THE INSTITUTION OF NAVAL ARCHITECTS.

Our last report gave the proceedings of the Institution of Naval Architects down to Wednesday afternoon. At the morning meeting on March 15th the first paper read was by Mr. R. J. Butler, Member,

On the Steam Trials of the Satellite and Conqueror under Forced Draught.

After pointing out the advantages which are obtained in torpedo boats and other small craft fitted with a single boiler by the successful employment of forced draught by fans in closed boiler-rooms, and that the French Government have used the fan draught with ordinary boilers in closed boiler-rooms in ships of war for some two or three years, while in this country the firm of Sir W. Armstrong and Co. have adopted and carried it out successfully, in connection with low circular boilers, in some fast cruisers which they have built during the last two years for foreign Governments, the author proceeded to describe the arrangements of the machinery on board the Satellite and Conqueror.

The Satellite is a single-screw composite sloop of 1420 tons displacement. Her engines are of the usual two-cylinder compound type, placed horizontally. The boilers are of the long, low kind, with two furnaces in each, an intermediate fire-box, and the tubes beyond. The boilers are arranged in pairs in two separate water-tight compartments, being fired at the forward and after ends respectively. One funnel serves both sets of boilers. The engines and boilers are placed beneath a steel deck, which is below the water-line.

Natural Draught Trials.

	Satellite.	Heroine.	Hyacinth.
Date of trial	April 3, '82	May 30, '82	July 25, '82
Duration of trial ... hours	4	6	3
Number of boilers used	4	4	4
Mean steam pressure in boilers ... lbs.	84	82·6	81·6
Mean vacuum ... inches	26·5	26·1	26·0
Mean number of revolutions per minute	98·52	104·2	105·8
Mean pressure—lbs. high	32·36	32·07	31·6
Mean pressure—lbs. low	13·85	12·9	14·1
I.H.P. high	493 } 1116	515 } 1127	515 } 1195
I.H.P. low	623 }	612 }	680 }
Grate area ... sq. ft.	110	110	110
I.H.P. per square foot of grate	10·15	10·25	10·87
Tube surface of boilers per I.H.P. ... sq. ft.	2·18	2·16	2·03
Total heating surface per I.H.P. ... sq. ft.	2·61	2·59	2·44
Wind force	4	1 to 4	2 to 4
Sea	Smooth	Smooth	Moderate
Diameter of screw ... feet	13·0	13·0	13·0
Pitch of screw	13′ 6″	13′ 6″	13′ 6″
Draught of water forward	11′ 8″	11′ 10″	11′ 8″
Draught of water aft	14′ 9″	14′ 9″	14′ 9″
Maximum temperature in the boiler-rooms	111°	108°	98°
Mean temperature in the boiler-rooms	90°	87°	84°

Steam Blast Trials.

	Heroine.	Hyacinth.
Date of trial	May 31, '82	July 25, '82
Duration of trial ... hours	3	2
Number of Boilers used	2	4
Mean steam pressure in boilers ... lbs.	83·9	85·0
Mean vacuum ... inches	26·0	25·1
Mean revolutions per minute	89·4	111·6
Mean pressures—lbs. high	22·45	34·05
Mean pressures—lbs. low	9·63	16·9
I.H.P. high	310 } 702	586 } 1445
I.H.P. low	392 }	859 }
Grate area ... sq. ft.	55	110
I.H.P. per square foot of grate	12·76	13·1
Tube surface per I.H.P. ... sq. ft.	1·73	1·68
Total heating surface per I.H.P. ,,	2·08	2·02
Wind force	1	2 to 4
Sea	Smooth	Moderate
Area of funnel ... sq. ft.	*7·5	15
Number and diameter of blast nozzles.	Two, $\frac{5}{8}$in.	Four, $\frac{5}{8}$in.
Diameter of screw ... feet	13·0	13·0
Pitch of screw	13′ 6″	13′ 6″
Maximum temperature in the boiler-rooms	98°	100°
Mean temperature in the boiler-rooms.	87°	88°

All the necessary openings in this deck for ventilation and other purposes are protected by shutters or stout bars, and cofferdams. Direct communication between the boiler-rooms, and to the back end of the boilers, is obtained by means of a passage at one side. An air lock is provided at each end of this passage, and also at the entrance to the after boiler-room from the engine-room. Air-tight screens of thin sheet iron are worked flush with the fronts of the boilers, attached to the fore and aft coal-box bulkheads at the sides, and to the steel deck and ship's bottom. Doors are provided in these screens to give access to the tops of the boilers. Each boiler-room has a fan 5ft. in diameter, placed horizontally under the steel deck, with separate air-supply shafts extending well above the upper deck. Other air shafts and openings are provided for ventilation and access to the boiler-rooms, but these are closed when the forced draught is applied. The Conqueror is an ironclad ram of 6200 tons displacement, having twin-screw engines of 4500 estimated I.H.P. Her engines are vertical inverted three-cylinder compound, with cranks at equal angles. A middle-line bulkhead separates the two engine-rooms. There are eight high boilers with return tubes over the furnaces. They are arranged in pairs in four boiler-rooms, separated from each other and from the engine-rooms by water-tight bulkheads. The boilers are placed with their backs to the middle-line bulkheads, and are fired from the wings. One funnel is common to all the boilers. Hinged doors are fitted along the ceiling to be open under normal conditions of working, so that the original system of ventilation by means of cowl pipes from above the upper deck then operates. Air locks are provided between the engine rooms and after boiler rooms, and also the passage way across the ship at the forward end of the other boiler rooms. When working with all the boilers under air pressure, communication is open between the forward and after boiler rooms through doorways in the cross bulkheads. Two vertical 4ft. fans on one spindle, fixed at the after ends of the rooms above the ceiling, supply each of the after sets of boilers; and one 5ft. fan at the forward ends of the rooms supplies each of the forward sets of boilers. From trials made with the Satellite under natural draught alone, it appears that under the most favourable conditions, from 10 to 10½-horse power is obtainable per square foot of grate from this class of boiler, when worked without forcing the draught; and that nearly 13-horse power, or about 24 per cent. more, can be realised when the ordinary steam blast is employed, the boiler rooms being open as usual. On the Conqueror's first trial, scarcely 8-horse power per square foot of grate was obtained. The first of the Satellite's forced draught trials, like the first steam blast trial, was made with the two forward boilers only, to keep well within the limits of the capability of the engines to transmit the power. The air pressure used varied from 1in. to 1½in. of water, but was in effect only an inch throughout, the increase being required gradually as the heating surface became diminished by the lower tubes being blocked up by coal thrown over the bridges. 864 I.H.P. was realised as the mean of the three hours' work, or 15·7 horses per square foot of grate, and this power was maintained during the whole time as uniformly as could be expected. The tendency of the boilers to prime prevented this air pressure being exceeded. On a subsequent trial three boilers were used, the air pressure being increased gradually. With ½in., the effect is very nearly the same as when using the steam blast. At an air pressure of 1in., 16-horse power was obtained per foot of bar, but it will be noticed that the condensing apparatus, which maintained a good vacuum up to about 1200-horse power, was being overtaxed, and a fall in the vacuum took place. The three boilers were further worked at an air pressure of from 1¼in. to 2in. With the increase in air pressure the vacuum was further diminished, but the power and speed of the engines were maintained with a very fair degree of uniformity. Apparent unsteadiness in the water caused the feed to fluctuate, and necessitated variation in the air pressure to keep the power uniform. The indicated horse-power now obtained reached as high as 1397, or 16·9 per foot of grate bar, as the mean of the two hours' trial. This exceeds the performance under natural draught by 62½ per cent., and that under steam blast by 30 per cent. Considerable leakage of air occurred through the furnaces of the unused boiler, especially at the higher air pressures, so that an increased fan speed was necessary in one boiler-room to maintain the required air pressure. After this an attempt was made to work all the boilers, commencing with 1½in. of air pressure, but the engines could not take the steam, and it was abandoned. The indicator diagrams taken showed that 1570-horse power had been developed, or about 65 per cent. above the specified power of 950-horses, the engines running at 126 revolutions. In the Conqueror two series of forced draught trials took place. The first, which immediately followed the ordinary trial, was made solely with the object of ascertaining the maximum power and speed the vessel could attain on an emergency, and it is only valuable on that account. Steam blew off freely from the safety valves during the whole time, and additional pipes were fitted to admit steam direct from the main pipes to the low-pressure cylinders. Thus a large quantity of the steam generated was wasted, and another large portion used uneconomically. The other trials were made to determine the capabilities of the boilers, and for this purpose the after boilers only were used. They were worked for one and a-half hours under an air pressure varying from 1in. to 1½in. in the two rooms, and subsequently for the same period at from 1½in. to 2in. of air pressure. The indicated horse-powers developed under these conditions were 3665 and 4023, or at the rate of about 12·2 and 13·4 horses per square foot of grate respectively. The same length of grate bar, viz., 7ft. 6in., was

Satellite—Forced Draught Trials.

Date of trial.	May 10, '82.	July 5, '82.	July 11, '82.	July 11, '82.	July 11, '82.
Number of boilers used	2	4	3	3	3
Duration of trial ... hours	3	½	½	½	2
Air pressure ... inches of water	1 to 1½	¼	½	1	1½ to 2
Mean steam pressure in engine-room ... lbs.	79	90	86·5	78·7	80·5
Mean vacuum ... inches	26·6	25·0	25·38	23·88	23·41
Mean revolutions per minute	95·4	113·5	103·36	110·66	121·45
Mean pressure—lbs. high	27·52	29·95	29·4	33·7	31·93
Mean pressure—lbs. low	10·58	12·52	12·85	14·9	14·45
I.H.P. high	405 } 864	524 } 1171	469 } 1074	575 } 1326	598 } 1397
I.H.P. low	459 }	647 }	605 }	751 }	799 }
Area of fire-grate ... sq. ft.	55	110	82·5	82·5	82·5
I.H.P. per square foot of grate	15·7	10·6	13·0	16·0	16·9
Tube surface per I.H.P. ... sq. ft.	1·41	2·08	1·70	1·37	1·30
Total heating surface per I.H.P. ,,	1·69	2·5	2·04	1·65	1·56
Area of funnel ... ,,	15	15	15	15	15
Maximum temperature in the boiler-rooms	86°	—	—	—	—
Mean temperature in the boiler-rooms	76°	—	—	—	—

Conqueror—Steam Trials.

Date of trial.	January 24, '83.	January 24, '83.	January 26, '83.	January 26, '83.
Number of boilers used	8	8	4	4
Duration of trial ... hours	2	1½	1½	1½
Air pressure ... inches of water	—	1½	1¼	1¾
Mean steam pressure in engine-room ... lbs.	64	65	61	63
Mean vacuum ... inches	28·4	27·6	27·8	27·5
Mean revolutions per minute	100·8	106	92·21	95·2
Mean pressure—lbs. high	27·7	27·3	24·27	25·61
Mean pressure—lbs. low	8·27	11·58	6·98	7·48
I.H.P. high	2325 } 4658	2408 } 5842	1864 } 3665	2030 } 4023
I.H.P. low	2333 }	3434 }	1801 }	1993 }
Area of fire-grate ... sq. ft.	585	585	300	300
I.H.P. per square foot of grate	7·96	10	12·22	13·41
Tube surface per I.H.P. ... sq. ft.	2·37	1·89	1·55	1·41
Total heating surface per I.H.P. ,,	2·86	2·28	1·88	1·71
Area of funnel ... ,,	64	64	64	64
Maximum temperature in the boiler-rooms	100°	102°	110°	116°
Mean temperature in the boiler-rooms	73°	85°	91°	98°

Particulars of the Machinery of Satellite and Conqueror.

	Satellite.	Conqueror.
Description of engine	Horizontal compound single-screw, return connecting rod, 2 cylinders	Vertical compound twin-screw, direct-acting, 3 cylinders to each set
Diameters of cylinders	H.P. 36″ L.P. 62″	H.P. 54″ Two L.P., each 70″
Length of stroke	2′ 6″	3′ 0″
Diameter of crank shaft	9½″	13⅜″
Diameter of propeller shaft	8½″	12¾″
Crank pins—diameter × length	10″ × 11″	13¾″ × 12″
Total length of main bearings	5′	8ft. each set
Material of shafts	Siemens-Martin steel	Wrought iron
Cooling surface of condensers	1900 square feet	9000 square feet
Air pumps—No. × diameter × stroke	One, 14″ × 2′ 6″ double-acting	Eight, 14″ × 3′ 0″ single-acting
Screws—description	2-bladed Griffiths', feathering on Bevis's plan	4-bladed modified Griffiths'
,, diameter × pitch	13′ 0″ × 13′ 6″	14′ 0″ × 16′ 6″
Boilers—No. and description	Four, of long circular type	Eight of high type, 6 flat-sided, 2 circular
,, working load ... lbs.	90	70
,, width × length × height	7′ 5″ diameter × 14′ 8″ long	Six, 12′ 2″ × 9′ 6″ × 15′ 0″; Two, 12′ 4″ diameter × 9′ 6″ long
,, thickness of shell plates	11/16″	15/16″
,, material of	Siemens-Martin steel, except furnaces, combustion chambers, and tube plates	Siemens-Martin steel, except furnaces, combustion chambers, and tube plates
,, No. of furnaces in each, and dimensions of	Two, 2′ 9″ diameter × 5′ 0″ long	Three, 3′ 4″ diameter × 7′ 6″ long-high; 3′ 0″ ,, × 7′ 6″ ,, circular
,, total grate area ... sq. ft.	110	585
,, tubes, material of, and dimensions	Wrought iron, 0·165″ thick, 2½″ diam. × 5′ 8″ between tube plates	Brass, 0·137″ thick, 3″ diameter, × 6′ 6″ between tube plates
,, tube surface ... total sq. ft.	2430	11,050
,, total heating surface ... sq. ft.	2920	13,340
Funnel—description and height from dead plates of lowest furnaces	Lifting, 50′ 0″	Fixed, 65′ 0″
Fans for forced draught—No. and diameter	Two, 5′ 0″	Four, 4′ 0″ aft. Two, 5′ 0″ forward
Fan engines—description and dimensions	Direct-acting, single-cylinder, 7″ cylinder × 4″ stroke	Brotherhood, 3-cylinder, 7″ diameter × 4½″ stroke

* A diaphragm was placed in the funnel for this trial.

used on all these occasions, and there is no doubt that the high boilers were worked at a considerable disadvantage on this account, as compared with the low boilers of the Satellite. But as one object of the trials was to ascertain the workability or otherwise of the long bars, they were retained. Unfortunately, circumstances did not permit of further trials being made with the bars shortened, so as to reduce the grate area to the usual proportion, for they would have yielded useful information. It is to be regretted that no estimate can be given of the quantity of coal burnt under this system of forcing the combustion. The trials being made almost entirely with the object of observing the behaviour of the boilers, and of realising the maximum power obtainable, and, being in a certain degree progressive, they were necessarily of short duration; too short, in fact, to admit of any account being taken of the rate of combustion of the fuel which could be considered of value. One thing appears certain, viz., that as the air pressure was advanced, the increase in the consumption of fuel proceeded at a much higher rate than did that of the power given out at the engines. This is borne out by the observations made of the temperatures produced in the uptakes. On the forced draught trial of the Satellite with the two forward boilers, a pyrometer fixed to the uptake registered a temperature from 1000 deg. to 1200 deg. Fah., whilst on the steam blast trial of the Heroine, a pyrometer, similarly placed, recorded from 775 deg. to 850 deg. Also, on the trials of the Conqueror, pyrometers were attached to the funnel just above the junction of the uptakes. On the first occasion, under the ordinary draught, the temperature varied from 275 deg. to 280 deg., when the steam blast was off. When the blast was on, it varied from 490 deg. to 600 deg. On the trial immediately following, when the fan draught was used, the temperature registered ranged from 850 deg. to 1000 deg. The forced draught trials made in these two vessels can in reality only be regarded in the light of experiments, carried out with the general object of making the ground sure for an extended application of the system, and although they are not so complete as could be desired, they have yielded useful information. The results obtained are sufficient to show that, with engines of suitable size, the steaming power of the low boilers can, by employing forced draught, be increased by about 30 per cent. beyond the maximum power hitherto obtainable with the steam blast, and that the increase of effect is even considerably greater than this in the case of the high boilers.

The discussion was opened by Mr. F. C. Marshall, who, after complimenting the author upon the importance of the experiment recorded in the paper, pointed out that, as he had stated some years ago, the only direction for improvement left to marine engineers seemed to be in the employment of forced draught. He thought it would be a physical impossibility to work a grate 7ft. 6in. long properly, and as a lot of cold air would pass unchanged through the bars and cool the combustion chamber and tube plates, the maximum effect would not be obtained. He had even found a difficulty in keeping 6ft. bars well covered. In experiments with a locomotive boiler in which the grate and heating surfaces were as 1 to 80, he had got as much as 20 indicated horse-power per square foot of grate, and he did not see why this should not be reached in the case of marine boilers. He considered that the great increase in efficiency of the high boilers when under forced draught was due to the greater heating surface as compared with the low type, the gases escaping up the chimney at a much less temperature.

Mr. Humphreys, the maker of the boilers of the Satellite and Conqueror, did not think 7ft. bars too long for forced draught, and stated that at the end of the trials the bars were well covered. In this, however, he was in a decided minority, the general feeling of the meeting being that 5ft. or 6ft. was as much as should be attempted. After some remarks from two or three other speakers who had experience in forced draught, Mr. Butler replied, agreeing that in his experience short bars gave the best results. Answering Mr. Ravenhill, he stated that after the trial no deterioration or damage was visible to the fire-bars, which were of wrought iron 3½in. deep, but that the bridge was slightly burned. The thickness of fire kept in the Satellite's boilers was about 7in.

The next paper was by Mr. J. T. Milton,

On the Influence of the Board of Trade Rules for Boilers upon the Commercial Marine.

The author first gave some idea of the great influence which the Board of Trade rules has upon the commercial marine, mentioning that at the present time there are nearly 1000 sea-going vessels, of an aggregate gross tonnage of nearly 2,000,000 tons, and of nearly 300,000 registered nominal horse-power, holding passenger certificates; also that out of the large number of new steam vessels registered in the United Kingdom in 1882, 38 per cent. of the tonnage, and 45 per cent. of the nominal horse-power, came under the Board of Trade rules, there being in that year about 114 new sea-going vessels built under these rules, having a gross tonnage of over 295,000 tons, and an aggregate nominal horse-power of over 41,000. Seeing what a large proportion of British steam vessels are compelled by law to come under the periodical survey of the officers of the Board of Trade, and to have their boiler pressures fixed by the Board's rules; and recognising that these vessels are built with the idea of their producing a commercial return upon their cost, and that in all cases this return is largely, and in some cases wholly dependent upon the economy of their fuel consumption, which is itself governed in a large measure by the steam pressures the boilers are permitted to carry; it was essential that the rules by which the surveyors are guided in fixing these pressures should be framed upon an equitable basis, which, while providing for absolute safety, should in all cases allow the greatest pressures to be carried which are consistent with safety. Referring to the Board of Trade rules for cylindrical shells, it is stated that:—"When cylindrical boilers are made of the best material, with all rivet-holes drilled in place, and all the seams fitted with double butt straps, each of at least five-eighths the thickness of the plates they cover, and all the seams at least double rivetted, with rivets having an allowance of not more than 75 per cent. over single sheer, and provided that the boilers have been open to inspection during the whole period of construction, then 5 may be used as the factor of safety. The tensile strength of the iron is to be taken as equal to 47,000 lb. per square inch with the grain, and 40,000 lb. across the grain. The boilers must be tested by hydraulic pressure to twice the working pressure, in the presence, and to the satisfaction, of the Board's surveyors. But when the above conditions are not complied with, additions according to a scale given must be added to the factor 5, according to the circumstances of such case." Further examples in relation to rivets and other parts were then given, after which the author proceeded to state that as the pressure on the ends of the boiler was mostly borne by the stays, very little strain comes upon the circumferential seams, and so long as these seams are tight no more is required of them; the designs of these seams, whether lap, single strapped, or double lapped, single or double rivetted, with punched or drilled holes, having absolutely no effect upon the ultimate strength of the shell. There were, however, no less than six provisions in the scale as to the design of these joints, and five as to the method of making the holes in them, some of these provisions involving a possible reduction of 12 per cent. in the working pressure. Curiously enough, although these eleven provisions are made, no notice whatever is taken of the proportions of the diameter and pitch of the rivets in regard to the thickness of the plates, the most important points so far as the efficiencies of these joints are concerned. With regard to the longitudinal joints, there can be no doubt if the holes are punched the plate is weakened to a somewhat greater extent than it would be if they were drilled, and possibly the plate may be left a little stronger if it is holed after bending than if holed before bending; but there can surely be no justification whatever for the provision A in the above scale, the holes in each case being required to be fair and good, and drilled after bending. When we consider the rivets, however, experience has shown that rivets in punched holes are certainly not weaker than those in drilled holes; yet these rules, by requiring the same sectional area of rivet as net section of plate in all cases, or by reducing the pressure in proportion as the rivet area falls short of this, allow a less strain to be borne by rivets in punched holes than by those in drilled holes of the same size; a difference of 10 per cent. being made in this way by provision D. The Board of Trade rules for furnaces, again, give a variety of different pressures for flues of the same diameter, length, and thickness, according to the method of constructing the longitudinal joints, a furnace with a welded seam being allowed to work at a pressure 50 per cent. in excess of that which would be allowed if the joint were lapped and single rivetted with punched rivet holes. In these rules, as with those referring to the circumferential joints of cylindrical shells, the method of making the holes in the plate is deemed to be of great importance, while the proportions of diameter and pitch of rivets to the thickness of the plates are again ignored. Referring to the figures showing the interest this country has in the steam commercial marine, an estimate was then made of the monetary loss annually inflicted upon the country by the Board of Trade rules, which the author took to be not less than half a million pounds per year. In conclusion, it was suggested that the president and council of the Institution might with great public advantage bring their influence to bear upon the authorities of the Board of Trade, with a view to having these rules placed upon a satisfactory basis; and also that engineers of eminence, who have had large experience not only in making but in the upholding and running of marine machinery, should be invited to give their experiences, as these would be of the greatest value in framing rules for minimum strength.

An animated discussion followed the reading of this paper. Mr J. McFarlane Gray, speaking entirely in a private capacity, and disclaiming having had anything to do with the framing of the rules, attacked the author at considerable length, pointing out that his conclusions were such as might have been arrived at by a person who had been educated entirely at school, without the benefit of practical experience. He instanced the case of the boilers of the ss. Thames, which cracked for about 100in. along the lower part of a circumferential seam with a pressure of only 17 lb. per square inch, owing to cold water being run in by a careless attendant, and argued from this that if it had not been for the extra thickness imposed by the Board of Trade, the two parts of the boiler would have entirely separated. It was, however, maintained by Dr. Siemens and others, that probably the accident would not have happened at all if the plates had not been too rigid from their greater thickness. Dr. Siemens mentioned the ss. Faraday, which was constructed about seven years ago, and which, though in frequent use ever since, had, from the intermittent character of the work in which she was engaged, really undergone no great hardships; nevertheless, the working pressure permitted in the iron boilers was being so much reduced, year after year, that an expense of £10,000 had to be incurred in putting in new ones of steel, though the inspector pronounced the old boilers to be in perfect condition. As an engineer, he should say the Board of Trade erred on the side of excessive thickness, and he thought that if every plate, whether steel or iron, was tested, and not passed without an elongation of 20 per cent., all reasons for allowing a large margin of safety would vanish. Other speakers followed up the same lines, Mr. Andrews thinking that a much more careful inspection was wanted during construction than is now given. In replying, Mr. Milton drew attention to some boilers which had given way in a similar manner to those of the Thames, but which were satisfactorily patched with a flexible strap so as to admit of expansion and contraction. He instanced some steel boilers now under construction, with 1½in. plates which by Lloyd's would be passed for a working pressure of 140 lb. to the inch, but which, according to the Board of Trade rules, should only work at 107½ lb.

The Earl of Ravensworth, in a few remarks, stated that it certainly appeared as if there should be some attempt at reconciliation between conflicting rules, and though he thought that the boilers of vessels carrying perhaps hundreds of lives should have a higher margin of safety than those carrying cargo, still he, as president of the Institution, would be glad to arrange for a conference with the Board of Trade, with the view of taking steps in what everyone seemed to think the desired direction.

The Secretary, in the absence of the author, then read a paper

On Sea-Going Torpedo Boats,

By Mons. J. A. Normand, in which was advocated the extended use of sea-going torpedo boats, of from fifty to eighty tons' displacement, having a maximum speed of eighteen to twenty knots, capable of steaming at least 1000 nautical miles at ten or twelve knots, costing from £8000 to £11,000, and manned by a crew of from ten to fifteen men. The importance of vessels of this class in future warfare was then referred to, and the consequences that would follow on their adoption. These were (1) No ironclad, no squadron or fleet, no cruisers (unless cruisers should attain the speed of torpedo boats) could navigate in a sea of moderate dimensions, such as the Channel or Black Sea, belonging simultaneously to powers at war, unless they should be escorted by sea-going torpedo boats, equal in strength to those of the enemy. (2) Military ports situated in those seas, or nearer than 200 or 300 miles to the enemy's shores, would be rendered useless as stations for ironclads or cruisers. For instance, supposing a war between England and France, this would be the case for Cherbourg, Plymouth, Portsmouth, and Sheerness. Cherbourg and Plymouth could then be assimilated to two military ports, whose entrances should be under the fire of each other, shot being here replaced by torpedo boats. (3) Powers not having military ports sufficiently far from the enemy's shores would be actually deprived of the use of their navy, with the exception of those vessels stationed in foreign neutral waters, unless they could force the blockade of sea-going torpedo boats with a fleet of the same kind equal in strength. The above propositions are founded on the hypothesis that one squadron of sixty to eighty sea-going torpedo boats, equal in men and cost to one ironclad, are stronger than this ironclad by daylight, and *a fortiori* at night, even when reduced to half its number, the other half having left to coal and reprovision itself. Could sea-going torpedo boats be coaled at sea by means which are yet to be found, or could they, by such means as the use of liquid fuel, have their time of steaming doubled, their importance in warfare would be immensely increased. No second-class torpedo boats could replace boats of this kind, because they cannot stand a gale, nor can they then be lowered or shipped, so that the enemy can escape the attack of small torpedo boats by taking advantage of bad weather. The question now is, are torpedo boats of such small displacement as from fifty to eighty tons really sea-going? If they are not, can they be made so? Time and experience will show, but we already know that with their steel deck and hatchway coverings they can stand very bad weather. In an appendix was given the results of the official trials made last summer at Cherbourg of the sea-going torpedo boat, No. 60, the first of a series built or building by the author for the French Government:—Length of hull at load line, 108ft. 2in.; breadth, extreme, 10ft. 10in.; diameter high-pressure cylinder, 12·60in.; diameter low-pressure cylinder, 20·48in.; stroke, 14·96in.; heating surface, fire-side, 816 square feet; grate surface, 19·3 square feet. Full speed three hours' trial. The boat was complete, with launching tubes, compressing engines, air reservoir, six 19ft. Whitehead torpedoes, 2½ tons coal, two Berthon collapsible boats, no masts. Displacement, 43 tons; mean speed, 20·62 knots; consumption of coal during the three hours, 1·58 tons; consumption of coal per hour, 0·53 tons; indicated horse-power, about 500; revolutions per minute, 328·5; boiler pressure, 132 lb.; air, 3⅜in.

In the discussion which followed several speakers remarked on the extremely low rate of consumption of fuel, and desired that further information should be supplied in regard to the engines and boilers, but more especially the latter. Mr. Samuda thought that Mons. Normand was entirely wrong in his view that a naval contest at sea could ever be carried on with cruisers and torpedo boats of from fifty to eighty tons. Such boats might be useful as scouts, but for the actual work at least 1200 or 1400 tons displacement would be required, and he questioned whether a protection of armour would not be necessary, in which case 2500 tons displacement would be nearer the mark. Admiral De Horsey confirmed Mr. Samuda's opinions, and thought that boats capable of steaming only six hours would be of no value at sea. What was wanted was a certain size of torpedo boat for harbour work, a larger size for the Channel, and larger again for the Mediterranean; but for the ocean he submitted that no torpedo boat was of any use whatever. Mr. White, however, pointed out that the boats mentioned in the paper, though only of 50 to 80 tons displacement, were practically unsinkable, while they were self-supporting under sail at sea, so that the fuel would not be used till the enemy was actually in sight, and operations about to commence. Reference was made to the recent bombardment of Alexandria, and to the fact that if the Egyptians had been provided with torpedo boats of the class mentioned in the paper, the bombardment would in all probability not have taken place, as our fleet would have found it very difficult to stay off Alexandria at all. The meeting was then adjourned, in order that the members might attend the University boat-race.

Since the construction of the Lincoln and Spalding Railway, placing the Great Eastern Railway in direct communication with the North, a very marked difference in the number of travellers staying short periods in Peterborough has been observed.

RAILWAY MATTERS.

THERE is a regular telephonic service on some of the Austrian secondary railroads, so that all of the stations can communicate with each other.

IN 1881 the gross paid-up capital invested in railways in England and Wales was £23·74 per inhabitant, while the population per mile of line has decreased between 1861 and 1881 to 2028 from 2093.

ON the railways of England and Wales there were in 1881, 2263 inhabitants per locomotive, as against 2607 in 1871, and there were 1017 inhabitants per passenger vehicle as compared with 1232 in 1861.

IN England and Wales the average railway receipts by passenger trains per inhabitant was 15s. 9½d. in 1881. The receipts per inhabitant from goods' traffic amounted to 23s. 10·4d., and the total from all sources amounted to 43s. 7½d. The expenditure per inhabitant was 22s. 7d., and net receipts 21s.

THE quantity of Bessemer steel rails produced during 1882 by the fourteen works in the United States was 1,334,349 tons. Allowing 100 tons per mile of track, which is a very liberal estimate, this output would lay 13,343 miles of railway main line. These figures do not include iron rails, rails made from imported steel blooms, or open-hearth rails.

THE terms upon which the steam tramway in Birmingham is being worked under the town council are now officially set forth by the borough surveyor, Mr. W. S. Till. The rental to be paid by the company on a twenty-one years' lease is £410 per annum for the first fourteen years, and £605 for the next seven years. They have also to pay £205 per annum for repairs of line. The engines used upon this line are those of Kitson and Wilkinson.

GREAT exertions are being made in the organisation of the National Exposition of Railway Appliances which is to be held in Chicago from the 24th May to 23rd June next. Though styled national, the exhibition is to be international, and those interested in the construction of railway rolling stock, apparatus, fittings, and permanent way, may gather all particulars and regulations relating to the exhibition from Mr. C. D. Peters, Commissioner for England, Moorfields, London.

THE total length of the railways of India open to traffic on January 1st, 1882, was 9880 miles, of which the State railways took up 3286 miles, the guaranteed lines 4640 miles, East Indian 1507 miles, and Native States 447 miles. The traffic work performed was equivalent to 2626 million passengers, and 2340 million tons of goods carried one mile. The gross earnings were: Rs. 14,32,30,801; the working expenses, Rs. 7,07,12,465; and the net profits, Rs. 7,25,18,336, or an average return of 5·38 per cent. on the capital cost of open line.

SOME of the French papers, especially the *Echo Industriel*, have condemned the action of the French Minister of Public Works with regard to the Westinghouse brake. But the *Echo* makes the following remarks:—"It is an absolute rule in the French companies never to adopt any system that is in use on a neighbouring line. If the rule is sometimes violated, some modification in the details of the object is introduced, so as to have a special type. The same system was to be carried out with brakes. In the east, to gain time, experiments continued to be made with the electric brake of M. Achard—a system that during twenty years has been transformed in every way, but never adopted, on account of the capricious principle of its motor. At Lyons the Westinghouse was adopted on the Montargis line. The attempt made by the minister in favour of the Wenger brake is hardly justified by the success of that brake."

IN an analysis of the statistics of the passenger traffic of the United Kingdom the *Railway News* says:—"Notwithstanding the enormous increase in numbers and receipts from the third-class traveller, the additional business cannot be regarded without some feelings of apprehension, because, tested by the gross passenger receipts per train mile—exclusive of revenue from season tickets—there is a falling off in the average take per mile run. This, of course, is resultant also, to some extent, upon the diminished receipts from the higher-class customers." Yet it may be remarked that the railway companies continue to devote most of their improvement energy to super-excellence of the first-class carriages. Some railways—as, for instance, the South-Eastern—have carriages which may repel any first-class passenger, but some of our railway companies are expending money in first-class carriages as though people were to live in them for a week at a stretch.

A COMPANY has been formed to construct a railway ten miles in length, from Wareham to Swanage, a watering-place at present in charming unrailwayed simplicity, below the Purbeck Hills, on the Dorsetshire coast. The share capital is £90,000, divided into 9000 shares of £10 each, with the usual borrowing powers. The London and South-Western Railway Company has undertaken the perpetual working and maintenance of the projected line, upon terms which secure to the shareholders of the Swanage Company a fixed dividend at the rate of 4 per cent. from the opening of the line for traffic, and by this agreement an option is given to the South-Western Company to purchase the railway upon the terms of exchanging the Swanage Railway shares for equal amounts of London and South-Western Railway Four per Cent. Preference Stock, or otherwise of redeeming those shares at the rate of £105 in money for each £100 in shares. A contract for the construction of the works has been entered into with Messrs. Currey and Reeve, of Westminster.

ABOUT a quarter past six o'clock on Monday evening a severe collision occurred near the Eglinton-street station of the Caledonian Railway in Glasgow, resulting in the death of four persons, and the injury of between twenty and thirty others. The train from Edinburgh had reached the Eglinton-street station and had again started on its way. At 6.15 a train for Busby and East Kilbride had been despatched from the central station, and just as the Edinburgh train emerged from the Eglinton-street station the former approached from Bridge-street. About this point the Busby line branches off from the main line, but to reach it the up line has to be crossed, and the Busby train was taking the crossing when the Edinburgh train came up, and the two engines came into collision. The engine of the Edinburgh train was overthrown and completely destroyed. The first third-class carriage of the Busby train was telescoped into and half through the carriage following it, which in turn was telescoped through the compartment of a first-class carriage behind it.

AN American paper says: The Reading Railroad Company has been testing an ingenious device for lighting the platforms and steps of railroad cars at night, and also station platforms in the vicinity of the car steps. The object of the device is obtained by means of a lantern placed under the steps of the car. The rise of each step is provided with a window of thick plate glass, through which the light illuminates the steps. In the back of the lantern is set a door which has a bull's-eye of suitably coloured glass, through which the light also shines, and may serve as a substitute for the danger and other signals usually placed upon the platform or railing of the rear car. The lamp inside the lantern is an ordinary double-wick burner, and for the purposes of illumination on the trial trips mineral sperm oil was used. The lamp appears to have withstood the shocks of coupling and the jars incident to the application of air brakes to the train, going through tunnels and passing moving trains without a noticeable flickering of the flame from excessive drafts, or a dislocation of any part of the lamp from shocks. It not only lit up the steps and a space of 5ft. to 6ft. on either side, but also the ground beneath and around them, thereby enabling passengers to see both the steps and the platform when the train was drawn up at a station. Apart from guarding against accidents and consequent risk of life, other advantages are claimed.

NOTES AND MEMORANDA.

AN ampère is very nearly the current required to maintain an eighteen-candle incandescent lamp.

IN Scotland there is one locomotive to every 2268 inhabitants, and one passenger carriage to 1019 inhabitants.

IN 1882 the number of persons of all grades employed on the railways of Saxony was 23,828, more than one-third of whom, or 8375, were officers.

M. NORDENSKIOLD maintains that the aurora is a permanent phenomenon in polar regions, being always seen when the sun is below the horizon and when the moon is invisible.

AN American paper says:—"English milling engineers are introducing square rope belts, which are said to be very suitable for transferring power. They are made in strips with 'step' joints, screwed together; the sides of the rope leaving the pulley groove without loss of power. It is stated that a 1½in. rope, at 4000ft. a minute, has driven over 100 horse-power."

IN an improved bichromate of potash battery M. Luigi Ponci uses a liquid thus made:—One kilogramme of bichromate is crushed and dissolved in 4 litres of boiling water, and to this 2 litres of chlorhydric acid is added. A liquid is thus obtained containing choride of potassium and bichromate of potash, which prevents the formation of crystals in the battery.

NATURAL oil, though possessing several advantages as a lubricant over vegetable or mineral oils, has the disadvantage of wanting the necessary viscosity and solidity to resist great pressures. M. Boulfroy has remedied this defect by concentrating natural oil in a special apparatus until it acquires a density of from 0·91 to 0·912. On continuing the process of concentration, a mineral tallow is obtained, which takes the place of animal tallow with advantage.

M. DOMOJIROFF continues to publish in the *Izvestia* of the Russian Geographical Society his anemometric observations on board the clipper Djighit. In June, 1881, during the cruise from the Zond Strait to the Seychelles Islands, he met mostly with south-east winds, the velocity of which varied from 3 to 7·5 metres per second, with one exception, on June 9th, when it reached 15 metres. On the cruise from the Seychelles to Aden, from June 25th to 30th, the wind was mostly south-west, and varied from 5 to 12·7, reaching 14·3 metres per second on June 29th.

M. DE MOLINARI calculates that the municipal expenditure of Paris equals that of London, although it has not two-thirds of the population. The most expensive capital on the Continent from a ratepayer's point of view is Munich. But after Mnnich comes Paris, with an annual expenditure of £4 per head of its population. The expenditure of London, including loans, is about £2 16s. per head. Both London and Paris spend £10,000,000 on their local government. Berlin is much more economical, the rate per head in the Prussian capital being only £1 17s. 6d. per annum.

ON the power required to shear hot steel blooms some figures have been given in *Stahl und Eisen* by Mr. R. Lauenstein. The shears with which the experiments were made are driven by a 10 by 16 horizontal engine geared one to four and a-half, the stroke of the shears being 9in., and the dimensions of the bloom 6⅜in. square. When the engine is running at a speed of 45 revolutions the power is just sufficient to cut the blooms, the speed of the fly-wheel being sensibly affected. When the blooms were not quite hot enough, the engine stopped without cutting entirely through the whole bloom. This, therefore, proved to be the minimum limit of speed. From this Mr. Lauenstein calculates that the entire pressure upon the cutting tool of the shears was 125,120 lb. or 2746 lb. per square inch of the bloom to be cut.

DR. JOULE has been experimenting, with a view to counteracting the bad effects produced by the sulphuric acid, which the combustion of ordinary illuminating gas produces in sufficient quantities to destroy the binding of books, and to tarnishing the lettering on their backs, besides, of course, vitiating the atmosphere so much that the health of the person breathing it is injured. He suspended two plates of finely perforated zinc, one 3in. and the other 12in. above the burner. At the end of three months the lower plate showed an accumulation of the ordinary brownish-black deposit, and a furring of sulphate of zinc, but the upper plate was only slightly affected. "The inference," *Knowledge* says, "from this examination is that a single plate of perforated zinc, about a foot square, placed over a gas jet is sufficient to retain most of the noxious emanations." Such a thing would be a nice-looking ornament, and it might be suggested that the difficulty could also be overcome by using tallow candles or, perhaps, an electric light.

WRITING on iron in brewery waters, the *Brewers' Guardian* refers to a sample of water used for mashing, which was remarkable for the quantity of iron it contained. "When first drawn from the well it was very bright and free from colour, but on standing only for a few hours it became quite cloudy and yellow, and on boiling deposited an abundant ochrey precipitate. On determining the amount of iron in the water we found it amounted to as much as 1·76 grain of ferrous oxide per gallon, equal to 2·8 grains of carbonate of iron—the form in which it probably existed in the water. We may mention that this water is used for brewing, and gives very good results; but the whole of the iron is rendered insoluble by boiling before the liquor is run into the mash-tun. We consider, however, it is a dangerous water for brewing with, for should any of the iron escape separation it might produce very disastrous results, especially as regards the colour of pale ales. There is a very simple test for the presence of iron in water, which is very easy of application. The water to be tested must first be acidulated with a few drops of nitric acid and gently boiled, and then a little solution of potassium sulphocyanide added. If the slightest trace of iron be present, a distinct red colour will at once appear."

