ADMIRALTY COEFFICIENTS.

By ROBERT MANSEL.

IN the communication on this subject published in THE ENGINEER of May 21st, illustrations have been given of the fact that it is possible to find a form of factor which, when applied to the quantities known as the "Admiralty coefficients," will remove the objectionable variations which, as usually derived, these quantities invariably exhibit; it being understood those cases are excepted where such variations can be referred to a change of conditions or circumstances under which the vessel is tried. Since they are then an indication and definite measure of the resultant effect of the changed conditions, some of which may be perfectly obvious, whilst others can only be detected by means of a delicate and involved analysis. Obviously, it would be unreasonable to expect constant coefficients if the vessel or vessels compared were tried under different conditions of wind and sea at different immersions and trims. Or equally, and probably the most important class of variation, with the foregoing condition sensibly the same, were trials to be made after definite alterations in the propeller. We should then have new circumstances, to each of which would attach a definite alteration in the constants; and, to a greater or less extent, it can be shown these changes of coefficients are a measure of the resultant effect of the changed conditions. In this direction the experiments conducted by the Admiralty authorities on H.M.S.S. vessel Iris are certainly the most complete and valuable that have ever been published; the data, as given in the Admiralty tables, having been further elucidated by the excellent papers of Messrs White and Wright, published in the Transactions of the Institution of Naval Architects. These experiments, conducted under altered conditions of the twin screw propellers, had four set at the same displacement, and the fifth with the displacement increased from 3290 tons to 3724 tons, and the immerged mid area from 700 square feet to 775 square feet. According to the principles explained in my foregoing paper, and taking the three highest speeds in each set, there is but little difficulty in arriving at the values of the coefficients of a and C of my formula, which I have stated to be the very approximately true form of the Admiralty displacement formula, viz,

$$E = \frac{D^{\frac{2}{3}}}{C} V \log.^{-1} a V . \quad . \quad . \quad . \quad . \quad . \quad (1)$$

in which E denotes the gross indicated horse-power required to drive a vessel of D tons displacement at the speed V knots. Let us distinguish this power in the five several cases of the Iris by a suffix, and we will find very approximately,

Power and Speed Formulas for the Iris Trial.

$$\left.\begin{aligned}
E_I &= \frac{(3290)^{\frac{2}{3}}}{7{\cdot}875} V \log.^{-1} {\cdot}0728\, V . = 28{\cdot}10\, V \log.^{-1} {\cdot}0728\, V . \\
E_{II} &= \frac{(3290)^{\frac{2}{3}}}{10{\cdot}310} V \log.^{-1} {\cdot}0707\, V . = 21{\cdot}46\, V \log.^{-1} {\cdot}0707\, V . \\
E_{III} &= \frac{(3290)^{\frac{2}{3}}}{10{\cdot}940} V \log.^{-1} {\cdot}0707\, V . = 20{\cdot}21\, V \log.^{-1} {\cdot}0707\, V . \\
E_{IV} &= \frac{(3290)^{\frac{2}{3}}}{13{\cdot}50} V \log.^{-1} {\cdot}0750\, V . = 16{\cdot}40\, V \log.^{-1} {\cdot}0750\, V . \\
E_V &= \frac{(3724)^{\frac{2}{3}}}{9{\cdot}133} V \log.^{-1} {\cdot}0662\, V . = 26{\cdot}31\, V \log.^{-1} {\cdot}0662\, V .
\end{aligned}\right\} \quad . \quad . \quad (2)$$

The direct crucial test of these equations is to calculate by them the required indicated horse-power for the three highest trial speeds of each set, and then contrast the results with the published experimental values.

Iris I.

Trial speeds	12·06	15·12	16·58
V × ·0728 . . . . =	·8779	1·1007	1 2070
Log. V . . . . =	1·0814	1·1796	1·2196
Log. 28·10 . . . . =	1·4486	1·4486	1·4486
Sum log. E. . . . =	3·4079	3 7289	3·8753
∴ E . . . . =	2558	5356	7505
By trial . . . . =	2560	5251	7503

Iris II.

Trial speeds. . . . =	11·58	14·52	15·73
V × ·0707 . . . . =	·8187	1·0266	1·1121
Log. V . . . . =	1·0637	1·1620	1·1967
Log. 21·46 . . . . =	1·3316	1·3316	1·3316
Sum log. E . . . . =	3·2140	3·5202	3·6404
∴ E . . . . =	1637	3313	4370
By trial . . . . =	1637	3306	4368

Iris III.

Trial speeds . . . . =	12·28	16·56	18 57
V × ·0707 . . . . =	·8682	1·1708	1·3129
Log. V . . . . =	1·0892	1·2191	1·2688
Log. 20·21 . . . . =	1·3057	1·3057	1·3057
Sum log. E . . . . =	3·2631	3·6956	3·8874
∴ E . . . . =	1833	4962	7720
By trial . . . . =	1833	5108	7714

Iris IV.

Trial speeds	12·48	15·75	18·59
V × ·0750 . . . . =	·9360	1·1813	1·3943
Log. V . . . . =	1·0962	1·1973	1·2693
Log. 16·40 . . . . =	1·2146	1·2146	1·2146
Sum log. E . . . . =	3·2468	3·5932	3·8782
∴ E . . . . =	1765	3920	7555
By trial . . . . =	1765	3958	7556

Iris V.

Trial speeds	12·63	16·07	17·98
V × ·0662 . . . . =	·8361	1·0638	1·1903
Log. V . . . . =	1·1014	1·2060	1·2548
Log. 26·31 . . . . =	1·4201	1·4201	1·4201
Sum log. E . . . . =	3·3576	3·6899	3·8652
∴ E . . . . =	2278	4897	7332
By trial . . . . =	2278	4930	7333

Hence it will be seen the sum of the errors on the middle speed of each set of three experiments; on which, by the mode of analysis adopted, all errors and insufficiencies of observation have been concentrated, only present the comparatively insignificant total of a defect of 105 indicated horses on the fifteen experiments, as follows:—

Set	I. error +	105 indicated horses.
,,	II. ,, +	7 ,,
,,	III. ,, −	146 ,,
,,	IV. ,, −	38 ,,
,,	V. ,, −	33 ,,
	Sum = −	105 ,,

We can also, within the trial limits, calculate the power necessary to propel the vessel under the five sets of circumstances at definite speeds—for example, ten knots and sixteen knots. Then the work done in each case being the same for all, the ratio of this work at ten knots and sixteen knots to the respective powers for those speeds is the definite measure of the efficiency, which will, consequently, vary inversely as the power thus determined in each respective case. Let E_{10} and c_{10} denote the power and coefficient for ten knots, and E_{16} and c_{16} the same for sixteen knots respectively; then—

$c_{10} \times E_{10}$ = work done in propelling the vessel at 10 knots = the same quantity for each set.

$c_{16} \times E_{16}$ = work done in propelling the vessel at 16 knots = the same quantity for each set.

We will now proceed to illustrate this:—

"IRIS" IN FIVE DIFFERENT TRIAL CONDITIONS.

Calculation of Power Required for 10*-knot Speed.*

Set of trials	I.	II.	III.	IV.	V.	
Values of a	·0728 ..	·0707 ..	·0707 ..	·0750 ..	·0662	
Log. $10 + 10\,a$ =	1·7280 ..	1·7070 ..	1·7070 ..	1·7500 ..	1·6620	
Log. Constant =	1·4486 ..	1·3316 ..	1·3057 ..	1·2146 ..	1·4201	
Sum log. E .. =	3·1766 ..	3·0386 ..	3·0127 ..	2·9645 ..	3 0821	
					−·0359*	
					3 0462	
∴ E.. .. .. =	1502 ..	1093 ..	1030 ..	922 ..	1112	indicated horses.

Calculation of Power Required for 16*-knot Speed.*

Values of a	·0728 ..	·0707 ..	·0707 ..	·0750 ..	·0662
Values of $16\,a$ =	1·1648 ..	1·1312 ..	1·1312 ..	1·2000 ..	1·0592
Log. 16 .. .. =	1·2041 ..	1·2041 ..	1·2041 ..	1·2041 ..	1·2041
Log Constant =	1·4486 ..	1·3316 ..	1·3057 ..	1·2146 ..	1·4201
Sum log. E .. =	3·8175 ..	3·6669 ..	3·6410 ..	3·6187 ..	3·6834
					−·0359*
					3 6475
∴ E.. .. .. =	6569 ..	4645 ..	4375 ..	4156 ..	4442 indicated horses.

Next: on referring to the equations (2) let us extract the values of a and c, and as explained in the foregoing paper, on adopting the least value of $a = {\cdot}0662$, as standard, carry out the calculation of C_{10} and C_{16} in the manner there shown, as follows:—

Set of trials.	Values a	Values $a - {\cdot}0662$	(16 times) preceding	(10 times) same.	Values of C.	Logs. of do.	Log. of C_{16}†	Values C_{16}	Logs. of C_{10}†	Values C_{10}
I.	·0728	·0066	·1056	·0660	7·875	·8962	·7906	6·175	·8302	6·764
II.	·0707	·0045	·0720	·0450	10·310	1·0132	·9412	8·734	·9682	9·294
III.	·0707	·0045	·0720	·0450	10·940	1·0391	·9671	9·270	·9941	9·865
IV.	·0750	·0088	·1408	·0880	13·500	1·1302	·9894	9·760	1·0422	11·020
V.	·0662	·0000	·0000	·0000	9·133	·9606	·9606	9·133	·9606	9·133

With the values of logs. E and the logs. C_{16} and logs. C_{10} thus obtained, let us now calculate the work done at the speeds 16 knots and 10 knots, as stated in the preceding; we will find this exactly the same for each set, furnishing a striking proof of the correctness of the principle, and a thorough check upon the numerical calculation.

Calculation of Comparative Work Done, at the Speeds 16*-knots and* 10*-knots.*

Set of trials	I.	II.	III.	IV.	V.	
Value log. E_{16} =	3·8175	3·6669	3·6410	3·6187	3·6475	
Log. C_{16} .. =	·7906	·9412	·9671	·9894	·9606	∴ Power for 16 knots [× efficiency coefficients = 40,560.
	4·6081	4·6081	4·6081	4·6081	4·6081	

Similarly, we find — Power for 13 knots × [efficiency coefficients [= 20,860.

Again, as above, for 10 knots,

Values log. E_{10} =	3·1766	3·0386	3·0217	2 9646	3·0462	
Values C_{10} .. =	·8302	·9682	·9941	1·0422	·9606	∴ Power for 10 knots [× efficiency coefficients = 10,160.
	4·0068	4·0068	4·0068	4·0068	4·0068	

In concluding, for the present, I would remark that the ratio of the works at 16 knots and 10 knots is obviously 3·993, and the ratio of the speeds 16 and 10 when raised to the third power, is 4·096; showing, at a comparison with these speeds, the old cube theory comes out very approximately correct—a circumstance which has doubtless diverted attention from the real facts of the case.

