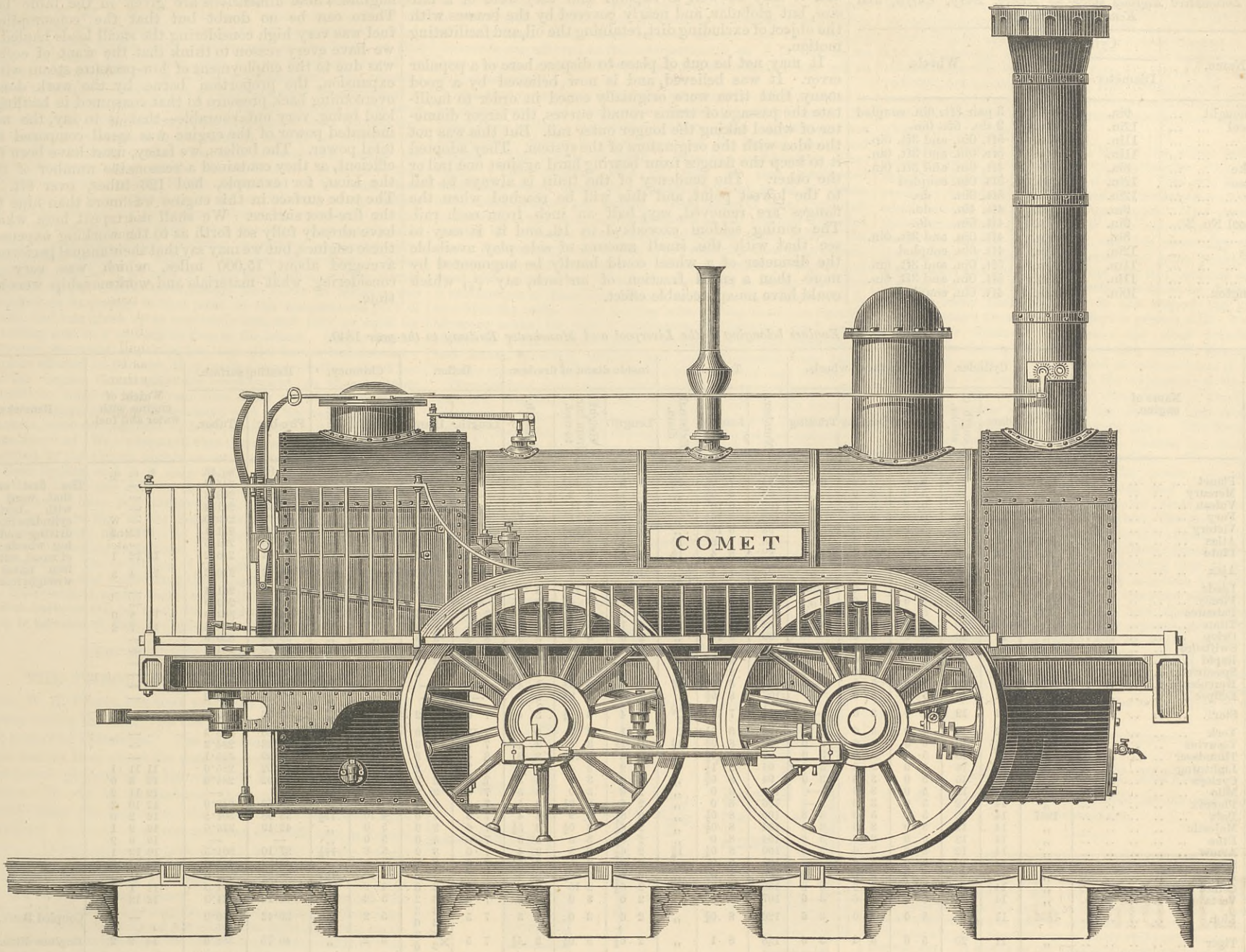
PASSENGER ENGINE, NEWCASTLE AND CARLISLE RAILWAY, 1835.

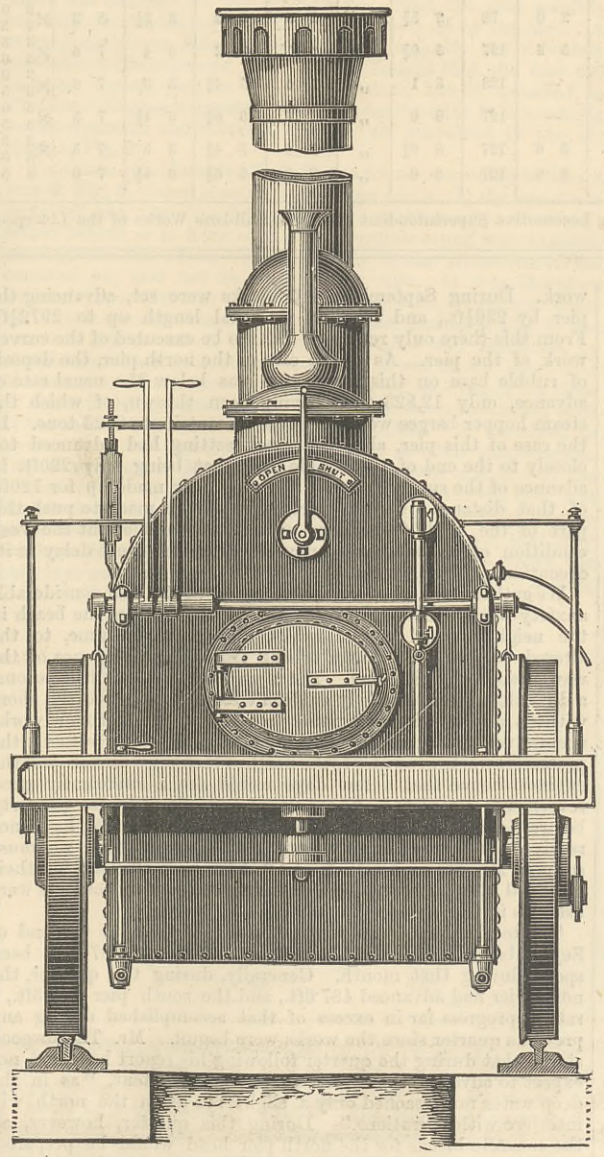


LINKS IN THE HISTORY OF THE LOCOMOTIVE.

No. X.

After the Liverpool and Manchester Railway had been opened for a little time, it was found that engines of the Rocket type were not competent to deal with the considerable traffic. The anticipation of the directors was that the line would be employed mainly for the conveyance of goods, and especially cotton, to Manchester; and from Manchester to Liverpool, and the carriage of passengers was regarded as quite a secondary matter. But these anticipations were rapidly dispelled. The passenger traffic augmented with great rapidity, while the goods traffic came comparatively slowly. The carriage of goods by rail was expensive, and much dispatch was not wanted; but that a Manchester merchant should be able to run over to Liverpool in two hours, transact a good deal of business there, and get back to his own city in time for an early dinner, was a new thing well worth paying for. The railway brought two great centres of commerce within a couple of hours of each other, and it was appreciated and patronised. The Rocket and its fellows were quickly displaced, and engines of another type took their place. The progenitor of these locomotives was the Planet, the first engine made with horizontal cylinders set in the bottom of the smoke-box, and fitted with crossheads and guides closely resembling these now in use. The engine had a crank axle, and a single pair of driving wheels. The valve gear was similar to that of the Rocket in the first instance, but it is possible that it was subsequently fitted with gab gear.

It is somewhat singular that these new locomotives have never attracted much attention or been regarded with much interest, and yet they were in all respects as superior to the Rocket as that engine was to the old "Puffing Billy." It has been said that the Rocket contained all the principal features of the modern locomotive. This is not quite true, but the engines with which we are now dealing did. The Planet may be taken as the true progenitor of the modern locomotive. It had horizontal inside cylinders built into the base of the smoke-box. It had two side frames; of wood it is true, but they were the first true frames used. The horn plates were of the modern type bolted on to them. The Rocket's frames resembled the modern American bar frame more than the plate frame; but the great point of difference between the Planet and the Rocket was in the boilers. If our readers will turn to the views of the Rocket published in our impression for September 17th, 1880, they will see that in it the fire-box is an excrescence tacked on, so to speak, to a plain cylindrical boiler traversed by tubes. But in the Planet this was not the case. The Planet and its fellows had boilers into which the fire-box was put, as in modern locomotive boilers, instead of being bolted against the end. In this way a host of advantages were gained. It is doubtful if the Rocket type of boiler could ever have been made to comply with modern requirements. The water had all to be led into it by two small pipes at the bottom, while



the steam was taken off by other pipes at the top. It would have been impossible to keep up proper circulation in a large box in this way. We do not hesitate to say that, whoever designed the boiler of the Planet—and on this point history is unfortunately silent—accomplished a great work. It is by no means certain that Robert Stephenson invented the Planet—for its design was the result of pure invention, or the highest class of what is known in the drawing-office as "scheming"—and it is nearly certain that George Stephenson did not. We should gladly see the name of this man, whoever he was, rescued from oblivion. Of course it may be that the Stephensons really did the work. If so, however, the fact has never been stated, save in very vague and general terms; and it is extremely probable that, at the time the Planet came into existence, the Stephensons had a regular drawing-office, and on the head of this office most of the work of carrying the general ideas of George and Robert Stephenson into practice would devolve. Who was the head of the office? Perhaps some of our readers can supply the information needed.

Through the courtesy of Mr. Harrison Aydon, we are enabled to publish herewith information which has never been published before. At the end of this article will be found a table, originally prepared many years ago by Mr. Forsythe for Mr. Fyfe, giving particulars and dimensions of nearly all the engines in use on the Liverpool and Manchester Railway in the year 1840. It will be seen that the numbers up to nine and number ten are missing, as well as a few others. Number one was, we believe, the Rocket, and this engine with its companions had been withdrawn from active service some time before 1840. The dates of the construction of all the engines named are given in the table. Some of the engines had boilers oval in section. Thus, for example, the Lion had a boiler 3ft. 3in. × 3ft. 6in.; as the pressures were small, say 50 lb. only, there was no difficulty in making the boilers strong enough.

To cast additional light on the construction of the engines which immediately succeeded the Rocket, we illustrate herewith an engine called the Comet, built by Messrs. R. and W. Hawthorn, of Newcastle-on-Tyne, in 1835. Our engraving is copied from an old copper-plate engraving, for which we are indebted to Mr. Wilson, of Loughborough. This engine was very similar to Stephenson's Planet, except that it had four coupled wheels, while the Planet had but two driving wheels, and two leading wheels of smaller diameter. The Comet took one of the first trains which ran over the Newcastle and Carlisle Railway, on the 9th March, 1835. It continued running until the year 1860, when it it was re-purchased by Messrs. Hawthorn. The flanges were turned off the leading wheels, and the engine being set up on cast iron brackets, was employed to drive the shafting of a saw mill and pattern shop, and it did this work until about 1870, when the boiler, which was the original one, was deemed unsafe, and the engine was broken up. The engraving explains itself without description.

Among the earlier locomotives built were fourteen by Messrs. Bury, Curtis, and Kennedy, and of the following dimensions. Their type was something like that of the Comet,

with, however, the well-known Bury bar frame, and, we believe, the semicircular fire-box:—

Early Locomotive Engines made by Messrs. Bury, Curtis, and Kennedy, Liverpool.

Name.	Cylinder.		Wheels.
	Diameter.	Length of stroke.	
Dreadnought ...	9in.	24in.	3 pair 3ft. 6in. coupled
Liverpool	12in.	18in.	2 do. 6ft. 0in.
Liver	11in.	16in.	5ft. 0in. and 3ft. 0in.
Bee	11in.	16in.	5ft. 0in. and 3ft. 0in.
Roanoke	8in.	16in.	4ft. 6in. and 3ft. 0in.
Clarence	12in.	18in.	5ft. 0in. coupled
Collier	12in.	18in.	5ft. 6in. do.
Coma	9in.	16in.	4ft. 4in. do.
Liverpool No. 2 ...	9in.	16in.	4ft. 6in. do.
Creola	8in.	16in.	4ft. 6in. and 3ft. 0in.
Widnes	12in.	18in.	4ft. 6in. coupled
Bury	11in.	16in.	5ft. 0in. and 3ft. 6in.
Paris	11in.	16in.	5ft. 0in. and 3ft. 6in.
Washington... ...	10in.	16in.	4ft. 6in. coupled

In looking at our engraving, it will be seen that the crank pins in the coupling rods appear to be ridiculously small, and it may be well to explain that they were of a fair size, but globular, and nearly covered by the brasses with the object of excluding dirt, retaining the oil, and facilitating motion.

It may not be out of place to dispose here of a popular error. It was believed, and is now believed by a good many, that tires were originally coned in order to facilitate the passage of trains round curves, the larger diameter of wheel taking the longer outer rail. But this was not the idea with the originators of the system. They adopted it to keep the flanges from bearing hard against one rail or the other. The tendency of the train is always to fall to the lowest point, and this will be reached when the flanges are removed, say, half an inch from each rail. The coning seldom exceeds 1 in 16, and it is easy to see that with the small amount of side play available the diameter of a wheel could hardly be augmented by more than a small fraction of an inch, say $\frac{1}{10}$, which could have no appreciable effect.

In The Engineer for Oct. 15th, 1880, page 291, we dealt with the coke consumption and cost of repairs of the engines whose dimensions are given in the table below. There can be no doubt but that the consumption of fuel was very high considering the small loads hauled, but we have every reason to think that the want of economy was due to the employment of low-pressure steam without expansion, the proportion borne by the work done in overcoming back pressure to that consumed in hauling the load being very unfavourable—that is to say, the net or indicated power of the engine was small compared to its total power. The boilers, we fancy, must have been fairly efficient, as they contained a reasonable number of tubes, the Lion, for example, had 126 tubes, over 8ft. long. The tube surface in this engine was more than nine times the fire-box surface. We shall not repeat here what we have already fully set forth as to the working expenses of these engines, but we may say that their annual performance averaged about 15,000 miles, which was very good considering what materials and workmanship were at the time.

Locomotive Engines belonging to the Liverpool and Manchester Railway to the year 1840.

Number of engine.	Name of engine.	Date when made.	Cylinder.		Diameter of wheels.			Tubes.			Inside diam. of fire-box.			Boiler.		Chimney.		Heating surface.		Weight of engine with water and fuel.	Remarks.
			Diam.	Length of stroke.	Driving	Leading	Trailing	Number.	Length.	External diam.	Length	Height from bar to roof.	Breadth.	Length.	Diam.	Length.	Diameter.	Fire-box.	Tubes.		
No.		Year.	in.	in.	ft. in.	ft. in.	ft. in.	No.	ft. in.	in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	in.	sq. ft.	sq. ft.	t. c. q.	
9	Planet	1830	11	16	5 0	3 6	none	94	7 0½	1⅝	1 9	2 10¾	3 7½	—	—	—	—	34·87	248·2	—	The first engines that were made with horizontal cylinders had both driving and leading wheels made of wood, with cast iron naves and wrought iron tires.
11	Mercury	1830	11	18	5 0	3 6	,,	83	6 8½	,,	2 1½	3 2	3 5	—	—	—	—	39·86	208·8	—	
19	Vulcan	1831	11	16	5 0	3 6	,,	102	6 10	,,	1 8½	2 11	3 7½	6 4	3 0	5 5	12	34·70	261·4	—	
21	Fury	,,	11	16	5 0	3 6	,,	102	6 10½	,,	1 8¾	2 11	3 7½	6 4	3 0	5 8	,,	34·70	263·0	—	
22	Victory	,,	11	16	5 0	3 6	,,	98	6 10¼	,,	1 10⅝	2 10½	3 7	6 5	3 0	5 5	,,	35·34	251·1	9 12 3	
23	Atlas	1832	12	16	5 0	5 0	,,	68	7 8	1¾	2 8½	2 6½	3 5	7 2	3 2	5 0	—	37·69	234·5	—	
27	Pluto	,,	12	18	5 0	3 6	3 0	82	8 4	1⅝	2 4½	3 0	3 7	7 10	3 2	5 1	12	41·64	256·2	13 12 1	
29	Ajax	,,	11	18	5 0	3 6	,,	57 / 7	7 1	2 / 1⅝	1 11	3 3	3 5	6 8	3 2	—	—	38·96	210·3	11 4 3	
30	Leeds	,,	11	16	5 0	3 6	none	102	6 10	1⅝	1 8	2 10	3 7	6 4	3 0	5 6	12	33·12	261·4	—	
31	Firefly	1833	11	18	5 0	3 6	,,	89	7 9¼	,,	1 11½	3 4	3 6½	—	—	—	13½	40·82	260·0	—	
33	Patentee	1834	12	18	5 0	3 6	5 0	106	7 7½	,,	3 0	3 1	3 4	7 0	3 5	5 10	14	46·26	303·0	14 8 0	
34	Titan	,,	11	20	5 0	5 0	3 0	88	8 10½	1⅝	2 1	3 3	3 6	8 5	3 0	5 9	12	40·58	322·5	13 7 2	
35	Orion	,,	11	20	5 0	5 0	—	89	8 11	,,	2 0	3 4	3 5	8 5	3 0	,,	,,	39·94	326·9	—	
36	Swiftsure	1835	11	18	5 0	3 6	—	88	7 5	1⅝	2 0⅛	3 2½	3 5	7 0	3 0	5 6	12	39·50	244·7	—	
37	Rapid	,,	11	16	5 0	3 6	3 0	89	8 5½	,,	1 8½	3 2	3 6½	8 0	3 0	4 9	,,	36·70	281·6	—	
38	Speedwell	,,	12½	16	5 0	3 6	3 0	89	8 5	2	1 8½	3 1	3 5½	7 11	3 0	5 8	11½	34·57	355·7	—	
39	Hercules	1836	15	16	5 0	5 0	—	98	8 11½	1⅝	2 9	3 2¼	3 4	—	—	—	12	45·90	329·2	—	
40	Eclipse	,,	12	18	5 0	5 0	—	107	8 5¾	,,	1 10	3 2¼	3 5	—	—	—	,,	37·15	340·2	—	
41	Star	,,	14	12	5 0	3 6	—	71 / 21	7 11	1⅝ / 2	2 4	3 1¼	3 4	7 6	3 2	—	,,	40·06	289·7	—	
42	York	,,	12	18	5 0	5 0	3 0	78	8 5½	2	1 11	3 3	3 4½	7 11	3 0	4 10	11½	37·86	313·3	—	
43	Vesuvius	,,	12½	16	5 0	3 6	3 0	94	8 0¾	1⅝	2 1½	3 0	3 4	7 7½	3 3	5 8	12	37·33	284·2	—	
44	Thunderer	,,	15	16	5 0	5 0	3 0	97	8 11¼	,,	2 8	2 10¾	3 3	8 4½	3 3	5 10	14	40·39	325·1	—	
45	Lightning	,,	12½	16	5 0	3 6	3 0	94	8 1½	,,	2 2	3 4	3 5	7 7½	3 2	5 8	12	42·02	285·6	11 11 1	
46	Cyclops	,,	12½	16	5 0	3 6	3 0	94	8 0¾	,,	2 2	3 4	3 5	7 6	3 2	6 3	12½	42·02	284·6	12 8 0	
47	Milo	,,	14	12	5 0	3 6	—	100	8 0	,,	2 6	3 0	3 5	7 6	3 2	—	12	—	—	12 11 2	
48	Phœnix	,,	14	12	5 0	3 6	—	106	8 0	,,	2 6	3 2½	3 5	7 6	3 2	—	,,	43·60	318·0	12 10 2	
49	Dart	1837	14	12	5 0	3 6	3 6	100	8 0¼	,,	2 6½	2 9	3 4	7 6	3 0	4 10	11½	38·08	301·5	12 2 0	
50	Majestic	,,	14	12	5 0	3 6	3 6	104	8 0½	,,	2 6¼	3 0½	3 5¼	7 6	3 0	5 0	,,	42·19	313·6	12 9 1	
51	Etna	,,	14	12	5 0	3 6	3 6	104	8 0	,,	2 6½	3 0	3 5	7 6	3 0	5 0	,,	—	—	13 0 2	
52	Arrow	,,	14	12	5 0	3 6	—	107	8 0	,,	2 6¾	3 1	3 5½	7 6	3 0	—	,,	42·89	321·0	12 12 0	
53	Sun	,,	14	12	5 0	3 6	3 6	100	8 0¼	1⅝	2 6½	2 8	3 4	7 6	3 0	5 8	11½	37·10	301·5	10 13 1	
54	Meteor	,,	14	12	5 0	3 6	3 6	100	8 0¾	,,	2 6⅝	2 9½	3 4	7 6	3 0	4 10	12½	38·57	302·3	—	
55	Comet	,,	14	12	5 0	3 6	3 6	100	8 0½	,,	2 6½	2 10	3 4	7 6	3 0	4 9	,,	39·05	301·5	12 1 2	
56	Vesta	,,	14	12	5 0	3 6	3 6	107	8 0	,,	2 6	3 0	3 5	7 6	3 2	5 2	12	41·14	321·0	12 12 2	
57	Lion	1838	11	20	5 0	5 0	3 6	126	8 0¾	,,	2 6	3 0	3 3	7 5	×3 3 / 3 6	5 2	,,	39·42	380·9	—	Coupled Bank.
58	Tiger	,,	11	20	5 0	5 0	3 6	128	8 1	,,	2 6¼	3 0¼	3 4¼	7 5	×3 3 / 3 6	5 2	,,	40·75	388·0	14 9 2	Engines ditto.
59	Rokeby	,,	11	18	5 0	3 6	—	128	8 0	,,	2 6½	3 4⅜	3 5	7 6	3 3	5 0	,,	45·84	384·0	14 15 2	
60	Roderick	,,	11	18	5 0	3 6	3 6	128	8 0½	,,	2 6¼	3 3¾	3 5	7 6	3 3	4 9	,,	44·64	385·9	14 13 2	
61	Mammoth	1839	12	18	5 0	5 0	3 0	78	8 8¾	2	2 4	3 2½	3 4½	8 2	×3 3 0 / 5	5 6	13	41·03	323·4	13 19 0	Coupled Bank engines.
62	Leopard	,,	11½	18	5 0	3 6	3 6	127	8 1¼	1⅝	2 5½	3 2	3 4	7 6	×3 3 / 3 6	5 3	12	41·67	385·9	13 13 0	
63	Mastodon	,,	12	18	5 0	5 0	3 0	78	8 8¾	2	2 3	3 2	3 3½	8 2	×3 3 0 / 5	4 10	13	39·50	323·4	14 5 2	Ditto.
64	Panther	,,	11½	18	5 0	3 6	3 6	127	8 0¾	1⅝	2 5½	3 2	3 4	7 6	×3 3 / 3 6	5 2	12	41·67	384·0	14 4 0	
65	Elephant	,,	14	20	5 0	5 0	—	128	8 1	,,	2 6	3 4¾	3 3	7 6	×3 3 0 / 5	5 0	13	—	388·0	—	Ditto.
66	Samson	,,	11	20	5 0	5 0	—	127	8 0	,,	2 6	3 6¾	3 4½	7 5	×3 3 0 / 5	4 10	,,	47·10	381·10	15 3 2	Ditto.
67	Buffalo	,,	14	20	5 0	5 0	3 6	127	8 0¾	,,	2 6	3 4⅜	3 3	7 5	×3 3 / 3 6	5 2	12	—	384·0	—	Ditto.
68	Goliah	,,	11	20	5 0	5 0	3 6	127	8 0	,,	2 6	3 6¾	3 4½	7 6	3 5	5 0	,,	47·10	381·10	15 3 0	Ditto.

This Table was compiled for Mr. Fyfe, Locomotive Superintendent at the Ordsall-lane Works of the Liverpool and Manchester Railway, Manchester.

MADRAS AND COLOMBO HARBOUR WORKS.

Mr. Thorowgood, the superintendent of the works now in progress at Madras, has submitted his latest report of proceedings, and states that during the month of September last the length of deep sea pier finished exceeded by 90 lineal feet that completed during the previous month of August, during which month 447ft. had been constructed, so that the work of September was no less than 537ft., making a total for the two months of 984ft. The weather during both months had been exceedingly favourable for the operations, and every advantage was taken of it. On the superstructure of the north pier, during September, 360 blocks were set, advancing this section by a length of 210¾ lineal feet, and making its total length 3512½ft. From this point, only 163ft. remained to bring the work to the commencement of the proposed head, and it was anticipated that this could hardly be got through at the same rate of speed as had been attained during August and September, as that speed had severely taxed the supply of blocks sufficiently hardened for use, and great care was exercised that none of these should be employed in the work until they had had sufficient time to harden thoroughly. The total number of blocks set in this northern pier during the two months under review was 680. The deposit of rubble stone for the base of this pier during the same period did not proceed with the same great rapidity as had been attained on the superstructure. This was greatly due to the failing supply of laterite in one of the quarries, that of Ambatur, and partly to the laying up of the two tug steamers, Hobart and Salisbury, for much-needed repairs. There had been 12,445 tons of stone deposited on the base during September, of which quantity the steam hopper barges were only available for the deposit of 3935 tons. The block work had been run out rather close to the end of the rubble bank, which, at the end of September, extended 215ft. in advance of the superstructure; but of this length only about half had been fully made up in readiness for block setting upon it The necessity referred to above of slackening this latter work, owing to the diminished supply of blocks in readiness, would, Mr. Thorowgood reported, give an opportunity for completing the base as far as the pier head, and, at the same time, would restore the proper amount of advance of base over blockwork.

On the south pier the rate of progress had been much greater than the resident engineer had anticipated; far greater, he thought, than had ever before been reached in any deep sea work. During September, 416 blocks were set, advancing the pier by 236¼ft., and bringing its total length up to 2972¼ft. From this there only remained 51ft. to be executed of the curved work of the pier. As in the case of the north pier, the deposit of rubble base on this south pier was below the usual rate of advance, only 12,823 tons having been thrown, of which the steam hopper barges were only able to contribute 2923 tons. In the case of this pier, also, the block setting had advanced too closely to the end of the rubble base, that being only 220ft. in advance of the superstructure, and only fully made up for 120ft. of that distance. Every exertion would be made to push this part of the work forward as rapidly as possible, but the weak condition of the steamers unavoidably caused great delay in its execution.

We gather, from what Mr. Thorowgood wrote, that considerable anxiety was still felt as to the effect of the sea on the beach in the neighbourhood of the works, owing, we presume, to the altered condition of things arising from the divergence of the waves caused by the piers. The report stated that it had become a difficult matter to supply sufficient stone to protect the shore without seriously impeding the progress of the harbour works themselves. A larger force of labour was at once to be put on to the protective works necessary to the north of the Police tannah, and the engineer hoped that a few days would see a sufficiently good revetment completed, "to prevent any damage to property before the wind changes to the north-east." As we have not received intelligence of any damage having occurred, we must suppose Mr. Thorowgood's works to have been efficient for their intended purpose. During September 900 tons of boulders were used up in these protective works.

The total expenditure incurred on the harbour to the end of September had been £452,304 10s., of which £15,397 had been spent during that month. Generally, during the quarter, the north pier had advanced 487·6ft., and the south pier 572·3ft., a rate of progress far in excess of that accomplished during any previous quarter since the works were begun. Mr. Thorowgood stated that during the quarter following his report he could not expect to advance the works to any great extent, "as in the deep water now reached only a slight sea from the north will interfere with operations." During this quarter, however, all the concrete blocks for the north pier head would be prepared, and this would enable that pier to be complete by the 31st March, 1881. Some fears are expressed in the report as to danger to be apprehended by over pumping at the southern end of the intercepting beach drain, and the Government had communicated its intention of calling the attention of the Municipal Commissioners to this matter. Everything in connection with this work appears to be going on satisfactorily, and the Madras Government had expressed itself greatly pleased with the progress made.

The north-east monsoon, which will, as pointed out in Mr. Thorowgood's report, retard the progress of the Madras works during the present quarter, is that favourable for the prosecution of the sister works at Colombo, on the opposite coast of Ceylon. In our last notice of these works we referred to the deficient information published as to them, and we are therefore unable to offer our readers the same details in regard to them that have been at our disposal in the case of Madras. We regret to hear that Mr. Kayle, the resident engineer at Colombo, Harbour, had been temporarily incapacitated from the effects of sunstroke, and that he had been obliged to leave Colombo for the hills to ensure recovery from them. In his absence, however, block making was proceeding both day and night, relief gangs of workmen being employed upon them, and, as the latest accounts received from the colony state the north-east monsoon to have fairly set in, we may shortly expect to hear of rapid progress. The final decision as to the ultimate design of these works has been still further delayed by discussion of Sir John Coode's plans for them, and the colonists appear—unwisely, as we think—to give preference to proposals made by the local surveyor-general, and to seting aside those submitted by an engineer so practised in this branch of the profession as is Sir John Coode. A sub-committee of the Legislative Council appointed to consider this subject, and more especially in its financial aspect, have reported that the expenditure must, looking to prospective returns, be limited to £800,000, and it is feared that Sir J. Coode's designs cannot be carried out in their entirety within that limit. Doubtless this consideration has mainly caused the desire to seek alternative plans from another and less experienced quarter. It may be very properly necessary for the colonists to "cut their coat according to their cloth," but we fear from all we have heard that such a resolution may lead to the fulfilment of a second adage, the "spoiling of the ship for the ha'porth of tar." In view of the large interests involved in securing the most complete harbourage at Colombo, this would be greatly to be deprecated. At the recent meeting of the Peninsula and

Oriental Steam Navigation Company, its chairman stated the intention of the directors to shift their present coaling station and port of call at Galle to Colombo, when the works at the latter place are sufficiently advanced to afford protection to their steamers, and such a large development of the trade of that port may then be expected, that a wise prevision should be exercised to provide for its utmost requirements. The colonists seem to be quite decided that all attempts shall be abandoned to fit their harbour, when completed, for the docking of the large vessels of the Imperial Navy, and have stated their opinion that if such accommodation is required, it should be provided for from the Imperial funds. To such a resolution, under the financial circumstances of the colony, it is not possible to take exception ; but certainly, if the views held at the time these works were first conceived are to be carried out, every facility should be afforded for the largest ships of the mercantile marine.

In one section of this work there has been very considerable delay, viz., in that of the dredging operations required to give the desired depth of water within the breakwater. Some eighteen months or so back, a large steam dredger, the Merak, sent out by the Dutch Government for works at Batavia, was wrecked on its passage to that place in the tempestuous port of Galle, and was given up as hopelessly lost, and sold as such for a trifling sum to a mercantile firm in the island. Its purchasers, however, succeeded in raising her, and after having had necessary repairs effected at Bombay, they made a remunerative sale of her to the Ceylon Government for employment on the dredging operations referred to. From some cause or other with which we are unacquainted, that necessary part of her gear, the ladder buckets, were not supplied with her, and these had to be ordered from England. We understand that these, when completed, were rejected by the Crown agents on account of defective steelwork in their lipping, and it is only by a mail or two back that we heard of their safe delivery in Ceylon. Messrs. Green and Co., of Blackwall, have just dispatched a paddle steamer built by them for the service of the hopper barge train, and when this arrives out there should be no further delay in the commencement of deepening operations.

Comparing the condition of matters at the ports of Madras and Colombo, and considering the financial difficulty attaching to the latter-named works, there seems little doubt but that the Indian harbour will be ready for the reception of vessels some time in advance of that in Ceylon.

THE THEORY OF THE PHOTOPHONE.

MR. W. H. PREECE last week presented a paper to the Royal Society having the title, "On the Conversion of Radiant Energy into Sonorous Vibrations." The experiments described in this paper had for their object the determination of the cause of the photophonic phenomena as discovered by Professor Bell and Mr. Tainter. It will be remembered that at first Professor Bell ascribed these phenomena to the effect of intermittent light vibrations. It was not long before several scientific men in France expressed doubt as to the part played by light in the results obtained, and Professor Tyndall in England made several experiments in the presence of Professor Bell, which seemed to point to heat as the acting agency. Professor Bell described the phenomena obtained, treating the cause as a matter for investigation. Mr. Preece determined once for all to investigate the cause, and he claims to have settled the question, and to show that radiant heat and not light is to be credited with causation. In the paper presented to the Royal Society he pointed out that Prof. Bell and Mr. Tainter have partially answered the question by showing that the disturbances are not necessarily due to light, for they found that sheets of hard rubber or ebonite do not entirely cut off the sounds but allow certain rays to pass and the effect to be obtained. M. Mercadin has shown that the effects are confined to the red and ultra-red rays of the spectrum. Prof. Tyndall has shown that the sound effects are a function of all gases and vapours absorbing radiant heat, and that the intensity of the sounds is a measure of this absorption. The first series of experiments by Mr. Preece was to show that ebonite is diathermanous. The following is the result, and the numbers indicate the relative diathermancy of the substances used to the source of light used :—

Experiments in Diathermancy.

Material.	Standard candle.	Lime light.
Air	100	100
Ebonite No. 1	60	91
,, 2	24·3	79·3
,, 3	24·3	79·3
,, 4	24·3	68·2
,, 5	24·3	68·2
,, 6	0·	9·
India-rubber (native)	44·3	61·4
,, ,, (prepared)	60·	54·
,, ,, (vulcanised)	0·	0·
,, ,, (and ozokerit)	0·	0·
&c.		

Ebonite, however, proved to be very variable, some pieces being diathermanous, while others were athermanous. This being so, shows, however, that luminosity cannot be the cause sought for, which is thermic rather than luminous. The questions raised are—is this thermic action expansion and contraction of the mass due to the absorption of heat, or is it a disturbance of molecular pressure, or is the effect due to some other cause? Experiments were made to test whether the sonorous effects of hard discs could not be explained by the change of volume due to the impact of the heat rays. The experiments, however, were pretty conclusive against the theory.

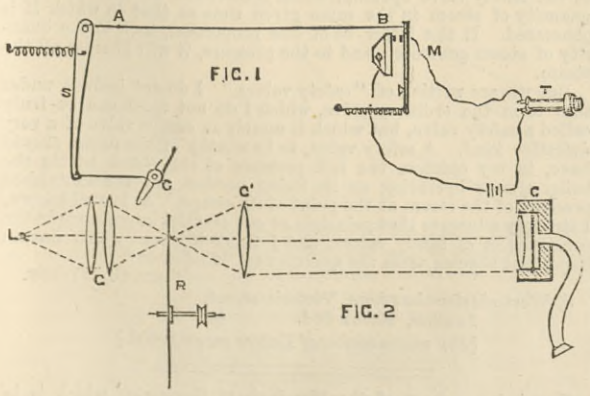
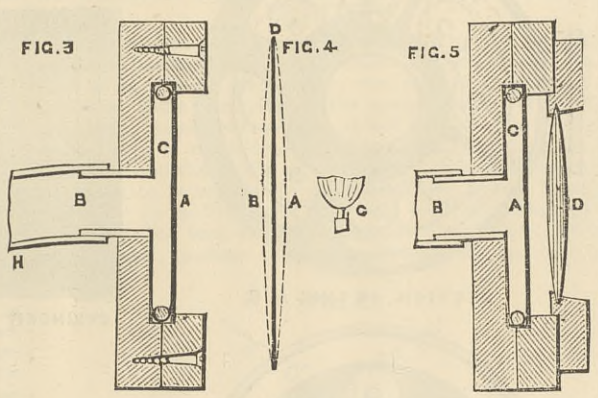


FIG. 2

A B is a thin strip or wire 6 centimetres long, of the substance to be examined, fixed to a platinum "make and break" M, and adjusted to a lever S, round whose axis is fastened a silk thread, the end of which is attached to the strip or wire as A, and whose position could be adjusted by a screw C. Any variations due to expansion and contraction of the wire would produce intermission in the electric currents passing through the telephone T, which if periodically produced would result in sonorous vibrations in the telephone. Heat from various sources and from various distances was allowed to fall intermittently on A B, but, as we have said, the results showed that the investigation was not so soon determined.

The next question to settle was whether the effect was due to a disturbance of molecular pressure, which may for short be called radiometer action. An apparatus was constructed similar to that described by Messrs. Bell and Tainter. The source of light L was an oxyhydrogen lime-light. The rotating disc R was of zinc perforated with holes, which could be noiselessly rotated, so as to obtain 1000 intermittances per second. Glass lenses G were employed to focus the light upon the perforations of the rotating disc, and another G^1 to render the rays parallel on the other side of the disc. A mahogany case or cup C to retain the discs to be experimented upon was constructed as shown in section in Fig. 3, and fixed 400 centimetres from the source L; *a* being the disc 5 centimetres in diameter, clamped on by screws, a brass tube *b*, to which the india-rubber hearing tube (*h*) was fixed; *c* a circular air space behind the disc, 6 centimetres in diameter, and 3 millimetres to 5 millimetres deep. Cavities of various dimensions and forms, spherical, conical, and trumpet-shaped, were tried, but the ones described were those which gave the best effects.

Experiments were made with various discs of ebonite, zinc, mica, &c., blackened, clean and bright, but the results were inconclusive. The effects produced by the zinc disc, though very weak, favoured the theory; those given by the mica disc completely refuted it; while those given by the ebonite discs were almost of a neutral character. If D be the disc—Fig. 4—and C the source of light, then if the excursions of the discs to and fro were due to expansion from the absorption of heat, it would first bulge towards A, since the side towards the source of light would expand first. If, on the other hand, it were due to the radiometer effect, it would first bulge towards B. An extremely delicate electrical contact arrangement was constructed to determine this by means of a telephone, which recorded the excursions to and fro of the disc ; but the result was sometimes in one direction and sometimes in the other. Moreover, the effect was slow, and no more than five distinct vibrations per second were obtained. This result raised the question whether in Bell and Tainter's experiments the discs vibrated at all.



A delicate microphone was fixed in various ways on the case Fig. 3. Although the sounds emitted in the hearing tube were as intense as indicated in experiment 1, scarcely any perceptible effect was detected on the microphone. Had the disc sensibly vibrated, its vibrations must have been taken up by the case. A microphone never fails to take up and magnify the minutest mechanical disturbances. It was thus evident that the disc did not play a prime part in this phenomenon, but it appeared, as Professor Hughes suggested, that the result might be due wholly to an expansion and contraction of the air contained in the air space *c*, Fig. 3.

To obtain considerable effects it was found necessary to have a lens *d*, Fig. 5, placed close in front of the disc *a*. If the lens *d* was removed, and the disc left supported without any air cavity, either behind or in front of it, no perceptible sound was obtained, proving that the effects were really due to the vibrations of the confined air, and not to those of the disc. It was, therefore determined to dispense with the disc altogether, which was done, and better results obtained. A clean case, similar to Fig. 5, was found to give no effect, but when its interior was blackened by camphor smoke it gave strong sounds. It was thus evident that the sonorous effects were materially assisted by coating the sides of the containing vessel with a highly absorbent substance, such as the carbon deposited by burning camphor. It remained to be seen how far the lens played a part in this phenomenon. Experiments show that the sonorous vibrations are due to the motions of the contained air and are independent of the disc, and that their production is materially assisted by lining the surface of the containing space with an absorbent substance, that they are dependent on the heat rays, and are not obtained where the heat rays are stopped by an athermanous diaphragm. A long

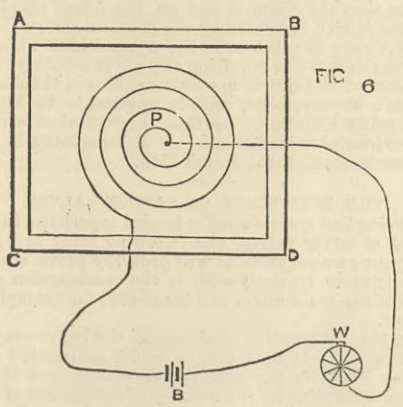


FIG 6

series of experiments fully described by Mr. Preece in his paper shows that transparent bodies behave in an opposite way to opaque bodies. Glass and mica can be rendered athermanous and silent by a thick coat of carbon. Zinc, copper, and ebonite produce sonorous effects by a proper disposition of carbon. The effect in the latter case might be due to a radiometer effect, though feeble in intensity, or to conduction through the mass of the diaphragm. Tests were made to determine this, the results establishing the inference that the effect is one of conduction.

Since these sonorous effects are due to the expansion of absorbent gases under the influence of heat, and since wires are heated by the transference of electric currents through them, it seemed possible that if we enclosed a spiral of fine platinum wire P(Fig. 6) in a dark cavity *a b c d*, well blacked on the inside, and sent through it, by means of the wheel brake W, rapid intermittent currents of electricity from the battery B, heat would be radiated, the air would expand, and sounds would result. This was done, and the sounds produced were excellent—in fact, with four bichromate cells, sounds more intense than any previously observed were obtained.

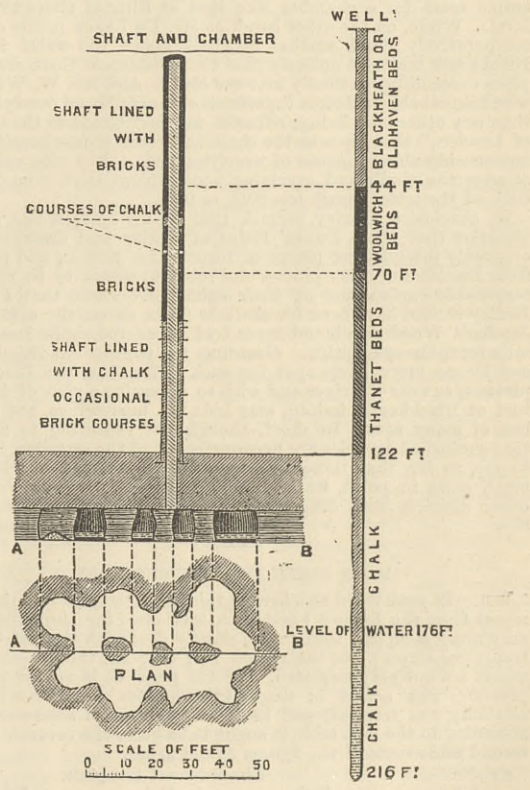
Furthermore, it was evident that if the wheel brake W were replaced by a good microphone transmitter articulate speech should be heard in the case of *a b c d*. This was done, and an excellent telephone receiver was the consequence, by means of which speech was perfectly reproduced. The explanation of these remarkable phenomena is now abundantly clear. It is purely an effect of radiant heat, and it is essentially one due to the changes of volume in vapours and gases produced by the degradation and absorption of this heat in a confined space. The discs in Bell and Tainter's experiments must be diathermanous, and the better their character in this respect the greater the effect ; remove them and the effect is greater still. Messrs. Bell and Tainter obtained their *timbre* and pitch notwithstanding variation in the substance of the disc, and M. Mercadier found that a split or cracked plate acted as well as when it was whole. These facts are consistent with the expansion of the contained air, but not with any mechanical disturbance of the discs. Moreover, M. Mercadier showed that the effect was improved by lamp-black, but he applied it in the wrong place. The discs may, and, perhaps, do under certain conditions, vibrate, but this vibration is feeble and quite a secondary action. The sides of the containing vessel must possess the power to reduce the incident rays to thermometric heat, and impart it to the vapour they confine, and the more their power in this respect, as when blackened by carbon, the greater the effect. The back of the disc may alone act in this respect. Cigars, chips of wood, smoke, or any absorbent surfaces placed inside a closed transparent vessel will, by first absorbing and then radiating heat rays to the confined gas, emit sonorous vibrations. The heat is dissipated in the energy of sonorous vibrations. In all cases, time enters as an element, and the maximum effect depends on the diathermancy of the exposed side of the cavity, on its dimensions and surfaces, and on the absorbent character of the contained gas. The remarkable property which deposited carbon possesses of reducing radiant energy to thermometric heat is strikingly shown by these experiments, and it suggests an important field for inquiry for those who are working in the region of radiant heat.

LETTERS TO THE EDITOR.

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

THE BLACKHEATH SUBSIDENCES.

SIR,—I had hoped that one result of the articles in THE ENGINEER of February 4th, and *Nature* of February 17th, would have been to place the Subsidence Committee in the possession of funds sufficient for the work of exploration. Money, however, comes in but slowly, and there is consequently still room for speculation on the subject. It seems to me that while various hypotheses involving the agency of water, have received their due share of attention, to say the least, man, as a maker of peculiar holes, has met with less than he is justly entitled to. This is the more evident when we consider what he has done in old times in the immediate



neighbourhood of Blackheath, about Bexley, Chiselhurst, Eltham, and other places, and in "Jack Cade's Cave" at Blackheath itself. Having heard that the "Danes' Holes" of Bexley and Crayford bore some resemblance to the Blackheath pits, I made inquiries of Mr. F. C. J. Spurrell, of Belvidere, an authority on the Danes' Holes, asking where they might best be seen in the neighbourhood of Bexley. He pointed out Joyden's Wood as a good place, and remarked that he thought the Blackheath pits belonged to the Danes' Hole class.

The pits of Joyden's Wood appear to abound most in that part of it called Caveys Spring. Besides a number of shallow excavations, resembling the bell-shaped pits so common in colliery districts about the outcrop of a coal, there are several vertical shafts which were too deep to be measured by my measuring tape of 66ft. These shafts were narrow, about 3ft. in diameter, and their sides perfectly vertical. They were all in the Thanet sand, which about Bexley is rather more than 50ft. thick—Whitaker, Geol. Lond. Basin. In a field on the east side of Caveys Spring were two pits, one partly filled up and of the same type as those already mentioned, the other of precisely the same character as the two deeper of the three Blackheath pits—see drawing in THE ENGINEER,

February 4th. The sides of the latter were vertical, except near the bottom where the pit widened considerably, and its depth varied from 20ft. to 25ft., there being a mound of sand in the centre. Its diameter was about 25ft., or considerably more than that of any of the Blackheath pits. This pit and the narrower one close by are both marked on the Ordnance 6in. map. They are between the words "Caveys Spring" and the old lodge. Two gentlemen living at Bexley, Mr. Wheeler and Mr. F. Wheeler, informed me that at the bottom of each of the narrow shafts was a chamber in the chalk formed on the same plan as that shown in the section of the Eltham Park pit; a bed of flint forming the roof, and pillars of chalk being left here and there as supports. They had been down several.

The remarkable discovery at Eltham Park three years ago, in February, 1878, discloses the existence of a pit, originally, in all probability, a Danes' Hole, within three miles of Blackheath. This Eltham pit is now covered in, but full particulars were obtained from a paper on it by Mr. W. M. Hindes Petrie,* and a plan and sections—from which those here given have been reduced—both kindly lent by Mr. Jackson. As Mr. Petrie's paper is not illustrated by any plan or section, those given will be found interesting. Referring those desirous of full details to Mr. Petrie's paper, I will here mention only the more important points in connection with the pit. It was discovered by a workman who was sent along a disused drain to find out the course taken by a quantity of water that had escaped through a leakage. He eventually found himself close to the top of a deep shaft, which was covered over by an arch of brickwork. This brick arch was broken up and the shaft and chamber below were explored. It was found that the chamber had been used as a cesspool, probably for a century or more, the solid stuff being represented by a deposit of about 6in. of clayey matter, and the more liquid part of the sewage having percolated through the chalk. The chamber was about 30ft. by 50ft. and 9ft. high, the extreme dimensions being somewhat greater. The shaft was lined in its upper part with brick and its lower with courses of chalk, as shown in the section, the lowest 20ft. being unlined. Mr. Petrie notices that five courses of chalk occur in the midst of the brickwork about 47ft. below the surface, and remarks that the chalk for these courses was no doubt procured from the chalk in the shaft 70ft. below, which must have been unlined at the time from these chalk courses downwards. This circumstance shows that possibly the shaft may have existed for centuries in an unlined state before being modified as it now is. The diameter of the shaft at present is from 49in. to 50in., or somewhat greater than is usual among the unlined shafts of Bexley. As the chamber below is of precisely the same character as those of the Danes' Holes eastward, and as the lining of the shaft may be, as we have seen, a modern addition, the only point in which this pit—in all probability—originally differed from those of Bexley is in its greater depth. The pits of Caveys Spring are about 70ft. deep, while this is 140ft.; they are through Thanet sand alone to the chalk, while this pit is through the Woolwich and Blackheath beds in addition. We have seen that the Thanet sand stands well in an unlined shaft. The beds above it, however, vary so much from place to place, as regards their likelihood of standing well in such a position, that it is impossible to predict their behaviour. The Blackheath pebble beds, for instance, may form a hard conglomerate or a comparatively loose gravel.