AT a recent meeting of the Chemical Society a paper was contributed, entitled "Contribution to the Chemistry of 'Fairy Rings,'" by Sir J. B. Lawes, J. H. Gilbert, and R. Warrington, which, though not an engineering matter is one of much interest. The circles of dark green grass which frequently occur on pasture land, and which have been long known by the name of "Fairy Ring," have attracted much attention from botanists and vegetable physiologists. Professor Way in 1846 explained this phenomenon as follows:—"A fungus is developed on a single spot of ground, sheds its seeds and dies. On the spot where it grows it leaves a valuable manuring of phosphoric acid and alkalies, &c., the ground then becomes occupied by a vigorous crop of grass, rising like a phœnix on the ashes of its predecessor; the grass crop is then removed and with it the greater part of the inorganic materials the fungus had collected." Professor Way therefore attributed the effect chiefly to the inorganic elements. Experiments were made on the subject at Rothamsted, and in 1851—"Jour. R. Agr. Soc.," vol. xii., 32—it was stated that the manuring action was due to the nitrogen collected by the fungus rather than to the ash constituents. In 1874 an attempt was made to obtain direct experimental data on the subject. Samples of soil were taken from the inside of a fairy ring, from the ring, and outside. The quantity of organic carbon and nitrogen was carefully estimated, the mean results obtained were—nitrogen within the ring, 0·247 per cent.; on the ring, 0·266 per cent.; outside the ring, 0·281 per cent. Carbon within, 2·78 per cent.; on the ring, 2·99 per cent.; outside, 3·30 per cent. The percentage of nitrogen and carbon is, therefore, highest in the soil outside the ring, and lowest within the ring, whilst the quantities found in the soil from the ring have an intermediate value; it is obvious, therefore, that the growth of the fungus and the subsequent increased growth and removal of the associated herbage is accompanied by a considerable reduction in the amount of the organic carbon and nitrogen in the soil, and that fungi have taken up organic carbon and nitrogen from the soil, which was not available to the previously established vegetation.

MISCELLANEA.

OLD boiler tubes are heated and re-drawn in the United States to form new tubes of smaller diameter.

MR. BENJAMIN WILLANS, now engaged at the Carlinghow Ironworks, has been appointed manager of the blast furnaces of the Barrow Hematite Iron and Steel Company.

A NEW ratchet brace is made by Brener, Schumacher, and Co., in which the pawl acts on two ratchet wheels, one for rotating the drill as usual, and the other for giving the feed more uniformly than can be done by the screw.

THE autumnal congress of the Sanitary Institute of Great Britain will be held this year in Glasgow from September 25th to 29th. The exhibition of sanitary apparatus and domestic appliances in connection with the congress will remain open until October 20th.

SHIPBUILDING trade on the Clyde is on the increase, and the returns for February show a great extension. The output from the stocks in the month indicated was 33,202 tons, against 30,304 tons in the previous year, 21,754 tons in 1881, and 15,874 tons in 1880.

THE Colchester Corporation has made up its mind that electric lighting of streets will be a permanent institution, and is providing a permanent channel along the street pavement curbs, constructed of bricks in cement mortar, for the reception of the electric conductors.

M. MAUSER has succeeded in sending a telephonic message to 100 listeners at the same time, at a distance of 250 kilometres—155 miles—namely, from Paris to Nancy. This he is said to effect by the use of stronger currents than usual, but this must involve special construction of the telephone.

M. CHEVREUL has probably enjoyed a longer working period than any other great scientific worker. About a month ago he communicated a paper to the Academie des Sciences, at the close of which he remarked: "The observation is not a new one to me; I had the honour to mention it here at the meeting on the 10th May, 1812."

FOR some few years there have been various schemes proposed for the supply of water to Wellington, Somerset, but beyond this nothing definite has been done. The Local Board, however, evidently considering the present condition of things unsatisfactory, have decided to obtain further assistance, for which purpose Mr. E. Pritchard, C.E., of Westminster, has been instructed to examine the district, and to report upon the schemes already submitted.

THE *Bulletin of the American Iron and Steel Association* is responsible for the following statement:—"We have received a communication from Sir Titus Salt, of Saltaire, England, in which he informs us that he proposes to sail for this country on the 1st of March, intending to make a personal examination into the condition of the American iron trade, with the view of erecting blast furnaces in Tennessee if the outlook is favourable. He is president of the Dayton Coal and Iron Company, of Rhea county, Tennessee."

A FIRM in Paris has patented an invention for the instantaneous formation of steam, which permits of its use at once in the cylinder of the engine. A pump sends the required quantity of liquid between two plate surfaces, which are heated, and between which there is only a capillary space. The liquid spreading in a thin layer evaporates at once, without going into the so-called spheroidal state, and this steam acts in the cylinder as fresh formed steam. The speed of the pump is regulated by the engine, the pump being connected with the shaft of the engine.

A FINE opportunity, which should not be lost, of constructing a subway for gas, water, and electric mains, is offered by the construction of the Inner Circle Completion Railway along Cannon-street. Along the whole length of this street a heading is made which is above the tunnel, and which will be filled in with earth unless the excavation is utilised for the construction of a subway. This might be done at a comparatively small expense, and thus save for ever afterwards the constantly recurring expense, and what is worse, street obstruction, by the operations of the gas, water, and electric companies.

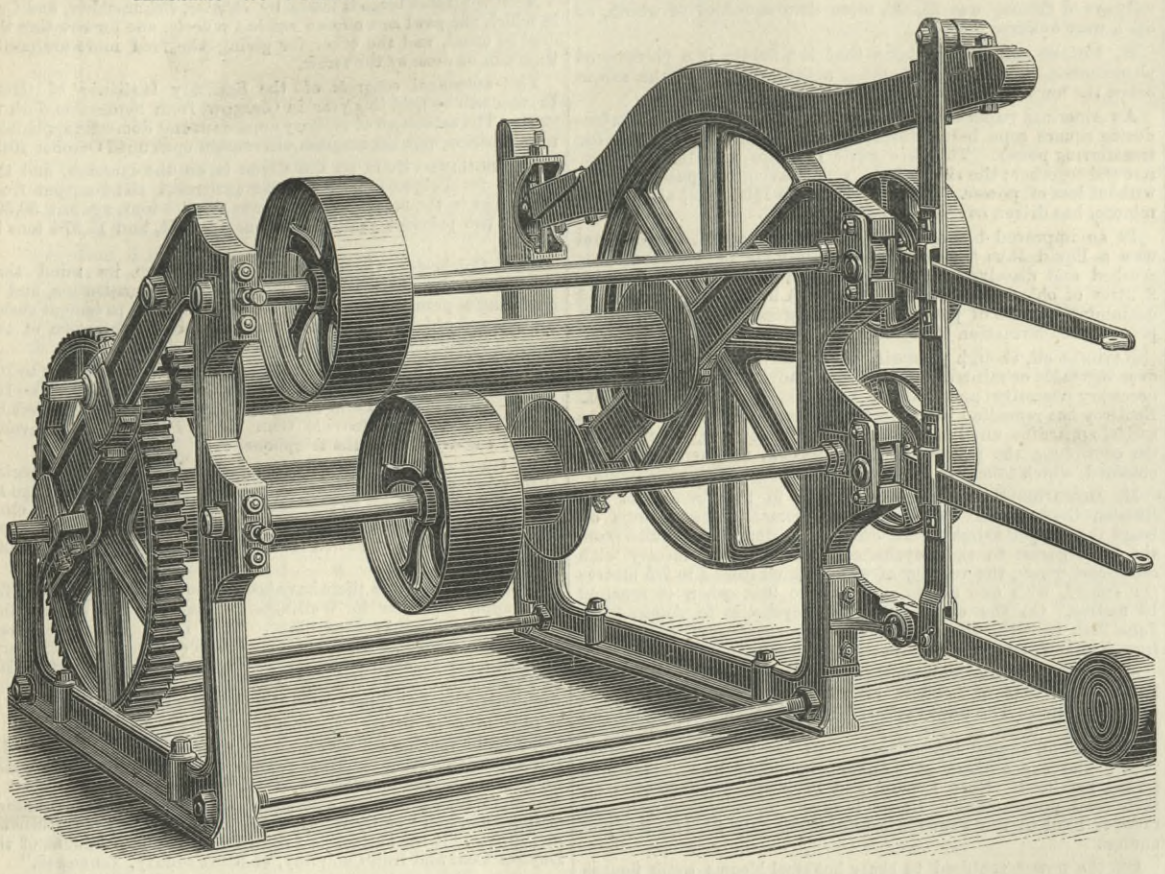
AT a meeting of the Lower Rhenish and Westphalian Engineering Association held a short time ago, Herr Gleim gave some detailed particulars as to the use of steel in the construction of bridges. He alluded to the fact that American engineers attach more importance to the extensibility of steel than to its possessing a high degree of strength. In the standard bars used for the tests—8in. in length—the former quality must represent 15 to 10 per cent. before a fracture takes place. The productions of American steel manufacturers have now, he remarked, a strength of 29½ tons to 35½ tons per square inch, while the limit of elasticity lies between 16 tons and 17 tons approximately. He further stated that from the fact of the limit of elasticity of steel being somewhat over the half of its ultimate strength, while in iron it is, he says, much less. American technical authorities claim for steel an advantage over iron in greater proportion than the difference between the relative ascertained ultimate strengths of the two substances.

THE *Galloway Gazette* records the death of Mr. Thomas Wheatley, manager of the railway running into that town. Mr. Wheatley was born at Micklefield, near Leeds, in 1821. His parents intended he should study medicine, but in early boyhood he evinced a preference for railway work, and spent his spare hours in the locomotive works. While still very young he was apprenticed for seven years on the Leeds and Selby Railway—now a part of the North-Eastern system. After completing his apprenticeship, he was employed for several years on the Midland Railway, and thereafter for seventeen years on the Manchester, Sheffield, and Lincolnshire. The latter company he left to take charge of the locomotive department of the southern district of the London and North-Western, where he remained for five years. At the end of that time he went to Scotland as locomotive superintendent of the North British Railway. This appointment he held for eight years. Mr. Wheatley leaves a widow and two sons. The elder son is assistant locomotive superintendent on the North British Railway at Burntisland, and the younger, Mr. W. T. Wheatley, has been associated with his father in the management of the Wigtownshire line since its opening.

MESSRS. ROGERS BROTHERS, of Watford, some fifteen months since brought out a new system of making shale gas, which has now had trial enough to prove it. The shale oil is introduced continuously, but in small quantity, into a double retort. At the mouth of the inner retort the oil is injected by the aid of a jet of steam, which is led from a boiler through a pipe passing through the furnace which heats the retorts and by which means the steam becomes highly superheated. The retort consists of two tubes of different diameters placed one within the other, and the formation of the gas is commenced in the inner tube. Flowing to the end of this it returns along the outer tube through the annular space between the two, and is conducted thence to a washer in which the gas is simply passed through water and is then stored in a gas-holder for use, no purification except that of washing in water being necessary. The refuse oil from the retorts is saved and is used for making the gas in the same way as the shale oil. The result is a gas which burns with a very bright and pure white light, and with which there is no difficulty in distinguishing colours. It travels well, does not condense, and is, moreover, shown by analysis to contain neither sulphuretted hydrogen nor carbonic acid, so that the air is not vitiated and rendered prejudicial to health, nor do plants, books, and pictures suffer from its use, and as the successful experience of the Pintsch Patent Lighting Company is lighting railway trains and buoys with oil gas for several years shows, the cost of the gas is very moderate, for it is stated to be somewhat less than 2s. per 1000 cubic feet. It can be manufactured at existing coal-gas works with a very slight alteration of the plant. This is being done at the Royal Paper Mills, at Wandsworth, which are owned by Messrs. M'Murray and Co.

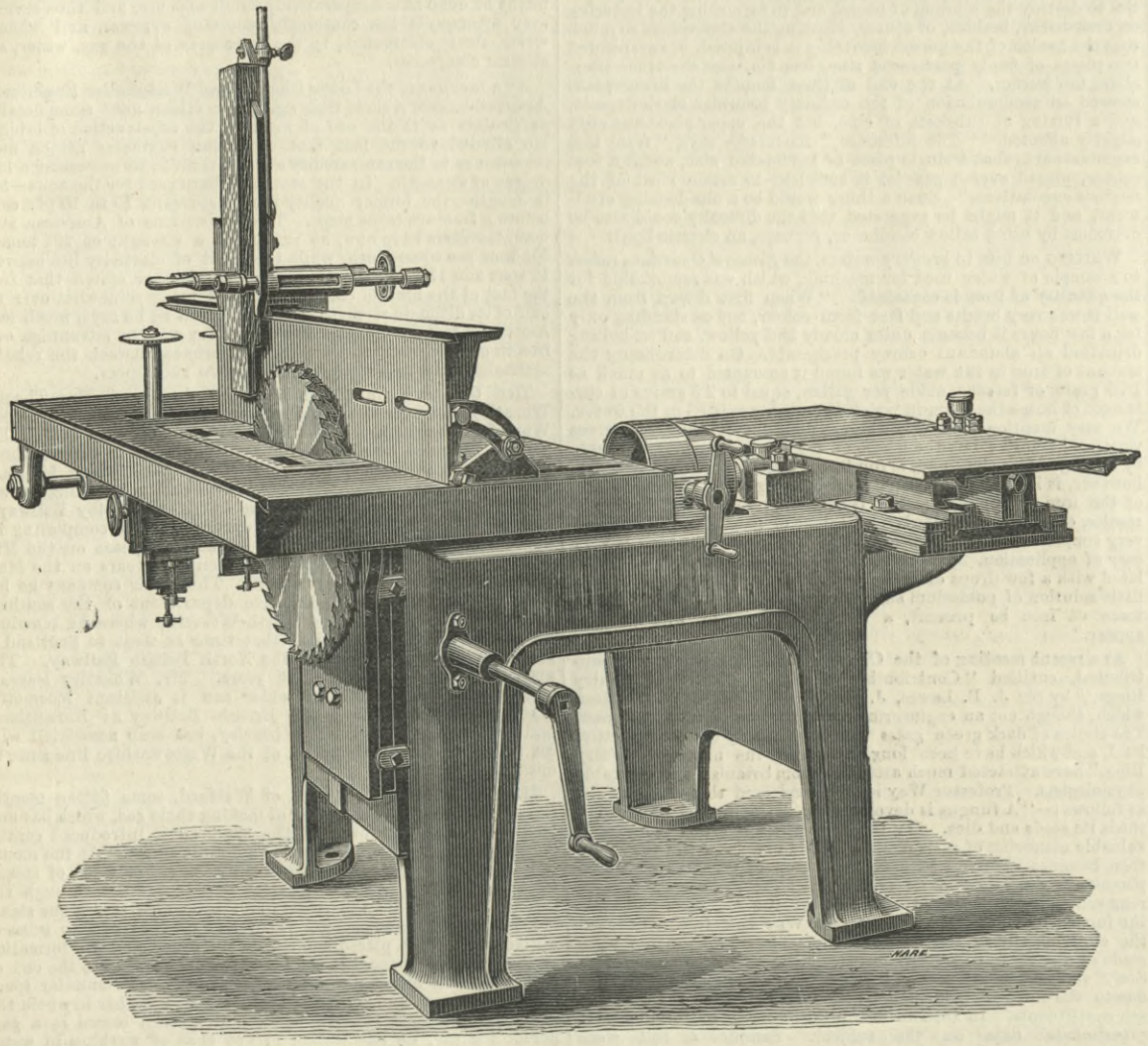
FRICTION HOIST.

MESSRS. W. JONES AND SON, BEWSEY FOUNDRY, WARRINGTON, ENGINEERS.



The above engraving represents Messrs. Wm. Jones and Son's patent high-speed friction hoist. This is one of the largest size made, and is double acting, as will be seen from the length of the barrels. The hoist has two driven shafts, with pulleys for open and cross straps. The invention consists in the application of the two small friction driving wheels by means of the two short levers and cam motion and connecting rod when in work. By moving the first lever with a rod or line the hoist will either raise or lower the load, and stop or break. The other lever will reverse, lower, and break. When heavy weights, say from 10 to 45 cwt., have to be raised, the spur wheel and pinion are brought into gear. Thus Messrs. Jones do away with a multiplicity of gears for heavy weights, long levers are secured, and greater simplicity.

WORSSAM'S GENERAL JOINER AND HAND FEED PLANER.



The machine illustrated by the accompanying engraving has been recently improved by the makers, Messrs. S. Worssam and Co., Chelsea. When it is said that the machine may be called a general joiner, its description is almost complete, but it may be noticed that the complication attending the use of automatic feed is dispensed with by using hand feed, which, for a variety of work, has great advantages, as the operator can at will feed according to the nature and quality of the material being operated upon. By means of this machine, stuff may be surfaced and trued up, ordinary and circular mouldings stuck or worked, and boring, mortising, tenoning, and grooving from ¼in. to 1½in. wide effected by it. The saw table rises and falls, and is fitted with fence, false fence, tenoning clamp as shown, and cross-cutting plate for squaring and mitreing, &c.

THE LEPANTO.

The Lepanto, launched on the 17th of this month, is sister ship to the Italia. The following description is partly abbreviated from one given in King's "War Ships," and copied from that work into Sir Thos. Brassey's work on the "British Navy." Side armour proper is dispensed with, the only plating being about 19in. of steel-faced or steel armour on the barbette tower, and horizontal armour in the form of a deck 4ft. 6in. below the water-line consisting of 3in. of steel. She carries four Armstrong breech-loading 100-ton guns in the centre barbette tower, which is of peculiar shape, and consists of a wall enclosing two turn tables placed diagonally like the turrets of the Inflexible, and so arranged as to permit of all-round fire from the guns. The hull is of steel sheathed with wood, the lines fore and aft being very fine. It is constructed with the usual double bottom 3ft. 3in. between the skins amidships, and divided into numerous separate cells. Great strength is given to the structure by the bulkheads and decks. Two longitudinal water-tight bulkheads extend for the length of 254ft. 6in. in the ship. These, together with the transverse bulkheads, divide the hull into fifty-three large compartments which are again subdivided horizontally by four water-tight decks. The first of these is the armoured deck above mentioned, which extends from stem to stern, and is incurvated at both extremities, meeting at the bow the extreme point of the ram, and thus adding material strength where most needed in the event of ramming an enemy. Immediately above this armoured or lowest deck is another 6ft. above the water line, constructed of thin iron or steel and covered with wood, The side compartments between this and the lower deck just named, which are divided into water-tight cells, are to be filled with cork, as in the Inflexible. There is, however, this important difference, that whereas the last-named ship has a long citadel in the middle of her length, protected by heavy armour and relies upon cork only at her extremities, in the Italia the cork and water-tight cells afford the only means of preserving stability when the sides are penetrated near the water-line. The third, or battery deck, is 14ft. above the water-line, and upon it are to be carried twelve guns of 6in. calibre, and 7ft. 9in. above this, and 25ft. above the water-line, is the fourth or upper deck, supporting the casemate battery, 7ft. 6in. in height, in which are to be placed the great guns in quadrantal shields at each extremity of the oval. The guns are to be fired *en barbette*, being supplied with ammunition from below the armoured deck through armour-plated cylinders or shafts of 9ft. inside diameter. In The Engineer of February 28th, 1879, is given a full description of Admiral Albini's proposal for loading these guns, with wood engravings. The gun itself, with the hydraulic gear now fitted to its carriage, was illustrated in The Engineer of January 26th last.

M. Dislère, in the *Revue Maritime*, gives further particulars as to the Italia and Lepanto. Each vessel is to be propelled by two screws of 19ft. diameter, each of them being worked by an engine of six cylinders. The power expected is 18,000-horses, giving, it is hoped, a speed of sixteen knots. The usual amount of coal is 1500 tons, but 2500 can be carried. At low speed the fires might be kept in for six months. The principal dimensions are as follows:—

Length between perpendiculars	400ft. 6in.
Breadth of beam at water-line	72ft. 9in.
Breadth of beam at upper deck	65ft. 6in.
Draught of water forward	25ft. 6in.
Draught of water aft	30ft. 6in.
Draught of water mean	28ft. 0in.
Area of immersed midship section	1770 square feet.
Displacement at load draught	1148 tons.
Length of armoured tower on fore and aft line	88ft. 6in.
Breadth of armoured tower across ship—extreme	72ft. 6in.
Length of armoured tower *per se*	96ft. 0in.
Breadth of armoured tower	52ft. 9in.
Distance of stem from armoured tower	170ft. 0in.
Thickness of sides of tower, including armour	3ft. 3in.
Thickness of iron armour on tower	1ft. 7in.
Height of centre of heavy guns above water-line	32ft. 8in.
Height of top of tower above water-line	30ft. 0in.
Height of upper deck above water-line forward	25ft. 0in.
Height of upper deck above water-line aft	23ft. 0in.
Height of upper deck above water-line amidships	22ft. 6in.
Height between upper deck and battery deck	7ft. 9in.
Height between battery and second deck	7ft. 9in.
Height between second and armoured deck	7ft. 6in.
Depth of lower deck below water-line amidships at sides	5ft. 6in
Depth of hold under lower deck	21ft. in
Extension of ram beyond forward perpendicular	6ft. 4in.
Distance of point of ram below water-line	8ft. 6in.
Motive Machinery—	
Number of engines	4
Number of cylinders	12
Number of propellers	2
Diameter of propellers	19ft. 6in.
Number of boilers	26
Number of furnaces—three to each boiler	78
Length of ship fore and aft occupied by engines, coal, and boilers	250ft. 0in.

The estimated weights of the hull, armour, &c., are approximately as follows:—

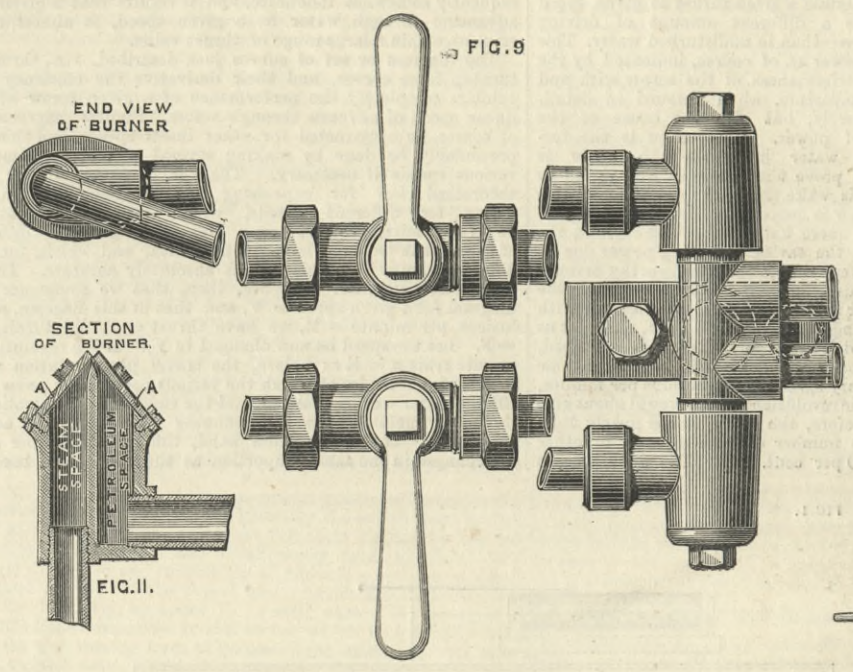
Hull	5000 tons.
Armour of armoured deck	1200
Citadel	900
Ammunition shafts	246
Chimneys	552
Total weight of armour	2898 tons.
Teak backing	114 tons.

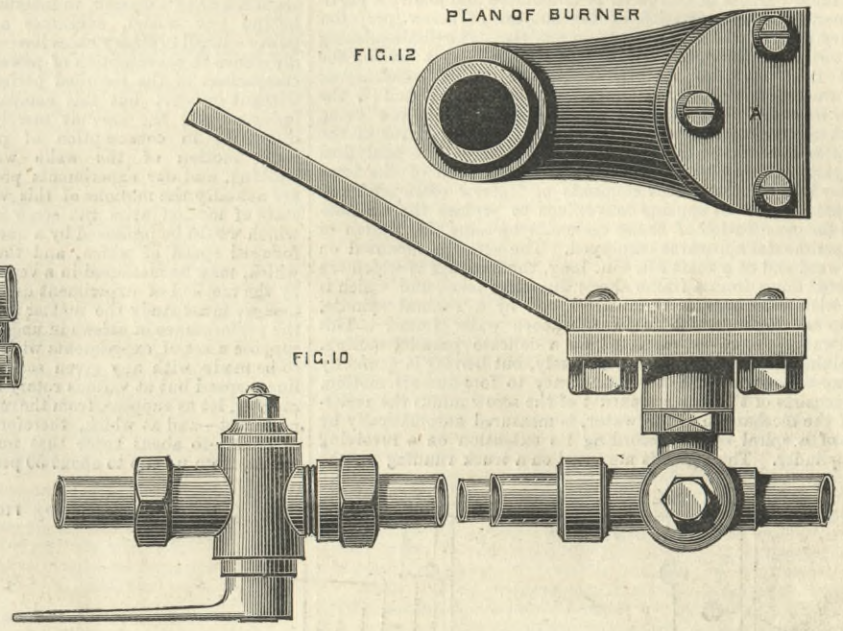
The boilers were designed and made by Messrs. Penn. The engines are two sets of the three-cylinder vertical inverted type, on each of the two screw propeller shafts, making twelve cylinders in all. Twelve of the boilers will be located in three groups aft of the engines, and fourteen in the three groups forward of the engines. The after boilers are placed sufficiently high above the keel to admit of the passage of the screw shafts under them. The engines are of the same type as have been supplied by Messrs. Penn to the Northampton and Agamemnon, the cylinders being of equal diameters, applied to cranks set at equal angles. The steam and exhaust valves are so arranged as to allow of the engines to be worked either on the compound or non-compound system, as desired.

More about the Weather Forecasts.—The Rev. A. W. Owen writes that he has received many letters in answer to his, from which he gathers, on the whole, that the forecasts are of no practical value, and that very few people, if any, have such faith in them as to guide their actions by them, or prefer them to their barometer. The forecasts seem to be much more correct in Districts 4 and 5 than in any other. Several correspondents from these districts express themselves quite satisfied with their correctness. One observer writes that last year, in District 5, there were 131 right, 132 partially right, and 102 totally wrong, but implies that, all the same, he would rather trust his barometer. From the North and East of England his correspondents agree with those of the public prints in thinking the forecasts worse than useless. One correspondent reads them to promote a healthy action of the liver, by having a good laugh at their inconsistency with fact; and many others are astonished at the Meteorological Society continuing thus to stultify itself publicly. "I may add," one writes, "that here these prophecies are ludicrously incorrect; so much so that I would rather be guided by their opposites." Another correspondent, "Hortator," is much inclined to agree with "M.A.," from another "Parsonage," concerning the forecasts as given to the daily papers. He finds they certainly do not foretel the weather exactly, but he has always found that they give one a good idea of what it is likely to be. "This branch of science, if I may be allowed so to call it, is as yet in its infancy, and there is every reason for believing that it may some day reach still greater accuracy. Why, then, discourage efforts likely to prove so useful?" We would again urge the importance of forecasting the weather, at least as far as the very important element of rain is concerned, by observations on the rain-band, as proposed by Prof. Piazzi Smyth. We have ourselves carried out some observations, with the result that we find the forecasts as regards London, about as often right as wrong.

PETROLEUM BURNING FURNACES, SARATOFF WATERWORKS.

MR. W. GOLDEN, SARATOFF, ENGINEER.





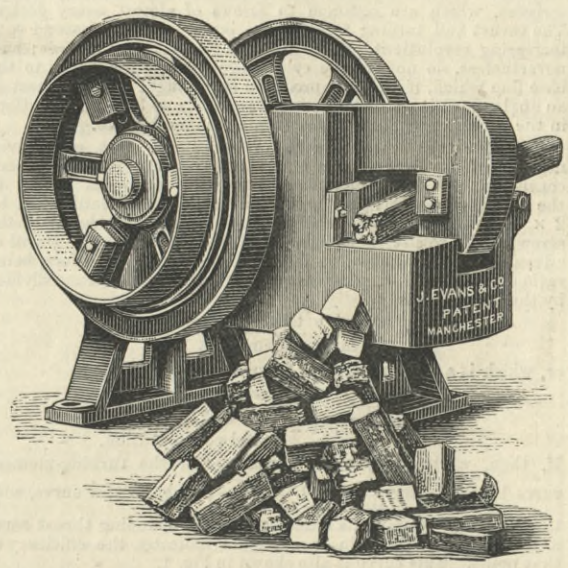
WE have so frequently been asked for information concerning the employment of liquid fuels on a practical scale that we are glad to acknowledge our indebtedness to Mr. W. Golden, C.E., of the Saratoff Waterworks, for the drawings which we give on page 228, and description of the apparatus successfully employed for several years at these waterworks. The apparatus is similar to that employed in the steamboats on the Danube and Volga. The material burnt is not petroleum, but that which remains after the kerosine has been extracted by distillation. It is called by a Russian word signifying "that which remains," which is translated as refuse of petroleum. It is the product from which is extracted the mineral oil so largely used in the country for lubricating machinery. Mr. Golden first tried the material in 1875, but the price was too great to allow of its adoption, and it was only in 1879 that the price fell sufficiently to allow it to compete with wood as fuel. The wood fuel has increased some 50 per cent. in price, so that nearly all steamers on the Volga employ the refuse, and the demand being so great, it is now attainable at a much lower figure than it was. The quantity of petroleum and refuse brought up the Volga last year was about 11,000,000 pouds. The drawings of the boiler-house—Figs. 1 and 2—will show how simple the arrangements are. The material is carted to a well in the engine-house yard, whence it is pumped through a 2in. pipe into the small tank fixed over the boilers; from thence it descends by the copper pipe into the burner, at the mouth of which it mixes with the steam coming by the other small pipe direct from the boiler. One fireman is sufficient for two boilers, as there is little to do, except to regulate the admission of petroleum and steam, so as to insure complete combustion. With the most ordinary care there is never any smoke from the chimney. The engines at the Saratoff Company's waterworks are worked with 60lb. steam, and stand always eight to ten hours during the night, and as they cannot start the burners without steam, the man in charge lights the burner when the pressure gets down to 15 lb., and works till there is a pressure of 30 lb.; so that in the morning they have a 15 lb. to 20lb. pressure to start the boiler. This costs about two pouds of petroleum, and takes about a quarter of an hour. With this pressure to commence with they obtain a full head of steam in about twenty minutes in the morning. The boilers being tubular, it has been found necessary to protect the tube plates by raising the bridges and lining them with fire-bricks to protect the tubes from the direct action of the flame jet; also to keep the burner a little out of the horizontal, to throw the jet against the lower part of the bridge. But this applies only to burners—shown at Figs. 3, 4, 5, 6, and 7, and at Figs. 11 and 12—which throw a long, straight jet, while the burner—Figs. 13 to 17—owing to the shape of its mouthpiece, disseminates the flame all round the furnace, and does not destroy the bridge lining in double the time taken by the others. The bridge linings with the first of these burners require replacing about every four months. A careful survey of the boilers, after three years' work with the refuse, did not show any special wear or injury that could have arisen from the use of the burners, and Mr. Golden thinks there is no fear of special injury to the boilers if proper care is taken with the bridges and the direction of the jet of flame. The burners—Figs. 3 to 7 and 11 to 12—make a great noise, so much that one can hardly hear a person speak near them. That shown at 13 to 17 does not cause one-half of this noise, but Mr. Golden attributes a great deal of this to the employment of high-pressure steam, which pressure is more than is absolutely necessary. As an experiment he found the burner work equally well with 30 lb. of steam, but as a matter of expense it did not pay to get steam for burning only in a spare boiler.

The drawings of the burners sufficiently explain themselves, but Mr. Golden gives the following description: In the burner—Figs. 3 to 7—the flow of the petroleum is regulated by the handles A A, which enlarge or diminish the orifice at the junction with the steam. One-eighth of an inch is sufficient for the petroleum, but it is occasionally necessary to open it ½in. or more, in case of any impurity in the petroleum, which might close the orifice. The supply of steam is regulated by the wheel B, attached to the end of the rod which opens or shuts the orifice at C. The handles D D are the stop cocks for shutting off the supply of petroleum and steam when stopping or starting. E is the cock for draining the burner, but is quite superfluous. The burner—Figs. 11 and 12—is so simple it requires no explanation; it is worked solely by the stop cocks—Fig. 9—one on each pipe. The mouthpiece cannot be regulated while at work. This can only be done by placing screws under the plate A A—Figs. 11 and 12. It is much less costly, but works very well, the only inconvenience being that it is liable to be stopped by anything in the petroleum. The burner—Figs. 13 to 17—is by far the best apparatus, it spreads the flame well, makes much less noise, and burns 2 to 3 per cent. less fuel. The petroleum enters by the pipe A and the steam by B. The petroleum passes by the inner pipe, regulated by the wheel D, while the steam enters this pipe by slots cut in the pipe at C, and mixes with the petroleum before leaving the burner, instead of meeting together at the actual point of burning. This material costs at Saratoff 25 kopeks the poud, or 15·50 roubles the English ton, at present exchange £1 11s. The only other fuel obtainable at Saratoff is fir wood. This is sold by the Peterick, containing 571 cubic feet of wood, not solid, but stacked billets. Careful experiments have shown that for steam generating, 98 to 100 pouds of oil are equal to one Peterick. This Peterick costs 42 roubles, while 100 pouds of petroleum costs 25 roubles. There is, therefore, a very great economy in the use of the petroleum. The engines are beams, with high and low-pressure cylinders, and plunger and bucket pumps. The lift to reservoirs is 335ft., with half-a-mile length of main. Steam is cut off at half stroke, and the engines lift 14,000 vedros, or 38,000 gallons per hour, employing 7½ pouds of the petroleum refuse per hour, or 270 lb. English. As the engines indicate 90-horse, this gives 3 lb. of fuel per horse-power. These results are not from experiment, but actual working of the last three years, during which Mr. Golden has found only fractional differences in the fuel employed. The quantity of fuel is calculated from the actual amount of petroleum used for all purposes during the month divided by the actual number of hours run.

Mr. Golden disclaims all credit in the invention of the burners, and says he has simply tried them, and found which worked to the best advantage for his company. The burner—Figs. 3 to 7—was, he thinks, patented by Mr. Sintz, engineer to the Mercury Company, owning steamboats on the Caspian Sea, this company being the first in that part of the world to employ this material, and as long ago as 1875. The burner—Figs. 11 and 12—was made by a mechanic in Saratoff as a cheaper form of burner, and that shown at Figs. 13 to 17 is patented, and is, he believes, the property of a Mr. Smith of Petersburg, who is agent for the firm of Nobel and Co., the largest dealers in petroleum, &c., in Russia. These gentlemen have given great attention to the burning of petroleum, and have patented several forms of improved burners quite lately.

PIG IRON BREAKING MACHINE.

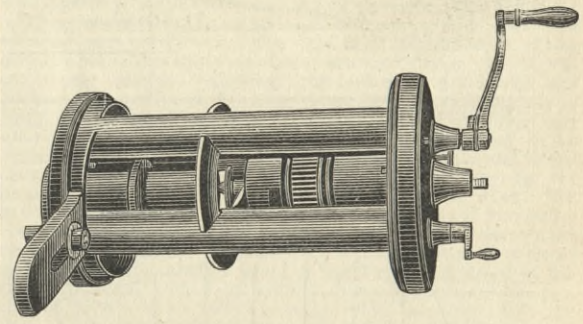
THE machine for breaking pig iron which is illustrated by the annexed engraving is made by Messrs. James Evans and Co., of Trumpet-street, Gaythorn, Manchester, and is one the want of which has long been felt by steel makers and large founders. The construction of the machine is evident from the engraving,



except in so far as it is necessary to explain that the reciprocating breaking jaw arm receives its motion from an excentric forged on the driving pulley shaft, which is of steel. It may also be remarked that as the pig may by its aid be broken into almost uniformly short pieces, the melting costs less, a saving which is added to the saving in labour.

FLANDERS' PATENT CRANK PIN MACHINE.

THIS machine for turning crank pins in position, and while the wheels are under the engine, is fastened by means of scroll and self-centreing jaws at one end to the collar of the pin, upon which there is no wear; it is then clamped in position by bolts passing through the spokes of driver. The tail stock centre is then run up, and if the pin is not bent it will exactly fit in the old centre, holding the outer end true; if it does not come exactly central, the tool is pushed down and turned around the outer collar, showing exactly all the variation; the old centre is then chipped till it does fit. The cut shows the cutter bar, and its gear driven and fed either way by the crank intermediate gearing, which gives motion to the screw. The cutter is bent



and fastened by a set screw in the extreme end of the cutter bar and is readily applied to the work and fed by a nut moved by a screw as before mentioned. We understand that it is in use on the Pennsylvania, Chicago and Grand Trunk; Quebec, Montreal, Ottawa and Occidental; Fonda, Johnstown and Gloversville; Union Pacific, and other railways.

NAVAL ENGINEER APPOINTMENTS.—The following appointments have been made at the Admiralty:—Henry Benbow, chief engineer, to the Antelope; Benjamin R. King, engineer, to the Hector, additional, for service in the Avon; and Oscar G. Egan, engineer, to the Antelope.

MR. ABEL ON EXPLOSIVES.—Professor Abel, F.R.S., chemist to the War-office, and head of the Chemical Department, Royal Arsenal, read a paper at the United Service Institution, on Friday last, March 16th, the chair being taken by Mr. Spottiswoode, F.R.S., President of the Royal Society. The matters of chief interest that were touched on were the recent attempt to do mischief by firing an explosive at a corner of the Home-office, and the new substance "blasting gelatine." With regard to the attempt at the Home-office, in the present state of the investigation, in which Mr. Abel as well as Colonel Majendie is engaged, there is little to be said beyond what is known generally, namely, that there is every mark of the explosive having been of a most violent nature, probably consisting mainly of nitro-glycerine. The new explosive "blasting gelatine," invented by Mr. Nobel, consists of nitro-glycerine taken up by collodion cotton. Mr. Abel had often wished to produce a similar compound by the union of gun-cotton and nitro-glycerine, which he considered theoretically very perfect, because in the explosion of nitro-glycerine oxygen is in excess, and in gun-cotton carbon. These might be utilised in a judicious compound of the two explosives. Mr. Abel, however, did not happen to try the precise mixture of collodion, cotton and glycerine, with which Mr. Nobel has been so successful. The substance is a soft solid, which may be used very much in the way dynamite is used, but it is much stronger, having the inactive absorbent replaced by an explosive one. It is not dangerous to handle, being only fired by detonation. Like dynamite it is very liable to freeze in cold weather.

THE NEW SALT FIELD OF NEW YORK.—A press despatch from Warsaw, N.Y., dated February 13th, states that the representative of a syndicate of English capitalists has selected that new salt field as a site for large works for the manufacture of caustic soda, to be used in soap making, bleaching, dyeing, and other purposes. For this commodity this country now relies solely upon Europe, one company in New York selling 4,000,000 dols. worth the past year. Investigation of the brine underlying Warsaw proved it to be of the exact strength and the salt of the desired purity for manufacturing this article. Land has been purchased at Warsaw, and the expectation is that the English company will soon begin the erection of extensive soda works, to give employment to perhaps 1000 men, and to have a capacity to decompose 100,000 tons of salt a week. Experienced salt manufacturers assert that the Warsaw district is certain to become the future salt field of the United States. A general salt fever seems to pervade western New York. In all towns of any size stock companies are being formed to investigate. Pifford, on the Rochester, New York, and Philadelphia; Castile, on the Erie; and Pike, on the Rochester and Pittsburg, will sink wells. In Wyoming and Greggsville salt has already been found. Leroy has two wells which produce brine of varying strength. Warsaw seems to have all the natural advantages desirable, and experienced men locate their wells here after very short examination. Prospectors, contractors, derrick builders, speculators, and capitalists are coming to town daily from all over the United States.—*Scientific American.*

A DESCRIPTION OF A METHOD OF INVESTIGATION OF SCREW PROPELLER EFFICIENCY.*

By Mr. R. E. Froude.

