus is described for carrying on the process.

4660. OPERATING UPON THE ATMOSPHERE OF APARTMENTS IN WHICH ARTIFICIAL SHEET ICE IS USED, *W. W. Nightingale, Southport.—30th September*, 1882. 4*d*.
In apartments in which sheet ice obtained by artificial means is provided for skating and other purposes a mistiness or fog is produced, in order to avoid which a fan is caused to draw air from the lower part of such apartments, and after being passed through a suitable refrigerator, is reintroduced at the top of the apartments.

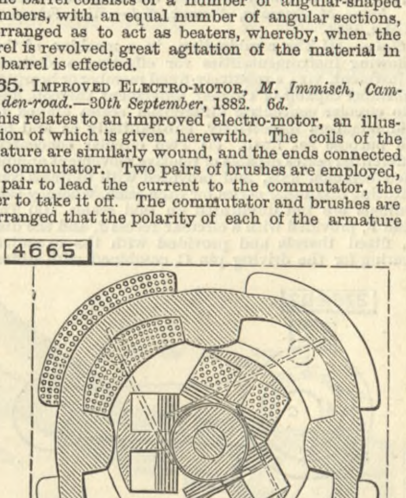
4661. APPARATUS FOR REGISTERING THE SUPPLY OF ELECTRICITY, *J. H. Greenhill, Belfast.—30th September*, 1882.—(*Not proceeded with.*) 2*d*.
This relates to a meter composed of a cylinder having paper wound round it, which is rotated by clockwork. A pencil is attached to the armature of an electro-magnet in the circuit and marks the paper.

4663. OBTAINING MOTIVE POWER, *J. A. Stephan, Worcester.—30th September*, 1882.—(*Not proceeded with.*) 2*d*.
Hydrochloric acid and tin are placed in a vessel and the gas and vapour generated is conducted to a condenser containing the same acid, and in the upper part of which hydrogen collects and a part of same is used to heat the first vessel, while the remainder is used to drive a suitable motor.

4664. CHURNS, *J. Llewellin, Haverfordwest.—30th September*, 1882.—(*Not proceeded with.*) 2*d*.
The barrel consists of a number of angular-shaped chambers, with an equal number of angular sections, so arranged as to act as beaters, whereby, when the barrel is revolved, great agitation of the material in the barrel is effected.

4665. IMPROVED ELECTRO-MOTOR, *M. Immisch, Camden-road.—30th September*, 1882. 6*d*.
This relates to an improved electro-motor, an illustration of which is given herewith. The coils of the armature are similarly wound, and the ends connected to a commutator. Two pairs of brushes are employed, one pair to lead the current to the commutator, the other to take it off. The commutator and brushes are so arranged that the polarity of each of the armature

4665



magnets is changed four times in one revolution. Each also receives four times in one revolution a double amount of current, just when the magnets are in such a position of the magnetic field that this double current is most conducive to procure rotary motion.

4667. LOCKS FOR PORTMANTEAUS, &c., *J. Jackson, jun., and C. Sheekey, Westminster.—30th September*, 1882. 6*d*.
The object is to provide additional locking apparatus in connection with the extending bar described in patent No. 4682, A.D. 1881. The bar has a central slot, and one at each end, and any number of intermediate slots. The opposite side of the mouth of the bag has as many hasps as there are slots, and which catch behind the bar held up by springs, so that when depressed the hasps are released. A lock is provided for securing the bag closed.

4668. VELOCIPEDES, *S. Miller, Kennington-road.—30th September*, 1882. 6*d*.
The objects are to arrange and construct the gear so as to protect it from dust and the effects of the weather, and to better adapt the machine for hill climbing. As applied to tricycles, a hollow axle extends between the driving wheels, and has a hollow sphere in the centre containing bevel wheels on the driving axle, gearing with corresponding wheels on a shaft enclosed in a tube, having a sphere at bottom, in which is another bevel wheel at bottom gearing with a pinion on the crank axle passing through the sphere. When driven one way speed gear is brought into operation, and when driven the other way power gear is operated.