ROBERT MANSEL.

White Inch, Glasgow, May 20th.

* This deduction is for the extra displacement in this case, to enable the figures to compare; its derivation will be obvious—$\frac{2}{3}$ (log. 3724 − log. 3290) = ·0359.

† Log. C_{16} = log. C − 16 (a − ·0662) and log. C_{10} = log. C − 10 (a − ·0662.)

THE STEPNEY BOILER EXPLOSION.

THE inquest upon the two men Grant and Richardson, who were killed by the boiler explosion noticed in our issue of the 27th ult., was concluded upon the 11th inst., and resulted—after about an hour's consideration by the jury—in the following verdict:—"We find that the cause of the death of the deceased was suffocation, due to the explosion of a steam boiler, the property of Mr. George Mattison, of Rhodeswell-road, Limehouse, owing to the wasting of the plates, and we consider that he is censurable for not having had the boiler tested by hydraulic pressure as recommended by his own engineer."

We will now state the facts and essential parts of the evidence, divested of all matter not directly bearing on the technical aspect of the disaster. Beginning with all that is known of the history of the boiler, the evidence went to show that Mr. Mattison, being in need of a boiler about three years ago, heard that the one in question was for sale at Messrs. Clark's, paint and colour merchants, West Ham. Mr. Mattison had been himself apprenticed to engineering, and pursued the business till he was twenty-seven years old, when he gave it up. Being now about forty-seven, it is of course twenty years since he gave attention to it. Feeling some confidence in his own judgment, however, he went to West Ham and examined the boiler, but he also called in a Mr. Chapman, who has a place of business, the Brompton Ironworks, Limehouse. He is a man experienced in boiler work, and employs about fifty hands. Mr. Chapman's evidence was to the effect that he saw the boiler in October, 1883, before it was purchased by Mr. Mattison, and made a written report to him upon it. He found that the flue had been patched, and mentioned also one or two trifling defects, but considered it safe to work at 40 lb. pressure. It appears that Messrs. Clark purchased the boiler second-hand, apparently for their own use, but sold it again to a dealer or agent for the sum of £13 10s., and he sold it to Mattison for £15. This was for the mere shell, without fittings or mountings of any kind. It was alleged in the evidence that although this seemed a very low price, it was not so very low, as the cost of transport would be about £5 more. It was called a ten or twelve-horse boiler, and we have already given its dimensions and design. Nothing is known as to who made it or of its age. Chapman recommended Mattison to have it tested by hydraulic pressure, but this was not done, and hence the censure of the jury. A bricklayer named Chalk set the boiler in the usual manner. A brick bed 15in. thick was first laid as a foundation, and on it were built two 14in. side walls with a 9in. flue between. When the boiler was set he got up steam to 80 lb. pressure, not to test the boiler, but to ascertain the maximum revolutions or power that could be got out of the engine. Although purchased in October or the beginning of November, 1883, the boiler was not put to work till the end of February, 1884. We now come to the evidence referring to the subsequent management of the boiler. It appears that at the time the boiler was put to work Mattison had the deceased man Richardson in his employment as, according to his own evidence, engineer to the works. This Richardson would seem, from the tenour of the evidence, to have been a sort of fitter. He had worked at two engineering works before he came to Mattison, and had been also an engine driver on the London and North-Western Railway, but for how long or in what grade was not shown. The boiler in question was first put in the charge of the deceased man Grant, who was little better than a labourer. He had general instructions if anything went wrong to call Richardson to see to it. Grant had worked with Mattison for eight or ten years, beginning as a mill boy, and could not therefore have received any training other than that obtainable at Mattison's. Mattison has another, a shoddy works, with engine and boiler, under some railway arches a few minutes' walk from the scene of the explosion; and Richardson had charge of it, being paid piece work, receiving £1 a ton for all the "wool" or shoddy he could turn out, and his average weekly earnings were £3; out of this he had to find any help he required, and, in fact, he had a boy at 10s. a week. When he had any repairing job at the other works he stopped his own engine, and was paid time work for the repairs at the rate of 9d. an hour. The evidence of other witnesses showed that Grant was at times called away from the boiler to help to pack or load goods, and the boiler was either left in charge of one of the work girls or to take care of itself. It was also in evidence that the feed-pump was frequently out of order and would not act, and the cause was stated to be that at one time the water was drawn from a tank into which, though covered, fibres of flock and felt found their way, and thence to the pump valves. At some subsequent period not specifically stated, the feed was drawn directly from the service pipe—from the street main—and owing to the faulty action of the pump the boiler had constantly to be stopped. On November 4th, 1885, Grant, as confessed by himself some months afterwards to his master, forgot to turn the feed-water on, let the boiler get short, and the furnace crown came down—this was on the Friday evening. He said nothing about it, and got up steam on Saturday morning as if nothing happened; and Mattison, in his evidence, stated that some one told him something was wrong with the boiler, and he ought to see to it. On going to the boiler he found the water springing out round the rivets of the flue, and that the crown had come down. He dismissed Grant on the spot, telling him he deserved five years' penal servitude for setting the boiler to work in such a state; he sent for Richardson, and told him to see to it. Richardson drew the fire, blew out the boiler, took off manhole cover, and left the boiler till Monday to cool down. He spent the following Monday and Tuesday cutting out the defective part of the flue and putting a new piece on. On Tuesday night he went and told Mattison that he had done the repairs, caulked the boiler, and that it was a "first-class job." Mattison asked him was it right and fit to be worked next morning. He said yes, it would last for years, and he did not fear to sleep on it. After Grant left, a labourer named Hamond was put in charge of the boiler, and evidence was given to the effect that Richardson and Hamond had both observed that there would be an accident to the boiler; the former, it was alleged, said to a witness named Chisnell, that "Mr. Mattison would one day pay for his cheap labour," and Chisnell also stated that he heard Hamond tell Mattison there would be an accident. A witness named Sargent, in Mattison's employ, also said he had warned Mattison, but his evidence was given in such a way as to deprive it of some of its value. He had had differences with Mattison about money matters, and appeared to have an animus against him.

It is not necessary for us to go further into the evidence than to state that a girl of twenty, named Stevens, said she at different times had been asked to look after the boiler fire while Grant was helping the packers, that is to say, she was to put some coal on. Mattison said he showed seven or eight of his hands how to stop the engine, believing it an expedient thing to do, but that he knew nothing of any one but Grant or Richardson having charge of the boiler. He thought it possible that the flood water which came up from the drain two or three times into the boiler house after he connected the blow-off pipe of the boiler to it, and which, he said, reached the bottom of the boiler, might have caused the corrosion. Mr. Barnard, a professional engineer called in by the coroner, gave evidence as to the terribly corroded state of the boiler. He first examined it as it stood, and again after it was lifted out and cleaned; the plates of the bottom in places were as thin as a knife blade, $\frac{1}{32}$in. thick, and in places daylight could be seen through them. A boiler maker named Besbrook, of thirty years' experience, called in on behalf of the relatives of the deceased, examined the boiler and testified to the corroded state of the plates. He was of opinion that the boiler was eighteen or twenty years old, and totally unfit to work.

We may now sum up the matter. Mattison buys a second-hand boiler from a firm who purchased it from a dealer for their own use, but would not keep or use it, a suggestive matter in itself. He buys it, as he admitted himself, thinking it a good bargain; for, in fact, about the sixth part of what a new one of the same size would have cost him. He had it examined by a reasonably competent man, but did not adopt his advice to have it tested. He said he had it caulked, but unfortunately was not asked why he thought this necessary. Besbrook said the plates must have been thin when the boiler was bought, as such extensive corrosion must have been in progress for ten or twelve years. We beg to dissent from this. The rapidity of corrosion depends upon what causes it, and though the plates were probably wasted somewhat when Mattison purchased it, we are inclined to think Chapman was not likely to pass the boiler for purchase if badly corroded. The whole evidence goes to show gross laxity and inattention in the management of the boiler. No one had sole and undivided charge of it. The only man with the smallest pretension to competence was not engaged on the spot. He had to leave other and probably more profitable work to put things right with this boiler, and it seems he had to do this pretty often. It is nearly certain that the boiler shell must have been at least weeping on to the seating walls for some time before the explosion; the "weeping" in all probability being caused in the first instance by the expansion and contraction strains set up by the

water supply getting so intermittent and the fire door being open or shut any time and every time. This and not the sewer water was the cause; but of course the probably damp state of the brickwork after the flooding contributed to the corrosion. The evidence of the experts, that such extensive corrosion could not have been discovered without taking down the brickwork, we altogether dissent from. It is clear that a hammer could have been knocked through the corroded plates, and had the slightest trouble been taken to examine the boiler from time to time, this would all have been found out. It is not at all clearly proved to our mind that the water alleged to be due to sewer flooding was always due to this cause, nor that shortness of water was due invariably to deficient feed. The boiler might have been leaking badly and often, for all that anyone concerned would apparently have been the wiser. We dissent from the verdict of the jury that Mattison deserved censure because he did not have the boiler tested on the advice of his own engineer. As a fact, it was tested to 80 lb. by steam when set, and Chapman only advised the test to be made before the boiler was purchased. The better time was to test it after delivery, as the boiler might have been injured in transit. What verdict ought to have been returned upon Mattison's conduct of his business in relation to the boiler we prefer to leave to the judgment of all engineers of any repute. It was given in evidence that a few minutes before the explosion the unfortunate man, Richardson, was seen running as fast as he could from the place at the arches to the other works, having been summoned by Grant, who told one of the witnesses that it was strange that though he had 40 lb. pressure in the boiler he could not get the engine to start. One of the experts at the inquest opined that the boiler had only a mixture of hot air and steam in it, being, in fact, as we take it, nearly empty of water. Possibly this was the case, and Richardson, when he came, succeeded in setting the engine going, and impulsively put on the cold feed. The resulting chill and contraction strain was the final feather that finished the boiler. It is almost superfluous to say that it was not insured.

LETTERS TO THE EDITOR.

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

FORTY-KNOT SHIPS.