The main purpose of this paper is to describe and justify a particular method of investigation of the subject of screw propeller efficiency by means of experiments on models. The distinguishing characteristic of this method of investigation is that it divides the subject into two principal branches, viz.: (1) The efficiency of screws working by themselves in undisturbed water; and (2) the manner in which that efficiency is affected by the screw being brought into conjunction with the hull of a ship, in virtue of the interaction of the screw and hull. The first step in the analytical investigation of propulsive efficiency is the division of the total efficiency into the component elements of "screw efficiency" and "hull efficiency." It appears convenient to preface the explanation of the constitution of these elements by some description of the experimental apparatus employed. The screw is mounted on the forward end of a shaft 3ft. 6in. long, the bearings of which are bracketted down from a frame above the water level, and which is driven with mitre gearing at its after end by a vertical spindle, the top bearing of which is in the above water frame. This above water frame is mounted on a delicate parallel motion, constraining it vertically and transversely, but leaving it perfectly free fore-and-aft-wise; and its tendency to fore-and-aft motion, which consists of the forward thrust of the screw minus the resistance of the mechanism in the water, is measured automatically by means of a spiral spring, recording its extension on a revolving paper cylinder. The whole is mounted on a truck running on the straight and level railway, which extends throughout the length of the experimental tank 1½ft. above the water surface. The vertical spindle which drives the screw is driven by means of cord belts and a system of poly-grooved pulleys, by the truck wheels, so that by duly speeding those pulleys any desired proportion of rotary speed to linear speed of advance—or, in other words, any desired linear travel per revolution—can be rigorously assigned to the screw. Any desired linear speed can be assigned to the truck by the governor of the engine which drives it. The final cord belt which drives the spindle passes over a system of delicate levers and pulleys, by which the difference in the tension of the two parts of the belt—which is the measure of the turning moment applied to the mechanism—is automatically recorded on the same cylinder as the fore-and-aft force of the frame. When twin screws are used, each screw has its own frame, the two frames being mounted, at their proper distance apart, on the same parallel motion, the driving belt passing successively over the sheaves on the two vertical spindles, so that the diagram in that case records the sum of the net fore-and-aft forces delivered by, and the sum of the two turning moments applied to, the mechanisms of the two screws. For eliminating the resistance of the framework, &c., to its passage through the water, from the recorded fore-and-aft force, and the friction of the bearings, &c., of the mechanism, from the recorded turning moment, so as to convert these measures into true thrust delivered by, and true turning moment applied to, the screw, various expedients are adopted, which space will not admit of my describing here. In the experiments, the truck carrying the apparatus above described is joined to the somewhat similar truck running on the same railway which is used for experimenting on the resistances of models, the model being for this purpose attached beneath it. When the two trucks are joined the model may either be attached in its place or omitted, and the screw experiments accordingly made either behind model or in undisturbed water as desired; or, again, either the screw may be removed from the shaft or the trucks disconnected, so that the model also can be tried either alone or with screw working behind. The apparatus that carries the screw measures the thrust, speed, turning moment, and revolutions per minute, consequently the experiments on screw working without model in front determine the element of "screw efficiency" proper; that is to say, they show the power expended in performing a given amount of useful work by maintaining a given thrust at given speed. The experiments on resistance of model alone measure the useful work to be done. The comparison of these records with those yielded by corresponding experiments with model and screw in combination show the modifications introduced into the results by bringing the model and screw into conjunction, and these modifications constitute the "hull efficiency." Now, these modifications are two in number, viz., the effect of presence of screw upon resistance of model, and the effect of presence of model upon efficiency of screw. The former effect consists in what has been termed the "augmentation" of the resistance of the model by the action of the screw, an effect which is necessarily a loss of efficiency, the amount of this loss being directly measured by the comparison of the resistances of the model with and without screw working behind. The second mentioned effect consists in the fact that, behind the model, the screw is working in water in a certain state of motion, and that, in consequence of this motion, to maintain a given thrust at given speed behind the model, consumes a different amount of driving power—in all ordinary cases less—than in undisturbed water. This difference in consumption of power is, of course, indicated by the comparison of the recorded performances of the screw with and without model; but this comparison, when pursued in detail, indicates not the amount merely, but also the cause of the difference in consumption of power. This cause is the forward motion of the wake water in which the screw is working, and our experiments prove that, complex and varied as are actually the motions of this wake water, the net effect of this state of motion upon the screw is practically identical with that which would be produced by a mere uniform forward current, the forward speed of which, and the saving in driving power due to which, may be measured in a very simple and trustworthy manner by the method of experiment described. To show how this is the case we must study the matter in greater detail, commencing with the performance of screws in undisturbed water. First, then, let us suppose a set of experiments with the apparatus already described, to be made with any given screw without model in front, at one linear speed but at various rotary speeds or revolutions per minute, ranging, let us suppose, from the revolutions which would about give no thrust—and at which, therefore, the screw would nearly turn of itself—to about twice that number of revolutions; in other words, from no slip to about 50 per cent. slip. The apparatus, it has been stated, measures revolutions per minute, thrust, and turning moment, and the results of the experiments may therefore be represented by diagram in the manner shown in Fig. 2, where the thrust and turning moment are plotted as ordinates to an abscissa scale of revolutions per minute. We thus obtain curves of thrust and turning moment for a given screw at given speed and varying revolutions. Such curves possess the following characteristics, which are common to screws of almost every design. The thrust and turning force curves both, of course, ascend with increasing revolutions. They are slightly concave upwards; but, nevertheless, do not become even approximately tangential to the base line which, if they are produced far enough, they intersect at an angle, such intersection being necessarily at higher revolutions in the thrust curve than in the turning moment curve.

Now for the measurement of efficiency. At any given number of revolutions per minute, the energy in foot-pounds consumed per revolution in driving the screw is equal to the turning moment in foot-pounds of moment multiplied by $2 \times \pi$. The energy delivered per revolution by the thrust of the screw is the thrust in pounds multiplied by the linear travel or advance, per revolution, in feet. The efficiency, therefore, being ratio of energy delivered to energy consumed, is the former divided by the latter, namely,

$$= \frac{\text{thrust} \times \text{travel per revolution}}{\text{turning moment} \times 2\pi}$$

or, which is a more convenient form—

$$= \frac{\text{thrust}}{\text{turning moment} \times \frac{2\pi}{\text{travel per revolution.}}}$$

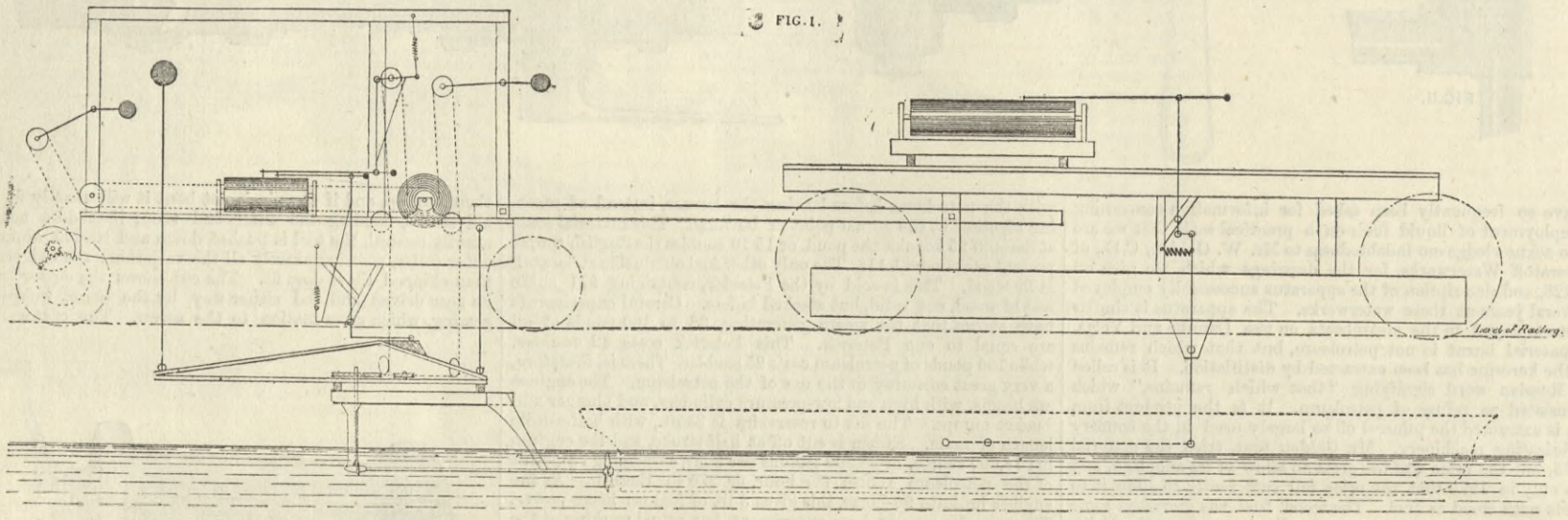
If, then, we multiply all the ordinates of the turning-moment curve by the factor $\frac{2\pi}{\text{travel per revolution}}$, we get a new curve, such that the ratio between its ordinate and corresponding thrust curve ordinate at any point in the diagram indicates the efficiency at that point. This curve is also shown in Fig. 1.

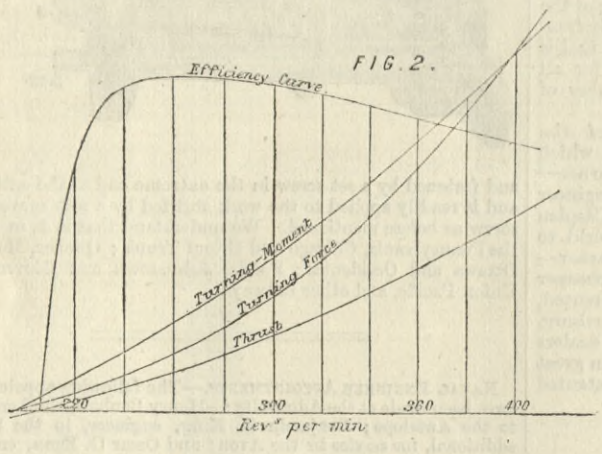
It will be seen that the effect of multiplying the turning moment by the factor $\frac{2\pi}{\text{travel per revolution}}$, is simply to convert it from absolute turning moment, or turning force measured at a unit radius of one foot, into turning force measured at a radius whose circumference is equal to the linear travel per revolution. The new curve, therefore, represents the turning force measured in this manner. For convenience we may term it the curve of "turning force," as opposed to "turning moment." The "thrust," then, divided by the "turning force"—or turning moment $\times \frac{2\pi}{\text{travel per revolution}}$ — measures the efficiency; the ratio of the ordinates of the thrust and turning force curves may accordingly be measured at successive points in the diagram, and an efficiency curve thereby constructed. Again, see Fig. 1.

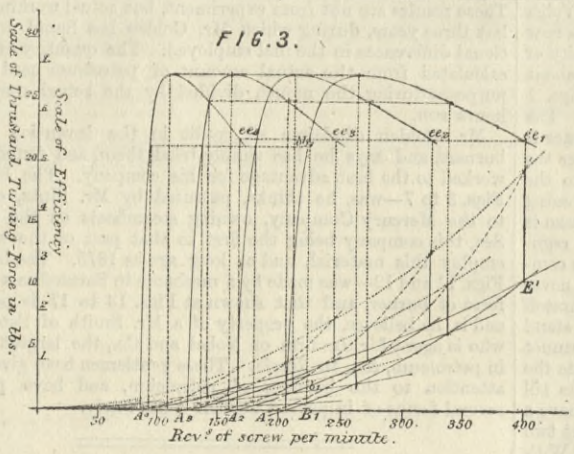
The prominent characteristics of this efficiency curve are common to almost all screws. Its ordinate is necessarily zero at the point where the thrust is zero, and, like the thrust curve, it intersects the base line at an angle. It rises steeply and uniformly at first as the rotary speed increases, but rounds off and becomes gradually level at the point where maximum efficiency is obtained, whence it descends again gradually. The point of maximum efficiency is consequently somewhat indefinite, and it results that a given screw, advancing through water at a given speed, is almost equally efficient within a large range of thrust value.

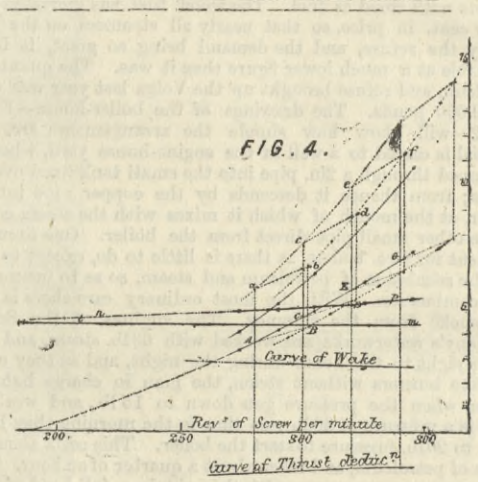
The diagram or set of curves just described, viz., thrust and turning force curves, and their derivative the efficiency curve, exhibits completely the performance of a given screw at given linear speed of advance through water. Similar diagrams may, of course, be constructed for other linear speeds, and this might presumably be done by making several sets of experiments at various speeds if necessary. There is, however, a very simple theoretical law for expressing the relation between such curves for different speeds, which experiment proves to be very fairly correct even for the greatest differences of speed that we ever have to deal with, and which, for minor differences, may be considered as absolutely accurate. This law we will now consider. Suppose, then, that we commence with a diagram for a given speed = V, and that in this diagram, at revolutions per minute = R, we have thrust = T, and turning force = F. Let the speed be now changed to V_1. If the revolutions per minute remain = R as before, the travel per revolution will be increased, the angles at which the various parts of the screw blades cut the water will be changed, and the conditions of operation will be thereby metamorphosed in a manner which will defy accurate calculation. If, on the other hand, the revolutions per minute are changed in the same proportion as the speed, and become R_1 $\left(= R\frac{V_1}{V}\right)$, the travel per revolution remains unchanged, so does the slip ratio, and so also do the angles at which all parts of the blades cut the water. The stream-line motions involved will consequently be unchanged in arrangement, the speeds at all points in the stream-line systems being simply changed in the same ratio as the linear speed of advance. The directions and relative proportions of all forces acting on all parts of the screw blades, whether due to friction or pressure, will therefore remain unchanged, and their magnitude will be simply proportional to the square of the linear speed of advance. The items or component forces being alike changed in this ratio, the totals or resultant forces of thrust and turning moment will be changed in the same ratio, and so will also the "turning force," since this is turning moment $\times \frac{2\pi}{\text{travel per revolution.}}$ and the travel per revolution remains the same. In changing speed V into V_1, then, the original revolutions are multiplied by $\frac{V_1}{V}$, and the original thrust and turning force are alike multiplied by $\left(\frac{V_1}{V}\right)^2$. The efficiency, therefore, which is thrust divided by turning force, remains unchanged.

To illustrate as completely as possible the relations which these propositions establish between the diagrams severally expressing the performance of a given screw at different speeds, I show in Fig. 3 a series of thrust, turning force, and efficiency curves for a given screw at four different speeds. A_1 E_1, A_2 &c., are the several thrust curves, the corresponding turning moment curves are shown by somewhat similar dotted lines, and ee_1, &c., the corresponding efficiency curves. It will be seen that the four curves of each kind must be reproductions of one another on different scales, the zero of ordinate and abscissæ being common to all, the abscissæ scales of all being proportional to the speed, the ordinate scales of the thrust and turning force curves being proportional to the square of the speed, and that of the efficiency curves being constant. It also follows that if any points, as B_1, be taken in the thrust curve, and corresponding points b_1 in the corresponding turning force curve, at certain revolutions per minute; and if points at the "corresponding" revolutions to these—that is to say, at revolutions bearing the same ratio to the speed and giving the same slip ratio—be taken in the thrust and turning force curves of other speeds; and if the successive points of equal slip ratio be joined by curves, these curves will be parabolas, originating at the zero of revolutions. Also, if the corresponding points be taken in the efficiency curves, the successive points, bb_1, &c., will fall in a straight and level line. I should here point out that the above train of reasoning also establishes a theoretical law for expressing the relation between the performances of similar screws of different absolute size; namely, that at the "corresponding" revolutions, *i.e.*, the revolutions of identical slip-ratio, the efficiency is constant, the thrusts and turning forces being, for given linear speed, proportional to the squares of the dimensions. Supposing the speed of the model through the surrounding water









* Read at the Twenty-fourth Session of the Institution of Naval Architects, 16th March, 1883.

to be V, and its speed through the wake water in which the screw works to be V_1—so that the forward speed of the wake water is $V-V_1$—it is clear that the screw will be circumstanced precisely as when working in undisturbed water at speed V_1. If working at the same revolutions, the thrust will be the same, and so also will the turning *moment*. The linear travel or advance per revolution will, however, be greater in the case of the screw behind the model in proportion as V is greater than V_1, and the "turning *force*"—as measured for efficiency—will therefore be less in the same ratio. The thrust being the same, the efficiency of the screw working behind model will accordingly be greater than in still water, in proportion as V is greater than V_1, and if we call the efficiency in the still water = E, the efficiency behind the model will be $E \times \frac{V}{V_1}$.

The measure of the gain in efficiency due to wake is, then, the proportion between V and V_1, and at this speed V_1 in undisturbed water, the thrust of the screw is the same for the same revolutions as behind model at speed V. Now from what we have seen above—Fig. 3—concerning the performance of screws in still water, it is obvious that a given thrust with given revolutions in still water—a given single "spot," in fact, on the diagram shown in Fig. 3—is in a given screw consistent with but one linear speed and no other. If, therefore, we find that with model speed V we get a certain thrust for certain revolutions, and that we get the same thrust for the same revolutions in still water at speed V_1, we know that the speed of wake must be $V-V_1$, and that the efficiency of the screw when working behind the model must be its efficiency in the still water experiment, multiplied by $\frac{V}{V_1}$. The criterion of the speed of the wake, therefore, and of the consequent gain in efficiency, is the comparison of the thrust curves given by the experiments behind model and in still water. What are the facts yielded by the experiments behind model and in still water, taken together? We have (1) the thrust and revolutions of the screw working at speed V behind model; (2) the thrust and revolutions, each identical with the foregoing, at speed V_1 in still water; (3) the turning moment at the same speed in still water, which we generally state in the form of turning force as measured for efficiency. We then infer, on the assumption of a uniform wake, that the turning moment behind the model will be the same as in still water, and that the turning force will therefore be less in the ratio in which V_1 is less than V. But we also have, recorded by the experiment (4), the actual turning moment behind model, which in the same manner we convert into turning force; and the degree of agreement between this actual turning moment or turning force—it does not matter in which form the comparison is made—with that calculated from the experiments in still water, is a criterion of the sufficiency of the assumption that the disturbance of water which we term the "wake" amounts in effect to a mere uniform forward current. In order, in the case of any individual model and screw, to determine the "hull efficiency," or, in other words, the propulsive efficiency in so far as it is affected by the characteristics of the hull, and is not determinable by experiments in still water, the only records we have to make use of are (1) the resistances of model with and without screw, which give the loss by "augmentation" of resistance, and (2) the thrust of the screw with and without model, which give the gain by "wake." Records of turning force behind model are not required at all, and although in most of the experiments which I have made such records have been taken for the purpose of testing the validity of the hypothesis on which the measure of the "wake" gain is based, they serve no other purpose. The resistance and thrust records above mentioned evaluate the two elements of "augmentation" and "wake," which together constitute the "hull efficiency," and whatever further information is required to determine the total propulsive efficiency can be obtained from experiments with screws alone. The experimental investigation of the whole subject of propulsive efficiency accordingly divides itself into two sections: (1) Experiments on screw thrust and model resistance to determine "hull efficiency;" and (2) experiments on thrust and turning force of screws in still water, to determine "screw efficiency." Fig. 4 is a typical diagram showing the results of a single set of such experiments, viz., the complete set necessary for ascertaining the "augmentation" and "wake" values for a single model with its screw, at one speed which we will call V. The speed of the experiment with model and screw equals 297ft. per minute; the speed of the experiment with screw without model equals 250ft. per minute. A C E G, thrust of screw with model; *a c e g*, turning-force of screw with model; B D F H, thrust of screw without model; *b d f h*, turning-force of screw without model; *l m*, resistance of model without screw; *n p*, resistance of model with screw; o o o, results of individual experiments with model and screw; + +, results of individual experiments with screw without model, or model without screw. The set comprises the three essential kinds of experiment, viz., (1) Experiments on model without screw; (2) experiments on model and screw together; (3) experiments on screw alone. The last two kinds of experiments, namely, those made with screw, each comprise several successive experiments at different numbers of revolutions per minute. The recorded forces in these are plotted as ordinates to a base of revolutions, and the "spots" so given are joined by curves. We thus get three curves: (1) The curve of thrust of screw behind model; (2) the curve of corresponding—augmented—resistance of model; (3) the curve of thrust of screw in undisturbed water. The ordinate representing the resistance of the model without screw may be indicated by a level line drawn across the diagram.

Now, when experiments such as we are here considering are being made, it is generally the case that the curve of resistance of model without screw has already been ascertained; not unfrequently, also, the thrust curve of the screw in still water, at a speed sufficiently near to V_1, has already been ascertained for other purposes. It may be thought that in such cases the special experiments on model without screw and screw without model, to compare with those with model and screw together, might be dispensed with. But it must be remembered that in the experiments we are now considering we are concerned with not the absolute values of the resistance of model and thrust of screw, so much as with the differences between those values when model and screw are separate and when in combination; therefore, in view of the slight gradual or occasional changes in resistance of model and in thrust curve of screw which are found to arise—mainly, as I imagine, from variations in surface-resisting quality—it is desirable to make all the experiments concerned in the measurement of the "augmentation" and "wake" in any given case, within a short time of each other. It is, therefore, generally necessary to take special experiment on model without screw, and screw without model, to compare with each set on model and screw in combination.

Let us now examine the character of the curves which exhibit the results of these experiments. We will first deal with the results of model and screw in combination, which consist of a thrust curve of screw, and curve of corresponding resistance of model. The point to be noticed here is that as the thrust increases, so also does the augmented resistance, thus showing that the augmentation is not due to the mere presence of the screw in its position, but to the amount of thrust produced, the suction exerted in front of it, which causes the augmentation, being the essential counterpart of the sternward ejectment of water, which produces the thrust. The augmentation is therefore a function of the thrust, and we ought to regard it as essentially a percentage drawback or discount from the generated thrust, whereby the thrust available for overcoming the natural hull resistance is less than the thrust actually generated. It is therefore better to term it "thrust deduction" than "resistance augmentation," and the term "thrust deduction" has for this reason superseded "augmentation" in the notation used in the experimental establishment at Torquay. I shall therefore use the term "thrust deduction" in the remainder of this paper. The "thrust deduction," then stated as a factor of the total efficiency, is the discounted thrust—or thrust minus augmentation of resistance—divided by the total thrust; or, stated as we more commonly state it, as a percentage, it is the percentage of the total thrust whereby the discounted thrust is less than the total, or, in other words, the percentage whereby the value of the thrust-deduction factor is less than unity. The absolute amount of augmentation or thrust deduction is not, however, exactly proportional to the thrust. It may be more truly described as consisting of two terms, one proportional to the thrust, and the other a constant, this constant being the value of a certain small amount of thrust deduction which is found to exist even when the thrust is zero, as indicated by the dotted lines in Fig. 4. The explanation of this phenomenon lies apparently in the fact that the forward speed of the wake is not uniform throughout the sectional area operated on by the screw, whence it arises that when the slip of the screw in reference to the mean speed of the wake is zero, this mean slip is the resultant of a positive slip in some parts and a negative slip in others, so that in some parts the screw is creating thrust and making suction in front of it, and in others is conversely backing water and making pressure in front of it. If these regions of diminished and increased pressure in front of the screw were equally close to the surface of the hull, we should expect the consequent resisting and assisting forces on the hull to balance one another, and so produce no net effect. We know, however, that it is the part of the wake nearest the surface of the hull that must have the greatest forward speed, consequently the regions of positive slip, and diminished pressure in front of screw, must be nearer the surface of the hull than the regions of negative slip and increased pressure, so that the former must operate more effectively to increase resistance than the latter to diminish it.

We now come to the consideration of the two thrust curves of the screw with and without the model. These will more or less closely coincide according to how closely the actual speed of the experiments without model, and which we will call U, approximates to the speed V_1, or speed of model minus speed of wake. If the two curves coincide, then $U = V_1$, and the wake factor of efficiency $= \frac{V}{U}$. If they do not so coincide, we have to determine the value of V_1 by calculation from the known value of U, and this is done by the following construction, which is based on the propositions concerning the relation between the thrust curves of a given screw at different speeds. In the thrust curve behind model—again see Fig. 4—take a point A, corresponding to revolutions per minute = R, say. Through this point describe a parabola originating at the zero of revolutions—*i.e.*, such that the ordinates vary as the square of the revolutions—continuing it so as to cut the thrust curve of screw without model at the point B corresponding to revolutions $= R_1$, say. Then $V_1 = U \frac{R}{R_1}$; the wake factor consequently $= \frac{V R_1}{U R}$ This is the "wake" value for the revolutions corresponding to the point A; and in the same manner the wake value for revolutions corresponding to any number of other points C, E, G, &c., may be found by describing the parabolas CD, EF, GH, &c. Now the wake is a creation of the model, not of the screw; there is, therefore, no *primâ facie* reason why the wake should be different for different revolutions of the screw, and we should accordingly expect to find that the thrust curves with and without model coincide throughout if at all, and if not at all, that the revolutions corresponding to the points D, F, H, &c., bear severally the same proportions to the revolutions for points C, E, G, &c., as the revolutions for B do to the revolutions for A. As a fact, however, this is not always the case; the thrust curve behind model, in the largest class of conditions we have subjected to trial, being somewhat less steep than that which would give the above result, thus indicating that the wake diminishes slightly with increase of thrust. In another, but a smaller, class of conditions, the difference is the other way, the wake increasing with increase of thrust. The cause of this result, like that of the variation of thrust deduction with variation of thrust, already referred to, appears to lie in the non-homogeneity of the wake. This non-homogeneity results in the fact that the mean forward speed of the portion of the wake comprised within the disc area of the screw often differs from—is generally greater though sometimes less than—the mean forward speed of the zones surrounding that disc. Now when the screw is working with slip, and exerting thrust, there can be no question that the supply of water to it demands a convergence of streams towards it from without its own disc area, and that the degree of this convergence and extent of the surrounding water effected by it must increase with increasing slip or thrust of screw. Consequently, it is evident that the extent of the wake dealt with by the screw will be dependent on the thrust, and consequently the value of its mean effective speed will increase or diminish as thrust increases, according as the speed of the surrounding zones is greater or less than that comprised within the disc area of the screw.

The diagram—Fig. 4—shows also two other curves of force record, viz., the curves of "turning force" of screw with and without model. In describing this diagram I have hitherto avoided referring to these, because, as already explained, they play no part in the measurement of hull efficiency. I have shown them in the diagram, however, because thus far these records have almost always been obtained in our experiments, for the purpose, as above stated, of testing the validity of the assumption that the effect of the actual wake upon the efficiency of the screw does not materially differ from that of the hypothetical uniform wake. An explanation of the way in which test is applied will perhaps be useful, as an additional illustration of the meaning of this assumption. Let us first suppose the speed U of the experiments without model to be exactly equal to V_1, so that the two thrust curves exactly coincide. Then if the wake were uniform, its effect would be to increase the efficiency given by the recorded performance of the screw in still water, by multiplying it by the wake factor as found from the thrust curves, or in other words, to diminish the turning force by dividing it by that factor. Hence, in so far as our assumption is correct, we should in such a case find the ratio of the ordinates of the turning force curves, as actually recorded with and without model, to be exactly equal to the wake factor. In fact, the thrusts being equal, the turning force behind model will be less than that without model, in exactly the reciprocal of the ratio in which the efficiency behind model is increased by the wake. If, however, as in this diagram, the two thrust curves do not coincide—*i.e.*, if speed U does not equal speed V—the first step is to infer from the thrust and turning-force curves without model at speed U, the turning forces corresponding, in still water at speed V_1, to the thrusts recorded behind model, which is done thus: At the revolutions for the point A in the thrust curve behind model, we know the still water efficiency for speed V_1 to be equal to that at the point B in the thrust curve without model at speed U, these being points of "corresponding" revolutions or identical slip ratio, and in the same way at the points C, E, G, &c., the efficiency will be the same as at D, F, H, &c. Consequently the still water turning forces will severally bear the same ratio to the thrusts A, C, E, G, &c., as the ordinates *b*, *d*, *f*, *h*, of the turning force curve without model do to the thrusts B, D, F, H, &c. We thus obtain the ordinates *a*, *c*, *e*, *g*, &c., forming a new curve *a c e g* of still water turning force to correspond to the thrust curve behind model, and the ratio of the ordinates of this curve to those of the actual curve of turning force behind model should, as just now pointed out, be equal to the value of the wake factor as found from the thrust curves. In this diagram, which shows the actual result of one of our sets of experiments, the agreement happens to be exact. But it is generally the case that the set of experiments with screw without model is only one of a large number of similar sets, with the same screw—and sometimes with others very similar to it—taken on different occasions to compare with experiments either behind other models or behind the same model in different positions or at different speeds. And although these various still-water experiments have generally been made at various speeds, yet by aid of the propositions before described, they can be reduced to a common speed and compared, and thus an average curve of efficiency for the screw in still water can be obtained, which is much better authenticated—in view of the occasional errors in the measure of turning force—than a curve of efficiency given by any individual set of experiments. By using the still-water efficiency given by this average curve, and multiplying by the wake and thrust-deduction factors, a more trustworthy estimate of the total efficiency can be made than by multiplying the efficiency given by the actual experiment behind model by the thrust-deduction factor only. Hence, what I have above termed the second method, thus modified, affords a better measure even of the total efficiency in any individual case than the more direct method of using the actual recorded efficiency behind model as the basis of calculation. In considering the experiments in connection with models, we are concerned solely with the "hull efficiency," viz., with the "wake" and "thrust-deduction" factors of efficiency.

There is no condition in which we can consider that the model truly represents the condition of the ship with clean surface propelling herself, and in order to put ourselves in a position to estimate the propulsive efficiency in a ship from experiments on her model, our only resource is to undertake a systematic series of experiments on the wake and thrust deduction in models, aimed at discovering the laws of the effect of variation in skin friction resistance upon amount of wake, and how far, if at all, such variation in wake affects the thrust deduction also. A large portion of the experiments upon models and screws which have been recently made at the Torquay establishment have been devoted to this object, and a report to the Admiralty upon the experiments made thus far, is in process of preparation. The work which has generally to be performed by model experiments may be thus described. A design of vessel is required, to fulfil certain novel conditions, and experiments are thereupon made with models of various alternative designs, in order to discover the best design for the purpose. The information yielded by such experiments has hitherto been practically limited to the determination of the relative resistances of such designs; we now purpose, by aid of screw experiments, to extend the information to the relative propulsive efficiencies. But the total propulsive efficiencies of these designs will depend upon the design of screw with which they are severally to be fitted; and this is a point which is generally undecided at the time when the designs are first under consideration, namely, at the time when the model experiments are most required. Even if provisionally decided, the design of screw is generally, in many important respects, open to subsequent reconsideration. Plainly, then, the model experiments should determine the propulsive efficiencies of the proposed designs, not with any particular screw, but with whatever may prove to be the most suitable screw for each; and they should also be capable of determining what that most suitable design of screw is. The process of determination of the probable propulsive efficiency of any intended design of hull will accordingly take the following form:—Supposing diameter and position of screw to be fixed by circumstances, we have only to make one set of experiments with the model with screw—any screw that we may happen to have, of the correct diameter—in the correct position; and we shall thus determine the wake and thrust deduction factors—and their product, the hull efficiency—for the proposed shape of hull, and diameter and position of screw. We have then to select, by aid of our previously obtained knowledge on the subject of screw efficiency proper, the design of screw that will give with maximum efficiency the required thrust at a linear speed equal to the intended speed of vessel minus the speed of the wake. This will be the most suitable design of screw, and the product of its still-water efficiency under these conditions, into the wake and thrust deduction factors, will give the total efficiency.

SAID I TO MYSELF.

The following lines read by Mr. J. C. Bayles at the Subscription Dinner, given by members of the American Institute of Mining Engineers at the Hotel Brunswick, Boston, February 22nd, 1883, will no doubt amuse not a few of our readers, who will not be slow to recognise their application.

WHEN I was a nascent professional man,
Said I to myself, said I,
An Institute member I'll be if I can,
Said I to myself, said I.
For membership there is an honour indeed;
To the meetings I'll go with long papers to read,
And I'll do what I can when it comes to a feed,
Said I to myself, said I.

I'll never throw dust in a stock-holder's eyes,
Said I to myself, said I;
Nor hoodwink an expert who's not overwise,
Said I to myself, said I.
If I'm working a mine and the ore "peters out,"
Or its future is somewhat a matter of doubt,
I'll tell everybody they'd better keep out,
Said I to myself, said I.

If I'm running a blast furnace, little or big,
Said I to myself, said I,
I'll not count my cinder as Bessemer pig,
Said I to myself, said I.
My worthy profession I'll never disgrace.
By claiming of phosphorus only a trace,
When analysis shows that it isn't the case,
Said I to myself, said I.

If I work as a chemist in iron and steel,
Said I to myself, said I,
I'll never deceive, by a very great deal,
Said I to myself, said I.
I won't say that silicon vainly I've sought,
That sulphur, if present, declines to be caught,
Nor put down for manganese decimal nought,
Said I to myself, said I.

If as a geologist fortune I seek,
Said I to myself, said I,
I'll try to avoid being bashful and meek,
Said I to myself, said I;
For many geologists fail of success
Because they lack courage their views to confess,
And fear to offend if their thoughts they express,
Said I to myself, said I.

If some well-endowed college of science and art,
Said I to myself, said I,
As a learned professor should give me a start,
Said I to myself, said I,
I'll try to know something of what I'm to do;
I'll read up on subjects relating thereto,
And besides teaching science, I'll study it, too,
Said I to myself, said I.

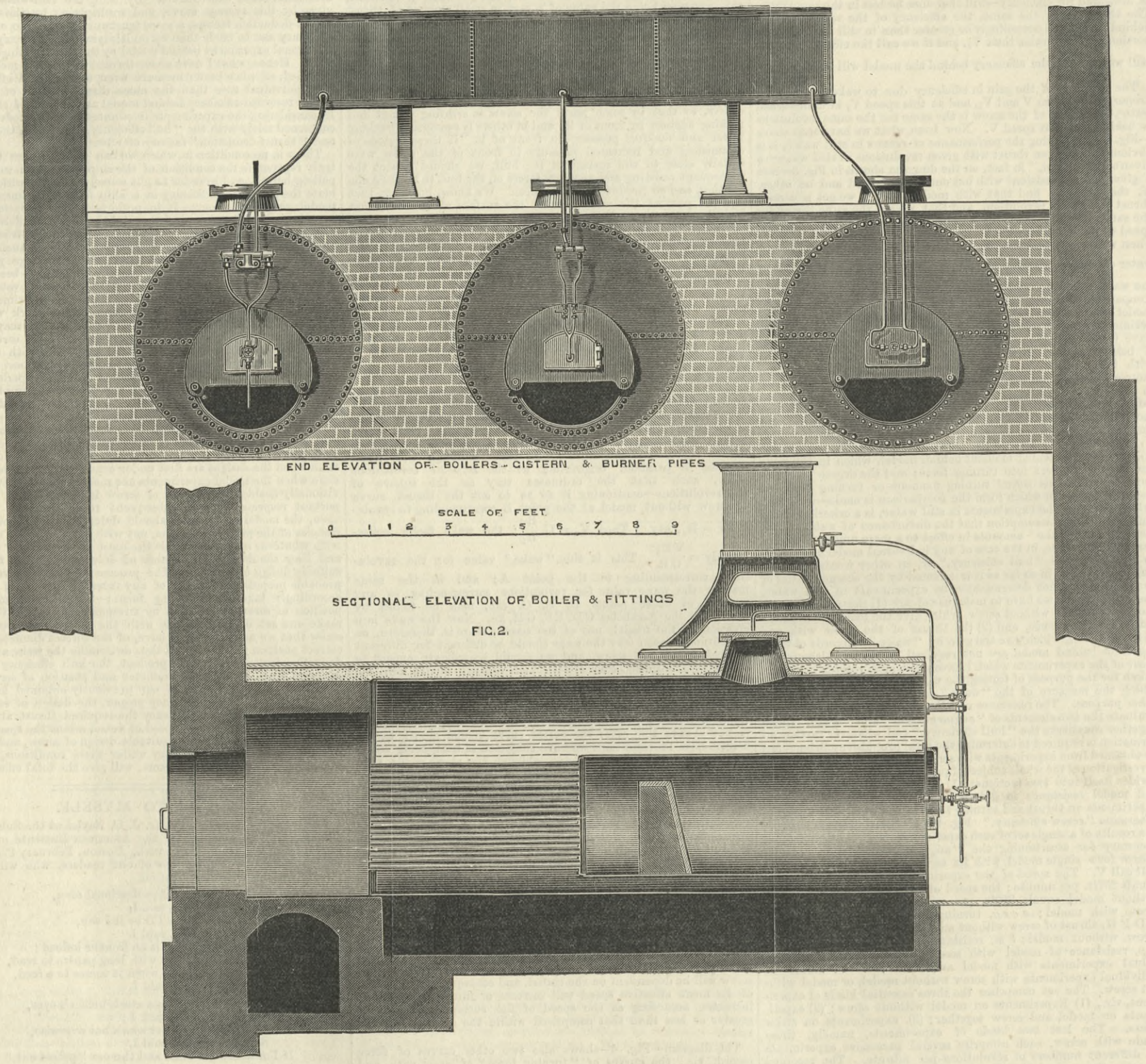
In other professions in which men succeed,
Said I to myself, said I,
Of "cheek" and assurance they often have need,
Said I to myself, said I.
Professional modesty's pushed to excess;
The value of confidence all must confess,
And even M. E.s. need a little, I guess,
Said I to myself, said I.

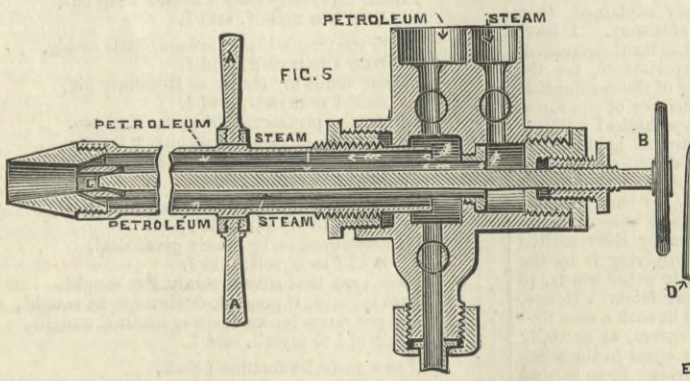
WE learn from the *American Manufacturer* that the parties who purchased the Centennial Building in Philadelphia for 97,000 dols. have already realised 405,000 dols. from the iron in it, and have sold the *débris* for 100,000 dols.

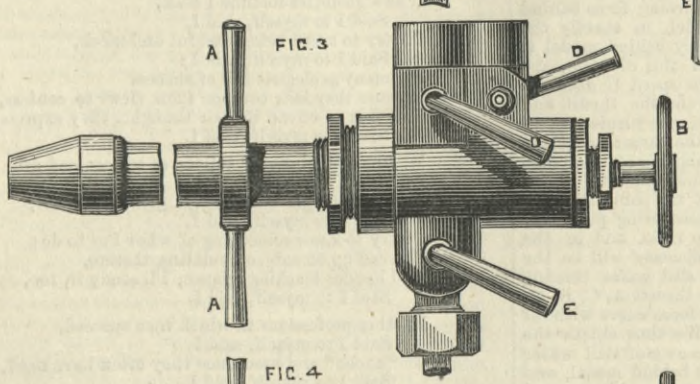
PETROLEUM BURNING FURNACES, SARATOFF WATERWORKS.