4669. STEAM GENERATORS, *W. Clark, London.—30th September*, 1882.—(*A communication from M. Hervier, Paris.*) 8*d*.
The boiler shell is generally disposed vertically, and is of cylindrical or other form and sufficiently large to enable a person to enter it. From this shell radiate a number of water tubes arranged in rows, the tubes in one row being opposite the spaces between the tubes in the rows above and below it. These tubes are subjected to heat from a furnace, being enclosed in a case through which the flames pass.

4670. COMPOSITION FOR IMPARTING A LUSTROUS APPEARANCE TO BOOTS, SHOES, HARNESS, &c., *E. and A. Wright, Surrey.—2nd October*, 1882. 2*d*.
A compound of Carnauba wax, white cerisin, palm or olive oil, soap, and vegetable black is made by subjecting the substances to heat. The compound is dissolved in turpentine or other solvent, and a sufficient quantity of beeswax added to form a paste, which is then ready for use.

4671. PHOTOGRAPHY, *C. P. Evans, Birmingham.—2nd October*, 1882.—(*Not proceeded with.*) 2*d*.
This consists in photographing an object or person direct on to a bust or image prepared with a white surface, by placing such bust or image within the camera instead of the negative plate, the bust or image having been previously prepared to receive the photograph.

4676. INCANDESCENT ELECTRIC LAMPS, *J. F. Phillips, Chancery-lane.—2nd October*, 1882.—(*A communication from C. H. F. Müller, Hamburg.*) 6*d*.
This relates chiefly to the manufacture of carbon filaments. To radiate the light to the best advantage the inventor constructs his carbons so as to form two cylindrical or conical spirals, crossing one another. His filaments are made of fine strips of sugar cane, which are placed in a receptacle; this is then exhausted of air, and a solution of hydrate of carbon in water filled into it. The fibre is then shaped and carbonised, and then impregnated with a solution of cellulose in the same manner as above described.

4678. REGENERATING SULPHUR FROM ALKALI WASTE, *W. Weldon, Burstow.—2nd October*, 1882. 2*d*.
This consists in the method of obtaining from alkali waste sulphur in the state of sulphuretted hydrogen, by combining the treatment of the alkali waste by water under pressure with the decomposition of the resulting solution of calcium sulphydrate by either hydrochloric acid or carbonic acid.

4683. AXLES FOR VEHICLES, *W. Clark, London.—2nd October*, 1882.—(*A communication from J. H. Huyler, Tenafly, U.S.*) 6*d*.
The object is to increase the durability of vehicle axles and facilitate their repair. The axle is constructed with an adjustable bushing secured by a tubular nut, and having grooves and passages to receive oil, and an adjustable band provided with set screws, and an oil hole, whereby the bushing can be adjusted as each side becomes worn, and can readily be supplied with oil.

4684. CENTRIFUGAL MACHINES FOR SEPARATING CREAM FROM MILK, *A. Steenberg, Copenhagen.—2nd October*, 1882.—(*A communication from L. B. Nielsen, Denmark.*)—(*Not proceeded with.*) 2*d*.
This consists of a fixed vessel standing on a pedestal, and containing a rotating vessel mounted on a vertical spindle, and having a central opening, to which milk is supplied by a tube.

4686. EXPRESSING OIL FROM SEED, *W. Bushell and W. T. Haydon, Dover.—2nd October*, 1882. 6*d*.
The vessel in which the seed is compressed is made up of a series of bars or rings, so arranged that the inner corners touch while the outer corners are removed from each other, by which means a free passage for the oil is provided. On the side of the bars grooves or indentations are formed, extending from the points of junction of the bars partially or wholly across the bars. The bars are held together by rings at intervals, and the vessel secured to the frame of the hydraulic ram. The cover is arranged so that it can be readily removed by means of a counterweight.