Sir,—As Mr. Robert Mansel is one of the highest authorities upon naval architecture and marine engineering that this country possesses, any judgment he may pronounce upon such subjects as that which I have lately submitted to your attention must be received with corresponding deference. The displacement co-efficient of 307, which he has deduced from the particulars of performance of a torpedo boat recited by me, is, of course, correct, and may without further question be accepted. But it seems to me that an inadvertence has been committed in the application of this co-efficient to vessels of greatly superior size, and to this point I ask leave to call Mr. Mansel's attention. We all know that, other things being alike, large vessels are more easily propelled per ton of displacement than small. The difference finds its expression in the difference between the displacement coefficients of different vessels, which are large in the proportion of the easiness of propulsion, and by comparing the coefficients of a number of vessels of similar form, but of dissimilar size, it will be seen that the largest vessels have the largest coefficients. Thus, in the Dwarf, with a displacement or size of 98 tons, the coefficient was found to be 115·1; in the Fairy, with a displacement of 168 tons, it was 197·7; in the Perseverance, with a displacement of 2299 tons, it was 275·4; and in the Himalaya, a still larger vessel, it was 297·4. If it would be improper to apply the coefficient of the Dwarf to the Himalaya, it must be equally so, I submit, to apply the coefficient of a torpedo boat of 52½ tons displacement to a vessel twenty-seven times larger and of the same proportionate power. Every one knows that the large vessel should have a larger coefficient than the small. How much larger it should be may be open to debate. But Reech's law as deduced from experiment, and as verified by the researches of Mr. Froude and others, is, so far as I am aware, the best expression we possess of the rate of increase in the coefficients of vessels, which properly follows from increase of size.

But magnitude is not the only factor of superior speed. A still more important one is lightness—by lightness is meant smallness of displacement relatively with magnitude; of course all vessels of the same displacement have the same absolute weight—by virtue of which a vessel rises in the water when under weigh, and thus diminishes her resistance. It is to the existence of this property that torpedo boats mainly owe their high rate of speed, and the obliteration of the adverse condition resulting from their small size. A torpedo boat of 52½ tons displacement, being little more than half the size of the Dwarf of 98 tons displacement, should, if cleared of extraneous sources of disturbance to the resistance, have a coefficient a good deal less than the Dwarf's coefficient of 115·1. But instead of this the coefficient comes out as 307, or considerably larger than the coefficient of the Himalaya. In the case of a light vessel twenty-seven times larger than the torpedo boat, the coefficient would necessarily be much larger than 307, by virtue of the larger size, and would in fact be 532·3, as Mr. Mansel has set down as the resulting amount. Thus much then I take it is clear. There are two main factors of speed in steam vessels of similar form and propelled by the same proportionate power. One is magnitude, and the other is lightness. Torpedo boats possess the lightness, but not the magnitude. Great vessels, such as the Umbria and others, possess the magnitude but not the lightness. There is no existing example of the combination of both properties. No reasonable being, however, will deny, that by effecting such a combination we shall get a higher result than if one expedient of acceleration had alone been employed, and my proposal simply is to effect such a combination—a procedure to which there is no visible technical impediment that cannot be readily surmounted, when the effort is aided by such skill as Mr. Mansel can bring to bear on the solution of the problem.

I now come to Mr. Bleasby's letter, and in dealing with it I cannot but feel that the task devolving upon me somewhat resembles that of the man who had to fence with a haystack, of which the main physical characteristics were great bulk, slight coherence, and little weight. Before dealing, however, with Mr. Bleasby's latest utterances, I have to call his attention to the main contention of his previous letter, the fallacy of which I pointed out in my reply, but which, nevertheless, in Mr. Bleasby's present missive, I do not find to be either justified or recanted. This contention was, that although the power necessary to propel one of the proposed large and light vessels at the prescribed rate of speed, might be got in if introduced in the form of a large number of small engines, yet that if introduced in the form of a small number of large engines, the weight would be so great that it would inevitably sink the vessel to the bottom. Such a theory involved the obvious sequence, that a given power would weigh less if generated by a large number of small engines than if generated by a small number of large, a doctrine advanced not merely without proof or warrant, but one that is in direct contradiction to all engineering experience. This doctrine Mr. Bleasby does not attempt, in his last letter, to reassert or justify. But neither has he had the grace frankly to say that he finds he was in error, and therefore abandons a position he could no longer hold. My contention all along has been, and is, that seeing torpedo boats can be propelled at a high speed by a weight of machinery of 60 lb. per horse-power, and seeing further that large engines properly constructed are not heavier per horse-power than small, but on the contrary are somewhat lighter, it is practicable to propel large vessels of the light torpedo boat type with the same weight of machinery per horse-power that suffices for the smaller class of vessels, whereby the benefits resulting from lightness and from magnitude would be simultaneously obtained. It is of no avail for Mr. Bleasby to contend that such lightness of machinery is impossible of attainment. The conclusive answer to any such pretence is, that it already exists, that it lies within my option to use such machinery, that it is daily produced in no inconsiderable quantity, and that it is difficult to discern any inducement which could warrant the adoption of machinery of that slow and cumbrous character which Mr. Bleasby admits would be too heavy, but which nevertheless seems to constitute his only ideal of fitness as applicable to such a case. The machinery I purpose to use will not be slow and heavy, but fast and light; and although the speed of piston will not be infinite, but will have a limit, it will no doubt greatly exceed Mr. Bleasby's antique ideas of propriety. What are the impediments to even so high a speed of piston as 4000ft. or 5000ft. per minute? Mr. Bleasby does not specify any, and it will be time enough to assert their existence when they have been discovered.

I am sorry that Mr. Bleasby should consider me indifferent to the sufferings of the human element, as represented by stokers in the stokehole of a steamer when subjected to so serious a pressure of air as is represented by a few inches of water. No doubt it is very afflicting to learn that on trial trips, with an air pressure of 2in. of water, it is nothing uncommon that some of the stokers have to be carried on deck completely exhausted, and that it would consequently be impossible to work under such a system on a voyage across the Atlantic. My impression, however, has heretofore been, that not only stokers but delicate ladies and invalids are habitually subjected—if the barometer tells a true tale—to changes of atmospheric pressure represented not merely by inches of water but by inches of mercury, which are twelve times greater, and this without those persons being conscious from any personal sensation of a change in the pressure having taken place. With regard to the cases of exhaustion which have occurred at trial trips, from the operation of the forced draught, I have also known of such cases where the draught was not forced at all, but was quite spontaneous. The recovery of the patient, however, has been prompt in all cases where bottles have been kept out of his reach. Such is a specimen of the humanitarian cant that Mr. Bleasby condescends to employ to aid in the condemnation of a mechanical improvement. The fact is that stokeholes with forced draught are better ventilated and kept cooler than ordinary open stokeholes, the fans acting as punkahs, or therm-antidotes of a most effectual character.

In my last letter I endeavoured to show that if the engines of the Trafalgar were placed in a lighter hull the hull would necessarily move faster, and as a consequence the engines would move faster, and if kept supplied with steam would generate more power, and therefore be lighter per horse-power than they were at first. The force of this elementary proposition, however, Mr. Bleasby does not appear able to discern, and tells us that in the case supposed the engines would race and would have to be throttled, so that they would be working below their power—a condition implying increased weight instead of increased lightness. The necessity of throttling the engines, however, which Mr. Bleasby assumes, is obviously quite imaginary. The engines would at once accelerate, until, as in all vessels, the propelling force is balanced by the resistance. The power exerted in the lighter hull would be larger in the proportion of the higher speed of engine which the diminished resistance permits, and at this increased power the engine would work as steadily as before, and without any corresponding increase of weight. I admit, with Mr. Bleasby, that in large vessels "it is necessary to use large engines of considerable stroke," but that they shall necessarily be "slow running owing to a limited piston speed" I deny; and although the piston speed must in every case be limited in the sense that it cannot be infinite, I decline to accept any such old-fashioned limit of speed as Mr. Bleasby seems anxious to impose. The same screw which is suitable for one speed of hull is suitable for another, as the volume of water acted upon depends not merely upon the diameter, but also upon the amount of its end motion in a given time, and which of course is greater at the higher speed. Mr. Bleasby informs us in justification of his incredulity in regard to the vessels I have suggested, that we "cannot reduce the number of boilers, their weight, and the weight of engines, much below what engineers at present find necessary." But I have never claimed any such power of reduction, but have only asserted the importance of the property of lightness, and have maintained the practicability, now no longer disputed, of constructing large engines of the same proportionate lightness, that has long since been reached in small. If this can be done the vessels I have proposed will carry the necessary weights. That it cannot be done, I venture to believe that not even Mr. Bleasby will now assert.

C. F. Hurst.
June 8th. Student, College of Practical Engineering, Chiswick.

Sir,—My attention has just been called to Mr. Hurst's scheme, which aims at no less than the complete reconstruction of our navy and mercantile marine. His proposals, if practicable, would reflect very seriously on the many good men who have brought naval architecture and engineering to its present advanced state, and a knowledge of this might have made him pause before adopting so rash a course as making his views public. He ought rather to have shown his calculations to one of his professors, who would no doubt have gladly told him where he erred. His miscalculation of the requisite horse-power has been pointed out by Mr. Mansel, whose authority he will hardly dispute. His fellow student, Mr. Bleasby, has disposed quite satisfactorily of his machinery weights, as far as his boilers are concerned, while his argument with respect to the engines requires only to be supplemented to make it quite convincing. First, however, I would notice that in calculating his ship weights, Mr. Hurst has overlooked completely the strength of his vessel. We need only look at it in one way. Let him imagine his ships at sea, and each riding on the top of a wave. He will at once see that there will be a tendency for each to part about the centre due to the weight of the ends of the ship itself. Comparing the torpedo boat with a ship in every way similar, but four times the size, the weights are as 1 to 4^3; the leverage of the weights of one end in each ship about the centre as 1 to 4. Thus, the total moments tending to break the backs of his ships are as one to 4^4. Now let him consider what provision he has made to meet this. The sectional areas of his plates, &c., are as 1 to 4^2; the depth of his ships as 1 to 4. Thus, with the same stress in his material, the moment which his ships will stand is unfortunately only increased in the proportion of 1 to 4^3. And if his centre section is strained to 3 tons per square inch in the small vessel, it will be strained to 12 tons per square inch in the large one. He will thus have to adopt a somewhat different style of construction in the large boat, which in this case will add considerably to his ship weights at the expense of his carrying capacity. But when he publishes the details of the proposed vessels, which we await with impatience, we will no doubt see him riding triumphantly over this and the many other difficulties which suggest themselves.