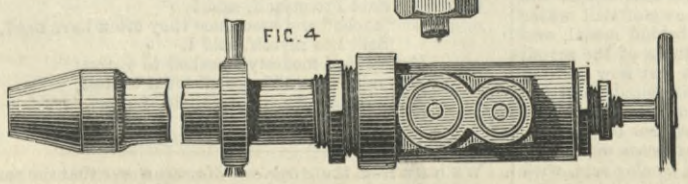
MR. W. GOLDEN, SARATOFF, ENGINEER.

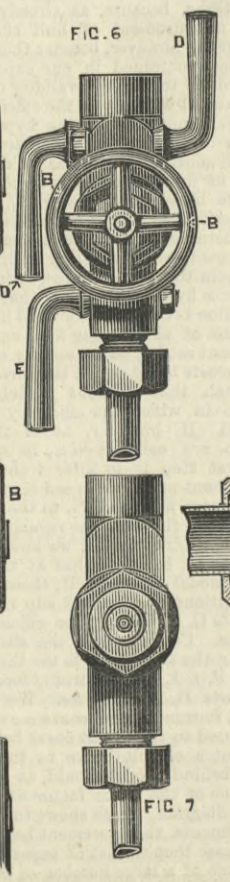
(*For description see page* 224.)

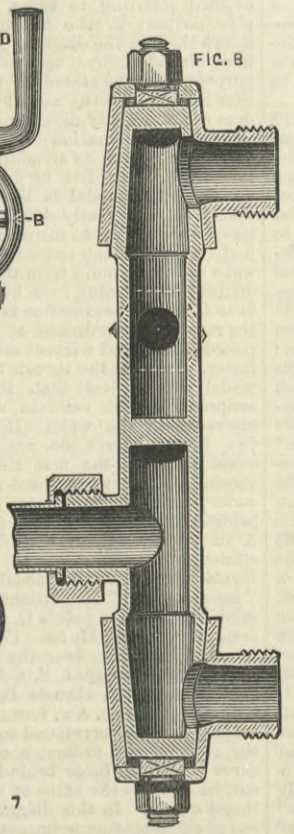


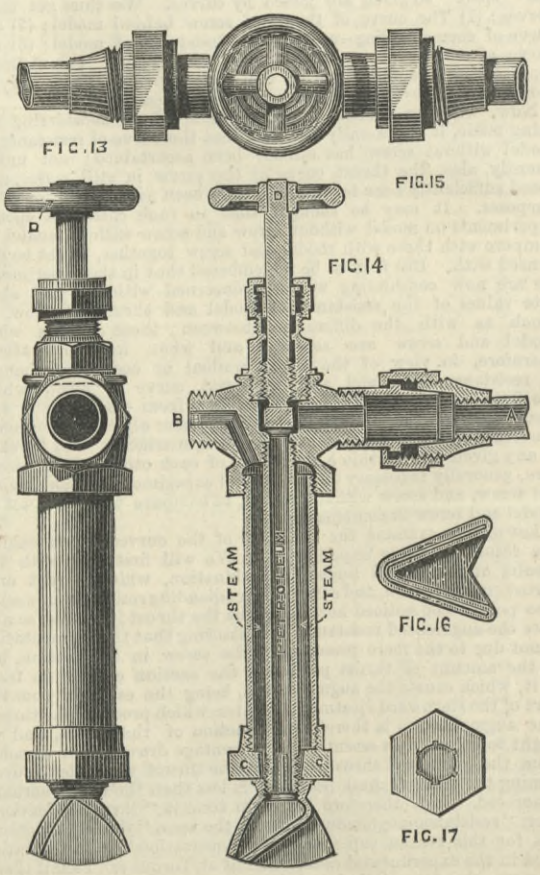












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W. J. P.—*It would be simply impossible for you to obtain, under the conditions, more than a theoretical knowledge of civil engineering, and that of a very limited kind. If you are already engaged all day in another business, you could not possibly find time for field or outdoor work of any sort, and the civil engineer who had not practical experience outside his rooms would not deserve the name, nor could he obtain an engagement.*

YOUNG BOATBUILDER.—*The displacement of your canoes would probably be about two-thirds of that of the circumscribing paralelopipedon. The displacement will depend on the weight to be carried, and may be reckoned at* 62·5 *lb. per cubic foot. Probably it will be sufficient to provide for* 400 *lb., including your own weight, and this will be got by a displacement of, say,* 6·5 *cubic feet, or* 3¼ *for each canoe. The diameter of the paddle-wheel will depend on the speed you want to go, allowing about* 20 *per cent. slip, and about* 20 *revolutions per minute. Floats about* 8*in. by* 4*in. will probably be large enough, but the best size can only be settled by experiment.*

MIXTURES FOR CAST IRON GIRDERS.

(To the Editor of The Engineer.)

SIR,—Will some reader kindly tell me of a good and cheap mixture of cast metals to stand the following test, viz., a cast bar 2in. by 1in. and 3ft. between supports, that will stand in centre without fracture 30 cwt.?

CAST GIRDER.

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THE ENGINEER.

MARCH 23, 1883.

THE LEPANTO.

THE Lepanto, the last of the four great ships forming what we may term the naval "quadrilateral" of Italy, was launched on Saturday at Leghorn. We give the principal details of the Lepanto in another place. The wisdom of constructing these vessels, and the part they will play in war, is one of the chief naval questions of the day. From time to time we get fresh opinions from various authorities on this matter; and from time to time new features find place in our armaments which may affect the question. At first the Italian policy was boldly condemned both in this country and in America; but latterly, from one cause or another, opinions have been much modified. Mr. Barnaby certainly did not condemn monster ships in his paper read at the United Service Institution on February 7th last; indeed, he expressed himself so as to leave it doubtful whether he did not think that such ships might after all prove to be wise designs. Let us look at this question as it now stands. Signor Brin the ex-Minister of Marine in Italy, is chiefly responsible for the ships. He argues as follows:—Success in war, whether by land or sea, mainly depends on concentrating at any given spot a greater force than that of the enemy. At sea this is most effectually done by the construction of specially large and powerful ships—ships which can move faster and hit harder than any others. Thus, in comparing a few single ships of great power with a corresponding power distributed among small vessels, Signor Brin says:—"The slower group cannot overtake the single faster ship, and she can always be mistress of the situation and maintain herself in the front, in the rear, and on the flank of the group, at whatever distance she pleases, by changing these positions by approaching nearer or drawing away from the group in order to attack one of the vessels." In torpedo warfare also he considers that great speed gives a great advantage. On the other hand, we find Admiral Colomb, in his prize essay of 1878, arguing in the opposite way on the same question. He maintains that the main object in a fleet is to secure to the utmost degree the power of concentration and the power of dispersion. For the latter, it is obvious that smaller ships are required; but the question arises where to stop. Admiral Colomb's plea for maximum dispersion might be used against him theoretically wherever he drew the line down to a fleet of gunboats. Sir Thomas Brassey observes with satisfaction that our naval authorities have latterly, with the exception of the Inflexible, constructed ships of moderate size. The Ajax, the Agamemnon, the Colossus, the Edinburgh, the Conqueror, and Collingwood are all less than the Devastation, none of them exceeding 9150 tons. We are inclined to think, however, that opinion is coming round to larger ships, and that there is solid reason for a change. At the root of the matter lies the probable introduction of hard armour, by which we mean armour that cannot be punched, but which must be destroyed by breaking it up into fragments. The explanation is as follows:—Until steel armour came in the punching attack was the most formidable one. It was slow work racking an iron ship—the Glatton turret for example, at Portland, was contorted by heavy blows, but its efficiency was not impaired; and the introduction of steel shot capable, like those of Whitworth and Krupp, of passing through thick armour without injury, was thought by many to promise the abandonment of armour altogether. About the same time, however, steel armour began to assert its power of keeping out even shot which were much more than a match for it. This it did at the cost of its own existence, for it was shattered and crumbled to pieces under fire in a way unknown in wrought iron. Nevertheless, it is so essential to keep fire out that we hold that success in driving steel shells containing gun-cotton through soft armour in such a way as to burst inside the ship renders hard armour a necessity, and with the introduction of hard armour the artillery conditions of attack become altered to an extent which is likely to affect the ships. Hard armour is destroyed by shattering, and the power of a shot to effect this depends mainly on the stored-up work it contains, which is a different thing from its power of perforation, the former being simply the weight multiplied by the square of the velocity, while in the latter the stored-up work is divided by the diameter of the bore and other factors. The difference between guns in their relative powers of perforating soft armour and smashing hard armour is, however, still further increased by the behaviour of the shot themselves under different conditions. All shots break up or set up against hard armour, and the blow delivered on the armour in this act depends much on the resistance of the shot as it yields, and this again depends on the tensile strength of the metal, and also on the striking velocity. A brittle shot striking at a very high velocity makes a mere splash on a hard shield. Our chilled shots behave much in this way. A heavier shot striking with a lower velocity may contain no more stored-up work, but the shot will stand up better and produce more effect. In justice to our chilled shot we must point out that the 100-ton gun shot at Spezia had this advantage, they were a match for the plates they attacked when their striking velocity was reduced to about 1220ft. This must be remembered in comparing them with our own shot fired by our sub-committee, generally at about 1500ft. striking velocity.

We will take one example to show how great the difference may be between penetrating and smashing power, and to take one bearing on the question of our ships and those of Italy as nearly as possible, we will select the 43-ton gun, which until quite recently was intended to be our heaviest afloat, except the four Inflexible guns; and we will compare it with the 100-ton muzzle-loading gun of the Duilio and Dandolo, which is much less powerful than the 100-ton breech-loading gun of the Italia and Lepanto. The 43-ton gun at the muzzle, and the 100-ton gun at 2100 yards range, have about the same power of penetration; that is, both can perforate about 24in. of iron, but their stored up work is about as two to three; that is, the 100-ton gun shot will smash about half as much again as that of the 43-ton gun, supposing both projectiles to hold together equally well. The striking velocity, however, of the smaller shot is about 2000ft., and that of the larger only 1500ft. Consequently, the metal in the former will be more severely strained, and will break up more. In short, it is doubtful whether the 43-ton gun would produce half the smashing effect of the 100-ton gun, even under conditions when its perforation appeared to be the same, and that is giving it a start, as it were, of 2100 yards range, which we have done merely to compare equal perforations with smashing effects.

To return, then, to our ships. With hard armour, new type guns with small bores and high velocities lose much of their power, sheer weight telling in the way above indicated. This is a strong argument for carrying heavy guns. There is still another. In all the newest ships side armour is in a greater or less degree discarded, so that there is a considerable portion of every ship which may be best attacked by common shells, and these contain larger bursting charges and are more powerful as the size of the gun increases. Supposing, however, that the heavy guns are otherwise employed, it is an argument for an effective secondary armament. It is true that such portions of ships are not of vital importance, nevertheless we venture to think that injury to such parts beyond a certain measure would cripple a ship. Recently we have heard that the 100-ton breech-loader is to be introduced into our Navy. This is a move in the direction of large ships, for a ship to carry such guns and an efficient secondary armament for light work is likely to be a very large ship, though not necessarily of precisely the same class as the Lepanto. We spoke lately of the work that would probably fall on our fleet if we endeavour to protect our trade in time of war. How should we reckon with such vessels as the Italia and Lepanto? commanding as they do the speed of 16 knots and, each possessing four 100-ton breech-loading gun and eighteen 6in. guns, they would prove a formidable scourge to our trade. We have no ships that could overhaul them; so that if such ships really got to sea, it appears as if they might prey upon merchant vessels and replenish their stores of provision and coal so long as their ammunition lasts. Belonging to Italy, as they do, we might watch for them with a fleet at Gibraltar, and attack them if they endeavoured to pass out of the Straits, so as to frustrate such an attempt, or should they get out, so as to leave them considerably crippled. It will be more serious when France possesses such ships—and we know that some of her new ships approach the same powers. The Admiral Baudin and Formidable are to carry 100-ton guns. We do not know their speed, but the Admiral Dupérré and Redoubtable, on paper, have a greater speed than anything we possess, except the Dreadnought. We confess that we do not see how it is possible to deal with such vessels, except with those of equal powers, although we may only require a limited number of them.

STRAINS ON MACHINERY.

THE patent case reported in our columns last week serves to draw attention to some points often overlooked by engineers when designing machinery. An analysis of the case to which we refer will show that a great deal turned on the presence of a flat bar or plate of iron used to stiffen the frame of a lace-making machine. At first sight it would appear that the use of such a bar was not a fit subject for a patent; but it may be taken for granted that any device, no matter how simple, which has not been used before for a given purpose, and which by accomplishing that purpose effects an improvement in the working of the machine to which it is applied, is a good subject for a patent. It was necessary that the frame of the machine in question should be made stiff. The bar patented made it stiff, and this method of stiffening had not been previously used. The machinery in which stiffness is not imperatively demanded is strictly exceptional; and in no way is the skill of a mechanical engineer better displayed than by the means he adopts for securing this desirable end. The principles involved are, however, extremely simple. This very simplicity has, indeed, had the effect of putting them a good deal out of sight; and we do not know a single text-book to which the student can turn for information on this subject, which deals with it in a compact and useful fashion.

Three general propositions may be laid down concerning the framing of machines. The first is that a strain of any kind should, when possible, be made to pass directly through some part of the framing; the second is that the strains should always be transmitted longitudinally through members of the framing; and the third is that if this end cannot be secured, initial stresses should be set up to secure stiffness. If these principles are applied in practice the maximum of stiffness can be secured with the minimum of material. Concerning the first we shall have something to say in a moment. As to the second proposition, its reason will be understood in a moment when we reflect that want of stiffness is caused by mobility in the framework which carries the moving portions of the machine; and that the minimum of mobility is always found in metals or wood strained in the direction of their length. Thus, for instance, a pull put on any part of a machine, say a holding-down bolt, can produce little or no effect because the elongation of iron or wood under tensile strains much below their limit of elasticity is extremely small. When transverse strains is put on them the reverse is the case. Thus a beam loaded in the middle is certain, unless made extremely heavy, to spring and move under variations in the insistent load, and for this reason plummer blocks should not be carried on beams when great stiffness is desirable. An apt illustration of what we wish to convey is supplied by the engines of torpedo boats. The cylinders are mounted on an extremely light steel frame, consisting of six round bars bolted into the bed plate below and the cylinder flanges above. At first sight this looks a very flimsy structure; but as a matter of fact it is about the most rigid engine frame which it is possible to make, complying with the first and every one of the conditions of perfection which we have laid down. The strains to be borne are nearly vertical—for the moment we neglect the strains on the guide bars—and they are two in number, operating in right lines drawn through the piston-rods in the two cylinders. To deal with each of these strains there are four pillars, accurately parallel to the line of strain. These pillars lie outside the line of stress, equidistant all round it, so that there is no twisting moment at work. The pillars are alternately in compression and tension as the steam is admitted below or above the pistons, and these are the very strains which the metal is best adapted to resist. Let us suppose that instead of using six columns, four only were employed under the low-pressure cylinder, the high pressure cylinder overhanging. It will be seen at a glance that the lines of resistance would no longer surround the line of strain; cross-bending forces would be brought into play, and, without using an enormous weight of metal it would be quite impossible to prevent the high-pressure cylinder from lifting up and down at each stroke, bending the bars as it did so backwards and forwards. Or, again, let us suppose that the cylinders, instead of being carried directly on the columns, were supported on a short girder spanning the boat. It is evident that unless a great deal of metal was put into this girder—probably ten times as much as sufficed in the shape of turned steel uprights—the cylinder would certainly jump up and down, bending the girder at each stroke. A further example of influence of position on stiffness of framing may be found in flour mill work. In old-fashioned mills the foot step was supported on what was known as a bridge, hinged at one end, and lifted up or let down at the other end to adjust the stones either by wedges or a screw. We have seen

these bridges, although not more than 6ft. long between centres, made of 12in. square oak beams. If less in dimensions they would not be sufficiently rigid; it was not a question of strength, but of stiffness. The oak beams were succeeded by cast iron, but that had the same defect as the oak in a lesser degree, and they in turn have disappeared in favour of the vertical pillar foot-steps, through which the strain goes direct to the foundations of the mill, and the maximum degree of vertical stiffness is secured.

We have said that strains should always, when possible, be made to pass through some member of the framing. This put into other words means that the support should be given just where it is wanted. This cannot always be done directly, but it can nearly always be done by supplying two or more supports for each strain, and dividing the work of resisting it equally between the two. There is here much room for ingenuity. An excellent illustration is supplied by outside cylinder locomotives. As made at one time, the cylinder was simply secured to a flat frame-plate by about eighteen turned bolts, driven in as tight as they would go, and secured inside by heavy nuts. No one ever yet succeeded in making a good job in this way with cylinders much above 12in. in diameter. If the bolts held tight the side frame buckled in and out, because the line of stress caused by the action of the steam in the cylinder did not fall in the line of the plate, but a good deal outside it. Then heavy transverse stiffening plates were put in, and the bottom of the smoke-box was made very strong. This did not answer; the bolts worked loose. Then engineers both in this country and the United States grappled with the problem, and three different methods of securing outside cylinders were adopted, and were all successful. The first consisted in adding a second frame, which butted against the after end of the cylinder and was secured to it. Examples of this type of engine may be found by the dozen on the London and North-Western Railway. The result was quite satisfactory, for the stress was surrounded by lines of resistance. The second arrangement was invented in the United States, the peculiar form of the bar frames used there precluding a resort to the outer plates. A very heavy casting, known as a saddle, lies across the frames under the smoke-box, and to this casting the cylinders are secured not only with turned bolts, but with dovetailed slots, and cotters driven home hard. The two cylinders and the saddle are virtually made one, and the two lines of stress then lie symmetrically outside the two lines of resistance supplied by the frames. The third method was devised by Mr. William Adams, now locomotive superintendent of the London and South-Western Railway, but at the time in question holding a similar appointment on the North London Railway. He was much troubled by the working of his outside cylinders under the very heavy pressure—150 lb.—carried, and to prevent this he carried his valve chests through the side frames, and united them together by a casting secured with bolts and a long cotter which locked everything up. The result was quite satisfactory. The plate side frames no longer buckled, because, as in the case of the American engines, the stress fell symmetrically outside the frames which supplied the resistances. Putting all this into the fewest words, overhang should be avoided in machinery, and when it is unavoidable its effects should be neutralised by doubling strains, just as though we had a crane with two jibs, one always pointing one way, the other the other, and equally loaded and worked.

It is impossible, no doubt, always to do just what we wish in designing machinery, and it is of importance to know how best to secure stiffeness when overhang, or its equivalent, must be introduced. The best method of doing this, and one little practised, because little understood, lies in the application of the principle of initial strains. In other words, that portion of the machine where elastic motion is to be avoided, is first exposed to an initial strain greater than any that will be put on it by the machine. To make this statement as clear as possible, let us suppose that a shaft bearing has to be carried on a flat wrought iron plate 1in. thick, 12in. wide, and overhanging 2ft. Such a plate will be certain to vibrate if a shaft carrying heavy pulleys revolves rapidly in the bearing, and it will do this because the metal has no initial strain on it worth mentioning, and its powers of resistance are not called into action until some motion has taken place. If now we carry down from the end of this plate and secure to the floor a small rod of iron fitted with a nut and screw, we can put a bending stress on the plate which will be much in excess of anything that the working of the shaft can produce, and we shall have at once a sufficiently stiff base for our plummer block. Of course we have here supposed an almost impossible case, but its analogue is not far to seek. It is well known that in certain types of horizontal engine, with wrought iron frames, the side plates will "whip" in and out at each revolution, owing to the fact that the crank-shaft is itself not quite stiff. The frames whip because they have no initial strain on them, and easily yield to a slight impulse. If now these frames were originally made with a camber outwards, and they were then drawn straight by transverse rods screwed home tight, whip would be impossible, because the plates could not bend inwards, for they had been set outwards, and pulled hard against the bolts holding them together; and they could not go outwards because the bolts resist motion in that direction. Here, then, stiffness could be got with a minimum of metal. But the great advantage of this system of initial stress for obtaining stiffness lies in the fact that very light tension rods can be made to take the place of heavy bars. Let us suppose that we have a structure mounted on four legs, like a table. We can secure stiffness by putting stout plates between the legs, and these plates must be heavy, for they have to be thick enough to act as struts, and must not bend. But just the same result could be got if, to begin with, we spread the legs of our table a little, and then brought them back to the perpendicular by the use of small tie rods. Under almost every conceivable circumstance these tie rods must remain in tension; and this being so, all the stiffness that could be obtained in any way is obtained.

It forms no part of our present purpose to show precisely how the principles we have endeavoured to explain are to be applied in practice. Our object will be served if what we have said influences the proceedings of the engineer. By paying attention to them peculiar elegance of design may be secured, with a distinct saving in first cost in many cases. A gross neglect of them is sure to offend the educated eye. To take an extreme case, can anything look worse than an overhanging wheel mounted on a shaft about a foot away from a bearing? Here the line of stress falls a long way outside the lines of resistance, and is very far indeed from being surrounded by them. Certain makers of traction engines used to be notorious offenders in this way. We fancy their sins have found them out, for "air bearings," as the late Mr. Aveling used to call them, are not so plentiful as they were at one time. A favourite modern expedient for securing stiffness is the use of plenty of material, and this has called into existence certain massive types of horizontal engine now growing in favour. These engines have tremendous bed-plates and not much else to recommend them. We fear it must be admitted that Mr. Corliss, an American engineer, first taught us how a horizontal engine bed-plate should be made. The use of mountains of cast iron, not only in steam engines, but in other machinery, will, no doubt, secure stiffness, and mere massiveness has a beauty and fitness of its own. But the highest type of engineering skill is shown by the man who can so dispose his materials that he gets the best results with the smallest quantity of them. The modern locomotive of the best type, and some marine engines, supply admirable examples of what we mean.

A NORTHERN ARSENAL.

There is now growing up on the banks of the Tyne an establishment which promises to bear comparison with Herr Krupp's enormous works at Essen, *plus* a shipbuilding yard capable of turning out vessels of war of the largest size. The significance of the event is not likely to be apprehended at first but attention is now being drawn to it by the resignation, by of Mr. W. H. White, of his appointment as Chief Constructor at the Admiralty. Although the title of Chief Constructor no longer bears the significance which attached to it in the days when Sir Edward Reed was at Whitehall, the duties discharged by Mr. White have been of no ordinary character, and he has given proof of his scientific ability. Little need be said on this point after the emphatic appreciation expressed by the Lords of the Admiralty with regard to the services he has rendered to the country. By his personal qualifications and official position, Mr. White was marked out as the future Director of Naval Construction, whenever Mr. Barnaby should resign that post. But Elswick has been found to offer superior attractions, and, after sixteen years of Government service, Mr. White accepts an engagement in the newly-constituted company, which has Sir W. G. Armstrong for its chairman. This new organisation includes not only the Elswick works, but also those of Messrs. C. Mitchell and Co., of Low Walker, a few miles distant. For these properties, and all that relates to them, the company pay a sum exceeding a million and a half sterling, of which £390,000 will be in cash, and the remainder in shares. The nominal capital of the company is fixed at two millions, of which £1,850,000 is being issued. A balance of £275,000 will remain out of the capital about to be issued, after paying for the acquisition of the property, and this residuum will provide for the establishment of steel works, which are to be added to the existing appliances.

We cite these figures to show the magnitude of the undertaking. Elswick, which is now a little Woolwich, is to grow into closer resemblance to the Royal Arsenal. Woolwich has ceased to build ships, but Elswick is going to begin in that line. Low Walker will continue to construct vessels for the merchant navy; but Elswick aims at something higher. It has sought to absorb into its *personnel* all the talent necessary for making it the arsenal of the world. On the Board of Directors we meet with names already familiar in the mechanical arts which will have to be exercised for this purpose. It is true that there is a loss in the departure of Mr. George Rendel to become a Civil Lord at the Admiralty. But there is Sir William Armstrong still at the helm, and Mr. Percy Westmacott possesses qualifications which have made him the head of the mechanical engineering department. Captain Andrew Noble is an artillerist of high repute, to whom General Younghusband will be a worthy coadjutor. The name of Dr. C. W. Siemens guarantees the success of the steel manufacture. Messrs. Mitchell and Swan are also directors of the company. Strength in the conduct of business is to be derived from the presence of Mr. Stuart Rendel. The name of Lord Thurlow throws an aristocratic halo over the undertaking; and it is a little startling to find Sir James McGarel Hogg engaged in the control of so warlike an enterprise. There are other names of note, and there has been lately an important addition in the person of Mr. Vavasseur, whose London Ordnance Works, situated in Southwark, now become part and parcel of the company's property, subject to financial arrangements in addition to those already specified.

Elswick, with the aid of Messrs. Charles Mitchell and Co. at Low Walker, is already famous for turning out unarmoured vessels carrying one or two exceptionally heavy guns. The Chinese gunboats are examples of this kind; but armour-clads as long as the Minotaur are henceforth to figure on the programme, should such be required. The low-level swing bridge on the Tyne, itself made at Elswick, will give room for the passage of ships with something like 80ft. beam. It is in this respect that significance attaches to the passing away of Mr. White from the Admiralty to the Armstrong and Mitchell Company. Mr. White is a man who has never shown himself afraid either of work or responsibility. He has been specially engaged in the preparation of designs for armour-clad ships, under the supervision of Mr. Barnaby, and there can be no doubt that he has fully qualified himself for the post he is to take as head of the shipbuilding department at Elswick. His *rôle* will consist in something more than building merchant ships or unarmoured gunboats, and we may speculate on the probability of fully equipped armour-clads steaming forth from the Tyne, with batteries of 100-ton breech-loading guns to serve a foreign Power. Of course there is this advantage, that if an enemy should ever strike at England, he will have to seize two arsenals instead of only one; and there will be an additional naval establishment for him to blockade. Also, in the event of war, our national resources will be enlarged by the existence of a second Woolwich.

In the matter of ordnance there will be a further advantage in the pressure which Elswick must necessarily bring to bear on the Government establishment. Woolwich cannot possibly allow Elswick to go far ahead in the manufacture of artillery; and a healthy stimulus will thus be given to the Royal Gun Factories. Breech-loading is now a revived art, and steel is coming fast to the front. Sir W. Armstrong has done much for wrought iron; but the manufacture of steel is passing into an advanced stage, and a new era is clearly opening. The Northern Arsenal is avowedly going to do its uttermost in that direction, and already it has undertaken to supply heavy guns in which wrought iron will be conspicuous by its absence. Whether steel-faced armour will serve to exclude plates made wholly of steel is an open question, but we may expect that the Elswick metallurgists will try to make themselves independent of Sheffield, though some time may elapse ere they succeed. Herr Krupp and M. Schneider may now look to their laurels, and may reckon on a competitor even more formidable than Sir Joseph Whitworth with his fluid compressed steel.

FOUNDATIONS IN THE TROPICS.

A curious instance of the difficulties which the peculiarities of tropical soils give rise to when dealing with the foundations of heavy buildings has recently occurred in Georgetown, the capital city of British Guiana. Designed by the Government engineer until lately in charge of the Public Works Department of that colony, some erections intended for use as law courts had proceeded to a certain point, when the successor to the office above named discovered that the buildings were bodily sinking, and this—as far as we have been able to learn—was taking place without any settlements or cracks being visible in the walls of the building, and without any disturbance of the surface soil close to them. In fact, it was not easy to detect the immediate cause of the subsidence, but it was ultimately found that at a few yards distance the ground was bulging upwards. The present head of the Public Works Department in his report in no way reflects upon the character of the design given by his predecessor to the footings, or on the dimensions of the foundations. There is nothing, indeed, in these to find fault with, and the difficulty has arisen apparently from the two-fold character of the soil in the immediate vicinity of the buildings; that on which the work is erected being of good solid unyielding sand, but being surrounded to all appearance by a bed of earth less capable of withstanding either vertical or lateral pressure. The consequence has been that this surrounding belt of earth has yielded upwards to the force exerted upon it by the lateral thrust of the squeezed material immediately below the buildings.

Now in such a case as this there are questions of difficulty to be met which appear to be almost insurmountable unless the surrounding soil which has been lifted can be weighted down. We do not mean to say that an occurrence of a similar nature to this is never met with in European practice, but it is exceptionally rare; whereas engineers in the tropics find themselves often troubled after this manner. Instances are particularly frequent in localities where, as in the sea-board provinces of British Guiana, the whole of the soil between the base of the inland mountains and the sea has been formed by alluvial deposit. The rivers, the discharge of which has brought down through countless ages the detritus of their inland course, have brought with them also immense masses of uprooted timber from the forests of the interior. These last becoming from some accidental circumstance deposited in great quantity in some particular spot, and having been covered in their turn by later layers of silt, have lain for centuries, perhaps, until the process of their decay has been completed, with the result that they shrink within the matrix wherein that process has been accomplished. It is easy to realise how the selection of apparently firm soil in the neighbourhood of some such undetected spot might lead to such a result as has caused the bodily settlement of the new buildings to which we have above referred; and it would be almost impossible, unless very deep trenches were cut in all directions radiating from the proposed site of any building, to discover the presence of the danger, which only shows itself when work has proceeded to an extent which renders it economically impossible to counteract it. The only course, it appears to us, which is open to the engineer in charge, is to underpin the foundations to a depth which shall ensure the lateral pressure being transmitted to firm soil below the level of the treacherous layer.

Such an operation must doubtless, in many instances, entail great outlay, and even if successful, the reduced level of the building cannot be amended, and the original design may have to be entirely altered if such reduced level renders the building liable to be entered by flood water, or become otherwise unsuitable. Numerous instances of this upheaval of the soil have been noticed by us in tropical countries, and it has been the cause of failure with many of the old Dutch and Portuguese buildings so constantly met with in our East Indian possessions. Our predecessors in such countries of those nationalities sought to overcome the treacherous character of the soils with which they had to deal by enormous thickness of walling and spread of foundation. Many of these buildings, indeed, that we have examined, have had walls of what seemed to be greatly unnecessary thickness; but they proved on opening them to consist of only outer

casings of brickwork filled in with earth. In seeking to thus give spread to their earth base, and obtain what seemed to the old builders the requisite large area of bearing, they were indeed committing the very fault certain to bring about the results they sought to avoid, but the true cause of which they do not seem to have been able to appreciate. They simply increased the evil by building weak walling of quite useless weight, instead of erecting on a wide foundation base, with reducing footings, work of the strongest but lightest character. It needs some long experience of work under the conditions which tropical soils present before the advisability of light walling becomes forced upon the engineer, and it is largely to this want of experience doubtless that so many failures of barracks and other buildings erected by military engineers in India and elsewhere are due. It is admitted the fierce heat of the sun is more felt in a building having thin walls exposed to its rays, but then it is rarely the case that they are so exposed, or, at all events, they never should be, but should in all cases be sheltered by verandahs.

The alternations in the tropics between rain and sun are not frequent, and the soil, deprived of moisture for months together, shrinks to an extent quite unknown in European practice. Our observations have led us even to believe that in instances watched by us the normal level of some buildings has varied to an extent of fully 2in. between the dry and wet seasons. This lift and fall in a high erection must, of course, throw immense strain on every part of the structure, and will account for many instances of failure where the blame has been thrown on the designer. To meet such strains mere massive work is useless, and only adds to the liability of failure. First-class bonded work of light character, having well-stepped and broad foundations, is the only thing by which the effects of such strains may be safely borne.

THE SMOKE ABATEMENT EXHIBITION.

THE fact that enthusiastic amateurs are not the proper men to carry out scientific investigations has just received a startling illustration. It will be remembered that a series of experiments was carried out in 1881, at the Smoke Abatement Exhibition, to test the value of various systems of warming dwelling-houses. The report of the committee has been very recently issued. In reading it over we felt that there were some inconsistencies which demanded explanation, and that certain somewhat anomalous results were recorded. The mystery has been cleared up by a letter from Mr. F. Edwards, of Ravencourt Park, from which we learn that a most extraordinary oversight has just been discovered in connection with the testing of grates and stoves. The committee made use of certain structures with chimneys called "test-houses," which were used by the Society of Arts in 1873 for a similar exhibition; but they do not appear to have inquired into the fitness of the test-houses, or to have known that the testing in 1873 was found to be so unsatisfactory that no awards were made and no reports issued. It appears by the report of Mr. D. Kinnear Clark, the engineer, that the flues in the "test houses" were only "8¾in. in diameter, and were prolonged by 6in. zinc piping to a height of 25ft." All ordinary chimneys measure 14in. by 9in., and are sometimes larger. "The cause of the extraordinary failure," says Mr. Edwards, "was at last accounted for. Flues had been used which were admirably suitable for close stoves to burn gas or non-bituminous fuel, but utterly unsuitable for all open fireplaces, and for bituminous fuel. The consequence is that all open fire-places stand at a great disadvantage as compared with gas and other stoves, and all open fire-places stand in a false position with reference to each other, the most modest contrivances occupying apparently the highest positions, while the most important ones occupy the lowest. It may be as well to explain, for the benefit of those who are not familiar with the subject, that a flue contracted to the size of 6in. in diameter is very much the same as a flue of 6in. throughout, and that its effect on all fire-places except very small ones would be to make them act badly in every respect, to be imperfect in combustion and in heating power, to occasion an accumulation in the chimney of noxious products and the emission of a great portion of such products into the testing room. It must be stated that the exhibitors were not in the least responsible for the mistake either in 1873 or in 1882, as the flues were embedded in brick and nothing was known of their unfitness till the late reports appeared. All that the Smoke Abatement Committee can now do is to withdraw the whole of the misplaced awards, and to institute a proper inquiry. It is probable, however, after such a lamentable mistake, that nothing very effectual will be done except by practical men and private enterprise. Captain Douglas Galton, Dr. Siemens, and Dr. Alfred Carpenter have all disclaimed any responsibility for the testing. Though the mistake was fully explained in the *Builder*, neither the chairman nor any member of the committee has though fit to acknowledge the blunder." Now it is pretty certain that those who have received prizes will regard this question from a very different point of view, and we do not see how it is possible for the committee to adopt the course recommended by Mr. Edwards. It was a matter of notoriety already that the proceedings of the committee were regarded as ridiculous in many respects, and the threatened prosecution of the body for making smoke was looked upon as the climax of the joke. It is now evident that this was not the case. The absurdity of the whole affair becomes each day more evident. The only thing valuable about it was the report of a trained engineer, like Mr. D. K. Clark, and now it would appear that even this possesses but a secondary value. The questions at issue are sufficiently important to be worth proper investigation, and we would gladly see the whole matter taken out of the hands of incompetent enthusiasts and worked out by skilled investigators, who would supply reports having real scientific value. If what Mr. Edwards states to be true is true, then the committee find themselves in a very awkward position, and they are by no means to be pitied.

THE ACCIDENT TO SLIP CARRIAGES ON THE GREAT NORTHERN RAILWAY.

ANOTHER of those emergencies for which the Great Northern Railway Company has become famous has been enquired into by General Hutchinson, whose report has just been issued. The incident occurred near Hatfield, on the 22nd December last. As the front portion of the 9.30 p.m. passenger train, consisting of engine, tender, and five vehicles fitted with the Smith's non-automatic vacuum brake, from King's Cross for Cambridge was being stopped near the Red Hall signal cabin—about a mile south of Hatfield, where the signals were against it, it was run into by the rear portion of the train, consisting of four vehicles which it had been intended to slip so as to stop at Hatfield, but which the guard by mistake prematurely slipped about two miles south of Hatfield. Four vehicles were damaged, and seven passengers and three guards were injured. The collision was in the first instance due to the guard in charge of the slip portion not observing the rules laid down for working slip carriages, but there is little doubt that no harm would have resulted had not the brake power been deficient. It is most important that these slip portions of trains should be provided with abundant means of stopping, but upon many lines these vehicles are not only wanting in brake power, but they seriously cripple the whole train. With the vacuum brake, whether in the automatic or non-automatic form, there is no means of disconnecting the brake couplings, and of closing the pipes while the train is running. The brake must therefore be disconnected in front of the slip portion before starting, so that it may be worked up to that point. This prevents the brake being used either by the driver or guard on the slip portion before slipping, and the guards in the slip portion cannot apply the brakes to any portion of the train either before or after slipping. Hand brakes are consequently the only means of stopping on which to rely in an emergency such as the one in question. These can, of course, be of no service. On lines where the compressed air brake is in use, however, portions of trains are regularly slipped, the brake not being shut off the rear portion until it is time to slip the carriages, consequently both driver and guards have control of the whole train before slipping, and the guard of the slip portion is provided with the means of applying and releasing the brakes a number of times after slipping. This is only one of the many advantages possessed by a pressure brake over any vacuum brake, whether automatic or non-automatic. Those who have hitherto sustained injuries through the failure of the vacuum brake have, it would appear, not been people of sufficient importance to induce the railway company to equip their trains properly. In America, however, they appear to manage these things better. We commend the following, from an American contemporary, to our readers :—"In the case of a Kentucky railroad company, sued for damages for injury to a passenger, it was shown by expert evidence that the accident would not have happened had the defendant's train been equipped with the air brake, and also that such equipment would not have required an outlay exceeding 1 per cent. of the defendant company's capital stock. The judge in his charge held that the defendant was guilty of contributory negligence in not having supplied every requisite to ensure the safety of passengers, and a verdict for the full amount claimed by the plaintiff was returned. This decision is of considerable interest to Pittsburg as the centre of the air brake manufacture."

THE NORTH-WESTERN IRON TRADE.

LESS attention is paid to the north-western iron trade, and especially to that of the West Cumberland district, than it deserves. In the region between Carnforth and Maryport there are over sixty blast furnaces, and of these about forty are in blast. It is well-known that the reduction in the price of hematite iron presses hardly upon the trade in the north-west. Some other centres import Spanish iron and smelt it cheaply, and thus there has been, in the last few years, an increased competition. There has been a reduction of the cost of production in some of the items, but there are others, such as that of the carriage of the coke, which seems to be fixed at a very high rate. Most of the coke used in the smelting of the iron in the north-west is brought from the Durham coalfield, and it is handicapped by a heavy charge for carriage. Indeed, it has been stated that coke is carried to Spain as cheaply from the Tyne as it is to West Cumberland. Thus, the smelters of iron in Spain are able to produce hematite iron with Durham coke cheaper than the ironmasters of West Cumberland; and it is said that the Spanish hematite pigs are competing keenly with those of English smelters in some of the markets to which large quantities have been wont to be sent. It is in part to the competition with other districts, and to that with foreign producers, that out of the total of seventy blast furnaces in Cumberland and Lancashire, as a whole there are not fewer than thirty-six idle at the present time. There are expectations that higher prices may prevail in the hematite iron trade; but of this there are, at the present time, no indications, and as the stocks of iron in the stores have increased, there is little probability of higher prices till the increase of the stocks is checked, and till these stocks have been brought within more reasonable dimensions. It is possible that with the approach of the summer, and the resumption of larger shipments, there will be an enlarged tonnage sent out, and when this proves to be the case higher prices will be probable. But the largeness of the unproductive plant in the district—the fact that nearly every firm of consequence has idle furnaces—leaves some ground for the belief that a serious increase of prices is not, at the present time, very likely, though it is quite within the bounds of probability that some advance from the very low rates now known may take place.

EFFECTS OF DISRUPTIVE EXPLOSION ON GLASS.