4687. MECHANISM FOR THE TRANSMISSION AND REPRESSION OF POWER, &c., *W. P. Thompson, Liverpool.—2nd October*, 1882.—(*A communication from J. D. Wright, Worcester, U.S.*) 6*d*.
Upon a shaft a sleeve is mounted so as to turn freely, and is provided with an excentric, such sleeve being the hub or axial support of a wheel, gear, pulley or other device. A toothed wheel is mounted on the excentric, and is prevented turning therewith by its teeth gearing with teeth formed in a casing concentric with the shaft and fixed to the frame. A curved wedge is arranged between the toothed wheel and the casing, and can wedge between such parts when moved to the right or left.

4689. METAL PUNCHES, *A. J. Boult, London.—2nd October*, 1882.—(*A communication from E. A. Bailey, G. W. Constantine, T. W. Fowler, and F. W. Smith, Washington, U.S.*)—(*Not proceeded with.*) 2*d*.
The punch is provided with a base of less lateral diameter, but of the same longitudinal diameter as the body of the punch, and provided with concave cutting edges extending from the base upwards. Another punch is described having a flat central base of less lateral than longitudinal diameter with parallel edges, said base being provided with a centreing point and curved cutting edges extending upwardly from the base.

4690. SAFETY HOOKS FOR HARNESS TRACES, *H. H. Lake, London.—2nd October*, 1882.—(*A communication from W. H. Rawigh, St. Petersburg, Pennsylvania.*) 6*d*.
To the main part of the hook the latch or jaw portion is hinged so as to close the entrance, a coiled spring contained in a recess in the main part acting upon the jaw portion. A lug is cast on the jaw so as to facilitate opening the hook. The main part is formed with a perforated tongue adapted to pass between the plies of the trace, which is formed with openings in which are placed projections formed on a clamp plate, one projection being screw-tapped to receive a screw threaded stud upon another clamp plate.

4692. MANUFACTURE OF BI-CARBONATE OF SODA, *A. W. L. Reddie, London.—3rd October*, 1882.—(*A communication from B. T. Babbitt, New York.*) 6*d*.
This consists, First, in impelling soda ash against a hard body, so as to powder and scatter it, and in exposing it while so scattered to the action of carbonic acid gas; Secondly, in the use of a blast of carbonic acid gas for impelling the soda ash against the hard body; Thirdly, in the use of a steam blast for this purpose. It also relates to the apparatus to be used for carrying on the process.

4701. APPLIANCE TO THE FOOT TO ASSIST IN SWIMMING, *J. Imray, London.—3rd October*, 1882.—(*A communication from La Société P. Garcet et Nisius, Paris.*) 4*d*.
A rectangular board has fixed on its upper surface a sock to receive the foot, and to its lower surface are hinged two other boards, which, as the foot is moved to and fro in the water, are caused to turn on their hinges, so as to alternately open out and close again.

4705. MANUFACTURE OF VESSELS FOR DOMESTIC USE, *T. A. Brown, South Norwood Hill.—3rd October*, 1882. 6*d*.
This relates to vessels which are required to keep their contents warm, and it consists in making their walls double and filling in the space between them with "slag wool" or other bad conductor of heat.

4703. REFRIGERATORS, *P. Jensen, London.—3rd October*, 1882.—(*A communication from C. Klein, Germany.*) 6*d*.

The refrigerator consists mainly of a double walled box of zinc, with a space between the walls, through which water is caused to circulate.

4706. PAPER BAGS, *W. L. Wise, London.—3rd October*, 1882.—(*A communication from W. N. Stanley, New York.*) 6*d*.

This relates to folding apparatus to be applied to machines for making paper bags from continuous bands of paper, so as to make two or more additional lateral folds therein before it enters the machine, in such a manner as to obtain bags shaped like a pair of bellows with rectangular bottoms when opened. The apparatus consists of two plates connected to two supports by screws. On each plate a guide is screwed so as to form two grooves, in each of which is a counter plate held by a support.