I inquired of a farmer at Bexley if holes ever appeared there suddenly as they had done at Blackheath. He replied that once while ploughing in a field he traversed a spot which, on his return, disclosed a large hole. Such a hole might appear suddenly either from the breaking in of an insufficiently filled up or covered shaft, or from old burrowings too near the surface for stability.

On comparing the geological section at Eltham Park with that probably existing at Blackheath, the only difference is found to lie in the greater thickness of the beds above the chalk at the former place. Chalk may reasonably be expected at Blackheath at a depth of from 80ft. to 90ft. instead of 115ft. In spite of its great depth the Eltham chamber is seen to be well above the water level in the chalk, which is there about 64ft. above Ordnance datum. At Blackheath Mr. De Rance states—*Nature*, February 17th—that the water level in the chalk is about Ordnance datum. The height of the surface of Blackheath at the holes is from 130ft. to 135ft., so that, supposing the chalk to be 90ft. below, there would be ample room for a chamber like that at Eltham above the water level. While, on the other hand, as Mr. De Rance points out, the comparatively small amount of chalk above the water level at Blackheath makes it unlikely that the subsidences there are due to pipes descending vertically into the chalk. And Mr. W. Whitaker, who has probably had more experience of the chalk and overlying beds than any other man living, remarks, in his "Guide to the Geology of London," that pipes in the chalk are never seen where there is any considerable thickness of overlying beds. But pits exhibiting at once the chalk and overlying beds seldom show even 50ft. or 60ft. of the latter, much less 80ft. or 90ft.

In conclusion, I may remark that in my opinion the popular tradition that these Danes' Holes of Bexley and elsewhere were originally intended as places of security for persons and property from Danish and other pirates and robbers, seems to be the most reasonable explanation of their existence. Those that I saw at Bexley cannot have been for chalk or flints, as on the east side of Joyden's Wood is a broad spread of uncovered chalk less than a mile from Caveys Spring. Granting the popular tradition, there can be no more likely spot for such holes than the Blackheath plateau, so near the river and with so extensive a view of it. The turf of Blackheath, indeed, may hide the burrowings, not of one, but of many ages. In short, though not venturing to conclude that geological agencies are necessarily out of the question, it seems to me, so far, that these Danes' Holes of the neighbourhood are really cases in point, while geological explanations derived from other districts with different strata and physical conditions are not.

T. V. Holmes.

MILD STEEL FOR SHIPBUILDING.

Sir,—In your third number of this year you give an interesting report from the *Bureau Veritas* on mild steel for shipbuilding. I very much complain that you so shortly deal with the resistance to transverse stress; but the reason is, I suppose, that these experiments are not yet completed. (*a*) On page 42 it is said that the pressure was added in single kilogrammes until the limit of elasticity was reached, and in two kilogrammes afterwards; but according to the first table it ought to be quite the reverse. In the second table some of the figures do not agree.

(*b*) No.	Dimensions of test-piece.		
356	25·4	11·8	299·72

(*c*) No.	Sect. Area. Square m.m.	Limit of elasticity. Total strain. Kilos.	Strain per sq. in. Tons.
358	228·41	7223	17·1
361	313·95	7530	18·3
364	302·26	6044	18·3
366	326·8	6891	17·1

I shall be much obliged, Sir, if you will give these figures correctly. (*d*) Your expression about the impact of 447 kilogrammetres is not clear and easy to understand, as the dimensions of the two samples are not alike. What information on this subject you might give will probably be interesting for many of your readers. Bm.

Newcastle-on-Tyne.

[In reply to "Bm.'s" letter we have to observe:—(*a*) As a rule the pressure was added in single kilogrammes until the sample took a permanent set; but it so happened that in one or two instances this practice was reversed, and this was the case with the sample referred to in the first table. (*b*) The sectional area of sample No. 356 is correct; but in the breadth a "9" has been copied by mistake for a "4." The following figures are correct:—

$$25{\cdot}4 \times 11{\cdot}8 \text{ mm.} = 299{\cdot}72 \text{ square mm.}$$

(*c*) These figures are practically correct, though in the column of strain in tons per square inch 18·3 is a nearer equivalent for the kilogrammes per square metre than 18·4. "Bm." will see that it is a mere accident that samples of different sectional area and standing a different total strain should work out to exactly the same strain per unit of sectional area; or, rather, I should say it is a proof of great uniformity in production. (*d*) The decimal point has been inadvertently omitted in the impact, which should be 4·47 kilogrammetres—or more strictly 4·464 km.; but the dimensions of the two samples have nothing to do with the question, as it is their breaking strain per unit of sectional area that is compared. According to Mallet's rule for ascertaining the dynamic resistance to rupture by multiplying the breaking weight into half the ultimate elongation, in No. 356

$$\frac{48 \text{ kilogs.} \times 0{\cdot}18 \text{ metre}}{2} = 4{\cdot}464 \text{ kilogrammetres,}$$

and in No. 353

$$\frac{43 \text{ kilogs.} \times 0{\cdot}24 \text{ metre}}{2} = 5{\cdot}16 \text{ kilogrammetres;}$$

consequently the latter is the tougher sample of the two. The directors are continuing their experiments and investigations.—Ed. E.]

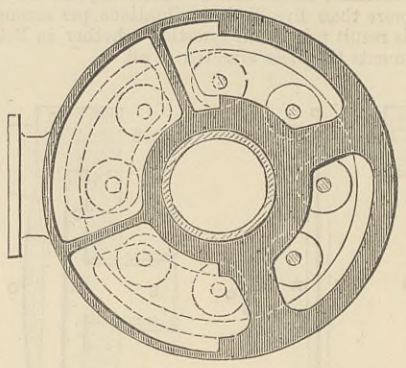
* Proc. Roy. Archæol. Inst., March, 1878.

A NEW CONDENSER.

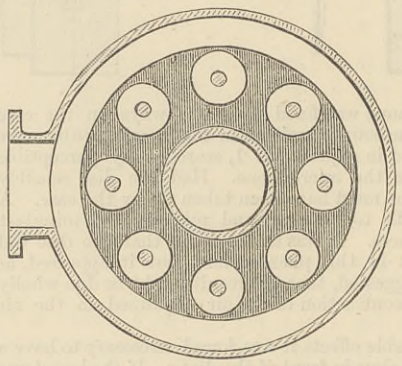
Sir,—The proposal for a new form of condenser, published in your impression of the 11th inst., by which the impact of the exhaust steam clears the condenser is not new; the form, as indicated in the illustration, would not work in practice, although the system itself has recently been carried successfully into effect.

Three years ago a patent for this system of condenser was taken out by Mr. James Wimshurst, principal surveyor of iron ships to the Board of Trade; and as I have just concluded a series of experiments upon it, in conjunction with Messrs. Tangye Bros., of Birmingham, I have no doubt some of your readers will find an interesting description of the apparatus and the results.

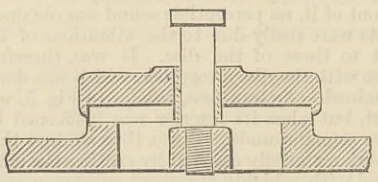
The tracing herewith shows the condenser in section, as attached to a Tangye engine. It will be observed that the exhaust steam is led in at the top of the condenser, that it almost immediately encounters the injection water, which is fed through a non-return valve A, and that, passing downwards, it is led through a bell-mouth-shaped termination of the condenser proper to a box fitted with non-return valves opening vertically upwards, BBBBBBBB; C is the overflow pipe.



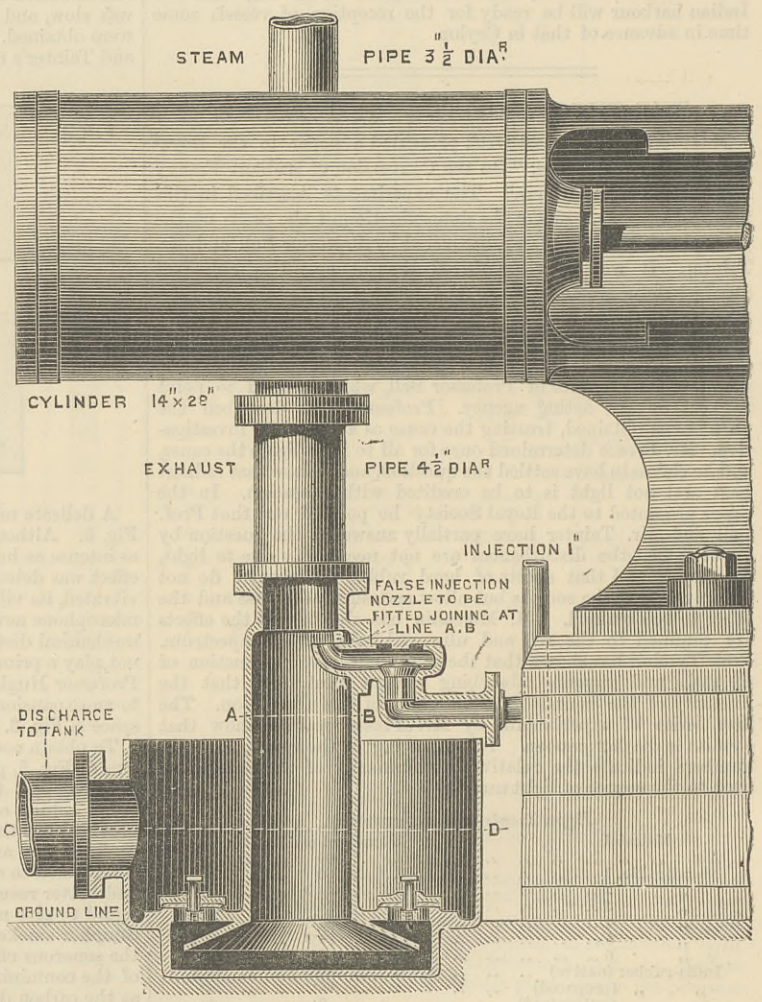
SECTION ON LINE A. B.



SECTION ON LINE C. D.



SECTION OF VALVE



The results most recently obtained were as follows:—The condenser was attached to a 12in. Tangye horizontal engine, and after correcting the small but important details in the temporary arrangements made for trial, the vacuum was found to vary from zero to 25in., with 128 revolutions of the engine. Upon the exhaust being led to the atmosphere instead of the condenser, the revolutions of the engine, with the same constant load, were found to decrease to 100, showing that the vacuum had an important effect upon the power, as was indeed indicated by the pressure gauge.

It is unnecessary to point out that a condenser which will produce such results without requiring any air pump duty, and at the small first cost of the simple apparatus shown in the diagram, is a very valuable improvement, and is applicable to high-pressure engines in many situations, provided always that an abundant supply of cold water is available. J. Fortescue Flannery.

9, Fenchurch-street, E.C., March 15th.

THE EFFICIENCY OF SAFETY VALVES.

Sir,—Having had a somewhat extended experience in the design and working of safety valves, the following reply to "Inquirer's" letter and your own suggestions will probably prove acceptable:—

The first point to be dealt with is the consumption of fuel per square foot of fire-grate under full fires—say, for example, 20 lb. of coal per hour.

Secondly, the evaporative efficiency of the boiler—say, 10 lb. of water per 1 lb. of coal; or 200 lb. of water evaporated into steam per hour; or 3·333 lb. per minute per square foot of fire-grate, which, being multiplied by the number of square feet of grate, will give the total weight of steam to be discharged per minute.

Thirdly, the necessary opening of safety valve to permit the discharge of this quantity of steam. The outflow of steam in pounds per square inch of safety valve opening, at all pressures, is practically three-fourths of the absolute pressure, and therefore it follows that the requisite opening for the discharge of any given constant weight of steam is very nearly in the inverse ratio of the absolute pressure. That is to say, while one square inch of opening would discharge 75 lb. of steam at 100 lb. absolute pressure, two square inches would be required to discharge the same weight of steam at 50 lb. absolute psessure.

Fourthly, it has been proved that the valve, if of the ordinary construction, should be of such a size that to blow off all the steam a boiler can make the necessary opening should be provided by the valve lifting from its seat not more than one-thirty-sixth of its diameter, so as not to allow of any undue accumulation of pressure when blowing off all the steam the boiler can make under full fires, with stop valves and other means of escape screwed down.

Fifthly, the question of loading, either by dead-weight or springs, is important. If a spring is used, it should be of such a length or number of coils that, when the valve is at its full lift, the additional load due to the spring by this lift should be as small as possible.

I have proved in practice that, when due attention is paid to the above points, the size of safety valve is readily fixed to produce the results required, and is in conformity with the German law. The British regulations are slightly different.

I have found a great saving of time, for future reference, to properly register all calculations, &c., of valves I have to deal with, and have accordingly published a book—size, folio foolscap—for office use, with all necessary instructions for the design of, and tables with blank columns for registering all calculations and particulars of, any safety valves, either according to the German or British law, including strength of springs, &c. This book will, I think, satisfy those who, like myself, are impressed with the responsibility incurred by all who have to do with this most important steam fitting. Thomas Messenger.

43, Strond-street, Dover.

Sir,—"Inquirer" asks an odd question in your issue of 25th ult. about the function of the safety valve on a boiler. It certainly should prevent the pressure rising above what is intended. It is well known it does not do this; witness on board vessels a man told off when the engines are stopped to screw valves up to make the necessary outlet for the surplus steam, or on land the pressure is just allowed to rise often 5 lb. to 10 lb. Should this be tolerated? I say no; there is no need for such a state of matters. Make the valves open themselves; and this can only be done by an automatic easing apparatus attached to each valve, or series of valves, that will act the part of the man with the screw I have referred to. Why a well-made valve does not open so as to prevent the pressure rising more or less has never been fairly explained; perhaps the steam passing between the valve and seat loses its sensible heat and force from the friction or some other cause. I have found from experience that an easing apparatus, acting apart but coming in contact with the lever of the common valve, will prevent the steam rising more than 7 lb., although the fires are forced to their utmost, the action being just a gradual opening and closing exactly at the blowing off point. There is no mystery about just a simple mechanical arrangement. X. X.

Glasgow Athenæum.

Sir,—In reference to the letter of "Inquirer," respecting safety valves, in your issue of the 25th ult., I beg to endorse your opinion, viz., that safety valves on a boiler ought to be able to keep the pressure down to safe limits under all conditions of firing. It is, of course, a question of—(1) The quantity of steam generated in the boiler in a given time. (2) The pressure of the steam, which will regulate the speed of its issue through any opening. (3) The area of the safety valve opening, which is intended to emit the whole quantity of steam in the same given time as that in which it is generated. If the latter be of due proportion, both to the quantity of steam generated and to the pressure, it will liberate all the steam.

But we are writing of "safety valves." I do not include under that term the ordinary valve, which I do not think can be truly called a safety valve, but which is merely an escape valve of a very defective kind. A safety valve, to be worthy of the name, should have, in my opinion, the full pressure of the steam within the boiler always operating on its rising portion, not the diminished pressure of the steam at the point of its escape. As is well known, I strongly advocate that principle as one of vital importance in the construction of safety valves, and I think it is one which has an important bearing upon the question of "Enquirer."

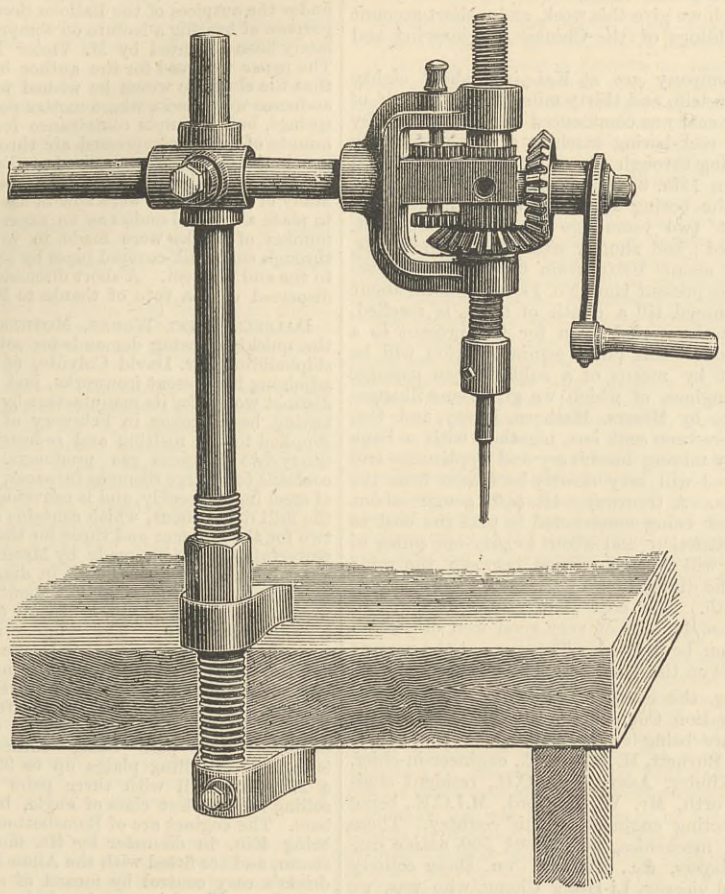
John C. Wilson.

5, Westminster-chambers, Victoria-street,
London, March 2nd.

[*For continuation of Letters see page* 203.]

The balance-sheet of the Birmingham Gasworks, which is in the hands of the Corporation, shows a net profit on the past year of no less than £57,000. Out of this splendid profit the Corporation determined on Tuesday to hand over £25,000 to the Improvement Fund, to appropriate £26,000 to the reduction of the Sinking Fund created for the purchase of the works, and to reduce the price of gas in the current year 3d. per 1000ft.

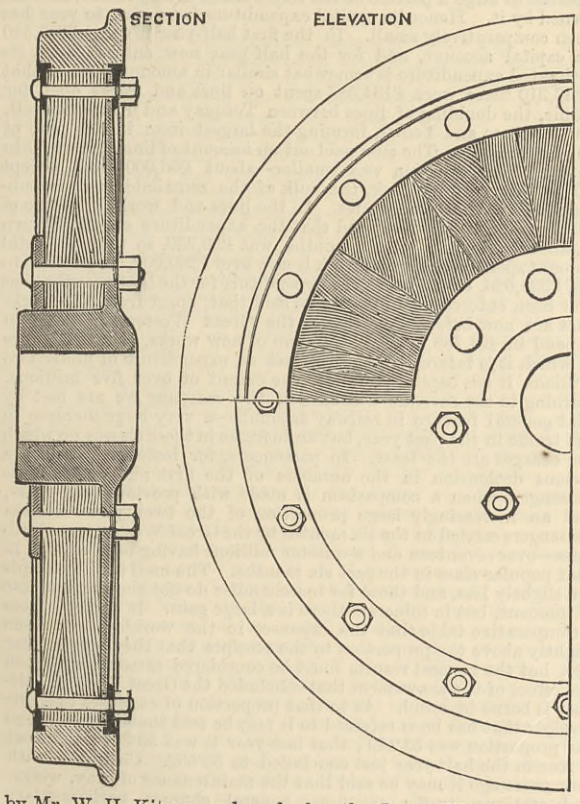
LEE'S SELF-FEEDING DRILLING MACHINE.



We illustrate herewith a useful tool to take the place of the old ratchet brace for drilling by hand power in places where the work cannot be done by an ordinary drilling machine ; it also answers the purpose of an ordinary drilling machine when fixed to a bench. Its construction is so simple and so fully shown in this engraving that little or no description is required. The machine is fixed by means of the clamps at the foot ; the arm or cross bar is to be turned in the socket until the drill points to the place where the hole is required, and it is then secured in that position by tightening the set screws. The feed consists of an ingenious application of differential gear in a very simple form. When the small knob handle at the side of the feed screw is lifted, the upper of the two small wheels upon the spindle to which the knob is attached is put out of gear with the small wheel on the drill spindle nut ; the latter then stands still, and the spindle is given a quick motion for getting the drill to and from its work. When the handle is down the wheels are in gear, and the feed motion is self-acting and gives a feed suitable for the average sizes of holes drilled by the machine. It is manufactured by Messrs. T. and R. Lees, Hollinwood, near Manchester.

KITSON'S WOOD CENTRE WHEEL.

In our impression for the 4th inst., we gave the substance of a report on the accident on the London, Brighton, and South Coast Railway, which showed the necessity for a strong and simple means of supporting the wood body so as to prevent the boss from being torn out. This has been effectually done by means of the armed boss in Mr. Cleminson's wheel, which we have already illustrated, and the annexed illustrations show a very neat wheel designed

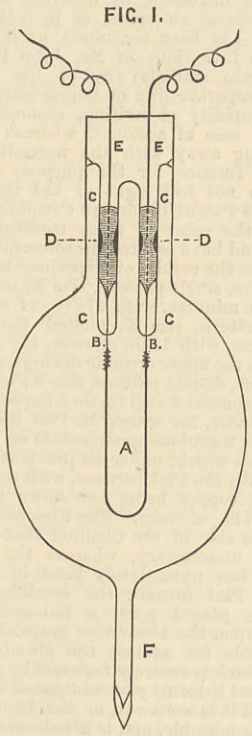


by Mr. W. H. Kitson, and made by the Leeds Wheel and Axle Company. It will be seen from the section that the boss is made in one piece with a large disc forming a cover over the whole of one side of the wheel. This disc is connected directly with the tire by the two gripping rings, freedom for contraction and slight elastic flexion of the wood being left by making the disc a little smaller than the inside of the tire. The tire is so held that even if it breaks in several parts, it is prevented from flying to pieces. The design is simple and the appearance good, and the fact that about 16,000 have been made is sufficient proof of the favourable opinions of railway engineers. Our half side elevation shows both sides of the wheel.

ST. GEORGE LANE FOX'S SYSTEM OF ELECTRIC LIGHTING.

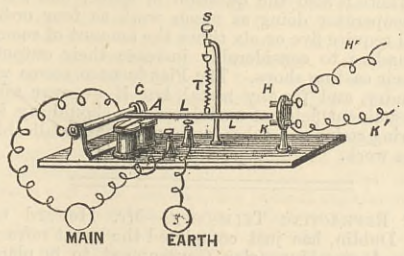
Mr. Lane Fox's new lamp and improved system of current regulation having excited considerable interest of late, we are glad to be able to place before our readers diagrams of the apparatus, and a description of the special features of Mr. Fox's inventions. As regards the lamp, it will be seen—Fig. 1—that in general form it resembles Mr. Swan's ; but the materials employed, as also the details of construction, are decidedly novel, and claim to be superior to those employed by the Newcastle inventor. In the first place, the pump used for exhausting the glass globe has been devised specially for the purpose, and will, it is alleged, produce a far more perfect vacuum than that

FIG. 1.



obtainable by means of the Sprengel pump. For the manufacture of the carbon filaments A, a thread of flax or cotton is wound round a block of carbon or graphite of the required shape, and the whole enclosed in a crucible hermetically sealed, which is then raised to a white heat. The threads thus carbonised are afterwards separately mounted in an atmosphere of coal gas and benzole, and a current being passed through them sufficient to render them incandescent, a deposit of hard carbon is formed upon their surface. The difficulty of getting a sufficient current through the thread in the first instance is got over by making a short circuit through a large electro-magnet of low resistance,

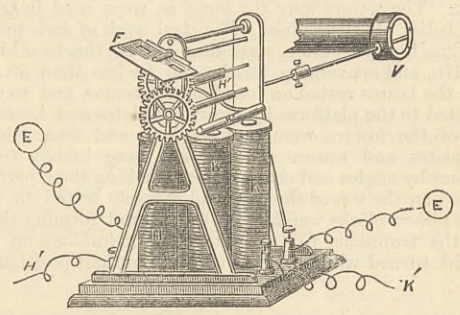
FIG. 2.



and then suddenly interrupting the short circuit, whereupon the extra current will momentarily raise the thread to a white heat, and on repeating this operation several times a sufficient deposit of carbon is obtained. The ends of the threads are thrust tightly into small spirals attached to the platinum wires B B, fused into the glass tubes C C. These tubes contain mercury, which covers the platinum wires, and into which dip the conducting wires E E. The lamp so constructed is attached to the exhausting pump by the tube F, and the bridge A being raised to incandescence by an electric current the exhaustion is continued for about two days. The light obtainable from this form of lamp is said to be very economical, and the filaments, proper care being taken in controlling the current, very durable. The lamps are constructed so as to give a light somewhat equivalent to that of an ordinary gas jet from 10 to 30 candles.

Mr. Lane Fox's method of distributing electricity for public lighting purposes consists of mains under the roadway, with central generating stations similar to those employed for the distribution of gas. These mains are charged at a constant electromotive force ; and the lamps, connected in multiple arc between the mains and earth, have each one wire to earth and one wire to a switch communicating at pleasure with the main. Figs. 2 and 3 represent the regulators for maintaining a constant force in the mains. The lever L connected with a main and actuated by an electro-magnet M, is balanced by the spring T at exactly the normal electromotive force. Any disturbance of this normal force by increase or diminution of the number of

FIG. 3.



lamps alight in the circuit, will put the lever in communication with the electro-magnets H K—Fig. 3. A throttle valve V attached to the armature of these magnets regulates the steam supply of the engine, the speed of which will therefore be determined by the action of H K. By this means Mr. Lane Fox proposes to make the steam power generated, and consequently the electric power, always commensurate with the demand upon the electric mains. We think further consideration of this scheme to regulate the revolutions of the engine will shown that it is far from being a good one.

THE EGYPTIAN OBELISK IN NEW YORK.

The Egyptian obelisk presented to the United States by the Khedive of Egypt has been successfully removed from Alexandria and erected in Central-park, New York. The *Scientific American* describes the removal of the obelisk, and in its remarks says that the obelisk was erected in Heliopolis about 3500 years ago, and that from fragmentary inscriptions on the copper crabs on which the obelisk rested at Alexandria, its erection there occurred in the eighth year of the reign of Augustus Cæsar, or B.C. 22.

The history of the removal of the obelisk from Alexandria to New York will doubtless be told at length by Lieutenant-Commander H. H. Gorringe, U.S.N., under whose direction its last migration has been brought to successful conclusion. The more salient facts of the history may however be given now.

A little more than three years ago Mr. John Dixon, C.E., of London, informed the *World* through Mr. Louis Sterne, an American engineer, that Ismail Pasha, then Khedive of Egypt, desired to present the remaining obelisk to the United States. The co-operation of Mr. Henry G. Stebbins, then a member of the Park Commission of New York, was enlisted by the editor of the *World*, and the possibility of securing the obelisk for New York city was publicly announced. Within a few days a wealthy citizen of the city—understood to be Mr. William H. Vanderbilt—agreed to defray the estimated expense of taking down the obelisk and bringing it to New York.

Meantime Mr. Dixon's unfortunate experience in the transportation of the London obelisk led him to decline the undertaking of lowering and transporting across the Atlantic, the companion of the obelisk with which he had had such bad luck. At this juncture Lieutenant-Commander Gorringe returned from a surveying cruise in the Mediterranean in command of the U.S. steamer Gettysburgh. He had made a study of the standing obelisk at Alexandria with reference to the conditions of its possible removal, and the methods previously adopted for such work, and submitted to the Secretary of State a proposition to undertake the task. His plans were approved ; and having seen to the construction—at the Phœnix Ironworks, at Trenton, N.J.—of the machinery he had devised for taking down and shipping the monolith, he sailed for Alexandria by way of Liverpool, August 24th. The completed machinery followed some weeks after. The ensuing winter and spring were spent by Commander Gorringe in the double task of overcoming the material difficulties and the more annoying political difficulties attending the lowering of the obelisk, its removal to the water, and its stowage in a vessel, the steamer Dessoug, which he had purchased for its conveyance to New York. The obelisk proper is 69ft. 2in. long, 7ft. 7in. by 8ft. 2in. at the base, tapering to about 5ft. square at the foot of the pyramidion. The weight of the stone is given as 196½ tons. The pedestal is 9ft. square, 7ft. high, and weighs 43 tons. The weight of the other stones of the foundation is given at 87 tons. The summit of the obelisk was something over 81ft. above the lower step of the marble platform which formed the base of the monument.

A description of the engineering operations at Alexandria was recently given by Lieutenant-Commander Gorringe before a meeting of the New York branch of the United States Naval Institute.

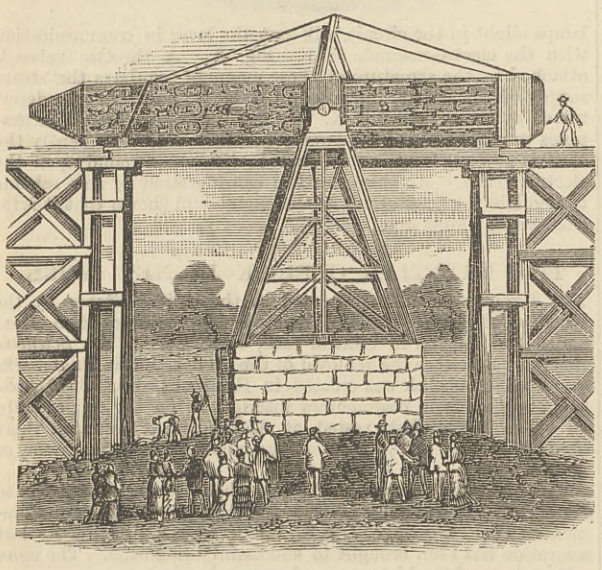
The Dessoug sailed with her cargo June 12th, 1880, and arrived at Gibraltar ten days later. The voyage from Gibraltar to New York occupied nearly a month, owing to a delay caused by a broken crank shaft. After her arrival, July 20th, the Dessoug lay at anchor in North River for some weeks while the final disposition of the obelisk was under discussion. She was then taken to Clifton, Staten Island, hauled out of the water on the marine railway there, and opened at the bow for the discharge of the stone, which was run out on a massive platform supported by two rows of piles in such a way that the stone could be floated off on pontoons at high tide. A proper conjunction of weather and tide did not occur until September 22nd, when the stone was floated to the pier provided for it at the foot of West 96th street.

Owing to the necessary narrowness of the opening in the bow of the Dessoug, the means by which the stone was to be moved had to combine the greatest strength with the least bulk. There was about 8in. to spare, and the usual device for handling such

heavy bodies would require at least four times that space. Accordingly, Commander Gorringe adopted a sort of railway formed of 6in. channel iron and 5¼in. cannon balls, one set of channel irons forming a trough for the cannon balls, the other set—inverted—riding above and carrying the stone. This device, Commander Gorringe is careful to state, was not original with himself, as had been reported. It was first employed, so far as he can discover, in the handling of the gigantic boulder on which stands the statue of Peter the Great in St. Petersburg.

The same machinery was utilised in moving the obelisk across the tracks of the Hudson River Railroad at 96th street. After that the plan of the ordinary marine railway consisting of rollers on a heavy wood track was employed, the balks forming movable track being carried forward as fast as the stone progressed. From the river the course of the stone was through several streets to 81st street, from which point an incline of massive trestle work, 920ft. long and rising ¾in. to the 1ft., led to the site of the final resting place of the obelisk. The power required in hauling the stone up the stiff grade of 96th street was equal to a dead pull of 36 tons; on the incline the power required was 24 tons.

Meantime the foundation stones and the pedestal had been put in place and the steel framework towers or gallows frame erected for sustaining the obelisk during the last critical stage of the work. The towers were the same as were used in taking down the obelisk at Alexandria. The steel work of each tower was of six 12in. heavy I-beams, spreading out at the base to a distance of 21ft., and converging at the top to less than 5ft. At their base the beams rested on four heavy I-beams, and were securely rivetted to the platform by means of plates and knees. On the top of the towers were caps 5ft. long and 30in. wide, secured by plates and knees. The towers were braced from top to bottom by angles and channel irons, making them perfectly rigid. Placed on the top of the caps and securely bolted to the towers were pillow-blocks weighing 3700 lb., and forming the bearings for the trunnions to turn in. The trunnions on which the obelisk turned while being swung into upright position were each



33in. long and 18in. in diameter, and were cast of the best quality of cannon metal. The trunnion plates, each 4in. thick and 9ft. wide, and 6ft. high, were securely held in position, just above the centre of gravity of the shaft, by strong connecting bolts. The two trunnions with their plates weighed 6 tons. The entire weight of metal employed in handling the stone was something like 60 tons. From the above cut and the description, it will be seen that the plan devised by Mr. Dixon for getting the Cleopatra's Needle into place was adopted by Commander Gorringe.

As the monolith stood at Alexandria it was supported by copper crabs at the base, which left room for passing under it heel straps to be connected with the trunnion plates to prevent their slipping when the obelisk was lifted. In Central-park the stone rests squarely upon its base, the heel of the shaft, which was originally rounded, having been cut square off. This made it necessary to provide a substitute for the heel straps. For this purpose two massive friction plates of gun metal were cast at the Brooklyn Navy Yard to snugly fit the base of the stone, the hold being secured by pressure, by the penetration of the metal into the hieroglyphic incisions, and by overlapping the corners which had been cut away for the crabs. These base plates were strongly bolted together and connected with the trunnion plates with steel rods tightened by means of shackle nuts.

The copper crabs alluded to were four in number, but two of them had been stolen at some time, probably for their metal. The place of one had been supplied by a block of stone, wedged in with iron; the other corner was vacant. The bodies of the remaining crabs, which were genuinely crab-like in form, were about 8in. thick, 12in. long, and 16in. broad, and weighed about 150 lb. each. They were much broken in lifting and turning the obelisk, and were replaced by other crabs of bronze made at the Brooklyn Navy Yard. Unlike the original, these do not bear the weight of the obelisk, which rests directly on the stone of the pedestal, but simply fill up and ornament the cut-way corners.

With the trunnions in exact line with the bearings, as in the accompanying engraving, the ponderous stone was lifted by means of six powerful hydraulic jacks; the cradle was removed, and then the obelisk was slowly lowered by the jacks until its weight rested on the trunnions. Here, poised on its centre of gravity between the towers, it awaited the final turn at noon Saturday, January 22nd.

A remarkable feature in the history, says the journal already quoted, of this transportation of a great historical monument over a hundred degrees of longitude and across a great ocean, is the uniform success, celerity and good fortune which attended every stage of the undertaking, a good fortune mainly due to the skill of Lieutenant-Commander Gorringe. Seeing, however, that seventeen months elapsed between the starting of the Dessoug and the completion of the erection of the obelisk, it would not seem that much should be said about celerity.

COAL MINING IN CHINA—CHINESE ENGINEERING AND MINING COMPANY.

The attempts that have been made by Englishmen and others of the Western World to persuade Chinamen to develope the resources of their country by railways, by mining, and other means, have become more or less generally known in this country for some time; but now that the Chinese, or a few of them, are really trying to overcome their old superstitious opposition to innovations, our readers will be interested in illustrations, one of which we give this week, and a short account of the engines and buildings of the Chinese Engineering and Mining Company.

The works of this company are at Kai-ping, about eighty miles north-east of Tien-tsin, and thirty miles from the Gulf of Pechili. The boring for coal was commenced in 1878, when by means of the Diamond rock-boring machine a depth of nearly 500ft. was reached, passing through six or seven seams of coal varying in thickness from 12in. to 7ft. or more; the samples of coal procured through the boring apparatus were considered so satisfactory, that about two years ago the first shaft, 14ft. diameter, was commenced; and shortly after the second shaft, also 14ft. diameter, and about 100ft. from the first, was likewise commenced. At the present time No. 1 shaft is down about 200ft., and will be continued till a depth of 600ft. is reached. No. 2 shaft is intended to be carried down for the present to a depth of only 300ft., and at this point communication will be opened with No. 1 shaft by means of a subterranean passage. Pumping and winding engines, of which we give some illustrations on page 204, made by Messrs. Hathorn, Davey, and Co., Sun Foundry, Leeds, have been sent out, together with a large quantity of all necessary mining machinery and appliances, and it is anticipated that coal will very shortly be drawn from the two above-named shafts. A tramway—4ft. 8½in. gauge—about five miles in length is now being constructed to take the coal to a canal, also under construction and about twenty-one miles in length; communication will thus be opened between the mine and the nearest port; the dimensions of the canal are 60ft. in width and 10ft. in depth. The coal is of good quality; and hard by there are immense deposits of very good iron ore, which will in all probability soon be utilised. There are at the present time 12,000 men engaged on the canal and tramway works.

Mr. Tong King Sing, the energetic manager of the China Merchants' Steam Navigation Company, is at the head of this concern. The works are being carried out under the superintendence of Mr. R. R. Burnett, M. Inst. C.E., engineer-in-chief, assisted by Mr. C. W. Kinder, Assoc. Inst. C.E., resident engineer, and Mr. J. Molesworth, Mr. W. Lawford, M.I.C.E., being the consulting and inspecting engineer in this country. There are also eight English mechanics, and about 500 native carpenters, masons, bricklayers, &c., engaged on these colliery works. The enlightened viceroy, Li-Hung Chang, who was, we believe, a strong supporter of the Woosung Railway, takes a very lively interest in the Chinese Engineering Mining Company, and it may be hoped that the Chinese generally will see the advantages derivable from the development of hitherto almost untouched resources of their country.

In an ensuing impression we shall give further illustrations and a description of the engines.

IMPROVED PORTABLE FURNACES FOR MELTING METALS.

The system of melting metals in the ordinary natural draught built furnaces has hardly been altered at all during the present century, except, perhaps, by increasing by different means the draught, either by giving greater air space, or by better arranged stacks. This arrangement has been continued until the almost simultaneously patented inventions of Mr. John Fletcher and M. A. Piat. They embrace scarcely any of the same features, but each strikes out a separate line of improvement. M. Fletcher's main aims being rapidity of melting, economy of fuel, and the saving of metal in case of accident, whereas Mr. Piat's leading feature is the doing away with the necessity of removing the crucible from the furnace for the purpose of casting. At the same time he has not lost sight of the importance of saving fuel and time. The Patent Plumbago Crucible Company were not slow to recognise the value of these modifications of the usual foundry practice, and have secured the sole control of both systems. At Battersea Works the results of experiments are as follows:—The Fletcher furnace, single pattern, size X, melted 120 lb. of gun-metal in thirty-five minutes, with 27½ lb. of coke. The Fletcher furnace, double pattern, size X, melted the same quantity in twenty-eight minutes with 17 lb. of coke, the charge having been heated to redness in the upper crucible during a preceding operation. The Fletcher furnace, double pattern, size X, with the "Piat Recuperator" attached, showed a still further improvement in time and fuel. This recuperator, for which M. Piat has obtained separate letters patent, is an ingenious modification of the hot blast stove, and utilises the gases which, under all previous systems, have been wasted. A trial with the Piat furnace, with recuperator attached, resulted in 90 lb. of copper being run down in twenty minutes, consuming only 13 lb. of coke. The Fletcher furnace is now so well-known on this side of the Channel that a detailed description is obviously unnecessary, whereas the patent right of the Piat furnace has until lately been in the hands of the patentee. In the Piat furnace the crucible is secured in its position by being placed upon a Salamander or plumbago stand, which rests upon the bottom or grate of the furnace. The front of the crucible fits against the plumbago spout of the furnace, while the back is securely fastened by a wedge of the same material. Thus fixed it forms part and parcel of the furnace, and is not removed until it is worn out, or the furnace requires cleaning. The furnace is portable, and is lifted—excepting the smallest size—by means of a simple crane to the required position for pouring. By this means the metal is kept at the proper temperature right up to the time of its entering the mould, a most important condition when fine and delicate castings have to be made, or highly refractory metals, such as steel, are poured. When emptied, the crucible still remaining surrounded by fuel, and therefore losing no appreciable amount of heat, the grate is gently cleared with an iron rod, and the furnace is swung back ready for a fresh charge. It will be seen that M. Piat's invention possesses many advantages. A great saving is effected in fuel and time, and besides the crucible has not to undergo the numerous risks inseparable from the old system; the metal is maintained at any required temperature during the process of pouring, however slowly it may be performed; the workmen are able to proceed steadily and without fear of accidents, and the whole operation is at once certain, rapid, easy, and cool. There is also the question of space, one Piat furnace with the recuperator doing as much work as four ordinary fires which would require five or six times the amount of room, thereby enabling founders to considerably increase their output without enlarging their casting shops. The Piat furnace seems well suited for any foundry, and for any metal, but if we were asked which were its pre-eminent fields of usefulness, we should say for mixing metals, pouring strips and tubes, and very small malleable iron or cabinet brass work.

A Great Refracting Telescope.—Mr. Howard Grubb, of Rathmines, Dublin, has just completed the great refracting telescope for the Austro-Hungarian Government, to be placed in the Observatory at Vienna. The commission appointed by the Government to examine the work transmitted on Monday to the Austro-Hungarian Embassy in London a report expressing their full approval of the manner in which the task has been completed. It is a matter of no little pride to Ireland, or to Mr. Grubb, that she has produced the largest refracting, as well as the largest reflecting, telescope in the world.

Compressed Air Clocks for London.—A meeting was held on the 11th Inst. in the lecture room of the Royal Aquarium, under the auspices of the Balloon Society of Great Britain, for the purpose of hearing a lecture on compressed air clocks which have lately been invented by M. Victor Popp, of Vienna and Paris. The paper was read for the author by Mr. Robinson, and stated that the clocks to which he wished to draw the attention of the audience were clocks whose motive power should not be weights or springs, but a simple contrivance for the admission minute by minute of highly compressed air through metal tubes. By these means the clocks never required winding up, cleaning, or regulating, the air was to be regulated by a system of central machinery; Many of these clocks were now in use in Paris, and it was proposed to place a few in London as an experiment. After the lecture a number of clocks were made to work by means of air forced through small silk-covered pipes by squeezing an air ball attached to the end of them. A short discussion followed and, the audience dispersed with a vote of thanks to Mr. Popp.

Dalzell Steel Works, Motherwell, N.B.—To meet with the quickly-growing demands for mild steel in boilermaking and shipbuilding, Mr. David Colville, of Motherwell, has, on ground adjoining his present ironworks, just completed an extensive and distinct works for its manufacture by the Siemens process; ground having been broken in February of last year. Gaseous fuel is supplied to the melting and re-heating furnaces by a battery of thirty-two Siemens gas producers. The melting department contains four large Siemens furnaces, capable of producing 500 tons of steel ingots weekly, and is conveniently situated for delivery to the mill department, which contains five large re-heating furnaces, two for the hammer and three for the mills. The hammer is of a powerful description, made by Messrs. R. Harvey, and Co., Glasgow, having a cylinder 33in. in diameter by 8ft. stroke. The hammer has a falling weight of about 12 tons, and aided by a steam working pressure of 80 lb. is capable of producing considerably over a 400-foot ton blow. The cylinder is supported on two massive wrought iron box frames, each in one piece reaching from cylinder to base. The anvil castings weigh in all over 150 tons. There are two mills—one on each side of the engines—and intended for the present to work alternate shifts. The one is a plate mill with two pairs of rolls, each 8ft. long, by 28in. diameter, one pair being chilled, the other grain, and is capable of rolling plates up to 93in. in width. The other is a 27in. bar mill with three pairs of rolls, and is capable of rolling the heaviest class of angle, bulb, and bulb-tee sections of bars. The engines are of Ramsbottom reversing type, the cylinders being 40in. in diameter by 4ft. 6in. stroke, worked with 80 lb. steam, and are fitted with the Allan link motion placed under the driver's easy control by means of steam and cataract reversing cylinders. The driver is placed on an elevated platform at rear of engines, and commands a complete view of both mills and engines. The engines are geared to the mills in the proportion of about 3 to 1. The whole plant is of the most improved modern description, of great strength and massiveness throughout in design, the forgings and gearing being almost entirely of Siemens steel, and the performance, since the start last week, has been giving great satisfaction. The plate shears are also of a powerful description, with shearing blades 10ft. in length, having 12in. stroke, and are capable of shearing steel plates 1½in. in thickness by 7ft. broad through at one stroke. The hot saw for the bar mill is of an improved design driven by a pair of 8in. horizontal engines. A long train of carrying rollers, driven by a separate pair of reversing engines, carries the bars to and from the saw. The whole of this fine plant—engines, mills, shears, and saw—are from the workshops of Messrs. Turnbull, Grant, and Jack, of Glasgow, and reflect much credit on the makers. Four large boilers of combined flue and multitubular type, worked at 80 lb. pressure, and constructed entirely of Siemens steel, supply the steam. The roof, entirely of wrought iron, covers an area of about 5500 square yards, and is well lighted and ventilated. The chemical and mechanical testing houses, combined in a new range of offices adjoining the works, are fitted complete with the most modern appliances, the latter containing a new improved testing machine, made by Joshua Buckton and Co., of Leeds, capable of testing up to 50 tons on the piece, the whole operation being entirely done by steam-power. The works have been constructed to the designs and specifications made under the superintendence of Mr. W. Cuthill, late of Newton Steelworks.

The Great Western Railway.—The great railway, of which Sir Daniel Gooch is the chairman, is, in many respects, exceptionally placed. For its great length it has a somewhat limited capital—limited, that is, in contrast with that of the London and North-Western Railway—but this is because so large a portion of the line worked is only leased, and not owned by it. Hence its capital expenditure from year to year has been comparatively small. In the first half-year it spent £343,310 on capital account, and for the half-year now entered upon its estimated expenditure is somewhat similar in amount. Out of that £343,310 there were £134,583 spent on lines and works open for traffic, the doubling of lines between Torquay and Kingskerswell, and Witham and Yeovil, forming the largest item in this part of the expenditure. The sum paid out on account of lines and works in course of construction was smaller—about £68,000—and, except £56,000 on working stock, the bulk of the remainder was in subscriptions to other companies. In the lines and works in course of construction it may be stated that the expenditure on the Severn Tunnel Railway, in the six months, was £30,339, so that the total amount spent on that great work is now over £260,000. In addition to the £330,026, estimated as the expenditure for the half-year that has now been entered upon, it may be said that, apart from the works that are now before Parliament, the Great Western proposes to expend £1,494,785 in the completion of new works, and of schemes in which it is interested, and to meet an expenditure of under two millions, it has capital powers to the extent of over five millions. Turning to the revenue accounts of the company we are met by that general feature in railway accounts—a very large increase in the traffic in the past year, but an increase in those classes on which the charges are the least. In passengers, for instance, there is a serious declension in the numbers of the first and second-class passengers when a comparison is made with previous half-years, and an increasingly large proportion of the twenty-two million passengers carried in the six months by the Great Western are third-class—over seventeen and a-quarter millions having been carried in that popular class in the past six months. The mail traffic receipts are slightly less, and those for merchandise do not show an increase of moment, but in minerals there is a large gain. It appears from a comparative table that the expenses in the working have been slightly above the proportion to the receipts that they bore a year ago, but the general results must be considered satisfactory, when the effect of the snowstorm that concluded the Great Western half-year is borne in mind. As to that proportion of expenses to traffic receipts that has been referred to it may be said that four years ago the proportion was 53·119; that last year it was 50·244; and that it rose in the half-year just concluded to 50·552. Compared with four years ago it may be said that the maintenance of way, works, and stations, traffic expenses, general charges, parliamentary expenses, and compensation are less costly now than they were, but other items are more so—especially rates and taxes. Indeed, it is not too much to say that the increase of the rates and taxes that the railway pay, is now so marked that a combined action of the railway companies will be needful shortly to check an increase that is still continuing. Generally speaking it may be said that if the increase on capital account on the part of the great railways could be checked, their prospects in view of the revival in trade, that is believed to have commenced, are most hopeful. The Great Western is not one of the chief sinners in regard to capital expenditure, and as it is completing some of its great projects, and lessening the unproductive capital expenditure, it may be hoped that there will be a continuation of that enlarged prosperity it has known in the last year in common with other railways.