FROM the grievous piece of wickedness perpetrated last week at Charles-street, Westminster, some interesting particulars are to be gathered as regards the effects of an explosion. Strong and massive objects were shattered to pieces, while delicate and fragile articles were in several instances left untouched. It is stated to have been no uncommon thing in Paris during the siege of 1871, when numbers of tombs were blown up in the cemetery of Père la Chaise, to find that while heavy slabs of stone and marble were riven in pieces, glass vases of immortelles altogether escaped. Many similar instances were noticed amongst the *débris* at the Local Government Board offices. In a bedroom close adjoining the spot where the ligno-dynamite was fired was a substantial clothes press which was split into matchwood, while a toilet bottle and glass on the mantelpiece were left unchanged. The glass face of the clock over the fireplace had been blown off, but the glass of a little picture hanging close by was intact. Similarly, the companion picture to the one just mentioned had been torn from its hook, and had been flung it is impossible to say where. We are reminded of the conditions of the explosion of gunpowder in a barge on the north side of Regent's Park early one morning about ten years ago. The window glass was broken over a very considerable area, and in some cases under circumstances that were at once unusual and curious. We have in our possession a piece of a window of an artist friend. All the windows in his house were blown out, and those in his studio were made of thick plate glass about five-sixteenths of an inch in thickness. These were blown out in slabs about 6in. long and 2¾in. or 3in. broad. The piece we refer to is of this size, and is traversed by four cracks which run parallel and lengthwise along it about ⅛in. or ¼in. apart, and extending nearly half through the thickness of the glass. Many questions suggest themselves: why do not they go through the glass; what determines the distances between them; and why are they parallel? We have not heard whether any glass broken at Westminster showed these characteristics, but it would be a matter of great interest to record it.

ON THE STRENGTH OF ROLLED IRON JOISTS.

M. DUPONT-LIXON, Régisseur de la Société Anonyme de la Providence, Belgium, has prepared a paper investigating the properties of rolled joists, which contains much information not generally available. Thus, we believe the following translation of it will be found interesting to many of our readers :—

The use of iron joists in public buildings gains every day in importance; thus, it becomes necessary to study the greatest effect of a section before fixing its proper dimensions. Now-a-days, people look only at the question of weight, and consumers when they have to select certain joists in the books of manufacturers, take generally the one that weighs 1 or 2 kilogs. less per run metre than other sections of the same depth. We will hereafter prove that the advantage of such a system is more apparent than real. A double-tee iron has four principal dimensions:—The depth h, width of flanges b, thickness of web e, and the average thickness of flanges t.

In this paper we shall adopt the following resolution:—$b^1 = b - e$, and $h^1 = h - 2t$. It was in 1881 that the question of rendering normal the ratios between different dimensions of I came under discussion in Germany, and that Professors F. Heinzerling and O. Jntze, of Aix-la-Chapelle, published a book of German normal sections. But the ratios therein given are empirical, as shown by the formulas, and the way they are written. These formulas are: For $h = 250$ mm., and less $b := 0{\cdot}4\,h + 10$ mm.; $e = 0{\cdot}03\,h + 1{\cdot}5$ mm. For $h > 250$ mm.; $b = 0{\cdot}3\,h + 35$ mm. $e = 0{\cdot}036\,h$. The same, however, could not be applied by Belgian manufacturers, who are compelled by commercial usages to produce several samples of same depth with flanges varying in width. Thus, the Providence Iron Company have four sections 200 mm. and four sections 250 mm. deep, &c., and each of these being in great demand, all must consequently be maintained in their section book. The greatest effect of a joist is to be found in the load P, uniformly distributed between supports over a given length L, relatively to its cost, say, to its weight per run metre. For instance, let us take a joist 100 × 48 × 7 mm. at 10 kilogs.—Providence section. Its momentum of resistance $\frac{I}{V} = 36{,}838$. The safe load uniformly distributed it will carry between supports 4 metres distant, will be found by the formula $P = \frac{8\,R}{L} \times \frac{I}{V}$, where R is the coefficient of security to which the iron is submitted.

For a span of 4 metres, let us assume that R = 10 kilogs., for the Providence Iron Company guarantee their ordinary quality to stand a tensile strain of 33 kilogs. to the square mm., before fracture, which is less than one-third of its breaking weight. In the case under consideration, $P = \frac{8 \times 10}{4000} \times 36{,}828 = 736{\cdot}7$ kilogs.

Dividing this load by 10 kilos. weight per run metre we obtain 73·67 kilogs. By modifying the section in the manner shown further on, the moment of resistance $\frac{I}{V}$ becomes 37,750 for a weight of 9 kilogs. per metre, and $\frac{P}{p} = 83{\cdot}88$ kilogs. These figures represent the useful effect of the section named. Therefore, the ratio of strength to weight in a joist is $\frac{P}{p} = \frac{S\,R}{L} \times \frac{I}{V\,p} \cdot \frac{8\,R}{L}$ being constant for a given length, it is obvious that the effect depends entirely on $\frac{I}{V\,p}$, but $\frac{I}{V} = \frac{b\,h^3 - b^1\,h^{13}}{6\,h}$, and $p = \frac{I}{0{\cdot}0078\ (h\,b - b^1\,h^1)}$; so that—

$$(A)\quad \frac{I}{V\,p} = \frac{b\,h^3 - b^1\,h^{13}}{6\,h} \times \frac{I}{0{\cdot}0078\ (b\,h - b^1\,h^1)}$$

In order that this expression be the maximum, it is necessary that each of the two factors of which the product is composed should be the greatest possible.

Any section in the trade is specified by its depth h, the width of flanges b, and the weight per metre p. The consequence is that only b^1 and h^1 are left to the choice of the manufacturer.

As will be proved hereafter, the question of first importance is that of reducing the thickness of web e as much as possible. However, this point may not remain unlimited, for considerations relating to the practice of rolling joists command a minima which may not be exceeded without great inconvenience. So that in the expression $\frac{I}{V\,p}$ there is but h^1, which is subject to variations. Now, let us examine what becomes of each of the factors $\frac{I}{V\,p}$ for successive variations of h^1. The first $\frac{b\,h^3 - b^1 h^{13}}{6\,h}$ increases as h^1 decreases, and becomes maximum for $h^1 = o$. The second, on the contrary, increases as h^1 increases itself, and the maximum corresponds to $b\,h = b^1\,h^1$. In order that $\frac{I}{V\,p}$ be maximum, h^1 while standing between zero and $\frac{b\,h}{b^1}$ must move inversely to the numerator and denominator.

It follows that there is at least a point of intersection in the two lines of variations of h^1, and consequently at least a value of h^1 corresponding to the maximum value of $\frac{I}{V\,p}$.

To find this maximum, we set down $\frac{b^1}{b} = \beta$ and $\frac{h^1}{h} = x$; let us draw from x the expression $\frac{I}{V\,p}$ thus transformed, and make the derivative equal to zero, we obtain the equation—

$$(B)\quad 2\,\beta\,x^3 - 3\,x^2 + 1 = 0.$$

Reproducing this equation by the figure $x^3 + p\,x + q = 0$, and making $\frac{b^1}{b} = \sin.\,\theta$, the roots of the equation are

$$X_1 = \frac{1}{2 \sin. \frac{\theta}{3}}$$

$$X_2 = \frac{1}{2 \sin. \frac{\theta + 2\,\pi}{3}} = 2 \frac{1}{\sin. \left(\frac{\theta}{3} + 120°\right)}$$

$$X_3 = \frac{1}{2 \sin. \frac{\theta + 4\,\pi}{3}}$$

The first of these roots corresponds to a minimum; the third is negative; both must be rejected. Thus, the second represents the proposed maximum. This root verifies the equation

(B); in fact, we have sin. $3a = 3 \sin. a - 4 \sin. 3a$. If we make $a = \frac{\theta + 2\pi}{3}$, we find sin. $(\theta + 2\pi) = 3 \sin. \frac{\theta + 2R}{3} - 4 \sin.^3 \frac{\theta + 2R}{3}$. Now, of the value of the root, we draw sin. $\frac{\theta + 2\pi}{3} = \frac{1}{2x}$; whence sin. $\theta = = \frac{3}{2x} - \frac{4}{8x^3}$, and finally, $2\beta x^3 - 3x^2 + 1 = 0$.

In order that $\frac{I}{V p}$ be maximum, or a joist to attain its greatest ratio of strength to weight, the relations between its four principal dimensions are to be—

$$\frac{b^1}{b} = \sin. \theta$$

$$\frac{h^1}{h} = \frac{1}{\frac{2 \sin. \theta + 2\pi}{3}}.$$

We will define the value of h^1 for section 100 × 48 mm. when the web is 4·3 mm. thick; $b^1 = 4{\cdot}8 - 4,3 = 43{\cdot}7$, $\frac{b^1}{b} = \frac{43{\cdot}7}{48} = 0{\cdot}9104 = \sin. \theta$; log. 0·9104 = 9·95923 = log. sin. θ = log. sin. 65° 33′. Therefore $\theta = 65° 33'$; $\frac{\theta}{3} = 21° 51'$; $\frac{\theta}{3} + 120° = 141° 51'$; but sin. $\left(\frac{\theta}{3} + 120°\right) = \sin. \left[\pi - \left(\frac{\theta}{3} + 120°\right)\right] = \sin. 38° 9'$. The table of logarithms shows sin. 38° 9′ = 9·79079 = log. 0·6177. Therefore sin. $\left(\frac{\theta}{3} + 120°\right) = 0{\cdot}6177\, h' = \frac{h}{2 \times 0{\cdot}6177} = 80{\cdot}9$ mm., so that the section 100 + 48 + 4·3 with the greatest ratio of strength possible has an average thickness t of flanges $= \frac{100 - 80{\cdot}9}{2} = 9{\cdot}55$mm.; its weight is 9·86 kilogs. per run metre.

From the foregoing it follows that:—(1) There exists a relation between the dimensions h, b, h^1, b^1, corresponding to the maximum ratio of strength to weight of section. (2) That the maximum ratio of strength does not correspond to the minimum weight of a section. (3) That $\frac{h^1}{h}$ is constant for as much as $\frac{b^1}{b}$ be constant itself and *vice versâ*. In fact, the equation (B) may take the form $\beta = \frac{3}{2x} - \frac{1}{2x^3}$ whence,

$$\frac{b^1}{b} = \frac{3\,h}{2\,h^1} - \frac{1\,h^3}{2\,h^{13}}$$

We deduce therefrom that $\frac{h^1}{h}$ decreases when $\frac{b^1}{b}$ increases and reciprocally. Now, let us examine what will be the influence of each of these three dimensions b^1, b, and h^1 on the ratio of strength in a joist of a given depth h.

Influence of b^1.—We take, for instance, section 250 × 115 mm. × 45 kilogs. per run metre, with a variation of thickness in web e from 9 to 12 mm. Let h^1 be determined by the formula $p = 0{\cdot}0078\,(b\,h - b^1\,h^1)$:—

h	b	e	b^1	h^1	p	$\frac{I}{V}$	$\frac{I}{V p}$	P. 4^m	$\frac{P.4^m}{p}$
								Kilos.	Kilos.
250	115	9	106	217	44·83	475·822	10·614	9·516	212
250	115	10	105	219	44·89	462·674	10·307	9·253	206
250	115	11	104	221	44·97	449 542	9·996	8 991	199
250	115	12	103	223	45·09	436·433	9·679	8·728	193

This table shows that the ratio of strength decreases rapidly in proportion as the thickness of web increases. For a difference of 3 mm. the safe load over a span of 4m. loses 788 kilogs., say, more than 8 per cent. It becomes thus a question of first importance that of determining the thickness of web. Unfortunately, there is some discrepancy between theory and practice, for the theory is based on a coefficient of security which becomes itself a matter of assumption. The empirical formula of German engineers gives good proportions in respect to the depth, but they seem to have neglected the ratio of the width of flanges to the depth of joist, and we propose to substitute the following:—

$$(C)\quad e = 0{\cdot}03\,h + 3\,\frac{b}{h}$$

It is the same formula where the constant is expresssed by $\frac{b}{h}$. The results thereby given are still practical, but they must be considered as a minimum. It would not be prudent to suggest any further reduction. The formula thus answers the purpose in view.

(1) The proof is supplied by calculating the shearing strain at the point of bearing. For a load uniformly distributed, this strain is equal to $\frac{P}{2}$. Thus, we have $R^1\,S = \frac{P}{2}$, R^1 representing the coefficient of resistance to the shearing, and S the area at the point considered. We infer from this formula that—

$$R^1 = \frac{4\,R}{L} \times \frac{I}{V s} = \frac{4\,R}{L} \times \frac{1}{V p} \times 0{\cdot}0078.$$

For section 300 × 125 × 10·3 at 60 kilogs. and L = 2^m 000, we find $R^1 = 2$ kilogs. 4.

Influence of b.—We take the section 300 mm. depth, and make the ratio $\frac{b}{h}$ successively equal to $\frac{1}{4}$, $\frac{1}{2}$, $\frac{3}{4}$, and 1; calculating b^1 according to the formula (c) and then the maximum ratio of strength to weight.

h	b	b^1	h^1	P	$\frac{I}{V}$	$\frac{I}{V p}$	P. 4^m	$\frac{P.4^m}{p}$
							Kilos.	Kilos.
300	75	65·25	234	56·41	660·532	11·709	13·210	234
300	150	139·50	248	81·15	1·067893	13·159	21·354	263
300	225	213·75	254·8	101·68	1·410591	13·872	28·312	277
300	300	288·00	258·8	120·62	1·726598	14·314	34·531	286

This table shows that, in the practical limits of ratio $\frac{b}{h}$, the the ratio of strength in a joist increases simultaneously with the ratio of the width of flanges to depth.

Influence of h^1.—Take the section 200 × 100 × 7·5 and let h^1 vary from 155 to 170 mm., and calculate the corresponding $\frac{I}{V p}$—

h	b	b^1	h^1	P	$\frac{I}{V}$	$\frac{I}{V p}$	P. 4^m	$\frac{P.4^m}{p}$
							Kilos.	Kilos.
200	100	92·5	155	44·17	379·618	8·594	7·592	172
200	100	92·5	160	40·56	350·933	8·652	7·018	173
200	100	92·5	164·4	37·38	324·162	8·672	6·483	173·4
200	100	92·5	165	36·95	320·398	8·671	6·408	173·4
200	100	92·5	166	36·23	314·065	8·668	6·281	173·3
200	100	92·5	167	35·51	307·654	8·663	6·153	173·2
200	100	92·5	170	33·34	287·956	8·636	5·759	172·7

These figures demonstrate the accuracy of the formula which gives the value of h^1 corresponding with the maximum ratio of strength to weight. In this particular case, $h^1 = 164$ mm. 4.

This section 200 × 100 mm. is required at 31 kilogs. per metre run. Then its ratio of strength to weight is 8·585, showing a difference of 109 units with the maximum. But it results also of this table that the ratio of strength varies little in the proximity of the maximum, and we may, without great inconvenience, take h^1 a little greater to the maximum value, in order to satisfy consumers who should require light sections. Thus for section 100 × 48 × 4·3, the $\frac{I}{V p}$ maximum is 4201 for 9·86 kilogs., whilst for same section at 9 kilogs. per run metre, the $\frac{I}{V p}$ is 4194. It seems preferable to us, in these conditions, to offer the latter to consumers.

Conclusions.—To obtain the greatest resistance possible in a joist of a given depth, it is necessary (1) to calculate the thickness of web by the formula $e = 0{\cdot}03\,h + 3\,\frac{b}{h}$, which corresponds to the practical minimum of the size required. (2) To increase as much as possible the width of flanges. (3) To determine the value of h^1 after the formula $h^1 = 2 \sin. \left(\frac{\theta}{3} + 120°\right)$ in which sin. $\theta = \frac{b^1}{h}$, h^1 may be taken a little above the value found to lessen the weight. In all cases it will be found easier to estimate the loss in the ratio of strength to weight occasioned by the diminution of weight per run metre.

PATENTS FOR INVENTIONS BILL.

The Government Patent Bill has just been issued. It includes a Bill for the modification of the Designs and Trade Marks Act, with which we do not propose to deal at present We give so much of the Bill here as refers to patents. We may point out that nearly all the provisions of the Bill are identical with the suggestions which we made in our impression for February 23rd. The Bill has a memorandum on it which very fully explains all the provisions.

Memorandum on Bill.

This Bill is designed to amend and consolidate in a single measure the provisions of the numerous laws relating to Patents, Designs, and Trade Marks, and at the same time to simplify procedure, lessen its cost, and increase the protection afforded. The law regulating applications for and the grant of patents is thirty years old, dating from 1852; and there are some half dozen other statutes relating to patents, passed between 1835 and 1859. The principal Acts which provide for the registration of ornamental and useful designs, and for conferring copyright therein, are forty years old, having been passed in 1842 and 1843; and there are amending Acts of 1850, 1858, 1861, and 1875. Some of the above statutes contain provisions which have become obsolete or unnecessary, and are confused in arrangement and form. The Trade Marks Act is comparatively modern, having been passed in 1875; but it contains some unworkable provisions relating to the Cutlers' Company,* and the definition of a trade mark also requires amendment. The Trade Mark Acts of 1876 and 1877 are short amending Acts. In 1865 and 1870 two Acts were passed for the protection of unpatented inventions and unregistered designs from the consequences of user or publication at or during the holding of industrial or international exhibitions. The Bill proposes to consolidate and repeal these Acts also. As regards the provisions of the three divisions of the Bill relating respectively to patents, designs, and trade marks, the principal alterations in the present systems are as follow:—

I.—*Patents.*

The fees payable at present in order to obtain a patent amount to £25, with further payments of £50 before the expiration of the third year and £100 before the expiration of the seventh year of the patent. Under the Bill a patent will be obtainable for £4, and, while the amount of the further payments remains unaltered, the payment of the £50 is postponed to the fourth year; so that a four years' patent will only cost £4. Under the existing Acts it is necessary for an intending patentee or his agent to apply personally at the Patent-office at least seven times, and make four separate payments, using four documents for the application. By this Bill an applicant or his agent will only have to call twice at the Patent-office, to use three documents, and to make two payments; but applicants may, if they please, transact their business entirely by post, and thus avoid either personal attendance at the office or the payment of agency fees. This will be best illustrated by the tabular comparison in the next column, giving a key to the procedure on an unopposed application, with provisional specification.†

It is also proposed to sell the new application and specification forms ready stamped at the Patent-office, or to send them by post at the price of the fee, *i.e.*, no charge to be made for the blank form itself. Only two stamped forms will be necessary, one a £1 declaration form, and another a £3 form for the complete specification. The Inland Revenue Department will also arrange to sell these stamps at Post-offices in the principal commercial centres of the kingdom. At present, persons residing in the country must either employ an agent in London to obtain the stamped forms, or obtain them through a stamp office from the Inland Revenue Department by post. The Bill provides for enforcing the grant of licences in certain cases, and subject to proper safeguards. It is proposed to lay down principles for the guidance of the Court which has jurisdiction to extend the term of a patent. In any action for infringement, either party will be empowered under the Bill to require a skilled assessor to be called in, and in any such action a patentee will be able, by leave of the Court, to disclaim, and give his disclaimer in evidence, but not in such case to obtain damages without leave of the Court. The proceeding by *scire facias* to repeal a patent is abolished, and power to obtain revocation on petition to the Court substituted.

* The Company of Cutlers of Hallamshire in the county of York was incorporated by statute in the reign of James I.—1624—since which time the company has exercised the privilege of assigning trade marks to persons engaged in the cutlery manufacture of the district.

† As the majority of applications for letters patent are by way of provisional protection, these observations refer to applications with provisional specifications in a correct form.

(I.) *By Applicant or his Agent.*

Under existing Acts.	Under Bill.
1. Petition, declaration, and provisional specification left at Patent-office.	1. Declaration and provisional specification left at or sent by post to Patent-office. Cl. 5.
2. Call for certificate of allowance of provisional protection.	2. Complete specification, with fee for sealing patent, left at or sent by post to Patent-office. Cl. 8.
3. Notice to proceed given.	
4. Call for certificate of notice to proceed.	
5. Warrant and seal bespoken and paid for.	
6. Call for patent.	
7. Specification filed.	

(II.) *By Patent-office.*

Under existing Acts.	Under Bill.
1. Provisional documents entered in Register.	1. Provisional documents entered in Register.
2. Application advertised in Journal.	2. Provisional documents referred to Examiner at Patent-office. Cl. 6.
3. Provisional documents sent to Law Officer.	3. Notification of acceptance sent to applicant or agent by post.
4. Provisional protection allowed by Law Officer.	4. Complete specification referred to Examiner. Cl. 19, 1.
5. Provisional protection advertised.	5. Advertisement of acceptance of complete specification. Cl. 10.
6. Notice to proceed advertised.	6. Notification of acceptance of complete specification sent to applicant or agent by post.
7. Provisional documents again sent to Law Officer.	7. Patent prepared and sealed. Cl. 12.
8. Law Officer's fiat for warrant received.	8. Patent sent to applicant or agent by post.
9. Warrant sent to Law Officer for signature.	
10. Warrant received from Law Officer.	
11. Patent prepared and sealed.	

The following are the other principal new provisions:—(1) Limitation of patent to one invention made statutory; with a proviso that it shall not be competent in an action or other proceeding to object to a patent on the ground that it comprises more than one invention. (2) Extension of provisional protection from six to fifteen months, or from application to sealing of patent. (3) Extension of first term of a patent from three to four years. The duration of patents will continue to be fourteen years. (4) Specification to contain distinct statement of claims. This will be of very great service for the purposes of indexing and reference. (5) Deposit of complete specification before the grant of the patent. This must be made within nine months from date of application with a provisional specification for patent. Class 8. (6) Appointment of examiners—(*a*) To examine applications for the purpose of seeing that the invention is subject matter for a patent, and that its nature has been fairly described; (*b*) to compare complete with provisional specifications for the purpose of seeing that they correspond (Cl. 19); (*c*) to examine amendments an disclaimers. (7) Appeal to law officer from examiners. (8) Substitution of seal of Patent-office for wafer seal now used in lieu of the Great Seal. (9) Enlargement of time for payment of fees and renewal. (10) Publication of an illustrated journal of patented inventions. (11) Discontinuance of register of proprietors; copies of deeds, &c., hitherto copied therein, to be supplied by the parties interested at their own cost. (12) Discontinuance of sending to Edinburgh and Dublin transcripts of letters patent and deeds and certified copies of specifications and disclaimers, but printed copies of the Patent-office publications will be sent to these cities. (13) Transfer of Patent Museum to Department of Science and Art, with power to require models on payment. (14) The provisions of the separate Acts relating to the protection of unpatented inventions exhibited at industrial and international exhibitions are repealed and re-enacted in the Bill.

The Bill proper is divided into parts, Part I. runs as follows:—

Part I.—Preliminary.

1.—This Act may be cited as the Patents, Designs, and Trade Marks Act, 1883.

2.—This Act is divided into parts, as follows:—Part I., Preliminary; Part II., Patents; Part III., Designs; Part IV., Trade Marks; Part V., General.

3.—This Act, except where it is otherwise expressed, shall commence from and immediately after the thirty-first day of December, one thousand eight hundred and eighty-three.

Part II.—Application for Grant of Patent.

4.—(1) Any person, whether a British subject or not, may make an application for a patent. (2) Two or more persons may make a joint application for a patent, and a patent may be granted to them jointly.

5.—(1) An application for a patent must be made in the form set forth in the first schedule to this Act; and must be left at, or sent by post to, the Patent-office in the prescribed manner. (2) An application must contain a declaration to the effect that the applicant is in possession of an invention, whereof he claims to be the true and first inventor, and for which he desires to obtain a patent, and must be accompanied by either a provisional or complete specification. (3) A provisional specification must describe the nature of the invention, and be accompanied by drawings, if required. (4) A complete specification, whether left on application or subsequently, must particularly describe and ascertain the nature of the invention, and in what manner it is to be performed, and must be accompanied by drawings, if required. (5) A specification, whether provisional or complete, must commence with the title, and end with a distinct statement of the invention claimed.

6.—The Comptroller shall refer every application to an examiner, who shall ascertain and report to the Comptroller whether (*a*) the invention is subject matter for a patent; and (*b*) the nature of the invention has been fairly described, and the application, specification, and drawings—if any—have been prepared in the prescribed manner.

7.—(1) If the examiner reports that the invention is not subject matter for a patent, the Comptroller may refuse the application. (2) If the examiner reports that the nature of the invention is not fairly described, or that the application, specification, or drawings has not or have not been prepared in the prescribed manner, the Comptroller may require that the application, specification, or drawings be amended before he proceeds with the application. (3) Where the Comptroller so refuses an application or requires an amendment, the applicant may appeal from his decision to the law officer. (4) The law officer shall, if required, hear the applicant and the Comptroller, and may make an order determining whether and subject to what conditions, if any, the application shall be accepted. (5) The Comptroller shall, when an application has been accepted, give notice thereof to the applicant.

8.—(1) If the applicant does not leave a complete specification with his application, he may leave it at any subsequent time within nine months from the date of application. (2) Unless a complete specification is left within that time the application shall be deemed to be abandoned.

9.—(1) Where a complete specification is left after a provisional specification, the Comptroller shall refer both specifications to an examiner for the purpose of ascertaining whether the complete specification has been prepared in the prescribed manner, and whether the claims in the two specifications are substantially the same. (2) If the examiner reports that the claims in the two specifications are not substantially the same, the Comptroller may refuse to accept the complete specification; but any such refusal shall be subject to appeal to the law officer. (3) The law officer shall, if required, hear the applicant and the Comptroller, and may make an order determining whether and subject to what conditions, if any, the complete specification shall be accepted. (4) Unless a complete specification is accepted within twelve months from

the date of application, then—save in the case of an appeal having been lodged against the refusal to accept—the application shall, at the expiration of those twelve months, become void.

10.—On the acceptance of the complete specification the Comptroller shall advertise the acceptance; and the application and specification or specifications with the drawings—if any—shall be open to public inspection.

11.—(1) Any person may at any time within two months from the first advertisement of the acceptance of a complete specification give notice at the Patent-office of opposition to the grant of the patent. (2) Where such notice is given the Comptroller shall give notice of the opposition to the applicant, and shall, on the expiration of those two months, refer the case to the law officer. (3) The law officer shall, if required, hear the applicant and any person so giving notice and being, in the opinion of the law officer, entitled to be heard in opposition to the grant, and shall determine whether the grant ought or ought not to be made. (4) The law officer may, if he thinks fit, obtain the assistance of an expert, who shall be paid such remuneration as the law officer, with the consent of the Treasury, shall appoint.

12.—(1) If there is no opposition, or, in case of opposition, if the determination is in favour of the grant of a patent, the Comptroller shall cause a patent to be sealed with the seal of the Patent-office. (2) A patent so sealed shall have the same effect as if it were sealed with the Great Seal of the United Kingdom. (3) A patent shall be sealed as soon as may be, and not after the expiration of fifteen months from the date of application, except in the cases hereinafter mentioned, that is to say:—(*a*) Where the sealing is delayed by an appeal to the law officer, or by opposition to the grant of the patent, the patent may be sealed at such time as the law officer may direct; (*b*) If the person making the application dies before the expiration of the fifteen months aforesaid, the patent may be granted to his legal representative and sealed at any time within six months after the death of the applicant.

13.—Every patent shall be dated and sealed as of the day of application: Provided that no proceedings shall be taken in respect of an infringement committed before the publication of the complete specification.

Provisional Protection.

14.—Where an application for a patent in respect of an invention has been accepted, the invention may during the period between the date of the application and the date of sealing such patent be used and published without prejudice to the patent to be granted for the same; and such protection from the consequences of use and publication is in this Act referred to as provisional protection.

Protection by Complete Specification.

15.—After the acceptance of a complete specification and until the date of sealing a patent in respect thereof, or the expiration of the time for sealing, the applicant shall have the like privileges and rights as if a patent for the invention had been sealed on the date of the acceptance of the complete specification.

Patent.

16.—Every patent when sealed shall have effect throughout the United Kingdom, the Channel Islands, and the Isle of Man: Provided that a patent shall not have effect in any of the Channel Islands unless and until it has been duly registered in the Royal Court having jurisdiction therein.

17.—(1) The term limited in every patent for the duration thereof shall be fourteen years from its date. (2) But every patent shall, notwithstanding anything therein or in this Act, cease at the end of the fourth or seventh year of its term, unless in the fourth and in the seventh year respectively of its term the patentee takes out at the Patent-office a certificate of renewal, which shall be granted on his request in writing. (3) If, nevertheless, in any case, by accident, mistake, or inadvertence, the patentee fails so to take out a certificate of renewal, he may apply to the Comptroller for an enlargement of the time for taking it out. (4) Thereupon the Comptroller may, if he thinks fit, on receipt of the prescribed fee for enlargement, not exceeding ten pounds, enlarge the time accordingly, subject to the following conditions:—(*a*) The time for taking out such a certificate shall not in any case be so enlarged as to extend beyond six months from the end of the fourth or the seventh year as aforesaid as the case may be. (*b*) No proceeding shall be taken in respect of an infringement of the patent committed within the enlarged time, unless by leave of the Court before which the proceeding is proposed to be taken.

Amendment of Specification.

18.—(1) An applicant or a patentee may, by request in writing left at the Patent-office, seek leave to amend his specification by way of disclaimer or explanation, stating his reasons for the same. (2) The request shall be advertised in the prescribed manner, and at any time within three weeks from its first advertisement, any person may give notice at the Patent-office of opposition to the amendment. (3) Where such notice is given the Comptroller shall give notice of the opposition to the person making the request, and shall refer the case to the law officer. (4) The law officer shall, if required, hear the person making the request and the person so giving notice, and being in the opinion of the law officer entitled to be heard in opposition to the request, and shall determine whether and subject to what conditions, if any, the amendment ought to be allowed. (5) Where no notice of opposition is given, or the person so giving notice does not appear, the Comptroller shall determine whether and subject to what conditions, if any, the amendment ought to be allowed. (6) When leave to amend is refused by the Comptroller, the person making the request may appeal from his decision to the law officer. (7) The law officer shall, if required, hear the person making the request and the Comptroller, and may make an order determining whether and subject to what conditions, if any, the amendment ought to be allowed. (8) No amendment shall be allowed that would make the specification, as amended, claim an invention substantially larger than or substantially different from the invention claimed by the specification as it stood before amendment. (9) Leave to amend shall be conclusive as to the right of the party to make the amendment allowed, except in case of fraud; and the amendment shall in all courts and for all purposes be deemed to form part of the specification. (10) The foregoing provisions of this section do not apply when and so long as any action for infringement or other legal proceeding in relation to a patent is pending.

19.—(1) In an action for infringement of a patent, and in a proceeding for revocation of a patent, the Court or a judge may order that the patentee shall, subject to such terms as to costs and otherwise as the Court or a judge may impose, be allowed to disclaim any part of the invention specified in such order, and give the disclaimer in evidence. (2) Where a patentee so disclaims he shall within the prescribed time leave at the Patent-office a copy of the order giving him leave to disclaim, and of his disclaimer.

20.—Where an amendment by way of disclaimer has been allowed under this Act, no damages shall be given in any action in respect of the use of the invention before the disclaimer, unless the patentee establishes to the satisfaction of the Court that his original claim was framed in good faith and with reasonable skill and knowledge.

21.—Every amendment of a specification shall be advertised in the prescribed manner.

Compulsory Licences.

22.—If on the petition of any person interested it is proved to the Board of Trade that by reason of the default of a patentee to grant licences on reasonable terms—(*a*) The patent is not being worked in the United Kingdom; or (*b*) The reasonable requirements of the public with respect to the invention cannot be supplied; or (*c*) Any person is prevented from working or using to the best advantage an invention of which he is possessed, the Board may order the patentee to grant licences on such terms as to the amount of royalties, security for payment, or otherwise, as the Board, having regard to the nature of the invention and the circumstances of the case, may deem just.

Register of Patents.

23.—There shall be kept at the Patent-office a book called the Register of Patents, wherein shall be entered the names and addresses of grantees of patents, notification of assignments and of transmissions of patents, of licences under patents, and of amendments, extensions, and revocations of patents, and such other matters affecting the validity or proprietorship of patents as may from time to time be prescribed. (2) The Register of Patents shall be *primâ facie* evidence of any matters by this Act directed or authorised to be inserted therein.

Fees.

24.—(1) There shall be paid to and for the use of the Crown, on the several instruments described in the second schedule to this Act, the fees in that schedule mentioned. (2) The Board of Trade may from time to time, if they think fit, with the consent of the Treasury, reduce any of those fees.

Extension of Term of Patent.

25.—(1) A patentee may, after advertising in manner directed by any rules made under this section his intention to do so, present a petition to her Majesty in Council, praying that his patent may be extended for a further term; but such petition must be presented at least six months before the time limited for the expiration of the patent. (2) Any person may enter a caveat, addressed to the Registrar of the Council at the Council-office, against the extension. (3) If her Majesty shall be pleased to refer any such petition to the Judicial Committee of the Privy Council, the said Committee shall proceed to consider the same, and the petitioner and any person who has entered a caveat shall be entitled to be heard by himself or by counsel on the petition. (4) The Judicial Committee shall, in considering their decision, have regard to the nature and merits of the invention in relation to the public, to the profits made by the patentee as such, and to all the circumstances of the case. (5) If the Judicial Committee report that the patentee has been inadequately remunerated by his patent, it shall be lawful for her Majesty in Council to extend the term of the patent for a further term not exceeding seven, or in exceptional cases, fourteen years; or to order the grant of a new patent for the term therein mentioned, and containing any restrictions, conditions, and provisions that the Judicial Committee may think fit. (6) It shall be lawful for her Majesty in Council to make, from time to time, rules of procedure and practice for regulating proceedings on such petitions, and subject thereto such proceedings shall be regulated according to the existing procedure and practice in patent matters of the Judicial Committee. (7) The costs of all parties of and incident to such proceedings shall be in the discretion of the Judicial Committee; and the orders of the Committee respecting costs shall be enforceable as if they were orders of a division of the High Court of Justice.

Revocation.

26.—(1) The proceeding by *scire facias* to repeal a patent is hereby abolished. (2) Revocation of a patent may be obtained on petition to the Court. (3) Every ground on which a patent might, at the commencement of this Act, be repealed by *scire facias*, shall be a ground of revocation. (4) The plaintiff must deliver with his petition particulars of the objections on which he means to rely, and no evidence shall, except by leave of the Court or a judge, be admitted in proof of any objection of which particulars are not so delivered. (5) Particulars delivered may be from time to time amended by leave of the Court or a judge. (6) The defendant shall be entitled to begin, and give evidence in support of the patent, and if the plaintiff gives evidence impeaching the validity of the patent, the defendant shall be entitled to reply. (7) Where a patent has been revoked on the ground of fraud, the Comptroller may, on the application of the true inventor made in accordance with the provisions of this Act, grant to him a patent in lieu of and bearing the same date as the patent so revoked.

Legal Proceedings.

27.—(1) In an action for infringement of a patent, the Court may, if it thinks fit, and shall, on the request of either of the parties to the proceeding, call in the aid of an assessor specially qualified, and try and hear the case wholly or partially with his assistance. (2) The Court of Appeal or the Judicial Committee of the Privy Council may, if they see fit, in any proceeding before them respectively, call in the aid of an assessor as aforesaid. (3) The remuneration, if any, to be paid to an assessor under this section shall be determined by the Court, or the Court of Appeal, or Judicial Committee, as the case may be, and be paid in the same manner as the other expenses of the execution of this Act.

28.—(1) In an action for infringement of a patent the plaintiff must deliver with his statement of claim, or by order of the Court or the judge, at any subsequent time, particulars of the breaches complained of. (2) The defendant must deliver with his statement of defence, or, by order of the Court or a judge, at any subsequent time, particulars of any objections on which he relies in support thereof. (3) If the defendant disputes the validity of the patent, the particulars delivered by him must state on what grounds he disputes it, and if one of those grounds is want of novelty, must state the time and place of the previous publication or user alleged by him. (4) At the hearing no evidence shall, except by leave of the Court or a judge, be admitted in proof of any alleged infringement or objection of which particulars are not so delivered. (5) Particulars delivered may be from time to time amended, by leave of the Court or a judge. (6) On taxation of costs regard shall be had to the particulars delivered by the plaintiff and by the defendant; and they respectively shall not be allowed any costs in respect of any particular delivered by them unless the same is certified by the Court, or a judge, to have been proven or to have been reasonable and proper, without regard to the general costs of the case.

29.—In an action for infringement of a patent, the Court or a judge may on the application of either party make such order for an injunction, inspection or account, and impose such terms and give such directions respecting the same and the proceedings thereon as the Court or a judge may see fit.

30.—In an action for infringement of a patent, the Court or a judge may certify that the validity of the patent came in question; and if the Court or a judge so certifies, then in any subsequent action for infringement, the plaintiff in that action, on obtaining a final order or judgment in his favour, shall have his full costs, charges, and expenses as between solicitor and client, unless the Court or judge trying the action certifies that he ought not to have the same.

Miscellaneous.

31.—Every patent may be in the form in the first schedule to this Act, and shall be granted for one invention only; but it shall not be competent for any person in an action or other proceeding to take any objection to a patent on the ground that it comprises more than one invention.

32.—A patent granted to the true and first inventor shall not be invalidated by an application in fraud of him, or by provisional protection obtained thereon, or by any use or publication of the invention subsequent to that fraudulent application during the period of provisional protection.

33.—A patentee may assign his patent for any place in or part of the United Kingdom, Channel Islands, or Isle of Man, as effectually as if the patent were originally granted to extend to that place or part only.

34.—If a patent is lost or destroyed, or its non-production is accounted for to the satisfaction of the Comptroller, the Comptroller may at any time cause a duplicate thereof to be sealed.

35.—The law officers may from time to time make, alter, and rescind rules regulating the practice and procedure before them under this part of this Act; and in any proceeding before either of the law officers under this part of this Act, the law officer may order costs to be paid by either party, and any such order may be made a rule of the Court.

36.—The exhibition of an invention at an industrial or international exhibition, certified as such by the Board of Trade, or the publication of any description of the invention during the period of the holding of the exhibition, or the use of the invention for the purpose of the exhibition in the place where the exhibition is held, or the use of the invention during the period of the holding of the exhibition by any person elsewhere, without the privity or consent of the inventor, shall not prejudice the right of the inventor or his legal personal representative to apply for and obtain provisional protection and a patent in respect of the invention or the validity of any patent granted on the application, provided that both the following conditions are complied with, namely:—(*a*) The exhibitor must, before exhibiting the invention, give the Comptroller the prescribed notice of his intention to do so; and (*b*) the application for a patent must be made before or within six months from the date of the opening of the exhibition.

37.—The Comptroller shall cause to be issued periodically an illustrated journal of patented inventions, as well as reports of patent cases decided by courts of law, and any other information that the Comptroller may deem generally useful or important.

38.—The control and management of the existing Patent Museum, and its contents shall from and after the commencement of this Act be transferred to and vested in the Department of Science and Art, subject to such directions as her Majesty in Council may see fit to give.

39.—The Department of Science and Art may at any time require a patentee to furnish a model of his invention for deposit in the Patent Museum on payment to the patentee of the cost of the manufacture of the model; the amount to be settled, in case of dispute, by the Board of Trade.

40.—(1) A patent shall not prevent the use of an invention for the purposes of the navigation of a foreign vessel within the jurisdiction of any of her Majesty's Courts in the United Kingdom, Channel Islands, or Isle of Man, or the use of an invention in a foreign vessel within that jurisdiction, provided it is not used therein for or in connection with the manufacture or preparation of anything intended to be sold in or exported from the United Kingdom, Channel Islands, or Isle of Man. (2) But this section shall not extend to vessels of any foreign State in whose territories British subjects do not enjoy equal benefits in respect of the subject matter of this section.