4708. SPRING MOTORS, *W. P. Thompson, Liverpool.—3rd October*, 1882.—(*A communication from A. E. Rouif, Montreal.*)—(*Not proceeded with.*) 2*d*.

This consists of a coiled spring arranged in connection with a train of gears on parallel shafts, and serving to give rotary motion in either direction. The main feature is the means for reversing the action of the spring by causing either end to work while the other is held fast.

4720. SPINNING MACHINERY, *T. Coulthard, Preston.—4th October*, 1882. 6*d*.

This relates, First, to self-contained spindle apparatus of the "Rabbeth" type, and consists in making the lower end of the hook bent to one side, and then forward, so that by raising the lower portions bent forward towards the front of the frame, the hook is moved backward so as to clear the "whirl" or "warve;" Secondly, to an arrangement for supporting the porcelain thread guide in worsted spinning frames, by mounting it in a sheet metal holder secured to thread board by a screw working in a slot, so as to enable the guide to be adjusted; and Thirdly, to ring travellers with a projecting arm attached to the traveller, and consists in forming the traveller and arm of one piece of wire, arranged so that the arm may accommodate itself to the varying diameter of the cop or bobbin.

4729. TRICYCLES, BICYCLES, &c., *E. Brown, Birmingham.—4th October*, 1882. 8*d*.

This consists, First, in providing the cranked shafts of velocipedes with double cranks or two pairs of cranks of different lengths, so as to enable the driver to propel the vehicle at two different powers; and, Secondly, providing the seats of velocipedes with a back and shoulder rest.

4731. CONNECTING SPINDLES TO LOCKS AND LATCHES, &c., *J. Drewitt, Peckham.—4th October*, 1882. 6*d*.

One of the knobs is placed on the spindle, and when inserted in the lock, a split pin is passed through the spindle, and opened out so as to secure the knob thereon. The other knob may be secured on the other end of the spindle in the usual manner.

4781. WATCHES, *J. A. Knott, Balsall Heath.—7th October*, 1882. 6*d*.

This relates to watches with lever escapements, and consists in making the "banking studs" or "banking pins" by which the vibratory motion of the lever of the escapement is limited adjustable.

4832. TELEPHONES, *J. H. Johnson, Lincoln's-inn-fields—11th October*, 1882.—(*A communication from L. de Locht-Labye, Paris.*) 6*d*.

This relates to a telephone formed of a permanent or electro-magnet, provided at one or both of its poles with an induction coil of insulated wire; a rigid armature of steel or soft iron is allowed to oscillate freely in its centre, one end forming a hammer bearing against a rigid disc, and the other being attracted or repulsed by the coils which are in the telephone circuit. The attraction or repulsion of the one end of the armature causes the hammer to create vibrations in the disc.

5030. MANUFACTURING ANHYDROUS ALUMINA, *H. A. Bonneville, Paris.—23rd October*, 1882.—(*A communication from F. Gardair and T. Gladysz, Marseilles.*) 4*d*.

This consists in the manufacture of anhydrous alumina by preparing crystallised chlorhydrate of alumina, by means of chlorhydric acid; and Secondly, the successive regeneration of the two re-agents, viz., sulphuric acid to dissolve alumina from bauxite, and chlorhydric acid to precipitate it in the form of chlorhydrate or acid liquid.

5398. HYDRAULIC LIFTS, *J. S. Stevens, C. G. Major, and T. W. Barber, Surrey.—13th November*, 1882. 6*d*.

This relates to lifts in which the cage is attached to the top of a ram forced upwards by hydraulic pressure, and the objects are, first, to abolish the chains and weights used to counterbalance the ram and cage; and secondly, to use the weight of the ram and cage in descending to return a portion of the water used back to the source of supply. An intermediate loaded receiver balances the weight of the cage and ram, and this weight in descending works a hydraulic pumping engine.