RAILWAY MATTERS.

IT has been rumoured that the Smyrna Railway Company has offered the Porte £1,200,000 for a concession for the extension of the railway.

TWELVE large locomotive engines for use on the Narine and North lines have, according to the *Colonies and India*, recently arrived at Adelaide from America.

THE New Brunswick Railway Company, having secured powers, intend to push the road on to Presqu' Isle at once. The widening of the gauge is also to be hurried on, and broad-gauge trains will probably be run in August.

A LARGE and influential meeting was recently held at Dartmouth, Nova Scotia, in support of the railway extension; 24,000 dols. were voted either in money or land, and a right of way through the town was granted.

IT was stated, at last departure of mails, that the gauge of the Western Railway of Canada is to be changed, and several locomotives had been shipped to Kingston to be altered, as the shops at Toronto were overcrowded with work.

THE Wolverhampton Chamber of Commerce, pursuant to its determination to inform the Select Committee appointed by the House of Commons for considering the question of railway freightage rates as to the excessive prices charged for the conveyance of iron and hardwares from South Staffordshire, has now elected a local committee to collect evidence on the subject.

THERE is something curious in the following paragraph sent to the *Times* by its Philadelphia correspondent:—"A passenger train on the Hannibal and St. Joseph's Railway, near Macon, Missouri, was thrown from the line by a broken rail on Tuesday morning, demolishing the coaches. This caused the wrecking of the train, which fell through a bridge, killing or injuring every one aboard. Eight persons were killed and twenty were injured by both accidents."

ABOUT eight o'clock on the morning of the 11th inst., while a train from Aberdeen was passing through a deep snow cutting, near Laurencekirk Station, on the Caledonian Railway, the driver, named Sievewright, got on front of the engine to put sand on the rails. The train was in motion, and the deep snow piled at the side of the cutting caught Sievewright, and pushed him off the engine. The whole train passed over his body, and he was cut to pieces. Deceased was forty years of age, and has left a widow and ten children.

A MEETING was held at the London Mansion House on the 10th inst. to arrange for a celebration of the Centenary of the birth of George Stephenson on the 9th of June, and to raise in connection with the event a fund for the building and support of a new wing to the Railway Servants' Orphanage at Derby. The orphanage is purely a charity devoted entirely to the maintenance of the fatherless children of railway servants who lose their lives in the performance of their duty. A resolution in favour of the celebration was adopted unanimously.

THE Canadian Pacific Railway Syndicate are making energetic preparations for carrying out their vast undertaking, and have resolved to hold out the most generous inducements to settlers in their territory. They have just decided to sell their lands at the low figure of 2·50 dols. (10s.) per acre, with a rebate of 1·50 dols. per acre on actual settlement, the breaking up of 25 acres being considered proof of *bonâ fide* settlement. By this the price of land to actual settlers in this region, with all the advantages of railway communication, will be only one dollar (4s. 2d.) per acre.

FROM the report of the Great North of Scotland Railway Company it appears that the locomotive power cost 11·42 per cent. on the traffic receipts, the average cost per train mile being 6·53d. These figures were 10·73 and 6·44 for the half-year ending 31st January, 1880. The cost of locomotive power has thus increased 6·4 per cent. in traffic receipts, while it has only increased 1·4 per cent. per train mile. The receipts per train mile in the half-year ending January, 1880, were 62·99d. per mile, while in 1881 they were 59·87. The total train mileage goods and passengers was in 1880, 556,979 miles; in 1881 it was 578,687.

A TRAIN having run into a snow-drift on the Delaware River Railroad, a few days ago, the president sent this despatch to the conductor:—"Use all the fence rails you can lay your hands on if your coal gives out; throw in a barn or two, if necessary; and if that fails you, take all the pork offered at 6 dols. per hundred. Keep your steam up, and come through at any cost." The conductor and engineer obeyed instructions, reaching Woodbury about 10 p.m., where, says the *National Car Builder*, a corpse and funeral *cortège* from Philadelphia, with a number of passengers, had been awaiting it in the depôt since five o'clock, the hour for its return trip.

IN consequence of the increased passenger traffic and of the stricter rules enforced, the amount of the Government duty paid by the railway companies for the past half-year shows a general increase. The London and North-Western Railway Company paid £76,391 in the last half-year; the Great Western Railway, £57,468; the Great Northern, £18,477; the Midland Railway, £30,989; the North-Eastern Railway, £18,386; the Lancashire and Yorkshire, £16,421; and the Metropolitan Railway, £4710. On the Great Western Railway the Government duty is about 1·6 per cent. on the traffic receipts, but on the Metropolitan Railway it is about 1·9 per cent. on the traffic receipts.

IN addition to the landslips which occurred on the main line of the Caledonian Railway, near Blackford, on Thursday and Friday last, a more serious disaster happened on Saturday, by which all traffic north from Stirling was put an end to for a time. Late on Friday night, owing to the excessive flooding of the Earn, apprehensions were entertained for the safety of a bridge which carries the line across that river near Forgandenny, a few miles south from Perth. About one o'clock on Saturday morning the water rose to such a height that part of the bridge was swept away. All trains from London and the south had previously been stopped at Stirling, where the passengers were accommodated for the night. Traffic was stopped on Saturday between Stirling and Perth.

MAJOR-GENERAL HUTCHINSON, for the Board of Trade, visited Newcastle on the 9th inst. to inspect the tramway engine about to be used on the Westgate Hill gradient. The engine tried was the No. 4 of Brown's patent, built by Messrs. R. and W. Hawthorn and Co., Newcastle-upon-Tyne. It is of the same description as that employed on the North-road, and was originally built for working on a level line. On the trial of the 9th inst. the engine proved itself, however, to be equally suitable for running on gradients, and although a stronger engine is in course of construction by Messrs. Hawthorn for the Westgate Hill branch, the present locomotive will in the meantime be used. When opened it is intended to run this branch with one-horse cars, the whole of the line, with the exception of the steep gradient of Westgate Hill, being perfectly flat. Westgate Hill is nearly 750 yards long, and rises in that distance 115ft., the gradient varying from 1 in 53 at the bottom to 1 in 12¾ in the middle. In ascending the hill the car will be pushed by the engine from behind, the horse, though remaining attached to the vehicle, being slackened in the traces and simply walking to the top, where it will have to recommence the journey unassisted, while the engine returns to await the next car. This method was adopted in the trial, and it seemed to give every satisfaction. In descending, it was allowed to run at full speed, always stopping from the effect of the self-acting brake. Major-General Hutchinson visited Sunderland on the same date, and examined the working there of Messrs. R. and W. Hawthorn's steam tram locomotive, of which there are three in Sunderland. He went over the whole route to Roker, Christ Church, and Southwick, tested the self-acting brakes, and every other point in the running. The trial was, it is stated by the *Newcastle Daily Chronicle*, highly satisfactory. The engine was used lately with a snow plough to clean the roads, and during the recent storm gave great satisfaction in this work.

NOTES AND MEMORANDA.

ACCORDING to the census lately taken, the population of the German Empire is now 45,194,172 persons.

DURING a hailstorm in Geneva on January 19th, Prof. Colladon observed the hailstones as they fell repel each other mutually and to bound about after lying quiet for a moment or two on the ground exactly after the fashion of the pith balls in Newton's well-known experiment of the electric hail. The observation, says *Nature*, would appear to have a bearing on Volta's somewhat neglected theory of the formation of hail.

THE following is obtained from the proceedings of the Maryland Academy of Sciences by the *Scientific American*:—"Dr. Theobald showed a species of beetle and gave the following figures: Weight of beetle, 2 grains; weight moved by it, 5½ ounces—2640 grains, or 1320 times the weight of the beetle. A man weighing 150 lb., endowed with the strength of this insect, should therefore be able to move 198,000 lb., or nearly 100 tons."

AT a meeting of the Académie des Sciéncés on the 21st ult., a paper was read "On the Parallax of the Sun," by M. Faye. He indicates in a table nine methods of determining the earth's distance from the sun. He holds that the method of physicists is best; that the sun's parallax, 8·813", is now determined by them to within $\frac{1}{100}$ of a second; and that the seven astronomical methods converge more and more towards this result, and tend to confirm it, without having equal certainty.

A PAPER on the cooling power of gases and vapours was read at a recent meeting of the Académie des Sciéncés by M. Witz. He infers equality of the cooling powers of dry air and air saturated with moisture. The cooling power of coal gas compared with that of air is equal to 3·48, that of sulphurous acid does not exceed 0·61—the pressure being 760 mm. The velocities of cooling increase more quickly than the 1·233 power of the excesses. For steam they increase proportionally to the 0·83 power.

THE magic mirrors of Japan formed the subject of a communication to the Paris Academy of Sciences recently, and from the examples shown by the author it appears perfectly evident that the phenomena is due to the arrangement of the particles or crystals of the material in different directions under compression or tension either mechanical or molecular, as observed by Mr. Reeks, and described in our pages for the 2nd May, 1879, and not to any minute curvatures on the polished surface.

SUNDAY last was the centenary of the discovery of the planet Uranus by Herschel, at Bath, while engaged in the telescopic comparison of a large number of stars. The discovery was made about 11 p.m.; and the six satellites were discovered between 1787 and 1797, also by Herschel. The name given by Herschel to his new planet was Georgium Sidus, in honour of the reigning king, George III. But this name gave no satisfaction to astronomers, and after a variety of suggestions that of Uranus, at the proposal of Bode, was adopted.

THE recent report of Mr. Burchard, Director of the Mint in the United States, contains a valuable *résumé* of the production of gold and silver in the world for 1879 and the two previous years. The total yields were in value:—1879, gold, 105,365,697 dols.; silver, 81,037,220 dols. 1878, gold, 119,031,085 dols.; silver, 87,351,497 dols. 1877, gold, 113,947,173 dols.; silver, 81,040,665 dols.; or a total of 338,343,955 dols. and 249,429,382 dols. respectively. Or a grand total for the three years of 587,773,337 dols., or about £146,943,000 The lion's share of this enormous production was from the United States, the yield of gold and silver in which during 1879 was nearly equal, being 38,899,858 dols. of the former and 40,812,132 dols. of the latter. Australia comes next with a production of 29,018,223 dols., all in gold, and she is closely followed by Russia, which furnishes a tolerably uniform annual supply of about 27,000,000 dols. of gold, though but a small quantity of silver. The Mexican yield is almost entirely silver, value 27,000,000 dols. There has been a considerable falling off in the coinage of the world during 1879 from that of the previous years, the coinage of 1879 being in value 207,287,384 dols., while in 1878 it was 349,578,524 dols.

ON taking up some of the underground telegraph cables recently in Germany, it was found that in some places the lead pipe had become brittle and porous, and a chemical examination showed that some of the lead had been converted into a basic carbonate—white lead. It was found that this change had taken place only where the pipe had come into contact with mortar or cement. Dr. Rossel finds that in contact with lime mortar lead always loses perceptibly in weight, and in contact with cement the loss is nearly as great. Lead buried in moist earth that contains chlorides, saltpetre, and sal ammoniac, lost weight, but to a much less degree than in mortar. The sulphates, like plaster of Paris and Glauber salts, had no action upon lead; neither did the carbonates, like chalk, soda, and potash, nor the silicates, sand, and clay. He calculates that a pipe one millimetre thick, or one twenty-fifth of an inch, might be eaten through in fifteen or sixteen months, and he considers that lead pipes should never be brought in contact with any sort of mortar or cement. Clay does not attack lead pipe if free from sal ammoniac and saltpetre, the latter resulting from the decay of organic matter. Plaster of Paris offers the best protection for lead pipes, over which mortar or cement can then be safely laid.

THE acceleration of gravity has been recently measured by Mr. T. C. Mendenhall. He has done this at the top of the extinct volcano Fujiyama, which plays so prominent a part in the mythology and in the art of Japan. The value found for the summit of the mountain was $g = 9{\cdot}7886$, whereas at Tokio the value was found to be 1·7984. The average barometric pressure at the summit was 19·5in., the mountain itself being an almost perfectly symmetrical cone of vertical angle 138 deg., and of a height of 2·35 miles. It rises alone out of a plain of considerable extent, and appears to be composed of a uniform rock of a porous nature. Tradition states that the mountain was thrown up in a single night in the year B.C. 286. The density of the rock in the lump was 1·75, but when reduced to powder the density was 2·5; competent geologists conclude the mean density of the mountain mass to be 2·12. Assuming the mountain to be a cone of semi-vertical angle of 69 deg., and density 2·12, Mr. Mendenhall calculated its attraction upon a particle placed at the vertex, and comparing it with his result, deduced for the mean density of the earth the value $D = 5{\cdot}77$. If, however, the accepted density of the earth as determined by Bailly at 5·67 be adopted, it follows that the mean density of Fujiyama is only 2·08.

ON Friday evening last a lecture was delivered at the London Institution by Mr. G. Phillips Bevan, F.G.S., on the "Gold and Silver Mines of the World." Speaking of the early discoveries in the colony of Victoria, he cited Mr. Brough Smyth respecting the great diggers' finds, and the large nuggets. He said that the Victoria goldfields now cover an area of 1241 square miles, which in 1879 yielded 715,000 oz., valued at £3,000,000. Queensland was traversed by a chain of gold rocks from north to south, and at least 4000 square miles were being worked with all the experience gained from the failures of the sister colony. The yield for 1879 was was over a million sterling. South Australia was more a copper than a gold country, but the goldfields of Part Darwin were being industriously worked by the Chinese. After mentioning South Australia and New Zealand, the present rage for speculation in Indian gold mines was touched on, with a caution to perplexed investors. The Russian mines in the Ural range were interesting, as having enabled Murchison to forecast the success of gold mining at the Antipodes. Passing over to the American continent, the lecturer spoke of the goldfields of North Carolina and Virginia, the Californian discoveries, and the rich silver mines of Nevada and New Mexico. He described the great Comstock lode, the two mines of which had yielded in twenty years 363,671,605 dols. He spoke of the immense wealth of the Arizona and Colorado silver mines, as well as of the Bolivian mine long known by the name Potosi, and of those worked in Peru, Chili, and Mexico.

MISCELLANEA.

A NEW dry dock at South Brisbane is nearly finished, and is soon to be in use.

WE are informed that Messrs. Thomas Robinson and Sons, of Rochdale, have been awarded three first-class medals at the Melbourne Exhibition, the highest award in each class of woodworking machinery in which they exhibited.

AN Austrian manufacturer of railway plant is offering a semaphore signal arm, the surface of which is illuminated at night by several lamps, so as to show its form, and thus do away with signalling by coloured lights.

THE Commissaire Général of the Paris International Exhibition of Electricity wishes to direct special attention to the date fixed as the last day for receiving applications for space for exhibition, namely, the 31st inst., after which applicants run the risk of refusal.

THE use of sea water for watering the streets of Sydney was rendered necessary by the fear of a scarcity of fresh water, and the Sydney people have thus found that which many others long knew, but cannot very well apply—namely, that some salt in the water used for this purpose makes it more efficient.

THE Minneapolis *Tribune* is responsible for the statement that there is a boy living at St. Paul's, in that State, whose left hand is a strong magnet, so that knives, needles, pins, &c., adhere strongly to it. When heavy articles are placed on it he complains of pains in his arm. His arm and the left side exert magnetic power, but in a less degree, and there is none evidenced on his right side.

AN Erie, Pa., paper says that a brakeman was recently caught between the bumpers of two freight cars, and so horribly squeezed that no hopes of his recovery were entertained. He has, however, partly recovered, and is likely to get well. His head, once round, was pressed out by the accident, long and slim, and he is also from one-half to three-quarters of an inch taller. The terrible squeeze has made him cross-eyed, but his mind is as bright and clear as ever.

THE Inman Steamship Company's ship, the City of Paris, having been fitted with new engines, will shortly commence running to New York. She has also been fitted with the electric light in the steerage, the system employed being the same as that which has given so much satisfaction on the City of Berlin. The whole of the work has been furnished and set to work by the Electric Lighting Supply Company, under the superintendence of Mr. Killingworth Hedges, C.E.

A COMMITTEE has been formed at Dijon for erecting a statue to Carnot, the celebrated French geometer and politician, who, says *Nature*, was born at Nolay, a small country town of Burgundy, in 1753. The youngest son of Carnot is now living, one of the members of Senate, and his grandson is M. Sadi Carnot, the present Minister of Public Works. The other son of Carnot died fifty years ago, after having written a small essay, "Sur la Puissance motive du feu." M. Carnot's brother has just published a new edition of this work, with a number of essays, mostly unpublished, by the same author, and a history of his life.

THE annual amount paid for gas consumed by the public lamps of the city of London is about £14,000. The amount agreed upon for the electric lighting, by way of experiment, of three districts for twelve months, from sunset to sunrise, is £8060. It is roughly estimated, says the *Citizen*, that the cost of the experiment, including the plant, machinery, fixing, replacing, and so on, will be about four times the price now paid for gas; but eliminating these expenses, which would not be recurrent, the cost would only be twice that of gas. In the districts where the experiment is in operation gas will not be used unless the electric light should fail.

The secretary of the Birmingham Patent Law Association, which was established about ten years ago, is urging "the various persons engaged in large establishments" to agitate in favour of the Bill introduced by Mr. Anderson, for it embodies the programme of the association. The secretary says he has reason to believe that even during this session the Government may be induced to adopt that programme if, "by public meetings and largely-signed petitions," and suitable deputations of mechanics and employers to the Board of Trade, the question of patent law reform should be made to assume, in the eyes of the Government, the importance which it merits.

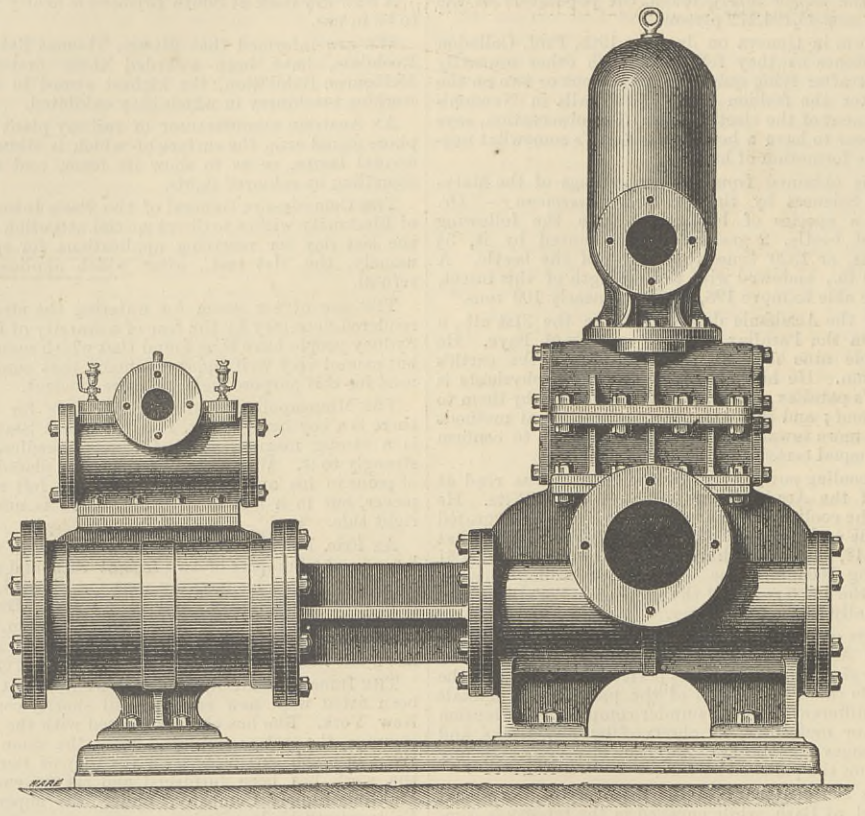
A STENOGRAPHIC piano has been experimented on by the daughter of the inventor, in the French Chamber of Deputies, the Senate, and to the Municipal Council of Paris, with great success. The system, which is illustrated in the *Annales Industrielles*, consists of a combination of signs through which every sound is represented. The reproduction is as rapid as speaking, and the same operator can continue the work for hours. The signs used in this system being printed by machinery, the reading is immediate, and can be made by other people than the operator. The State stenographers propose to be trained in the use of the instrument. It is an affair of a few months of practice.

THE Russian Finance Minister has just concluded an inquiry through the Department of Manufacture and Commerce into the state of the Russian commercial fleet. On the 1st of January this fleet stood as follows:—The ports of the White Sea had 11 steamers, of 916 lastels tonnage, 575 sailing vessels, of 14,512 lastels; Baltic ports, 63 steamers, of 9539 lastels, and 578 sailing vessels, of 43,771 lastels; Black Sea and Sea of Azof, 171 steamers of 29,564 lastels, and 1964 sailing vessels, of 76,091 lastels; Caspian, 36 steamers, of 5491 lastels, and 1004 sailing vessels of 49,656 lastels; Pacific Ocean, 15 steamers of 10,000 lastels. In all 296 steamers of 55,510 lastels, and 4121 sailing vessels of 184,130 lastels. Of the total number—4417—1196 are employed in deep-sea navigation, and 3221 in the coasting trade. Of the total number 3695 have been built in Russia, and 722 abroad.

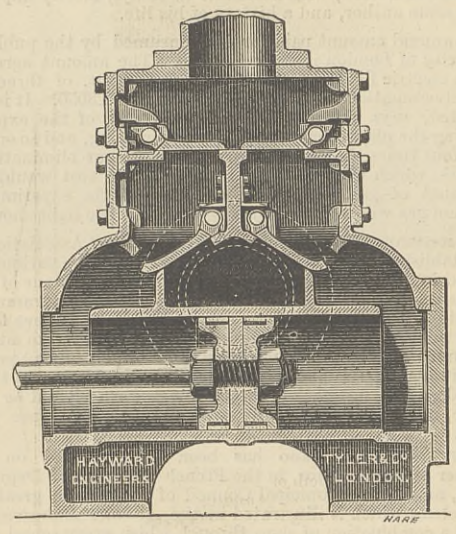
AN American thus shows the appreciation with which American engineers regard English tools in their own country:—"In replacing a round-house turntable, there is but one safe course to adopt, namely, to empty the house of all engines which may be called on for service. This, however, is to expose these valuable monsters to the cold, unless they have proper care; an additional reason for getting in the new table at the earliest possible moment. The repair shops of the Pennsylvania Railroad at West Philadelphia recently completed this little job in about twelve hours, although the centre box of the new table weighed five tons. The celerity with which the work was done was due, aside from good management, to a steam crane made by Appleby Brothers, of London, and one of the four exhibited at the Centennial of 1876. The crane is mounted on an iron car, and lifts, turns round, alters radius of jib, and moves itself along the track by its own steam power." It became the property of the Pennsylvania Railroad Company after being used in building the elevated railroad, where it proved of great service.

ENGINEERS have sometimes been accused of underrating the scientific attainments of architects, but the following from one of themselves shows at once that some architects put a very low estimate upon their brothers' accomplishments in this respect, and at the same time involuntarily prove that their estimate is not too low. The members of the Architectural Association were recently told by one of their number that there were some present "to whom it never occurred, and who were never taught that the smaller the pipe the less the friction; the greater the hydraulic pressure the greater the velocity, and consequently the less chance there is of any obstruction." He was speaking of drains, and perhaps to puzzle his hearers he soon afterwards explained that "the greater the proportion of the wetted perimeter to the volume of water to be discharged, the greater the resistance." Probably few architects would attempt to find out which statement is correct, but for the benefit of those who might, the speaker said, "Mistakes are frequently caused by scanning books of reference instead of reading them." It would seem so.

MESSRS. HAYWARD TYLER AND CO.'S TAR PUMP.



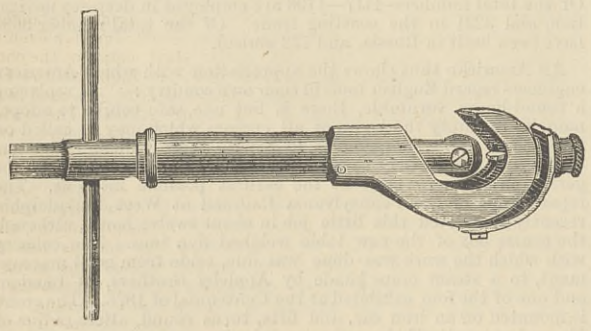
We illustrate a rather neat arrangement of direct-acting steam pump, by Messrs. Hayward Tyler and Co., applicable chiefly to thick materials, such as tar. The engine or motive power is the well-known "Universal," having an outside valve and long stroke, so well understood by most of our readers that no comment is necessary, beyond that of a passing remark as to the great durability displayed by this type of the



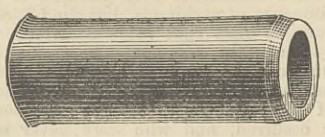
direct-acting class of pumps which has now been extensively employed, doing hard work for over eleven years. The improvement illustrated consists in the arrangement of valves and doors, by which access can be obtained to the boilers without disturbing any of the pipe joints, which was not the case with the old tar or "California" pumps. The sectional drawing shows clearly the design. We understand that the new pump has already been adopted by several of the gas companies for tar and ammonia liquor.

BUCKLEY'S DIE STOCKS AND TUBE CUTTERS.

It is generally known that the ordinary wheel or disc tube cutter forms a burr on the ends of the tube cut, which has to be

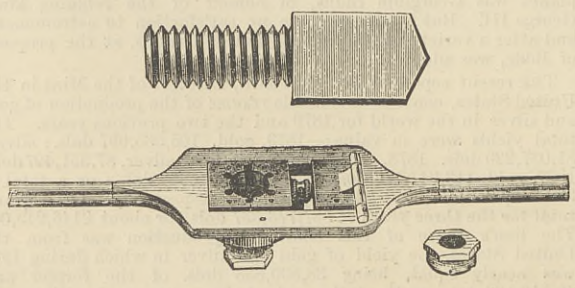


taken off with a file or other means before screwing the pipe end. In order to avoid this necessity, Messrs. Buckley and Leech, of the Hooley Hill Tool Works, Guide Bridge, near Manchester, have



made a tube cutter, as shown by the annexed engravings, fitted with a shaving tool, which either cuts the end of the tube parallel, or if ground as shown, tapers the end of the tube, so that cutting the screw is facilitated, and the screwed pipe enters more easily into a socket than if cut in the usual manner. The tube-cutting tool, the shaver, and a piece of tube cut by the ordinary and the new cutter are shown in the annexed cuts.

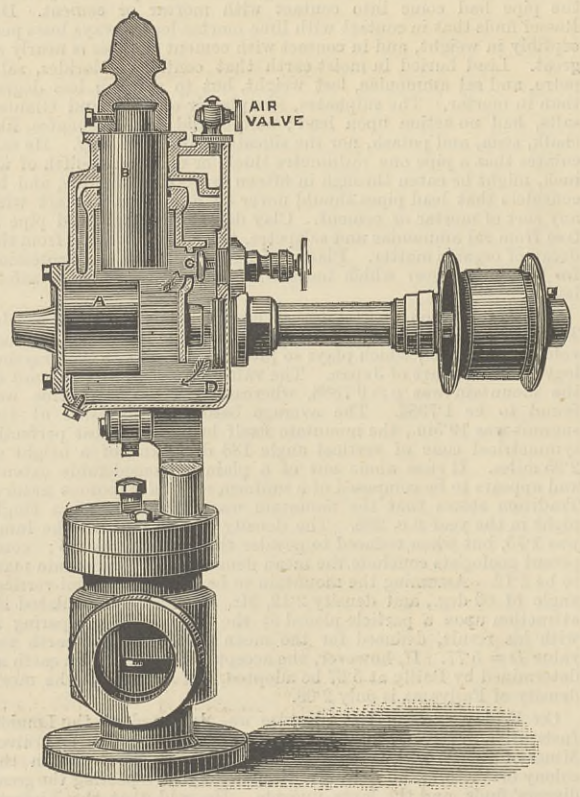
The advantages of the arrangement of die stock shown herewith are self-evident. The dies may be changed by simply slackening



the screw and throwing back the hinged block, as shown. The arrangement is simple and strong.

CRAIG'S HYDRAULIC GOVERNOR.

Hydraulic or fluid resistance has now been applied by several inventors as the means of securing quick action in a governor designed to control an engine at a certain fixed maximum, the resistance increasing as the square of the velocity, or under the conditions even more rapidly, making fluid resistance the most effective for the purpose. The action of Craig's governor is



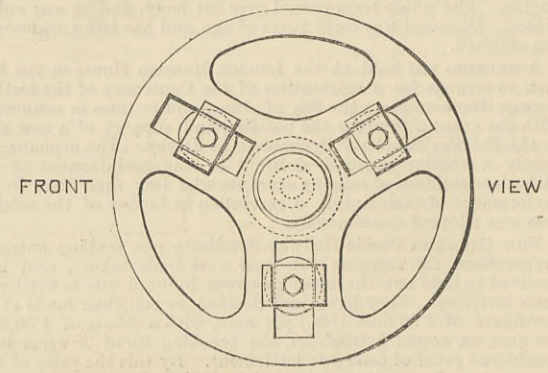
derived from a positive delivering force-pump, pumping a fluid under a weighted piston, and through a given opening, which may be increased or diminished to change the speed of the engine, the weighted piston rising and falling by the action of the pump to regulate the supply of steam to the cylinder.

By reference to the sectional illustration, which we take from the *Scientific American*, the operation will be readily understood by the following brief description :—The pump A consists of two pistons and two operative gears attached to them and enclosed in a closely-fitting case. The oil with which the governor is filled is drawn by the pump from the reservoir D, and forced up against the plunger B, and through the valve C into the reservoir, to be used over again. Any increase of speed introduces more oil into the plunger chamber than can be forced through the valve C by the weight of B, and its immediate connections to the steam valve or valves. Therefore plunger B is forced upward, cutting off the supply of steam, and the engine is brought to the same speed as before. Any decrease in the speed would produce a reverse action of B, the settling down of which supplies more steam to the engine. By opening the valve C, the engine will run fast ; by closing, slower. The air-valve is opened or closed to prevent over action or jumping, common among other governors. It is also removed to fill the governor with oil.

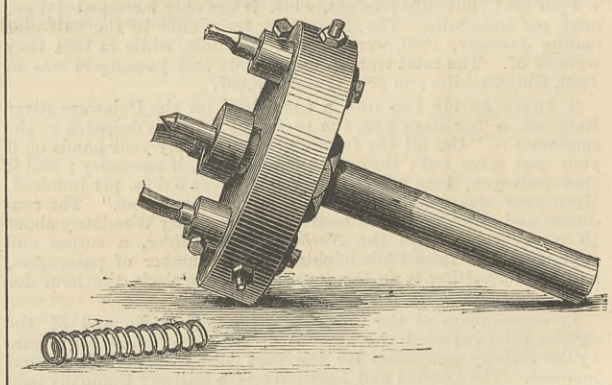
The advantages claimed for this governor are :—(1) Perfect regulation under all conditions of labour so long as there is any surplus steam. (2) The admission of full steam pressure, if necessary, to do the work. (3) Twice the durability of any other governor, therefore making it the cheapest in use. (4) This governor is perfectly balanced, and no springs used in its construction. (5) Almost unlimited power. (6) Perfect lubrication of the working parts, insuring the greatest possible durability. (7) Has not one-fourth the friction of any other governor, making it very sensitive to the slightest change of speed. (8) The engine will run the same speed with a load as without, giving a larger product of work, and making a direct saving of fuel. (9) Has a perfect, adjustable speed, giving he widest range either way from the regular speed of any known device. (10) Does not compress any springs or close the steam passage to change the speed, but will admit full steam pressure with one speed as well as another, if necessary to do the work. (11) Has a positive automatic stop or check, in case of the breaking or slipping off of the belt, if required. (12) Requires less care than any other governor, and is not liable to stick. In its action, however, it is nearly identical with the old Pitcher governor, and open to the same objection, viz., sluggishness.

BENNETT'S TUBE PLATE CUTTER.

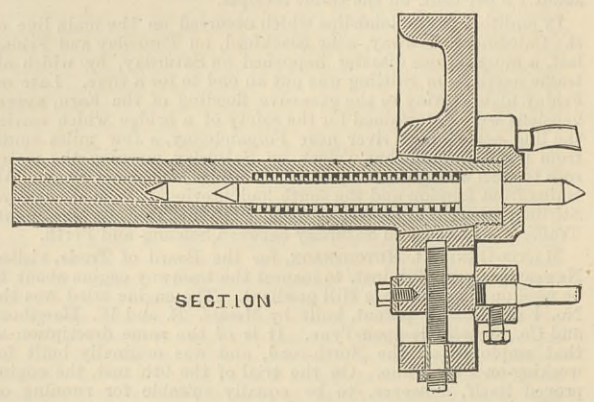
The accompanying engraving illustrates a new tool for cutting holes in tube plates, invented by Mr. E. H. Bennett, of 88, Leadenhall-street. It consists of a headstock or disc, in which are set the tool holders, the position of which can be adjusted



by radial screws fitted with lock nuts, as shown in the section. This disc is secured on the end of the main drill spindle by a cone and lock nut, as shown in section. The spindle is bored out and fitted with a spiral spring, within which works the spindle of the centre pin. This spring is gradually compressed as the



tools cut through the plate. The following advantages are claimed by the inventor for this tool :—(1) A screw adjustment, by which the tools may be moved to any required position ; (2) requires no hole-drilling in plate, an impression made with a centre punch being all that is required. There being no hole



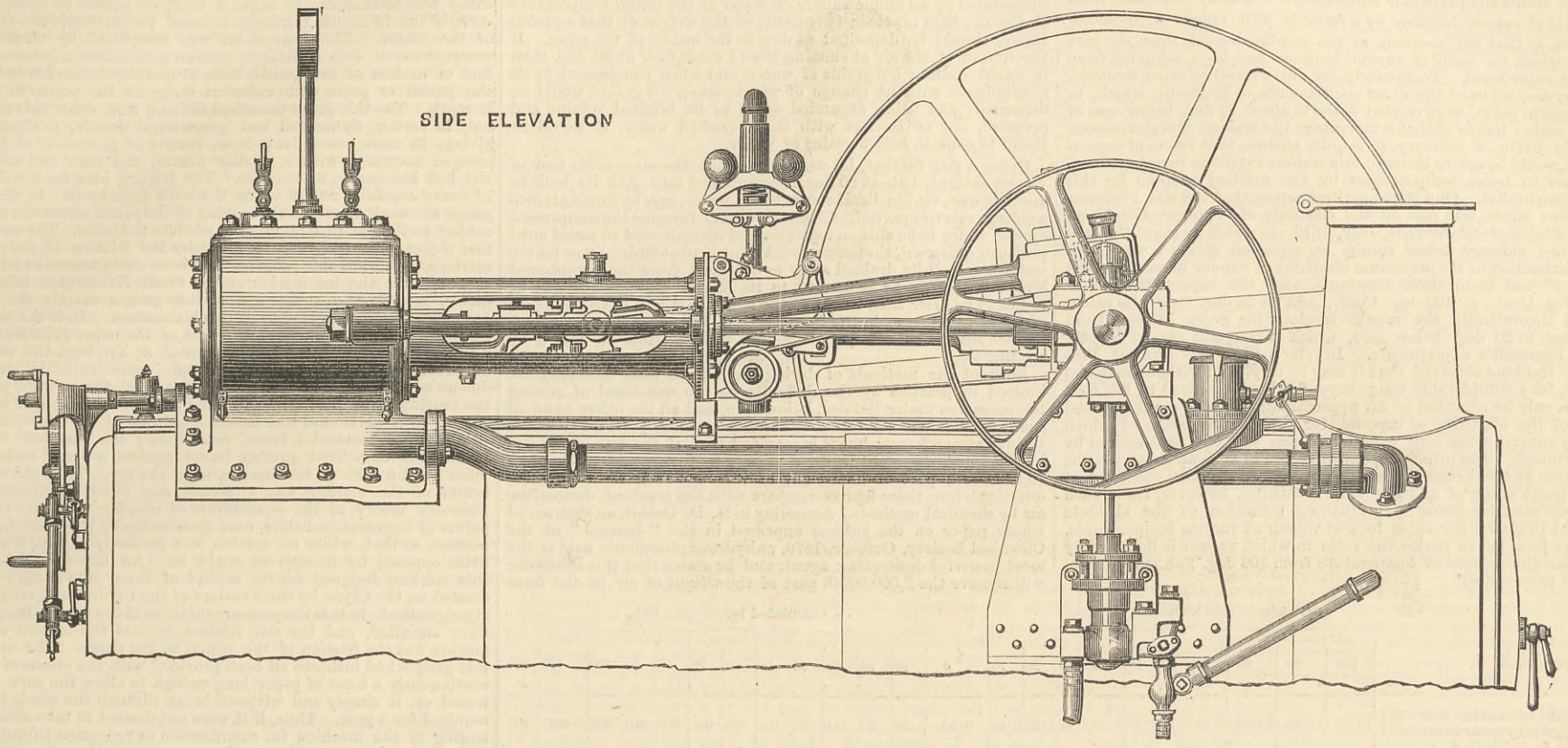
required, there is no risk of injuring the plate through punching ; (3) no dead pressure upon the tools ; (4) the tools especially designed and prepared for running at high speeds ; (5) the formation of a truly cylindrical hole may always be insured ; (6) a saving of at least 20 per cent. in time on each boiler front or plate.

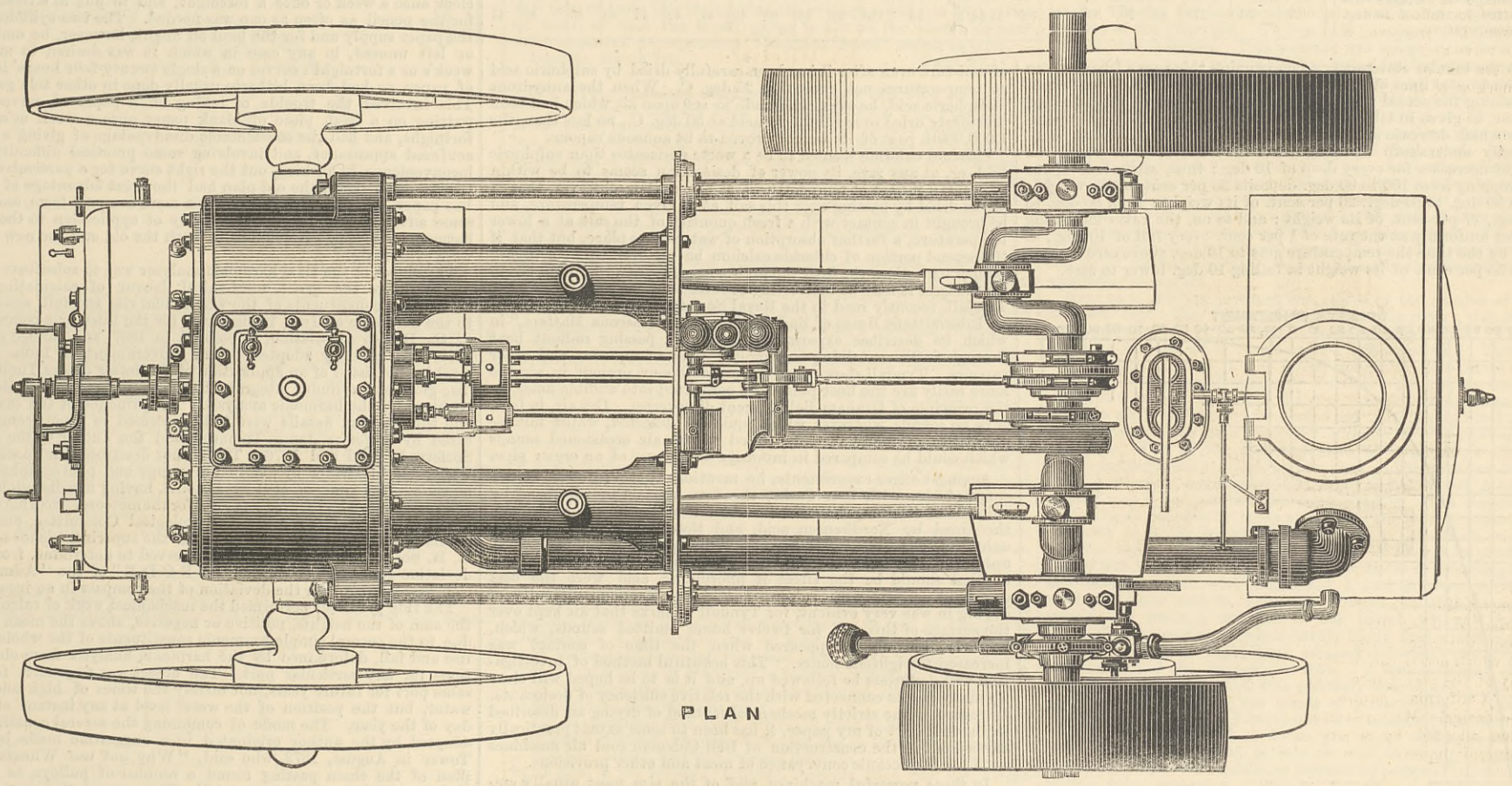
London Association of Foremen Engineers and Draughtsmen.—The twenty-eighth anniversary festival is now appointed to take place at the Cannon-street Hotel, on Saturday, April 16th. Further particulars will be announced hereafter.

Paris International Exhibition of Electricity.—We are asked to make known that at the request of the Commissaire Général, the "Society of Telegraph Engineers" "and of Electricians" have undertaken to supply to and collect from intending British exhibitors applications for space at the forthcoming exhibition. Forms of application and copies of the general rules can be obtained at the offices of the society, 4, Broad Sanctuary, Westminster, London, by letter addressed to the secretary of the society, or by personal application between the hours of eleven and five.

14-H.P. COMPOUND PORTABLE ENGINE.

MESSRS. MARSHALL, SONS, AND CO., ENGINEERS, GAINSBORO'.





We illustrate above a compound portable engine, exhibited by Messrs. Marshall at Islington last December. It has cylinders 6·5in. and 12·5in. diameter and 12in. stroke. The engraving explains itself. It is much to be regretted that Messrs. Marshall sold the engine and delivered it to the purchaser before they had any opportunity of testing it for economy, so that we are unable to draw a comparison between it and Messrs. Garrett and Sons compound portable. We understand that Messrs. Marshall and Sons have some other compound engines from the same patterns in hand, and we hope that with one of these what cannot fail to be a very interesting series of trials may be made, when we shall return to the subject.

FLETCHER'S SUBSTITUTE FOR PUTTY.

Although in some of its forms Mr. Fletcher's metallic substitute for putty forms a very good and light glazing bar for roofs of various kinds, he prefers to describe that which is illustrated in the following sketches, as for glazing purposes only. It will

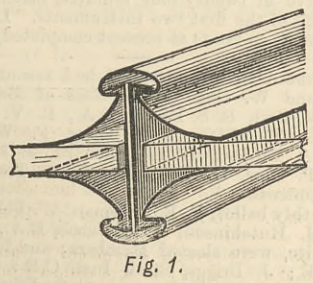


Fig. 1.

be readily seen that the chief feature in this invention is the sectional form of the thin bent zinc—or other metal not affected by the atmosphere—which is such that the lip which rests upon the glass and nips it is free under a certain amount of elastic flexure to follow any bends or ordinary curvature in the glass. In the annexed illustrations, Fig. 1 shows the top and bottom bent metallic substitute, as considered suitable for horticultural and other light buildings. A light copper or zinc bar of the necessary form constitutes a core, upon which the substitute depends for the maintenance of the proper distance between the two parts. The depth of this bar depends on the thickness of the glass to be used, in order that the necessary spring fit of the

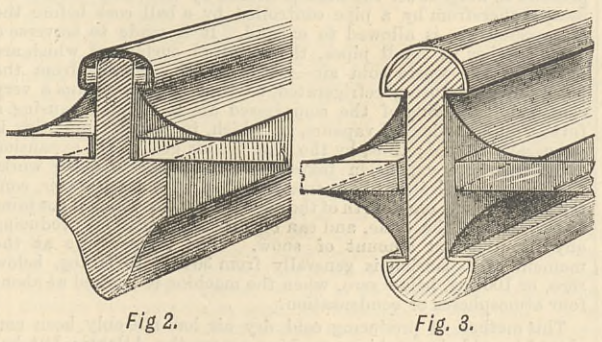


Fig. 2. *Fig. 3.*

substitute on the glass may be obtained. Fig. 2 shows a galvanised iron glazing bar, with "substitute" on top only, suitable for skylights or metal conservatories ; and Fig. 3 shows a special section galvanised iron core, with "substitute" top and bottom, forming a very strong, neat bar for large and small roofs. It will be seen that, especially in the forms shown at Figs. 1 and 3, leakage must be very difficult, if any take place, and even should any occur, the lower section forms a gutter by which the water can be carried off. Messrs. Fletcher, Lowndes and Co., of 13A, Great George-street, Westminster, the makers of the new "substitute," point out that it is cheap because of the rapidity with which the glazing can be effected, and that there is no outlay for maintenance. It will be easily seen that the arrangement gives every freedom for expansion and contraction.

Naval Engineer Appointments.—The following appointments have been made at the Admiralty :—Robert Mayson, engineer to the President, for service at the Admiralty, Whitehall, vice Corner. William Castle, chief engineer, to the Asia, additional, for service in the Volcano, vice Williams.

Liverpool Engineering Society.—The usual fortnightly meeting was held at the Royal Institution on Wednesday evening, the 2nd March, the president, Mr. Alfred Holt, being in the chair. A paper "On the Application of the Electric Light at the Free Public Library, Liverpool," by Mr. John S. Brodie, was read in the author's absence by the hon. secretary, Mr. Allies. The author premised his remarks by stating that though many and varied applications of the light for outdoor purposes had been made, it was reserved for London and Liverpool to promote its introduction for the purpose of illuminating large rooms—the former at the reading room of the British Museum, the latter in the new large reading room called after Mr. Councillor Picton. The considerations which led to the adoption of the light were first the serious loss and damage sustained by bindings, and caused by the fumes given off by gas, and secondly the extreme difficulty found in ventilating the old reading room when crowded of a winter's evening. The last and chief consideration, pointing as it does to the injurious effect of gas on the human constitution, cannot be too highly estimated. It may be stated that after the electric light had been temporarily in use for some time, when gas was used instead for a few weeks, during the substitution of permanent machinery for working the light, the library officials were overwhelmed with complaints on account of not only bad light but bad ventilation. The details of the engine power required to generate the electric current, and of the light itself, which is of the description known as the Serrin's patent lamp or regulator, were then stated very completely, and one of the lamps was exhibited and explained by Mr. Clare, the curator in charge of the machinery at the library. In conclusion the author stated that although the question of economy was not considered in the matter, yet on comparing the cost of the electric light with that of gas used for the same room, the former came out more favourably in spite of being saddled with the first cost and working expenses of machinery for ten lamps, three being all that at present had been used. Mr. R. R. Bevis, jun., then gave an interesting description of the "Brockie" lamp now in use of Messrs. Laird Bros.' workshops at Birkenhead. Discussion on this interesting subject was deferred to the next meeting

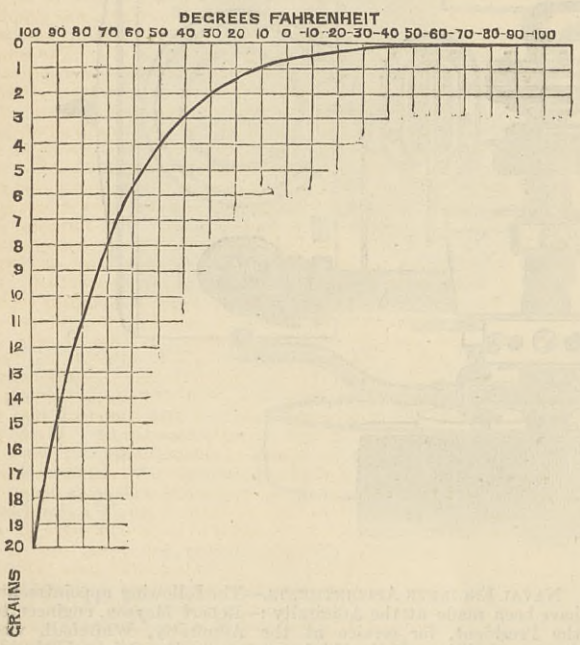
ON THE REMOVAL OF AQUEOUS VAPOUR FROM THE ATMOSPHERE.*

By J. J. Coleman, F.I.C., F.C.S.