41.—(1) The inventor of any improvement in instruments or munitions of war, his executors, administrators, or assigns—who are in this section comprised in the expression the inventor—may—either for or without valuable consideration—assign to her Majesty's Principal Secretary of State for the War Department—hereinafter referred to as the Secretary of State—on behalf of her Majesty, all the benefit of the invention and of any patent obtained or to be obtained for the same; and the Secretary of State may be a party to the assignment. (2) The assignment shall effectually vest the benefit of the invention and patent in the Secretary of State on behalf of her Majesty, and all covenants and agreements therein contained for keeping the invention secret and otherwise shall be valid and effectual—notwithstanding any want of valuable consideration—and may be enforced accordingly by the Secretary of State. (3) Where any such assignment has been made to the Secretary of State, he may at any time before the application for a patent for the invention, or before publication of the specification or specifications, certify to the Comptroller his opinion that, in the interest of the public service, the particulars of the invention and of the manner in which it is to be performed should be kept secret. (4) If the Secretary of State so certifies, the application and specification or specifications with the drawings, if any, and any amendment of the specification or specifications, and any copies of such documents and drawings, shall, instead of being left in the ordinary manner at the Patent-office, be delivered to the Comptroller in a packet sealed by authority of the Secretary of State. (5) Such packet shall until the expiration of the term or extended term during which a patent for the invention may be in force, be kept sealed by the Comptroller, and shall not be opened save under the authority of an order of the Secretary of State, or of the law officers. (6) Such sealed packet shall be delivered at any time during the continuance of the patent to any person authorised by writing under the hand of the Secretary of State to receive the same, and shall, if returned to the Comptroller, be again kept sealed by him. (7) On the expiration of the term or extended term of the patent, such sealed packet shall be delivered to any person authorised by writing under the hand of the Secretary of State to receive it. (8) Where the Secretary of State certifies as aforesaid, after an application for a patent has been left at the Patent-office, but before the publication of the specification or specifications, the application, specification, or specifications, with the drawings—if any—shall be forthwith placed in a packet sealed by authority of the Comptroller, and such packet shall be subject to the foregoing provisions respecting a packet sealed by authority of the Secretary of State. (9) No proceeding by petition or otherwise shall lie for revocation of a patent granted for an invention in relation to which the Secretary of State has certified as aforesaid. (10) No copy of any specification or other document or drawing, by this section required to be placed in a sealed packet, shall in any manner whatever be published or open to the inspection of the public, but save as in this section otherwise directed, the provisions of this part of this Act shall apply in respect of any such invention and patent as aforesaid. (11) The Secretary of State may, at any time by writing under his hand, waive the benefit of this section with respect to any particular invention, and the specifications, documents, and drawings shall be thenceforth kept and dealt with in the ordinary way. (12) The communication of any invention for any improvement in instruments or munitions of war to the Secretary of State, or to any person or persons authorised by him to investigate the same or the merits thereof, shall not, nor shall anything done for the purposes of the investigation, be deemed use or publication of such invention so as to prejudice the grant or validity of any patent for the same.

Existing Patents.

42.—(1) The provisions of this Act relating to applications for patents and proceedings thereon shall have effect in respect only of applications made after the commencement of this Act. (2) Every patent granted before the commencement of this Act, or on an application then pending, shall remain unaffected by the provisions of this Act relating to compulsory licences. (3) In all other respects—incluing the amount and time of payment of fees—this Act shall extend to all patents granted before the commencement of this Act, or on applications then pending, in substitution for such enactments as would have applied thereto if this Act had not been passed. (4) All instruments relating to patents granted before the commencement of this Act required to be left or filed in the Great Seal Patent-office shall be deemed to be so left or filed if left or filed before or after the commencement of this Act in the Patent-office.

Definitions.

43.—In and for the purposes of this Act—"Patent" means letters patent for an invention; "Patentee" means the person for the time being entitled to the benefit of a patent; "Invention" means any manner of new manufacture the subject of letters patent and grant of privilege within section six of the Statute of Monopolies—that is, the Act of the twenty-first year of the reign of King James the First, chapter three, intituled "An Act concerning monopolies and dispensations with penal laws and the forfeiture thereof"—and includes an alleged invention.

LETTERS TO THE EDITOR.

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

GUIDE-BLADE PROPELLERS.

Sir,—The paper read last Wednesday week at the Institution of Naval Architects by Mr. Thorneycroft is extremely interesting, as showing some progress in the art of scientific screw propulsion. It is a curious thing, however, that he seems ignorant of the fact that just twenty years ago I tried much the same kind of experiments that are described in his paper, and many of my results are published in the *Times*, 30th August, 1865; in "Papers on Naval Architecture," No. XIV., vol. iv., 1865; "Proceedings" Inst. C.E. in Scotland, 20th December, 1865; "Proceedings" Inst. Naval Architects, 1867 and 1868; "Proceedings" Society of Engineers for 1868, &c. But though my invention seems now called "Mr. Thorneycroft's Deflector," and is by him rather inconsistently attributed in some degree to the Hon. Richard Parsons, yet as my patent has long ago become public property, and the invention cannot be claimed by either of these gentlemen, I hope you will permit me to make a few remarks upon his experiments.

The diagram—page 202—is evidently not a working drawing, but it shows with sufficient accuracy the way in which several of my patent screw propellers were constructed. I do not, however, think the conical projection C of any use; and I found the cylindrical tube pernicious. Indeed, a moment's consideration will show that no cylindrical tube can have a forward resultant from the divergent streams of water impinging upon it, but these must get reflected into the main stream, and to some extent damage its efficiency, an efficiency directly dependent upon the absence of any element of motion in the reverse current at right angles to the vessel's course. The proper form of casing for a screw is not cylindrical, and it is easily discoverable for any given vessel. But I found the enlarged boss in the guide blades a very considerable gain, and used it in several of the few propellers made under my patent. Its effect is the same as the large boss in Mr. Griffith's propeller, and its proportions vary from one-third of the diameter upwards, according to the velocity, pitch, and diameter of the propeller. It would trespass too greatly on your space to explain how to proportion this boss. But if anyone is interested in the matter, and will study the highly unorthodox theory given in my published papers, they will find in it an unerring guide to the design of this class of propeller, and sufficient information for ascertaining the diameter of boss for any given case. Indeed, this theory of mine, though somewhat scouted by the old school, possesses several advantages. It is geometrically enunciated, and made in the form which is used in Germany, when things become too complicated for mathematics. It will lead to no wrong inferences, or land one in the absurdities of "negative slip," and if applied to Mr. Thorneycroft's experiments, it shows that his increased pitch is unmixed gain, and he can advantageously go further in the same direction provided he proportions the deflectors to suit.

It has always appeared to me that the guide blade system is the only one by which the diameters of screw propellers can be reduced, and their velocity of rotation accelerated; and if we regard the modern steam engine developing itself in the same direction, we cannot fail to be struck with the singularly harmonious laws of matter and motion by which both propeller and engine will ultimately run in quiet unison at a high speed, as they now do so uneasily at a low speed. The largest set of guides or deflectors I ever made was attached to the ss. Corsyra. The diameter of this propeller was 12ft., and its results were extremely instructive. All vibration was destroyed, and the vessel ran a perfectly straight course, and overtook every other while meeting head winds; but during calm weather the blades did no good, and possibly harm. As an experiment, however, this trial was completely successful, and most encouraging.

The turbine and screw propeller have much in common, and if one takes an old-fashioned water wheel to represent the screws now generally in use, the guide-blade propeller compares exactly with the turbine, and is subject to very much the same laws of hydrodynamics. Just as a turbine, unscientifically designed, will waste 90 per cent. of the water power flowing through it, so will a guide-blade propeller, improperly designed, give a worse result than the common screw, though all the time it has a potentiality for better things.

It is pleasant to see one's invention revive after sleeping for twenty years, though under another name; and if I am so fortunate as to witness another equal interval, probably then it may be found in general use, and this would furnish another argument for revising the patent laws, by which inventors or their remote descendants should receive a just reward for their unrequited labours.

Arthur Rigg.

42, Old Broad-street, E.C.

STEAM POWER ON TRAMWAYS.

Sir,—I have noticed the correspondence in The Engineer on this subject. Permit me, as one having a little experience, to say that the getting rid of steam by superheating it has two objections. The first is, that although no steam issues directly from the funnel of the engine, yet in cold or damp weather condensation takes place the moment the steam gets out of the influence of the furnace gas, and thus a cloud of steam will accompany an engine, and yet be apparently disconnected from it by two or three feet. This result ensues with the Wilkinson engine used in this town, and very recently one of the drivers was fined 10s. by Mr. Bruce for this very thing.

The second point is, that superheating the steam runs away with a great deal of fuel; in fact, visible steam is practically water, and to render this invisible it must be evaporated all over again. Mr. Wilkinson may doubt this, but I may tell him that some years ago the superheating plan was tried on the locomotives of the Metropolitan District Railway, with this result—that the steam was effectively got rid of, never appearing as vapour, but condensing into water in the sides of the tunnel; but the consumption of fuel was augmented from a little under 30 lb. per mile to over 50 lb., and so the scheme was abandoned.

Mr. Wilkinson is now going through what I call the first stage of tramway experience. Nearly all makers have been through it—Messrs. Merryweather, Mr. Hughes, Mr. Brown, of Winterthur, &c. It is known as the sanguine stage. In about six months he will begin to learn that all is not gold that glitters.

Leeds, March 20th. J. D. Harte.

Sir,—Mr. Charles Crowden makes a mistake. I am not a maker of or dealer in tramway locomotives, but only an examiner for tramway companies, in which capacity I am pretty well able to judge of their respective merits. A few years ago I was a maker, and lost a large sum of money by the venture. Messrs. Merryweather, I am sure, will be the first to admit that they copied my water condenser, and have also made use of Messrs. Kitson's air condenser. If engineers do not copy other people's ideas, it will be the worse for them in the end.

But, leaving personalities, let us return to the subject at issue. Messrs. Wilkinson say that their engine is economical in fuel. Surely this cannot be the case, seeing that they get up steam twice—once to drive the engines, and again to render the steam invisible; and as to sparks being emitted, I saw both blue flames and sparks issuing from their chimneys in Leeds only a fortnight ago. No doubt their engine is well designed for power in ascending gradients, but this necessitates a much greater speed of the machinery.

I believe I was the first person to point out that all the exhaust steam can be condensed, and yet enough draught be left to keep up steam if the boiler be properly proportioned, and it is a question well worthy of discussion whether it is not better to reduce the gases in the chimney by keeping the steam out rather than superheat the exhaust in the chimney to render it invisible.

Foundry-square, Leicester, 20th March. Henry Hughes.

Sir,—I trust you will bring to bear your influence with a view to opposing the movement started to induce the Board of Trade to modify the existing rules to regulate the use of steam on street tramways in order to admit of the display of exhaust steam. It is well known that the object of the proposals is to secure authority for running a type of engine which is, in many respects, objectionable to the public; and, as several types of tramway engines have been constructed by first-rate engineers which avoid the objectionable features, it is important that the engineering press, and mechanical engineers, as well as the public generally, should oppose most strenuously the attempt referred to. Every mechanical man knows that the alleged superheating of the exhaust steam can only be very partially effective under the atmospheric conditions experienced at certain seasons in England, and at such times the display of exhaust steam would be an unbearable nuisance. This is evidenced by the correspondence in the *Leeds Mercury* recently. One writer says:—"These engines, jangling, wheezing, and flaring along the road day and night, seem to me, apart from any question of horses, to add another curse to existence." This superheated steam, in fact, would frighten horses more speedily than any white steam shown by a locomotive.

I trust the authorities at the Board of Trade will not be hoodwinked by the *ex parte* representations made to them, which clearly emanate from interested quarters, and it is evident that if the existing rules are adhered to—which were framed in the true public interests—manufacturers will be stimulated to introduce fresh contrivances to get over any existing objectionable features in the present types of engines.

Pro Bono Publico.

Southwark, March 19th.

CONTINUOUS BRAKES UPON SLIP CARRIAGES.

Sir,— the collision which took place near Hatfield, on the 22nd of December last, between the front and rear portions of the 9.30 p.m. train from King's-cross, again directs attention to the important question of continuous brakes upon slip carriages.

In this case the main portion of the train was fitted with Smith's vacuum brake, but the four slip carriages had only hand brakes available. When the slip guard saw that the train was being stopped he applied his hand brake to the one vehicle in which he was riding, but was unable, with this small proportion of braked weight, to pull up in time. It is, however, perfectly certain that if these four slip vehicles had been fitted with a continuous brake under his charge, he would have been able to have stopped them, and entirely avoided the accident, or, at the very least, reduced the speed to such an extent that no collision would have followed. General Hutchinson points out that there must always be a certain amount of risk attaching to the slipping of carriages.

This is quite true; therefore, to reduce the risk to a minimum, all slip carriages should be fitted with continuous brakes; it will be advantageous to consider what are the requirements. (1) The driver must have the control over the whole of the brake power—including the slip portion—up to the point of slipping. (2) The guard of the slip portion must be able to apply the whole of the brake power even upon the engine wheels, so long as his portion be attached to and forms part of the train. (3) The brake must be automatic upon the whole train and apply itself to both portions, in case of a break loose or separation at any other part of the line, except where the vehicles have to be slipped. (4) When "slipped" the continuous brake must be left in perfect working order, upon both the train and slip portion. (5) The guard of the slip portion must be able to take off and put on the continuous brake upon his portion in order to regulate it in running to the platform. In case of emergency, or the train being suddenly and unexpectedly stopped—as at Hatfield—it is most important that the slip guard should have an efficient continuous brake or a serious collision may result. Trains are daily running upon the Great Eastern, London, Brighton, and South Coast, and other lines, provided with brake power which fulfils the whole of these essential conditions or requirements. Why, then, does not the Great Northern Railway Company also adopt efficient appliances to ensure the safety of those passengers who ride in their slip carriages?

The inefficiency of the Clayton two-minute vacuum brake used upon the Midland Railway has frequently been pointed out in your columns, and details of many failures have been published. On Saturday morning, 10th of March, another instance occurred. The up express train due to arrive at St. Pancras at 5.15 a.m. was observed to pass a block signal-box with the tail lamp out; the signalman, according to rule, sent the signal, "stop and examine train" to the next station—Child's Hill. When the Clayton brake was applied it completely failed to act; the train ran past the station and danger signals, and ultimately came to rest at the next station, West End. The train had to run forward to St. Pancras without the use of the continuous brake, as the apparatus on the engine No. 104 was out of order. This circumstance naturally caused much consternation amongst the passengers, several of whom have given me the above details, and state positively that they did not feel the least action of the brake, and that when the train came to rest the brake blocks were found full off.

Saxe-Coburg-street, Leicester, March 19th. Clement E. Stretton.

ELECTRO-MAGNETS.

Sir,—As the translator of Count du Moncel's recent work on the "Construction of Electro-magnets," I noticed with interest the letter from "An Electrical Student" in your issue of the 9th inst., and at once communicated with Count du Moncel on the subject. In the work in question, "Elements of Construction for Electro-magnets," published by Spon, of Charing Cross, "An Electrical Student" will find the results of very numerous and complete experiments. It will therefrom be seen that the experience of Count du Moncel is that tempered cores are less usefully employed than soft iron. For rapid magnetisation and demagnetisation there can be no question that the latter is preferable, in that tempered iron acts as a permanent magnet, and the effects produced only correspond with the difference between the permanent magnetism retained by the core and that imparted to it by the exciting current. In tempered cores the magnetisation is also more slowly developed, owing to the greater difficulty with which the molecular movements to produce the polarisation are effected. But for armatures the question may be different, according to the extent of their magnetisation, and according as attraction at a distance or on contact is considered. In the first case strongly polarised armatures act more powerfully than soft iron; but in the second, supposing the magnetic power of the magnet to be greater than that of the armature, a less effect is produced, since the magnetic action cannot so well penetrate the tempered metal. In 1857 Count du Moncel published a book entitled, *Le Magnetism au point de vue du la Construction des Electro Aimants*, which, I believe, is now out of print, but a copy will be found in the library of the Society of Telegraph Engineers, and at pages 75 and 103, "An Electrical Student" will find that the question has been very thoroughly gone into, with the result that, on the whole, soft iron armatures may be considered more advantageous than polarised ones in the proportion of, perhaps, 18 to 11.

C. L. Wharton.

8 and 9, Holborn-viaduct, London, E.C., March 15th.

GOSLING'S FUEL ECONOMISER.

Sir,—I have read the reports of this economiser with interest, as in 1874 I made several tests with John Lake's coal economiser, which is the same principle as Gosling's, that is, discs in the flues. I put them on to six or seven boilers at Messrs. Andrews', Harpurhey, Manchester, and two boilers in the Royal Gun Carriage Department, Woolwich Arsenal. I can name about forty other boilers which were fitted with them; and Mr. Lake also had an arrangement for locomotives, as I fitted one on at the Lillie Bank Engine Works, West Brompton, London. The London agent was Mr. William Yates, Princes-street, Storey's-Gate, Westminster, London. A company was formed to work the invention, and the registered office was in Lincoln's-inn-fields, London.

Henry-street, Keighley, March 14th. Jas. Baldwin.

THE PRINCIPLES OF MODERN PHYSICS.

Sir,—Permit me, through the medium of your correspondence columns, to say that I do not quite hold with "A Student" in his arguments on the conservation of energy. If we reason as he reasons, we may apply his reasoning to anything. For example, a boiler is standing ready for work, with an internal steam pressure of 60 lb. to the square inch. Instead of this force being utilised, the fire is extinguished, the water in the boiler cools down, and the steam condenses until the pressure is equal to the external air. What then becomes of the energy? And yet who is bold enough to deny that the boiler did not contain energy, seeing that it is an indisputable fact?

I consider the energy was quite as much lost in the above example as in the 20 lb. of coal, or the clock spring.

Torquay, March 20th. A Fellow Student.

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

(*From our own Correspondent.*)

The finished ironworks are this week putting forth much effort to complete by Thursday night those orders which customers press for delivery. On Thursday night the works will be laid off for the Easter holidays. How long they are to remain idle will depend upon the state of individual firms' order books. It is not, however anticipated that much will be done until certainly Wednesday next.

The extent of new business which has been transacted on our Exchanges this week is not large. Actual prices of manufactured iron favoured buyers, though nominal quotations were upheld.

The representatives of John Bagnall and Sons, Limited, quoted: Bars, 1in. to 6in. flat and from $\frac{7}{16}$in. to 3in. round and square, £7 10s.; 6½in. to 9in flat and 3½in. to 3½in. round and square, £8; 4½in. and 4¼in. ditto, £8 10s.; 4⅜in. and 4½in. ditto, £9; 4⅞in. and 5in. ditto, £10; 5¼in. and 5½in. round only, £10 10s.; 5⅝in. and 5¾in. ditto, £11; 5⅞in. and 5⅞in. ditto £11 10s.; 5¾in. and 6in. ditto, £12; 6⅜in. and 7in., £14; 7⅝in. and 7¾in. ditto, £15. Turning and horseshoe bars are ranged under the £7 10s. head, and plate and fullered shoe and angle bars under the £8 head. Best rivet iron was £9, and double best £10; hoops of 14 to 19 w.g., £8; and as to best locomotive and gas strip, the firm would only quote prices against specification. Sheets, singles, to 20 w.g., were £9; doubles, £10 10s.; and lattens, £12. Ordinary boiler plates were £9; best, £10; double best, £11; and treble best, £12—all at works.

The Pelsall Coal and Iron Company, Limited, gave their quotations as: Ordinary ½in. round and square bars, £6 5s.; hoops and strips, £6 10s. to £7; "Eureka" hoops and strips, £8 10s.; crown and horseshoe bars, £6 15s.; gas strips, to 6⅜in. wide, £6 5s.; 7in. to 8½in., £6 15s.; 8¾in. to 12½in., £7 5s.; nail strip, from 12in. to 24in. and not thinner than 14 w.g. to 12 w.g., £6 10s.; hinge strip, £7 10s.; angles, £6 10s. to £7; Tees, £7 10s. to £8; sash iron, £8 5s.; sheets, not thinner than 20 w.g., £7 10s.; tank sheets, not thinner than 13 w.g., and tack sheets to 18 w.g., also £7 10s.; "Eureka" sheets, not thinner than 20 w.g., £9 10s.; charcoal sheets, up to 20 w.g., £14 10s.; and charcoal rods, £13 5s.; steel hoops and strips, 1 by 18 w.g., and upwards, marked "Crown P.L.S.L.," £8 10s. per ton; and steel rails, as per section sheet, £7 10s.

Sheetmakers report a lack of specifications from the galvanisers. Prices remain at: £8 nominal for singles, £8 5s. to £8 10s. doubles, and £9 5s. and on for lattens. Boiler plates keep dull, but girder and tank plates are here and there in rather better sale. £8 10s. to £9 and £10 is quoted for boiler plates, and 10s. per ton less for tank and girder plates.

The animation noted last week in pigs made in other districts than Staffordshire, and sold on our Exchanges, does not show abatement. Other considerable sales have been made, and one consumer is credited with having bought 5000 tons. Derbyshires stand at 48s. 6d. to 50s.; Northamptons at 47s. 6d.; and Staffordshire at 50s. to 52s. 6d. for part mines.

The blast furnace proprietors have this week given their men notice of a reduction in wages of 5 per cent. consequent upon the low selling prices which at present prevail.

Messrs. J. Wright and Co., of Tipton, are busy making Berryman feed-water heaters.

Engineers' and cable and anchor forgings are in active production.

The enamelling of ornamental iron castings has this week been begun in Wolverhampton by a new firm of manufacturers, who claim for their process superiority to some of those at present in operation. The enamel is so thin, they say, that the sharp outlines of the castings are not obliterated, and that the enamel is in every way much tougher than that generally employed. The firm intend to apply their new enamel to wrought iron goods also.

At a meeting of nail and chain manufacturers, held in Birmingham to discuss Mr. Broadhurst's proposed Bill affecting female labour in the nail and chain trades, a resolution has been passed denying that the method at present in vogue of carrying on the industry was conducive to immorality, and pointing out that the restrictive measures Mr. Broadhurst's Bill proposed would render idle thousands of women and children who could get no other employment. At the same meeting a committee was appointed to co-operate with one already appointed at Old Hill in opposing the Bill.

NOTES FROM LANCASHIRE.

(*From our own Correspondent.*)

Manchester.—The iron trade of this district, so far as the market for pig iron is concerned, seems to be returning to a condition of inactivity similar to that prevailing prior to the recent spurt in the demand. The influx of orders during the last two or three weeks is no doubt to be accounted for in some degree by the conviction amongst buyers that with the settlement of the American tariff question any further downward movement in the market would in all probability be arrested, and that it was advisable to effect such purchases as they might have to make whilst prices were at their minimum. This led to a large amount of buying which, of itself, had the effect of strengthening the market, but whether there is behind this buying any really permanent spring in trade is doubtful. Notwithstanding the large buying prices have not been advanced to any material extent, and this fact seems to have allayed any real anxiety on the part of consumers with regard to future requirements, and with their present wants in most cases well covered there is a cessation of inquiry. On the other hand makers are so well sold that they are under no necessity to press for orders, and consequently a steady tone is maintained in prices.

There was only a dull market at Manchester on Tuesday, and for pig iron the demand was extremely small. Lancashire makers, who are well sold for the next three months, have during the week advanced their list rates 1s. per ton, their quotations for delivery equal to Manchester being now 47s. 6d. to 48s., less 2½ for forge and foundry qualities, but this has completely stopped buyers. Local makers, however, are indifferent about taking further orders at present, and show no anxiety to press sales. In

district brands transactions have been very limited; a few sales of Lincolnshire foundry continue to be made, but this seems to be all. Makers, who are not in want of orders, hold, however, to late rates, and for delivery here quotations remain at 45s. 6d. to 46s. 10d. for Lincolnshire, and about 48s. to 50s. for Derbyshire forge and foundry, less 2½ per cent.

Although some of the hematite makers show a disposition to hold in anticipation of an increased demand when American shipments of steel rails under the new tariff commence, there are sellers at low figures, and good brands of foundry delivered here are to be bought at 62s. to 62s. 6d. per ton, less 2½.

Finished iron makers are kept moderately employed with orders for home requirements, and if anything prices have a tendency to harden upon the lowest rates, but good orders for prompt delivery can still be placed on the basis of £6 5s. for bars delivered into the Manchester district.

In my last week's "notes" I referred to the fact that the activity in shipbuilding was absorbing the surplus labour from the inland engineering centres. I have since had an opportunity of obtaining special information upon this subject which will be of interest. A friend, who has been travelling officially through the most important shipbuilding centres, reports to me that in all the districts activity is not only fully maintained, but, if anything, is on the increase, and new shipbuilding yards are being opened in considerable numbers. In connection with the same matter, I may give extracts from the last report of the Boilermakers' Society, which will be also of interest. All the reports from the various districts show that trade keeps remarkably good, and that various classes of men are wanted in the shipbuilding yards of Scotland, Ireland, and on the Humber. With regard to the opening of works, the following information is given:—"The North-Eastern Marine Engineering Company, Limited, are about to commence the erection, on the Tyneside, immediately to the north of their marine engine works, of an extensive steam winch manufactory, and a large forge capable of turning out forgings of any size. The work will be proceeded with early in the spring. On the south side of the Tyne a new shipbuilding yard is to be commenced by Messrs. McIntyre and Son, who were formerly connected with the Yarrow yard. Messrs. H. S. Edwards and Sons have begun the construction of their new shipyard to the west of the Northumberland Dock. Mr. Dobson, the late managing partner at Messrs. Mitchells, Walker, will very soon commence building, as the yard on the Tyne is nearly completed. There are two new yards for iron shipbuilding about to commence operations in Blyth shortly, and these new yards opening will cause a still greater demand for our members. Thirty thousand tons of new shipping have been ordered on the Clyde during the last fortnight. The North German Lloyd Company have ordered from Messrs. Elder and Co. two steamers, each 5200 and 6000-horse power." The general abundance of work in the shipbuilding trade is, of course, a very satisfactory feature, and has largely contributed to the active employment of the machine tool-making trade in this district, as in the present age of competition and the many complications introduced into the construction of marine engines, an entirely special class of tools has been required to turn out the requisite work with the greatest economy and despatch, which has kept many of the tool shops busy for a considerable time past. Judging, however, from what I hear, shipbuilders themselves do not seem to be securing any great advantage so far as increased profits on capital are concerned, as, however large the demand for ships, it is being met by increased means of production, and although the men are able to command much higher wages, shipbuilders have still to take contracts at comparatively low figures.

The Manchester Exhibition of Gas and Electric Lighting and Engineering Appliances is settling down into something like working order, but is still in an incomplete condition. The engineering section presents no very novel feature beyond a fairly good collection of engines with special advantages for electric driving. Amongst these are Messrs. Deakin and Parker's "Sandon" engine, the details or which it is unnecessary to give, the only new feature being that the outer bearing is now carried on an arm fixed on the engine base and the fly-wheel is overhung, thus dispensing with the separate pedestal or support in previous engines.

The gas engines I have already referred to, and with regard to these no opportunity has yet been afforded of actually testing their respective merits. J. Proctor, of Burnley, shows his mechanical stoker, with an improved arrangement which enables the machine to feed either large coal or slack. The electrical section is still in a backward state, several of the exhibitors not having their installations complete. Apart, however, from simply electric lighting one or two new applications of electricity to mechanical purposes are shown by Messrs. Pike, Sanderson, and Pike, of Manchester. These include electric pit signals for use between the engine-house on the pit bank and the shaft bottom and for underground signalling. By a new application of relays a special feature is introduced into these signals by which the bells are simultaneously rung at both ends when the wires are in use. For signalling underground the arrangement is most simple, and by merely pressing together two bare wires at any part of a pit road a bell is rung simultaneously at the pit eye and at the workings. This arrangement would of course be of special advantage in the case of runaway tubs on a tramway or in any sudden emergency arising from accident in the workings, as a signal could at once be sent to the bottom of the shaft from any point. A magneto shot firer, for use in mines or pit sinkings, is also shown by the same firm. The apparatus consists of three tolerably-sized magnets enclosed in a case, and by a simple arrangement, magnetism drawn from the magnets is transferred to a wire which conveys a magnetic spark to the shot to be fired. Other novelties, including a portable electric bell and the Griscomb motors for driving small machines, are also shown by the firm.

The death of Mr. J. G. Lynde, C.E., the former well-known city surveyor of Manchester, has, during the past week, been received alike with deep regret and surprise. It is only a month back that, in my "notes," I referred to Mr. Lynde as having, at the annual district dinner of the members of the Institute of Engineers, responded on behalf of that society, of which he was one of the oldest members, having been for fifty years connected with the institute. Mr. Lynde, who was a native of the South of England, practised for many years as a civil engineer in London as a member of the firm of Lynde and Simpson, and in 1857 was appointed city surveyor of the Manchester Corporation. This position he held for a period of twenty-one years, when he resigned the appointment in 1879, and with his son, Mr. J. H. Lynde, carried on the profession of a civil engineer in Manchester. During his connection with the Manchester Corporation Mr. Lynde had the carrying out of many important improvements, and upon his resignation a resolution was unanimously passed by the Council recording their sense of the ability, integrity, and zeal with which he had served the Corporation for a period of twenty-one years, and their best wishes for his future prosperity. The remains of the deceased were interred on Monday at the Brookland Cemetery, and deputations attended from several public bodies, the Institute of Civil Engineers being represented by Messrs. Swindells and Moorsom.

It may be of interest to mention that the new Member for Mid-Cheshire, the Hon. Alan Egerton, is a member of the engineering profession, having passed three years at the works of Messrs. Sharp, Stewart, and Co., in this city, coming at eight o'clock in the morning, like an ordinary mechanic, and doing the full tale of the day's labour. It seems it was the fixed determination of the late Lord Egerton of Tatton that his sons should learn some useful employment, and the present lord served an apprenticeship in an architect's office.

A good demand is still kept up for all classes of coal and fuel in this district, which takes away the whole of the present output, and prices are steady at late rates.

THE SHEFFIELD DISTRICT

(From Our Own Correspondent.)

The increase of the American tariff on razors—from 35 to 50 per cent.—has not been a satisfactory item for local makers. It affords proof, however, of the care which has been taken to so arrange the new duties as to afford the slightest relief possible to Sheffield firms. Razors are very briskly called for, particularly for the American market, and the addition of 15 per cent. to the duty shows how keenly the Americans regard any article which competes favourably with their home production. It is not anticipated that even 15 per cent. extra will materially injure the Sheffield razor makers. In the United States the manufacturers will have an opportunity of seeing whether they can induce their countrymen to buy their razors in preference to English productions at 15 per cent. more money than former prices. In Sheffield the razor firms labour under the serious disadvantage of not being able to get sufficient work out of their artisans' hands, and the men distinctly set their faces against teaching their industry to "too many apprentices."

Messrs. Charles Cammell and Co., Limited, Cyclops Steel and Ironworks, have announced their intention of paying a further dividend of £4 per share, making, with the interim dividend of £2 per share paid in October last, a dividend equal to 7½ per cent. for the past year. This is at the same rate as last year. Messrs. W. Jessop and Sons, Limited, Brightside Steelworks, in their report, state that after paying interest on mortgage loan and on advanced calls, there remains a sum of £37,026, from which it is proposed to set aside £4000 for depreciation in buildings and machinery, to transfer £5000 to the reserve fund, which will then stand at £10,250, to declare a dividend of 45s. per share, making, with the interim dividend of 15s. on the 1st of October last, 60s. per share, being equal to 10 per cent. for the year on the paid-up capital, and to carry forward to the next account a balance of £4965. Last year's dividend was £9 3s. 4d. per cent. Messrs. Newton, Chambers, and Co., Limited, Thorncliffe, have held their first annual meeting. In spite of the depression in the coal trade and the increase of miners' wages by 10 per cent., without any corresponding rise in the selling price of coal, the company has earned a net profit of £25,354.

The effort to reconstruct the Northfield Ironworks as a limited company has been successful, the whole of the capital having been subscribed. The Camot compound railway tire is the chief speciality to be produced by the new company. In the Rotherham district the wheel and axle trade is brisk. One firm is fulfilling a large contract for the New South Wales Government. When Messrs. Charles Cammell and Co. announced their intention of removing their export rail trade to Workington, it was rumoured that Messrs. Steel, Tozer, and Hampton had some intention of also going coastward. Middlesbrough was named as their destination. This rumour has again been revived, but it is understood there is as little foundation for it now as at the first. There will always be a large home demand for rails, and companies situated in the Ickles can do this work much more cheaply than those at the coast. The latter would be handicapped by cost of railway carriage to inland lines, just as they were formerly handicapped in the export trade by cost of transit to the port of delivery.

The rapid strides made by the "crinoline" show that fashion's decree has once more been obeyed. Wire manufacturers report a very active call both on home and foreign account. Both crinoline and corset steels are in great request, and the reduction of duty in the American tariff by £4 13s. 4d. per ton will encourage more attention in that direction, though the reduction is not large enough to lead to extensive business. France and the Continent generally are the chief markets, and the home call proves how quickly the old fashion is coming in again.

Iron continues firmer, with increased sales. Unfavourable reports reach Sheffield of the condition of the Cumberland hematite iron ore trade; but these do not in any way adversely affect business in this quarter. In coal, the continued cold weather causes the recent advance of 6d. to 1s. per ton in household qualities to be maintained. There is no rise in prices for local markets, the increased quotations being for London, where stocks had been permitted to get abnormally low when the storm set in. The quantity of coal sent to London from the Barnsley district by the Great Northern Company in February was excessively limited, being 19,000 tons less than the corresponding month of 1882. The weather at the end of February and the beginning of March was remarkably mild, and merchants consequently kept their orders as small as possible. When the returns for March are made public it will be seen that the demand was as severe and sudden as the weather which caused it. The Eastern and other markets are also ordering more freely. Steam coal is being sent in large quantities for shipment at Hull. When the Baltic ports are reopened next month, the tonnage of this coal will be greatly increased.

Cutlery manufacturers and ivory cutters are again expecting an advance in ivory, owing to the unexpectedly small deliveries in London and Liverpool. For the London April sales only about 24 tons of tusks and 4 tons of sea horse teeth are forward; a large parcel of Egyptian ivory which was expected cannot be to hand in time. It is not expected there will be any sale in Rotterdam before June. There are about 6 tons of Angola ivory in Rotterdam up to the present time.

NOTES FROM SCOTLAND.

(From our own Correspondent.)

The Glasgow iron market has been again dull, with very little business of importance doing, so far as speculative transactions are concerned. Although the fluctuations in prices have been comparatively unimportant, the tendency has been downward, and there has been a very marked want of interest in the market on the part of the outside public. It must be admitted that the position of the pig iron trade as a whole has not improved since the present month began. The shipments of pigs have been a little heavier than they were in the preceding week, but they are still far short of those of the corresponding week of 1882. By this time it was calculated that the foreign inquiry for spring supplies would have been considerably more brisk. Of course, there is yet time for an improvement before the season is at an end, but so far the business from abroad is generally regarded as disappointing. The consumption of pig iron at home, on the other hand, is maintained upon an extensive scale, with the prospect of a continuance of activity during the greater part of the year. Stocks of pig iron in Messrs Connal and Co.'s Glasgow stores are still on the decrease, while makers are believed to be adding somewhat to their private holdings. There are 113 furnaces blowing as compared with 108 at the same date last year.

Business was done in the warrant market on Friday morning at from 47s. 5d. to 47s. 6½d. cash, and 47s. 7½d. to 47s. 6½d. one month, the afternoon quotations being 47s. 5½d. to 47s. 6d. cash, and 47s. 7½d. to 47s. 8d. one month. On Monday forenoon transactions took place at 47s. 5½d. to 47s. 4½d. and 47s. 5½d. cash; also 47s. 7½d. to 47s. 8d. one month. The market was idle in the afternoon, with business at 47s. 5d. to 47s. 4½d. cash, and 47s. 7½d. one month. On Tuesday the market was a shade firmer at 47s. 4½d. to 47s. 7½d. cash, and 47s. 7d. to 47s. 8d. one month. To-dry—Wednesday—business was done from 47s. 6½d. to 47s. 7d. cash, and 47s. 9d. one month.

There is little change in the values of makers' iron, the current quotations of which are as follows:—Gartsherrie, f.o.b., at Glasgow, per ton, No. 1, 62s. 6d.; No. 3, 55s.; Coltness, 64s. 6d. and 55s.; Langloan, 64s. 6d. and 55s.; Summerlee, 62s. and 52s.; Chapelhall, 62s. and 54s.; Calder, 62s. 6d. and 52s. 6d.; Carnbroe, 55s. 6d. and 50s. 6d.; Clyde, 52s. and 50s.; Monkland, 49s. and 47s.; Quarter, 48s. 6d. and 46s. 6d.; Govan, at Broomielaw, 49s. and 47s.; Shotts, at Leith, 64s. and 56s.; Carron, at Grangemouth, 52s. 6d. (specially selected, 57s.) and 51s. 6d.; Kinneil, at Bo'ness, 48s. and 47s.; Glengarnock, at Ardrossan, 55s. 6d. and 49s. 6d.; Eglinton, 49s. 6d. and 48s. 6d.; Dalmellington, 50s. and 48s. 6d.

The malleable iron trade is still actively employed, although nothing of importance appears to have transpired in the course of the week with reference to fresh orders. The past week's shipments of manufactured articles from the Clyde embraced £17,000 worth of machinery, £640 sewing machines, £11,500 steel manufactures, and £23,030 iron manufactures of different kind.

The coal trade in the West of Scotland keeps well employed. There has been for a week or two a scarcity of vessels to carry away foreign and coastwise orders, the ships that were expected into port having in many cases been detained outside by stress of weather. Coalmasters and dealers have, however, good orders in hand for both the home and foreign markets. Prices have been for some kinds slightly tending downwards, although no general reduction can as yet be noted. At Grangemouth the export of coal in the past week was comparatively small, but about 3600 tons were shipped at Bo'ness. The rough weather has greatly disarranged the continental trade between Leith and the Continent, and only three sailing vessels left with coals, taking an aggregate of 1126 tons.

Much dissatisfaction exists among the miners on both sides of the Firth of Forth in consequence of the late reductions in their wages. The men in Fifeshire are restricting the output as far as possible, and at a number of the collieries in the Lothians the miners have been out on strike for about a week. A largely attended meeting of the colliers was held at Dalkeith on Saturday, when it was reported that all the men at Arniston were idle, and meant to remain so until the reduction was withdrawn. In other places the colliers were also idle, and where work was being done the men were either prepared to abide by the resolution that a majority of their number might arrive at, or to restrict the output of coals. It was proposed at the meeting that they work only four days per week, an amendment was also submitted not to resume operations. The meeting determined by a considerable majority to continue on strike until the reduction was withdrawn. A man from Rosewell Colliery said that there were about 400 men employed there whom he was certain would not strike.

WALES AND ADJOINING COUNTIES

(From our own Correspondent.)

Contrary to all expectation the Cardiff and Monmouthshire Valleys Bill is postponed owing to some technical errors in the lithograph. This will cause a delay of six months, and is a subject much to be regretted. A large area of virgin soil awaits development; interests of large works and collieries are affected; yet the promoters will go on with renewed vigour, and in other ways the loss of time may be minimised.

The Barry Bill, I see, has passed its second reading. Efforts are being made by the town council of Cardiff to bring about a compromise, and I am in a position to state that two of the high contending parties—the Taff Vale and the Marquis of Bute's representative—have expressed a willingness to meet and confer with the promoters of the Barry scheme.

In the course of an interesting correspondence it has transpired that the Taff Vale authorised rate is as follows:—For coal and iron ore, ¾d. per ton per mile; iron, 1⅜d. per ton per mile; pitwood, 2⅛d. per ton per mile; coke, 1½d. per ton per mile; and for the use of sidings, 1½d. per ton. The present rates and charges are as follows:—Coal, $\frac{7}{10}$d.; iron ore and iron, ¾d.; pitwood, 1d.; coke, 1d.—per ton per mile; and taking the quantity conveyed last year into consideration, the change amounts to a concession by the Taff Vale of £107,554. These figures speak for themselves, and show that the Taff Vale Co. has not been so chary in its reductions as some imagine.

The success of the Barry Dock Bill would divert about three million tons of coal per annum from the Taff Vale and Bute Docks. I saw it estimated in the interesting notice of products, which we may be likely to obtain from the manufacture of coke, that London consumes one million tons of coal annually for house purposes. This is just three millions short of the output of the Rhondda Valley.

About 150 shipwrights struck work at Newport this week. The grievance alleged is that Cardiff pays 6s. 6d. per diem, and they only get 6s. at Newport.

The vigour of the coal traffic is well maintained. Cardiff, Swansea, and Newport have been fully occupied, and over 200,000 tons have been again despatched to foreign destinations during the week. Small coal is selling at a better price than it has been—an indication that the patent fuel trade is not backward, and house-coal quotations are firmer. The house-coal collieries in the Cwmfelin Valley, under direction of Mr. Truran, are turning out well. At the Bedlinog pit, however—the great sinking of the Dowlais Company to the 4ft.—the long-sought-for coal has not been won, and now about 200 tons daily are being worked of the lower coals, there being a hope that some day the 4ft. will be gained. The experience at Plymouth in working the 4ft. as it trends in the direction of Bedlinog was that the seam began to split into three or four veins, and thus probably may not be gained at all.