5691. LOOMS FOR WEAVING, *P. J. Garin, Moroy, France.—29th November*, 1882.—(*Complete.*) 6*d*.

This consists, First, in forming the warp beam of a tube of drawn copper mounted upon axles of wrought or cast iron, and also securing the warp threads to the beam either by means of gummed paper, or of grooves formed in the drawing operation, or by apertures with blades fitting therein; Secondly, in forming the crank shaft of cast or wrought iron or cast steel, and equilibrating the cranks by weights cast or fixed on the shaft; Thirdly, in reducing the shock produced by the stoppage of the lathe by the use of elastic stops or buffers; Fourthly, in the brake apparatus for the purpose of arresting the motion of the loom in case of breakage of weft, storing the force of the inertia of the loom by a spring or cords and counterweights, and utilising it to bring the fly-wheel and other parts back to the position occupied when the breakage occurred; Fifthly, fixing the rotary or oscillating parts on their axles by split hubs; Sixthly, the combination of an oscillating tightening roller with a spring for maintaining constant the tension of the warp or chain threads.

13. CLEANING AND SEPARATING THE FIBRES OF TOW, OAKUM, &c., *F. C. Glaser, Berlin.—1st January*, 1883.—(*A communication from T. Calow and Co., Germany.*)—(*Complete.*) 4*d*.

A number of rows of tines or teeth are arranged beneath each other in an inclined plane and caused to oscillate, and act in combination with an oscillating screen, the tow being first acted upon by the oscillating teeth, so as to shake and free it from adhering bodies, and then falling on to the screen, which sifts off the fluff.

247. TREADLE MECHANISM FOR DRIVING SEWING MACHINES, &c., *A. M. Clark, London.—16th January*, 1883.—(*A communication from G. B. Ward, New York.*)—(*Complete.*) 4*d*.

This relates to the use of a rotating crank shaft driven directly by the feet instead of using treadles.

325. WOOD SCREW, *H. H. Lake, London.—19th January*, 1883.—(*A communication from the Harvey Screw Co., New York.*)—(*Complete.*) 6*d*.

This consists in a screw having the spiral rib forming the thread raised from the body of the blank, instead of being formed by cutting a spiral groove in the blank, such spiral rib being continued around the pointed part of the body and forming a gimlet-point.

364. MOVABLE TORPEDOES, *S. Pitt, Surrey.—23rd January*, 1883.—(*A communication from C. G. Francklyn, Rome.*)—(*Complete.*) 8*d*.

The object is to provide a system of moving and firing torpedoes, so that they may be moved under water by machinery on shore connected by cables with the torpedoes, over which complete control will thus be kept, and they may be examined and taken up.

487. SEWING MACHINES, *R. H. Brandon, Paris.—29th January*, 1883.—(*A communication from The Morley Sewing Machine Company, Boston, U.S.*)—(*Complete.*) 8*d*.

This relates to "needle-feed" machines, the object being to adapt them to heavy fabric lap and butt seam work, the needle-feed motions being positive in both directions, and easily adjustable to vary lengths of stitches. The machine has a needle bar frame hung upon trunnions in the frame; two needle bars, each with a cam slot therein, and each carrying a needle located on said oscillating frame at angles to each other; a driving shaft hung in the oscillating frame, having two cranks engaging with the cam slots in the needle bars; a take-up pivotted to the frame and having an arm extending over the driving shaft, a cam on which strikes the arm of the take-up, suitable means being provided for rotating the driving shaft and oscillating the frame.

535. ELECTRIC MOTORS AND DYNAMO-ELECTRIC MACHINES, *S. Pitt, Sutton.—31st January*, 1883.—(*A communication from F. B. Croker, C. G. Curtis, and S. S. Wheeler, New York.*) 6*d*.

This relates to the regulation of dynamos, which the inventors accomplish by so winding the field-magnets and armatures that their internal resistance may be varied at pleasure. Both field-magnets and armature are wound with one, two, or more independent wires, the ends of which are connected to a circuit-controlling switch, by means of which any of them can be connected in multiple arc and placed in circuit with the current supplying conductors. Other modes of connecting to different kinds of switches are also described.