The absolute weight of moisture contained in any given volume of air, and at any particular temperature, is usually calculated from a table of vapour tensions by a formula well known to meteorologists, so that the accuracy of the results depends upon the care with which the table of vapour tensions has been compiled from direct experiment. Fortunately for this as well as other branches of physics, we have the exact experiments of Regnault, which, in the case in point, were carried down to about 20 deg. below zero of Fah. scale; but as at that temperature the tension of water vapour is only ·017in. of mercury, it is quite obvious that errors of experiment would be apt to increase to a serious extent in carrying observations to lower temperatures by the method adopted by this experimentalist. One of the earliest papers that the late Professor Rankine wrote was one on the elasticity of vapours—*Edinburgh New Philosophical Journal*, July, 1849—in which he says, "I have obtained amongst other results an equation giving a very close approximation to the maximum elasticity of vapour in contact with water," and from three constants, viz., the vapour tension at 220 deg. Cent., at 100 deg. Cent., and at 26 deg. Cent., he calculated theoretically the vapour tensions for every 10 deg., from 230 deg. to 20 deg. below zero, which correspond almost exactly with Regnault's experiments. In reference to this formula, Professor Rankine observed that it may be employed without material error, for a considerable range beyond what he proved it, but that it can only be regarded as an approximation to the exact physical law of the elasticity of vapours, for the determination of which many constants are still wanting, which can only be supplied by experiment. The principal point involved in such an inquiry is the question as to whether aqueous vapour ceases to have elasticity at any point short of absolute zero. Passing, however, from such remote considerations, and directing attention to the absolute weight in grains per cubic foot of vapour at various temperatures, I have been led to notice the ratio in which vapour is liquefied by regular diminutions of temperature from 100 deg. Fah. above zero, down to zero itself.

	Glaisher's tables above zero. Fah.										Calculated below zero. Fah.												
Temperatures.	100	90	80	70	60	50	40	30	20	10	0	10	20	30	40	50	60	70	80	90	100	110	120
Weight of cubic foot of saturated vapour in grains.	19·84	14·85	10·98	8·01	5·77	4·10	2·86	1·97	1·30	0·84	0·55	·36	·23	·14	·08	·05	·03	·017	·009	·005	·003	·0015	·001
Percentage of weight deposited for fall of 10 deg. in temperature.	25	26	27	28	29	30	31	34	35	34·5	35	36	37	38	39	40	41	42	43	44	45	46	47

On the tabular statements accompanying this paper I have given two horizontal lines of figures, the upper line up to half its length containing the actual weight in grains of a cubic foot of saturated vapour, as given in Glaisher's Hygrometric Tables, and for temperatures which decrease at the uniform rate of 10 deg. down to zero. Directly underneath these figures I show the rates in which the weight decreases for every drop of 10 deg.; thus, saturated vapour in dropping from 100 to 90 deg. deposits 25 per cent. of its weight; from 90 deg. to 80 deg., 26 per cent. of its weight; from 80 deg. to 70 deg., 27 per cent. of its weight; and so on, the ratio increasing almost uniformly at the rate of 1 per cent. every fall of 10 deg., so that by the time the temperature gets to 10 deg. above zero it parts with 35 per cent. of its weight in falling 10 deg. lower to zero.



It seems reasonable, therefore, to suppose that some similar ratio of decrease will maintain for temperatures far below zero, and in accordance with this view I have ventured to extend the line of figures to a temperature of 120 deg. below zero, from which I have calculated the figures on the remaining half of the line above alluded to, thus showing the probable weight of a cubic foot of vapour for every 10 deg. to 120 deg. below zero. The result can, of course, only be considered as an approximation, for in reality the ratio of liquefaction must be accelerated to ensure complete liquefaction at a point above absolute zero; but at any rate, it is very clear that at a temperature of 120 deg, below zero a cubic foot of saturated aqueous vapour does not weigh more than the thousandth part of a grain, or $\frac{1}{536,000}$ part of the weight of the same volume of dry air at 60 deg., or about $\frac{1}{800,000}$ of the weight of a cubic foot of dry air at 120 deg. below zero.

I have also thought it might be interesting to put the result in the form of a graphic curve, the vertical figures representing the weight of a cubic foot of vapour, and the horizontal figures representing the temperature, commencing at 100 deg. above zero and ending at 100 deg. below zero. One of the most curious facts that strikes the eye is the independent influence of the freezing point of water upon this curve, although there is a little irregularity. There is no sudden deposition of moisture when the freezing point is attained, ice, in fact, imparting humidity to air just as water had previously done before the freezing point was attained.

With a view to consider for a moment the joint effect of cold and pressure upon aqueous vapour, I have now to remind you of a well-known law of physics, viz., that when saturated vapour is subjected to pressure it will liquefy in the direct ratio of the pressure, temperature being constant; and also that atmospheric air saturated with aqueous vapour behaves in this respect just the same as if the air were not present. This principle was illustrated by Dalton, who introduced volatile liquids into the Terricellian vacuum of a barometer tube, and showed that the liquids evaporated or recondensed in proportion to the elevation or lowering of the tube in a mercurial trough. Assume, then, that air at 60 deg. Fah. and saturated with moisture is compressed to 20 atmospheres, and in a surface condenser consisting of a suitable system of tubes surrounded by an ample supply of water at the initial temperature of the air, then nineteen-twentieths of the weight of that aqueous vapour should be deposited as dew in the inside of the pipes. If the volume of the air at starting were 1 cubic foot at 60 deg. then it would contain 5·8 grains of water, and when compressed to 20 atmospheres without change of temperature 5·5 grains would be deposited, and being expanded again to its original volume and pressure, out of contact with the deposited water, it would be found to contain only 3 grains of water.

Going a step further, let us suppose that the same cubic foot of vapour saturated air at 60 deg. is compressed into $\frac{1}{20}$th its bulk in another way, viz., in direct contact with water, say, by forcing it into a strong reservoir partially filled with water. Imagine the compressed air and water to be shaken together, and then allowed to stand until perfectly quiescent, the temperature being kept at 60 deg.; now let the water be carefully drained away or detached from the compressed air, and the air be expanded to its former bulk, and it will be found to be drier than it was at the start, as it will have lost $\frac{19}{20}$ths of its vapour just as in the former case. Thus we are brought face to face with a curious paradox—that it is possible to dry air by wetting it.

Both of the methods of drying air I have thus described are limited in practice by the difficulty on the one hand of getting temperatures under 100 deg. below zero, and on the other hand of compressing air in a continuous current to higher pressure than the twenty atmospheres; but it is manifest that if the two operations be combined, air might be dried so as not to contain more than 10,000,000th part of its weight of vapour. It is an interesting question—how these figures compare with the result of desiccating air by chemical methods. According to H. D. Debbit, an abstract of whose paper on the subject appeared in the "Journal" of the Chemical Society, October, 1876, anhydrous phosphoric acid is the most powerful desiccating agent, and he states that this substance will remove the 2,000,000th part of the weight of air in the form of moisture even after it has been carefully dried by sulphuric acid at temperatures not exceeding 25 deg. C. When the anhydrous phosphoric acid, he says, was made to act upon air which had been previously dried over sulphuric acid at 50 deg. C., no less than the 1,000,000th part of its weight proved to be aqueous vapour.

Calcium chloride seemed to be a worse desiccator than sulphuric acid, or, at any rate, its power of desiccation seems to be within very small ranges of temperatures, as the author observes, that if air be dried by passing over this salt at a given temperature, and be brought in contact with a fresh quantity of the salt at a lower temperature, a further absorption of water takes place, but that if the second portion of chloride calcium be maintained at a higher temperature than the first, the air becomes moister. In reference to this subject it may be interesting to refer to the paper of Professor Tyndall, recently read to the Royal Society, "Upon the Action of an Intermittent Beam of Radiant Heat upon Gaseous Matters," in which he describes experiments made by passing radiant heat through flasks containing varying quantities of aqueous and other vapours. Tyndall shows that the more vapour present in air the more easily are the heat pulsations converted into audible noise, on the principle of Graham Bell's recent discoveries. Dry air, in fact, gave no sounds whatever which could be detected, whilst minute quantities of many vapours added to the air occasioned sounds which could be compared in intensity with those of an organ pipe.

Amongst other experiments, he mentions that Professor Dewar supplied him with four flasks, the first containing air dried by chloride of calcium, the second one dried by strong sulphuric acid, the third by Nordhausen acid, and the fourth by phosphoric anhydride; and curious to say, the flask containing the phosphoric anhydride emitted the strongest sound, which is the exact reverse of what should be the effect if phosphoric acid were the best desiccant. Even with sulphuric acid the extreme difficulty of drying in was very evident, for Tyndall remarks that air kept over the surface of this acid for twelve hours emitted sounds, which, however, entirely disappeared when the time of contact was increased to eighteen hours. This beautiful method of investigation will doubtless be followed up, and it is to be hoped will clear up many points connected with the relative efficiency of desiccants. In regard to the strictly mechanical method of drying air described in the first part of my paper, it has been to some extent practically carried out in the construction of Bell-Coleman cold air machines used for the oceanic conveyance of meat and other provisions.

In these powerful machines, and of the size most usually employed in the Transatlantic traffic, about 36,000 cubic feet per hour of atmospheric air is taken into the air compressors; and supposing this air is two-thirds saturated, and of a temperature of 80 deg. Fah., it contains 37½ lb. water vapour, some of which must be removed before the air is finally discharged from the machine below zero, or the discharged air would become loaded with clouds of snow, which would be a great practical inconvenience. But in point of fact about half this aqueous vapour is at once deposited and mingles with the water which is freely injected into the compressors to keep down the heat produced by the compression, and escapes therefrom by a pipe controlled by a ball cock before the compressed air is allowed to expand. It is made to traverse a great number of small pipes, the external surface of which are cooled by the waste cold air—say of 30 deg.—coming from the provision room being refrigerated, so that by this means a very considerable cooling of the compressed air is effected, causing a further liquefaction of vapours, by which, in fact, its quantity is practically halved; thus, by the time the air gets to the expansion cylinder, where expansion takes place in the act of doing work, the air, although it has been freely washed with fresh water, contains only about one-fourth of the aqueous vapour which it contains at the start of the cycle, and can be expanded without producing any inconvenient amount of snow. The temperature at the moment of expansion is generally from 30 deg. to 50 deg. below zero, or 100 deg. below zero, when the machine is worked at about four atmospheres of condensation.

This method of producing cold dry air has not only been employed in cold air machines working across the Atlantic, but has also been recently found to work well with machinery traversing the Red Sea and Indian Oceans.

* Read before the Chemical Section of the Glasgow Philosophical Society.

THE INSTITUTION OF CIVIL ENGINEERS.

THE TIDE GAUGE, TIDAL HARMONIC ANALYSER, AND TIDE PREDICTER.

On Tuesday, the 1st of March, Mr. Abernethy, F.R.S.E., President, in the chair, the paper read was by Sir William Thomson, LL.D., F.R.SS. L. and E., M.I.C.E.

The author stated that the self-registering tide gauge was a well-known instrument for automatically recording the height of the sea level at every instant, above or below some assumed datum line. The first essential of the instrument was a floater, which rose and fell with the water. The practical annulment of wave disturbance, so that the floater at each instant might be nearly enough in the position corresponding to the mean of the water-level for several minutes, was an important detail. The next thing was mechanism to cause a marking pencil to move in a straight line in simple, but much reduced, proportion to the motion of the floater. The instrument was completed by clockwork, carrying paper with a uniform motion perpendicularly across the line of motion of the pencil, with proper arrangements to cause the pencil to press with sufficient force on the paper to make it mark. The tide gauge described differed from other tide gauges only in certain dynamical and geometrical details, designed for giving, in more convenient form, results of greater or of better assured accuracy, with a smaller floater, and finer and smaller, but not less hardy, mechanism. The leading idea for the design of every machine ought to be the work done by it. In the tide gauge the work done was the moving of the pencil across the paper, subject to the pressure required to produce the mark. The author's first object, therefore, was to minimise the friction of the pencil carriage. Considerable progress had been made towards attaining this object in the ink marker of the South Kensington tide predicter, and in the author's first tide gauges exactly the same geometrical slide was used as in this instrument. In it the motion of the marker was vertical, the axis of the paper cylinder being vertical, instead of both being horizontal, as had been the case in all previous tide gauges. The couple, constituted by gravity downwards through its centre of gravity and the upward pull of the bearing wire, was balanced by the reaction of the paper on the marker in a horizontal line near the bottom of the mass, and an equilibrating horizontal force, constituting the reaction of the plane back of a fixed guiding frame against a round-ended pin fixed to the back of the marker, near the top. Thus the equilibrium of the marker was a simple and direct application of Poinsot's theory of the equilibrium of couples. The five sliding points of a geometrical slide were systematically provided for the marker, so that, while its motion was perfectly steady, it was as little opposed by friction as might be. An improvement upon this marker, designed for the second of three tide gauges being erected on the Clyde by the Trustees of the Clyde Navigation, was also described. In this the pressures of three of the five sliding points were annulled, and the sole friction against the motion of the marker was the friction of the pencil on the paper. The author's tide gauges had hitherto all been provided with the means of using continuously a band of paper long enough to allow the curve to be traced on it simply and without break through the whole length required for a year. Thus, if it were not desired to take away any tracing of the machine for examination or reduction through the course of a year, no other work was necessary than to wind the clock once a week or once a fortnight, and to put in a fresh lead for the pencil as often as one was needed. The two cylinders for the paper supply and for the haul-off might, however, be omitted, or left unused, in any case in which it was desired to mark a week's or a fortnight's curves on a single twenty-four hours' length of paper, as had been hitherto usually done in other tide gauges. This involved the trouble of taking off a paper of curves and putting on a fresh piece of blank paper once a week or once a fortnight, and had the considerable disadvantage of giving a more confused appearance, and involving some practical difficulty and inconvenience in picking out the right curve for a particular day. On the other hand, the old plan had the great advantage of using less paper, and giving the results in a more compact form, and also some advantage in respect to facility of application to the tidal harmonic analyser. Specimens of both the old and the new plans were exhibited.

The object of the tidal harmonic analyser was to substitute brass for brain in the great mechanical labour of calculating the elementary constituents of the whole tidal rise and fall, according to the harmonic analysis inaugurated for the tides by a committee of the British Association, appointed in 1867, and carried on till 1876, and recently adopted by the Government of India. The machine consisted of an application of Professor James Thomson's disc-globe and cylinder integrator to the evaluation of the integrals required for the harmonic analysis. The principle of the machine and the essential details were fully described in papers communicated by Professor James Thomson and the author to the Royal Society in 1876 and 1878. The author described the machine—which was illustrated by detailed drawings and photographs—and he showed the working of it by a model, having five disc-globe and cylinders, which had served as model for the meteorological harmonic analyser constructed for the Meteorological Committee, and now regularly at work at their office, under the superintendence of Mr. R. H. Scott. This instrument also served to determine, from the deviation curve, the celebrated "A B C D E" of the "Admiralty Compass Manual" for the deviation of the compass in an iron ship.

The tide predicter performed the mechanical work of calculating the sum of the heights, positive or negative, above the mean level, due to the several simple harmonic constituents of the whole tidal rise and fall, determined by the harmonic analysis from observations for any particular port. The object was to predict for the same port for future years, not merely the times of high and low water, but the position of the water level at any instant of any day of the year. The mode of combining the several constituents adopted by the author originated in a suggestion made by Mr. Tower in August, 1872, who said, "Why not use Wheatstone's plan of the chain passing round a number of pulleys, as in his alphabetic telegraph instrument?" This proved the very thing wanted. The plan was completed, with a fine steel hair-spring, or wire, instead of the chain, which was obviously too frictional for the tide predicter. The general object of the tide predicter, and some of the details of the first instrument—which was exhibited by permission of the Science and Art Department, under whose care it had been permanently placed by the British Association—were described in the catalogue of the South Kensington Loan Exhibition of 1876. A second instrument, including twenty tidal constituents instead of the ten in the original instrument, and with greatly improved arithmetical exactness in respect of the several shafts, and on a much larger scale than that of the first instrument, had been constructed for the Indian Government by Mr. Légé, under the superintendence of Mr. Edward Roberts, and in accordance with the author's advice. In it, as in the British Association instrument, the number of teeth in the toothed wheels was calculated by Mr. Roberts. This instrument had already done excellent work, in predicting the tides for the Indian ports as given in the volume of Tide Tables for the year 1881, prepared by Captain Baird, R.E, assisted by Mr. Roberts, who had charge of the instrument in London. The author had nearly completed a third instrument, with great simplifications of mechanism, one important result of which was that it was adapted to run off a year's tide curve in twenty-four minutes, instead of four hours required by each of the first two instruments. Detailed drawings of this instrument, so far as at present completed, were exhibited.

It was announced that the Council had recently transferred C. J. Bowstead and W. Hall to the class of Members; and had admitted J. W. Bell, B. S. Biram, B.A., R. V. Boswell, R. H. Brookhouse, G. T. Elliot, A. J. Hogg, F. W. Kershaw, P. MacGuire, A. A. Minjoot, H. E. Punchard, J. H. Punchard, W. C. Punchard, P. Ross, G. N. Taylor, H. W. Teed, and W. Price Williams as Students.

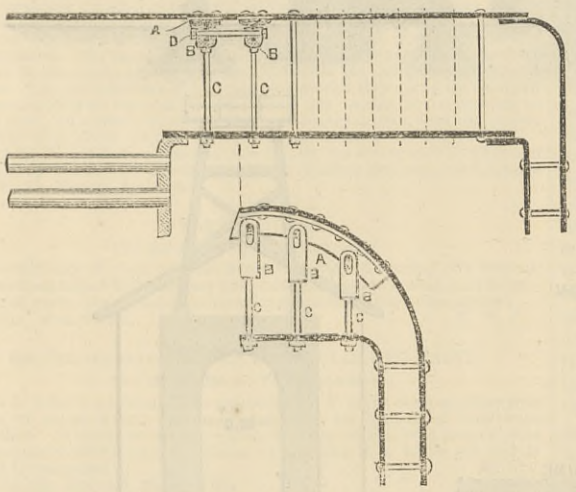
At the monthly ballot, F. F. Bateman, W. Fiddes, E. J. Grice, C. Hunt, J. H. Hutchinson, A. H. Jacob, B.A., C. H. Moberly, and H. F. White, were elected Members; and H. O. Bell-Irving, Stud. Inst. C.E.; J. Briggs, Stud. Inst. C.E.; C. Clegg, Stud. Inst. C.E.; T. A. Cox; L. Creasey; C. S. Ellery; C. T. Elton; A. C. Evans; G. H. Garrett; R. Hay; W. F. How, Stud. Inst. C.E.; W. Jackson; F. R. Johnson, Stud. Inst. C.E.; F. Jopling; E. Pillow; E. H. Stevenson; F. W. Stevenson; and S. E. Stevenson, Associate Members; and T. A. Dash and J. S. Hollings, Associates.

LETTERS TO THE EDITOR.

[*Continued from page* 196.]

PERKINS' HANGING FIRE-BOX ROOF STAY BOLTS.

SIR,—In your issue of yesterday, I observe a woodcut and letter-press explanatory of an arrangement of fire-box top staying, designed and patented by Mr. Perkins. Your readers may not be aware that this is a colourable imitation of an arrangement of mine, which has been in use, I think, over six years. Mr. Perkins has simply inverted my plan, and to my mind, with detriment to the object in view. Twenty years ago, when I was an apprentice, the universal method of fire-box top staying was by the saddle stay, either solid or by two rivetted plates. Later, the single bolt stay screwed through box top and outer shell was introduced, I think, from America. The old saddle stay gave most satisfactory results in all but one particular—it impeded free circulation of water over the fire-box top, and induced caking of dirt, causing loss of evaporative power. The single bolt stay is an improvement, giving all needful rigidity, and leaving a free passage for washing out and keeping the box top free. With this latter form of staying, however, was introduced an evil which rarely, if ever, arose with the saddle stay, namely, cracking and crippling of tube-plates. When in charge of an important Indian railway, I had twenty-four engines sent out to me, with this single bolt rigid staying. When they had been at work four or five months, my foremen began reporting the tube-plates at all the out stations. Taking the matter up, I was fairly amazed at the condition of affairs, finding in some engines the tube-holes gone oval as much as $\frac{3}{16}$in., principally in the top corners of the box. I saw at once the cause and the remedy. I applied one, of which I enclose a sketch. This proved a complete cure in all the engines, when new tube-plates were put in. I sent a drawing home to England to the company's consulting engineer, who forwarded it to Messrs. Neilson and Co., of Glasgow, who had other engines in hand for me. Mr. Reid, of Neilson's, thought so well of the design that he has adopted it as a principle in all the engines he builds, unless otherwise ordered. You will observe my plan leaves the box top clear. A A are two T-irons rivetted to the boiler shell of boiler; B B, jaw eyes, into

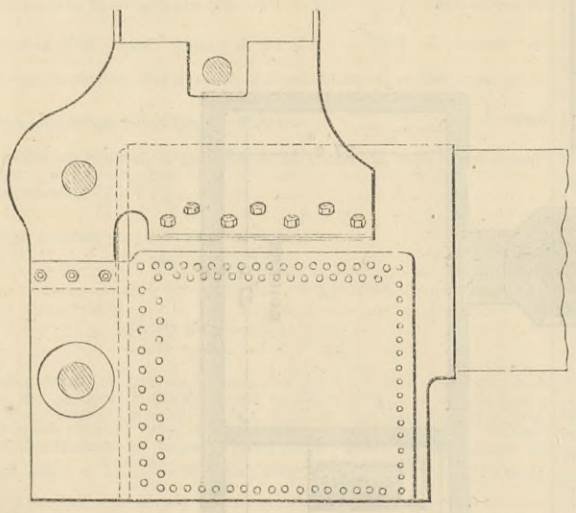


which the bolts C C are screwed from the inside of the fire-box; D, long bolt passing through jaws and T-irons. In the cross-section the holes in the jaws will be seen to be elongated, to admit of upward travel over the bolt D, when the tube-plate expands and lifts. Mr. Perkins perpetuates the old evil by giving a hold for scale and silt to cake against on the box top. I may give Mr. Perkins and your readers this further information, that, from five years' practical experience, I found there is no need to put expansion staying beyond, in large boxes, three rows of stays; in smaller ones, two rows. This suffices to give elasticity to the tube-plate, and allows it to go up under the expanding of the tube-plate metal from the fierce heat of the box when hauling a load. I am sorry Mr. Perkins' "designed and patented" plan is not as novel or effective as it appears. EDWARD G. SHEWARD.

2, Dynevor-road, Richmond, March 12th.

AVELING *v.* MCLAREN.

SIR,—I enclose tracing of the bracket arrangement used by Messrs. McLaren, and which was the subject of the late action.



You will see that it differs somewhat from the sketch published in your journal of last week. THOS. AVELING.

Cannon-street, London, March 15th.

DAMPING DOWN BLAST FURNACES.

SIR,—The following experience may be of interest to some of your readers:—At these works a boiler explosion took place on January 16th, doing considerable damage, but fortunately not resulting in any loss of life. Of course the steam power was lost at once, and the furnaces were damped down. It was decided to prevent in future any similar accident, whilst doing the necessary repairs required by this, to cut all the boilers, which were of long cylindrical type—eight in number—in two, connecting the two portions of each, top and bottom, after a similar plan to that already adopted at the Clarence Works, and, I believe, at one or two other works in the Cleveland district.

This work took considerable time, and some anxiety was felt as to what the state of the furnaces would be when again ready for work. The blast was got on, on February the 22nd, and both furnaces started without any trouble or difficulty; the slag was black for the first twenty-four hours, after which it turned to grey, as it has continued ever since.

This is interesting as showing the length of time furnaces in fair working order may be allowed to stand upon an emergency, without preparation, and without serious disorganisation following.

Brigg, Lincolnshire, March 5th. GEORGE DOVE.

HIGH SPEED LOCOMOTIVES.

SIR,—Owing to the late discussion on "High Speed Locomotives" in your esteemed paper, I feel it my duty to bring forward a few facts which I have no doubt will serve to eradicate the error of imagining that only the Great Western average over fifty miles an hour:—On Saturday, 5th, I left Euston by the 4 p.m., the London and North-Western Company's Manchester and Liverpool express; arrived at Willesden Junction, 4.12, departed 4.15, passed Harrow at 4.24 (6 miles 9m.), Bushey at 4h. 29½m. (4½ miles 5¼m.), Watford at 4h. 30m. 43s. (1½ miles 1m. 28s. Here it will be seen we ran more than 60 miles an hour), passed Tring 4.48 (14¼ miles in 17m. 17s., nearly 50 miles an hour); as far as this point, "Tring," it is all up hill from London, the 31¾ miles being done in 48m., the stop at Willesden included. We next passed Cheddington at 4.52½ (4¼ miles in 4½m.), Leighton at 4h. 56m. 7s. (4½ miles in 3m. 37s., an average of 74$\frac{14}{17}$ an hour); passed Bletchley at 5h. 3m. (6½ miles in 6m. 53s.), bringing the trip from Tring to Bletchley, 15 miles in 15m., an average of 60 miles an hour. We had hardly got out of Bletchley when the Denbigh Hall signal box's "distant" was against us; having reduced speed to about 12 miles an hour, we proceeded at a slow rate to the point of obstruction, viz., a slip on the down fast side of the line; fortunately the road was clear and the home signal was dropped to all right, and we started again at 5.8, the slack having occupied nearly 4m. Passing Wolverton at 5.12, where we were slacked again badly for about 3m., owing to a tremendous slip on the up side of the road; passed Blisworth at 5.26¼; here it began to rain and drizzle alternately, and the engine slipped a good deal; passed Crick at 5.41 (13¼ miles in 14$\frac{3}{4}$m., about 53 miles an hour average); pulled up at Rugby 5.48, a very excellent performance considering the rails were very greasy, and the load we had, viz., twelve 6-wheeled coaches, nine of them weighing 14 tons each, and three brakes weighing 16 tons each, making a total weight of 174 tons without passengers or luggage. Now, allowing only 3m. each for slacks and 1 for starting from them and Willesden, it makes the journey from Willesden to Rugby in 1h. 26m., 77¼ miles, or 1 mile farther than Swindon to Paddington in a minute less time than the Great Western "crack" takes.

But this is not the fastest train on the London and North-Western Railway, nor the heaviest one. Supposing the Great Western broad gauge carriages to weigh half as much again as the London and North-Western Company's carriages, even then the latter takes the heavier load of the two, for when, I ask, and how often does the Flying Dutchman take more than six carriages, and what gradients does she have to climb? Two-thirds of the road to Rugby is a rising gradient, and that a stiff one in some places. It will be seen from this timing that the average speed was 53$\frac{3}{4}\frac{1}{3}$ miles an hour, so that the broad gauge is not so far ahead as your most respected correspondent "Running Board" seems to infer.

London, March 7th. FAIR PLAY.

SIR,—The illustrated description you have this week given us of the new express engines built by Messrs. Beyer and Peacock, of Manchester, comes opportunely, as bearing on the subject which has for some time been discussed in these columns. This engine is certainly of a type which has a large preponderance of advantages over disadvantages; and on an examination of its characteristics, it shows, I think, that it merits all the encomiums you have passed upon it. If in a future issue you could publish a complete list of its dimensions, it would, I am sure, be scanned with interest by a large section of your readers.

One cannot avoid being struck with the contrast between this elegant and well-designed engine and the uncouth American machine built for express traffic on the Bound Brooke line, and illustrated in THE ENGINEER of the 11th ult. In my opinion, the Americans will never succeed in producing a rational high-speed locomotive until they condescend to copy the large wheels and plate frames universally adopted here and on the Continent. The greatest bane of American locomotive practice is, doubtless, the fact that its "master mechanics" cannot be induced to give up the antiquated bar framing, which is not only a source of general inconvenience, but it so reduces the width of the fire-box as to make it 6in. narrower than it need be. This, in my opinion, evinces an amount of prejudice paralleled only by the tenacity with which some of our own locomotive superintendents cling to their darling type, represented by inside cylinders with single inside frames, necessitating "cramped" ports with minimised journals, and a narrow spring base with rigid springs—a type, however tolerable for small locomotives, is, in large express engines, little short of an absurdity. NEMO.

March 9th.

SIR,—I am glad to find, what I really did not know before, that so many trains in the United Kingdom run as fast as the Flying Dutchman. I agree with one of your correspondents, and think that perhaps enough has been said about these trains' speed, and that we may turn our attention in another direction. Let us consider how high speeds are best to be obtained, and by interchange of thought we may do some good.

I have examined with much attention your engravings of Messrs. Beyer and Peacock's express engine for the Holland State Railway. It is a fine design, and the engine deserves, I think, all that you have said in its favour. I think, however, that our own Great Western single express narrow gauge engines compare very favourably with it, and I would even venture to back one of these Swindon engines to do as good work as Messrs. Beyer and Peacock's engine, always provided that the road be level and the weather good. In damp weather, or up a bank, the Holland engine's coupled wheels would have a great advantage over the Swindon engine. Having said so much, I would like to suggest that such of your readers as are competent might send you outline sketches of the style of engine they would propose to perform a certain duty, which, if you have no objection, and would publish in THE ENGINEER, would, I am sure, prove useful. I shall be happy to do my part if others are agreeable.

I would suggest that we take as a standard a net load of 220 tons, besides the engine and tender; that the length of run be 100 miles—this is less by five miles than the Midland run to Grantham—that the average speed shall be sixty miles an hour; sharpest curve, 20 chains radius; steepest incline, 1 in 200 three miles long; the remainder of the inclines to balance each other—that is to say, the stations at each end of the 100 miles shall be at the same level; any design of engine to be admissible—inside cylinder, out side cylinder, Fairlie, bogie, or coupled or not. It is to be understood that the engine must start at one end of its run, and stop at the other, and the start at one end at least must be up 1 in 300. The road is to be supposed to be kept clear, but a delay of three minutes ought to be allowed for to provide for the chance of signals being against the express, which is understood to have to run through two large yards, such, for example, as Swindon. It will be seen that smartness in getting away with a train is a matter to be thought of in designing an engine for this class of work.

I do not think any elaborate drawings would be required, but just outlines, showing general arrangement; but all the dimensions ought to be given, especially those of the wearing parts likely to send the engine in for repairs, and special attention ought to be paid to lubrication.

I hope you will find this meet your views enough to give it a place in your valuable columns. I am sure the subject discussed interests a great many of us. RUNNING BOARD.

Swindon, March 14th.

THE EFFICIENCY OF A TANDEM ENGINE.

SIR,—I have read your article in THE ENGINEER of 11th March with feelings of surprise and regret—surprise at learning that "all the calculations" in the former article "referred to a suppositious case, and in no way affect the question at issue;" regret at finding that I had been so far "drawn" as to write a whole column of newspaper in reply, since it now seems it was of little consequence whether the figures or the conclusions you drew from them were correct or the reverse. In making the few comments which seem necessary on the present article, therefore, I shall be as brief as possible. First, I regret I did not mention that the steam pipe was clothed, but as I never imagined anybody would have thought otherwise, I did not think it desirable to lengthen what was already a lengthy report with what appeared to me unnecessary matter. The pipes were covered with one of the ordinary compositions used in these parts, about 2½in. thick. Secondly, as to the coefficient 0·002, you say it is the coefficient for unclothed pipes. I fear you are inaccurate. If you will turn to the authority I quoted, viz., "Société Industrielle de Mulhouse Bulletin," 1879, page 730, and will look at the ninth line on table 3, you will find that the condensation in the unclothed pipe was 6·124 kilogrammes—13·47 lb.—per hour, the difference between the internal and external temperatures being 125·6 Centigrade—258 deg. Fah. Whence, as the diameter of the pipe was 150 mm. and the length 2·5 m.—surface, 13 sq. ft.—it follows that the weight of steam condensed per square foot of surface per hour and per degree Fah. was $\frac{13}{13{\cdot}47 \times 258} = 0{\cdot}004$ lb. This therefore is the co-efficient for unclothed pipes, a co-efficient which it may be observed agrees better with Mr. Head's than yours does. Thirdly, you are certainly correct in stating that I would have been quite mistaken if I had fancied that all the water in the steam was caught by the drain pipe. The statement, however, was unnecessary, inasmuch as I never fancied any such thing. Had you read note 2, page 19, of the report, you would have seen exactly what I did fancy and why. Fourthly, with regard to Mr. Fletcher's report. I am quite aware of its contents. If I had thought it possible to arrive at an estimate of the performance of Messrs. Nuttall's engine, by adding the coal accounts and boiler pressures of a lot of other engines together and striking an average, I have a thousand and odd engines handy in my own company's books, only waiting to be added up. But as it seemed to me that the very magnitude of the calculation might detract from its accuracy, I preferred to tackle the one engine only. I am sure Mr. Fletcher will agree with me when I say that his report was meant for a very different purpose. Fifth, I am sorry I cannot comply with your request to give an explanation of the causes which have conduced to the results I have recorded, but I will gladly supply what little further information I can on the manner in which the tub record was kept and the mode in which the contents were measured.

First, then, a galvanised iron bucket was hung up, and 12 quarts—three gallons—of water were measured into it from a standard quart measure. Secondly, a mark was made on the bucket at each end of the diameter in the plane of the handle to show the water level. Thirdly, the bucket was weighed full and empty to test the honesty of the quart pot. Thus a unit measure, containing three gallons, was obtained. This measure was taken to the boiler house and suspended near the tubs; it was then filled three times up to the marks and emptied into one of the tubs, and as soon as the water level had settled the lath C D, shown in plate N of the report, was put down to the bottom of the barrel and marked at the top of the wetted part. In this way ten times nine gallons were measured into the tub, and ten marks were obtained on the rod. Lastly, an overflow was bored at the water level. As I saw every bucket filled to the proper height, and poured it myself into the barrel, I had no doubt as to the accuracy of the measurement; nevertheless, thinking it best to make assurance doubly sure, I have since had my measurement checked by weight as you suggested. The weight of water contained in a barrel up to the overflow was just under 900 lb. I think, therefore, it is beyond doubt that the barrels were accurately measured.

Next as to the way in which the record of the number of barrels used was kept. The water, as explained in the report, was supplied by a hose pipe from the Bolton Water Company's main. This pipe could be put into either barrel or into neither at will. The supply was so regulated that it took rather longer to fill a barrel than to empty one. Hence it was only necessary as soon as one barrel was full to move the end of the pipe into the empty barrel. The overflow above mentioned prevented any barrel being filled too full. The inspector who kept the tally attended to the moving of the hose pipe. One of the assistants from the company's office was at the donkey close at hand, and as soon as the inspector told him a tub was empty, he stopped the donkey and shut cock A say, then opened cock B and started the donkey again. The inspector had therefore no occasion to move away from the tubs or concern himself with anything beyond lifting the hose pipe from one barrel into the other, and noting the number of barrels emptied. The record was kept in such a way that the times of emptying each of the barrels, which were numbered 1 and 2, were entered on alternate lines and in separate columns, so that it was impossible to make a mistake of one barrel without its being at once perceived; and as it is hardly likely that a mistake of two consecutive barrels could have escaped detection, particularly in the presence of the waterworks man. I feel confident that the number of barrels emptied was correctly ascertained. Sixth, you say I left a great deal in the hands of subordinates. I don't see what else I could do. I could not have taken all the observations myself. If I had tried to do so, you might well have distrusted the results. I preferred to rely on men in whom I could place entire confidence—a confidence justified by personal knowledge not dating from yesterday. Finally, I may say I am not at all offended at your pointing out that the statements I have made are startling. I expected they would be, or perhaps I should never have tested the engine. But I think you have gone rather beyond this. You have not merely declared that my figures are startling, but that they are impossible, and you have given calculations to prove that they are impossible; and when I have gone through the calculations, and pointed out the mistakes, you tell me, like Mr. Toots, that "it's of no consequence," as they don't affect the question, and you go into a second set of calculations, which, to say the truth, don't seem to me to be more relevant than the first. Indeed, I cannot help feeling you have sat down determined to scarify my report—perhaps because the engine was a compound one—without giving proper time or attention to the operation, and you can hardly be surprised if I have some objection to being scarified under such conditions, for the process is a painful one, even when carefully and judiciously performed.

I may add that I hope to make some further experiments with Messrs. Nuttall's engine during the present year.

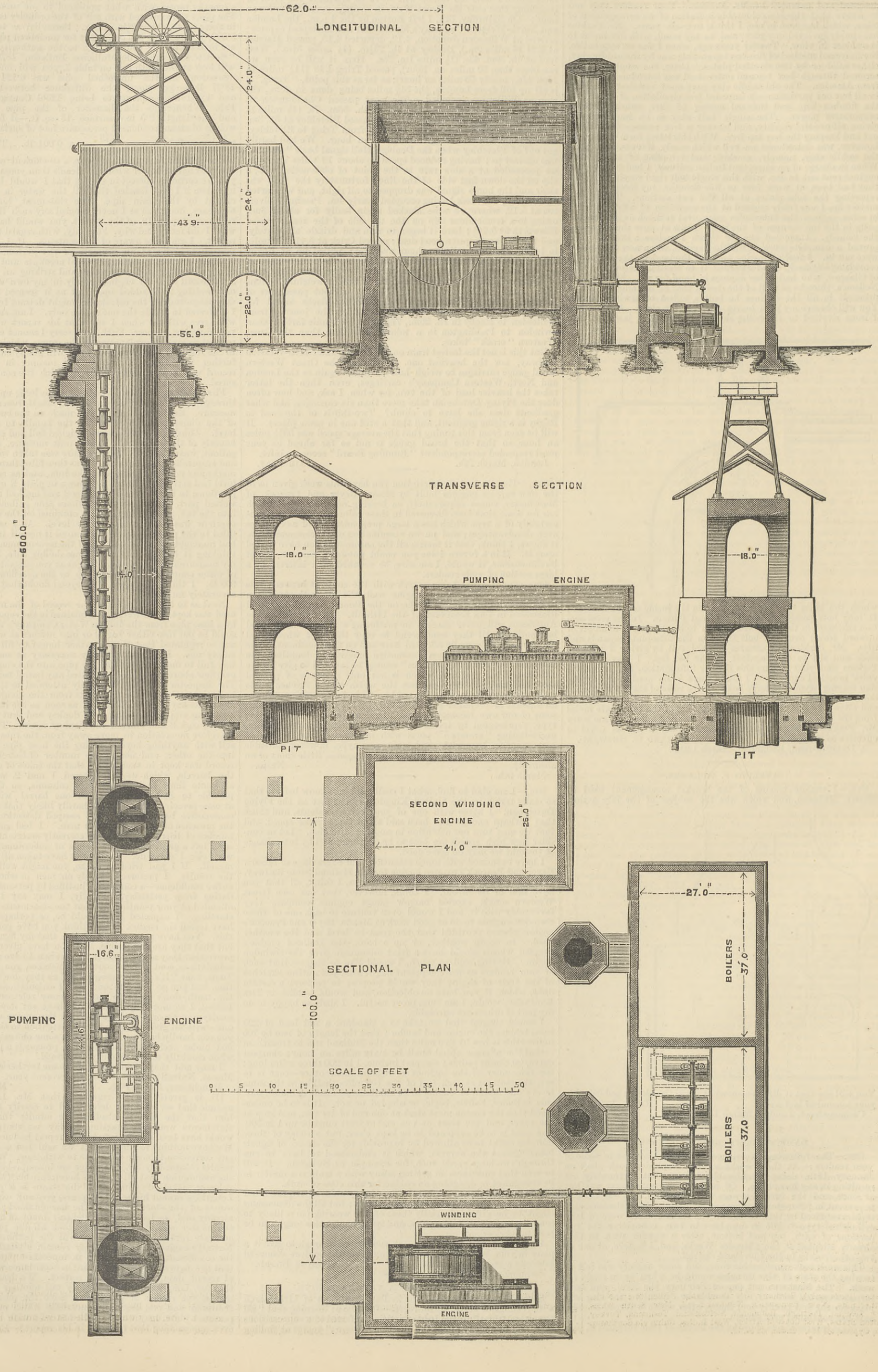
Manchester, March 16th. M. LONGRIDGE.

[It is greatly to be regretted that Mr. Longridge should assume that we sat down determined to scarify him. We assure him that the idea is absurd. He admits that he knew his statements would be startling. May we venture to think he would have been disappointed if his report had not been criticised? We have nothing to add to what we said last week, nor have we any correction to make nor a line to withdraw. We assert that the results obtained by Mr. Longridge are incomprehensible, unless on the assumption that all that has heretofore been asserted about the value of jacketted cylinders and dry steam is a pure myth. Mr. Longridge cannot himself, it appears, give any explanation of the causes of the startling results he has obtained; but as we have already said, we have not the slightest doubt of his good faith in the matter, and it seems that he took all due precautions to get accurate results. None the less will the performance of Messrs. Nuttall's engine for one day only remain a puzzle. Concerning the co-efficient of condensation in unclothed pipes, we may state that the figures we have given are in accordance with experiments of recent date, and are quite correct. We learn with pleasure that Mr. Longridge is going to carry out another series of experiments, the results of which may solve the puzzle. Among the thousand and odd engines, concerning which our correspondent possesses data, may we ask if he has met with any performance even approaching that recorded in his report?—ED. E.]

COAL MINING PLANT, KAI-PING, CHINA.

MR. R. R. BURNETT, M.I.C.E., ENGINEER.

(*For description see page* 198.)



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BERLIN.—ASHER and Co., 5, *Unter den Linden.*
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NEW YORK.—THE WILLMER and ROGERS NEWS COMPANY, 31, *Beekman-Street.*

TO CORRESPONDENTS.

*** *In order to avoid trouble and confusion, we find it necessary to inform correspondents that letters of inquiry addressed to the public, and intended for insertion in this column, must, in all cases, be accompanied by a large envelope legibly directed by the writer to himself, and bearing a 2d. postage stamp, in order that answers received by us may be forwarded to their destination. No notice will be taken of communications which do not comply with these instructions.*

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

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

R. N.—*A fire-box could be made and stayed as shown in your sketch, but it would be expensive and troublesome to make, and would possess few advantages over other methods of staying.*

SLIDE VALVE.—*The arrangement shown in your sketch will work. The area of the piston ought not to exceed that of the exhaust bridge in the slide valve. All the surfaces which rub together have steam between them, and the valve is so far balanced.*

A. Y. T.—*There is no published information on the subject. The power expended in driving the mill can, however, be ascertained by interposing an integrating dynamometer, of the kind used by the Royal Agricultural Society, between the driving and driven pulleys. Messrs. Easton and Anderson, Whitehall-place, could help you in this matter.*

J. W. H. (Wilmington Hall).—*The diagrams are not very good, and seem to show that the piston valves are leaking, or that they close the ports very slowly. The engines have far too light work for economy. We fancy that one of the engines could do all your work, and if so, you would save fuel by uncoupling the other engine and letting it stand idle. It might in this case be necessary to increase the boiler pressure a little.*

B. AND G.—*When tube expanders are used at both ends of a tube no ferules are required. The usual practice is, in locomotive work, to ferule the tubes at the fire-box end, because the ferules protect the tube from the cutting action of the fine particles of coke and coal carried through by the draught. Expanded tubes do not need ferules. There are several tube expanders in the market, all needing somewhat different manipulation, and you cannot do better than follow the instructions which the makers will give you.*

ERRATUM.—*In our last impression, page* 179, *in the article on "The Flanges of Leading Wheels" for* London *and* North-Western Railway, *read* London *and* South-Western Railway.

"POT" BOILERS.

(*To the Editor of The Engineer.*

SIR,—Will any of your readers favour me with a tracing of a Thompson's vertical boiler with copper pot, and give me some idea as to proportion of grate, plate, and tubular surfaces as used, per horse-power?

London, March 16th. F. W. J.

SILVER OR GALVANISED IRON COLOURED PAINT.

(*To the Editor of The Engineer.*)

SIR,—If I don't mistake, there exists a sort of paint used to cover iron fittings of ships, which, when treated with it, look as if they were galvanised. If there be such a paint or composition, will any of your readers kindly afford me information as to where it is to be got and of what it is composed? M. L.

Kinderdyk, Holland, March 11th.

A PROBLEM IN WINDING GEAR.

(*To the Editor of The Engineer.*)

SIR,—I think "A Young Mechanic" will find the following a correct olution to his question:—Let $5x$ and $3x$ = the circumference of wheels, in yards, then will $2x + 280$ = the difference of the ropes, and $(15x : 3x :: 5 : 1 ::$ the length of the longer rope : the length of the shorter. Therefore let $5y$ and y = the lengths of the ropes, in yards, then $4y = 2x + 280$, and $\frac{5y}{5x} = \frac{y}{3x} + 12$, or by transposing and clearing fractions $\therefore 4y = 72x$, whence $72x = 2x + 280$, or by transposition we have $70x = 280 \therefore x = 4$. Therefore the circumference of the wheels are $(4 \times 5 =)$ 20 and $(4 \times 3 =)$ 12 yards respectively. Again $4y = 72x \therefore y = 18x$ or $18 \times 4 = 72$. Therefore the lengths of the ropes are 360 and 72 yards.

JAMES TOMKINS.

Moorfield Ironworks, Stockton-on-Tees, March 14th.

(*To the Editor of The Engineer.*

SIR,—The following is a solution of "A Young Mechanic's" problem re winding gear, in THE ENGINEER of March 11th:—Let x = circumference of largest wheel in yards. Then $\frac{3x}{5}$ = circumference of smallest wheel. The difference in the length of ropes $= 280 + \left(x - \frac{3x}{5}\right)$. Let y = length of shortest rope in yards. Then $y + 280 + \left(x - \frac{3x}{5}\right)$ = length of longest rope in yards. The number of revolutions of, or the number of times the rope wraps round largest wheel $= \frac{y + 280 + \left(x - \frac{3x}{5}\right)}{x}$. The number of revolutions of, or the number of times the rope wraps round smallest wheel $= \frac{y}{\frac{3x}{5}} = \frac{5y}{3x}$

Thus from problem we get the two equations

$$\frac{y + 280 + \left(x - \frac{3x}{5}\right)}{x} = \frac{5y}{3x} + 12$$

and

$$\frac{y + 280 + \left(x - \frac{3x}{5}\right)}{3x} = \frac{5y}{3x}$$

Clearing fractions and simplifying, we get $2x - 20y = -1400$, and $174x + 10y = 4200$. Multiply second equation by 2, and add to first: thus $350x = 7000 \therefore x = 20$. Again, multiply first equation by 87 and subtract from second: thus $-1750y = -126{,}000 \therefore y = 72$. Therefore, circumference of largest wheel = 20 yards; circumference of smallest wheel $= \frac{3 \times 20}{5} = 12$ yards; length of shortest rope = 72 yards; length of longest rope $= 72 + 280 + (20 - 12) = 360$ yards.