We will now look at the engines. Mr. Hurst proposes to drive his boat of 440ft. long at over forty knots per hour by placing in it engines of about 30,000 indicated horse-power—following Mr. Mansel we would have to double this—and, furthermore, to drive these enormous engines at from 400 to 600 revolutions per minute. "He's no fear't." Can he imagine it? I should like to see them, but at a distance; certainly I do not wish to be in the same ship with them. No doubt if we had only to consider steam stresses he could run his engines much faster than has been found practicable. But the reason for limited piston speed, which Mr. Bleasby has quite properly mentioned, is not far to seek. Let us consider for a moment the stresses coming on the piston-rod. Suppose the linear dimensions of the engines kept in proportion to the cube roots of the horse-powers. This will keep the engine weights per horse-power constant if the revolutions and steam pressures are kept the same. The areas of the piston-rods will be proportional to the squares of the linear dimensions, and so will the steam stresses. So far, good; but when we come to the momentum stresses the case is very different. The weights will increase as the cubes of the linear dimensions, and the momentum stress per lb. in the moving parts as the stroke, that is, as the first power of the linear dimensions when the revolutions are constant. Therefore the total momentum stress on the piston-rod will increase as the fourth power of the linear dimensions, while its area increases as the square only. We see, then, that to bring things right in the supposed case, the revolutions will have to be decreased in the same proportion as the linear dimensions are increased, since the momentum stresses vary as the squares of the revolutions.

Judging, then, from this particular case, the limit of piston speed for the small and large engines will be about the same. Consideration of most of the other parts of the engine would lead to a similar result. Mr. Hurst need not then expect to get a large engine as light per horse-power as a small one. If it had been practicable, the Admiralty would certainly have reduced the weights per horse power of their engines, since weight is of such importance. Th could be done by slightly altering the pitch of the propeller, and putting in smaller engines which would run at a greater speed.

From another point of view altogether Mr. Hurst's scheme would not work. He would never propose to run merchant vessels at forty knots an hour if he had the coal bill to pay, and the owners would not carry the necessary machinery to run the vessels at this speed, if they intended to run at twenty knots.

Paisley, June 8th. John H. Macalpin.

Sir,—I hope ere this time Mr. Hurst's attention has been drawn to the reprint of Mr. Arthur Rigg's paper in your last issue on "The Influences of Reciprocation in High Speed Engines," and that to him they are no longer "obscure."

Judging from his letter of 25th May, Mr. Hurst is entirely ignorant of the conditions to be satisfied in designing large high-speed engines. He will find that steam stresses are not quite all that is required to be taken into account, but that the stresses due to the inertia of the reciprocating parts also make their influences felt in the design. Mr. Hurst will find that these inertia stresses are proportional to $W w^2 R$, where W is the weight of that portion of the reciprocating parts affecting the section under consideration, w the angular velocity of crank, and R the radius of the crank pin path; and, Sir, with your permission, I take this opportunity of explaining to Mr. Hurst the application of the above law.

Suppose the scantlings of the torpedo-boat engine are increased n times, while the revolutions remain constant, as Mr. Hurst assumes; then the following results will be obtained: The weight of the reciprocating parts of the large engine will be increased n^3 times, and the radius of the crank-pin n times, thus increasing by n^4 times the inertia stresses of the small engine, while to meet this a section of material increased only by n^2 times has been provided. In quick-running engines, like those in torpedo-boats, the maximum stress on the big ends of the connecting-rods is due almost wholly to inertia, and thus it is obvious that, in the large engine, the connecting and piston-rods—if they are to be under the same conditions of stress as those parts in the small engine—will have n^2 times too small a section. Mr. Hurst, in the case of his 40-knot ship, takes $n = 4$; and therefore, even for a first approximation, makes the weights of the above parts sixteen times too light. It would be interesting, if his studies are not at present too pressing, if he would investigate their dimensions, so as to retain them in the same conditions of stress, after successive increments of weight of the amounts as above indicated have been made, and their reciprocal effects allowed for. Mr. Hurst will now see that his valve and pump gear will require to be strengthened in about the same proportion, that his sole-plate and keelsons will require to undergo a more extensive modification than the multiplication of each dimension by 4, and that his crank-shaft——but as he has kindly volunteered to give us some particulars regarding his design, I will await the same, hoping that at least in this most important part of the engine he may be correct.

I agree with Mr. Bleasby, that for large engines designed on the lines of torpedo-boat engines the total weight of machinery, including water, &c., cannot be much less than 150 lb. to 160 lb. per indicated horse-power, with closed stokeholes. There is but one other point to which I would refer, namely, the strength of the ship's hull. In the course of Mr. Hurst's studies he may have heard of "curves of loads," of "curves of bending moments," and of a ship's "equivalent girder." The modifications which these undergo when the dimensions, scantlings, and weights of a ship are only similarly increased are as follows: The ordinates of the "curve of loads" are increased n^3 times, thus increasing the ordinates of the "curve of bending moments" n^4 times, while to meet this the strength of the ship's hull to resist cross-breaking has only been increased n^3 times, the scantlings being therefore n times deficient in strength to resist hogging and sagging.

I do not here forget that large ships are in practice more highly strained than smaller ones, but that increase is very far short of being four times as great, as it would be in the case of Mr. Hurst's proposed ship. I think there is now little need of examining this question further, at any rate on the lines proposed by Mr. Hurst, since on the very threshold of the inquiry so glaring mistakes at once appear. He is hopelessly wrong with his estimate of the weight of machinery, too light with his hull, and above all, Mr. Mansel in your last issue has shown him that he has misunderstood the estimation of power for the speed.

Edinburgh, June 9th. Alexander Cleghorn.

CERTIFICATES FOR ENGINE-MEN.

Sir,—Permit me to occupy a small space in your journal to call the attention of engine-men, and fitters who desire to have charge of engines and boilers, to the fact that a very important movement is being made by Mr. Burt and other members of Parliament, to obtain for them a Government certificate. To those who have not followed the proceeding of what takes place in the House of Commons, I may state that permission has been given to introduce a Bill for granting certificates to men in charge of steam engines and boilers. This is an object which lies very near my heart, and I hope that all engine-men, and those who think that a Government certificate is the right thing, will use their best endeavours to get the Bill passed. Nothing is done without effort and perseverance to get that which is a crown of glory. I appeal to all engine-men, more especially to those in charge of stationary engines and boilers—because the locomotive section is so very small comparatively, and it will therefore rest with the stationary engine-men whether the Bill passes or not.

Well, what is to be done? There is something to do, everyone will admit, and what is done to pass other Bills must be a pretty good answer to the question. If engine-men sit still now, and allow an opportunity to pass that is full of promise, and offers them that which I have, as you know, aimed at for years, it will be a matter of regret, and to lose the Bill will postpone a boon that is now within measurable distance of their grasp. (*a*) There must be organisation; (*b*) there must be a fund to pay the expenses, which is a trifling matter per man.

I think, Sir, I have said enough this time for the space I ask for, and I hope with my whole heart that all men who think anything of a Government certificate will pull with all their might to land this beloved object.

Michael Reynolds.
Standeford, Wolverhampton, June 9th.

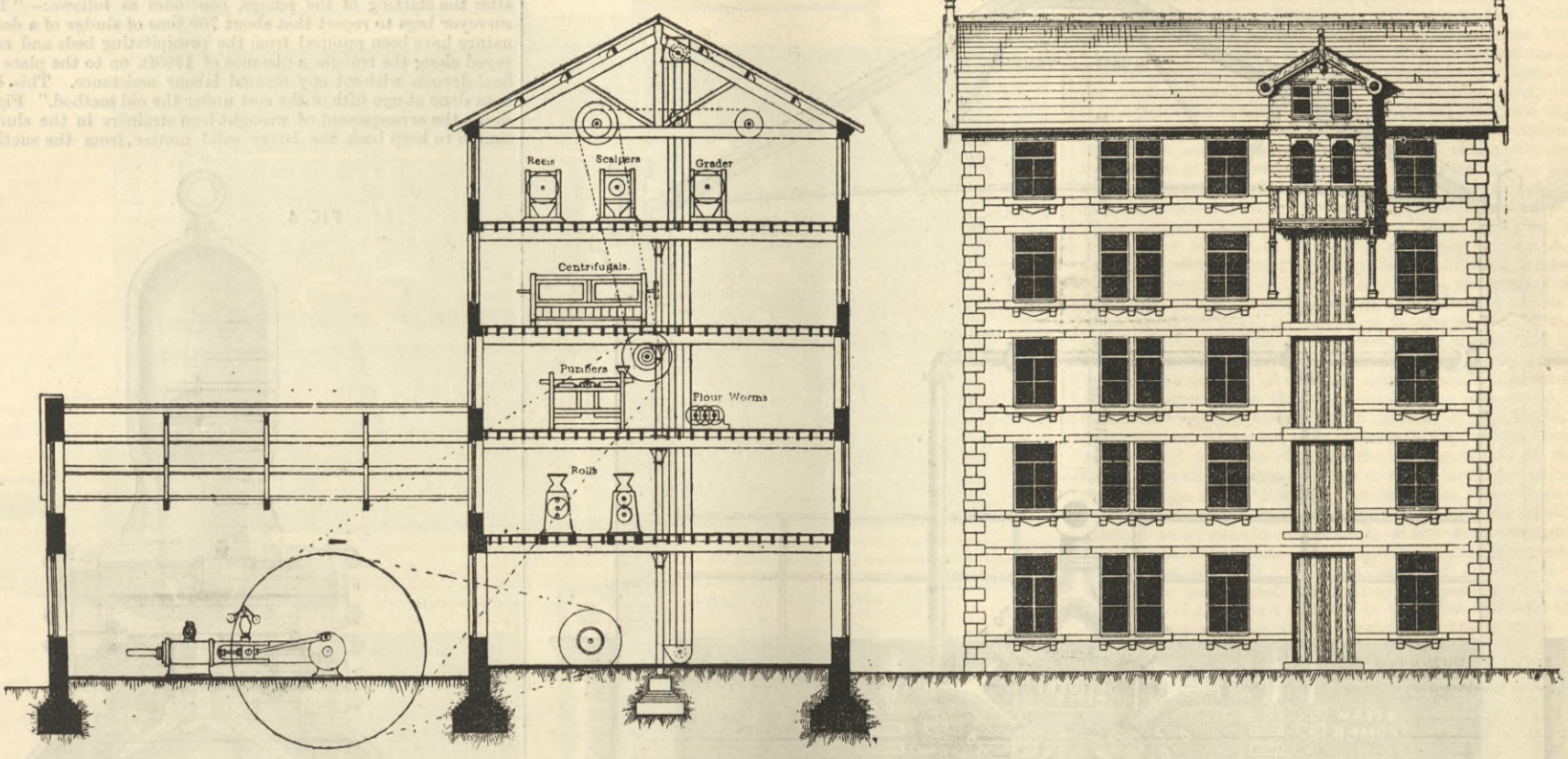
[*For continuation of Letters see page* 490.]