621. FINING OR CLEANSING MALT LIQUORS, &c., *R. Dean, Fulham Palace-road.—5th February*, 1883.—(*Complete.*) 4*d*.

This consists of a funnel to be inserted in the bung-hole of casks for pouring in the "finings" and "topping," and which is combined with a tray or receptacle for the "workings" or liquor which works out after the finings have been introduced.

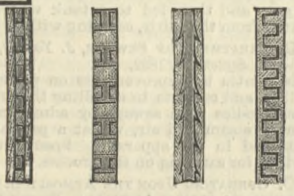
SELECTED AMERICAN PATENTS.

From the United States' Patent Office Official Gazette.

275,986. SECONDARY BATTERY, *Charles F. Brush, Cleveland, Ohio.—Filed May 27th*, 1882.

Claim.—(1) A secondary battery element having its active or absorbing substance or material made of particles of metallic lead having their surfaces oxidised

275.986



and united together into a firm and strongly-coherent body or mass substantially as set forth. (2) A secondary battery element consisting of particles of metallic lead having their surfaces oxidised and united together into a firm and strongly-coherent body or mass, substantially as set forth.

276,154. DEVICE FOR PACKING GLASS GAUGE TUBES, *Wm. H. Bray, Boston, Mass.—Filed December 18th*, 1882.

Claim.—A water gauge for steam boilers, consisting of a cock or cocks B, provided with a threaded nipple J, a shouldered exteriorly-threaded screw plug L, an elastic gasket interposed between said plug and nipple,

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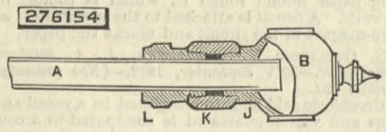

a sleeve K, interiorly threaded at both ends, into which said plug and nipple enter, and a straight glass tube A, which passes through said plug, gasket, and nipple into the bulb of the cock, substantially as described.

276,292. DIFFERENTIAL INDEX FOR MACHINE TOOLS, *James M. Seymour, Newark, N.J.—Filed February 1st*, 1882.

Claim.—(1) The combination, in a machine, of the following instrumentalities for effecting a delicate adjustment, viz., a relatively-fixed member or bearing, a member capable of circular movement thereon, and two circular concentric differential scales affixed to said members respectively, substantially as and for the purpose set forth. (2) Two circular concentric differential scales capable of relative movement around their common axis, and provided with ordinals constituting dissimilar series for each scale, whereby said ordinals are not duplicated on said scales. (3) The head F, provided with a circular recess *d*, and the disc A, fitted therein and provided with the excentric bearing for the driving pin C, combined with differ-

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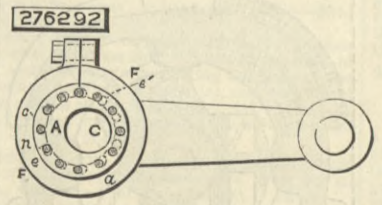

ential pin holes $e\ e^1$, located entirely within the edges of said head and disc respectively. (4) The head F, provided with the circular recess *d*, and the disc A, fitted therein and provided with the excentric bearing for the driving pin C, combined with differential pin holes $e\ e^1$, located entirely within the edges of said head and disc respectively, combined with the differential scale-marks *n o*, whereby the position of said pin holes are exactly indicated, as set forth. (5) The method of recording the coinciding ordinals of the differential scales which indicate the adjustment proper for any certain set of dies, which consists in marking said ordinals directly upon said dies, substantially as set forth.

276,323. CUTTER HEAD, *Robert H. Ainsworth, Montgomery.—Filed August 5th*, 1882.

Claim.—A cutter head for raising panels, consisting

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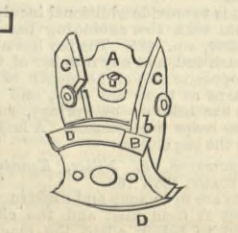

of the surfacing head A, surmounted by the moulding head B, surfacing cutters C C, and detached paneling cutters D D, the latter being held in place against the flanges *b* by the clamp E, substantially as herein described.