Tin-plate continues to exhibit declining tendencies, and it is feared that in a short time coke plates will be down to 15s., and charcoal 17s. per box.

Steel rails in some cases are as low as £4 12s. 6d. A fair amount of business is being done. The colonies are again coming forward with their rail orders, and though I am not in a position yet to give particulars, this fact may be stated, that one or two of the Welsh works have again been lucky in booking orders. Prices are low, but as long as the men are contented with moderate wages, the ironmasters of the district can compete satisfactorily, and thus secure full time work. One of the colonies likely to figure for rails this year is the South Australian. I hear of an immense order, not much short of 100,000 tons of steel rails, that has been received in the north.

It is to be hoped that Cyfarthfa will be able to start with a similarly good one. By June the progress that is being made in conversion will be very conspicuous.

No arrangement has yet been brought about by the Forest of Dean colliers.

A serious engineering difficulty has just now to be faced by the engineers to the Shropshire Union Canal Company. A powerful spring of water has developed itself beneath the Banbury Lock. This has forced great quantities of moving sand into the canal at that point. The side-plates of the lock stand 20ft. in height, and are braced by iron rods to strong supports; but the adjacent soil has been undermined, and gaps have formed on both sides of the lock. The whole of the lock bottom and sides are composed of iron plates. Large gangs of men are engaged to repair the damage, but the measures at present employed are only temporary, and difficult engineering, it is anticipated, will have to be accomplished before the evil is remedied.

Kelly's Engineers' and Iron and Metal Trades' Directory.—We have received a copy of Messrs. Kelly and Co.'s new edition of their "Engineering and Metal Trades' Directory." As is now generally well known, this directory gives the names of all engineers—consulting and manufacturing—and all engaged in pursuits connected with the manufacture of iron, steel, and the employment of these and other metals in Great Britain. It gives the names alphabetically, and also grouped under the towns in which those mentioned are engaged; these are also arranged alphabetically. The present edition is made as complete as possible, and shows that many changes occurred amongst addresses and proprietorships in the past year; and it also shows a large increase in the numbers of names. The directory is, as usual, well arranged and printed with clear type, and it is too well-known to require any complete description from us.

THE PATENT JOURNAL.

Condensed from the Journal of the Commissioners of Patents.

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

Applications for Letters Patent.

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

13*th March*, 1883.

1317. Preventing Waste of Water, J. Harsant, Wandsworth.
1318. Apparatus for Condensing Wool, &c., J. Wilkinson, Yeadon.
1319. Heating and Purifying Water, J. H. Johnson. —(*G. S. Strong, Philadelphia, U.S.*)
1320. Generating and Condensing Steam, J. Hodgart. —(*D. Provand, Valparaiso, Chili.*)
1321. Caissons, J. J. F. Andrews, Isle of Dogs.
1322. Engine Governors, F. M. Rogers.—(*J. M. Gorham, Bucharest, Roumania.*)
1323. Purifying Gas, W. W. Box, Crayford, and G. Waller, Southwark.
1324. Pumping Gaseous Liquids, C. J. Galloway and J. H. Beckwith, Manchester.
1325. Hydraulic Lifts, W. H. Johnson, Westminster.
1326. Governor Gear for Gas Engines, T. Ashbury, H. Sumner, W. Lees, and R. Sanderson, Manchester.
1327. Packing Rings and Springs, C. Mace and W. Tate, Sunderland.
1328. Tobacco Pipes, W. C. Dean, Liverpool.
1329. Railway Frogs, H. J. Haddan.—(*W. J. Morden, Chicago, Illinois, U.S.*)
1330. Sewing Machines, H. J. Haddan.—(*G. Wicke, Barmen, Germany.*)
1331. Mechanism for Converting Motion, S. Pitt.—(*L. B. Miller, Elizabeth, U.S.*)
1332. Smelting Furnaces, A. M. Clark.—(*G. Nichols, W. Nichols, and J. Herreshoff, Brooklyn, U.S.*)
1333. Burning Hydrocarbon Oils together with Steam or Water, A. Boult.—(*C. Holland, Chicago.*)
1334. Slide Valves, A. J. Boult.—(*W. T. Reaser and C. R. Stein, Madison, U.S.*)
1335. Centrifugal Separating Machines, F. Engel.—(*H. Peterson, Hamburg, and W. Ritter, Altona.*)
1336. Bakers' Ovens, F. Smith, Lambeth.
1337. Baths, Washing Troughs, &c., T. J. Saunders and H. W. Allan, Glasgow.
1338. Button-hole Feeding Mechanism, A. Reddie.—(*National Machine Company, Incorporated, Troy, U.S.*)
1339. Producing Coal Gas, H. E. Newton.—(*A. Klönne, Dortmund, Germany.*)
1340. Printing Machines or Presses, W. R. Lake.—(*H. P. Feister, Philadelphia, U.S.*)
1341. Lubricators for Journal Boxes, W. R. Lake.—(*H. Randall and C. Till, Brooklyn, U.S.*)
1342. Fire-escapes, W. R. Lake.—(*H. E. Braunfeld, Philadelphia, U.S.*)
1343. Machines for Cutting Paper, W. R. Lake.—(*O. Lelm, Paris.*)
1344. Pricking Cards for Jacquard Looms, P. A. C. de Sparre, Paris.
1345. Sewing Machines, W. R. Lake.—(*C. E. Tibbles, Burlington, Iowa. U.S.*)
1346. Air Pumps, F. Wirth.—(*H. Beins and J. F. Beins, Groningen, Netherlands.*)
1347. Dynamo-electric Machines, H. H. Lake.—(*G. W. Fuller, Norwich, U.S.*)
1348. Securing Stoppers for Bottles, T. le Poidevin, Guernsey.
1349. Production of Sulphurous Acids, &c., I. S. McDougall, Chadderton.
1350. Envelopes for the Projectiles of Rifled Small-arms, S. Pitt.—(*G. V. Fosbery, Bitton, near Bristol, and H. Pieper, Liége.*)
1351. Rolling on Edge Spiral Bands of Steel, &c., R. Brandon.—(*L. Poilvache and A. Nagelmackers, Liége.*)
1352. Velocipedes, W. Morgan, Birmingham.
1353. Lead and Colour Pencils, T. Lehmann, London.
1354. Facilitating Tram-cars Passing Points, J. Rettie, London.

14*th March*, 1883.

1355. Soluble Compound of Coffee and Sugar, C. A. Allais.—(*F. V. Pillard, Paris.*)
1356. Stitching Machines, B. Hague, Nottingham.
1357. Thermo-electrical Generators, R. Brandon.—(*E. G. Acheson, Paris.*)
1358. Apparatus for Opening Closed Packages, F. C. Glaser.—(*F. H. Arnd, Wiemar.*)
1359. Pole End Fittings for Vehicles, R. Hill and W. Pollitt, Heywood.
1360 Portable Fire-proof Shelving, B. Harlow, Macclesfield.
1361. Collars for Horses, &c., D. Gaussen, Lechlade.
1362. Colouring Matters, C. D. Abel.—(*Actien Gesellschaft für Anilin-Fabrikation, Berlin.*)
1363. Cement or Mortar, J. Imray.—(*E. Pick, Paris.*)
1364. Dynamo-electric Machines, C. W. Siemens, Westminster.
1365. Material for Seats and Backs of Chairs, H. J. Haddan.—(*R. Schimmel. Annaberg.*)
1366. Manufacture of Illuminating and Heating Gas from Petroleum, &c., H. J. Haddan.—(*H. Hirzel, Leipzig, Saxony.*)
1367. Tip Wagons, G. W. von Nawrocki.—(*A. Taeschner, Berlin.*)
1368. Fire-escapes, A. Diss, Bergholt.
1369. Obviating Damage from Collisions of Ships, G. H. Down, Cardiff.
1370. Mechanism of Electric Meters, P. Jolin and J. Parsons, Bristol, and M. Purcell, Dublin.
1371. Commutators, S. Z. de Ferranti and V. S. Szezepanowski, London.
1372. Glazed Structures, J. E. Rendle and F. B. Rendle, Westminster.
1373. Gas Stoves, A. J. Boult.—(*P. Géoffroy-Gomez, Toulouse, France.*)
1374. Facilitating Removal of Leaves from Books, L. Dee, London.
1375. Dynamo-electric Machines, H. H. Lake.—(*G. W. Fuller, Norwich, U.S.*)

15*th March*, 1883.

1376. Wood-working Machinery, E. Cory, Barnes.
1377. Spanners, J. Robson and J. Tingle, Sheffield.
1378. Fire-escape, S. Bott, Birmingham.
1379. Emery Wheel, T. West, London.
1380. Preparing Pictures for Photography, &c., R. Brown, R. Barnes, and J. Bell, Liverpool.
1381. Substitute for Wire Drawers' "Grounds," H. Law, and R. and R. Wood, Cleckheaton.
1382. Injecting Insecticide Liquid into Vines, &c., E. Edwards.—(*A. B. Escourron, Moux, France.*)
1383. Controlling Clocks, H. J. Haddan.—(*A. Lasmoles, Chateaurox, France.*)
1384. Fastenings for Bottle Stoppers, J. Murray and L. Spring, Kingston-upon-Hull.
1385. Bearings, H. H. Lake.—(*La Société des Couverts Alfénide, Paris.*)
1386. Securing Braces to Trousers, N. P. Davidson, London.
1387. Perambulators, W. Brassington, Manchester.
1388. Preparatory Treating of Flax, &c., J. R. Dry, London.
1389. Treating Grain, &c., K. Dance, Cleveden.
1390. Substitute for Plaster of Paris, &c., A. Boult. —(*E. Caspori, Paris.*)
1391. Latches, Locks, and Lock Furniture, E. R. Wethered, Woolwich.
1392. Sack Lifters, T. and A. Lewis, Kettering.
1393. Manufacture of Looped Fabrics, H. H. Lake. —(*La Société Couturat et Cie., Troyes.*)
1394. Treating Hops, H. H. Lake.—(*F. Sláma, Tachau, and F. Felix, Kauth, Bohemia.*)

16*th March*, 1883.

1395. Tilting Railway Coal Wagons, &c., G. Taylor, Penarth.
1396. Valveless Rotary Motor Pump, W. Dawes, Leeds.
1397. Loading Vessels with Coal, G. Taylor, Penarth.
1398. Straightening and Bending Metallic Plates, C. Scriven, Leeds, and J. Tweedy, Walker-on-Tyne.
1399. Automatic Pencil-holder, O. Bussler, Clerkenwell.
1400. Stud or Button, R. Benwell, Alexandria.
1401. Top Notches for Umbrellas, &c., W. Milner, Carbrook.
1402. Measuring and Marking Lengths, C. A. Weckbecker and L. Schwabe, Manchester.
1403. Telephonic Apparatus, W. Moseley, London.
1404. Facilitating the Cutting of Leather, C. P. Carpenter, London.
1405. Machines for Shearing Ropes, P. M. von Swyndreght, Rotterdam.
1406. Flushing Apparatus, W. Jones, Bangor.
1407. Treating Ores, T. Bowen, London.
1408. Disintegration of Animal, &c., Fibres, G. and J. E. Tolson, Dewsbury.
1409. Loading Ships with Patent Fuel, S. Butler, Cardiff.
1410. Spring Vehicles, R. Spence, jun., Richmond.
1411. Self-closing Letter-paper or Card, E. Edwards. —(*A. Callewaert, Brussels*)
1412. Lathe Chucks, W. R. Lake.—(*A. B. Wadsworth, Hopkinton, U.S.*)
1413. Spinning and Twisting Frames, A. M. Clark.—(*J. J. Bourcart, Zurich.*)
1414. Apparatus for Scutching Flax, &c., J. R. Dry, London.

Inventions Protected for Six Months on Deposit of Complete Specifications.

1304. Horseshoes, H. J. Haddan, Kensington, London. —A communication from M. M. Marks, Cincinnati, U.S.—12*th March*, 1883.
1313. Dynamo-electric Machines, H. H. Lake, Southampton-buildings, London.—A communication from G. W. Fuller, Norwich, Connecticut, U.S. — 12*th March*, 1883.
1332. Smelting Furnaces, A. M. Clark, Chancery-lane, London.—A communication from G. H. Nichols, W. H. Nichols, and J. B. F. Herreshoff, Brooklyn, U.S.—13*th March*, 1883.
1340. Printing Machines or Presses, W. R. Lake, Southampton-buildings, London.—A communication from H. P. Flister, Philadelphia, U.S.—13*th March*, 1883.
1345. Sewing Machines, W. R. Lake, Southampton-buildings, London.—A communication from C. E. Tibbles, Burlington, Iowa, U.S.—13*th March*, 1883.
1347. Dynamo-electric Machines, H. H. Lake, Southampton-buildings, London.—A communication from G. W. Fuller, Norwich, Connecticut, U.S. — 13*th March*, 1883.
1355. Soluble Compound of Coffee, C. A. Allais, Paris.—A communication from F. V. Pillard, Paris. —14*th March*, 1883.
1357. Thermo-electrical Generators, R. H. Brandon, Paris.—A communication from E. G. Acheson, Paris. —14*th March*, 1883.
1375. Dynamo-electric Machines, H. H. Lake, Southampton-buildings, London.—A communication from G. W. Fuller, Norwich, Connecticut, U.S.—14*th March*, 1883.
1382. Injecting Insecticide Liquids into Vines, &c., E. Edwards, Southampton-buildings, London.—A communication from A. B. Escourron, Moux, France. —15*th March*, 1883.
1409. Loading Ships with Patent Fuel, S. Butler, Cardiff.—16*th March*, 1883.

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

1091. Machine Tools and Tool Holders, J. Angus, Lambeth.—13*th March*, 1880.
1156. Guards for Circular Saws, R. W. Tayler, Bury St. Edmunds.—18*th March*, 1880.
1160. Bearings for Velocipedes, N. Salamon, London. —18*th March*, 1880.
1541. Hoisting and Removing Earth, H. A. Carson, Massachusetts, U.S.—15*th April*, 1880.
1114. Fog Signalling, S. A. Say, London.—15*th March*, 1880.
1154. Smoothing Plate Glass, W. W. Pilkington, St. Helens.—13*th March*, 1880.
1165. Manufacturing Buttons, G. L. Aston and A. Hames, Birmingham.—18*th March*, 1880.
1206. Cupola Furnaces, G. W. von Nawrocki, Berlin. —20*th March*, 1880.
1249. Railways, J. B. Fell, Ulverston —24*th March*, 1880.
1454. Printing Presses, P. M. Justice, London.—9*th April*, 1880.
1117. Photo-chemical Printing, W. Willis, jun., Bromley.—15*th March*, 1880.
1148. Issuing Tickets, J. N. Maskelyne, London.— 17*th March*, 1880.
1150. Engine for Preparing Pulp, W. Umpherston, Leith.—17*th March*, 1880.
1256. Velocipedes, E. H. Hodgkinson, London.—24*th March*, 1880.
1219. Driving Chains, H. Renold, Manchester.—22*nd March*, 1880.
1230. Scrapers for Cleaning Tubes, G. Preston, Manchester.—22*nd March*, 1880.
1161. Forming the Necks of Bottles, H. Codd, London, and H. Barrett, Hampton.—18*th March*, 1880.
1168. Horseshoe Nails, W. R. Lake, London.—18*th March*, 1880.
1228. Distilling Apparatus, S. Willoughby, Plymouth.—22*nd March*, 1880.

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

1271. Metallic Lines, G. Hookham, Birmingham.— 24*th March*, 1876.
1160. Sewing and Channelling Machinery, D. Mills, Aston.—17*th March*, 1876.
1179. Closet and other Valves, P. J. Davies, London. —18*th March*, 1876.

Notices of Intention to Proceed wtih Applications.

(*Last day for filing opposition*, 6*th April*, 1883.)

5109. Magnetic Brushes, E. Parr and J. R. Gibson, London.—27*th October*, 1882.
5364. Tricycles, H. S. S. Watkin, Waltham Abbey.— 10*th November*, 1882.
5371. Manufacture of Gas, B. Russ, London.—10*th November*, 1882.
5389. Hoisting Boats, &c., S. S. Sugden, Woodford.— 11*th November*, 1882.
5392. Receptacles for Biscuits, J. Hall, Sheffield.— 13*th November*, 1882.
5395. Ornamenting Terra-cotta Plaques, A. Tuck, London.—13*th November*, 1882.
5396. Grinding Lawn Mower Cutters, T. H. Gillott, Royston.—13*th November*, 1882.
5403. Separating Liquids from Chemical Waste Products, G. H. Bolton and J. R. Wylde, Rigby.—13*th November*, 1882.
5405. Extension Rules, J. F. Stephens, Bristol.—13*th November*, 1882.
5410. Steam Steering Apparatus, J. Duncan, London. —13*th November*, 1882.
5413. Circular Shuttles for Sewing Machines, F. O. Schmidt, Berlin.—13*th November*, 1882.
5418. Fastening Buttons to Boots, W. Morgan-Brown, London.—Com. from J. Davis.—14*th November*, 1882.
5425. Envelopes, R. B. Hayward, London.—14*th November*, 1882.
5435. Heating and Ventilating Apparatus, C. R. Stevens, Lewisham.—14*th November*, 1882.
5444. Apparatus for Delivering and Counting Newspapers to be Applied to Web-printing Machines, &c., T. Sowler and W. Pattison, Manchester.—15*th November*, 1882.
5445. Ornamental Tiles, J. Wetter, New Wandsworth. —A com. from J. B. Boulenger.—15*th November*, 1882.
5454. Pulverising Sand, &c., J. Nicholas, Illogan.— 16*th November*, 1882.
5456. Hammocks, A. Pratt, New York.—16*th November*, 1882.
5482. Mills for Grinding Grain, R. Young, Glasgow. —18*th November*, 1882.
5497. Saggers, J. H. Johnson, London.—A communication from J. F. Bapterosses.—18*th November*, 1882.
5530. Tents, &c., H. E. Newton, London.—A communication from J. G. van Döcker.—21*st November*, 1882.
5533. Wire for Fences, W. Friedlaender, London.—A communication from H. Honour and M. Friedlaender.—21*st November*, 1882.
5584. Electric Bell, W. R. Lake, London.—A communication from C. de Redon.—23*rd November*, 1882.
5607. Treating Solutions of Chloride of Copper and Sulphate of Soda, W. Weldon, Burstow.—25*th November*, 1882.
5631. Dynamo-electric Machines, C. A. McEvoy and J. Mathieson, London.—27*th November*, 1882.
5635. Shears, H. H. Lake, London.—A communication from G. S. van Pelt.—27*th November*, 1882.
5661. Automatically Winding up Clockwork, W. R. Lake, London.—A communication from N. Silberberg.—28*th November*, 1882.
5678. Feeding Calves, J. R. Hudson, Norton Woodseats.—29*th November*, 1882.
5686. Glass Furnaces, J. H. Johnson, London.—A communication from A. Duchet.—29*th November*, 1882.
5763. Protecting Ships' Funnels against Shot, P. Jensen, London.—A communication from H. von Stockhausen.—2*nd December*, 1882.
5789. Pneumatic Railways, A. W. L. Reddie, London. —A com. from E. P. Needham.—5*th December*, 1882.
5806. Tightening the Felloes of Wheels, A. M. Clark, London.—A communication from A. Galbraith.—5*th December*, 1882.
5907. Ironing and Pressing Machine, H. A. Oldershaw, Leicester.—15*th December*, 1882.
6033. Coupling and Uncoupling Railway Vehicles, J. Graham, Abergavenny, and T. J. Graham, Birmingham.—18*th December*, 1882.
6036. Steering Apparatus, E. Wimshurst, London.— 18*th December*, 1882.
6127. Railway Fog Signal Apparatus, J. Coleman and I. Henson, Derby.—22*nd December*, 1882.
95. Attaching Handles to Utensils, J. Lee, London. —8*th January*, 1883.
188. Engine Valves, J. Aimers and J. Tinline, Galashiels.—12*th January*, 1883.
265. Separating Solids, T. B. Sharp, Smethwick.— 16*th January*, 1883.
292. Salts of Strontia and Oxide of Strontium, W. A. Rowell, Newcastle-upon-Tyne.—18*th January*, 1883.
293. Salts of Strontia and Oxide of Strontium, W. A. Rowell, Newcastle-upon-Tyne.—18*th January*, 1883.
419. Barrels or Casks, F. Myers, London.—25*th January*, 1883.
435. Ventilating Railway Carriages, A. R. Holland, London.—26*th January*, 1883.
515. Cultivating Land, E. Cobham, Stevenage.—30*th January*, 1883.
722. Stoppers for Bottles, J. S. Davison, Sunderland. —9*th February*, 1883.
737. Metallic Solutions, C. R. A. Wright, Maida Vale. —9*th February*, 1883.
751. Coloured Marking Inks, J. Hickisson and H. W. Langbeck, London.—10*th February*, 1883.
752. Coloured Marking Inks, &c., J. Hickisson and H. W. Langbeck, London.—10*th February*, 1883.
843. Holding Dry Plates for Photography, &c., T. Samuels, Monken Hadley.—15*th February*, 1883.
879. Ships' Berths, &c., J. Hamilton, jun., and R. McIntyre, Glasgow.—17*th February*, 1883.
892. Preventing Fluctuation of Gas in Mains, C. G. Beechey, Liverpool.—17*th February*, 1883.
893. Furnaces, J. C. Mewburn, London.—A communication from L. C. Voorhees.—17*th February*, 1883.
944. Separating Gold from its Ore, A. E. Scott, London.—20*th February*, 1883.
964. Producing Designs on Wood, A. Guattari, London.—21*st February*, 1883.
983. Knitting Machinery, F. Johnson, Nottingham. —23*rd February*, 1883.

(*Last day for filing opposition*, 10*th April*, 1883.)

5433. Cleansing Wearing Apparel, S. Hulme, Manchester.—14*th November*, 1882.
5440. Self-emptying Centrifugal Machines, E. A. Brydges, London.—A communication from O. S. Andersen and T. Hansen.—15*th November*, 1882.
5442. Extracting Salt from Fluids, J. Maynes, Manchester.—15*th November*, 1882.
5446. Disinfecting Apparatus, F. J. Austin, Hounslow. —15*th November*, 1882.
5447. Sliding Gasaliers, G. and E. Atkins, Birmingham.—15*th November*, 1882.
5451. Sewing Machines, W. R. Lake, London.—A communication from E. Wilkinson.—15*th November*, 1882.
5458. Automatic Door Fastener, T. Scourfield, London.—16*th November*, 1882.
5463. Envelopes, E. Edwards, London.—A communication from J. Marzari, A. Manucci, and A. D. Noce. —16*th November*, 1882.
5465. Refining Cotton-seed Oil. J. Longmore, Liverpool.—16*th November*, 1882.
5470. Metallic Bedsteads, S. B. and S. I. Whitfield, Birmingham.—17*th November*, 1882.
5473. Self-recording Lever Weighing Machines, T. Williams, jun.. London.—17*th November*, 1882.
5475. Weaving Looms, G. R. Snowden and O. Ball, Bradford.—17*th November*, 1882.
5478. Spinning Mules, J. E. Heppenstall, Milnsbridge. —17*th November*, 1882.
5483. Pianofortes, W. Fischer, Leipsic.—18*th November*, 1882.
5485. Transit Instruments, J. L. Clark, London.—18*th November*, 1882.
5491. Boots, J. Wetter, New Wandsworth.—A communication from M. Ronekin.—18*th November*, 1882.
5506. Rotary Gas Engine, J. C. Mewburn, London.— A com. from C. D. Goubet.—20*th November*, 1882.
5531. Artificial Leather, H. Loewenberg, London.— 21*st November*, 1882.
5538. Wheels for Vehicles, W. R. Lake, London.—A communication from U. A. Chanveau and P. C. A. Laglenne.—21*st November*, 1882
5557. Trimming the Soles of Boots, &c., J. Keats, Bagnal.—22*nd November*, 1882.
5575. Extracting Tallow, C. D. Abel, London.—Com. from H. Lissagaray & H. Leplay.—23*rd November*, 1882.
5581. Wood-block Pavement, E. Hughes, Liverpool.— 23*rd November*, 1882.
5624. Obtaining Elastic Force, J. Graddon, Forest Hill.—27*th November*, 1882.
5743. Wind Motors, A. M. Clark, London.—A communication from A. Dumont.—1*st December*, 1882.
5765. Separating Vegetable from Animal Matters, W. C. Clennell, London.—A communication from C. A. Sanceau.—4*th December*, 1882.
5771. Screw Propulsion, A. M. Clark, London.—A communication from J. Gartner.—4*th December*, 1882.
5826. Heating Water, A. G. V. Harcourt, London.— 6*th December*, 1882.
5845. Heeling Boots, &c., J. Keats, Bagnal.—A communication from V. R. W. Keats.—7*th December*, 1882.
6122. Gas Fires, W. T. Sugg, London.—22*nd December*, 1882.
6130. Gas Engines, A. M. Clark, London.—A communication from V. J. Laurent.—22*nd December*, 1882.
44. Knitting Machines, H. J. Allison, London.—A com. from C. H. Carter.—3*rd January*, 1883.
76. Envelopes, W. H. Hook, London.—5*th January*, 1883.
88. Metal Printing Rollers, &c., D. Appleton, Manchester.—6*th January*, 1883.
429. Metallic Pens, H. Hewitt, Birmingham.—26*th January*, 1883.
524. Harvesting Machines, B. Samuelson & W. Manwaring, Banbury.—A com. from the Marsh Binder Manufacturing Company.—31*st January*, 1883.
616. Electric Generators, J. A. Fleming, London.— 5*th February*, 1883.
736. Transparent Block Ice, M. Mutter, Stockport.— 9*th February*, 1883.
827. Engine Governors, J. Whitley, Leeds.—15*th February*, 1883.
858. Collecting Rain Water, C. G. Roberts, Collards. —16*th February*, 1883.
890. Maintaining the Proper Level of Water in Boilers, H. H. Lake, London.—A communication from the Automatic Boiler and Engine Company.— 17*th February*, 1883.

Patents Sealed.

(*List of Letters Patent which passed the Great Seal on the* 16*th March*, 1883.)

4339. Wire Card Points, T. Morgan, London.—12*th September*, 1882.
4433. Knife-cleaning Machine, C. W. Spong, London. —18*th September*, 1882.
4447. Paper, &c., W. M. Riddell, London.—19*th September*, 1882.
4448. Hermetically-sealed Vessels, W. A. Barlow, London.—19*th September*, 1882.
4454. Transmitters for Telephones, W. P. Thompson, London.—19*th September*, 1882.
4462. Chimney Tops, J. McPhail, London.—19*th September*, 1882.
4465. Manufacturing Biscuits, G. Baruch, Podgorze Gallice.—19*th September*, 1882.
4466. Closing Window Frames, E. Edwards, London. —19*th September*, 1882.
4467. Joining, &c., the Ends of Railway Rails, E. E. Talbot, Paddington.—19*th September*, 1882.
4468. Nut Locks, C. A. Snow, Washington.—19*th September*, 1882.
4476. Wheels for Railway Carriages, G. W. von Nawrocki, Berlin.—20*th September*, 1882.
4477. Soap, J. Glover, Silcoates.—20*th September*, 1882.
4482. Handles for Table Cutlery, H. Hall, Wetherby, and T. W. Hall, Sheffield.—20*th September*, 1882.
4485. Protecting, &c., Buttons, &c., W. P. Thompson, London.—20*th September*, 1882.
4489. Gas-motor Engines, F. W. Crossley, Manchester. —20*th September*, 1882.
4498. Sugar Mills, E. Death and J. Ellwood, Leicester. —21*st September*, 1882.
4502. Ships' Rigging, G. Hughes, Wolverhampton.— 21*st September*, 1882.
4505. Wheels, &c., for Railway Cars, W. Morgan-Brown, London.—21*st September*, 1882.
4511. Storing, &c., Electricity, J. D. F. Andrews, Glasgow.—21*st September*, 1882.
4513. Potato-planting Machine, H. Gardner, London. —21*st September*, 1882.
4631. Bicycle Crank, F. G. Kinnaird, London.—29*th September*, 1882.
4686. Expressing Oil from Seed, W. Bushell and W. T. Haydon, Dover.—2*nd October*, 1882.
4703. Refrigerators, P. Jensen, London.—3*rd October*, 1882.
4759. Measuring Water, W. and C. W. B. Hamer, Northwich.—6*th October*, 1882.
4831. Machine Guns, A. Noble, Newcastle-upon-Tyne. —11*th October*, 1882.
4926. Range Finders, F. H. Poore, Portsmouth.—16*th October*, 1882.
5189. Cleaning, &c., Currants, &c., D. Fox and A. Wheeler, Darlington.—31*st October*, 1882.
5687. Harrows, J. Howard and T. Bousfield, Bedford. —29*th November*, 1882.
5846. Boats' Rowlocks, C. W. Morris, Lowestoft.—7*th December*, 1882.
5991. Tricycles, &c., O. Pihlfeldt, Coatham.—15*th December*, 1882.
6239. Umbrellas, L. Engel, London.—30*th December*, 1882.
13. Cleaning, &c., Tow Fibres, F. C. Glaser, Berlin.— 1*st January*, 1883.
204. Classifying Colours, B. J. B. Mills, London.— 13*th January*, 1883.
261. Electro-telegraphic Systems, P. M. Justice, London.—16*th January*, 1883.
364. Movable Torpedoes, S. Pitt, Sutton.—23*rd January*, 1882.

List of Letters Patent which passed the Great Seal on th 20*th March*, 1883.)

4507. Leather Paring Machines, E. G. Brewer, London.—21*st September*, 1882.
4519. Ventilating Saloons, &c., J. and J. K. Leather, Liverpool.—22*nd September*, 1882.
4525. Secondary Batteries, F. M. Lyte, London.— 22*nd September*, 1882.
4528. Frosted Glass, W. H. Beck, London.—22*nd September*, 1882.
4533. Ships' Anchors, J. Scott, Helensburgh.—23*rd September*, 1882.
4539. Iron, W. Clarke, Birmingham.—23*rd September*, 1882.
4541. Breech-loading Fire-arms, H. and E. Hammond, Winchester.—23*rd September*, 1882.
4544. Compound Atmospheric Funnels, E. Wery, London.—23*rd September*, 1882.
4545. Manufacturing, &c., Gas, J. Coley-Bromfield, Hove, and G. Symes, London.—23*rd September*, 1882.
4549. Metal Hurdles, &c., S. Bayliss and W. Bailey, Wolverhampton.—25*th September*, 1882.
4550. Indicating Presence of Water in Cisterns, J. Shaw and F. Milan, Lockwood.—25*th September*, 1882.
4557. Weaving Looms, H. Lomax, Darwen.—25*th September*, 1882.
4562. Producing Relievos, L. H. Philippi, Hamburg. —25*th September*, 1882.
4568. Heating Water, A. J. Billing, London.—25*th September*, 1882.
4576. Camping Stools, J. C. Mewburn, London.—26*th September*, 1882.
4577. Stowing Bags of Wool, &c., H. M. Whitehead. London.—26*th September*, 1882.
4579. Ice-making Machinery, W. H. Beck, London.— 26*th September*, 1882.

List of Specifications published during the week ending March 17th, 1883.

3377, 6d.; 3411, 1s.; 3415, 6d.; 3416, 6d.; 3426, 2d.; 3458, 6d.; 3490, 6d.; 3506, 2d.; 3512, 8d.; 3520, 6d.; 3528, 8d.; 3536, 6d.; 3539, 6d.; 3550, 8d.; 3553, 6d.; 3556, 6d.; 3557, 6d.; 3562, 6d.; 3565, 6d.; 3570, 6d.; 3575, 6d.; 3576, 6d.; 3577, 6d.; 3581, 6d.; 3587, 4d.; 3590, 6d.; 3591, 6d.; 3602, 4d.; 3606, 6d.; 3610, 8d.; 3612, 2d.; 3613, 6d.; 3615, 6d.; 3618, 4d.; 3620, 4d.; 3622, 4d.; 3623, 6d.; 3625, 6d ; 3628, 10d.; 3629, 6d.; 3632, 2d.; 3633, 1s. 6d.; 3634, 6d.; 3637, 2d.; 3638, 2d.; 3639, 2d.; 3643, 6d.; 3646, 8d.; 3647, 6d.; 3648, 6d.; 3650, 2d.; 3653, 6d.; 3654, 6d.; 3655, 2d.; 3656, 1s. 6d.; 3657, 6d.; 3658, 6d.; 3659, 4d.; 3662, 6d ; 3663, 6d.; 3665, 2d.; 3667, 6d.; 3668, 6d.; 3669, 2d.; 3671, 6d.; 3672, 4d.; 3674, 4d.; 3675, 6d.; 3677, 4d.; 3679, 6d.; 3681, 4d.; 3682, 2d.; 3684, 6d.; 3685, 6d.; 3686, 2d.; 3687, 2d.; 3688, 6d.; 3689, 10d.; 3690, 2d.; 3692, 6d.; 3695, 2d.; 3698, 2d.; 3700, 6d.; 3703, 6d.; 3704, 2d.; 3706, 6d ; 3707, 6d.; 3710, 6d.; 3711, 4d.; 3714, 6d.; 3716, 2d.; 3719, 6d.; 3720, 2d.; 3721, 2d.; 3722, 6d.; 3725, 2d.; 3726, 2d.; 3732, 2d.; 3737, 4d.; 3741, 4d.; 3744, 4d.; 3761, 4d.; 3786, 6d.; 3790, 2d.; 3796, 6d.; 3953, 10d.; 4518, 6d.; 5020, 4d.; 5535, 6d.; 5550, 8d.; 5694, 8d.

*** 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.*

3339. ARC REGULATOR LAMPS, *R. E. B. Crompton, London.*—14*th July*, 1882. 6*d.*

This relates to improvements on the inventor's patent No. 346, 24th January, 1882. Both carbons are connected by cords passing over pulleys, so arranged that the travel of each carbon is controlled by the other. According to one arrangement, one portion of this connecting cord is caused to gear with a pulley mounted on the same axis as the first wheel in the train of the gearing frame described in the above-mentioned patent; this gearing frame is influenced by an electro-magnet in such a manner that it rises and falls according to the magnetism. By this rising and falling it advances or retires the carbons affixed to the connecting cord, and regulates the length of the arc. Other improvements are also described.

3350. ELECTRIC LAMP HOLDERS, *J. S. Beeman, Earls Court-road.*—14*th July*, 1882. 8*d.*

This relates to a telescopic electrolier, combined with a ball-and-socket joint to render it rotary; also to switches for regulating the current.

3351. APPARATUS FOR AUTOMATICALLY SHUNTING ELECTRIC CURRENTS, &c., *J. S. Beeman, Earls Court-road.*—14*th July*, 1882. 6*d*

The object of this invention is to shunt a current from one circuit to another. It is carried out by inserting in the circuit or circuits a solenoid, with soft iron core, having a contact piece attached, so that when the current is on, the core is sucked up into the solenoid, and when the current stops by the circuit being broken, the core falls and completes another circuit.

3355. SUPPLYING ELECTRICITY FOR LIGHT, POWER, AND OTHER PURPOSES, *T. J. Handford, Southampton-buildings.*—14*th July*, 1882.—(*A communication from T. Edison, Menlo Park, New Jersey, U.S.*) 8*d.*

This relates to a method for supplying lamps, motors, &c., arranged in separate multiple arc circuits with current, which is transmitted through the copper mains at a high tension, in order to reduce the size and therefore cost of the latter. According to the method of carrying the invention out, secondary batteries are arranged between the lamps or motors, &c., and the source of electrical energy, such batteries being first charged in series from the source, and then discharged through the lamps, &c. To prevent loss, an automatic switching device, controlled by electrolytic action, is provided for breaking the charging circuit of each secondary battery, and at the same time completing the circuit to the lamps when the battery is fully charged, without interfering with the other batteries.

3370. AUTOMATICALLY INDICATING THE PRESENCE OF FIRE OR HEAT BY MEANS OF ELECTRICITY, *E. Edwards Chancery-lane.*—15*th July*, 1882.—(*A communication from B. Carré, Rouen, France.*) 6*d.*

This relates to an apparatus consisting of two contact pieces, one fixed, the other, a spring, held back by a wire or thread. This latter is carried round a room, or fixed to a certain point in a room. It is composed of materials that will expand or be consumed by excessive heat or fire. An electric bell and battery are included with this apparatus in an electric circuit, which is broken at the two contact pieces, so long as the one is held back by the wire or thread. When, however, it is released by heat or fire it makes contact with the other, the bell is rung, and the alarm given.

3377. VELOCIPEDES, *T. Smallwood and E. W. Cooper, Coventry.*—17*th July*, 1882. 6*d.*

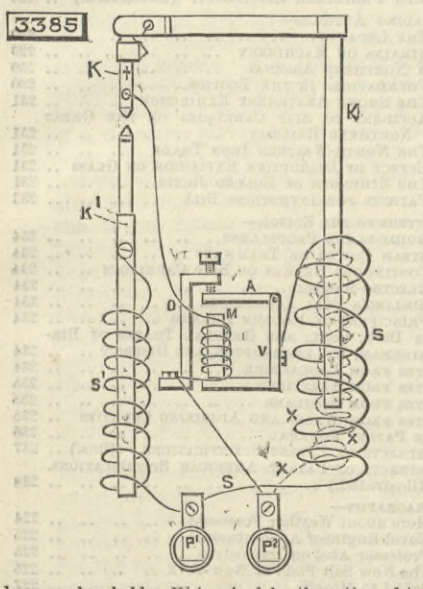
This relates, First, to the method of applying the centres to the steering or other parts of velocipedes, so as to distribute the friction; Secondly, to means for keeping the balls in position in the hubs of velocipedes and other vehicles.

3380. AN ELECTRICAL HAULAGE SYSTEM, &c., *W. E. Ayrton, F.R.S., and J. Perry, Finsbury.*—17*th July*, 1882. 8*d.*

The inventors use a wire rope supported on structures alongside a canal or road; this they call the "rail." On this "rail" runs an electric motor hanging from the axles of overhead suspending pulleys. The rotating parts of the motor actuate wheels which grip "the rail," so that when they are rotated the motor moves along the "rail." A rope or chain connects the motor with the boat or wagon to be hauled. The motor is so arranged as to grip the "rail" the tighter when it is hauling. The inventors claim the motor for hauling as described in the patent, and the combination of two motors, and two hauling lines, one of which winds up its hauling lines, whilst the other pulls; when the first stops to wind up, the second hauls.

3385. ELECTRIC ARC LAMP, *L. A. Groth, Finsbury-pavement.*—17*th July* 1882.—(*A communication from Prof. C. P. Jürgensen, Copenhagen, Denmark.*) 6*d.*

The figure gives a diagrammatic view of the working of this lamp. Suppose the carbons are so far apart that there is no arc, part of the current will pass from P^1 to insulated carriage O, movable armature A, insulated carriage V, through wire X to P^2. Upper carbon-holder K is thereby drawn down into S, and



lower carbon-holder K^1 is raised by the action of two grooved pulleys on the same axis which bear against each carbon-holder until the arc is formed by a branch of the current passing by O, M, and the upper carbon. This branching of the current attracts A to M, thus breaking the circuit through V and X. Should the arc become too long, S^1 is weakened and S strengthened, and the carbons approach. The reverse takes place if the arc is shortened.

3382. ELECTRIC LIGHT APPLIANCES, *H. J. Haddan, Kensington.*—17*th July*, 1882.—(*A communication from H. A. Seymour, Washington, U.S.*) 1*s.*

This relates (1) to arc lamps, (2) to electric light towers, (3) to switches, (4) to incandescent lamps, and (5), (6), and (7) to carbons for incandescent lamps. The invention, as regards arc lamps, consists of a device for shunting the current past a lamp when it is lowered for cleaning, &c., and certain other improvements. The inventor claims several improvements in the construction of incandescent lamps, amongst others, the combination with the glass globe and conductors, for supporting the carbon, of a yielding disc, hermetically sealed to the neck of the bulb, and a non-conducting disc secured within an aperture in said yielding disc, the conductors being sealed within said button; also a method of manufacturing carbons by cutting layers or elementary filaments in different positions from paper having its long fibres parallel with each other, and combining a number of these layers, having the fibres in different positions, to form a complete filament, and then carbonising the whole.