Naval Engineer Appointments.—The following appointments have been made at the Admiralty:—Henry J. Walker, engineer, to the Active, and Percy Bingham, acting assistant engineer, to the Ajax.

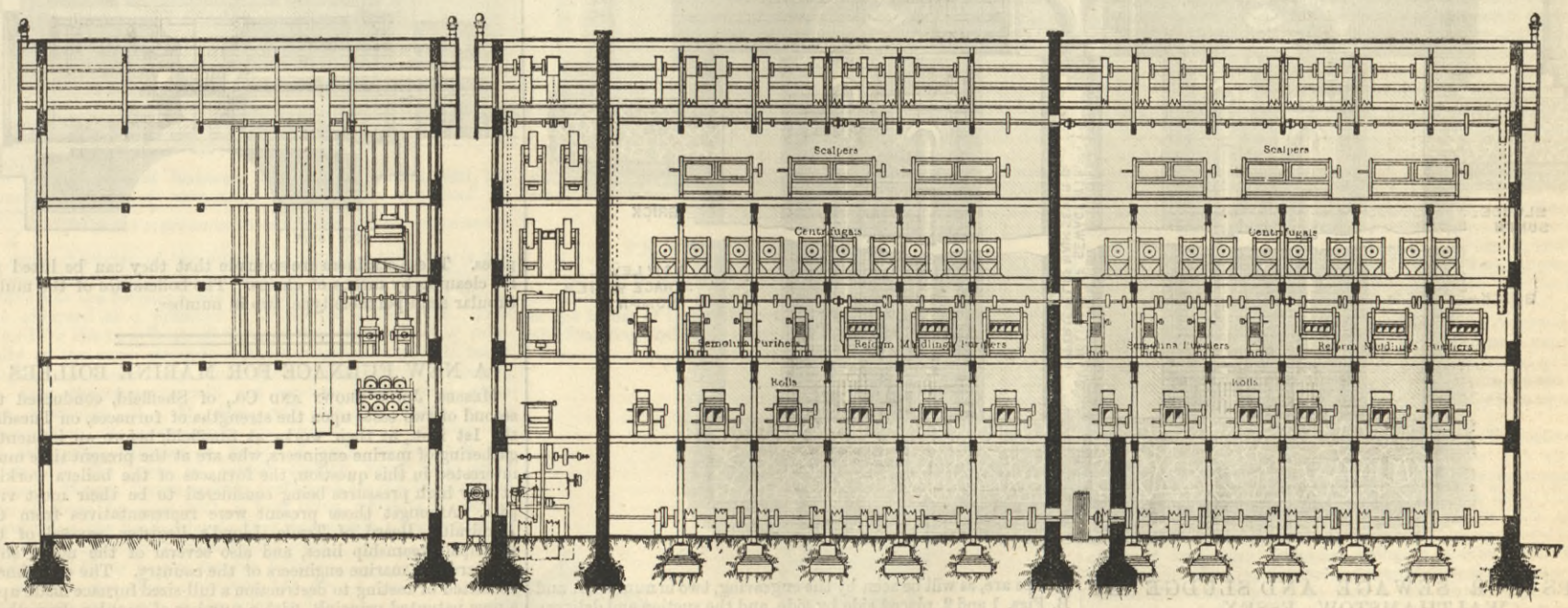
NEW ROLLER FLOUR MILL, BOMBAY.

MR. HENRY SIMON, MANCHESTER, ENGINEER.

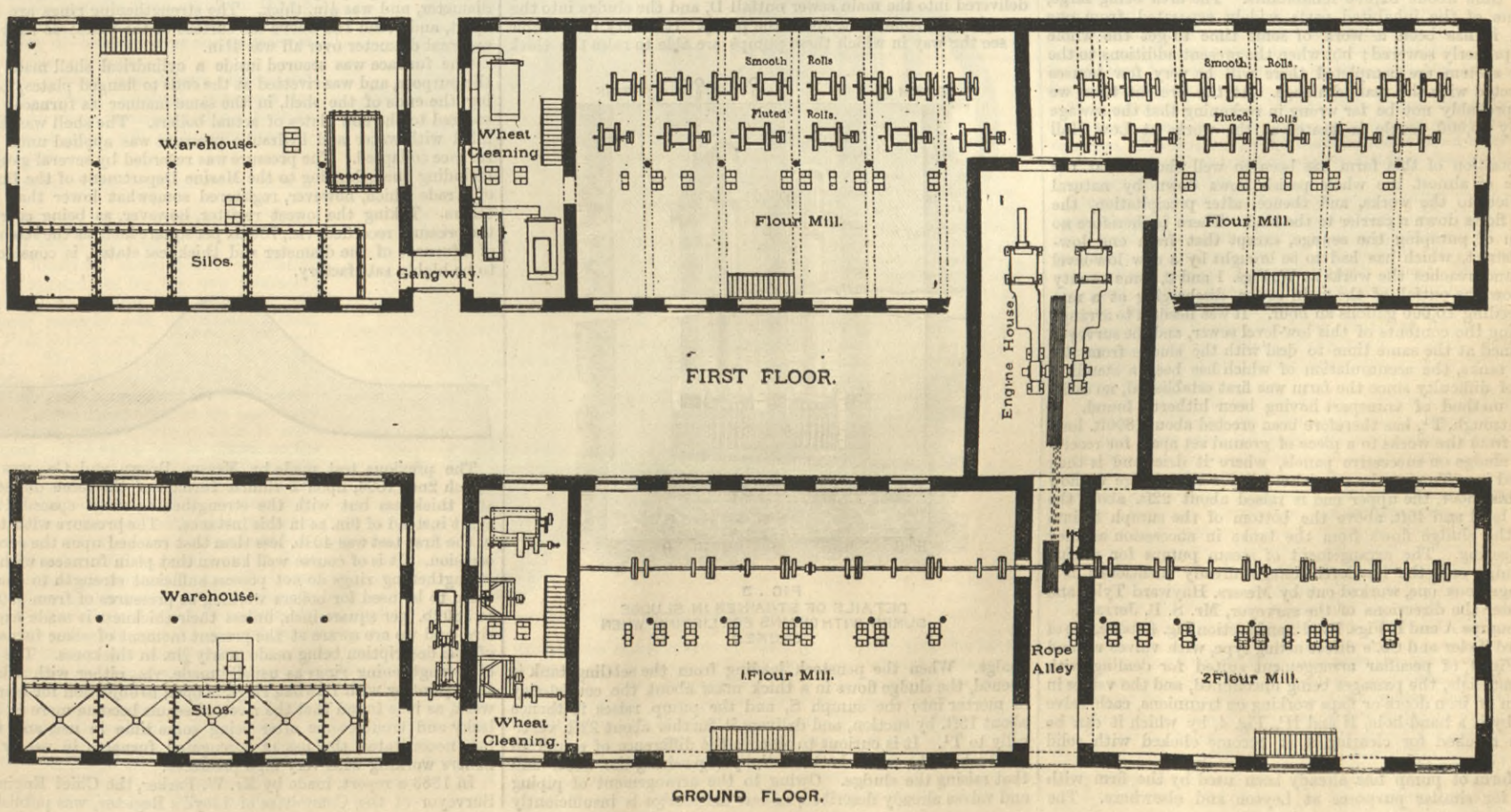
(*For description see page* 482)



TRANSVERSE ELEVATION.



LONGITUDINAL ELEVATION.



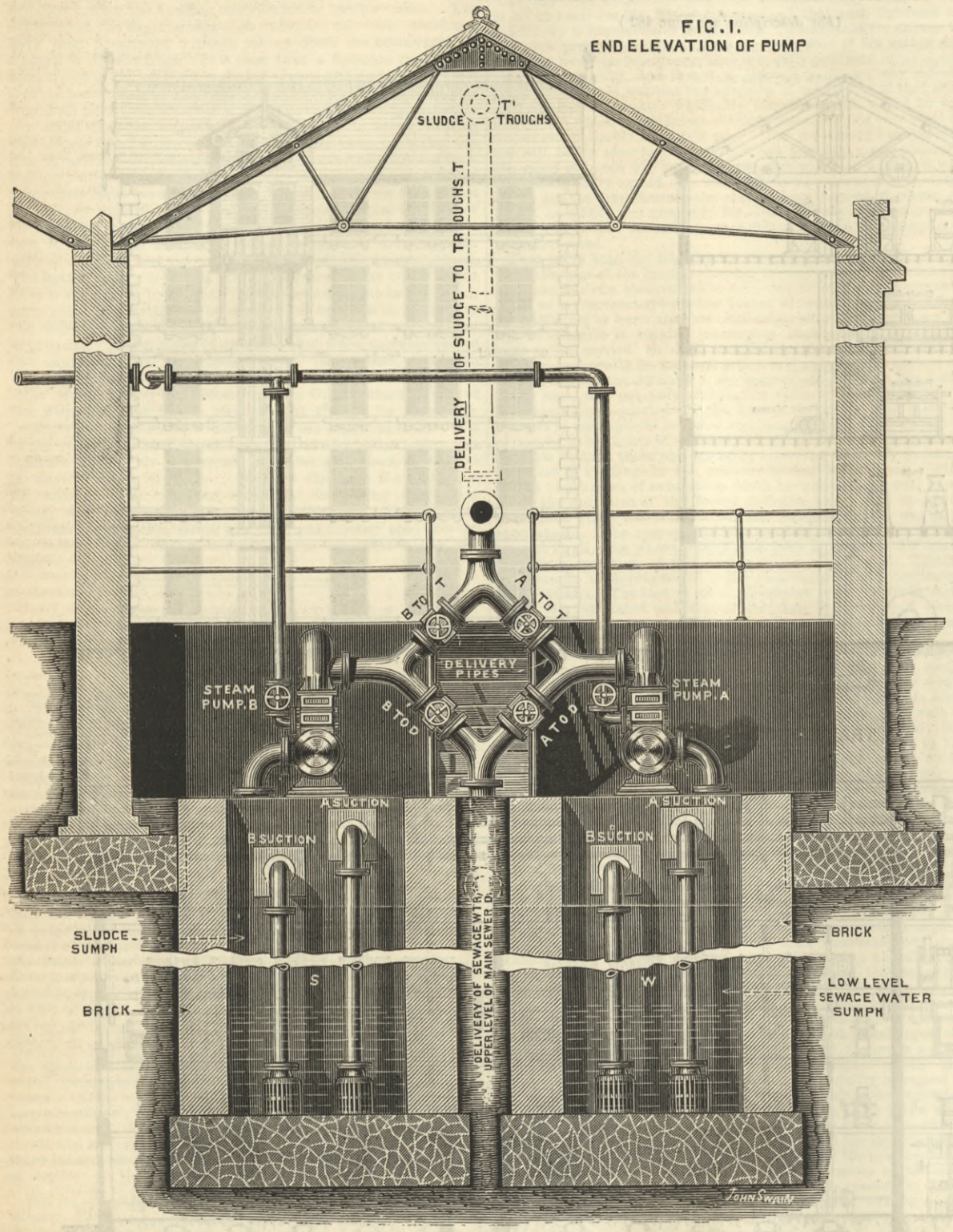
FIRST FLOOR.