Grantham, March 11th. J. FORREST BRUNTON.

[We have received several other solutions which we do not think it necessary to publish.—ED. E.]

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MEETINGS NEXT WEEK.

THE INSTITUTION OF CIVIL ENGINEERS.—Tuesday, March 22nd, at 8 p.m.: Paper to be read and discussed, "On the Comparative Endurance of Iron and Mild Steel when exposed to Corrosive Influences," by Mr. David Phillips, M. Inst. C.E.

SOCIETY OF ARTS.—Monday, March 21st, at 8 p.m.: Cantor Lectures, "The Scientific Principles Involved in Electric Lighting," by Professor W. G. Adams, F.R.S. Lecture III.—Use of magneto and dynamo-electric machines for electric lighting—Electric lighting by means of the arc. Wednesday, March 23rd, at 8 p.m.: Ordinary meeting, "The Increasing Number of Deaths from Explosions, with an Examination of the Causes," by Mr. Cornelius Walford. Thursday, March 24th, at 8 p.m.: Applied Chemistry and Physic Section, "The Future Development of Electrical Appliances," by Prof. John Perry.

THE ENGINEER.

MARCH 18, 1881.

THE NEW ORDNANCE COMMITTEE.

IN his speech on March 3rd in the House Mr. Childers spoke of the formation of the new committee in the following words:—"It has appeared that it would be desirable to recur to the advice of an independent Ordnance Committee, with functions somewhat differing from those of the former committee. It will consist of officers of the artillery, of the navy, and of the Engineers, with two eminent civil engineers; and while we hope to obtain from this committee technical advice of extreme value, we have determined not to run the risk of the disadvantages felt in connection with the old Ordnance Committee, and strictly to limit its functions to such inquiries and experiments as may be categorically referred to it by the Minister holding my office." We quote these words, then, as the official definition of our new Ordnance Committee. We have before pointed out that a strong desire existed for the institution of some tribunal of this kind. An independent Ordnance Committee, composed of members whose reputation places them above the suspicion of partiality, is a most essential thing, and Mr. Childers appears to lay special stress upon the independence of this Committee. As we presume that he does not mean to imply that there was a want of independence in the judgment pronounced by the members of previous committees, we are led to conclude that the alteration spoken of is to be found in the position and functions of the new one. Let us see what change has been made in these respects. The most striking feature in the construction of the Committee consists of course in the presence of two civilian members. These, to carry the maximum weight, should be men of high reputation, who are appointed for a given fixed time, and whose action affects their future in no way except as regards their reputation. That is to say, supposing that there should be a fixed salary, sufficiently high to be a matter of consideration, we should hold that whatever is the period of their appointment, it ought not to be renewable. It is not to be supposed that those whose proposals have to be considered will regard a man looking for the renewal of an appointment, carrying a high salary, as in an independent position. Individually his reputation may secure the desired confidence, but certainly his position does not favour it. As to the military members, their appointment differs chiefly from that of those serving on the various committees now extant in the fact of its being more permanent. The old committees were formed to conduct individual investigation, and ceased with the completion of the work. This new Committee is the permanent instrument for dealing with all such matters. This, again, is probably an improvement in theory, though how the numerous branches of investigation are to be dealt with practically by one set of men remains to be seen. It is only necessary to mention a few subjects of inquiry, we think, such as heavy guns, magazines, range finders, explosives, plates and projectiles, machine guns, saddlery, proportion of stores, siege operations, stores and fittings for magazines, friction tubes, packing and transport, to make this apparent. Probably, we imagine some sort of offshoots in the shape of sub-committees will spring up. It may be difficult to say what, but speaking generally, we should suppose in those cases where the matters at issue are connected with the convenience of the service, such as proportioning stores and the like, rather than original inventions submitted for investigation and trial.

We now pass on to an expression that certainly requires explanation. We are told that "the risk of disadvantages felt in connection with the old Ordnance Committee is to be prevented by the determination strictly to limit its functions to such inquiries and experiments as may be categorically referred to it by the Secretary of State for War." Now it appears very natural to refer applicants to the War-office. It would certainly prevent doubtful questions arising as to whether matters had ever formally come under the notice of a committee to have some such regular channel of communication. But it seems strange that it should be thought necessary to use this peculiar language on the subject. What was the inconvenience formerly felt? Were former committees in the habit of wandering about to the inconvenience of the War-office, seeking prey to occupy themselves with? If so inventors generally remained in strange ignorance of it. Or did they seek out-of-the-way objections and concern themselves with hypothetical difficulties that interfered with their business-like pursuit of the legitimate matters of inquiry before them? Was the committee, in fact, like the Irish groom's horse, that walked up to a wall and looked over it in order to find something to shy at? And must the new one consequently be driven in blinkers? As we say, the objection is wholly new to us. We sincerely trust that it does not indicate that there is to be any peculiar difficulty in the way of getting matters submitted to the new Committee. We only call attention to the words employed as certainly requiring an explanation for those who are interested in having their inventions placed "categorically" in the path of this straight-going committee. As to the members, Mr. Childers was unable to give their names to the House, but these we can now supply. General Sir Collingwood Dickson, V.C., K.C.B., is the president. The artillery members are—Colonel Smyth, Major Noble, Major Ellis, and Captain Bainbridge. The Royal Navy are represented by Admiral Howard and Captain Bridge; the Royal Engineers by Colonel Nugent; and the civilians are Mr. Barlow and Mr. Bramwell. We regret the loss of officers serving on the expiring committees, but the above names are unquestionably very good. The most natural objections to raise are, first, that the president, while he is an officer of European reputation, has not had anything to do with manufacturing questions for a very long time, if ever; and, secondly, that Mr. Bramwell took up so keenly the defence of the Thunderer gun that he may be regarded by steel-makers as prejudiced in favour of the present system of manufacture of ordnance. Taking them altogether, however, we believe that the committee is one which ought to deserve confidence in every respect.

THE EFFECT OF PUNCHING ON STEEL AND IRON PLATES.

WE referred last week at some length to certain experiments made by the Board of Trade on steel plates for boilers and ships. The most prominent feature in Mr. Trail's report is the absence of information on those points which most perplex engineers and shipbuilders; and before we have done we hope to make this fact very clear, in the hope that others will take new ground, and quit the beaten path of experiment, which, it may now be safely said, cannot lead us to a knowledge of that which we wish to know. It will be remembered that all the plates tested were pulled asunder by Mr. Kirkaldy, and the results obtained, although in many respects new to many persons, are just what were anticipated by those who have made steel a special subject of study. But although this is true of most of the results obtained, it is not true of all; and some of them are opposed in a small degree to those obtained by other inquirers. It is of the utmost importance that the effect produced on a plate by making holes in it should be understood very plainly. There are four ways in which a rivet-hole may be made. It can be punched, or it can be drilled, or it can be punched first and drilled subsequently, or it can be first drilled, and then punched. The value of all the three first-named systems has been repeatedly tested, but no one has tested the fourth, and yet it appears to have much to recommend it. It is well known that when a plate is punched the hole is always a little conical, and this conical shape is of much value, because it relieves the rivet head or point to some extent of strain, and even though the head should fly off the rivet is still useful. Drilled holes are not conical, and this is admitted to be a serious objection to them, and besides they are expensive. Now, if plates requiring such holes were first drilled to, say, $\frac{3}{4}$in., and then punched up to the proper dimensions, say 1in., the cost of drilling would be reduced, and the conical punched hole would be obtained. It remains to be seen whether under such conditions the plate would or would not be weakened by the punching; as on this point we possess no information we must content ourselves with suggesting to any one about to test steel the advisability of trying what would be found a very simple experiment. As regards the other three systems, the Board of Trade carried out, as we have said, a number of experiments with results the general nature of which we indicated last week. They appear to show that when a plate is punched it loses strength, but that when punched and annealed, or punched and rimed out to size, or drilled, it gains in strength. Thus a $\frac{1}{4}$in. plate which, unperforated, bore a strain of 30·7 tons per inch, bore 31·6 tons when punched and annealed, 31·23 tons when punched small and bored to size, and 31·46 tons when drilled. With a 1in. plate the figures are 28·17 tons for the solid plate, punched 21·26, punched and annealed 29·12, punched small and bored to size 29·15, and drilled 28·43 tons; all the dies were about 20 per cent. larger in diameter than the punch. Putting these figures into percentages we have for the $\frac{1}{4}$in. plate—the strength of the solid plate being 100—punched 93·8, punched and annealed 104·7, punched small and bored out 103·5, drilled 104·2; for the 1in. plate the figures are 75·4, 103·3, 103·4, and 100·9. Here, again, we have ample corroboration of our often urged argument that the properties of thin steel plates do not form a guide to those of thick steel plates.

If we compare these results with others obtained at different times, and by other experimenters, it will be seen that some difference exists. Thus experiments made at Liverpool and Sheffield in 1878 showed that $\frac{1}{4}$in. plates lost only about 8 per cent. by punching, which nearly agrees with the figures given above, while the 1in. plates lose more than 33 per cent., instead of less than one-fourth, as given above. Again, according to the Board of Trade, steel plates $\frac{1}{2}$in. thick lost but 8·6 per cent. by punching, while in the experiments of which we speak the loss was found to reach as much as 26 per cent. We have here a very important disparity, and one which should be cleared up. Is it to be explained by differences in the quality of the steel, or by peculiarities in the system of testing employed? So far as we can see it depends entirely on the first condition, namely, the quality of the steel; and it should be remembered that in both cases the steels used were ostensibly the best that could be made. We find then that while the steel made by one firm will lose less than 9 per cent. by being punched, the steel made by another firm at least as eminent loses 26 per cent., or nearly three

times as much. Furthermore, it is stated that the effect of punching is to deprive the metal of all power of stretching, and the consequence is that it breaks with a crystalline instead of with a fine silky fracture. Bearing these facts in mind, let us consider what light they throw on the peculiarities of steel. It is known that if a steel boiler plate be punched, the chances are about one hundred to one that cracks will start from all the rivet holes in the edges of the plate, if not from one to the other, almost before the rivetting of the seam is completed. On the other hand, Lloyds permit steel ship plates to be punched and rivetted up without riming or annealing, provided they are not more than $\frac{1}{2}$in. thick, and do not come under severe strains—garboard strakes, sheer strakes, and deck stringer plates must, if punched, be annealed or rimed. Leaving ships however, and returning to boilers, we may say at once that no one dreams of putting a steel boiler together with punched holes, unless the plates are carefully annealed. On the other hand, scores of iron boilers are made with punched holes, and no cracking takes place, and the boilers are quite sound and good. To this it will be replied that iron does not lose strength by being punched, and that for that reason it may be punched with safety. It will, perhaps, be new to many of our readers, but it is none the less true, that this is a complete mistake. Iron boiler plates do lose in strength by punching. A set of experiments made in 1878 on best best boiler plates $\frac{3}{4}$in. thick, such as are used for marine boilers of moderate size, showed that while the solid plate had a tensile strength of very nearly 20 tons per square inch, the metal lost in strength when punched with an open die, 22 per cent.; when punched with a close die, 20 per cent.; when punched and rimed, 11·4 per cent.; and when punched and annealed, 4 per cent. of its original strength. A second set of experiments on ostensibly a better class of "best best" plates as supplied to the Admiralty showed that under similar conditions the iron lost 18 per cent. of its strength by punching, and even when the holes were rimed the loss was 9·2 per cent., and when they were drilled 3 per cent. Here we see that although the loss is somewhat less than is the case with steel, it is nevertheless very considerable. But the injury inflicted on iron by punching does not seem to become apparent. The metal keeps its sorrows to itself. It shows no outward signs, and the 80 per cent. or so of strength left in the plate is always worth 80 per cent. But of the 80 per cent. or so left in steel no one can tell the value even approximately. Why is this? All the explanations which have been put forward to supply an answer will apply just as strongly to iron.

We are told that when a steel plate is punched, a ring of hard metal is left round the hole, which being compressed tends to split the plate, or prevents the strains being eqnally distributed through it. Remove this hard ring with the rimer, or soften it by annealing, and the plate becomes as strong as ever. But does not all this hold good of punched iron? Is there not in its case a hard ring round the holes? Cannot this ring be rimed with the rimer or softened away by fire? The answer must be in the affirmative. The only feature indicating a different condition is that iron seems to be permanently injured to a small extent even by drilling, while steel is improved. The hard rings will not render an iron plate treacherous, while they make steel plates quite untrustworthy. Like causes, in a word, do not produce like effects; and to complicate the case still further, a Motala plate from Sweden, did not seem to lose any strength by being punched, plates ·45in. thick having an initial strength varying between 27 and 28 tons per inch before punching, and standing as much as 28·2 tons after punching.

We have little reason, then, to doubt that the true reason why punched steel plates will not answer for constructive purposes, while iron plates will answer, has yet to be sought out, and the inquiry must take two distinct directions. In the first place, we must have much more accurate analyses of steel to deal with than are now available, and chemists appear to be agreed that to make them they must operate on comparatively large quantities of the metal. It is very easy to speak, for instance, of ·1 per cent. of carbon, but few persons realise what it is the chemist who seeks for this has to find. 0·1 per cent. of carbon means that a ton of steel contains 2·24 lb. of carbon, each pound of the metal will contain 7 grains of carbon; and as the chemist operates on but a few grammes of the steel at a time, it will be seen how minute are the quantities of carbon, sulphur, and phosphorus with which he has to deal. But this would present no difficulty were it not that the analysis of iron, especially for carbon, is one of the most troublesome known, and we feel certain that many statements which now serve to perplex investigators struggling to arrive at the truth would be found erroneous if only accurate analyses were available. Again, the testing of steel plates in a machine is not a true test, because it specially eliminates the conditions under which steel suffers most, and is least trustworthy. Thus the strength of rivetted steel joints should be ascertained by putting sudden strains on them, such as they may be supposed to suffer when a long ship is steaming head to wind in a heavy sea; and again, tests of boiler plates ought to be made with the plates hot, not cold. The inquiries which have been made up to the present are so misleading, that little or no regard is paid to them; and those who use steel freely rely entirely on their own practical acquaintance with it, and care little or nothing for the figures which exist in such multitudes. The great safeguard seems to be to deal for steel only with firms who have already supplied what has proved to be good. This is very hard, perhaps, on young firms; but it is not easy to see how it can be helped. If only steel did not now and then play those who use it false; if only it were not so susceptible of being deteriorated, that a change in the form of the ingot moulds has been known alone to suffice to render tons of steel next to useless, iron would cease to be made save for a few special purposes. The unsatisfactory aspect of the steel question as a whole is that we seem to make no progress, and that we know no more about it now than we did five years ago.

THE OFFICIAL EXAMINATION OF PATENTS.

Many persons who suggest improvements in the patent law of Great Britain propose that patent specifications shall be officially examined for novelty before a patent shall be granted. A very high value is set upon this scheme; and it is commonly held that by carrying out the examination system thoroughly it would be found possible to eliminate nearly all the existing defects in the working of our patent law. Only the examination would not reduce the cost of a patent. Given low fees and efficient examination, and nothing more would be demanded by hosts of grateful inventors. It is not to be disputed that the theory of prior examination has something to recommend it. It seems at first sight to be clear that the State has no right to grant a worthless patent to an inventor in return for his fees; and it also seems to be right that the State should, in granting a patent, give the world a kind of guarantee that the invention patented was a new thing. But when, instead of glancing hastily at the matter, we carefully consider the bearings of the questions involved, and the whole theory of patent law as practised in this country, we soon find reason to doubt that prior examination is a good thing; and if we turn to the United States, where examination is practised, we shall find nothing to encourage the belief that the system can ever be made to work well.

The arguments in favour of official examination are very few, however cogent they may be. They are, as we have said, that the State ought not to sell to anyone that which has no value, and that by stopping the intending patentee at the very outset from protecting an old invention, much trouble will be saved to manufacturers, an enormous amount of litigation will be got rid of, and the patents which pass the necessary ordeal will acquire a hitherto unknown value. As a minor consideration patentees and their agents will save the cost and time spent in making searches. If anything else can be urged in favour of the official examination it has escaped our notice. It will be seen that the examiners can do nothing more than say that a given invention is new or old. The value of the verdict when the invention is pronounced to be old is comparatively small. It is represented probably by the fees which the inventor will not spend under the circumstances. Its value as regards the invention pronounced to be new may be very great indeed. It may give a man an indefeasible title to a property worth many thousands of pounds. But it is obvious that in order that this may be the case, the verdict of the examiners must not admit of being questioned. If they say that Mr. John Smith's invention for improvements in penny whistles is new, then it must not be open to Mr. James Brown to say that the examiners were mistaken as to the scope of the invention; nor must Mr. Green be permitted to refuse to pay Mr. Smith a royalty on the ground that he had made whistles of the kind patented for years; nor may Mr. Robinson assert that the specification is so badly drawn that the only whistles which it really covers cannot be made at all. If the verdict of the examiners is open to revision, then it is quite clear that it does not give an indefeasible title. It is said now that no patent in Great Britain is really valid that has not been proved to be so by the result of an action at law. There is no doubt a substratum of truth in this statement. But assuming that the verdict of official examiners is not sufficient to keep patentees out of the law courts, then it is evident that the value to be attached to their verdict is much reduced; and it is easy to see that if the result of a little litigation was to overset the examiners' verdict in, say, half a dozen cases in the year, that verdict would almost cease to have any value whatever. In other words, if the verdict of the examiners is to give an indefeasible title, then the examiners must be infallible, in fact or by law. It is clear that no mortal can comply with the first condition, and it is equally clear that if it was enacted by Parliament that the verdict of examiners should invariably be regarded as final, a very wide door indeed would be opened for the entrance of injustice. It appears, therefore, that there must be in all cases a power of appeal. In other words, the verdict of the examiners as to the novelty would be taken for what it was worth, and we should have trials by jury just as we have now when disputes arise about priority of invention. In the United States an attempt is made to get over the difficulty. There is a large number of examiners; so many, we believe, that it is possible for each to give quite half-an-hour to ascertaining whether an invention is or is not new. The rule is not to give the inventor the benefit of a doubt, but to refuse a patent on the ground of want of novelty. Then the inventor can apply to a higher grade of examiners, and counsel can be heard in his favour. In other words, the patentee begins with something very like a lawsuit to prove the novelty of his invention. If the verdict is in his favour, then the value of his patent is, no doubt, augmented; but the cost of the trial is very considerable. It may amount, and sometimes does, to several hundred pounds. If the case is not of such importance, the Patent Examiners will send for the patentee or his agent, and call on him for explanations, and in the end will grant him either the whole or part of what he claims. Thus, to return to Mr. Smith and his penny whistle; he perhaps claims the use of a vulcanite instead of a wooden block in the mouth-piece, the making of a ninth hole, to give an extra note, and the introduction of a rivet at the lower end of the whistle, because solder sometimes does not flow well to the end of a lap joint, and ripping ensues. The Examiners, after hearing all that Mr. Smith has to say, grant him a patent for a whistle with a vulcanite mouth-piece; but they will not grant one for the ninth hole, because flutes have more than nine holes; nor will they grant a patent for the rivet, because the ends of cask hoops make a lap joint, and are secured with rivets. Mr. Smith has to be content with what he gets; but someone else subsequently obtains a patent for the ninth hole, and a third man secures the rivets, much, of course, to Mr. Smith's satisfaction. In saying all this we exaggerate not at all. Every American who has had experience at the Washington Patent-office will bear witness to the truth of our statements. In all this we have really a desperate, but legitimate, effort to make examination a genuine thing, and not a farce; and it is not to be denied that if the system was properly carried out it would prove of great use. But let us consider what doing this means. As it is, the American examiner carries, no doubt, a great deal in his memory, and is able to say at once that certain inventions are not new; but this does not prevent the patenting every week of old ideas to a surprising extent. He is also able to say that certain parts of other inventions are not novel; so can every respectable patent agent in Great Britain. The American official must, however, be in doubt again and again, and he satisfies his official conscience by giving an inventor in such cases only one-half or one-third of what he asks for. But this is a very defective system. It means an indirect pleading guilty to a charge of incompetence as an examiner. It can, however, only be got rid of by making the examination really perfect, and it is impossible to do this. An examiner may know what has been patented before, but no board of examiners can be supposed to know all the devices which are and have been in use for years without being patented, any one of which would suffice perhaps to render half-a-dozen patents invalid. Let us bear in mind that almost every week cases are tried in which all the skill of counsel; the acumen of a judge, and his power of analysing the evidence of an army of "expert" witnesses, barely suffice to settle whether a certain invention is or is not new, and consider what it is that an examining tribunal must be expected to perform. Is it not obvious that the examiners must discharge the combined functions of judge and jury, and is it not evident that the value of their verdict will depend largely on the fulness and accuracy of the evidence set before them? This being so, the whole machinery of a law court, now resorted to only as a last resource, and with comparative rarity, would have to be used before more than at most one half the patents now granted could be confined.

It may be urged that this is going much too far with the thing — that it will suffice if the examiners are moderately diligent and careful. To this we reply that unless their verdict of the examiners is to be regarded as practically final, it possesses little or no value. Under the supposed conditions the entire system may do more harm than good by leading to the summary rejection of really valuable and novel inventions on very frivolous grounds. This is the grand objection to the scheme. If it is not perfect it is worse then useless; and to make it even nearly perfect it must be enormously expensive in its working.

The objections, on the other hand, which can be urged against the existing British system, are very few. It is true that patents which are worthless are granted, and that pretty freely, but the mischief done thereby is not very great. It will be found as a rule that no two inventions are really identical, although there may not be any legal distinction between them. If an old thing is patented it can do no harm to anyone else, unless it possesses sufficient merit to make it worth while to work it. It will then usually be found that the patented invention is really better than that which anticipated it, and the world is not the loser by the patent. A case in point occurred some years ago. An invention for cleaning grain was patented; on inspection, however, it appeared that the new thing was neither more nor less than the old winnowing machine. As a matter of fact, however, the new grain cleaner had within it a board so set that it divided the current of wind, and did what the old machine did not, make a clean sample. The specification was beyond question bad as it was drawn, but no one was the worse of its existence. The owners of a patent, valid or invalid, cannot prevent a man from using a machine or a process which he had used previous to the date of the patent, and any attempt to compel the payment of royalties would end in a discovery of prior user. We suspect that the instances in which royalties are paid on patents for inventions absolutely old right through, are very few indeed, and that when a royalty is paid the owner of the patent has some substantial claim to it. But whether this be the case or not, and even if we concede that it is not the case, and that thousands of pounds are paid every year in royalties on worthless patents, we cannot see at all that a crude and insufficient examination would help to set matters right, even though it have official sanction. There remains one argument to be considered, namely, that the State has no right to sell an inventor a worthless patent. It seems to us that the well-recognised principle of *caveat emptor* applies accurately to this case. Let the purchaser look to his own interests. The law expects that every man shall use some caution in his dealings with others. Thus, for instance, a general warranty of soundness for a horse will not be taken to cover obvious defects, such as the want of an eye or a tail. The law says that a purchaser must see for himself whether the horse which he buys has or has not a tail. In the same way due facilities are supposed to be provided to enable would-be patentees to ascertain whether their inventions are or are not new. If they do not use these opportunities, and should discover subsequently that they have patented what was not novel, they have themselves to thank for the loss of their money. Finally, we may add that competent patent agents are always willing to make a search for inventors which will give them quite as good a title as anything done officially in the United States can confer. But most inventors object to the cost and delay, and take their chance. We have shown, however, that if the official system of examination is to be really worth anything, it will introduce elements of cost and delay which would be regarded as intolerable by the great mass of British inventors.

THE CITY AND GUILDS OF LONDON INSTITUTE FOR TECHNICAL EDUCATION.

Without entering into the variety of problems which are involved in devising a really useful system of technical educa-

tion, it may be admitted that the object of the City and Guilds of London Institute is a good one, especially as it is at the same time extending help to the industrial classes that most require it, and giving a proper employment to a small portion of the money at the disposal of the wealthy guilds. At present only seventeen of the seventy-five guilds have joined or are giving support to the Institute, the income of which is only a little over £15,000 per year. But with this a good deal of work is being done by the Institute, and by grants to small educational establishments in different places. Instruction is being given in applied chemistry, in applied physics, and in applied art among the industrial populations of Finsbury and of Lambeth; the chairs of applied art, chemistry, mechanics, and metallurgy are being supported in King's College and in University College, London, and other centres of technical teaching in London and in the provinces are being aided. Technological examinations are being conducted in no less than thirty-two industries, and have been already held in eighty-five localities in the United Kingdom. These examinations have proved very successful, the numbers who offered themselves in 1879 being 202; in 1880, 816; while those who are training for 1881 are as many as 2401. It is noticeable that of those who were examined, a larger proportion of failures occurred amongst those taught by science teachers in classes than of those who are self-taught, the failures being respectively 38·9 and 31·2 per cent. It is suggested that this may be accounted for by the eagerness of teachers to add to their classes, but it is much more likely that those who will teach themselves have not only most energy and determination to learn, but are very likely to learn more thoroughly, because of the real interest taken in their studies, and that, owing to habits of self-culture, they become careful observers of the practical details of the technical arts in which they are examined. In only two subjects are the failures larger in the case of the self-taught than the class-taught, namely, cotton and flax manufactures. Certain of the companies have agreed to contribute the necessary funds, and a building, at a cost of £20,000, is about to be erected in Finsbury for properly carrying on the work, and a central institution, at a cost of £50,000, is to be built on a site which the Commissioners for the Exhibition of 1851 have leased to the Institute for a term of 999 years at a nominal rental. It is intended that in this Institution principals, managers, foremen, and leading workmen shall be taught, and teachers for carrying out technical instruction throughout the country. The design of the building which is to be constructed at South Kensington has been made by Mr. A. Waterhouse. The total sum which at present appears likely to be at the disposal of the Institute to pay for this building is £55,000, but Mr. Waterhouse's estimate is for about £66,000, and with furniture, &c., it is estimated that at least £75,000 will be required. It is admitted that at least £18,000 has yet to be gathered from somewhere. Possibly some of the other guilds may be induced to come forward and do a little for the industries which in mere name they represent. It may be hoped that this Institute will keep free from the South Kensington influences, and that it may be of the value of which it gives promise.

LOCOMOTIVE BOILER EXPLOSIONS ON THE NORTH-EASTERN RAILWAY.

IT is four months since the explosion of a goods locomotive boiler occurred on the North-Eastern Railway at Rainton crossing, near Leamside, and Major-General Hutchinson's report to the Board of Trade, dated the 31st December, 1880, has only just been published. The engine was hauling a goods train, consisting of forty wagons, from Newcastle to York, and was stopped by signal at Rainton crossing for about two minutes, when, without any warning, the boiler exploded. The driver and fireman were both seriously injured; and the barrel of the boiler was almost completely blown away. The engine in question, a 6-coupled, with tender, was built by Neilson and Co., of Glasgow, and was delivered in March 1874, since which time it had run 186,000 miles. The boiler, made of Lowmoor plates $\frac{7}{16}$in. thick, was of telescopic construction, having a mean diameter of 4ft. 2$\frac{3}{8}$in.; the barrel was built up of three rings, with one plate to each ring, with ordinary lap joints, and a steam dome in the centre of the middle ring. In July 1878 the boiler had been tested up to 220 lb. with hydraulic pressure, and it had never been examined internally since it had commenced working in March 1874, a period of nearly seven years. The boiler is stated to have been nearly full of water, the steam pressure to have been 130 lb. to the square inch, and the steam to have been just beginning to ease off at the safety valves when the explosion occurred. The barrel was broken up into about eleven fragments. Major-General Hutchinson says that: "There appears to be no reason to doubt that the cause of the explosion is to be attributed to deep grooving along the horizontal joint of the middle plate. This joint, which was 15in. below the water-line, was grooved inside, more or less along the whole of its length at the bottom of the lap, the sound metal being in some parts not more than one-sixteenth of an inch in thickness. The plate showed lamination, which, no doubt, contributed to the rapid increase of the grooving after it had once been set up. The flaw was not ascertainable by any outward inspection, and the plates were very little pitted." This explosion of a comparatively new boiler raises many important questions, and Major-General Hutchinson suggests the following:—"(1) Whether every boiler ought not to be submitted to internal inspection after running a certain number of miles—say 100,000; (2) Whether boiler-barrels should not be constructed with butt joints rather than lap joints, so as to ensure their being perfect cylinders, and thus to make as uniform as is possible the effects of expansion and contraction at every part of the barrel; (3) Whether, with boiler-barrels made with one plate in each ring, the joints should not be arranged in all cases so as to be above the water-line. In the present case the joint was 15in. below that line." It is a curious fact that of all the locomotive boiler explosions on the railways of the United Kingdom, 60 per cent. have occurred on the North-Eastern Railway. That of November last makes ten in six years on this one railway, out of a total of sixteen on all railways. The remarkable frequency of explosions on this line suggests the necessity of an enquiry into the points of difference in the construction, work, and working of the engines on this and other lines.

THE LANCASHIRE AND YORKSHIRE RAILWAY.

THE Lancashire and Yorkshire Railway is coming into the front rank of railways, and it is also becoming a line of short passenger traffic. It carried in the last six months over 19,410,000 passengers, but the yield was £655,283 only, with the addition of the season ticket receipts; whilst from five millions less passengers the Midland extracted over £250,000 more in the same period. It is to this fact, as well as to the comparative smallness of the mineral traffic on the Lancashire and Yorkshire Railway, that the latter has to attribute its much smaller receipts. Still, on the Lancashire and Yorkshire Railway there is a steady rate of increase in the traffic, over £100,000 having been added in the past six months. Had it not been for the very great increase in the capital of the company, there would have been a much larger addition than there was to the dividend. In the past half-year the company spent not less than £451,000 on capital account, more than one-half being on lines and works in course of construction, whilst in the current half-year it is estimated that £754,685 will be spent on capital account. Out of this it may be interesting to state that £309,000 are to be spent on increased station accommodation and land; that £164,000 are to be expended on rolling stock; and that the remainder is to be chiefly expended on lines and works that are in course of construction, and several of which are now nearly completed—so nearly that it is only a question of weeks before a large amount of traffic is obtained, and a large amount of long idle capital is made productive. We have stated that the Lancashire and Yorkshire Railway carried last half-year over 19,410,000 passengers; out of these there were 954,736 first class, 1,354,598 second class, and the great bulk, over seventeen millions, were third class passengers. On this line there are comparatively few season ticket holders; but very singularly, the 8568 season-ticket holders pay in the half-year £45,446, whilst on the Midland Railway 23,675 season ticket holders pay only £35,919. In the merchandise receipts there is a satisfactory growth, whilst the mineral traffic shows only a slow but steady increase. In the expenditure the most notable items are first the growth of the salaries, and next the very large increase in the past half-year in the amount of that most unsatisfactory item—compensation for personal injury. Rates and taxes, parliamentary expenses, and law charges are rising in an unsatisfactory manner, and the interest on capital grows. In the latter item that growth must be expected; but it may fairly be hoped that in the course of a short time the revenue will grow more rapidly even than it did last year. At the half-yearly meeting there was a hint of the possibility of the revival of the great scheme of amalgamation between the Lancashire and Yorkshire and the London and North-Western Railway. Whilst it is evident that any such project, if revived, would need surrounding with safeguards that the interest of the public might not lose by the removal of competition, yet the benefits to the railway shareholder, by the lessening of costly parliamentary fights and the minimising of the creation of competing lines, expensive in working, and bringing in little profit, would be very great. One of the maxims of Robert Stephenson was that where combination is possible competition is impossible. It remains to be seen whether combination between these two great railways is possible; but it may fairly be said that the interests of the shareholders lie in the direction of such a combination.

THE COST OF A STRIKE.

AFTER a vain attempt to accomplish the impossible, the council of the Barnsley Miners' Association have held a meeting, and come to the conclusion that the failure is not their fault, but their misfortune. They think 10 per cent. advance might have been secured had the miners been sufficiently united, and they express regret that want of unity made the effort fall through. It does not appear to strike them that even if they had succeeded, their success would have been a defeat. The two causes upon which they based their claim have now departed—the weather is no longer severe, and the strike in Lancashire is at an end. The 10 per cent. advance could not have been fairly in operation before there would have been agitation to abolish it—an agitation which, in the face of summer, and diminished demands, must have been successful. As it is, the promoters of the industrial warfare can now sit down and count the cost of the campaign. Mr. William Chappell, one of the miners' agents who has had the courage to oppose the 10 per cent. demand throughout, gives us some particulars of "the little bill" incurred in the miners' disputes. Taking his figures as the basis, there can be little doubt that the miners are themselves out of pocket, in the form of wages, to the amount of £70,000. That is the colliers' side of the question, and then there is the coalowners' loss of capital, which would mount up to a formidable sum if the actual figures could be obtained. When a colliery is standing the expenses are as great—of course excepting the item of wages for actual coal-getters—as those incurred when work is going on, and extra care and expense are required in keeping the ways open for ventilation. The coalowners might do worse some day than put before the public their share of the costs in the big wars of industry. During the last twelve years there has been "lost" in the South Yorkshire district, in wages and strike-money alone, a sum of £800,000. May it be at last allowed, by those who have the ear of the working man, that strife is a costly means of settling wages' disputes; that the doctrine of idleness is a dear doctrine; and that South Yorkshire, having had more than enough of it, accepts the sensible principles of the sliding scale, by which the colliers' wages will advance with the advancing values of the coal they bring to bank.

LITERATURE.

The Elements of Mechanism. By T. M. GOODEVE, M.A. London: Longmans, Green, and Co. 1880.

THIS is a re-written and enlarged edition of Professor Goodeve's long-known treatise. Many of those who learned from the original edition, and whose reading has subsequently given them information upon the points which have become of importance in recent years, will almost wonder why a new edition should have involved re-writing. Besides, however, treating the elements of mechanism, and this in a very satisfactory way, Mr. Goodeve fully appreciates the value of the practical application of this knowledge, and for this reason has given illustrations and descriptions of mechanism, much of which is new since the date of the earlier editions. No subject is learned or mastered with such facility and thoroughness as it is when every-day or familiar applications form the means of its illustration. Professor Goodeve is very successful in his perceptions of the requirements of technical text books, and this is very largely due to a clear insight into what are the salient features of workshop mechanics and of mechanical improvements. The book before us now contains nine chapters and no preface. The latter is looked upon, perhaps, as unnecessary in what is presumably considered to be an improved edition of an already well-known and well appreciated work. The first chapter is introductory, and treats of velocity; circular motion of a point; transfer of circular movement; pairs of elements, and methods of transmission of power. In this chapter the author steers clear of making any new terms or definitions. The second chapter is on the conversion of circular into reciprocating motion, a subject necessarily demanding illustration by practical examples; these are well chosen, and the illustrations are, moreover, not of that half practical and half impossible appearance, which mars more than one book on this subject. The third chapter is on link work, and the fourth on the conversion of reciprocating into circular motion. On the teeth of wheels in the fifth chapter there is really no room for new matter. Chapter six, on the use of wheels in trains, contains much information concisely put. Chapter seven, on aggregate motions, contains illustrations of epicyclic trains, differential motion, feed motions, &c., which about half of all the patentees in America, and a very large number of those in England, might study with resultant economy of time and money. Chapter eight is on truth of surface and power of measurement, and deals with the form and construction of surface plates, Whitworth's measuring machines, standards of length, and cylindric gauges. Chapter nine is on miscellaneous contrivances, and includes such modern pieces of mechanism as those of the keyless watch, Root and other blowers, illustrations explaining the mechanical movements of the Plimpton roller skate, and locomotive reversing gear, all given in such a way that the student's interest in the subject will be increased by the facility that they give for model making. In the description of Stephenson's link motion, that which is usually spoken of as the reversing lever is here described as the starting lever. The book is provided with a good index, and is one which should be in the possession of every student. It is not, however, by the student alone that the book will be appreciated; there are many engaged in mechanical pursuits, who by want of a knowledge of the elements of mechanics fall into occasional error in mechanical design; such practical men, if they are not frightened at many of the treatises on the elements of mechanics, have little inclination or time to wade through a book that needs very careful and some mathematical study. In a work on mechanism, as distinct from mechanics, all abstruse formulæ may be absent, and yet illustrate to the practical mind by well selected examples of mechanism, that which can or cannot be done or should not be done.

BOOKS RECEIVED.

The Rudiments of Civil Engineering. By Henry Law, M.I.C.E. Including a treatise on "Hydraulic Engineering," by G. R. Burnell, M.I.C.E. Sixth edition revised, and with additions on recent practice of D. Kinnear Clarke, M.I.C.E. London: Crosby Lockwood, and Co. 1881.

Worked Elementary Examples in Geometrical Drawing; with Exercises. By Rev. J. Hunter, M.A. London: Longmans, Green, and Co. 1881.

Measures, Weights, and Moneys of all Nations. By W. S. B. Woolhouse, F.R.A.S. Sixth edition, revised. Weale's Series. London: Crosby Lockwood, and Co. 1881.

Sewage Disposal: Ten Years' Experience in Works of Intermittent Downward Filtration, with Notes on the Practice and Results of Sewage Farming. By J. Bailey Denton. London: E. and F. N. Spon. 1881. Paper.

Industrial Conciliation and Arbitration in New York, Ohio, and Pennsylvania. By J. D. Weeks, M.A. From 12th report Massachusetts Bureau of Statistics of Labour. Boston: Rand, Avery, and Co. 1881. Paper.

Horticultural Buildings: Their Construction, &c. By F. A. Fawkes. London: B. T. Batsford. 1881.

LEGAL INTELLIGENCE.

JUDICIAL COMMITTEE OF THE PRIVY COUNCIL.

(*Present* SIR BARNES PEACOCK, SIR MONTAGUE SMITH, SIR ROBERT COLLIER, *and* SIR RICHARD COUCH.)

March 1st, 1881.

RE REECE'S PATENT.

THIS was a petition for the prolongation of letters patent granted to Rees Reece, of Llandilo, in the county of Carmarthen, chemist, and dated 31st May, 1867, No. 1621, for an invention of "An improved mode of and apparatus for producing cold."

The patentee died on the 14th January, 1874, and the petitioners were the Reece's Patent Ice Company, Limited, as assignees and proprietors of the patent.

Mr. Aston, Q.C., and Mr. Goodeve were counsel for the petitioners; the Attorney-General, Sir Henry James, Mr. A. I. Smith, and Mr. Danckwerts for the Crown.

According to Reece's invention the ordinary liquid ammonia of commerce is allowed to flow downwards through a vessel called an "analyser," and to encounter a column of steam at a pressure of about 100 lb. per square inch, which, in its ascent, vaporises the ammonia and a portion of the water. The vapours of water and ammonia then pass into a vessel called a "rectifier," where the vapour of water is condensed, but the ammonia vapour passes on into a third vessel called the "condenser." In this latter vessel the ammonia vapour is condensed by its own pressure, and is converted into liquid anhydrous ammonia. The liquid ammonia so formed passes into a so-called "refrigerator," containing a coil of pipes charged with a solution of chloride of calcium. A communication is then opened between the refrigerator and a vessel called an "absorber," through which is passed the weak liquid escaping from the bottom of the analyser, and the result is that the vapour of ammonia, given off by the liquid ammonia in the refrigerator, is rapidly absorbed with a considerable absorption of heat, and the solution of chloride of calcium is cooled down to 20 deg. or 30 deg. below 0 deg. C., and becomes available as a source of intense cold. The remaining changes are important in the practical working of the apparatus, but it is enough to state that the ammonia is used over and over again without any waste.

At the hearing Mr. F. J. Bramwell, F.R.S., and Dr. J. Hopkinson, F.R.S., gave evidence as to the general merit and utility of the invention, particularly in relation to the manufacture of ice and the cooling of water in breweries.

The Attorney-General opposed the application on behalf of the Crown, upon grounds which appear in the judgment of the Court.

THEIR LORDSHIPS could not advise her Majesty to grant a prolongation. In the first place it appeared to them not to be a patent of such peculiarly exceptional utility and merit as to warrant such a recommendation. It seemed that the inventor during his lifetime could never bring it into use. According to one of his own witnesses he tried a number of times and he always failed, and he did not adopt the requisite improvements for making it useful. After his death in 1874 the interest of the widow and Mr. Fox devolved on a company, who carried on business, but apparently with small success. They did not succeed in manufacturing ice as far as their Lordships could make out, but they did succeed in selling a certain limited number of machines to brewers who used them for the purpose of cooling in some of their processes. The machines supplied to the brewers had to be made in accordance with a subsequent patent for improvements, which seemed to have been taken out by a person of the name of Stanley, and without those improvements the invention appeared to have been totally unworkable. It further appeared that Mr. Shingleton,

the husband of the widow, had used one of the machines, which he bought a few years ago, for the purpose of manufacturing ice; but he had not done so at a profit. Then, again, their Lordships had to consider the nature of the application and of the applicants. The applicant was not the inventor. The nominal applicant was the joint-stock company to which the invention was transferred. But it turned out that the nominal applicant was not the real applicant. It turned out that, by an arrangement executed a very short time ago, the great bulk of the shares of the company, the petitioners, had been transferred to another company, called the Shingleton Ice Company, founded by Mr. Shingleton, the husband of the widow, and that, if a prolongation were granted, the monopoly would really be granted, not to the petitioners, but to the Shingleton Company. Now their Lordships could not but observe that, in all these cases, *uberrima fides* was required. It would have been proper, at all events, to have given some intimation in their petition of who the real applicants were, whereas, from the beginning to end of it, no inkling was discernible of that company which was behind, and which were the real applicants, but the matter had been brought forward by the Attorney-General exclusively. It did not appear to their Lordships on the whole that, putting aside the question of merit and utility, it would be for the public advantage to grant an extension of the patent, which would be practically for the benefit of the Shingleton Company. On these grounds their Lordships felt that they were unable to accede to the application.

Solicitors for the petitioners, Messrs. Collis and Mallam; for the Crown, the Treasury.

March 2nd, 3rd and 4th.

Re NEWTON'S PATENT.

This was the hearing of the petition of Nobel's Explosives Company, Limited, the assignees of Nobel's English patent for the manufacture of dynamite, for an extension. The letters patent in question were granted to W. E. Newton as a communication from Alfred Nobel, and were dated 7th May, 1867, No. 1345. The petitioners stated that prior to Nobel's invention nitro-glycerine was to some extent used as an explosive, but that in consequence of serious accidents the Legislature passed an Act practically stopping its use. In consequence of the prohibition Nobel made attempts to adapt nitro-glycerine by the use of additional materials. In the first place he dissolved it in wood spirit; in this condition its transport was comparatively safe, but before it could be used the nitro-glycerine had to be precipitated by adding water to the mixture. He ultimately discovered the process of mixing nitro-glycerine with silica or charcoal or paper or other bodies, as absorbents to produce the explosive subsequently known as dynamite. It further appeared that from the date of the patent down to the passing of the Nitro-glycerine Act of 1869, the sole importers of this explosive were Messrs. Webb and Co., of Llanberis. Their object was to promote the use of this substance, but their operations were stopped by the Act and the regulations of the Home-office, under which the transport of nitro-glycerine was absolutely prohibited. In April, 1871, Mr. Nobel, a Mr. Downie, and Messrs. Webb and Co., promoted the British Dynamite Company, Limited, which company acquired Mr. Nobel's patent of 1867, and two others cognate to it. There was some difficulty or delay in obtaining the necessary authority to commence business, and it was not until October, 1872, that the company began to manufacture. The petition then stated that it was found that the company's capital was insufficient, and a new company was formed, namely, Nobel's Explosives Company, the petitioners. The whole of the shareholders in the old company became shareholders in the new company with the same relative proportions of shares, and the old company was wound up, the patents and property being transferred. The petitioners, however, alleged that the profits had been quite inadequate, but it was not alleged that seven years' extension would be insufficient to remunerate them. They prayed a prolongation for fourteen years, or such other term as her Majesty should think fit to grant. It appeared from the petition, and a supplemental statement subsequently filed by leave, that the following foreign patents had been taken out:—France, 27th July, 1867, No. 72,007, with a certificate of addition dated 27th July, 1867 (this being for the improvement patented in England in the same year); Belgium, 31st May, 1867, No. 21,582 (lapsed); Saxony, 18th Dec., 1867, No. 2881 III. A (lapsed); Sweden, 19th Sept., 1867 (lapsed); Austria, 31st October, 1867; Bavaria, 14th January, 1868 (lapsed); Wurtemburg, 27th January, 1862, No. 551 (lapsed); United States, 26th May, 1868, No. 78,317; South Australia, 8th April, 1872; New South Wales, 30th May, 1872; Queensland, 4th January, 1872, the three last being subject to proceedings involving their validity. Patents were also believed to have been granted in Spain and Italy on the 3rd Feb., 1872, and 27th Nov., 1871, respectively. The French patent had been allowed to expire in consequence of the State monopoly in the manufacture of explosives.

Objection had been lodged on behalf of a large number of opponents. Numerous grounds of objection were stated, but the chief were that the company had been sufficiently remunerated, that its managers had dealt unfairly with the public in making extortionate charges and in forbidding importation except at excessive royalties, and that having regard to the freedom of manufacture and sale abroad, it would be contrary to public policy to extend the monopoly here.

Mr. Aston, Q.C., Mr. Macrory, and Mr. E. Cutler appeared for the petitioners; Mr. Webster, Q.C., and Mr. Lawson for one set of opponents; Mr. Webster, Q.C., and Mr. Chadwyck Healey for another set; and the Attorney-General, Sir Henry James, Mr. A. L. Smith, and Mr. Danckwerts for the Crown.

Mr. ASTON, Q.C., opened the case for the petitioners. He gave a history of the invention and of the litigation to which the company had been exposed, and of the difficulties they had to encounter in procuring a site for the factory and perfecting the manufacture. For the first three years the company had made no profit; since 1873 it had been successful, but chiefly through the profits which had accrued upon the manufacture of the nitro-glycerine subsequently converted into dynamite, and which profit he urged ought to be separated from the profit actually realised by the sale of the manufactured article. The company was obliged to make its own nitro-glycerine, because it was not allowed to be transported. The capital of the old company was £24,000, and when it was wound up the assets were taken over as worth £240,000, that is to say, for every share in the old company ten shares were allotted in the new company. In preparing the accounts for the committee the petitioners had not brought in the profits accruing from the manufacture of nitro-glycerine. They had taken as the price of nitro-glycerine 1s. 9d. per lb., a low price, and had apportioned all their expenses of working, and by that means they had arrived at the sum of £4809, which he submitted was an inadequate remuneration having regard to the value of the invention.

The ATTORNEY-GENERAL objected that the petition was irregular in two respects. First, it was out of time, because it had not been presented at least six months before the date of expiration of the patent. It had been presented on the 17th December, 1880, and the patent expired on the 7th May, 1881. The Act 5 & 6 Will. IV., c. 83, mentioned no time for presentation; it was only material that it should be presented and prosecuted to effect before the expiration of the patent. Then came the Act 2 & 3 Vict., c. 67, by sec. 2 of which the Crown was to have the power of extension provided the petition had been presented at least six months before the date of expiration. Secondly, the Act 7 & 8 Vict., c. 69, sec. 2, gave an increased power of extension to the Crown, namely, for the full period of fourteen years, "in like manner and subject to the same rules as the extension for a time not exceeding seven years," which was all that could be granted under the law as it previouly stood. But that was only if seven years extension would not adequately remunerate the patentee, which was not alleged, as it should be, in the petition. If the petitioners could be compensated by seven years extension, then they were proceeding under the 2 & 3 Vict., c. 67, and were bound to present their petition in accordance with the rule as to time there enacted. If they were proceeding under the 7 & 8 Vict., c. 69, there was no allegation that they would not be remunerated in seven years, and it might be that they would.