276,379. STEAM PACKING DEVICE, *William Fidler, Topeka, Kans.—Filed January 22nd*, 1883.

Claim.—(1) A stuffing box consisting of an outer and inner cylinder, the outer cylinder formed with perforations for the admittance of steam or fluid, the two cylinders forming an annular space at their free ends, through which steam passing impinges against the piston-rod, substantially as and for the purpose set forth. (2) A stuffing box having an outer hollow case formed with a flanged top, having a rim or collar extending from its under face, said rim having a shoulder on its lower edge and a cone-shaped perforated section extending therefrom, said section terminating in an inwardly-curved edge, substantially as and for

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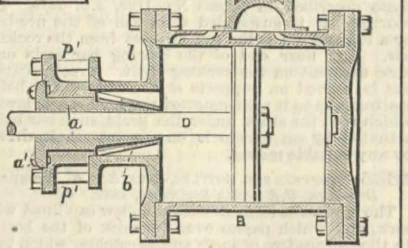

the purpose set forth. (3) A stuffing box having an outer case and an inner cylinder, the outer case formed with a flanged top and under collar, a perforated cone-shaped extending section having its end inwardly curved, the inner cylinder formed with a top projecting flange adapted to rest on the flange of the outer casing, said cylinder extending nearly to the inner face of the curved end of the outer case, sub-substantially as and for the purpose set forth. (4) The combination of the perforated cone-shaped section *b*, formed as described, and having collar *a* and flanged top a^1, the inner cylinder b^1, formed as described, with the steam cylinder B, front head *l*, rods or bolts p^1, and piston-rod D, substantially as shown and specified.

276,384. METALLURGICAL PLANT, *Robert Forsyth, Chicago, Ill.—Filed February 10th*, 1883.

Brief.—The casting pit is separate from the converter pit. The two pits are connected by a permanent track, so that the ladle on its truck can be transferred from the crane in the converter pit to the crane in the casting pit. Every part of the casting pit is commanded by cranes for removing the ingots. The transfer track may be mounted on a turntable. May use a hydrauic lift, and the ingot moulds may be mounted on a turntable. *Claim.*—( ) In a metallurgical plant, the combination, with the receiving and casting cranes or their equivalents, of an intermediate track, substantially as described. (2) In a metallurgical

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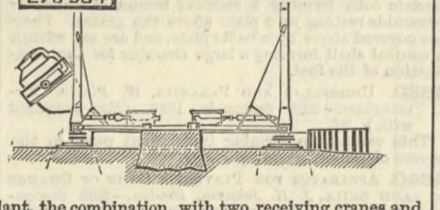

plant, the combination, with two receiving cranes and a casting crane or their equivalents, of two intermediate transfer tracks, substantially as described. (3) In a metallurgical plant, the combination, with the receiving and casting cranes, of an intermediate transfer track and means, substantially as described, for sustaining the ends of the crane jibs, substantially as set forth. (4) In a metallurgical plant, the combination, with the receiving and casting cranes or their equivalents, of an intermediate transfer track and means, substantially as described, for guiding the ends of the crane jibs into alignment with the track, substantially as set forth.

276,420. VARIABLE COUPLING JOINT FOR SHAFTING, *William Johnston, Philadelphia, Pa.—Filed September 26th*, 1882.

Claim.—(1) In a variable coupling joint for shafting a pair of heads on the respective shafts, a pair of blocks oscillating in said heads, a link having its ends arranged to turn in recesses of said blocks, and a pair of oscillating pins attached respectively to said blocks and passing through the ends of said link, substantially as set forth. (2) In a variable coupling joint for shafting, a pair of heads on the respective shafts, con-