GROUND FLOOR.

SEWAGE AND SLUDGE PUMPS, WALTHAMSTOW.

MESSRS. HAYWARD TYLER AND CO., LONDON, ENGINEERS.

FIG. 1.
END ELEVATION OF PUMP



PUMPS FOR SEWAGE AND SLUDGE AT WALTHAMSTOW, ESSEX.

THE urban sanitary district of Walthamstow contains at the present time about 32,000 inhabitants. The area being large, and some of the inhabited parts widely separated from one another, it has been a work of some time to get the whole district properly sewered; but when the present additions to the existing system are completed there will be very few houses unconnected with the main drainage. At the present time we should probably not be far wrong in reckoning that the sewage of nearly 30,000 people is treated at the works at Low Hall Farm.

The position of this farm has been so well chosen that the drainage of almost the whole parish flows down by natural gravitation to the works, and thence, after precipitation, the effluent flows down a carrier to the land. There is therefore no question of pumping the sewage, except that from one low-lying district, which has had to be brought by a new low-level sewer, and reaches the works at W, Figs. 1 and 2, some twenty feet below the outfall of the main sewer, discharging at a rate not exceeding 10,000 gallons an hour. It was needful to arrange for raising the contents of this low-level sewer, and the surveyor determined at the same time to deal with the sludge from the settling tanks, the accumulation of which has been a standing source of difficulty since the farm was first established, no satisfactory method of transport having been hitherto found. A wooden trough, T^1, has therefore been erected about 1800ft. long leading from the works to a piece of ground set apart for receiving the sludge on successive panels, where it dries and is then ploughed in. To give the requisite fall for the sludge to flow down this shoot, the upper end is raised about 22ft. above the ground level and 40ft. above the bottom of the sumph S, into which the sludge flows from the tanks in succession as they need clearing. The arrangement of steam pumps for raising this sludge and the low-level sewage already mentioned, is a very ingenious one, worked out by Messrs. Hayward Tyler and Co., under the directions of the surveyor, Mr. S. B. Jerram.

The pumps A and B, Figs. 1 and 2, and section Fig. 4 above, are of Hayward Tyler and Co.'s direct-acting type, with valves v v and v^1 v^1, Fig. 4, of peculiar arrangement suited for dealing with thick materials, the passages being unconfined, and the valves in the form of iron doors or flaps working on trunnions, each valve having by it a hand-hole, H and H^1, Fig. 4, by which it can be at once reached for clearing if it become choked with solid matter.

This form of pump has already been used by the firm with success for similar purposes at Leyton and elsewhere. The pumps are, as will be seen by the engraving, two in number, A and B, Figs. 1 and 2, placed side by side, and the suction and delivery pipes are so arranged that either pump can be set to pump either sewage water from W or sludge from S; the former being delivered into the main sewer outfall D, and the sludge into the troughing T, some 22ft. above the pump. It is very remarkable to see the way in which these pumps are able to raise the thick

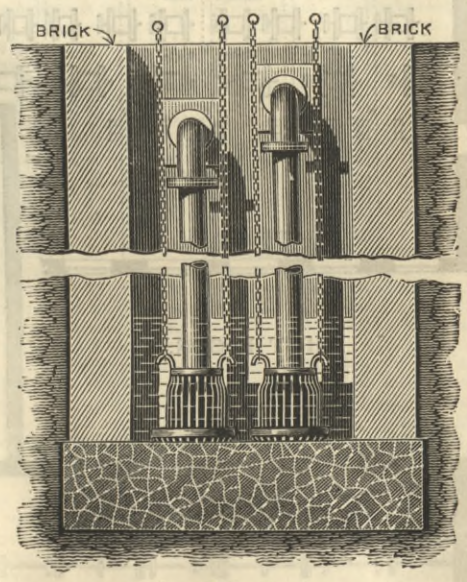
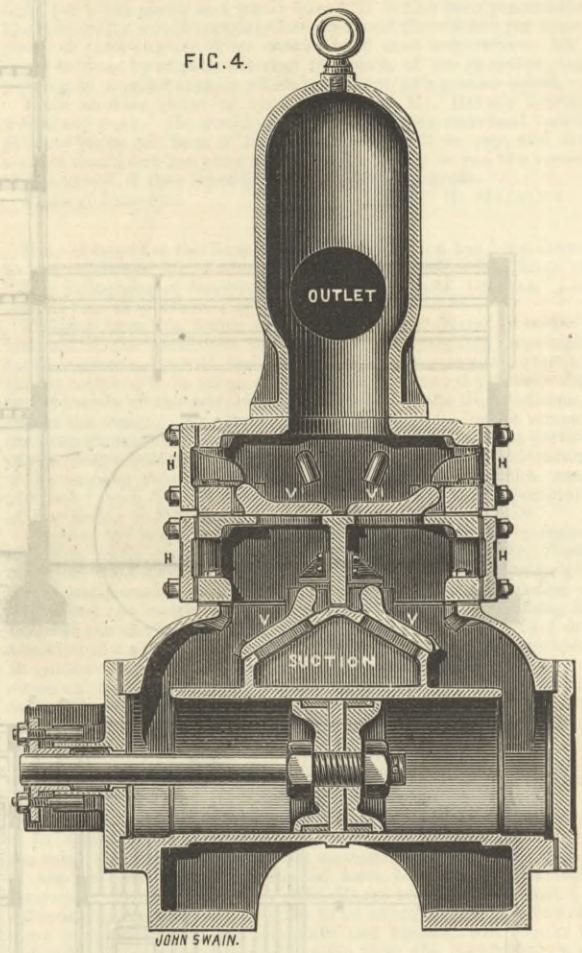


FIG. 3
DETAILS OF STRAINER IN SLUDGE SUMPH WITH CHAINS FOR LIFTING WHEN CHOKED

sludge. When the penstock leading from the settling tank is opened, the sludge flows in a thick mass about the consistency of mortar into the sumph S, and the pump raises it thence about 18ft. by suction, and delivers it further about 22ft. vertically to T^1. It is curious to observe the difference of sound in the beat of the valves between the pump raising the water and that raising the sludge. Owing to the arrangement of piping and valves already described, in case the sludge is insufficiently strained or so thick that the pump shows signs of becoming clogged, the suction of either pump can be connected with the water sumph W, and the valves and passages flushed out by pumping the water for a few minutes. This, however, appears not to be needful now that the arrangements shown in Fig. 3 are completed in the sumph for keeping back solids such as coke, gravel, rags, rats, &c., which hardly come under the designation of sludge. The report of the surveyor to the Board meeting, after the starting of the pumps, concludes as follows:—"The surveyor begs to report that about 700 tons of sludge of a dense nature have been pumped from the precipitating beds and conveyed along the troughs a distance of 1800ft. on to the place of final deposit without any manual labour assistance. This has been done at one-fifth of the cost under the old method." Fig. 3 shows the arrangement of wrought iron strainers in the sludge sumph to keep back the larger solid matter from the suction

FIG. 4.

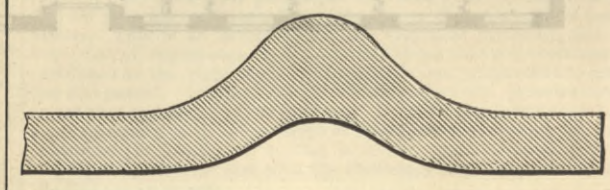


pipes. These strainers are so made that they can be lifted up for cleaning by means of chains. The boilers are of the multi tubular semi-portable type, two in number.

A NEW FURNACE FOR MARINE BOILERS

MESSRS. JOHN BROWN AND CO., of Sheffield, conducted the second of two tests upon the strengths of furnaces, on Tuesday, the 1st inst., at their works at Sheffield, before an influential gathering of marine engineers, who are at the present time much interested in this question, the furnaces of the boilers working at very high pressures being considered to be their most vital part. Amongst those present were representatives from the Admiralty, Board of Trade, Lloyd's Register, several of the principal steamship lines, and also several of the noted shipbuilders and marine engineers of the country. The experiment consisted of testing to destruction a full-sized furnace made upon a new patented principle, with a number of annular strengthening rings rolled upon the plate of which it was made, as shown by the accompanying sketch. The furnace was 38in. internal diameter, and was $\frac{1}{2}$in. thick. The strengthening rings are 9in. apart, and stand 1in. above the surface of the plate; so that the external diameter over all was 41in.

The furnace was secured inside a cylindrical shell made for the purpose, and was rivetted at the ends to flanged plates, forming the ends of the shell, in the same manner as furnaces are secured to the end plates of actual boilers. The shell was then filled with water and hydraulic pressure was applied until the furnace collapsed. The pressure was recorded by several gauges, including one belonging to the Marine Department of the Board of Trade which, however, registered somewhat lower than the others. Taking the lowest register, however, as being correct, the pressure recorded, viz., 780 lb. per square inch, as the strength of a furnace of the diameter and thickness stated, is considered to be highly satisfactory.