Mr. ASTON referred to the case of *Bodmer's patent* (1W.P.C. 740), and argued that the 2 & 3 Vict., c. 67, was passed to empower the committee to prolong a patent, notwithstanding that it had expired, provided the application had been lodged prior to the expiration. Before that Act there was no such powers, as was shown by the case to which he referred. The proviso as to presentation of the petition six months before the date of expiration only applied to cases which had not been "prosecuted with effect" within the meaning of the Act of 5 & 6 Will. IV., c. 83, sec. 4, and which cases would have failed under the old law. In effect the only object of presenting the petition six months before the date of expiration was to make sure that in the event of the petition not being heard before the date of expiration, the application should not fail for want of jurisdiction. If it were presented within the six months, and the patent had not expired when the case came on for hearing, which was the present case, no difficulty arose. As to the other objection, that only went to any extension beyond seven years, and that would only be material if their Lordships thought fit to advise an extension of more than that time.

The ATTORNEY-GENERAL replied.

Their LORDSHIPS held as to the first objection that the 2 & 3 Vict., c. 67, only applied to an extension, notwithstanding that the patent had expired at the date of hearing. If a petitioner did not come six months before the date of expiration he took the risk of his application not being heard in time, and therefore of failing. As to the other objection, the Attorney-General was right. There was not in the petition any foundation for a prayer for fourteen years extension. Upon the petition the committee could only recommend her Majesty to extend for seven years, and the petition ought not to be amended in this respect. There was no doubt that if more than seven years was sought there ought to be an averment that that term would not sufficiently remunerate the petitioner.

Evidence was then called on the part of the petitioners. Colonel Majendie, R.A., Professor Abel, Major Morant, Dr. Dupré, and others gave evidence as to the value of the invention, and the Government regulations affecting the manufacture of explosives. Mr. Webb was also called, who gave evidence as to the company's business; and Mr. Kemp, the accountant, who prepared the filed accounts, explained the system on which they were framed. In cross-examination it appeared that very large profits had been made by the company, as appears by their Lordships' judgment.

Ultimately Mr. ASTON stated to their Lordships that if they should be of opinion that the profits derived by the manufacture of nitro-glycerine ought to be taken into account with the profits on the sale of the dynamite, he could not but admit that the petitioners had been sufficiently remunerated, and should not therefore proceed with the case; but he submitted that that opinion ought not to be entertained, and argued that the former profits were mere manufacturer's profits, and should not be considered as accruing from the patent.

Mr. CHADWYCK HEALEY, on the other hand, argued that it was impossible to separate the profits. The manufacture of the nitro-glycerine was but one step in the manufacture of the dynamite. Even if the petitioners could have bought nitro-glycerine in the market, which they could not, they showed upon their own admission as to the economy with which they could produce it, that as prudent manufacturers they would in the ordinary course of business have done exactly what they had done. Had it not been for the possession of the patent for dynamite the company would not have made an ounce of nitro-glycerine. He cited *Muntz's Case* (2 W. P. C. 113) and *Saxby's Case* (7 Moo. P. C. N. S. 82) as authorities in his favour, and asked their Lordships to adopt that view and dismiss the petition.

Mr. ASTON replied and

Their LORDSHIPS then considered the case and delivered judgment. After observing that for the reasons already given they could not in any event recommend a prolongation beyond seven years, they stated that the question was whether any prolongation at all ought to be granted. Mr. Newton, the patentee, was not the real owner. Mr. Nobel was the person for whom it was taken out, and he was a foreigner. The patent had subsequently been assigned to the petitioners, and it was therefore necessary in the first place to determine whether they had made sufficient profit.

The company was originally formed under the name of the British Dynamite Company, Limited, and that company was registered on the 7th June, 1871. The capital of that company was £24,000, divided into shares of £10 each, 900 of which of the nominal value of £9000 were allotted to Mr. Nobel as the purchase money, it might be said, of his patent rights. The total amount of capital subscribed by the shareholders was £15,000, and the first question was whether the British Dynamite Company, which was afterwards converted into the Nobel's Explosive Company, had been sufficiently remunerated for the services which they had rendered in bringing this patent into execution. Now the company were certainly entitled to some merit from the mode in which they had carried on the manufacture of this dangerous explosive; it appeared that they had carried it on without any accident of a material nature, without any death or loss of limb, or any accident of a serious nature during the whole time that they had been carrying on the business. But still that would not entitle them to receive more than a fair and adequate remuneration for the services which they had rendered in bringing this patent into public notice. The accounts which had been rendered to their Lordships showed that the total amount of profit made by this company was £4809 and some shillings. But it appeared that the company not only manufactured dynamite by introducing into the nitro-glycerine the porous material which was necessary for converting it into dynamite, but they also had manufactured nitro-glycerine, and they had also manufactured the nitric acid with which that nitro-glycerine was prepared. In the manufacture of that nitro-glycerine and in the manufacture of the nitric acid, they had made very large profits. With regard to the nitro-glycerine they had sold a large quantity in amount, and upon all that large quantity, having manufactured the nitro-glycerine at 1s. 3d. per lb., they had received a profit of 6d. or 7d. for each pound that they had made. But it was contended that the profits they had made in manufacturing the nitro-glycerine were not to be taken into consideration in estimating the profits which they had made as the manufacturers of dynamite. It was clear that manufacturers' profits must be taken into account. But it was said that in this case these were not the manufacturers' profits of dynamite, but they were the manufacturers' profit of nitric acid or of nitro-glycerine which were not to be taken into account, and that there was one particular circumstance in this case which showed that they ought not to be taken into account, namely, the difficulties which had arisen in consequence of the Explosives Acts of 1869, and the very proper precautions of the Home Office in preventing those manufactures being carried on except under satisfactory regulations. The petitioners said then that it was necessary for them in consequence of the regulations to manufacture their nitro-glycerine. But it did not follow that because they had been compelled to manufacture it they should not account for the profits which they had made by manufacturing it. The profits of manufacture must necessarily be taken into consideration according to the cases which had been laid down from time to time by this committee. In *Hill's case* (1 Moo. P.C. NS. 296), it was laid down by Sir John Coleridge in a very carefully prepared judgment, that the manufacturer's profits must be taken into consideration. He said: "As to the first head, he deducts two-thirds as manufacturers' profits from the net profits received, and considered the remaining third as alone attributable to the patent, and therefore as alone to be brought into the present account, and this is objected to. Their Lordships find that this committee expressly laid down a contrary rule in the case of Muntz's patent, and as it seems to them on clear grounds. It is to be remembered that the accounts which a patentee renders in support in such a petition as the present are not such as might be proper between two several claimants on the returns of a mercantile firm, but such as show what profits made by a firm or individual are in a large sense attributable to the possession of the patent right, those which, without the patent, would not have existed at all, but of course excluding all just deductions for labour and capital." Then he adds, "If, but for the patent, there would have been no manufactory, then the net profits of the manufacturer are in that large sense attributable to the patent." This principle was merely carrying out the principle which had been laid down in *Muntz's case*, in which Lord Brougham, in his judgment, referred to the case of Mr. Watt, the inventor of the steam engine, and in which Mr. Watt, as the manufacturer of the steam engine, accounted for the manufacturer's profits. In *Saxby's case* the principle was upheld by their Lordships of the Privy Council, in which Lord Cairns delivered the judgment. He says, "Their Lordships are by no means prepared to say that, if they had taken these accounts simply as they stand, and had assumed that this was a patentee who, upon an invention of this kind, had received during the currency of the patent the sum of £4579 for royalties, and £14,322 for manufacturer's profits, if it had rested with those figures merely, that they would have been of opinion that they alone would have been an insufficient reward for a patent of this kind. It has been decided more than once by the committee that where a patentee is also the manufacturer, the profits which he makes as manufacturer, although this may not be in a strict point of view profits of the patent, must undoubtedly be taken into consideration upon a question of the kind. It is obvious that in different manufactures there will be different degrees of connection between the business of the applicant as a manufacturer and his business or his position as the owner of a patent. There may be patents of some kind which have little or no connection with the business of the manufacturer, and there may be patents of a different kind, where there is an intimate connection with the business of the manufacturer; that the possession of the patent virtually secures to the patentee his power of commanding orders as a manufacturer." In this case there was, no doubt, a most intimate connection. The company was formed for the purpose of manufacturing dynamite. But it was said that in manufacturing dynamite they also manufactured the raw material, or one of the raw materials of which the dynamite was composed. They manufactured the nitric acid, and it was in consequence of the regulations of the Government that they were compelled to prepare the nitro-glycerine on the premises. It was no disadvantage to the company that they were compelled to do so. If they had omitted to do it they would not have made the very large profits which they had made. It did not follow because they were compelled to do it, and did it, in consequence of that compulsion, that the very large profits which they had obtained by that manufacture were to be excluded from the profits of the manufacture of dynamite. They had merely manufactured the raw material of dynamite, instead of buying the raw material and converting that into dynamite. Those profits their Lordships thought must be accounted for. Now taking these profits into consideration, the sum of £15,000, which was the sole amount of capital advanced by the company, had been increased to the enormous sum of £232,978, exclusive of a sum of £120,000, the value of the goodwill of the business. In addition to this large sum of £232,978, to which the sum of £15,000 originally subscribed had been increased, the company had been realising dividends upon the £15,000 which they originally advanced for some years at the rate of 10 per cent. on the amount subscribed, and sometimes at the rate of 50 per cent., in consequence of converting the business, which was originally formed with a capital of £24,000, into a new company, Nobel's company, with a capital of £240,000. But still no larger portion of the capital had been paid than the £15,000, which had been since increased to the enormous sum of £232,978, and yet the company were not satisfied. It appeared to their Lordships that there was no ground whatever for recommending to her Majesty that the patent should be prolonged. Mr. Aston has taken a very proper course in asking their Lordships now to decide whether the profits of manufacturing the nitric acid ought to be taken into account or not. He had put the case upon that ground. Their Lordships thought that the profits of the manufacture of the nitro-glycerine and of the nitric acid must be taken into account in estimating the profits which the company had made. Their Lordships were of opinion not only that they had made sufficient remuneration, but that they had made a very large profit. Under these circumstances, their Lordships thought that the application must be dismissed with costs.

One set of costs was allowed to each set of opponents.

Solicitors for the petitioners—Messrs. Webb, Stock and Burt.

Solicitors for the opponents—Messrs. Helder, Roberts and Gillett, and Mr. J. Henry Johnson; and for the Crown—the Treasury.

HIGH COURT OF JUSTICE—CHANCERY DIVISION.

(*Before* VICE-CHANCELLOR BACON.)

March 11th.

EDISON'S TELEPHONE COMPANY *v.* INDIA-RUBBER AND TELEGRAPH WORKS COMPANY.

This was an interlocutory application, involving a point of practice of considerable importance. The action was brought for alleged infringement by the defendant company of Mr. Edison's patent for carbon telephone transmitters. The action was commenced on 5th March, 1880; the statement of claim and particulars of breaches were delivered on 19th of the same month; the statement of defence and particulars of objections were delivered on the 1st June, 1880. The action was originally brought by the Edison Telephone Company, in whom the patent was then vested. On the 12th July, 1880, the patent was assigned to the United Telephone Company, and on the 30th July, 1880, an order was obtained to amend the writ by joining the latter company as co-plaintiff, and the pleadings were subsequently amended. Issue was joined and notice of trial given on the 9th November, 1880, and the cause set down for trial. In the early part of February the hearing was by arrangement between the parties and consent of the Court fixed for the 15th March instant. On the 26th February last the defendant's solicitors applied for leave to amend their particulars of objections, and on the 1st March they handed to the plaintiffs' solicitors a copy of their proposed additions. They referred to several independent publications, which were alleged to contain prior publications of the invention in this country. They were the *English Mechanic* of 1st June, 1877; 18th August, 1876; the *New York Tribune* of 7th May, 1877: the *Telegraphic Journal* of 15th February, 1877; 1st July, 1877; and 15th May, 1876. There was evidence to the effect that these instances had not been discovered before the 24th February last.

Mr. Kay, Q.C., and Mr. Cozens-Hardy were counsel for the plaintiffs, and Mr. Aston, Q.C., Mr. Davey, Q.C., and Mr. Stirling for the defendants.

On behalf of the plaintiff company, it was submitted that the application ought not to be granted, except upon the terms of an order upon the defendant company to pay the plaintiffs' costs in the event of their electing to discontinue the action. Similar orders had been made in *Baird* v. *Moule's Earth Closet Company*, by the Master of the Rolls, on 3rd February, 1876; in *Aveling* v. *McLaren*, in the Common Pleas, by the Master, on 23rd December, 1880.* A similar order was stated to have been made in the case of *Wright* v. *Hitchcock*, in the Exchequer Division.

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* The following are the previous orders:—

"Upon motion, &c., this Court doth order that the plaintiff do within six weeks from the date of this order elect whether he will discontinue this suit, and if the plaintiff shall elect to discontinue this suit, and shall give notice thereof to the defendants within six weeks from the date of this order, it is ordered that it be referred to the Taxing Master to tax the defendants their costs up to and including the 23rd Feb., 1875" (the date of delivery of the defence), "and to tax the plaintiff's costs of this suit

His Lordship made the order in the terms of the order in *Baird v. Moule's Earth Closet Company*, with the variation that the plaintiff company should have one month instead of six weeks within which to elect to discontinue or not. The defendant company to pay the costs of the application, and he directed the cause to stand over generally, with liberty to the parties to apply to restore it to the paper if necessary.

Solicitors for the plaintiff company, Messrs. Waterhouse and Winterbotham; for the defendant company, Messrs. Murray, Hutchins, and Stirling.

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

(*From our own Correspondent.*)

Crude iron is being offered this week upon the exchanges of Birmingham and Wolverhampton at less money than would have been taken at the date of my last report. There were instances to-day—Thursday—in Birmingham, and yesterday in Wolverhampton, in which a quality of cinder pigs might have been bought in favourable instances at as low as 35s. for cash. At the same time there were makers of cinder pigs who would not accept less than 40s. with the usual conditions as to payment. Derbyshire pigs were offered at 45s. per ton, delivery to be limited to four months, but consumers asserted that they could buy at that figure with delivery to extend to the close of this year; and in this statement they were correct. Thorncliffe pigs were sought after, but though the price stood at 58s. 6d., which was a drop of 4s. in all within a few weeks, yet consumers declined to give the terms, alleging that the rates which they can alone secure for the finished product will not permit of buying on such terms. On their part the makers maintained that under 58s. 6d. would land them in a loss, and they held for that sum, even at the sacrifice of orders aggregating in all over 2000 tons. Cleveland gray forge was obtainable at 37s. 3d. at the furnaces, but no transactions calling for record were reported. Native all-mine iron ranged from £3 to £3 5s. and £3 7s. 6d., and part-mine tapered down from those figures to £2 5s., in gradations regulated by the proportion of mine to cinder used in the mixture.

The limited business transacted yesterday and to-day in crude iron, at a period of the quarter when sales are usually large, induced the expression of the intention of blast furnace proprietors to sensibly reduce their make if the demand has not improved by the next quarter day. If these expressed resolves should be adopted in practice, the number of furnaces now blowing will be reduced by from ten to a dozen within the ensuing two months. The last furnace which has been stopped is that of Mr. Firmstone, of Crookhey; but if the 1s. advance in coal should be taken off, this tendency would be checked.

The recent tendency to expansion in the business with the United States in baling strip has suffered a check from the success of the Pennsylvanian party in their effort to secure the selection by the President of a State officer who in the next few weeks would be likely to interpret the Tariff Laws as much as practicable in their favour. If, on the other hand, the efforts of the Free Trade party had been successful, and President Garfield had chosen their candidate, the strip mills of South Staffordshire would have had at least a few thousand more tons of strips to roll in the next few months than is now at all likely. And the orders which are this week being placed are accompanied with the proviso that if the effect of the selection cited should be to practically increase the duties now being levied upon completed baling hoops as distinct from ordinary hoop iron, or *vice versâ*, then that delivery of the unfinished remainder is to be cancelled at a week's notice. A few mills this week are working at the top of their bent upon baling strip. In other quarters preparations are being made to meet a demand which is still confidently anticipated.

The mails from China and Bombay, from Australia, New Zealand, and from Demerara, have been delivered this week. The New Zealand mail is pronounced "good as times go," and the Australian and West Indian advices are nearly as satisfactory as they have recently been. Nor can it said that the China and Bombay letters are more unsatisfactory than of late, inasmuch as there are instances in which they show a trifle of improvement. And there are markets in Eastern Europe that are displaying more energy.

The Australian mail was hardly likely to bring many orders for galvanised iron, and the event has not been opposed to expectation. Stocks are heavy out there, yet some quotations have slightly strengthened upon the month. Nor were the orders for fencing wire nearly so good as up to the last previous mail had been usual.

Nevertheless, some sheet makers are very busy this week, and one works is being enlarged by the laying down of two additional mills for rolling sheets for roofing purposes. The quotations to-day were :—Singles, from £7 5s. to £7 10s.; doubles, £8 5s. to £8 10s.; and latens, £9 15s. to £10. At these figures nothing, however, calling for record could be done.

Boiler plates were almost unsaleable; there was more inquiry for girder plates and angles and T's by engineers who are quoting for contracts in the market; and there were some sales of bars at from £5 15s. up to £6 10s., and onward to £7 10s. and £8 2s. 6d.

South Staffordshire ironmasters and manufacturers have carried off some capital honours at the Melbourne Exhibition. First-class awards have, it is this week learned by cablegram, been gained by Messrs. Wm. Barrows and Sons for their "B.B.H." finished iron, of which they have a large exhibit; and by Messrs. E. P. and W. Baldwin for their display of sheet iron and tin-plates. Similar honours have also been gained by Messrs. W. E. and R. G. Walker, galvanisers, Dudley and Walsall; Messrs. J. Wilkinson and Sons, of the Queen's-cross Vice and Anvil Works, Dudley; Mr. Henry Denton, agricultural engineer, Wolverhampton; Messrs. T. and C. Clark and Co., cast iron hollow-ware manufacturers, Wolverhampton; and Messrs. Meynell and Inman, brassfounders, Wolverhampton.

The Birmingham Proof House revenue returns for the year ended December 31st, 1880, show a total income of £7984, and an expenditure of £4270, and consequently a profit of £3713.

The new buildings for the gas department of the Birmingham Corporation, which are to form a continuation of the Council House, have now been planned. The ground floor will comprise a suite of 15 rooms, and the principal one, called the "General-office," will be 98ft. long by 52ft. broad and 23ft. high. The showrooms for gas fittings will also be spacious. The "General-office" will be divided in the centre by a series of ornamental cast iron columns, carrying a ceiling, arched in compartments in concrete, upon wrought iron girders of sufficient strength to support the floor above, moulded cornices being worked on each side of the girders. The rooms on the lower ground floor are proposed to be similar in style to those of the corresponding floor in the Council House. Like those on the ground floor, they will be devoted to gas department uses. All the rooms in the sub-basement will be vaulted in brickwork, as a security against fire. The whole of the first floor will be appropriated to the art galleries. These comprise twenty-four rooms, giving a total area of 17,380 square feet, and a wall space of 12,208 superficial feet, with the exception of the gallery set apart for the Industrial Museum. The museum will be 100ft. long, and will have within it an upper gallery, supported by two rows of cast iron ornamental columns.

subsequently to the said 23rd Feb., 1875, to the date of this order, and the said Taxing Master is to set off the costs of the plaintiff and of the defendants to be so respectively taxed, and certify to which of them the balance after such set off is due. And it is ordered that such balance be paid by the party from whom to the party to whom the same shall be certified to be due, and if the said plaintiff shall not give notice to the defendants of his discontinuance of this suit within the time aforesaid, it is ordered that the defendants be at liberty to add to the particulars of objections to the validity of the plaintiff's letters patent in the bill in this cause mentioned which have been already delivered by the defendants, the following further objections to be relied on by the defendants at the hearing of this cause, as objections to the validity both of the plaintiff's letters patent of the 15th August, 1867, and of the plaintiff's letters patent of the 9th March, 1868, that is to say"—(here followed particulars of the amendments)—"and it is ordered that the defendants, Moule's Patent Earth Closet Company, Limited, do pay to the plaintiff, Augustus Fraser Baird, his costs of this application to be taxed by the Taxing Master. Liberty to apply." *Baird* v. *Moule's Earth Closet Company.*

"Upon hearing counsel, &c., it is ordered that the defendants be at liberty to amend their particulars of objections dated the 11th day of March, 1880, by adding thereto" (here follow the amendments), "and that the defendants be at liberty to amend their particulars of objections by adding the particulars in the abstract hereto annexed, and that the plaintiff shall be in the same position as to discontinuing action as he would have been if the amended objections had been delivered with the defence, and that the costs of and occasioned by the amendment and costs unnecessarily caused to the plaintiff by reason of amendment being made at this later stage, be plaintiff's costs in any event." *Aveling* v. *McLaren.*

NOTES FROM LANCASHIRE.

(*From our own Correspondent.*)

Manchester.—In the iron trade of this district business seems to be relapsing into pretty much the same depressed condition as that which prevailed last year. The expectations which were entertained that the commencement of the spring trade would bring with it a revival of activity are not being realised, and consumers who bought in anticipation of orders coming in have in many cases more iron on their hands than there is any present prospect of using for some time to come. As a consequence, there is not only extremely little demand for iron, but there are numerous complaints of the difficulty experienced in getting buyers to take their deliveries on account of contracts already given out. During the past week there has been an almost complete cessation of buying, and at the Manchester weekly market on Tuesday very few inquiries even were reported. With the present absence of demand it is almost impossible to say what sellers would be prepared to take if *bonâ fide* offers were made, but the general want of firmness which is apparent, especially amongst holders of iron, indicates that to effect sales very low prices would be accepted.

Lancashire makers of pig iron have now reduced their quoted prices about 1s. per ton, No. 3 foundry iron delivered into the Manchester district being quoted at 46s. 6d., and No. 4 forge 45s. 6d. per ton, less 2½ per cent.; but these figures, which simply represent what would have been readily accepted some time back, do not lead to orders being given out, and local makers are still open to lower offers. Although new orders are not coming in, a good deal of iron is still being delivered from the local furnaces on account of old contracts.

In outside brands there is little or nothing doing in this market, and I cannot do more than quote nominal prices. For delivery equal to Manchester, g.m.b. Middlesbrough iron is quoted at 46s. 4d. per ton net cash; Lincolnshire at 45s. 6d. to 46s. 6d., less 2½; and Derbyshire, 46s. 6d. to 47s. 6d., less 2½, for forge and foundry qualities respectively.

The finished iron trade continues very dull, and local forges are only kept going by deliveries on account of contracts, very little new work of any kind coming in. Prices are weak, and for prompt specifications very low figures would be taken. For delivery into the Manchester district the average quoted prices are about as under :—Bars, £5 17s. 6d.; hoops, £6 10s. to £7; common plates, £7 10a.; and sheets, £7 15s. per ton.

In the engineering branches of trade, works, as a rule, are being barely kept going from hand to mouth by the work they have in hand, and it is only a few of the large firms who do a foreign business that are busy. On home account there is very little work coming in, and the prospects for the future are not encouraging.

The complete collapse of any pressure for supplies in the coal trade so soon after the termination of the strike has been surprising. Already all classes of fuel are being offered in the market considerably in excess of requirements, and even engine fuel is now tolerably plentiful. Although the Lancashire collieries have not yet resumed their full ordinary output, more coal is being raised in many cases than can be moved away, and there is a pressure for orders on the part of sellers that naturally imparts a very unsettled tone to prices. At the pit mouth the average quotations are about 10s. to 10s. 6d. for best Wigan; Arley, 8s. to 8s. 6d.; for Pemberton four-feet, 6s. 6d. to 7s. for steam and forge coal; 5s. to 5s. 6d. for burgy; and 3s. 6d. to 4s. 6d. for slack, according to quality. Buyers, however, are pressing for reductions, and in many cases there is a giving way upon the above prices.

The local coke ovens have again been re-lighted, some of them having been drawn during the last few days for the first time since the strike. Generally an advance of 10d. to 1s. 8d. per ton is being asked upon late rates, best cokes being now quoted at 12s. to 15s., and small cokes 9s. to 11s. per ton at the ovens.

At the next meeting of the Manchester Scientific and Mechanical Society a motion is to be submitted to the effect that the society be dissolved. Like other institutions, the above society has suffered from the severe commercial depression of the last few years, but it is still a comparatively strong society, numbering upwards of 100 members, and the nucleus of a valuable library has been collected. It will be matter of regret if the society, which has now been in existence for a number of years and has about it the means of doing good useful work, should, in an important engineering centre like Manchester, be allowed to collapse.

A paper on machine tools, with special reference to the planing machine, was read at the meeting of the Manchester Scientific and Mechanical Society, on Friday last, by Mr. John Kershaw, jun., of Manchester. The reader of the paper pointed out that the objections to double-cutting machines, such as the complicated motions required for working them, the difficulty in fixing the tools, and the machines being only capable of doing one class of work, had up to the present stood in the way of their adoption in the place of the single-cutting machines, which were still the class of tool used as a rule. The advantages to be derived from cutting both ways with the same machine were, however, manifest, and he proceeded to describe the double-cutting machine patented by Messrs. J. and J. Kershaw, which was illustrated in our pages for the 3rd December, 1880.

Barrow.—My information this week is of a much more cheerful character. The demand for both iron and steel has increased, and American and continental consumers are beginning to order more largely from local makers. The latter have already sold their output for this year well forward, and it is evident there is every effort being made to increase it to a considerable extent. The yield of the furnaces is large, and stocks represent a considerable quantity of iron, but deliveries are very fully maintained. Several heavy parcels of metal have been disposed of, subject to delivery by shipping early in the spring. Prices are given at the low rate of 60s. to 63s. per ton at works. Several makers, who are very fully sold forward, are declining to sell at these figures, as they do not represent any profit, and because they expect better prices in a short time. The steel trade is busy, and the mills, especially in the Bessemer rail department, are working full time. Iron shipbuilders and engineers are very fully employed, the latter especially in the marine department. Iron ore, 13s. to 16s. 6d. per ton at mines. Coal and coke steady.

THE SHEFFIELD DISTRICT.

(*From our own Correspondent.*)

The South Yorkshire colliers' strike has ended, as I anticipated when it started, in a collapse, and, for the present, the last word has been said by the employers. Mr. George Wilson, of the Cyclops Steel and Ironworks, who has acted as the chairman of the Coalowners' Committee, replied on Wednesday to a letter sent to him by Mr. John Frith, the secretary of the Barnsley Miners' Association. Mr. Wilson says the colliery owners are prepared to take into consideration any circumstances which may be suggested by the men in the matter of wages, and to deal with the whole question in a fair and liberal spirit, whenever the men may signify their willingness to accept the principle of a sliding scale. "I must add," says Mr. Wilson, "that if a sliding scale, as offered by the masters, had been accepted, there need have been no strike, nor any cessation of work at the collieries, and the men might have been in the uninterrupted enjoyment of the wages they have needlessly lost." "Should not some serious effort," concludes Mr. Wilson, "be now made to establish new conditions between the employers and employed, such as a sliding scale offers, whereby the recurrence of such waste and loss as all have experienced in the last few weeks may be rendered impossible for the future."

Steam coal was speedily affected by the close of the strike. Up till this week it was difficult to get sufficient supplies of steam coal, and a large amount of rubbish has been worked off from the pits, and run up to 4s. 9d. per ton for "smudge," and even 8s. per ton being given for slack. Prices have fallen during the week by about an average of 2s. per ton, quotations on Wednesday being—smudge, 4s.; slack, 5s. 6d.; common Silkstone, 7s. 9d.; best, 9s. 10d.; all on the wharves. Special qualities for household use have not fallen as yet, though the demand from London and the Eastern Counties has moderated with the advent of spring weather.

At the Wharncliffe Silkstone Collieries, the men resumed work on Thursday, on the understanding that all future disputes shall be settled by a joint committee, consisting of three employers and three men, with a chairman unconnected with the coal trade. I hear that instead of combining in one great industrial confederation, the Silkstone colliers intend to form a separate Union. During the recent dispute, most of the Silkstone pits granted an advance, whilst the thick seam coalowners took an opposite course. This, I believe, has led to the proposed separation of the Barnsley and Silkstone seam miners.

A somewhat languid feeling is apparent at present in the Bessemer steel trade, and prices are weaker. Ordinary Bessemer billets, best makes, sawn ends, are quoted £6 7s. 6d., a reduction of 2s. 6d. on the fortnight; No. 2 quality, with extra admixture of Russian iron, £7 2s. 6d.; best marked brands, for cutlery purposes, from Swedish pig, £8 15s. to £9 2s. 6d.

Messrs. William Jessop and Sons, Limited, Brightside Steel Works, have had a prosperous year, especially in the American trade, which has been remarkably brisk. They are to pay a dividend of 40s. per share—£50, £30 paid up—which is equal to £6 13s. 4d. per cent., and carry forward £3000 to the next account. The dividend for the previous year was 30s. per share, or 5 per cent.

Messrs. Charles Cammell and Company, Limited, Cyclops Steel and Ironworks, are to pay the same dividend as last year—5 per cent. During the year ended 31st December last they have made a profit of about £42,000, which with the sum of £20,695, makes a total of £62,455, of which £40,000 will go in paying the dividend and a balance of £22,455 be carried forward. This is the same dividend as was paid by the company last year.

Jessop's and Cammell's reports, which are not yet issued, will be looked forward to with interest in the steel and iron circles.

The Sheffield Telephone Exchange continues to be worked with great energy. Sheffield was the first town in the country to establish the exchange system, and the first to accept the conditions imposed by the Postmaster-General. Mr. Tasker—Messrs. John Tasker, Sons, and Co.—informs me that arrangements are nearly completed for connecting the central exchange with the head Post-office. When this is done subscribers will then be in direct communication with the postal head-quarters, and consequently with all parts of the world. The saving of messengers and valuable time will thus be very apparent. Another novel feature is about to be introduced by the Sheffield Exchange. If the permission of the Town Council can be secured a microphone will be fixed in the clock tower of the Town Hall, and by this means any subscriber may, on calling to the central office, have his wire switched to the Town Hall wire, and so hear the clock strike in his office any hour of the day. In this way subscribers may have correct time continuously. During last week the number of messages were 4202 as compared with 381 in the corresponding week of last year.

THE NORTH OF ENGLAND.

(*From our own Correspondent.*)

Dulness was again apparent in the tone of the market held at Middlesbrough on Tuesday. The fine weather ought to have some effect, and no doubt it has; but the political news is depressing, and the occurrence of fresh failures has increased the disposition to distrust and hesitancy. The "bears" have naturally made the most of their opportunity, and many have been the stories set afloat, some absolutely untrue, and all, tainted with exaggeration in order to pull down prices. The cry for limiting production is now general. People are becoming impressed with the undoubted fact that consumption is not nearly a match for production, and stocks are accumulating day by day with provoking regularity. This is only what has been going on for months, as has been again and again dwelt on in these columns. But so strong and so general was the belief in a heavy spring trade, and so determined were all interested to take a sanguine view, that only now is the possibility of disappointment beginning to be entertained. The change in feeling is well indicated in the excess over prompt iron obtainable for warrants. On Tuesday the difference was 1s. 3d. per ton, as against 1s. 6d. to 1s. 9d. during the earlier part of the present and the later part of last year. Should the present state of things continue this difference may be expected to grow less and less. The price of No. 3 iron is now 38s. buyers, or 38s. 3d. sellers, for prompt delivery, and 1s. less for No. 4 forge. The stock in Connal's stores has increased 2544 tons during the week, and amounts to 155,366 tons at Middlesbrough, and 531,433 tons at Glasgow.

In manufactured iron a further fall has taken place. Plates may now be had at £6 7s. 6d. per ton free in trucks at makers' works, cash less 2½ for large specifications; and half-a-crown more for odd lots. Several makers refuse, however, to sell at all at these prices, and having well-filled order books can afford to keep out of the market for a time. Angles and bars are offered at £1 per ton less, and puddled bars at £3 15s. net cash at makers' works. The improved weather has already had a marked effect upon the shipbuilding industry, and consequently upon the rolling mills. Specifications, so long withheld, are coming more freely forward, and the consumption is now probably at least equal to the current make.

Another meeting of the standing committee of the Board of Arbitration was held at Stockton, on Monday, to consider further difficulties which had arisen in respect of shearmen and their helpers. By the recent alterations the helpers were found to be earning more money than the contractors employing them. This dissatisfied the latter, who refused to continue on such terms. The decision of the committee was in favour of giving way to a new application for a further 1¾d. per ton, making a total concession from the employers of about 6d. The operation of shearing will now cost one-third more than previously, that is, a firm turning out 500 tons per week will have to pay £12 10s. per week more to the same number of hands—about twelve—for the same work, and without any substantial reason that can be perceived by those best qualified to judge.

It is announced that two new steel works are likely to be put up at Middlesbrough. The first is in connection with the Tees Side Iron and Engine Works Company—Hopkins, Gilkes, and Co. resuscitated—which proposes to convert its old bar, angle, and plate mills into steel works. The site is undoubtedly an excellent one for the purpose, the firm's own blast furnaces being close by. There is a good frontage to the river Tees, as well as railway connection with the North-Eastern system, and with the private lines of the Middlesbrough owners. It is supposed that the basic system will be the one adopted as most applicable to the capabilities of the district. With a view to such a change, the directors have been advertising for a new general manager.

The other steel works are to be erected by a new company which is understood to have purchased a site in what is known as the Ironmasters' district. The position is equally as good as the last-named one. Among the promoters and probable directors, are Mr. S. G. Thomas—of basis process fame—and Mr. T. Wrightson, of Stockton-on-Tees. It is proposed to manufacture in the first place ingots, blooms, and billets for sale to manufacturers; and afterwards to develope in such direction as may appear advisable. The Erimus Steel Works at Stockton, after being got ready for a start, are still inactive from some unknown cause.

The further failures alluded to are those of Thomas Tyers, Leeds, and J. Thorman, Newcastle-on-Tyne, both being iron merchants. With small original capital great risks appear to have been run in both cases, with the usual result.

A sad accident has occurred at the Eston Steel Works. A converter, containing 12 tons of molten metal was being turned down in order to introduce some scrap steel. One of the pipes forming part of the hydraulic manipulating machinery burst. Control was at once lost. The vessel turned over with a run, pouring out its contents upon the floor, where some water had recently been used to cool some slag. An explosion of steam was the immediate effect, scattering molten metal in all directions. About twenty men were more or less burnt, a dozen of whom were taken to the North Riding Infirmary at Middlesbrough, by a pilot engine and a van requisitioned for the purpose. Three of the sufferers have since died, but the rest are in a fair way for recovery. The accident occurred at two o'clock in the morning, and it was some time before a doctor and the necessary appliances could be obtained. Most of the men were Irishmen.

On dit, that the estate of Messrs. Oswald Mordaunt and Co., of Southampton, is likely to realise at least 15s. in the pound; that of the Darlington Iron Company, 20s.; Kirk Brothers, 7s. 6d.; Thomas Tyers, who was a creditor of Messrs. Oswald Mordaunt and Co., not more than 2s. 6d.; John Thorman, 11s.

NOTES FROM SCOTLAND.

(From our own Correspondent.)

Since last report, there is no perceptible improvement in the iron trade, and the opinion appears to be gaining ground that we shall have to content ourselves with a much lower estimate of business than that formed at the beginning of the year. The exports of pig last week aggregated only 8261 tons, as compared with 20,985 at the same date last year, and while that is so, the production is about as large as it was a year ago, and the stocks very much heavier. The entire shipments of pigs so far have been 90,733 tons, whereas at the same date in 1880 they had reached 145,561 tons. Connal's Glasgow stores now contain upwards of 530,000 tons, and they are being augmented by several hundred tons daily. The question is now being discussed whether it would be advantageous to reduce the production, and if the better weather that now prevails should not lead to an improvement in business, the matter will probably have to be still more seriously considered by the ironmasters.

There has been less animation in the warrant market this week. Business was done on Friday morning at from 48s. 11d. fourteen days to 49s. 1d. cash, the afternoon quotations being 49s. to 49s. 2d. cash and 49s. 3½d. one month. On Monday forenoon transactions were effected at 49s. to 49s. 3d. cash; and 49s. 2d. and 49s. 4d one month; the prices receding in the afternoon, when the figures were 49s. 2½d. to 49s. 1d. cash, and 49s. 4d. to 49s. 2½d. one month. The market was easier on Tuesday, with a considerable business at 49s. 2½d. one month, to 48s. 10d. cash. The market on Wednesday was dull with business down to 48s. 6d. cash, and 48s. 10d. one month. To-day—Thursday—the market was flat with transactions between 48s. 3d., and 48s. 1d. cash.

Makers' prices, which do not show much alteration, are as follows:—Gartsherrie, f.o.b., per ton, No. 1, 58s. 6d.; No. 3, 50s. 6d.; Coltness, 59s. and 51s.; Langloan, ditto, ditto; Summerlee, 58s. 6d.; Calder, ditto, ditto; Carnbroe, Clyde, Monkland, Govan, and Quarter, each 50s. and 48s.; Shotts, at Leith, 60s. and 52s. 6d.; Carron, at Grangemouth, 52s. 6d. (specially selected, 56s.) and 51s. 6d.; Kinneil, 50s. and 48s. 6d.; Glengarnock, 50s. and 51s.; Eglinton 50s. and 48s., Dalmellington, ditto, ditto.

The malleable iron trade is quiet, and orders do not come in so well as could be desired. Nevertheless there is a fair amount of work still in hand, and as a few shipbuilding contracts are being placed, matters will probably brighten a little. The steel-works continue busy, but ironfounders are in most cases ready for fresh orders.

There is a good business doing in coals, although not so large as it was a week or two ago. This will be apparent when it is stated that the shipments at the Scottish ports last week—east and west, and foreign, and coastwise—aggregated 22,535 tons, or 20,259 less than in the preceding week. This decrease is in a large measure owing to the circumstance that the close of the Lancashire strike has withdrawn the orders that came temporarily from the North-West of England. Without these orders the trade is considerably better than it was this time last year. Prices are down at least 6d. in the week, and there is an abundant supply of all kinds of coals, except dross, which is not quite so plentiful. At the Eastern ports trade is beginning to move a little, and as the navigation of the North Seas will be open presently, a considerable number of vessels are arriving for cargoes.

The miners are quiet everywhere, and they have been making good wages during the last two months.

The straitened affairs of the Monkland Iron and Coal Company were vividly brought before the shareholders at the annual meeting held in Glasgow on Tuesday, by the chairman, Mr. George Wilson, who stated that although they had a good property, they had from the first been restricted as regards working capital, and matters had at length come to the point when something must be done. They had got value, but not money, and they had obligations that must be paid in money, and could not be postponed. The directors had considered every possible way of overcoming the difficulty, first by the stoppage of the malleable iron department, next by the issuing of a preference stock, and lastly by the creation of permanent debenture stock. But difficulties cropped up in regard to all of these suggestions, and they had to be dropped. He requested the shareholders to appoint a committee of their own to confer with the directors, and report to a future meeting. This course was adopted.

A petition has been presented to the Court of Session for the judicial winding up of the Glenduffhill Coal Company, Limited, and for the appointment of Mr. Robert Galt, jun., C.A., Glasgow, as official liquidator. The petitioners are Mr. James Todd, of Glenduffhill, the owner of the collieries leased to the company, and Mr. Alexander M'Kinlay, horsedealer, Glasgow, a shareholder and contributory.

The Irvine Harbour Trustees have, by a majority, granted an application by Nobel's Explosive Company to erect a wharf at Irvine Harbour for the shipment of dynamite.

The shipments of gunpowder from the Clyde in the month of February were 34,750 lb. against 152,300 lb. in the same month last year. Nearly the whole of the powder went to Melbourne.

WALES & ADJOINING COUNTIES.

(From our own Correspondent.)

There has been a good deal of feeling displayed in Swansea by the throwing out of the Swansea and Rhondda Railway Bill, especially as it was through a technicality. I am assured, however, that the scheme will be persevered in, and the idea is now to have an independent line from Rhondda on to Briton Ferry, skirting Cmwavon, and Swansea, taking in its course all important works and collieries. This will open out the wealth of the richest coal valley in Wales. It may be urged, from evidence given at the commission, that though rich, fifty years will see a failing output. Possibly; but I think this time might be extended a little. Twenty years will witness a great change in the coal valley of Aberdare, which is being rapidly worked out. One lease, that of Abercwmboy, was, I hear, lately given up. Still, even fifty years would justify the formation of the line. The Taff Vale is only forty years old, and at the rate of 16 per cent. will have been an ample investment if it ceases at the end of that time, which, I need not state, is one of the most unlikely of occurrences, though one of the ablest minds in the Taff Vale has stated openly that its profitable life is only forty-five years more.

As I expected, the result of an examination of books by the accountants specially selected by the Coalowners' Association, do not justify an advance of wages yet. The time taken was the four months ending December. The next four months ending with April will most likely yield the desired advance, and colliers must be satisfied so far with the full time they are getting.

I am glad to be able to report a continuance of work at all collieries, and the exhibition of very little if any dissatisfaction, except at Coedcae Colliery.

At Cardiff the trade has remained firm, with little falling off in exports. At Swansea an increase of 3000 tons has to be reported, but there is greater difficulty at that port than at Cardiff in maintaining the last advance. Competition appears keener at Swansea, and it is the common report that coalowners work with less harmony, and undersell one another more than at Newport or Cardiff.

Rumours are abroad in the Swansea district that on account of the very unsettled state of the tin-plate trade several works are on the eve of giving notice to their men of an entire suspension of business next month.

In iron there is a disposition to recede in price; steel rails are firm; inquiry for scrap and old rails not so brisk, but on the whole the iron trade remains in about the same state as last week. The total exports of iron and steel rails from Wales last week, including also pig and bar, was 9746 tons, and judging from books, and steady continuance of make, a very gratifying amount of exports will continue on into the spring. Amongst the prominent shipments of the week have been 1000 tons of rails to Smyrna, 1220 to Bombay, and several large cargoes of similar proportion to South America.

The quantity of coal sent from Wales last week was only slightly in excess of 100,000 tons to foreign countries, but the coal traffic to Liverpool and London has been great, and there is not much cause either for present complaint, or for apprehension as to the future for some time to come. The majority of coalowners are well sold, especially for best varieties. Inquiries from France are increasing, and the unusual slackness of trade existing between Wales and the northern ports of France is decidedly giving way. France, too, I am glad to see, is putting in more orders than usual for tin-plate. L'Orient and Marseilles in particular have been fair buyers.

There is not much improvement going on in the Forest of Dean. Prices are retained for coal and iron, but sales of iron are only effected with difficulty, and at abatement. Several of the principal colliery owners of the Forest have appealed for remission of taxes in consideration of lessened trade, and this has been allowed.

One of the leading rail inspectors of the district, Mr. Davenport, died, after a brief illness, this week. He was well known, and much respected at all the ironworks. This is the second loss in his class lately, Mr. Teilo Davies having succumbed in the same manner only a short time ago.

It has been decided to let the Newport Tramway on lease for five years to Mr. Perry, who has agreed to give the company 7½ per cent.

British Trade in February.—The trade and navigation returns for February show the value of imports to have been £36,646,270 against £33,246,028 in February last year, and £28,661,080 in 1879. The value of exports for the month was £16,835,550 against £16,504,708 in February last year, and £12,713,069 in 1879.

THE PATENT JOURNAL.

Condensed from the Journal of the Commissioners of Patents.

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

Applications for Letters Patent.

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

8th March, 1881.

977. Signalling Apparatus, E. de Pass.—(*H. Leblanc and E. V. A. Loiseau, Paris.*)
978. Fog Bells, W. P. Thompson.—(*International Fog Bell Company, U.S.*)
979. Displaying Apparatus, F. McIlvenna, Liverpool.
980. Soda, W. Weldon, Burstow.
981. Pottery, &c., T. Willett, Burslem.
982. Propelling, &c., L. Groth.—(*A. Müller, Passau.*)
983. Cellulose, &c., A. Parkes, Birmingham.
984. Cranes, &c., C. R. Parkes, Millwall.
985. Turning Over Leaves, A. G. Morgan, London.
986. Soles, &c., H. Haddan.—(*V. Hervochon, France.*)
987. Watch Keys, F. A. Walton, Birmingham.
988. Wheels, E. C. F. Otto, Peckham.
989. Fastenings, E. F. Griffin, Birmingham.
990. Writing Slates, E. J. J. Dixon, Bangor.
991. Batteries, G. F. Redfern.—(*S. Marcus, Vienna.*)
992. Motive Power, H. Newton.—(*H. Hosmer, Rome.*)
993. Steam Engines, T. Spiller, London.
994. Condensing, J. Spence.—(*J. Spence, Calcutta.*)
995. Fuel, G. Walters, Frome, and W. Morgans, Bristol.

9th March, 1881.

996. Turning Lathe, O. Jones, Philadelphia.
997. Mills, H. J. Haddan.—(*J. Koerner, Waldenburg.*)
998. Landaus, J. Lewis, T. Hammond, and J. Hiller, Kilburn.
999. Dyeing Cotton Yarns, F. A. Gatty, Accrington.
1000. Mandril, J. Harrison, Manchester.
1001. Velocipedes, R. C. Fletcher, Preston.
1002. Tan Liquors, T. and G. Priestman, and J. Longshaw, Preston Brook.
1003. Condensing, F. Wirth.—(*P. Gavpp, Romanshorn.*)
1004. Stoppers for Bottles, N. Thompson, Brooklyn.
1005. Wash Boilers, A. Specht.—(*T. Harbeck and A. Haspery, Elmshorn.*)
1006. Brakes, S. C. Taylor and J. Wild, Morton.
1007. Boot Protectors, J. Fieldhouse, Keighley.
1008. Weaving Leno, R. Ecroyd, Lomeshaye.
1009. Traction, &c., Engines, J. Braby, Rudgwick.
1010. Preparing, &c., Hemp, J. Barbour, Belfast.
1011. Spinning Yarn, A. Combe, Belfast.
1012. Furnaces, B. R. Huntley, West Hartlepool.
1013. Pottery Ware, C. Westwood and R. Windmill, Stafford.
1014. Portable Railways, A. Dunlop, Glasgow.
1015. Heels for Boots, &c., W. Brewster, Hunslet.
1016. Veber-meters, E. G. Brewer.—(*T. Edison, U.S.*)
1017. Furnaces, A. Clark.—(*M. Marie, Martinique.*)
1018. Packing Material, J. A. Turner, Manchester.
1019. Steam Engines, F. W. Durham, New Barnet.
1020. Sewing Machines, J. B. Robertson, Ireland.
1021. Mounts for Pipes, D. O. Sandheim, London.

10th March, 1881.