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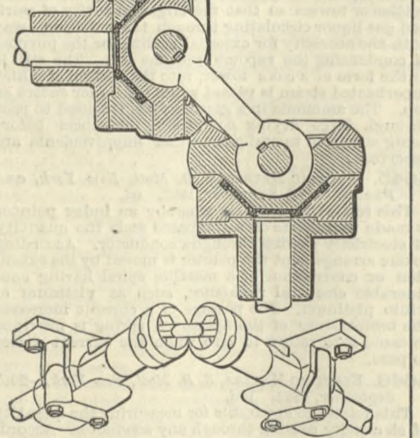

sisting of sections and a pair of blocks oscillating in said heads, a rigid link having its ends arranged to turn in recesses of said blocks, and a pair of oscillating pins attached to said blocks and passing through the ends of said link, substantially as set forth. (3) In a variable coupling joint for shafting, the heads having bevelled faces which are in contact, and operate after the manner of frictional gearing, substantially as and for the purpose set forth.

276,528. CUT-OFF VALVE, *Chas. H. Edson, Canisteo, N.Y.—Filed September 6th*, 1882.

Claim.—(1) In a cut-off valve, the outer valve having

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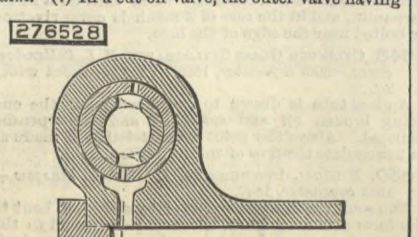

ports diametrically opposite each other, in combination with an inner valve having corresponding ports of increased area of openings, substantially as and for the purpose described. (2) In a cut-off valve, the combination of a casing having a single port, the outer valve having ports diametrically opposite, and the inner valve having corresponding ports of increased area of opening, substantially as and for the purpose described.

276,695. PUMP BUCKET, *Jas. La Tourette, St. Louis, Mo.—Filed October 25th*, 1882.

Claim.—(1) In a pump bucket, the combination of the packing A, the rings B and C, respectively having as an integral part the flanges *b* and *c*, the rod D, the straps E E^1, screw threaded on their lower ends e^1, and

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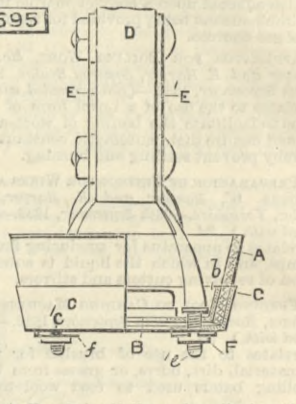

locked by nuts F, substantially as described. (2) In a pump bucket, the rings C *c*, of a single piece, and having projections c^1, the rod straps E E^1, screw threaded on their ends e^1, and shouldered nuts F *f*, substantially as described.

276,747. GAS ENGINE, *Cyrus W. Baldwin, Chicago, Ill.—Filed October 20th*, 1882.

Claim.—(1) The combination, in a gas engine, of appliances for arresting the motion with the parts always in the same position, and hand devices for forcing a charge of gases into the main cylinder and there exploding it without any movement of the main engine, substantially as set forth. (2) The combination of the arresting devices constructed to always stop the engine with a charge in the compression

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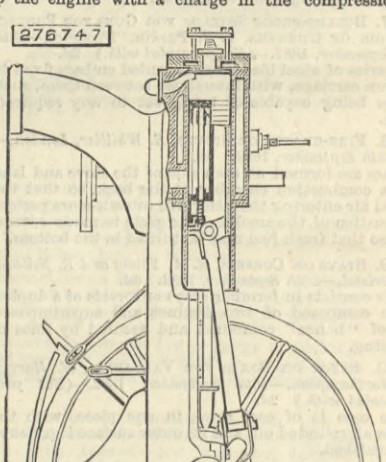

cylinder, and appliances for expelling said charge into and exploding it in the main cylinder without first operating the main piston, substantially as set forth. (3) The combination of the main cylinder and piston, having an igniting opening and constant flame, or its equivalent, and the charging cylinder, and appliances whereby the engine is automatically arrested with a charge in the charging cylinder, and with the main piston at the rear of the igniting opening, substantially as set forth.

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