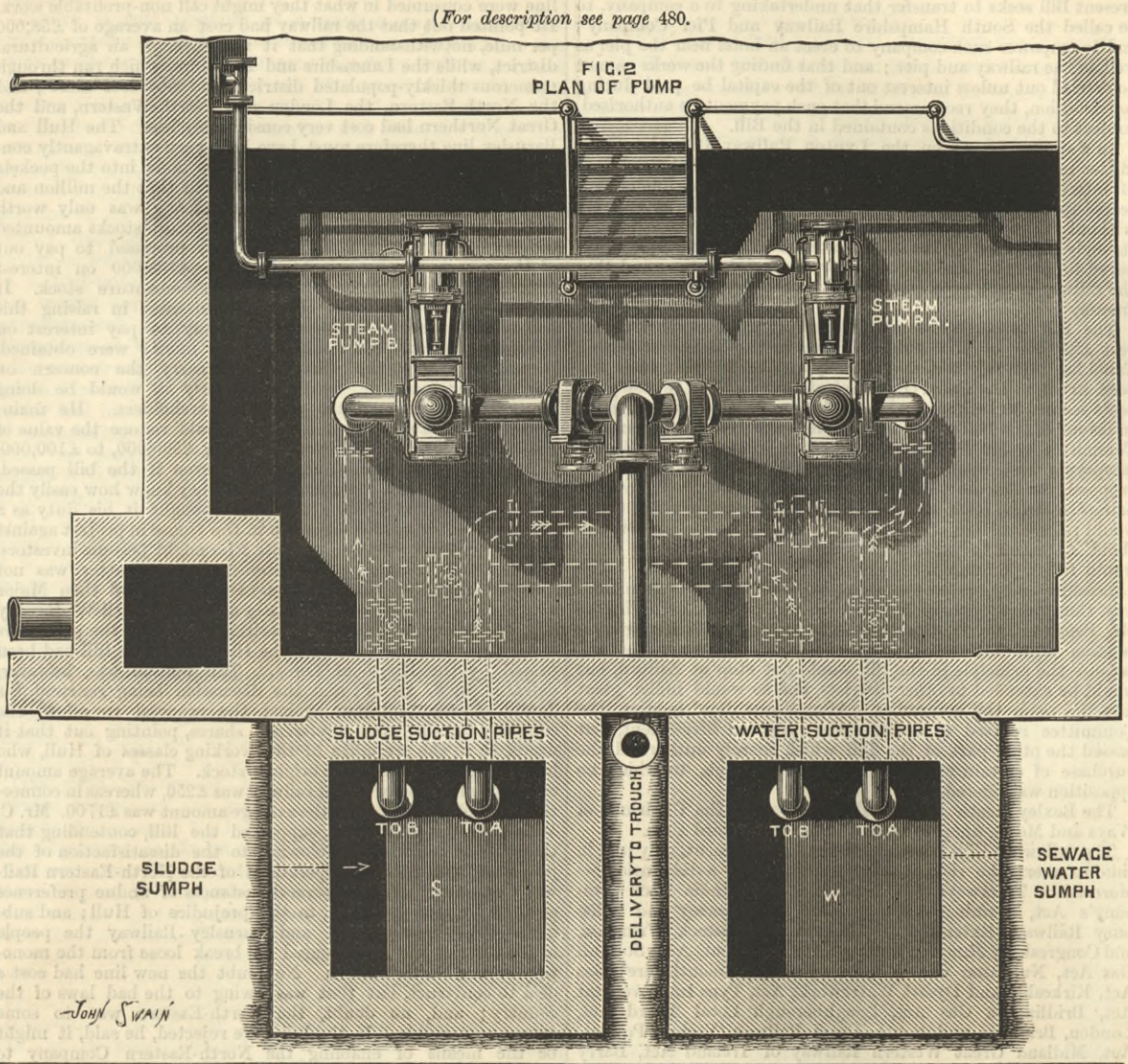


The previous test made by Messrs. Brown and Co., was on March 2nd, 1886, upon a similar furnace of the same diameter and thickness but with the strengthening rings spaced 12in. apart instead of 9in. as in this instance. The pressure withstood in the first test was 40 lb. less than that reached upon the second occasion. It is of course well known that plain furnaces without strengthening rings do not possess sufficient strength to enable them to be used for boilers working at pressures of from 150 lb. to 180 lb. per square inch, unless their thickness is made excessive, and we are aware at the present moment of some furnaces of this description being made nearly $\frac{3}{4}$in. in thickness. The use of strengthening rings as usually made, viz., either with Adamson's joint or with Bowling rings, is open to objection for marine work, as it is found that the rivetted seams become more or less leaky and troublesome after being some time in use, and this has necessitated the use of corrugated furnaces in nearly all boilers working with very high pressures.

In 1883 a report, made by Mr. W. Parker, the Chief Engineer Surveyor of the Committee of Lloyd's Register, was published

SEWAGE AND SLUDGE PUMPS, WALTHAMSTOW.

(*For description see page* 480.

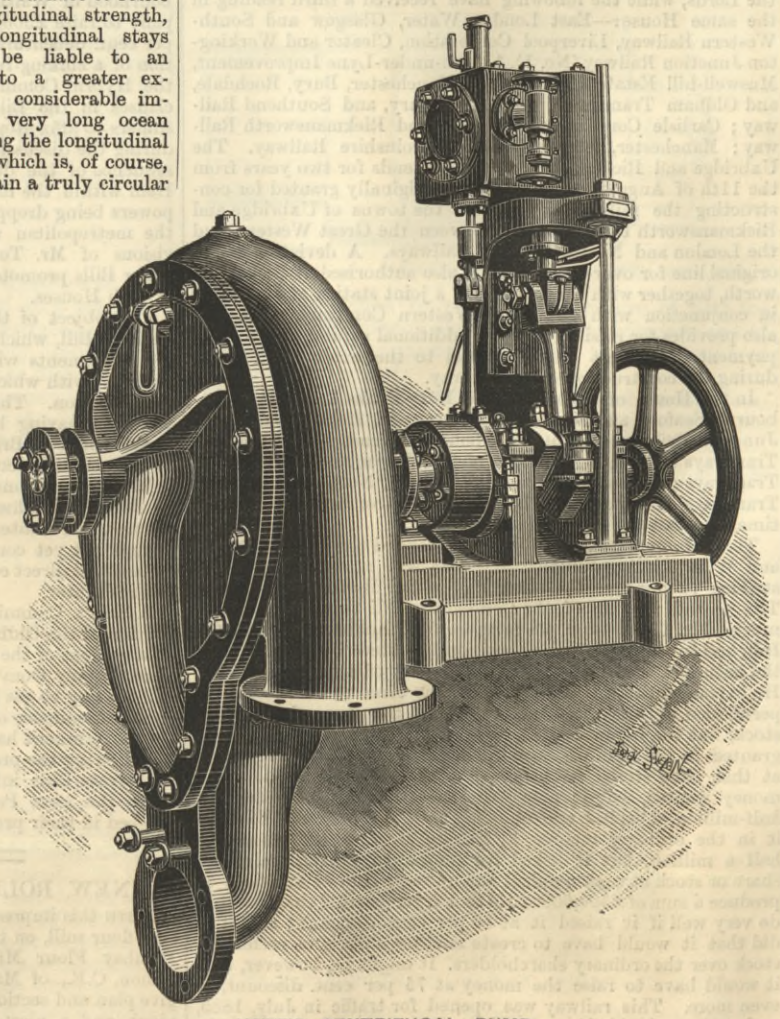


upon the strength of furnaces, in which he stated that the ultimate strength of corrugated furnaces was expressed by $\frac{60{,}000 \times t}{d}$, where t represents the thickness of the plate and d the mean diameter of the furnace. Applying this rule, it will be found that a corrugated furnace of the same diameter and thickness as the furnace made by Messrs. Brown and Co. would have collapsed at a pressure of 770 lb. per square inch. It is claimed for the new form of furnace that besides being practically of the same strength as the corrugated furnace to resist collapse, it possesses very much greater longitudinal strength, and that therefore it will not require longitudinal stays close alongside it. It also will not be liable to an accumulation of scale upon its crown to a greater extent than plain furnaces—a point of very considerable importance in the cases of vessels making very long ocean voyages. Messrs. Brown and Co. prefer making the longitudinal joint of these furnaces with a butt strap, which is, of course, placed below the fire-bar level; they thus obtain a truly circular form with a thoroughly trustworthy joint, which is not likely to give trouble by leakage as soon as a slight corrosion has occurred upon some part of the joint, as has often happened with welded joints. Further, they consider that a welded joint is more likely to suffer from corrosion than a rivetted one, on account of the material not being so homogeneous at the weld as at the other portions.

We understand that Messrs. Brown and Co. have already received numerous inquiries for these furnaces, and we have no doubt that they will soon come into extended use.

HETT'S 9-INCH CENTRIFUGAL CIRCULATING PUMP.

WE illustrate above a 9in. circulating pump, constructed for the new steamship building to replace the Eldorado, the steamer recently sold by Messrs. Wilson, the Hull shipowners, to the Greek Government. The circulating pump on the Eldorado, as well as that which we now illustrate, was constructed by Mr. Hett, of Brigg. Some modifications are introduced in the new engine, which make it more compact. The valve box is placed on the pump side of the cylinder, which permits of the opposite side being placed close to a bulkhead if desired. The moving parts are of Bessemer steel with hard gun-metal bearings. Every joint is lubricated by self-acting lubricators, which can be filled while the engine is running. The pump proper is of Mr. Hett's "Accessible" pattern, in which the whole side can be removed by breaking but a single joint, in one plane only, without disturbing either the pipes or packing. The spindle and disc are of gun-metal to prevent the corrosive action of the salt water. Although the engine is suitable for running at 500 or more revolutions per minute, it was found in the case of the Eldorado that 110 produced sufficient circulation to maintain the vacuum. Mr. Hett has met with some rather curious results in experimenting with his pump. For instance, a pump with a 2ft. disc gave a full discharge at a height of 16ft. 6in. when running 190 revolutions per minute, the velocity at the periphery being about two-thirds of the head due to gravity. This result is an apparant anomaly, and a similar result has never, so far as we are aware, hitherto been recorded.



HETT'S CENTRIFUGAL PUMP.

PRIVATE BILL LEGISLATION.

THE most important events in regard to Private Bill legislation since our last article have been the presentation of the report of the House of Lords Committee upon the question of altering the Standing Orders as to the payment of interest out of capital during the construction of railways, and the adoption by the House of Lords of a new Standing Order embodying the recommendation of the Committee. It is almost needless to remind our readers that these proceedings have been brought about by the introduction of a supplementary Bill to enable the Manchester Ship Canal Company to pay interest out of capital during the construction of its waterway, it having been found that unless this was done the necessary capital could not be obtained, either from subscribers or from individual capitalists, like the Rothschilds, who had offered to find the money for the work upon that condition. Upon this principle in legislation there has hitherto been a difference between the Standing Orders of the two Houses of Parliament, the Commons having, in 1883, so modified the old prohibiting Order as to allow the payment of interest out of capital upon certain conditions, while the Lords have rigidly adhered to the old Order of 1848—probably mainly through the influence of the late Earl of Redesdale. Having before them the evidence upon which the House of Commons made the alteration in 1883, the Select Committee only examined one witness, viz., Lord Rothschild (as we mentioned last week), and the issue of their deliberations is that they have arrived at the conclusion that it is expedient to alter the present Standing Order, and that this may safely be done if due provision is made that the public are informed that the interest paid during construction comes out of the capital. For this reason, and realising the advantage of uniformity between the Orders of the two Houses, the Committee advise that the present Standing Order of the House of Commons should be in substance substituted for the existing Standing Order No. 128. Their proposal therefore is that a new Standing Order be substituted for No. 128, in the following terms:—"128. A clause shall be inserted in every railway Bill prohibiting the payment of any interest or dividend out of any capital which the Company have been or may be authorised to raise either by means of call or of any other power of borrowing to any shareholder on the amount of the calls made in respect of the shares held by him, except such interest on money advanced by any shareholder beyond the amount of the calls actually made is in conformity with the Companies Clauses Consolidation Act, 1845, or the Companies Clauses Consolidation (Scotland) Act, 1845, as the case may be, and except such interest, if any, as the Committee on the Bill may, according to the circumstances of the case, think fit to allow, subject always to the following conditions:—(1) That the rate of interest allowed by the Committee do not in any case exceed 4 per cent. per annum; (2) that interest be allowed to be paid in respect only of the time allowed by the Bill for the completion of the railway, or such less time as the Committee think fit; (3) that payment of interest be not allowed to begin until the railway Company have obtained a certificate of the Board of Trade to the effect that two-thirds at least of the share capital authorised by the Bill, in respect whereof interest may be paid, have been actually issued and accepted, and are held by shareholders, who, or whose executors, administrators, successors, or assigns, are legally liable for the same; (4) that interest do not accrue in favour of any shareholder for any time during which any call on any of his shares is in arrear; (5) that the aggregate amount to be so paid for interest be estimated and stated in the Bill, and be not deemed capital within Standing Order 112; (6) that notice of the Company having power so to pay interest out of capital be given in every prospectus, advertisement, or other document of the Company inviting subscriptions for shares, and in every certificate of shares; and (7) that the half-yearly accounts of the Company do show the amount on which and the rate at which interest has been paid, and the Company shall be authorised by the Bill to pay interest accordingly, but not further or otherwise."