1022. T-squares, J. Corp, Bermondsey.
1023. Organs, G. Green and C. Savage, London.
1024. Purifying, M. Benson.—(*O. Oexle, Germany.*)
1025. Steam Generator, J. Teer, Salford.
1026. Buildings, &c., S. Rideal, Manchester.
1027. Electric Lamps, J. A. Berly, Peckham Rye.
1028. Motive Power, J. and G. Weir, Glasgow.
1029. Carding Cotton, F. Mills, Heywood.
1030. Musical Instruments, T. Paterson, London.
1031. Door, &c., Knobs, G. Price, Birmingham.
1032. Sheaf-binding, J. Howard and E. Bousfield, Bedford.
1033. Consuming Smoke, G. Hunter, Leeds.
1034. Generators, F. Duray, Belgium.
1035. Cleaning Knives, H. Courteen, London.
1036. Furnaces, J. H. Johnson.—(*C. Pernot, Paris.*)
1037. Packing Material, W. R. Lake.—(*R. H. Thompson, Brooklyn, and H. D. Norris, New York, U.S.*)
1038. Water-closets, W. R. Lake.—(*A. Edwards, U.S.*)
1039. Writing Instrument, J. Nadal, London.
1040. Electric Light, A. Common & H. Joel, London.

11th March, 1881.

1041. Dram Flasks, J. Hall, Sheffield.
1042. Sheep Shears, T. A. and R. H. Sorby, Sheffield.
1043. Dyeing, C. T. Bradbury, Stalybridge.
1044. Chimneys, R. and J. Douglass, Coventry.
1045. Flues, &c., G. Love, jun., Lanchester.
1046. Punching, &c., J. MacLellan Blair, Glasgow.
1047. Deleterious Gases, C. S. Rolfe, London.
1048. Maltose, J. Imray.—(*A. P. Dubrunfaut, Paris.*)
1049. Pickling Metal Plates, D. Matthews, Newport.
1050. Water-closets, W. B. Bryan, Blackburn.
1051. Heating Stoves, F. Arnold, Birmingham.
1052. Boots, &c., K. Proctor, Burnley.
1053. Lozenges, J. Rough and J. Hurry, Dalkeith.
1054. Brakes, A. Haughton, Grimsby.
1055. Brushing, &c., Rails, T. Hardeman, Manchester.
1056. Artificial Flowers, W. Spence.—(*W. Hagelberg, Berlin.*)
1057. Looms, C. Catlow, Burnley.
1058. Pneumatic Brake, F. W. Eames, Leeds.
1059. Gas Lamps, W. T. Sugg and R. Pierson, London.
1060. Boilers, R. and F. Garrett, Leiston.
1061. Furnaces, E. Brook, Bradford.
1062. Steering, W. Cooper and J. Taylor, Sunderland.
1063. Ores, J. H. Johnson.—(*S. Philippart, Paris.*)
1064. Tables, A. Lloyd, London.
1065. Steel Wire, W. F. Bateman, York.
1066. Straining Pulp, G. Tidcombe, Watford.
1067. Spinning, A. M. Clark.—(*C. Maillard, France.*)
1068. Air Engines, E. Major, China.

12th March, 1881.

1069. Date Powder, F. Pool, Charleston, U.S.
1070. Signals, J. Snowball and C. Warren, Kilburn.
1071. Elastic Webs, H. Booth, Attleborough.
1072. Switches, A. E. McDonald, New York, U.S.
1073. Blind Rollers, G. P. Lempriere, Birmingham.
1074. Gas Engines, E. Benier & A. Lamart, Beaumetz.
1075. Caps, D. Butterfield, Keighley.
1076. Steam Engines, H. Charlton, Gateshead-on-Tyne, and J. W. Wailes, Wednesbury.
1077. Looms, J. Slimon, Kirkintilloch, and J. Whyte, Glasgow.
1078. Engines, H. Jenkin & A. Jameson, Edinburgh.
1079. Cutting Machine, O. L. Deschamps, Paris.
1080. Floating Bridges, B. P. Stockman, London.
1081. Gas, W. L. Wise.—(*N. F. Delean and La Société Hubert Frères, Paris.*)
1082. Bottles, W. R. Lake.—(*F. Bohman, Sweden.*)
1083. Perforating, H. H. Lake.—(*Automatic Music Paper Company, Boston, U.S.*)

14th March, 1881.

1084. Gas Burners, J. B. Fenby, Sutton, Coldfield.
1085. Cards, G. Nawrocki.—(*J. Peschkes, Crefeld.*)
1086. Combing Wool, J. Bailey, Keighley.
1087. Hawse Pipe, T. Cockshott, East Greenwich, and H. M. Goodman, Catford.
1088. Iron, &c., Plates, J. Larue, Paris.
1089. Motors, D. Clerk, Glasgow.
1090. Friction Gearing, F. Wirth.—(*F. Voith Heidenheim, and A. Niethammer, Kriebstein.*)
1091. Tiling, A. M. Clark.—(*J. J. Williams, U.S.*)
1092. Pistons, A. M. Clark.—(*H. Waterman, U.S.*)
1093. Governors, A. M. Clark.—(*W. E. Gwyer, U.S.*)
1094. Telegraphy, B. Mills.—(*W. A. Leggo, U.S.*)
1095. White Lead, H. J. B. Condy, London.
1096. Obtaining Prints, J. H. Coghlan, London.
1097. Batteries, J. H. Johnson.—(*La Société Anonyme la Force et la Lumière Société Générale d'Electricité, Paris.*)
1098. Water-closets, J. Elms, London.
1099. Holding Shades, &c., W. R. Lake.—(*A. W. Crockett, U.S.*)
1100. Carriages, L. A. Groth.—(*G. Liedman and C. Beger, Berlin.*)
1101. Bricks, M. E. Dearnaly, Mirfield.
1102. Take Off Apparatus, D. Phillips, London.
1103. Fastenings, J. M. Banks, Birmingham.
1104. Baling Hay, J. H. Ladd.—(*P. K. Dederick, U.S.*
1105. Beds, E. Shipton-Price, Bristol.
1106. Knitting Machines, W. J. Ford, Humberston.
1107. Baths, W. Lake.—(*B. Barda, Vienna.*)

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

922. Fire-arms, J. H. Johnson, Lincoln's-inn-fields, London.—7*th March*, 1878.
927. Looms for Weaving, J. A. Porter and R. Thompson, Blackburn.—7*th March*, 1878.
1061. Punching Apparatus, T. Walmsley and J. Thompson, Bolton-le-Moors.—18*th March*, 1878.
1089. Breech-loading Fire-arms, S Mills, Birmingham.—19*th March*, 1878.
942. Gas Engines, C. Linford, Leicester.—8*th March*, 1878.
968. Mortise, &c., Locks, J. Green, Wolverhampton.—11*th March*, 1878.
978. Binding, &c., Crops, C. T. Burgess, Brentwood.—11*th March*, 1878.
1047. Brakes, J. Clark, Kensington, London.—16*th March*, 1878.
1053. Box Fastenings, C. T. Remmett, Wolverhampton.—16*th March*, 1878.
1151. Kilns, W Radford, Harrogate.—22*nd March*, 1878.
961. Couches, L. Robinson, Ilkley.—9*th March*, 1878.
840. Connecting Apparatus, J. Gresty and J. Mills, Salford.—1*st March*, 1878.
983. Self-acting Mules, D. Dixon, Pudsey.—12*th March*, 1878.
1130. Fastenings, W. B. Williamson, jun., Worcester.—21*st March*, 1878.
994. Welding, &c., S. Fox, Leeds.—12*th March*, 1878.
987. Dredging Apparatus, C. J. Ball, Torrington-square, London.—12*th March*, 1878.
995. Railway Crossings, J. S. Williams, Riverton, New Jersey, U.S.—12*th March*, 1878.
1010. Bedsteads, &c., J. Carter, New Cavendish-street, London.—13*th March*, 1878.
1016. Fire-boxes, J. Stephenson, East Mount-road, York.—14*th March*, 1878.
1117. Dyes, &c., W. L. Wise, Chandos-chambers, London.—20*th March*, 1878.

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

920. Lamps, &c., E. A. Rippingille, Holborn, London.—13*th March*, 1874.
698. Sewing Machines, I. M. Singer, New York, U.S.—24*th February*, 1874.
868. Locomotive Carriages, W. D. Scott-Moncrieff, Glasgow.—10*th March*, 1874.
884. Breech-loading Fire-arms, B. Burton, Brooklyn, U.S.—11*th March*, 1874.
1091. Railway Buffers, G. Turton, Hanover-street, Sheffield.—28*th March*, 1874.
919. Retorts, A. V. Newton, Chancery-lane, London.—13*th March*, 1874.
893. Stops of Organs, J. H. Johnson, Lincoln's-inn-fields, London.—12*th March*, 1874.
902. Carriages, J. Jardaine, Raleigh-street, Nottingham.—12*th March*, 1874.

Notices of Intention to Proceed with Applications.

Last day for filing opposition, 1*st April*, 1881.

4208. Urinals, H. Phillips, Albion-place, Heavitree.—15*th October*, 1880.
4459. Felted Thread, W. A. Barlow, St. Paul's-churchyard, London.—A communication from A. Monchablon.—1*st November*, 1880.
4533. Metal Joints, E. Ward, Union-street, and W. Bevis, Bower-place, Maidstone.—5*th November*, 1880.
4540. Detecting Apparatus, R. H. Reeves, Parkhurst.—5*th November*, 1880.
4541. Disinfecting Alcohol, W. A. Barlow, St. Paul's-churchyard, London.—A communication from L. Naudin and J. Schneider.—5*th November*, 1880.
4569. Battery, &c., Guns, T. Kiernan, Waterford.—6*th November*, 1880.
4580. Elevating, &c., Apparatus, E. Hill, Huntingdon.—8*th November*, 1880.
4584. Brakes, W. P. Thompson, High Holborn, London.—A communication from C. F. Sim and W. Studer.—9*th November*, 1880.
4585. Supplying Fuel, W. S. Melville, Frederick-place, Mile End, London.—9*th November*, 1880.
4589. Grinding, &c., Mills, J. Higginbottom, Seel-street, Liverpool.—9*th November*, 1880.
4590. Boots and Shoes, P. G. Acres and W. Freeman, Leicester.—9*th November*, 1880.
4591. Flexible Ink, L. B. Bertram, Cornwall-road, Bayswater, London.—9*th November*, 1880.
4595. Raising Apparatus, D. H. Sisson, Goole.—9*th November*, 1880.
4629. Ships' Windlasses, W. H. Harfield, Mansion House-buildings, London.—10*th November*, 1880.
4631. Pumps, C. Chapman, Salford.—11*th November*, 1880.
4641. Top-notches, G. G. Lusher, Birmingham.—11*th November*, 1880.
4658. Tricycles, E. Hughes, Green's End, Woolwich.—12*th November*, 1880.
4693. Extracting Apparatus, C. T. Bastand, Lower Kennington-lane, London.—13*th November*, 1880.
4721. Syruping, &c., Liquors, W. A. Ross and F. Lockhart, Belfast.—16*th November*, 1880.
4762. Screw-keys, &c., W. Thomson, Glasgow.—18*th November*, 1880.
4822. Capillary Generator, A. C. Henderson, Southampton-buildings, London.—A communication from J. J. Guiget.—22*nd November*, 1880.
4844. Treating Dolomite, W. R. Lake, Southampton-buildings, London.—A communication from A. Braconnier.—22*nd November*, 1880.
5170. Weighing Machines, W. B. Avery, Birmingham.—10*th December*, 1880.
5343. Weighing Machines, W. B. Avery, Birmingham.—20*th December*, 1880.
2. Playing Pianofortes, E. Underwood, Birmingham.—1*st January*, 1881.
298. Magnesia, C. Scheibler, Berlin.—22*nd January*, 1881.
331. Sugar, C. Scheibler, Berlin.—25*th January*, 1881.
358. Rolling Metal Wires, A. Hughes, Glasgow.—27*th January*, 1881.
493. Condensing Apparatus, J. W. Cade, Rock Ferry.—Com. from A. Mention.—5*th February*, 1881.
569. Silicious Pig Iron, A. Crawford, Glasgow.—10*th February*, 1881.
686. Cuffs, J. Felsenstein, Worship-street, Finsbury, London.—17*th February*, 1881.
732. Fire Annihilator, W. Walker, sen., New Wortley, Leeds.—21*st February*, 1881
741. Ink, A. F. Stoddart, Sneyd Park, Bristol.—21*st February*, 1881.
756. Knitted, &c., Fabrics, J. Booth, Grange, Ovenden.—22*nd February*, 1881.
796. Appliance for Boots and Shoes, H. Bland, Luton, Bedford.—24*th February*, 1881.
901. Filter-presses, H. E. Newton, Chancery-lane, London.—Com. from A. L. Dehne.—2*nd March*, 1881.

Last day for filing opposition, 5*th April*, 1881.

4608. Generating Apparatus, C. F. Heinrich, Guildford-street, London.—9*th November*, 1880.

4609. RIVETTING, &c., MACHINES, R. H. Tweddell, Delahay-street, Westminster, and J. Platt and J. Fielding, Gloucestershire.—*10th November*, 1880.
4616. PRISM, &c., GUNPOWDER, E. L. Beckwith and T. B. Lightfoot, Dartford.—*10th November*, 1880.
4621. SIGNAL APPARATUS, E. G. Brewer, Chancery-lane, London.—A communication from E. H. Johnson and T. A. Edison.—*10th November*, 1880.
4622. STEAM REDUCING VALVES, J. Wright, Tipton.—*10th November*, 1880.
4630. ANCHORS, J. Wright, Tipton.—*11th November*, 1880.
4638. BEVERAGES, E. W. Allen, Peckham.—*11th November*, 1880.
4639. PURIFYING APPARATUS, W. Hanson, Bradford.—*11th November*, 1880.
4652. CONSUMING SMOKE, J. Teale, Holbeck.—*11th November*, 1880.
4653. VELOCIPEDES, T. Pritchard, jun., Coventry.—*11th November*, 1880.
4660. SIPHONIC APPARATUS, H. E. Cooper, Great Dover-street, London.—*12th November*, 1880.
4661. FILES, W. Downie and W. F. Lotz, Barbican, London.—*12th November*, 1880.
4667. CAPSULES, L. Gros, Albany-street, London.—*12th November*, 1880.
4672. TWIST LACE FABRICS, G. Bentley, Nottingham.—*13th November*, 1880.
4678. LOOMS, J. Hindle, Blackburn.—*13th November*, 1880.
4680. MEASURING MILK, &c., J. Wilson, Orchard-street, London.—*13th November*, 1880.
4684. FURNACES, &c., T. J. Constantine, Fleet-street, London.—*13th November*, 1880.
4695. THERMOMETERS, H. H. Lake, Southampton-buildings, London.—A communication from R. and H. Mathieu and J. Tremeschini.—*13th November*, 1880.
4707. VELOCIPEDES, E. Burstow, Horsham.—*16th November*, 1880.
4717. ECONOMISING FUEL, W. R. Lake, Southampton-buildings, London.—A communication from L. Juilliard.—*16th November*, 1880.
4718. CONDENSING, &c., J. H. Johnson, Lincoln's-inn-fields, London.—A communication from F. Fouché.—*16th November*, 1880.
4737. LOOMS, E. Crossley, Halifax.—*17th November*, 1880.
4748. FEEDING OIL, A. C. Wells and R. Wallwork.—*18th November*, 1880.
4788. FOLDING SHEETS of PAPER, J. Davies, Bermondsey.—*19th November*, 1880.
4837. HEATING APPARATUS, R. J. Hutchings, The Mayalls, Mumbles, and H. F. Taylor and W. P. Struvé, Neath.—*22nd November*, 1880.
4869. SULPHATES of SODA, J. Hargreaves and T. Robinson, Widnes.—*24th November*, 1880.
4937. HEATING WATER, &c., B. J. Grimes, Mile End-road, and L. Dove, Tollett-street, London.—*27th November*, 1880.
5199. MOWING MACHINES, H. H. Lake, Southampton-buildings, London.—A communication from J. Evanno.—*11th December*, 1880.
5240. SPINNING ROPE YARNS, J. Barbour, Belfast.—*14th December*, 1880.
5311. CANS, &c., W. W. Marsden, Wirksworth.—*18th December*, 1880.
131. VALVES, J. N. Rowe, Tuebrook.—*11th January*, 1881.
250. PIECING DOUBLED YARNS, G. Balfe, Stockport.—*20th January*, 1881.
257. FASTENINGS, O. Vaughton, Birmingham.—*20th January*, 1881.
516. REFRIGERATORS, &c., G. Gilbert, Bedford Park, London.—*7th February*, 1881.
553. ICE, J. H. Willcox, Liverpool.—*9th February*, 1881.
678. OXYCHINOLINES, Z. H. Skraup, Austria.—*16th February*, 1881.
690. STEAMING TEXTILE FABRICS, J. Parkinson, West Leigh.—*17th February*, 1881.
704. CORKS, F. des Vœux, Southampton-buildings, London.—Com. from E. Gaston.—*18th February*, 1881.
725. COVERING ROLLERS, W., W. J., and C. H. Haynes, Salford.—*19th February*, 1881.
735. KITCHEN, &c., BOILERS, J. Tattersall, Manchester.—*21st February*, 1881.
761. PURIFYING CAST IRON, W. P. Thompson, High Holborn, London.—Com. from A. H. Siegfried and T. H. Purdy.—*23rd February*, 1881.
763. PRESSING APPARATUS, J. and J. C. Buckley, Leeds.—*23rd February*, 1881.
775. OPERA, &c., GLASSES, C. D. Abel, Southampton-buildings, London.—Com. from A. Loiseau and J. B. Germeuil-Bonnaud.—*23rd February*, 1881.
779. STEAM PRESSES, J. P. Cox, Nottingham.—*24th February*, 1881.
793. OILCLOTHS, W. Ayrton, Ormskirk.—*24th February*, 1881.
809. VELVET, I. Bamford, Oldham.—*25th February*, 1881.
826. TOBACCO-POUCHES, J. Burbridge, Tottenham.—*26th February*, 1881.
830. TRICYCLES, H. Kinder, Leicester.—*26th February*, 1881.
834. PERFORATING PAPER, H. H. Lake, Southampton-buildings, London.—Com. from the Automatic Music Paper Company.—*26th February*, 1881.
849. BITUMINOUS CEMENTS, J. H. Johnson, Lincoln's-inn-fields, London.—A communication from E. J. de Smedt and W. J. Twining.—*28th February*, 1881.
850. STEAM BOILERS, J. Shanks and J. G. Lyon, Arbroath.—*28th February*, 1881.
883. CAST STEEL, C. W. Siemens, Queen Anne's-gate, Westminster.—*1st March*, 1881.

Patents Sealed.

List of Letters Patent which passed the Great Seal on the 11th March, 1881.)

3266. EXHIBITING CARPETS, A. Peterson, Brooklyn, U.S.—*10th August*, 1880.
3718. MOTIVE POWER ENGINES, W. Adair, Liverpool.—*13th September*, 1880.
3723. LOOMS, S. D. Rhodes, Huddersfield.—*13th September*, 1880.
3737. EXPANDING BOILER, &c., TUBES, W. Thorburn, Luton.—*14th September*, 1880.
3749. CARDING WOOL, &c., E. Wilkinson, Marsden.—*15th September*, 1880.
3773. JOINTS, J. Page, Glasgow.—*17th September*, 1880.
3774. SELF-ACTING NEEDLE, F. W. Schwarzbach, Prussia.—*17th September*, 1880.
3775. PRINTING PRESSES, W. Morgan-Brown, Southampton-buildings, London.—*17th September*, 1880.
3781. NAILS, H. Sharrow, Smethwick, and T. King, Birmingham.—*17th September*, 1880.
3801. BOOTS, E. Barnes, Chesham.—*18th September*, 1880.
3807. DRIVING BELT, S. A. Dickins, St. Helen's-place, London.—*20th September*, 1880.
3824. LIFTS, J. M. Day, W. R. Green, and H. Walker, Falmouth-road, London.—*21st September*, 1880.
3827. IRON and STEEL, P. S. Justice, Southampton-buildings, London.—*21st September*, 1880.
3861. PAPER, N. G. Richardson, Tyaquin-Monivea, and W. Smith, Dublin.—*23rd September*, 1880.
3885. TELEPHONIC APPARATUS, W. Morgan-Brown, Southampton-buildings, London.—*25th September*, 1880.
3900. RAILWAY FROG, G. F. Redfern, South-street, Finsbury.—*25th September*, 1880.
3914. EXTRACTING, &c., PRUSSIATE of POTASH, W. Brierley, Halifax.—*27th September*, 1880.
3947. BEVELLING GLASS, W. H. Beck, Cannon-street, London.—*29th September*, 1880.
3956. PREVENTING PAIN in DENTAL OPERATIONS, W. R. Lake, Southampton-buildings, London.—*29th September*, 1880.
3988. STEAM CULTIVATION, D. Greig, and T. Benstead, Leeds.—*1st October*, 1880.
4136. SEPARATING ZINC, G. Barker, Colemore-row, Birmingham.—*12th October*, 1880.
4306. BOBBINS, I. Briggs, jun., Wakefield.—*22nd October*, 1880.
4340. PLANING, &c., MACHINES, J. Kershaw and J. Kershaw, jun., Manchester.—*25th October*, 1880.
4367. FASTENING TUBULAR HANDLES, F. Ryland, West Bromwich.—*26th October*, 1880.
4444. GAS-LIGHTING APPARATUS, H. H. Lake, Southampton-buildings, London.—*30th October*, 1880.
4560. SPINNING COTTON, &c., R. Curtis and W. H. Rhodes, Manchester.—*6th November*, 1880.
4562. LOOMS for WEAVING, P. Young and J. Mathieson, Glasgow.—*6th November*, 1880.
4733. COKING, &c., COAL, L. V. Semet and E. Solvay, Brussels.—*17th November*, 1880.
4740. GENERATORS, I. R. Blumenberg, Washington, U.S.—*17th November*, 1880.
4829. BICYCLES, &c., H. Hayward, Gloucester, J. Day and J. H. Gosling, Southsea.—*22nd November*, 1880.
4839. PROPELLING SHIPS, F. Hime, London.—*22nd November*, 1880.
5020. BRIMS of HATS, T. L. Sutton, Stockport.—*2nd December*, 1880.
5261. PREPARATION of COTTON, R. Southworth, Bolton.—*15th December*, 1880.
5375. LOOMS for WEAVING, E. Smethurst, Manchester.—*22nd December*, 1880.
5512. DRAIN PIPES, W. R. Lake, Southampton-buildings, London.—*31st December*, 1880.
34. WHEELS, J. Rigby, Rutland, U.S.—*4th January*, 1881.
138. TEXTILE MATERIALS, H. J. Haddan, Strand, London.—*12th January*, 1881.
284. WIND ENGINE, A. M. Clark, Chancery-lane, London.—*22nd January*, 1881.

(*List of Letters Patent which passed the Great Seal on the 15th March*, 1881.)

2626. BOTTLE STANDS, W. Staniforth, Upperthorpe.—*28th June*, 1880.
3760. WHEELBARROWS, F. Wirth, Frankfort-on-the-Maine.—*16th September*, 1880.
3769. REGULATING SPEED, J. G. Jones, Stoke Newington, London.—*16th September*, 1880.
3770. COOLING, &c., MILK, E. Fitch, Fetter-lane, London.—*17th September*, 1880.
3778. PERMANENT WAY, J. Holden, Nelson.—*17th September*, 1880.
3783. PAPER-CUTTING MACHINES, J. Salmon and J. Capper, Manchester.—*18th September*, 1880.
3803. RAILWAY SWITCHES, W. R. Lake, Southampton-buildings, London.—*18th September*, 1880.
3809. DIVIDING APPARATUS, J. B. Rogers, Lombard-street, London.—*20th September*, 1880.
3825. KITCHEN RANGES, R. Neville, Butleigh-court, Glastonbury.—*21st September*, 1880.
3848. SEWING MACHINES, H. Mills, Birmingham.—*22nd September*, 1880.
3859. COOPERAGE MACHINES, A. Ransome and T. J. Wilkie, Chelsea, London.—*23rd September*, 1880.
3897. WASHING MACHINES, E. Clements, Great Russell-street, London.—*25th September*, 1880.
3902. STAMPING LETTERS, C. Pieper, Gneisenau-strasse, Berlin.—*27th September*, 1880.
3927. HAULING in FISHING NETS, G. Howard, Ann's-place, Hull.—*28th September*, 1880.
3936. INSULATORS, J. W. Fletcher, Stockport.—*28th September*, 1880.
3937. PORTABLE, &c., ENGINES, F. Savage, King's Lynn.—*28th September*, 1880.
3961. BELT FASTENINGS, P. A. Martin, Great Charles-street, Birmingham.—*30th September*, 1880.
3982. PAPER, Comte de Sparre, Boulevard St. Denis, Paris.—*1st October*, 1880.
3987. LAMPS, C. Torr, Birmingham.—*1st October*, 1880.
3989. INDICATING APPARATUS, B. Tower, Beaufort-terrace, London.—*2nd October*, 1880.
3999. TAKING in WIRE, &c., J. Taylor, Birkenhead.—*2nd October*, 1880.
4016. FURNACES, J. Fletcher, Ashton-under-Lyne.—*4th October*, 1880.
4023. BUTTONS, J. A. R. de Barazia, La Rochelle, France.—*4th October*, 1880.
4058. LAYING OUT MATCHES, F. Wirth, Frankfort-on-the-Maine.—*6th October*, 1880.
4529. TREATING PELTS, E. P. Alexander, Southampton-buildings, London.—*4th November*, 1880.
4682. GRINDING, &c., APPARATUS, G. Etty, Manchester.—*13th November*, 1880.
4933. ELECTRIC LAMPS, J. W. Swan, Newcastle-upon-Tyne.—*27th November*, 1880.
5047. BOXES, C, Cheswright, City-road, London.—*3rd December*, 1880.
5149. HYDRAULIC LIFTS, E. B. Ellington, Chester.—*9th December*, 1880.
5281. WORKING TRAFFIC, J. S. Hughes, Portmadoc.—*16th December*, 1880.
5287. SULPHATE of ALUMINA, B. E. R. Newlands, East Ham.—*17th December*, 1880.
5337. FIRE EXTINCTEURS, E. D. Bruneel, Sheffield.—*20th December*, 1880.
5396. TREATING ORES, J. H. Johnson, Lincoln's-inn-fields, London.—*23rd December*, 1880.
5427. BLOWING, &c., APPARATUS, E. Alexander, Southampton-buildings, London.—*24th December*, 1880.
5482. TELEPHONIC APPARATUS, C. J. Wollaston, Great Winchester-street, London.—*30th December*, 1880.
5491. PRINTING MACHINES, J. Foster, Preston.—*30th December*, 1880.
27. LIME-LIGHT LAMPS, A. M. Khotinsky, St. Petersburg.—*4th January*, 1881.
50. GAS MOTOR ENGINES, C. D. Abel, Southampton-buildings, London.—*5th January*, 1881.
106. FLUE TUBES, J. A. and J. Hopkinson, Huddersfield.—*14th January*, 1881.

List of Specifications published during the week ending March 12th, 1881.

*269, 4d.; 1811, 2d.; 2633, 6d.; 2714, 6d.; 2856, 4d.; 2866, 6d.; 2928, 1s.; 2952, 6d.; 2959, 6d.; 2996, 8d.; 3008, 8d.; 3010, 8d.; 3016, 6d.; 3026, 6d.; 3037, 6d.; 3060, 4d.; 3067, 6d.; 3076, 6d.; 3077, 6d.; 3078, 6d.; 3079, 6d.; 3091, 6d.; 3094, 6d.; 3104, 6d.; 3137, 8d.; 3141, 6d.; 3142, 4d.; 3143, 6d.; 3145, 4d.; 3162, 6d.; 3163, 1s.; 3166, 6d.; 3167, 6d.; 3168, 6d.; 3178, 2d.; 3186, 6d.; 3190, 6d.; 3191, 6d.; 3207, 2d.; 3214, 6d.; 3236, 6d.; 3239, 2d.; 3241, 2d.; 3244, 4d.; 3246, 2d.; 3251, 6d.; 3256, 4d.; 3260, 2d.; 3262, 2d.; 3263, 6d.; 3264, 4d.; 3268, 2d.; 3269, 2d.; 3271, 2d.; 3276, 2d.; 3280, 2d.; 3282, 2d.; 3283, 6d.; 3292, 6d.; 3296, 2d.; 3298, 2d.; 3299, 2d.; 3303, 2d.; 3419, 6d.; 3702, 2d.; 4445, 6d.; 4850, 6d.; 4890, 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.

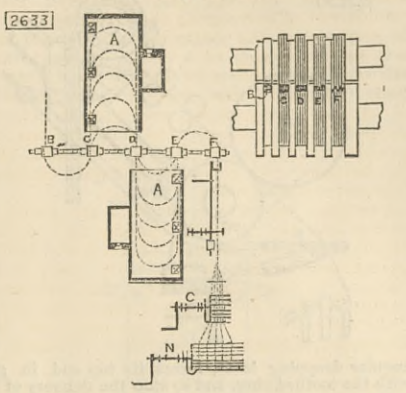
Prepared by ourselves expressly for THE ENGINEER *at the office of Her Majesty's Commissioners of Patents.*

1811. SELF-FILLING AND DISCHARGING SKEPS OR BUCKETS, *G. Allix.—Dated 3rd May*, 1880.—(*Not proceeded with.*) *2d.*

An angled strap or bar with a notch at each end is attached by side straps to the skep or bucket, and into the angled strap a sliding catch engages to tilt and lift the skep.

2633. DRAWING METALS INTO WIRE RAPIDLY, *G. M. Cruikshank.—Dated 28th June*, 1880.—(*A communication from C. Roy.*) *6d.*

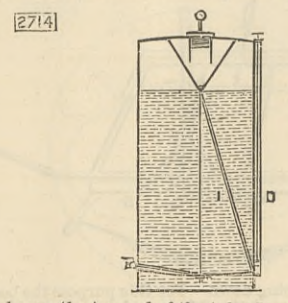
This consists in first passing the bar of metal between rolls, by which it is first flattened and then prepared for separation into a series of threads of wire. The rolls are made with channels in the form of arcs with ridges between, by which the bar is channelled to a greater depth by each succeeding pair of rolls, being at the same time prevented from extending sideway. The drawings show five pairs of rolls, the first pair B being plain, and serving to straighten the bar; the second, third, and fourth pairs C, D, and E, being fluted, while the last pair F is formed with channels, which alternately project and retreat, so as to separate the bar into isolated strands. A are two re-heating ovens to keep the metal at the desired



temperature, and G and N represent two different forms of winders.

2714. FORCING AND DISCHARGING WATER, AIR, &c., *A. Anderson.—Dated 2nd July*, 1880. *6d.*

The apparatus is portable, and discharges the water by means of compressed air supplied to the vessel containing the water by the air pump D, which discharges the compressed air above the level of the water, and to prevent it rushing back a glass ball is



placed over the top end of the tube I. So as to prevent the lid being blown off when necessary to unscrew it in order to supply the vessel with water, it is screwed on, and channels formed in the thread so as to allow the escape of the air.

2856. BRUSHING BILLS, HOOKS, OR SLASHERS, &c., *C. Whitehouse.—Dated 10th July*, 1880. *4d.*

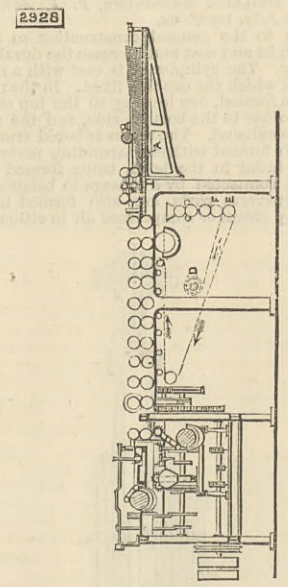
The straps of iron used to connect the handle to the tool are replaced by a socket united to the tool by welding, such socket being formed by cutting a blank from iron and closing it up with its edges in close proximity to each other.

2866. MATCH-BOXES, &c., *C. Kesseler.—Dated 12th July*, 1880.—(*A communication from C. Brämer.*) *6d.*

The boxes are so formed that the matches placed therein do not touch each other; as each match is withdrawn it is ignited. The boxes are formed of a number of strips of paper, corrugated lengthwise and joined together so as to form a number of cells, the insides of which near the outer ends are lined with a rough material, or an igniting composition.

2928. MAKING BAGS OR WRAPPERS OF PAPER, &c., *J. Nicholls.—Dated 15th July*, 1880. *1s.*

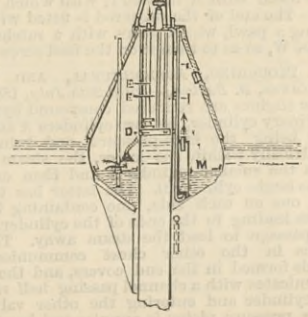
This relates principally to machines for making cases of wood slips or veneers, covered with paper on one side. These slips, cut to the desired size, are placed on table A, and pass successively through a series of squeezing rollers, the second pair of which coats one side with glue or paste. A strip of paper is led from roll D, and passing over the printing cylinder



and type-roller E and F to receive the printed matter, proceeds to the squeezing rollers and becomes secured to the veneers. The tenth pair of squeezing rollers are fitted with knives which divide the strips longitudinally. After leaving the squeezing rollers the strips are acted upon by the shaper, consisting of a core, to shape the case internally, and a mould with movable sides to shape the case externally, glue being supplied to the end, so as when lapped over by wings they will adhere and form the case. To one edge glue is supplied externally, and sand supplied to it so as to form a striking surface if required.

2952. AUTOMATIC LUMINOUS BUOYS, *N. F. D. Barbier.—Dated 17th July*, 1880. *6d.*

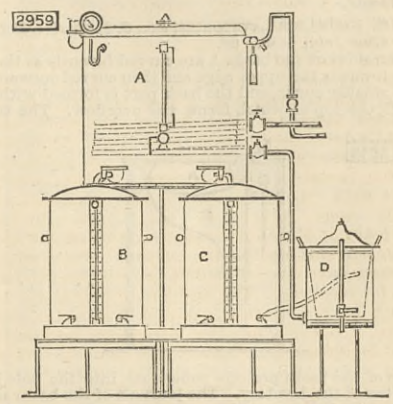
This relates to lighting the buoy by means of gas



generated in the buoy itself from air which is driven automatically through a suitable hydrocarbon liquid. Through the buoy passes a pipe, the lower end of which is open so that the level of water therein will be the sea level. Above this level is a diaphragm D to which the pipes E and F are secured, the former communicating with the atmosphere, whilst on the latter is mounted a whistle S. When the buoy is raised, air enters by E, and when it sinks it is forced out through F and sounds the whistle. So as to produce light, the interior of the buoy is divided by a diaphragm M, below which the hydrocarbon is placed. From the diaphragm D a pipe I passes down into the hydrocarbon, so that air is forced down into it, and becoming saturated, escapes to the upper part of the buoy whence it proceeds to a suitable burner in the lantern V.

2959. MAKING INFUSIONS OR EXTRACTS FROM SUBSTANCES, *R. U. Etzenberger.—Dated 17th July* 1880. *6d.*

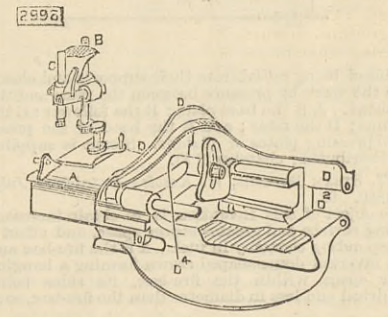
This relates to apparatus for making tea and coffee in large quantities, and consists of a boiler A for heating water, and itself heated by a steam coil. When hot, the water can be made to pass to either of two vessels B and C, one for preparing coffee, and the



other tea. The exhaust steam from A passes to a milk heater D, the milk in which it raises to any desired heat. The water enters B and C through tubes, to the end of which are suspended, centrally within the vessels, boxes to contain the tea or coffee, through which the water passes, so as to produce infusions, then passing out through the perforated sides of such boxes it enters the vessels.

2996. SEWING MACHINES, &c., *J. H. Johnson.—Dated 21st July*, 1880.—(*A communication from C. H Willcox.*) *8d.*

This relates to machines for sewing a continuous plait or braid upon itself, so as to form a hat or other article, and also to machines for attaching covered wire to the brim of a hat or other article. The invention comprises improvements in the feed mechanism, in the spool holder, in the means for attaching a work guide to the presser foot and adjusting it thereon, in the plait guides and means for adjustment, in the mechanism for stitching a covered wire to a hat brim, and in the particular construction of the wire guide, needle guide, and needle forming part of the said last-named mechanism. The drawing is a perspective view, with the upper part of the machine cut away



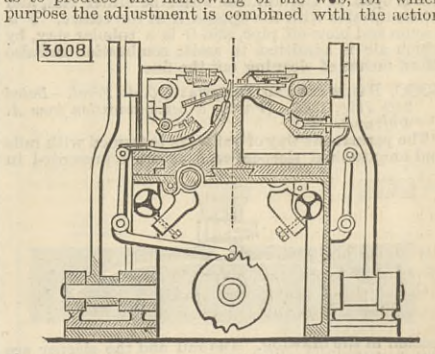
and plait guides removed. A is the cloth or throa plate; B is the presser foot bar supported in the head of the machine at the outer end of the gooseneck, and C the needle bar connected by a link with the needle lever; D is the feed mechanism composed of a feed bar D^1 with an arm projecting from the side thereof, and carrying at the outer end of the feed surface a feeder rocker D^2 hinged to the machine frame, and to the feed bar an excentric on the main shaft and a connecting rod D^4 with its head encircling the excentric and jointed to an arm of the rocker by a pin adjustable in a slot in the same arm.

2999. BROOMS, BRUSHES, &c., *R. D. Gallagher.—Dated 21st July*, 1880.—(*Void.*) *2d.*

The chief feature in these brooms is the peculiar manner in which the whisk is secured to the head.

3008. KNITTING MACHINES, *W. R. Lake.—Dated 21st July*, 1880.—(*A communication from J. F. Gommeret.*) *8d.*

The machine is intended to make stockings, partly plain, partly ribbed, the change from one style to the other being effected automatically. The machine is rectilinear, and has two channelled-curved needle beds each capable of being moved lengthwise by screw mechanism for the distance of one or more needles, so as to produce the narrowing of the web, for which purpose the adjustment is combined with the action



of point shifters which take the loops from the needles that are not to be further charged. In the interior of each needle-bed are placed guides, between which slide nearly horizontal plates, to which straight needles are attached and cross the curved needles, the straight needles being automatically brought into action when required to form a ribbed fabric.

3010. MANUFACTURE OF KNITTED FABRICS, *J. Cresswell.—Dated 22nd July*, 1880. *8d.*

The sinkers are formed of a curved or segmental figure to travel in segmental or curved courses, and they are connected by preference rigidly to lever arms or jacks, and these arms or jacks turn upon centres of motion corresponding with the radius of the arc in which the sinkers move. A represents portions of the main framing; D represents the sinkers, each being affixed to or forming part of the jack; E are combs for these sinkers and their jacks to sink in. The front edges of these combs are also let into saw cuts formed to receive them in the back of the presser-bar F, by which they are held steadily at those parts whilst the sinkers D are also guided in their motion

by saw-cuts formed in the upper projecting part F1 of the presser-bar F as well as by saw-cuts formed in a projection from the under side of the slea bar F2; G is the faller bar, which is fixed with capability of adjust-

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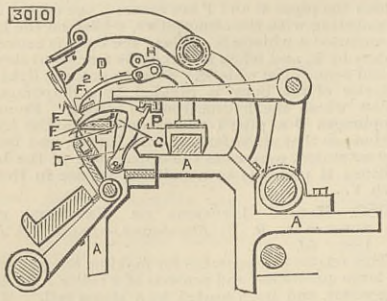

ment to regulate the extent of forward motion of the sinkers; H are thread carrier bars; P is the catch-bar.

3016. BASINS FOR LAVATORIES, &c., *C. F. Clark.—Dated 22nd July*, 1880. 6*d*.

The sides of the basin A are curved inwards as they rise towards the upper edge and then curved outwards in a smaller curve, and the back part is formed with a lip B, the top of which forms the overflow. The top

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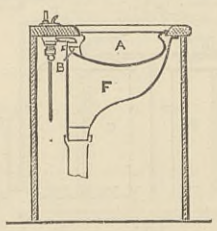

edge of the basin projects somewhat into the hole in the top of the lavatory. The journals of the basin are carried in the top of the container F. The shape of the basin prevents the water splashing over.

3026. DRYING AND PRESSING BOARDS AND VENEERS, *A. M. Clark.—Dated 22nd July*, 1880.—(*A communication from G. W. Read.*) 6*d*.

A number of hollow steam-heated pressing plates or platens are employed superposed between the ram or rams and crosshead of a hydraulic press, and supported when not in operation by the columns of the press at any required distances apart to permit of the work being introduced between them, and which are

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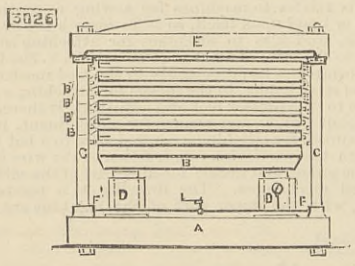

capable of being raised from their supports and closed upon the work by pressure between the rams and the crosshead. A is the base-plate; B the follower; C the columns; D the rams; and E the head of the press. B1 are pressing plates or platens. Steam is supplied to a distributing chamber F F1.

3037. STEAM BOILERS, *W. Keable.—Dated 23rd July*, 1880. 6*d*.

The object of this invention is to obtain increased heating surface and greater steam space, and effect a corresponding economy in fuel. A is the fire-box and B an inverted dome-shaped crown forming a hanging water space within the fire-box, its sides being cylindrical and less in diameter than the fire-box, so as

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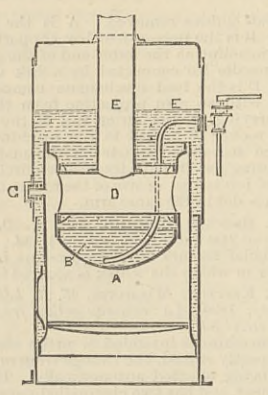

to leave an annular space all round it. A cross flue D traverses the hanging water space near the upper part and is open to the annular space at either end, and communicates with the uptake E at the centre. F is a scum and blow-off pipe, and G is a tubular stay, by which air is admitted to assist combustion and also afford means of cleaning out the flue.

3060. RAILWAYS AND TRAMWAYS, *C. de Féral.—Dated 24th July*, 1880.—(*Partly a communication from A. Dufrane*). 4*d*.

The permanent way of railways is formed with rails and longitudinal sleepers such as are represented in

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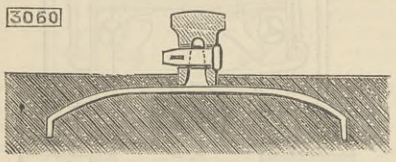

section in the drawing. The rail and the sleeper are attached the one to the other by transverse horizontal pins which are fastened by keys or wedges.

3076. SPINNING, &c., *E. and L. J. Crossley and W. Sutcliffe.—Dated 26th July*, 1880. 6*d*.

This relates to apparatus for stopping the progress of the roving towards the delivery rollers on the breakage or slackening of the spun thread. A back roller A is given to each set of roving threads, and to prevent the roving slipping it is made to rest on two rollers B and C, a certain distance apart, so as to produce a kind of wedge action which prevents the roving being drawn through when the stop motion is in action on the breakage or slackening of a thread. The inside face of roller A is made with a ring of teeth. A rail E extending the length of the frame is attached to a bracket supporting a weighted lever L, one arm of which is bent to clear the bottom roller G, and is fitted with a wire P over which the thread to the flyer Q passes, the drag of the thread keeping the end down. If a thread break or becomes slack, the other end of lever L falls, and sliding down the

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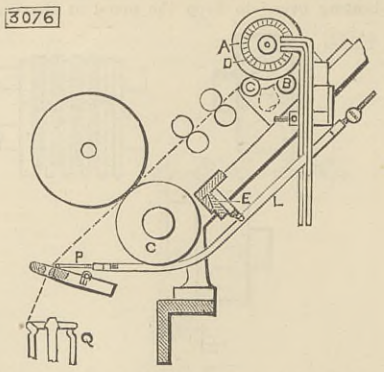

angular dropping lever, forces its top end in gear with the toothed ring, and so stop the delivery of the roving.

3067. DOG CARTS, &c., *J. and C. G. McDowell.—Dated 26th July*, 1880. 6*d*.

This consists in making certain parts of vehicles movable, so as to give greater convenience and comfort to the occupants and to the horse, by shifting the weight so as to bring it more forward in going up

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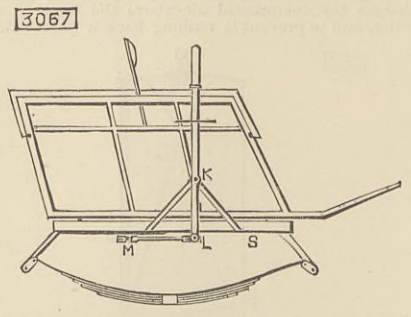

hill than in going down. For this purpose the body of the vehicle is made to slide on a frame S attached to the carriage being actuated by a lever, the lower end of which is connected by rods to a toothed quadrant gearing with a rack on the underside of the body of the vehicle.

3077. PERFORATING CHEQUES, *S. Williams and A. P. Filleul.—Dated 26th July*, 1880. 6*d*.

Two flat circular plates are secured together with a space for the passage of the cheque between them. Holes are pierced through the plates, and into them project dies which can be brought round under the

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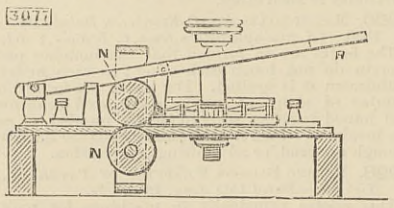

lever R, so as to be forced down and perforate the cheque, which is held between the rollers N. The lever is formed with a projection which engages with a ratchet on one of the roller shafts, so as to advance the cheque the required distance to receive the next perforation.

3078. ROCK DRILLING MACHINERY, *F. J. Adams.—Dated 26th July*, 1880. 6*d*.

This relates to the general construction so as to reduce the weight and cost and increase the durability of the machine. The cylinder A is cast with a recess on one side, in which the cap C is fixed. In the recess three ports are formed, one leading to the top side of the piston, another to the bottom side, and the third serving for the exhaust. The recess is bored true and receives a bush formed with corresponding ports, and the valve J is fitted in the bush, being formed with suitable ports connected by a passage to balance the pressure. Transverse ports are also formed in the valve to convey steam or compressed air to either side

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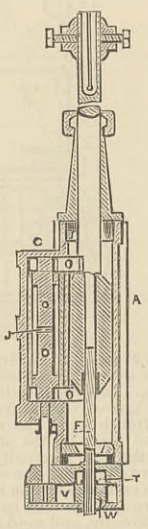

of it. O are tappets at either end of the valve, working within recesses in the cylinder at the ends of the ports communicating with both sides of the piston. The ends of the piston are bevelled to operate the valve J through the tappets O. A nut is fitted to the back end of the piston, and into it works the rod F cut with a spiral thread and working in the piston, which is bored out to receive it. This rod passes out, and is fitted with a ratchet T, with which gear two pawls. The end of the valve rod is fitted with a lever V having a pawl, which gears with a ratchet on the feed nut W, so as to turn it on the feed screw.