3393. ELECTRIC LAMPS, *J. D. F. Andrews, Glasgow.*—17*th July*, 1882. 6*d.*

This relates to the regulation of arc lamps by means of a solenoid, the object being to provide means of compensating for the varying attraction exerted in the core when it takes different positions in the solenoid. To accomplish this the core is suspended by a chain passing over a pulley and carrying the holder of one of the carbons, the holder of the other being attached to the core. Thus, when the core is just entering the solenoid from below, and when the attraction is greatest, the heaviest weight of chain hangs on the same side as the core, thus helping it to resist the attraction.

3411. POWER LOOMS, *R. J. Gülcher, Notting Hill.*—18*th July*, 1882. 1*s.*

This relates to power looms with several healds or heddles, and in which manifold shuttle changes are required, and it consists, First, in an arrangement for working the healds in which the "lathe" is caused to act as an open shed; Secondly, in making the cards of sheet metal; Thirdly, in an arrangement of cams and levers for effecting the changes of the shuttle boxes; Fourthly, in an arrangement for automatically controlling the release of the picker arms by means of jointed levers connected by straps to the brake levers mounted in the shuttle boxes; and Fifthly, in a stop motion in which the stop bolt stands normally in the path of motion of the stop catch, and is connected by levers with the mechanism by which the jointed levers of the picker catches are actuated.

3414. ELECTRIC TELEGRAPH SIGNALLING APPARATUS, *H. E. Newton, Chancery-lane.*—18*th July*, 1882.—(*A communication from O. Zadig, Paris.*) 6*d.*

The object of this invention is to provide a simple apparatus whereby the attention of the clerk at any given station on a line may be called direct through a single wire, and without the intervention of the other clerks in intermediate stations.

3415. SEPARATING GRAIN OR SEED, *P. van Gelder, Sowerby Bridge.*—18*th July*, 1882. 6*d.*

This relates to a machine for separating different kinds of seeds, in which the exterior, instead of the interior, is fitted and used as a separator, the pockets being shaped to suit the grain and having a flattish side perpendicular or at any acute angle to the cylinder. A trough and archimedean screw, beaters, or blades carry the grain forward. A revolving brush, driven rather faster than the cylinder, but with the opposing surfaces travelling in the same direction, assists in emptying the pockets. The parts are made adjustable to suit different kinds of grain.

3416. CHIMNEY TOPS OR VENTILATORS, *T. J. Baker, Newark.*—18*th July*, 1882. 6*d.*

The object is to prevent down currents of air in chimney or uptakes, and it consists in forming chimney tops or ventilators of tapering deflecting plates with slits provided between the edges.

3419. DYNAMO-ELECTRIC MACHINES, *S. Z. de Ferranti, Shepherd's Bush, and A. Thompson, Russell-square.*—18*th July*, 1882. 6*d.*

In place of using the ordinary bobbins of insulated wire set round the periphery of a wheel as the armature of an alternate current dynamo, the inventors employ one single conductor passing in an undulating form around the wheel, and so formed that there shall be as many radial portions of the zig-zag conductor as there are magnets on either side of the revolving wheel, so that if the wheel were at rest, this conductor might be traced in a zigzag direction first outwards from the centre of the wheel between the adjacent poles of the fixed magnets on one side, then returning inwards towards the centre between one of these poles and the pole of a third magnet, and so until the circuit is completed. This machine was illustrated and described in our columns some weeks since.

3420. DYNAMO-ELECTRIC MACHINES, *W. P. Thompson, Liverpool and High Holborn.*—18*th July*, 1882.—(*A communication from P. Payen and A. Sandron, Roubaix, France.*) 6*d.*

This invention consists in so mounting a series of discs, upon which are fitted coils of insulated wire, on a shaft, that the alternate discs shall be inductors, and shall revolve in an opposite direction to the discs which have the current induced in them. It also relates to other improvements.

3426. DUST-COLLECTING FLUES, *H. J. Haddan, Kensington.*—19*th July*, 1882.—(*A communication from the Mechernicher Bergwerk-Actien-Verein, Rhenish Prussia.*)—(*Void.*) 2*d.*

This relates to the use of vertical series of plates placed horizontally in flues, so as to increase the deposit of dust from the gases passing through the same.

3430. APPLICATION OF TELEPHONES OR MICROPHONES TO PIPES OR VESSELS CONTAINING FLUIDS, GASES, AND AIR, FOR THE PURPOSE OF DETECTING LEAKAGE THEREFROM, *A. G. Ross, Cincinnati, U.S.*—19*th July*, 1882.—(*A communication from T. J. Bell, Cincinnati.*) 6*d.*

This consists in the connection of microphonic apparatus for amplifying sounds to gas or water pipes, &c., whereby the noise of water or gas escaping from a leak can be heard, and the leak, as well as its locality, detected.

3434. ELECTRIC METERS, *C. V. Boys, Wing, near Oakham.*—19*th July*, 1882. 6*d.*

This relates to improvements on the inventor's patents Nos. 4472, 13th October, 1881, and 513, 2nd February, 1882, for electric meters, in which the electricity passing through a conductor is measured by counting the oscillations of a balance governed by an electro-magnet having its coil in the circuit of the conductor. The object of the present invention is to render the above apparatus more simple and more readily adjustable to varied requirements.

3455. DYNAMO AND MAGNETO-ELECTRIC MACHINERY *J. S. Beeman, Earl's Court-road.*—20*th July*, 1882. 6*d.*

The improvements consist in automatically removing from the armature certain sections when they cease to be active in producing current, and replacing them when they arrive at the active points in the magnetic field again. The invention is carried out by dividing the armature into sections, the last end of one section and the first end of the next being electrically connected by insulated springs making contact with insulated rubbing surfaces, and being removed from the circuit by the same means.

3465. ACCUMULATION AND DISTRIBUTION OF ELECTRICITY, *L. H. M. Somzée, Brussels.*—21*st July*, 1882. 6*d.*

The inventor claims the construction of secondary batteries wherein the oxidised matter or paste is placed in a series of supporting and retaining cavities formed by means of open metallic work or nets, which are united with each other by intermediate conducting pins, bars, &c., so as to constitute electrodes having a large number of contact surfaces, and yet capable of supporting the oxidised mass without the interposition of resisting diaphragms.

3441. APPARATUS FOR REGULATING ELECTRIC LAMPS AND FOR MEASURING ELECTRICAL CURRENTS, &c., *A. Gray and T. Gray, Glasgow.*—20*th July*, 1882. 10*d.*

This relates to the regulation of arc lamps by means of a motor in combination with a hollow regulating drum divided into compartments pierced by holes and containing liquid for separating and regulating the motion of the carbons, the rotary motion of the drum bearing a nearly constant relation to the motive force or turning couple. The invention also relates to the combination of the above-mentioned drum with fixed and movable coils for the purpose of measuring the quantity of electricity passing through a circuit in a given time.

3478. APPARATUS FOR ACTUATING THE VALVES OF AND REGISTERING THE WORK DONE BY STEAM ENGINES, &c., *P. R. Allen, Lambeth.*—21*st July*, 1882. 10*d.*

This relates to means whereby the valves of a steam engine of the Corliss or similar type can be released by means of electro-magnets, the circuit through which can be completed from any distant point in a factory, and the engine thereby at once stopped. Also to means whereby, should the governor exceed a certain speed, the electro-magnets are caused to close the valves. Also to an arrangement for registering the work done at each stroke of the engine by means of a chronograph actuated by the same current that releases the valves.

3490. CUTTING, SPLITTING, CHOPPING, AND BUNDLING AND SIFTING FIREWOOD, *J. Rowley, Dulwich, and H. Vulliamy, Newgate-street.*—22*nd July*, 1882. 6*d.*

This relates to improvements on patent No. 3673, A.D. 1879, and it consists in using cutters, the cutting surface of which acts as a chopper, and which are mounted on a reciprocating plate. The block of wood is pressed down in its holder by a weighted lever. The cut wood falls on to a sieve which separates the dust. The wood is collected in a conical receiver and forced out by a piston in the form of a bundle ready for tying up.

3506. APPARATUS FOR CARRYING COAL FROM BOTTOM OF PIT TO CONSUMER'S CELLAR, &c., *E. O. Greening and H. J. Collins, Camden-square.*—24*th July*, 1882.—(*Void.*) 2*d.*

The object is to prevent the breakage which occurs in transporting coal from the mine, and it consists in the use of wagons in the mine, the body of which can be removed from the frame, and placed in compartments formed in larger wagons, so that the coal does not require to be unloaded.

3508. ELECTRIC LAMPS, *A. M. Clark, Chancery-lane.*—24*th July*, 1882.—(*A communication from H. J. Müller and A. Levett, New York.*) 6*d.*

This relates to lamps so constructed that when one set of carbons is consumed another set will be automatically switched into circuit. The lamp has two or more sets of carbons and corresponding solenoids above and in line with the positive carbon holder, there being a pivotted armature and contact strip between each two solenoids, so that the armature will be in contact either with the solenoid or with the contact strip, according as the current is to pass through one solenoid or the other. The carbons are regulated by means of a lever actuated by the solenoid core and engaging by means of a pawl with a ratchet wheel fast upon a shaft in gear with a rack on one or both carbon holders.

3510. APPARATUS FOR OBTAINING MOTIVE POWER BY ELECTRICITY, *J. Barlow, Southampton-buildings.*—24*th July*, 1882.—(*Not proceeded with.*) 2*d.*

This relates to the construction of an electro-motor for transferring motive power to machinery, &c.

3512. BUOYANT OR LIFE-PRESERVING GARMENTS, *F. W. Brewster, Westminster.*—25*th July*, 1882. 8*d.*

This consists in forming garments with folds, plaits or puffings at suitable parts, and filling the same with some buoyant material, preferably carbonised cork, or cotton or wool which has been chemically treated to render it buoyant.

3513 TELEPHONES, *S. Bidwell, London.*—25*th July*, 1882.—(*Not proceeded with.*) 2*d.*

This relates to apparatus for reproducing speech and sounds by means of a magnetised bar placed in the interior of a flat electro-magnet, and fixed at one end, so as to be free to vibrate like a reed.

3532. SECONDARY OR POLARISATION BATTERIES, *G. L. Winch, Madras, East India, and Southampton-buildings.*—25*th July*, 1882. 6*d.*

The inventor prepares his plates by attaching to the surface of lead plates by mechanical, electrical, or chemical means, finely divided lead. To separate the plates he employs frames or strips of wood, gutta-percha, or other substances, and by covering the opposing surfaces with cork, vegetable pith, &c. Other improvements in construction are also described.

3534. DYNAMO ELECTRIC MACHINES, &c., *O. W. F. Hill, Gunnersbury.*—25*th July*, 1882. 6*d.*

It has been found that when an armature wound with a coil of insulated wire is brought in contact with the two poles of a magnet, and also when the armature is again separated from them, electric currents pass in the armature coil, if the circuit be closed, and these currents are much more energetic than those which may be produced by moving such an armature in proximity to the poles. The inventor so arranges that in his machine armatures are in succession brought into actual contact with magnet poles and are separated from them by a rolling movement.

3536. UNION JOINT OR COUPLING FOR PIPES OR TUBES, *W. H. Beck, London.*—25*th July*, 1882.—(*A communication from J. L. B. Bodel and J. L. F. Brauer, Paris.*) 6*d.*

One pipe is cylindrical, its end being enlarged and fitted with an elastic washer. A ring fits over the enlargement and is screwed externally to receive a ring fitting on to the end of the other pipe, the end of which is of elliptical form.

3539. FABRICS FOR PROTECTIVE AND PRESERVATIVE PURPOSES, *J. Jowitt and G. S. Page, New York.*—25*th July*, 1882. 6*d.*

This relates to the machinery for the manufacture of fabrics for protective and preservative purposes, in which the fabric in the form of a roll is caused to rotate in a bath of any suitable protecting material, and is then led over rollers and stretched, rolled, and dried.

3547. ELECTRIC CABLES, *J. G. Lorrain, Westminster.*—26*th July*, 1882.—(*A communication from J. André, Paris.*) 6*d.*

This relates to improvements on patent No. 5268, 15th December, 1880, taken out by A. W. L. Reddie, according to which a cable was composed of webs, consisting of a warp of metal wires and a weft of textile non-conducting material. According to the present invention, instead of weaving separately the series of webs which are to form the cable, the web is made with alternate conducting and non-conducting portions, and by preference with a wide border at each edge of non-conducting material.

3553. LUBRICATING BOSSES FOR LOOSE PULLEYS, &c., *W. R. Lake, London.*—26*th July*, 1882.—(*A communication from P. Decauville, Paris.*) 6*d.*

In the central portion of the pulley a reservoir is formed, and contains the lubricant, which is supplied to the bearing surface by small pieces of cane dipping into the lubricant at one end and bearing on the surface of the shaft at the other. The excess of oil returns to the reservoir by suitable apertures. The cane is kept in contact with the shaft by set screws.

3556. BOAT LOWERING APPLIANCES, *C. Grayson, Liverpool.*—27*th July*, 1882. 6*d.*

This relates to apparatus for lowering ships' boats, and releasing them as soon as they touch the water, and it consists mainly in the use of a cradle in which the boat rests, and which is lowered by ropes or chains secured to winches.

3562. TREATING SEWAGE, *J. Young, Kelly, N.B.*—27*th July*, 1882. 6*d.*

This consists in distilling off a portion of the sewage, the distillate containing a greater proportion of ammonia than the original sewage. The apparatus consists of a series of closed vessels, the vapours given o when heated by a current of air and steam passin from one vessel to the other.

3565. ADJUSTING VENTILATORS, *H. Morris, Manchester.*—27*th July*, 1882. 6*d.*

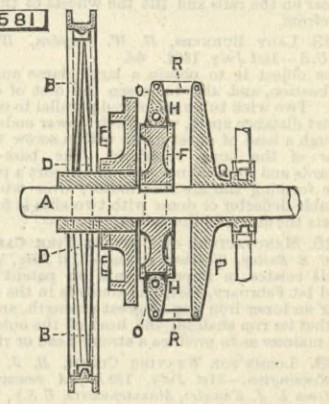
A tube is employed containing any liquid sensitive to variations of temperature, and upon the liquid rests a piston, the rod of which is suitably connected to the ventilator to be regulated. If desired the rise or fall of the piston may be transmitted to suitable registering mechanism.

3577. CAUSTIC SODA AND CAUSTIC POTASH, *A. J. Boult, London.*—27*th July*, 1882.—(*A communication from H. Herberts, Germany.*) 6*d.*

This consists essentially in the filtration of lyes under pressure higher than that of the atmosphere, and the apparatus to be employed for effecting the same.

3581. FRICTIONAL CLUTCHES OR BRAKES FOR MACHINERY, *H. Fisher, Nottingham, and J. S. Walker, Wigan.*—28*th July*, 1882. 6*d.*

This relates to a clutch that, First, can be put in and out of gear while the driving shaft is running at full speed; Secondly, can be put in gear by a slow and progressive acceleration from a state of rest to the required velocity; and, Thirdly, can be adjusted so as to overcome a certain resistance, and if additional resistance is communicated to the clutch it will slip, and so indicate that something is wrong. A is the



driving shaft; B the pulley to be driven mounted loosely thereon, and on the boss of which is secured a disc plate D with a number of pins; the friction wheel F rotating with shaft A, surrounded by a clip or brake made in four or other number of parts, the ends of which are formed with projections H tapped with holes to receive right and left-handed screws. Each part of the brake has a hole to receive one of the pins on disc D. The screws each carry a lever O connected to arms P of a sliding piece Q by arms R. The piece Q is shifted by means of a forked or other suitable lever.

3582. REGULATING ELECTRIC CURRENTS AND ELECTRO-MOTIVE FORCE, &c., *L. Campbell, Glasgow.*—28*th July*, 1882.—(*Not proceeded with.*) 2*d.*

This relates to a method of arranging the commutator brushes of dynamo machines so as to regulate the current and electro-motive force.

3587. HEAD COVERINGS FOR HOT CLIMATES, *J. F. Watson, Anerley.*—28*th July*, 1882. 4*d.*

This consists in fitting head coverings with a lining of some substance that can absorb liquids, so that it may be charged with water or a volatile liquid for the purpose of cooling the wearer's head.

3590. ROLLER MILLS, *A. W. L. Reddie, London.*—28*th July*, 1882.—(*A communication from H. F. Saint Requier, Paris.*) 6*d.*

The object is to effect a complete crushing of wheat or other substance by a single passage through the rolls, and it consists in the use of suitable feeding apparatus, whereby the grain is supplied to the rolls in a long thin stream, the granules being regularly and mathematically distributed over the length and breadth of the stream, so that each one is separately submitted to the action of the rolls.

3592. SECONDARY BATTERIES, *F. J. Bolton, Grosvenor-gardens.*—28*th July*, 1882. 10*d.*

This relates to various improvements in secondary batteries. Amongst other things the inventor places his batteries whilst being charged into an air-tight case, so that there shall be no escape of the gases evolved. He claims various means for making and breaking connection inside the battery by means of the gaseous pressure therein; also the construction of a plate by covering a lead or other plate with a layer of porous metallic lead, such plate being first coated with a paste or solution of chloride or oxychloride of lead, which coating is then reduced by means of metallic zinc.

3602. CLEARING WOOL FROM FRAGMENTS OF STRAW &c., *O. Imray, London.*—29*th July*, 1882.—(*A communication from La Société Harmel Frères, France.*) 4*d.*

The wool as it passes from the first combing cylinder of a carding machine is caused to pass over a roller on which it is pressed by other loaded rollers, one of which is fluted, and the fragments of straw or other flexible matter are crushed and pulverised, so that during the farther combing they are got rid of.

3606. ROLLING STEEL, &c., *W. T. Beesley, Sheffield.*—29*th July*, 1882. 6*d.*

The object is to prevent the metal cooling when hot rolling long thin bands of steel, and it consists in causing the metal to pass through a suitable furnace divided longitudinally on its passage to and from the rolls.

3610. OBTAINING PRODUCTS FROM BLAST FURNACE GASES, *J. Alexander and A. K. McCosh, Lanark.*—31*st July*, 1882. 8*d.*

This relates to improvements on patents No. 4117, A.D. 1879, No. 1433, A.D. 1880, and No. 3785, A.D. 1881, and according to one arrangement it consists in causing the gases to vertically traverse compartments in which internal horizontal cold-water pipes are arranged, and suitable apparatus being provided for causing films or streams of water to flow over the outside of the compartments, whereby the tarry matters in the gases are condensed and separated.

3612. HAULAGE CLIPS, *J. Walker, Derby.*—31*st July*, 1882.—(*Not proceeded with.*) 2*d.*

This relates to haulage clips for attaching corves to and detaching them from haulage chains or ropes, and it consists of a pair of jaws pivotted near the lower end, and above the recess in which the rope fits a groove equal to half the section of the rope is formed in each jaw. A taper wedge, actuated by a lever, causes the jaws to grip or release the rope.

3613. STOVES FOR HEATING BY A COMBINATION OF HOT AIR AND WATER, *A. C. Henderson, London.*—31*st July*, 1882.—(*A communication from Besson and Co., Paris.*) 6*d.*

A cylindrical case contains a grate, to which fuel is supplied through a vertical pipe running through the case. On each side a number of air heating tubes are arranged, and pass to the bottom of the stove. The chimney traverses the body of the stove, which, as well as the air tubes, is surrounded by water.

3615. LOOMS FOR WEAVING WOOLLEN CLOTH, &c., *J. Hopkinson, near Leeds.*—31*st July*, 1882. 6*d.*

This relates to means by which the tension of the threads of the warps when weaving with two, three, or more warps, is regulated, and the motions of the beams of the warps are governed so as to correspond with the take-up motion of the cloth beam on which

the fabric is wound; by which means better and more evenly woven fabrics are produced, and the work rendered more easy to the weaver.

3618. Discharging Oil on Agitated Water, *J. Gordon, jun., Dundee.*—31*st July*, 1882. 4*d.*

The oil is placed in a cylindrical case, the cover of which is strained by an internal spring tending to open it, but which is secured in position by a paper wrapping strong enough to resist the force of the spring while it remains dry, but which, when weakened by moisture, yields and allows the oil to escape.

3620. Horseshoes, *F. H. F. Engel, Hamburg.*—31*st July*, 1882.—(*A communication from O. Lampe, Hamburg.*) 4*d.*

This relates to means for attaching toes and calks as well as secondary iron shoes to the shoe fastened on the hoof of the animal. The main shoe is secured to the hoof by nails, and has on the underside dovetailed grooves to receive projections on the toes and calks or upon a secondary shoe, which are then secured in position by keys passing through them and through the main shoe.

3622. Railway Brakes, *G. E. Vaughan, London.*—31*st July*, 1882.—(*A communication from J. B. Charlier, France.*)—(*Not proceeded with.*) 2*d.*

This relates to an arrangement of screw actuated by a worm fitted on the driving axle, and working through a frame provided with shoes, which are caused to bear on the rails and lift the wheels of the vehicle therefrom.

3623. Lamp Burners, *H. W. Hayden, Waterbury, U.S.*—31*st July*, 1882. 6*d.*

The object is to obtain a large flame and perfect combustion, and also to lessen the cost of construction. Two wick tubes are placed parallel to each other a short distance apart, with their lower ends passing through a base of sheet metal with a screw to fit the collar of the lamp reservoir. The base extends upwards and forms three arms to support a perforated plate forming the air distributor, over which a removable deflector or dome with two slits is fitted, and directs the air on to the flames.

3625. Manufacture of Central Fire Cartridges, *C. S. Bailey, Waltham Abbey.*—31*st July*, 1882. 6*d.*

This relates to improvements on patent No. 496 dated 1st February, 1882, and consists in the means of using an inner iron cup of great strength, and ensuring that its rim shall fill the head of the outer cup in such manner as to produce a strong head or rim.

3628. Looms for Weaving Cloth, *H. J. Haddan, Kensington.*—31*st July*, 1882.—(*A communication from L. J. Knowles, Massachusetts, U.S.*) 10*d.*

This relates to the driving and brake mechanism of power looms, and more especially to that class of power looms in which the driving pulley is convertible into a loose pulley.

3629. Weft Stop Motion for Looms, *H. J. Haddan, Kensington.*—31*st July*, 1882.—(*A communication from L. J. Knowles, Massachusetts, U.S.*) 6*d.*

This consists of a long feeler shaft extending, when applied to a loom, from the middle of the warp to the exterior thereof, with feeler wires and dagger both rigidly attached to the said feeler shaft, so that they tilt or vibrate in opposite directions, but the former at the inner end and the latter at the outer end of said feeler shaft. Also of a governing rod, the same being a long rod, which has, when the stop motion is applied to a loom, a substantially upright position in the vertical plane of the dagger and is pivotted and connected with the other parts of the weft stop motion, so that it only swings with the lay, although upon a different centre, but, relatively to the lay, has at its upper end in vertical motion.

3632. Steam Engines, *D. Forbes and J. Hayes, Shoreditch.*—31*st July*, 1882.—(*Not proceeded with.*) 2*d.*

This relates to the arrangement of two pistons in one cylinder, one at either end, and three slide valves, one at each end and one in the middle.

3633. Tachygraphical Apparatus, *H. H. Lake, London.*—31*st July*, 1882.—(*A communication from V. A. de Celada, Cadiz.*) 1*s.* 6*d.*

This relates to an apparatus whose object is to serve for tachygraphy, replacing it in all its applications—that is to say, to follow and reproduce speech or language by mechanical means and in printed characters.

3634. Bobbin Frames for Looms, *H. H. Lake, London.*—31*st July*, 1882.—(*A communication from R. S. Cookson, Philadelphia.*) 6*d.*

This relates to bobbin frames, more particularly to those adapted to work in connection with Brussels carpet looms; and it consists essentially in supporting the bobbin upon loose friction wheels arranged in the frame and independent of the bobbin.

3637. Mechanism for Operating Signals on Railway Engines, *A. C. Emery, Dalston.*—31*st July*, 1882.—(*Not proceeded with.*) 2*d.*

This consists in an improved combination of mechanism for causing a whistle or other audible signal to be sounded on the locomotive engine of a passing train at any required time, in lieu of the fog signals now in use.

3638. Apparatus for Filtering, &c., Dust from Currents of Air, *A. Stevenson, Chester.*—1*st August*, 1882.—(*Not proceeded with.*) 2*d.*

The current of dust-laden air is caused to circulate or filter through a porous fabric in one direction, upon which the dust is deposited, and at intervals it is caused to pass through the fabric in the opposite direction.

3639. Purifying Coal Gas, *J. Walker, Leeds.*—1*st August*, 1882.—(*Not proceeded with.*) 2*d.*

This consists in mixing pulverised coke or breeze in any proportion with hydrate bog oxide earth or other oxide of iron suitable for purifying coal gas, whether supplementary purifiers of hydrate of lime and coke or breeze be added or not.

3643. Manufacture of Ammonia, *A. Feldmann, Bremen.*—1*st August*, 1882. 6*d.*

The invention is chiefly an application of the column system to the obtention both of volatile and non-volatile combinations of ammonia.

3646. Apparatus for Obtaining Products of Dry Destructive Distillation from Solid Matters, *G. F. Redfern, London.*—1*st August*, 1882.—(*A communication from H. Wurtz, New York.*) 8*d.*

This relates to improvements in the distilling chambers.

3647. Packing for Stuffing Boxes, Glands, &c., *J. Brown, London.*—1*st August*, 1882. 6*d.*

The core of the packing is made of asbestos or other suitable fibrous yarn which is lapped with wire of antifriction metal, and over this lapping asbestos or other suitable fibrous yarn is plaited.

3648. Fastening for Laces for Boots, &c., *G. F. Redfern, London.*—1*st August*, 1882.—(*A communication from E. C. C. Henderson and T. A. McDonald, Nova Scotia.*) 6*d.*

This relates to that class of boots or shoes which are laced with a single lace, which is alternately passed over hooks on the opposite side of the shoe slit or opening.

3650. Trousers, *R. Redman, Yorks.*—1*st August*, 1882.—(*Not proceeded with.*) 2*d.*

This consists in so cutting or forming the lining as to render a sewing machine available for stitching in the linings instead of by hand as heretofore.

3654. Saw-filing Apparatus, *A. M. Clark, London.*—1*st August*, 1882.—(*A communication from C M. Elkins and W. H. Weston, New York State, U.S.*) 6*d.*

This relates particularly to a clamping device.

3653. Railways and Tramways, *A. Vogt and A. Figge, London.*—1*st August*, 1882. 6*d.*

The inventors employ sleepers of a form which is approximately bell-like, and such that when the sleeper is bedded in ballast, it can, by turning it, be made to screw itself upwards out of the ground to correct the level of the rail.

3656. Machines for Manufacturing Cigarettes, *W. R. Lake, London.*—1*st August*, 1882.—(*A communication from the Cowman Cigarette Machine Company for Foreign Countries, New York.*)—(*Complete.*) 1*s.* 6*d.*

This relates to improvements in the general construction of the machine.

3657. Embroidering Apparatus for Sewing Machines, *W. R. Lake, London.*—1*st August*, 1882.—(*A communication from F. H. Chilton, New York.*) 6*d.*

According to one part the foot of the attachment is secured to the press bar by a horizontal bar and vertical hollow post, within which is a vertical post having at its upper end a horizontal arm, the outer end of which is placed between jaws at the end of a lever pivotted to the standard and having a loop secured to the screw holding the needle bar, the movement of which actuates the attachment. The attachment consists of a presser foot, an oscillating thread carrier, and a thread retainer, the two latter being connected so as to have a simultaneous movement imparted to them by a rack or pinion.

3658. Steam Pumps, *W. W. Beaumont, Strand.*—1*st August*, 1882. 6*d.*

The inventor claims in a direct-acting condensing steam pump in which both the working steam and the water to be raised enter at opposite ends of the same cylinder, so arranging and operating the piston in the cylinder that the steam end of the piston cannot enter or uncover to the steam the water wetted part of the cylinder, and that the water end of the piston cannot enter or uncover to the water the steam end of the cylinder; the principal object being to prevent condensation of the steam in the pump by contact with water or water wetted surfaces.

3659. Machines for Impressing the Post Mark and Obliterating the Stamp on Letters, &c., *E. A. Brydges, Berlin.*—2*nd August*, 1882.—(*A communication from D. Grove, Berlin, and A. Plümecke, Osterwedding.*)—(*Not proceeded with.*) 4*d.*

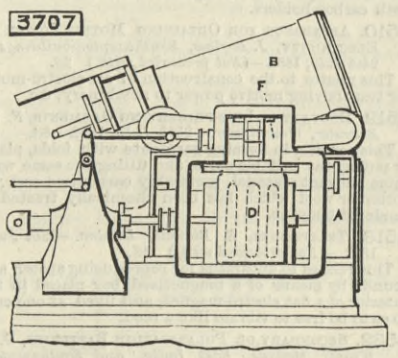
The machine is so constructed that a lever arm is set in operation in such a manner that the letters, post cards, or other objects are stamped, and the stamp which is attached to the said lever arm is automatically provided with fresh ink or colour.

3662. Tube Expanders for Steam Boilers, &c., *G. Sonnenthal, London.*—2*nd August*, 1882.—(*A communication from P. Revollon, Moulins, France.*) 6*d.*

The inventor claims in tube expanders a set of short rollers articulated together.

3707. Compound Steam Engines, *C. J. Galloway and J. H. Beckwith, Manchester.*—4*th August*, 1882. 6*d.*

The high-pressure cylinder B is placed at an angle above the low-pressure cylinder A, which is horizontal, and the piston-rods of both cylinders are connected to one crank, suitable guides being provided for each



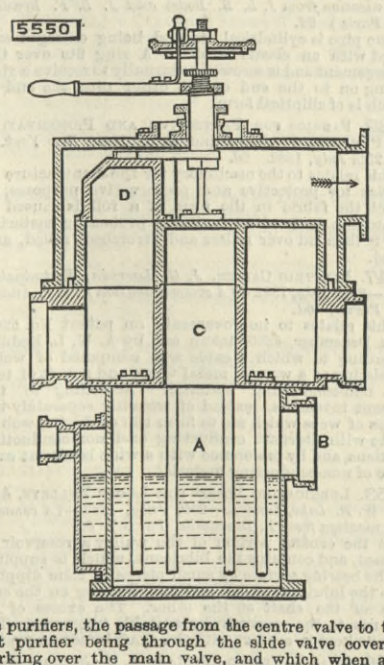
piston-rod. The low-pressure slide D is worked by an excentric, and its upper or top face moves over ports communicating with the opposite ends of the high-pressure cylinder, the passages thereto having other ports which are governed by the high-pressure slide F worked by an excentric or any known expansion gear.

5136. Watchman's Time Detectors, &c., *J. Wetter New Wandsworth.*—28*th October*, 1882. 4*d.*

This relates to a novel construction of an electro-magnetic watchman's detector or register, whereby a record can be kept of the time when a watchman has visited a certain point, at which is a push button completing the circuit of the registering apparatus, which revolves synchronously with and by the aid of the works of a clock.

5550. Centre Valves Employed in Connection with Gas Purifiers, *R. Dempster, jun., Elland, Yorks.*—22*nd November*, 1882.—(*Complete.*) 8*d.*

The object is to construct centre valves so that all the purifiers connected therewith may be in operation at one time, instead of one always remaining idle. A is the usual syphon pan into which the gas enters at B and passes in the centre of the body of the valve C to the outlet, and then successively through the whole of



the purifiers, the passage from the centre valve to the last purifier being through the slide valve cover D working over the main valve, and which when any purifier requires the lime or oxide of iron therein to be changed is shifted, so as to cover up the openings leading thereto. When the lime or oxide of iron has been changed the cover D is shifted back so as to bring the whole of the purifiers into use again, whereby one of the purifiers does not remain constantly out of use as in ordinary arrangements.

5695. Generating and Measuring Electricity, *V. W. Blanchard, New York.*—30*th November*, 1882. 6*d.*

This invention consists of an improved battery, which may comprise a storage battery; and an improved meter consisting of an arrangement of a vibrating pendulum, combined with an electro-magnet, armatures, and a recording device.

5673. Electric Wires and Cables, *A. J. Boult, Holborn and Liverpool.*—29*th November*, 1882.—(*A communication from R. S. Waring, Pittsburgh, U.S.*) 8*d.*

This relates to the construction of underground and submarine cables. The objects are to secure strength, flexibility, lightness, &c. The cable is formed of a pipe-like body of lead, having insulated wires embedded in it, by the method described in the patent. The inventor twists the wires so that they will interchange places and bring each conductor in contact with the metal sheathing so as to prevent induction.

5850. Electro-magnets, *Dr. V. W. Blanchard, New York.*—8*th December*, 1882. 4*d.*

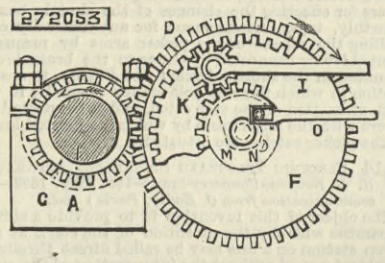
This relates to the use of copper plates in the construction of electro-magnets in place of the wire ordinarily used, and to novel means of connecting up and insulating said plates.

SELECTED AMERICAN PATENTS.

From the United States' Patent Office Official Gazttee.

272,053. Valve Gear, *Rudolph M. Hunter, Philadelphia, Pa.*—*Filed December* 12*th*, 1882.

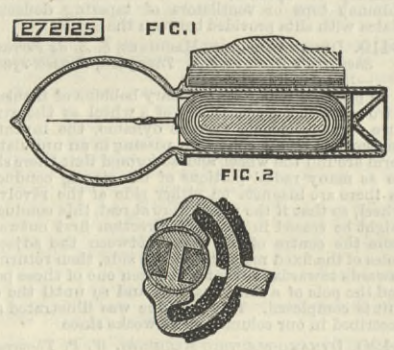
(1) Valve gear which consists of shaft A and its pinion C, in combination with spur wheels D F M, supported upon stationary axles, spur wheel K,



arranged to mesh with wheels F M, and adapted to be adjusted about said wheel M, crank pin N in wheel M, arm I, valve rod O, and means to adjust said arm in any desired position, substantially as and for the purpose specified.

272,125. Electric Incandescent Lamp, *Philip Diehl, Elizabeth, N.J.*—*Filed August* 28*th*, 1882.

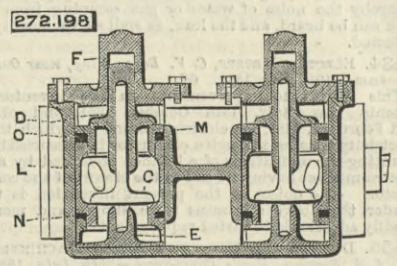
Claim.—(1) In an incandescent electric lamp the combination of a globe containing the light-giving part, a cylindrical shank made integral therewith, an interior coil arranged in the shank and placed in circuit with the light-giving part, and an exterior electro-magnet arranged in inductive relation to the interior coil, and provided with enlarged pole pieces that form a socket or holder for the lamp, substantially as specified. (2) In an incandescent lamp the combination of a globe containing the light-giving part, a cylindrical shank made integral therewith, an interior



coil arranged in the shank and placed in circuit with the light-giving part, and an exterior electro-magnet arranged in inductive relation to the interior, and provided with enlarged pole pieces, between which the lamp may be vertically or axially adjusted, so as to regulate the light or extinguish the same, substantially as set forth. (3) In an incandescent lamp a globe containing the light-giving part and having an extension or shank made integral therewith, said lamp having a contraction at the point of connection with the shank, and the shank an inwardly-projecting bottom, so as to retain the interior coil in position in the shank, substantially as set forth.

272,198. Pump Valve, *James H. Blessing, Albany, N.Y.*—*Filed March* 6*th*, 1882.

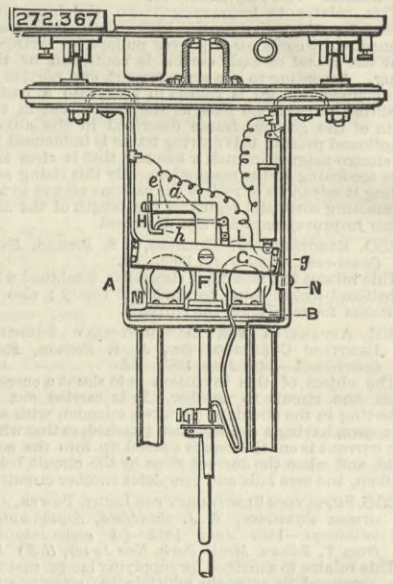
Claim.—(1) The combination of a metallic valve seating upon a metal seat and a free elastic cushion placed beneath said valve seat and capable of limited compression, thereby lessening the effect of the shock of impact between the metallic valve and metallic valve seat, substantially as described. (2) The combination of a metallic valve, a metallic valve seat, and an elastic cushion beneath said seat, and inclosed between said seat and the valve casing, so as to be



protected from the action of the steam or water flowing through the valve, substantially as described. (3) The combination of the supporting frame E, valve seat L, valve C, valve seat M, valve D, and cap F, whereby on the removal of said cap the valves and valve seats may be immediately removed, substantially as shown and described. (4) The combination of the frame E, packing N, valve seat L, valve C, packing O, valve seat M, valve D, and cap F, substantially as shown and described.

272,367. Electric Arc Lamp, *Edward Weston, Newark, N.J.*—*Filed September* 22*nd*, 1882.

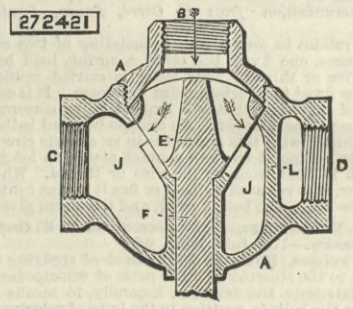
Claim.—(1) In an electric lamp the combination, with the carbons and mechanism for controlling the same, of a pivotted frame, the opposite sides of which constitute armatures, and electro-magnets included respectively in the main and shunt circuits and placed between the sides of said frame on opposite sides of the pivottal points, substantially as hereinbefore described. (2) In an electric lamp the combination, with fixed parallel cores wound with coils included respectively in the main and shunt circuits, of armature bars pivotted so as to swing in face of the opposite poles of said cores, and feed-controlling mechanism connected with said bars and operated by the movement thereof, in substantially the manner set forth. (3) In an electric lamp the combination, with the fixed magnets M and N, of the swinging or rocking frame composed essentially of iron side bars G G, and non-magnetic end pieces *g g*, the clutch *a*, the step or rest *h*, and carbon carrier, these parts being constructed and combined substantially as set forth. (4) In an electric lamp the combination, with the upright frame or standard F,



arm *e*, and plate H, bent as described, of the armatures G G, pivotted to the standard, the magnets M N, mounted between the armatures on opposite sides of the pivottal points, the bar L, the clamp *a*, and the gravitating carbon holder, these parts being constructed and combined in substantially the manner set forth.

272,421. Three-way Valve, *Benaiah Fitts, Worcester, Mass.*—*Filed September* 18*th*, 1882.

Claim.—A valve constructed as herein described—that is, composed of the case A with its inlet B, outlets C D, valve seat H, chambers or passages J O O, ports I I¹ and N N¹, and the valve E, with its ports or passages and its cells, the ports operating with the ports I I¹,



only to permit of passage of fluid from the inlet B to the outlet C, while the cells operate to open communication between the said outlets C and D and chambers J and O O by way of the ports I N and I¹ N¹, all substantially as and for the purposes stated.

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South Kensington Museum.—Visitors during the week ending March 17th, 1883:—On Monday, Tuesday, and Saturday, free, from 10 a.m. to 10 p.m., Museum, 9413; mercantile marine, Indian section, and other collections, 3317. On Wednesday, Thursday, and Friday, admission 6d., from 10 a.m. to 5 p.m., Museum, 1668; mercantile marine, Indian section, and other collections, 813. Total, 15,211. Average of corresponding week in former years, 15.085. Total from the opening of the Museum, 21,778,850.