3079. PLOUGHING, AGRICULTURAL, AND TRACTION ENGINES, *R. Burton.—Dated 26th July*, 1880. 6*d*.

These engines are rendered compound by replacing the ordinary cylinder, by two cylinders A and B, the former being the high-pressure, and being placed concentrically within the latter, the steam working first in the smaller cylinder A and then expanding into the larger cylinder B. The latter has two valve chests, one on each side, one containing the usual passages leading to the ends of the cylinder, and the outlet passage to lead the steam away. The steam passages in the other chest communicate with channels formed in the end covers, and the exhaust communicates with a channel passing half round the outer cylinder and entering the other valve chest. The low pressure piston is annular and has two rods, which, with the high-pressure piston-rod, are connected to the same crosshead. The valve rod for the

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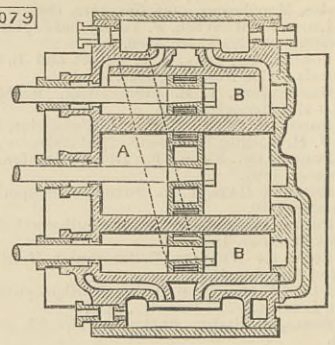

low-pressure cylinder is worked from the ordinary excentrics by a rocking shaft.

3091. BARS FOR SECURING AND CARRYING GLASS IN WINDOW SASHES, &c., *J. D. Mackenzie.—Dated 27th July*, 1880. 6*d*.

A strip of lead, copper, or other soft metal B is attached to the bars of window sashes and passes up on each side of the central web A, and when the glass

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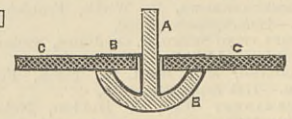

is in position the ends of the strip are bent back so as to secure the glass. The side feathers of the bar are formed with a hollow curved groove on the upper surface under the edge of the glass, so as to form a gutter.

3094. ROTARY APPARATUS FOR DRAWING AND FORCING LIQUIDS, *C., E. H., and J. W. Deans.—Dated 27th July*, 1880. 6*d*.

The cylinder A is fitted with two pistons J fitted on central shafts, to which an intermittent and alternate revolving motion is imparted, each piston making but one revolution at a time, one remaining stationary

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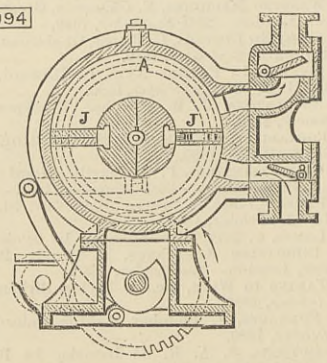

while the other acts to compress or force the liquid, and being held by suitable means which just before the completion of the stroke of the other piston is released, so as to allow the working piston to take its place, when it in its turn is held stationary while the other works.

3104. BRAKE FOR TULLE LOOMS, &c., *P. O'Halloran.—Dated 28th July*, 1880.—(*A communication from A. Masson.*) 6*d*.

This consists of a brake to effect the instantaneous stoppage of the loom when the loom suddenly chokes, and it consists of a balance bar H acting in conjunction with a draw bar D and lever C. When the loom

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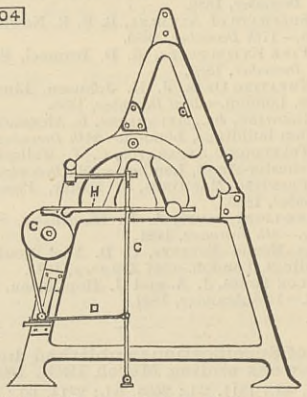

chokes a stud catch on the end of H drops into a hollow in the periphery of an excentric G fixed on the frame. The continuous motion of the loom causes the lever C to travel upon a cone and slip the driving belt off the fast pulley.

3119. WARPING OR BEAMING YARN, *J. Walmsley and S. Lang.—Dated 29th July*, 1880. 6*d*.

This consists in delivering the yarn to the beam directly from spools spun on ring or other spindles, so as to dispense with the process of winding preparatory to beaming. The yarn of one full spool is joined to the yarn of another full spool in such manner that the yarn of any number of spools may be connected or in one continuous length. This is effected by joining or connecting the end of the yarn at the top or finish of one spool, to the end of the bottom or commencement of a second spool, and so on. In forming the spools the end of the yarn at the bottom or commencement of the spool is allowed to hang below of a convenient length to permit of its being pieced up. The spools are mounted in a creel upon suitable stands or brackets attached to and adjustable upon upright rods.

3137. WEIGHING AND MEASURING MACHINES, *W. H. Baxter.—Dated 30th July*, 1880. 8*d*.

The beam B consists of two side pieces joined by a

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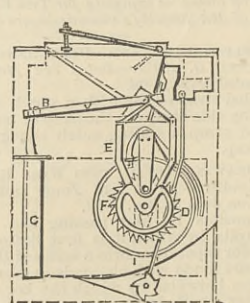

central piece, to which a counterpoise is suspended. The cylinder D, when full, contains some well-known unit of bulk, and about one-sixth of its circumference is cut away for the entrance and discharge of the material to be weighed or measured. Its axis rotates in a cradle E swinging on knife edges from the beam. A wheel F is keyed on this axis, and is formed with a flange, on which presses a stop on the frame. A tumbler is centred on the beam and determines the final cut off by its position being gradually altered until the centre of gravity is overcome, when the fall operates certain mechanism to effect the cut off.

3141. THREAD CASES AND UNDER TENSIONS FOR SEWING MACHINES, *S. Pitt.—Dated 30th July*, 1880. —(*A communication from L. B. Miller and P. Diehl.*) 6*d*.

The thread case consists of under and upper portions A and B hinged together, and each hollowed in the centre to form a box for the thread. The edges are

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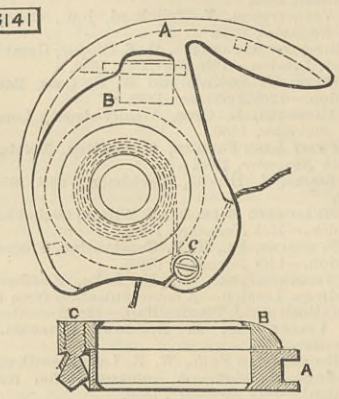

wide enough to give a sufficient tension to the thread. One part of A is fitted with a spring, while the other part B is provided with a screw C with an enlarged end to bear against the spring.

3142. PLOUGHS, &c., *P. Kotzó.—Dated 30th July*, 1880. —(*Not proceeded with.*) 4*d*.

The plough rests when not at work, and also when ploughing, on two wheels, the land wheel and the furrow wheel, both arranged so that the plough is nearly in equilibrium upon them. By means of mechanism worked by a lever the axle of the furrow wheel may be set higher or lower, independently of the position of the land wheel, as may be required on starting the first furrow and afterwards. By means of a second lever the land wheel is adjusted, the two levers being connected so as to adjust the furrow wheel at the same time.

3143. PIANOFORTES, *H. W. Pohlmann.—Dated 30th July*, 1880. 6*d*.

This relates, First, to the wrest plank, and consists in forming a double metal bearing bridge A, in combination with the pressure bar B, by means of which the tension of the strings is made more equal, and the strings keep longer in tune, and at the same time the pull-over strain on the wrest plank is lessened; Secondly, in dispensing with the wood under frame of horizontal pianos with metal frames and forming the

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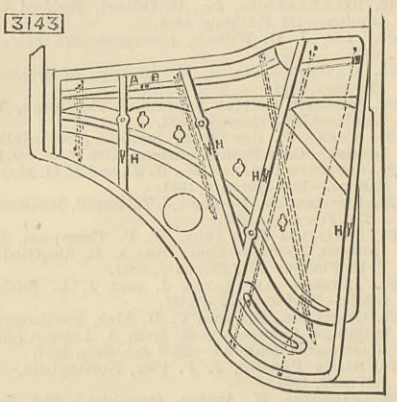

two frames in one casting; Thirdly, to the double metal frame used in upright pianos, and consists in extending the framework upwards at each side, into which the wrest plank is inserted, resting upon a solid metal surface; Fourthly, to making metal piano frames and connecting bars corrugated or hollow, as shown at H; lastly, to a double vibrating reflector or sounding-board, consisting of the upper sound-board, and a vibrating reflector underneath.

3145. DINNER PLATES, DISHES, &c., *W. T. W. Slater.—Dated 30th July*, 1880. 4*d*.

So as to prevent plates and dishes slipping about on the table in ships at sea, the rim on which the plate stands is made broader than usual, and its surface is roughened, like a file. A projecting ridge is formed round the inside of the plate, to prevent condiments slipping down into the plate itself.

3162. PRODUCTION OF HOLLOW INGOTS OR TUBES OF CAST STEEL, *R. Baker.—Dated 31st July*, 1880.—(*A communication from C. B. Morse.*) 6*d*.

The object of the invention is to produce seamless hollow ingots or tubes of cast steel of any grade or quality. The mould and core employed to cast these articles are shown in the drawing, and consist of a runner plate A with channel openings extending inwards, and connecting with a central hole in the base H of the mould, so as to admit a free escape of gas and air. The

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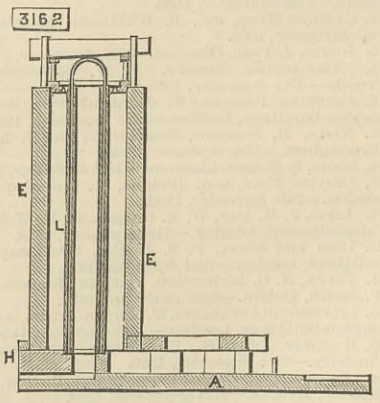


base has a rim round it to receive the mould E; it has in its centre a recess to receive the centre and hold in place the lower end of the core L. The core plate has rods attached at opposite points, and their ends connected together, the core being formed round them. To overcome the difficulties in swaging or hammering, the anvil employed has its horizontal face and the two convex faces inclined at an angle of about 60 deg.

3163. PROPELLING, STEERING, AND MANŒUVRING STEAMSHIPS, &c., *C. F. Osborne.—Dated 31st July*, 1880. 1*s*.

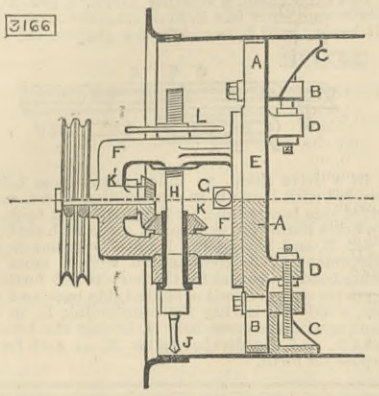
The main object of this invention is to provide a powerful and efficient substitute for paddle-wheels or screws, and according to one arrangement it consists of a pair of nearly flat vanes, paddles, floats, or blades, graduated sharply towards the advanced edges, and

fitted vertically or on edge, longitudinally at each side of the vessel at about the midship section, and at some depth below the water, so as to lie, when out of action, close to the ship's side. These floats or blades are actuated through suitable connections with motive power engines, so as to cause them to reciprocate intermittently at right angles to the direction of the ship's motion.

3166. RADIATING DRILLING MACHINE, *W. Boyd.—Dated 2nd August*, 1880. 6*d.*

This relates to a machine for drilling holes in cylindrical vessels from the interior. A is the frame carrying in grooves B the sliding clamps C, which are set out or expanded to suit the diameter of the work by screws fixed in brackets D on back of frame, and working in screwed bosses on the clamps C; E is a

3166

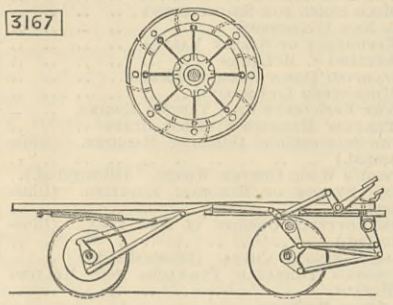


circular groove in frame A, to which the drilling machine frame F is bolted by the jam screws G, and in which it rotates. The drill spindle H, having a drill J fixed in it, is driven by a pair of mitre wheels K and K¹, and has a feed motion on its upper end worked by the hand wheel L.

3167. WHEELS AND RAILS FOR TRAMCARS, &c., *J. Ormerod.—Dated 2nd August*, 1880. 6*d.*

This consists in dispensing with the fixed flanges on the wheels for tramcars, and in substituting movable flanges made in one piece, or formed in segments

3167



attached to levers connected to a sliding collar on the rotary axle, so that by actuating a foot or hand lever or other mechanism, the flanges can be drawn in to allow the car to leave the rails.

3168. DRAWING CURVES KNOWN AS LISSAJOU'S CURVES, *A. R. Molison.—Dated 2nd August*, 1880. 6*d.*

The lid of a box has attached to it the different parts of the apparatus, and when required to be used the lid is reversed, and then with the box forms a stand. Two pendulums are arranged to vibrate at right angles to each other, and one of them governs a penholder and pen, while a table for the paper to be laid on, on which the curve is to be drawn, is guided or governed by the other pendulum.

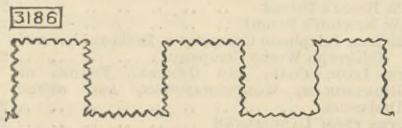
3178. BREWING, *P. L. Manbré.—Dated 3rd August*, 1880.—(*Void.*) 2*d.*

The farinaceous and amylaceous parts contained in maize, rice, barley, big oats, wheat, darn, millet, slags, mandioca, potato, arrowroot, and like substances are subjected to the processes of saccharification and purification, and used with purified malt worts.

3186. TIE AND CORE METAL, *T. Hyatt.—Dated 4th August*, 1880. 6*d.*

This consists in first roughening or crimping the metal sheets by any well-known means, this roughened or crimped sheet metal is then shaped by suitable

3186

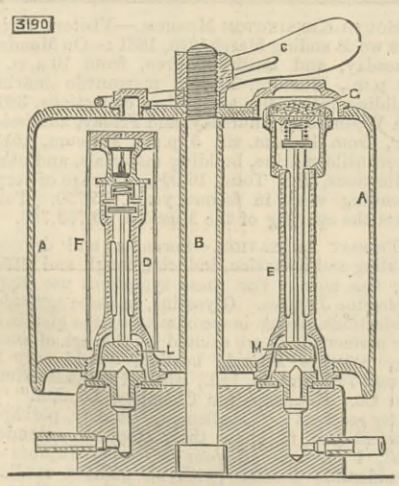


rollers or otherwise into folds or corrugations, the sides of which may then be either perpendicular or slope inwards, in the latter case forming wedge-shaped retaining channels for producing a bite upon the material or concrete to bind and cause the two to act together.

3190. CARBURETTING AIR FOR LIGHTING AND HEATING, *G. Westinghouse, jun.—Dated 4th August*, 1880. 6*d.*

The chief object of this invention is to provide facilities for charging the carburretting vessels, for connecting them to the pipes, and disconnecting them therefrom, and for making an exchange of vessels without interfering with the supply of the combustible to such lamps or heaters as it may be led to. A is the vessel with a central tube, through which passes a bolt B for holding the vessel down on its base, it being screwed firmly down thereon by turning the hand nut

3190

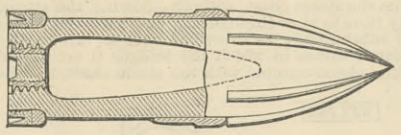


C. Within the vessel A are two tubular passages D and E, both open at the bottom to the exterior, and both open at the top to the interior of the vessel. The one tube D, which is the inlet tube, is enclosed within a tubular casing F, closed at the top, but open at the bottom at a little distance above the bottom of A. The other tube E, which is the outlet, is covered at the top by a cap G, containing porous material, beneath which are orifices opening into the upper part of E. L and M are nozzles, one being connected with the air supply pipe, and the other to the pipe leading to the burners.

3191. PROJECTILES FOR ORDNANCE, *W. Palliser.—Dated 4th August*, 1880. 6*d.*

This consists in the construction of projectiles for

3191



ordnance having an elongated conoidal ribbed head, a bearing ring at the springing of the ribs, and a bearing ring at the base of the projectile.

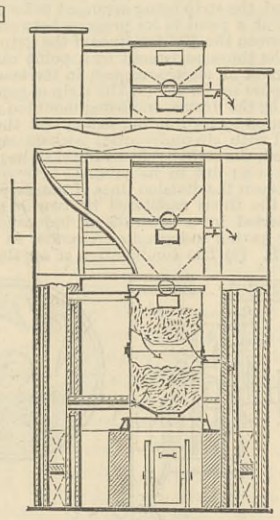
3207. VENTILATING RAILWAY CARRIAGES, &c., *C. T. Marzetti.—Dated 5th August*, 1880.—(*Not proceeded with.*) 2*d.*

Open-ended tubes are applied to the carriages, and pass to the outside, where they may be turned so as to face either in the direction of motion of the carriage, or in the opposite direction, according as it is required to produce an inward or outward current.

3214. GERMINATING APPARATUS FOR MALTING, *E. de Pass.—Dated 5th August*, 1880.—(*A communication from La Société Quiri et Cie.*) 6*d.*

This consists of a shaft of square sectional area and of suitable height, the upper part of which is closed by a movable lid covering the feed-hole and the lower part by a solid bottom provided with an opening for allowing the exit of the green malt. The shaft is divided into compartments by perforated sheet iron partitions. At the left-hand side the apparatus is fitted throughout its height with a series of tubes or conduits, one of which is fixed directly under

3214

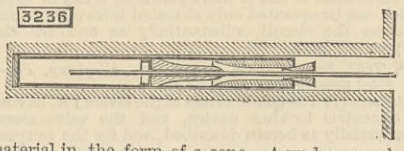


every alternate perforated sheet iron partition. All these tubes open into a flue or channel by which the air enters or is admitted. At the right-hand side and throughout its entire height the apparatus is fitted with another set of conducting tubes, each of which is fixed to one of those partitions, which are not provided with one of the first set of conducting tubes. All the tubes of the second set open into an outlet or suction flue or channel.

3236. CARTRIDGES, &c., *B. T. Moore.—Dated 7th August*, 1880. 6*d.*

This consists in manufacturing cartridges with which devices, which act as tamping, are combined, and also in making tampings separately for use with ordinary cartridges or other explosives. A tube of paper or other convenient material is partly filled with gunpowder or other explosive. Over the explosive is placed a block or plug of hard wood or other

3236



material in the form of a cone. A wad or gas-check may be placed between the powder or explosive and the plug to keep the powder more securely in its place and to check the escape of gas. In front of the block or plug is placed in the tube a hollow cylinder or prism made of any hard substance, the interior of which is tapered similar to the plug. It is fixed into the tube of the cartridge; the open end of the tube is then securely covered. A fuse passes through this cover and the cylinder, and through or by the side of the plug and wad into the powder beyond.

3239. TROUSERS, *H. H. Lake.—Dated 7th August*, 1880.—(*A communication from H. L. Riondet.*)—(*Not proceeded with.*) 2*d.*

So as to wear trousers without braces, a belt is passed through a guide attached inside the trousers, so that it may slide therein and be fastened in front by a buckle.

3241. MUSICAL BOXES, *E. H. Haffmann.—Dated 7th August*, 1880.—(*Not proceeded with.*) 2*d.*

The coiled spring is contained in a barrel as usual, the axis of which has at its end a pin which, when the barrel and spring are passed on to the end of the roller axis, engages in a slot in the inner end of the spring, and the axis of the roller and the inner end of the spring are thus connected together. On the barrel is a worm wheel with which a worm gears, the axis of the latter being fitted with a handle by which the spring is wound up.

3244. INCREASING THE TRACTIVE POWER OF VEHICLES, *A. C. Henderson.—Dated 9th August*, 1880.—(*A communication from P. Marquineen.*)—(*Not proceeded with.*) 4*d.*

This consists in an arrangement of semicircles and hooks, so connected together as to provide a large number of points upon which the drawing power is exerted.

3246. LOCKS, *H. J. Haddan.—Dated 9th August*, 1880.—(*A communication from J. W. Post.*)—(*Not proceeded with.*) 2*d.*

The lock consists of a transverse cylinder passing across the front plate, and provided with a keyhole and a bolt and tumbler carrying cylinder inserted from the edge of the door and passing through a recess in the transverse cylinder.

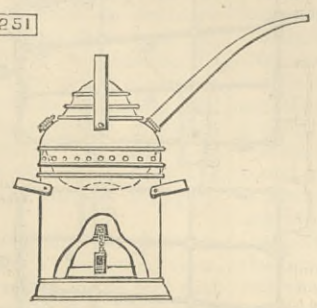
3260. FISH-PLATES, *J. H. Johnson.—Dated 9th August*, 1880.—(*A communication from W. Butcher.*)—(*Not proceeded with.*) 2*d.*

The fish-plates for connecting the ends of rails are made elastic by forming them of gradually diminishing thickness from the centre towards the edges, and are also provided with webs of uniform depth and thickness throughout their length, and form the bearings or points of contact between the fish-plate and the rails.

3251. COMBINED BRONCHITIS KETTLE AND FOOD-WARMER, *W. H. Lloyd.—Dated 9th August*, 1880. 6*d.*

The kettle body is formed with a slightly hollowed or concave bottom as shown, and curved sides so as to allow of the frame thoroughly to lick the bottom and sides of the kettle. To use the apparatus

3251

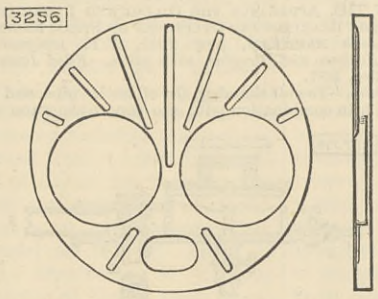


as a food warmer the kettle is removed, and over the lamp is placed a water pan, inside of which is placed an earthenware basin to contain the food.

3256. STEAM BOILERS, *J. A. and J. Hopkinson.—Dated 9th August*, 1880. 4*d.*

This consists in making the ends or plates puckered or corrugated in such a manner that the said plates

3256



will, without any extraneous or auxiliary support have the required strength and rigidity to resist any strain or pressure which may exist in the boiler. The drawings show one arrangement of the corrugations.

3262. AERATED DRINK, *A. S. Orr.—Dated 10th August*, 1880. 2*d.*

This consists in the application of salicylic acid to the production of a new aërated drink.

3263. SEAMS OF BOOTS, SHOES, TRUNKS, &c., *W. P. Thompson.—Dated 10th August*, 1880.—(*A communication from J. Papham.*) 6*d.*

In order to produce a durable watertight joint, between the surfaces to be joined is placed a layer of rubber cement, and then they are joined by a row of stitching and a continuous line of rivets.

3264. APPLICATION OF GRAVEL, &c., TO THE REFINING OF SUGAR, *H. Springmann.—Dated 10th August*, 1880.—(*A communication from G. F. Meyer.*) 4*d.*

The solution of raw sugar is filtered by means of sand or gravel, quartz, mineral coal, and minerals having alkaline earths as their base, those in lumps being first reduced to a granular state. To cleanse the materials after being in use a certain time they are washed with diluted muriatic acid and water.

3268. PURIFYING FEED WATER OF STEAM BOILERS, *W. Hanson.—Dated 10th August*, 1880.—(*Not proceeded with.*) 2*d.*

The feed water passes into a cylindrical vessel containing a steam coil by which the water is heated to 320 deg., causing the organic matters to dissolve and be precipitated into a discharge pipe.

3269. COAL-CUTTING MACHINE, *L. Short.—Dated 10th August*, 1880.—(*Not proceeded with.*) 2*d.*

For the purpose of under-cutting coal a bed carries an adjustable grooved roller, in any groove of which a heavy ram is supported, and has at one end a socket to receive the cutting tool, and at the other a handle to hold it by. For side cutting the coal vertically a pillar contains a second tube having at its upper end a screw with a point to fix into the roof, the lower end fixing into holes in the bed plate. The pillar carries a frame fixed at any desired height by a clip and hand screw and carrying on a shaft a roller on which the ram rests.

3271. SOLID DISINFECTING OR DEODORISING TABLETS, &c., *J. Hickisson.—Dated 10th August*, 1880.—(*Not proceeded with.*) 2*d.*

The tablets can be thrown into a liquid when desired to deodorise the atmosphere, and they consist in the combination of a deodorising or disinfecting substance, such as permanganate of potassa, chloride of lime, or carbolic acid, with a suitable base, such as chalk, gelatine, or other substance easily dissolvable in water or capable of absorbing moisture, by which the disinfecting gas can be evolved.

3276. BUTTONS, &c., *F. Waldeck.—Dated 11th August*, 1880.—(*Not proceeded with.*) 2*d.*

The head has a shank projecting from the back, and having a groove near its end. The back is formed of a hollow disc with a radial slot to receive the end of the shank, and secure it by a spring fastener.

3280. SAFETY BAR FOR SADDLES, *E. L. Anderson.—Dated 11th August*, 1880.—(*Not proceeded with.*) 2*d.*

So as to prevent people falling from a horse being dragged along, directly the rider's leg gives the slightest oblique traction an escapement turns on its pivots and rests on a stop-piece. If the rider is not then free, the escapement slides on its pivots in a groove in a plate fixed to the saddle bar, and when it leaves this groove it is free. The stirrup leathers are hung in the escapement to a latch, so that when the rider is thrown sideway or forward, the latch lifts, and permits the escape of the stirrup leathers.

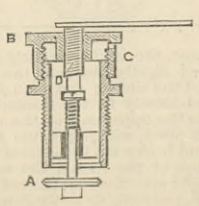
3282. COMBINED CALL-BELL AND LAMP, *W. Hilton.—Dated 11th August*, 1880.—(*Not proceeded with.*) 2*d.*

From the centre of a stand rises a vase, forming the lamp reservoir, which is surmounted by the burner. On either side of the vase are hollow pillars, containing spirit, into which dips a pipe-lighter. Beneath the stand is fixed a call-bell, sounded by a button depressed by the finger.

3283. VACUUM VALVES FOR STEAM DRYING CYLINDERS, &c., *W. Collier.—Dated 11th August*, 1880. 6*d.*

The drawing is a sectional elevation of the valve, which is shown open. A is the valve; B the cap or cover; C slots or openings in the cap for the escape of

3283



steam, water, or air, or for the entry of air inwards. The valve is kept open by means of the double-threaded screw D passing through the flange.

3292. TREATMENT OF METALLIC SURFACES, &c., *J. H. Johnson.—Dated 12th August*, 1880.—(*A communication from W. Ward.*) 6*d.*

So as to protect the surfaces of metallic articles from oxidation, alkaline silicates or metallic silicates, or mixtures of the same are applied to them, and so as to impart lustre to the surfaces thus treated they are platinised by the direct application of platinum, which is reduced by essential or other oils, purified free from its acids by ammonia, and held in solution in rectified ether, alcohol, or spirits. To obtain iridescence as well as lustre, sulphurous or metallic vapours or acid vapours are used in addition to platinum. To obtain a gilded effect gold is employed in conjunction with platinum.

3296. LATHE CHUCKS, *R. R. Grübs.—Dated 13th August*, 1880.—(*Not proceeded with.*) 2*d.*

The chuck consists of a head with three radial equidistant guideways in which slide the cheeks to centre and hold the piece to be inserted. The head carries a ring capable of turning thereon, but prevented from endwise motion by flanges or clamps. The cheeks are connected by separate links with the ring, so that when the latter is turned the cheeks move simultaneously in the same direction.

3298. GLAZING, *C. W. Knight.—Dated 13th August*, 1880.—(*Not proceeded with.*) 2*d.*

The frame is made with vertical division bars, but no horizontal ones, and on the top and down the centre of each bar is a groove to carry off moisture. At regular intervals in the bars holes are bored to receive the shanks of a clasp by which the glass is held in position.

3299. SPINNING FIBRES, *J. Booth.—Dated 13th August*, 1880.—(*Not proceeded with.*) 2*d.*

The apparatus is intended to afford increased facilities for putting in twist, to dispense with certain parts used to prevent "doubles," and to reduce the loss by waste to a minimum. In "cap frame" the top board and guide are abolished, the fibre passing directly from the front rollers to the cap and bobbin. By removing the top board prolonged guard plates can be used, and "doubles" thereby prevented. Below the cap and between each pair of guard plates an additional plate is placed in a horizontal position, so as to box off each cap and "end" or thread being spun, so that when an "end" is down or broken, it rests upon the plate, and prevents fouling the adjoining spindles.

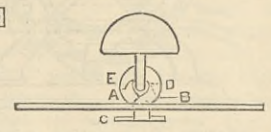
3303. SHADES FOR LAMPS, *H. W. Sambidge.—Dated 13th August*, 1880.—(*Not proceeded with.*) 2*d.*

The shade is formed with four, five, six, eight or more flat sides, instead of the ordinary form of globe, whereby the different sides may be made of different coloured substances or of different design. The gallery is correspondingly shaped to receive their lower ends, and their top ends are secured by small clips attached to a frame rising up from the gallery.

3419. ATTACHING BUTTONS TO ARTICLES OF DRESS, &c., *W. H. Sproston.—Dated 23rd August*, 1880. 6*d.*

The blank or strip from which the fastener is made is cut from sheet metal. The blank consists of two arms A and B, situated on opposite sides of the middle disc-like part C. At the outer ends of the arms A B, nearly semicircular flat hooks D E are made, the

3419



open side of the hook D being turned in a direction opposite to that of the open side of the hook E. By means of dies and pressure the arms A B are folded or bent inwards at right angles to the middle disc-like part C, and made partly to cross the said disc part, the hooks D E being brought parallel to one another.

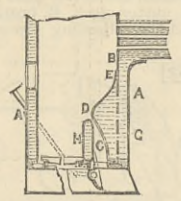
3702. COLOURED PHOTOGRAPHIC PRINTS, *W. Morgan-Brown.—Dated 11th September*, 1880.—(*A communication from T. Pixis.*) 2*d.*

This relates to pictures, and more particularly to improvements in the fabrication of coloured pictures by means of photo-printing. The materials, viz., cloth, wood, leather, &c., are prepared with the colours in such way that a photo-print, transferred thereon, gives to the picture a high degree of perfection which can be increased by re-touching. Before the plate is coloured a thin photo-print may give the outlines of the picture to facilitate the painting.

4445. APPARATUS FOR CONSUMING SMOKE AND SAVING FUEL, *J. B. Ball.—Dated 30th October*, 1880. 6*d.*

This relates to means for effecting in the furnaces or fire-boxes of boilers more perfect combustion of the fuel and gases than heretofore. A A are the plates of the outer fire-box; B is the forward or tube plate of the inner fire-box; C is a curved plate attached to the

4445

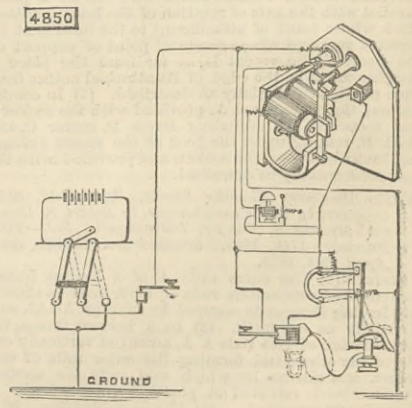


lower edge of the tube plate and curved back to the point D, where it is bent forward and is rivetted to the plate B at E. G are openings through the plate B to allow free circulation of water. H is a vertical hollow midfeather extending across the inner fire-box, to the sides of which it is rivetted.

4850. IMPROVEMENTS ON SWITCHES AND APPARATUS FOR USE UPON TELEPHONE LINES, *S. Pitt.—Dated 23rd November*, 1880.—(*A communication from C. D. Haskins.*) 6*d.*

The object of this invention is to enable signals to be exchanged between a central office and any station without operating the signal or call-bell of any other station on same circuit, and to prevent persons at other stations from interrupting or overhearing a

4850



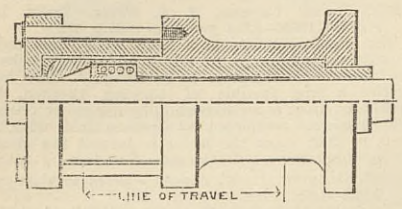
message, and to enable the operator at the central office to set the different instruments at a common starting point. To prevent the bells of other stations in same circuit being operated, the inventor uses a shunting and locking instrument, and electrical bell and switch connected together and to the main line,

whilst to prevent overhearing he dispenses with the earth wire at sub-stations, and by means of shunting and locking apparatus at each station, cuts out every telephone that is not being used. To bring the instruments to a common starting point he makes use of a unison stop; all as shown in the figure.

4890. METALLIC PACKINGS, *J. A. Osgood and E. P. Monroe.—Dated 24th November*, 1880.—(*Complete.*) 6*d*.

The drawing shows the invention applied to a locomotive engine having a fixed stuffing-box. It consists in a packing and supporting device for valve stems and piston rods, having the packing at such a

4890



distance from the nearest support or bearing traversed by the rod or stem that no portion of the latter exposed to wear or distortion from passing the support will enter or pass through the packing.

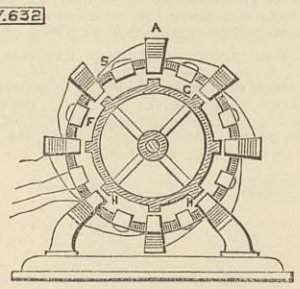
SELECTED AMERICAN PATENTS.

From the United States' Patent Office Official Gazette.

237,632. DYNAMO-ELECTRIC MACHINES, *Wm. E. Sawyer, New York, N.Y., assignor to Electro-Dynamic Light Company, New York.—Filed December 20th*, 1878.

Claim.—(1) A dynamo-electric generating machine constructed of stationary magnets, in which the magnetic force is continuous, such magnets being surrounded with conducting coils, in combination with a rotating barrel of unwound armatures, as distinguished from the stationary magnets, and rotating barrel of armatures of electro-magnetic engines, in which the magnets are energised intermittently to produce motion. (2) The combination of the magnets A S F, connected and operating substantially as described. (3) The two rings H H, connected by magnets and operating substantially as described. (4) The combination of magnets A, rings

237,632

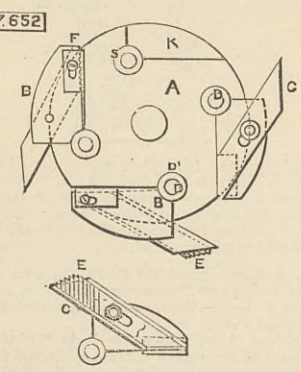


H, and armature G, operating substantially as described. (5) The combination of a series of contiguous magnets A, with a series of intervening sections of iron, joining their poles over a rotating armature, substantially as described, for the purpose of inducing and accumulating their magnetic force, substantially as set forth. (6) A dynamo-electric generating machine consisting of united rings fitted with a succession of electro-magnets, and combined with a succession of armatures rotating about a centre common to themselves, and the series of magnets. (7) In a dynamo-electric machine, a succession of electro-magnets fitted and connected upon stationary rims or rings, and energised by a succession of unwound armatures rotating within the rims carrying the magnets.

237,652. CUTTER HEAD FOR WOOD-WORKING MACHINES, *Solomon A. Woods, Boston, Mass.—Filed May 21st*, 1880.

Claim.—(1) In combination with the cutter-head A, provided with the socket S, the cutter-stock B, provided with the hub and cutter C, and serrated spur E, substantially as described. (2) In combination with the cutter head A, provided with a socket S, the adjusting screw D, swivelled centrally in the socket and provided with the collar D, polygonal splined collar and binding screw, substantially as described. (3) In combination, the cutter-head A, provided with recess K, the cutter-stock B, provided with make-fit slides F, and the adjusting screw D, substantially

237,652

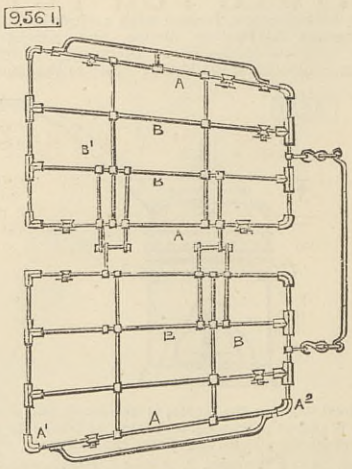


as described. (4) In combination with a cutter-head provided with a recess whose floor is on a plane parallel with the axis of rotation of the head, a cutter-stock whose point of attachment to the head is at its forward part and whose rearmost point of support on the floor of the recess is as far from the place of attachment as is the edge of its attached cutter from such point, substantially as described. (5) In combination, the cutter-head A, provided with the socket S and recess K, the adjusting screw D, cutter C, and stock B, resting upon the floor of the recess extending backward from the socket, and provided with the hub substantially as described.

9561. HARROW, *Timothy Rogers, Springfield, Ohio, assignor, by mesne assignments, to Robert S. Dorsey and Michael E. Bunger, Indianapolis, Ind.—Filed November 11th*, 1880. *Original No.* 214,955, *dated April 29th*, 1879.

Claim.—(1) The outer rails A of a harrow frame, composed of continuous rods or bars, bent as shown, and having their ends secured by clamps A^1 A^2, substantially as set forth. (2) In a harrow frame, the combination of two rods A A, arranged vertically one above the other, and forming the outer rails of said frame, and clamps by which said rods are secured together and retained in position substantially as shown and specified. (3) The combination, in a harrow, with the duplex rods A A B B, of transverse connecting-bars composed of sections of pipe secured between fittings B^1 which inclose the duplex rods and bolts which pass through said sections of pipe and said fittings and between said duplex rods, all substantially as shown and specified. (4) In a harrow, the combination, with the duplex rods composing the frame and having enlarged ends, of clamps provided with open-

9,561

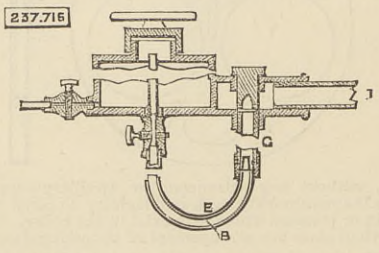


ings of similar formation, which are thus adapted to receive and securely hold said ends, and thus secure the frame together substantially as set forth.

237,716. APPARATUS FOR OILING AND LUBRICATING THE BEARINGS AND CYLINDERS OF STEAM ENGINES, *John Absterdam, New York, N.Y., assignor to Nathan and Dreyfus, same place.—Filed January 3rd*, 1881.

Claim.—The oil chamber, the oil outlet pipe, and the pipe I, in combination with the concentric water and

237,716

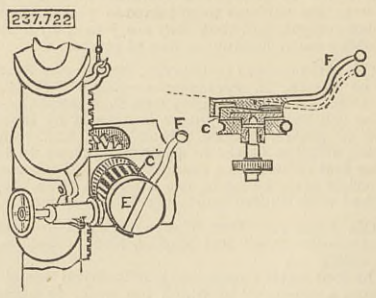


oil pipes E B and the glass tube G, substantially as and for the purposes hereinbefore set forth.

237,722. FEED DEVICE FOR DRILLING MACHINES, *Henry Bickford, Cincinnati, Ohio.—Filed September 15th*, 1880.

Claim.—In a drilling machine, the disc E, with pivotted lever F, having a projection C^1, constructed

237,722

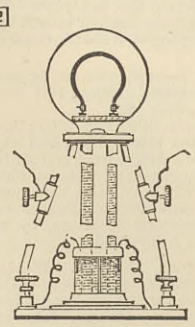


to engage with cavities C in disc E, in combination with the customary feeding mechanism of a drilling machine, as and for the purpose specified.

237,732. ELECTRIC LIGHT, *Thomas A. Edison, Menlo Park, N.J.—Filed June 30th*, 1880.

Claim.—(1) The combination, with the incandescing conductor of an electric lamp, of two fluid columns sustained by atmospheric pressure, and forming both a part of the circuit and the hermetical seal to the lamp, substantially as set forth. (2) The combination,

237,732

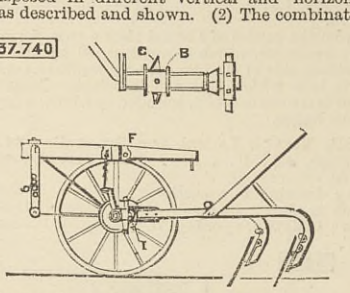


with the incandescing conductor and the fluid columns, of reservoirs connected to the source of electricity, and into which the columns dip for the maintenance of the column and the completion of the circuit therethrough, substantially as set forth. (3) The combination, with an electric lamp, of the stand or support therefor, consisting of an insulating base and top connected by adjustable standards, substantially as set forth.

237,740. CULTIVATOR, *Charles O. Gardiner and William C. Downey, Springfield, Ohio, assignors to P. P. Mast and Co., same place.—Filed June 28th*, 1880.

Claim.—(1) The cultivator coupling having the rigid arm, with its upper end provided with the series of holes disposed in different vertical and horizontal planes, as described and shown. (2) The combination

237,740

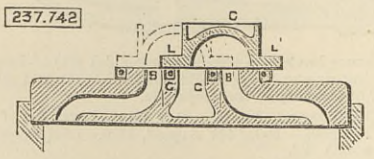


of the frame, the beam coupling having the upright arm formed rigidly thereon, the spiral compression spring, and the sliding and swinging rod, having one end seated loosely in the frame, and the other end pivotted to the upper end of the coupling arm by an adjustable pivot, which permits the rod to be moved forward and backward in relation to the arm. (3) The combination of the frame, the coupling having the rigid upright arm thereon, the rod and the spring, the spring being adjustable in tension, and the rod adjustable forward and backward at its point of connection with the arm, substantially as described. (4) In combination with the axle, the draft frame, and the beam operating rod, the flanged plate F, constructed as described and shown, with the lip or flange, whereby it is adapted to serve the double purpose of uniting the frame and axle and of holding the rod and its spring. (5) The combination of the parts B C, the connecting pivot, and the screw I, applied to hold the pivot, as shown.

237,742. BALANCE VALVE, *John H. Greenwood, Columbus, Ohio.—Filed September 21st*, 1880.

Claim.—(1) A valve seat for balance valves in which rows of holes are made and connected with the steam chest in the manner described, so as to relieve at all times the pressure on the valve by taking steam direct from the steam chest, without allowing the steam at any time to blow through the seat into the exhaust, all substantially as described. (2) A valve seat for balance valves in which the bridges G are provided with holes connected with the steam chest, to relieve

237,742



the pressure of the valve upon the bridges without permitting the escape of steam through the bridges from the steam chest to the exhaust, all in the manner specified. (3) The combination, in a balance valve seat, of rows of holes, constructed and arranged as described, with a steam chest and slide valve, all operating in the manner and for the purpose specified. (4) The arrangement and location of holes relatively to the rows of holes B and B^1, and the lips L L^1 of the slide valve C, in the manner described, for the purpose set forth.

237,753. ELECTRIC TIME REGISTER, *James F. Kettell, Worcester, Mass.—Filed April 3rd*, 1880.

Claim.—(1) The strip of paper or ribbon carried by the drums, one being mounted upon a clock and rotated by its winding arbor, and the other constructed with circumferential pockets and loaded, as described, the strip being arranged to be perforated or marked at a point in its progress between the drums and between the division lines of the strip corresponding to the times registered by a point carried by the armature of an electro-magnet, in the manner and for the purpose set forth. (2) The strip of paper or ribbon carried by the drums, one being mounted upon a clock and rotated by its winding arbor, and the other constructed with circumferential pockets and loaded, as described, the strip being arranged to be perforated or marked at a point in its progress between the drums and between the division lines of the strip corresponding to the times registered by two or more points, each carried by a separate or independent electro-magnet having independent circuits, in the manner set forth. (3) The combination of an electro-magnet

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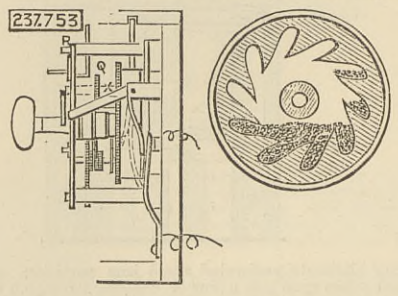
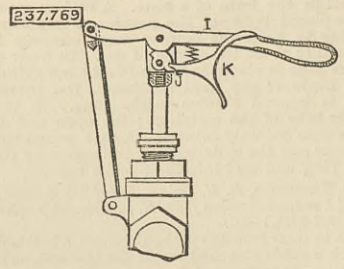


and its armature, carrying a puncturing device, with a time movement carrying a strip of paper provided with lines or marks graduated to correspond to the time movement of the clock, as divided into hours or fractions of an hour, or both, the time movement Q, having lever R, lever X, and circuit closer, substantially as and for the purpose specified. (4) The combination of the time movement Q, lever R, lever X, and circuit closer, substantially as set forth. (5) The tension drum, provided with circumferential pockets, and loaded and operating in the manner and for the purpose set forth. (6) In a registering clock carrying a strip of paper or ribbon provided with divisional lines corresponding to the time movement of the clock, the combination of an electro-magnet and its armature, carrying a puncturing device and having its circuit broken at one or more points by a key or keys, which can be operated only at stated intervals of time to close the circuit, substantially as and for the purpose set forth.

237,769. STOP VALVE, *James Old, Allegheny, Pa.—Filed October 20th*, 1880.

Claim.—(1) The combination of the levers I K, having an excentric looking device, and the valve stem, substantially as herein described, and for the purpose

237,769



set forth. (2) The combination of the levers I K, having an excentric locking device, clevis J, and valve stem, substantially as hereinbefore described, and for the purpose set forth. (3) The combination of the

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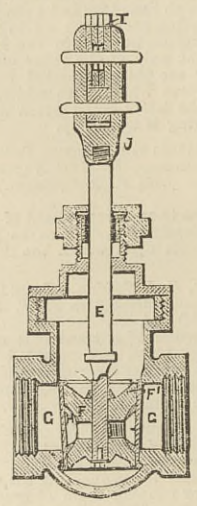
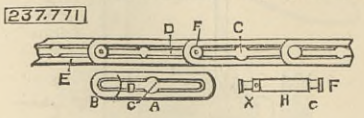


levers I K, clevis J, spring, and valve stem, substantially as herein described, and for the purpose set forth. (4) The hanger F, with bevel points F^1, and cavities in combination with the valves G G, having a recessed flange forming a section of a sphere recessed at its axis, substantially as herein described, and for the purpose set forth. (5) A valve having a V-shaped recess at or near its periphery, in combination with a hanger having a suspending point corresponding in form to said V-shaped recess, substantially as herein described, and for the purpose set forth.

237,771. DRIVE CHAIN, *Halbert E. Paine, Milwaukee, Wis.—Filed November 15th*, 1880.

Claim.—(1) A drive chain formed of two parallel lines of slotted side bars and independent cross bolts having heads which engage with said side bars, as and for the purpose set forth. (2) In a drive chain, a side bar having a longitudinal slot D, provided with an enlarged portion C, in combination with a cross bolt having a head F, as and for the purpose set forth. (3) In a drive chain, a side bar having a slot D, and countersunk outer face E, in combination with a cross bolt having head F, as and for the purpose set forth.

237,771



(4) In a drive chain, an independent cross bolt H, provided with heads F, in combination with a pair of slotted side bars, as and for the purpose set forth. (5) In a drive chain, the side bar A, made with the lateral off-set B, and having the longitudinal slot D, with enlargement C, in combination with a cross bolt having heads F, as and for the purpose set forth. (6) In a drive chain formed of slotted side bars and cross bolts, a side bar having the countersink E, in combination with the cross bolt H, having the heads F, necks G, and the divided collar X, as and for the purpose set forth.

CONTENTS.

THE ENGINEER, March 18th, 1881.

SOUTH KENSINGTON MUSEUM.—Visitors during the week ending March 12th, 1881 :—On Monday, Tuesday, and Saturday, free, from 10 a.m. to 10 p.m., Museum, 11,401; mercantile marine, building materials, and other collections, 3806. On Wednesday, Thursday, and Friday, admission 6d., from 10 a.m. till 5 p.m., Museum, 1513; mercantile marine, building materials, and other collections, 274. Total, 16,994. Average of corresponding week in former years, 15,730. Total from the opening of the Museum, 19,753,786.