The Committee further recommend that if in any case the Committee on a Bill do not think fit to allow any such interest, then there shall be inserted in the Bill provisions making liable to penalties recoverable summarily any director or officer of the Company who shall directly or indirectly pay, or procure to be paid, any interest or dividend prohibited as aforesaid, and making illegal and void any contract entered into by the Company or the directors thereof, or any of them, under which payment of any interest or dividend prohibited as aforesaid shall be directly or indirectly provided for. The Bill shall not be reported by the Committee until there has been laid before them a report from the Board of Trade respecting any proposed payment of interest, and the Committee shall report specially to the House in what manner they have dealt with the recommendations or observations in the report of the Board of Trade.

The sequel to this report was that the Lord Chancellor moved in the House of Lords that Standing Order 128 should be rescinded, and in its place be enacted the Order recommended by the Committee in the terms given above. The Lord Chancellor briefly reviewed the history of the question, and the action of the other House, commenting upon the awkwardness and difficulty of conflicting principles being in operation in 'the two branches of the Legislature, and mentioning that in one case the House of Lords, wishing to pass a Bill which under the rigid application of their Standing Order must have been rejected, had suspended the Order to enable the measure to pass. Lord Selborne maintained that the existing Standing Order was sound, and was preferable to that of the House of Commons; but realising the desirability of unanimity between the two Houses, and having regard to the recommendation of the Select Committee, he assented to the motion, and the new Standing Order was agreed to.

The successful passage of the Ship Canal Bill may now be considered assured, for the new Order will be applicable to that measure. The Bill was read a second time in the House of Lords on Monday, and has been referred to a Select Committee for the necessary examination.

During the week the following, among other measures, have been advanced in one or the other House. Second readings in the Lords': Dore and Chinley Railway, Manchester Ship Canal (payment of interest), Oldham Corporation, Guildford Corporation, East London Water, Lambeth Water, Southwark and Vauxhall Water, London, Tilbury, and Southend Railway; Mersey Railway, Leeds Hydraulic Power Company Bills. Third readings in the Lords: Tendring Hundred Water, Sligo and Bundoran Tramway, Ripon Corporation, North Dublin City Improvement, Kingston and Kingsbridge Junction Railway, and Orkney Roads Bills.

Second readings in the House of Commons: Ardrossan Gas and Water, Midland and South-Western Junction Railway, and the Dore and Chinley Railway Bills. Read a third time in the House of Commons and passed:—Lanarkshire and Ayrshire Railway, Lea River Purification, Leeds Compressed Air Power Company, Accrington, Clitheroe, and Sabden Railway, Cambridge University and Town Water, Harrow and Stanmore Railway, Skegness, Chapel, St. Leonard's, and Alford Tramway, Mountain Ash Local Board (Gas, Water, &c.), Ballymena and Port Glenone, Ballymena and Larne Railways, Ballymena and Ahoghill Tramways, Falkirk Drainage, Manchester, Sheffield, and Lincolnshire Railway, Barry and Cadoxton Gas and water Company, and Swansea Harbour Bills.

A somewhat singular discussion arose in the House of Lords the other day upon the unfortunate Gravesend and Northfleet Docks and Railway Bill. This scheme having been rejected by the Standing Orders Committee as having failed to comply with the Standing Orders, Earl Cadogan moved to refer it back to that Committee on the ground that the vote upon the Bill had been equal, viz., five on each side. Looking at the importance of the Bill, and the value of the employment the works would afford, he urged the House not to allow the Bill to be defeated

simply because the money deposit had been lodged a few weeks late. Lord Donoughmore and Lord Morley supported the motion; but the Earl of Limerick, as one of the Standing Orders Committee, and the Duke of Buckingham and Chandos, Chairman of Committees, opposed it. The latter, while admitting that the works would be of great use to the unemployed, enforcing the danger of overruling a decision of the Committee, especially as the neglect in lodging the deposit was not due to ignorance, as the same course was pursued last year. The Marquis of Salisbury supported the motion mainly on behalf of the unemployed, who he felt ought not to be punished because a capitalist had not deposited the money a month earlier. The Earl of Kimberley, however, opposed the motion, which was in the end rejected by fifty-four to fifty-two. Subsequently the Bill was withdrawn.

The Bill to transfer the Marquess of Bute's Docks at Cardiff to a limited liability company, having safely passed through the House of Lords, has now passed in the Lower House as an unopposed measure.

The London and North-Western and the Great Western Railway Companies are opposing the Mersey Railway Bill in the House of Lords. The object of the Bill is to carry the Mersey Tunnel system into the centre of Liverpool, and to extend it in other directions.

The Corporations of Manchester and Oldham have presented petitions in favour of the Ship Canal Bill, but the Birkenhead Corporation oppose it.

The Manchester, Sheffield, and Lincolnshire Railway Bill has been declared to have complied with the Standing Orders of the House of Lords.

The London, Brighton, and South Coast Railway Bill, which has passed the House of Lords unopposed, and is now awaiting the Royal Assent, authorises the company to construct short junction railways at New Cross, to stop up level crossings at Mitcham and Edenbridge, to extend the time for the purchase of lands, to complete the Oxted and Groombridge Railway, to make further agreements between the company and the Isle of Wight Marine Transit Company, and to make further provisions as to the maintenance and management of the Southsea Railway.

An important decision has been declared upon the Hyde Park Corner Bill, which came before a Select Committee of the House of Lords, the Duke of Richmond presiding. As originally introduced into the House of Commons, the Bill proposed that the burden of maintaining the improvements should be divided between St. George's, Hanover-square, and St. Martin's-in-the-Fields, but the House of Commons' Committee decided, after hearing evidence, that it would be fairer to divide the cost between St. George's, Hanover-square, and the Metropolitan Board of Works, as the improvement did not affect St. Martin's-in-the-Fields at all, more than the rest of the metropolis. The Government Board of Works have appeared, and asked that the settlement agreed on by the House of Commons should be confirmed by the House of Lords' Committee. On the other hand, the Metropolitan Board of Works object, arguing that the cost of maintenance should be divided between the parish in which the improvement is situated and the contiguous parish. The ground which is to be devoted to the improvement is situated in the extreme corner of the parish of St. Martin's-in-the-Fields, and the contiguous parish to be benefitted is St. George's, Hanover-square, and these are the parishes on which the Metropolitan Board would throw the cost of maintaining the improvements. The Committee proceeded to examine witnesses, and ultimately decided to omit Clause 1, the effect of which decision is to cut out all the operative parts of the Bill and leave nothing but a bare preamble, which says that it is expedient to make provision for the maintenance of the streets in question, but without prescribing how or by whom they are to be maintained. At the subsequent meeting of the Committee Mr. Bidder, Q.C., on behalf of the Commissioner of Works, brought up a new clause in substitution of the clause previously rejected for throwing the cost of maintaining the new streets at Hyde Park-corner equally upon the parish of St. George's, Hanover-square, and the Metropolitan Board of Works. The clause provided that the cost of maintenance should be borne by the parish of St. George's and the Metropolitan Board of Works in such proportions as should be determined by an arbitrator, to be hereafter named, the cost of such arbitration to be paid by the parish of St. George's. The chairman, after hearing the clause read, stated that as the proposal would require considerable consideration, the Committee would not proceed with the discussion upon it until after they had concluded the Oldham Corporation Bill. In reply to a question in the House of Commons by Mr. Labouchere, Mr. Leveson Gower, referring to the fact that the Select Committee had reversed the decision of the House of Commons on this Bill, explained that there were no funds in existence for the maintenance of these roads, except such as were provided by Parliament. In the event of this House refusing to grant any further expenditure for these roads, and if these roads became dangerous for want of repairs, the Government might be compelled to close them in the interest of public safety.

The London Street Tramways Extensions Bill has been passed by a Select Committee of the House of Commons. The object of the measure was to enable the company to lay down tramways from Highgate to Gray's Inn-road, and so to complete their system between Hampstead on the one hand and Highgate and Holloway on the other, converging at King's Cross and thence proceeding down to the Holborn Town Hall. For this purpose it was proposed to raise £75,000 of additional capital by shares and loans. Some opposition was offered, but it was not strong and proved futile. The Committee in their report to the House state that the Bill provided that the promoting company shall not commence the construction of certain sections unless and until the portion of Gray's Inn-road between Henry-street and the Holborn Town Hall had been widened so as to permit the laying down of Section 8A as a double line, so that there should not be at any point on the route a less space than 9ft. 6in. between the outside of the footpath on either side of the road and the nearest rail of the tramway. The Committee therefore express their opinion that the restriction imposed by Standing Order 158 need not be enforced in this case, but that the company should be allowed to complete the tramway within two years from the completion of the widening of Gray's Inn-road. The same Committee has likewise passed the preamble of the Bill of the North Metropolitan Tramway Company authorising a new line of tramway along Theobald's-road, Holborn, in continuation of the existing line which terminates at the end of Clerkenwell-road, and also another line along Commercial-street, East, to connect the line now being constructed in Great Eastern-street with the existing line in the Commercial-road.

In reporting to the House of Commons upon the South Hampshire Railway and Pier Bill, which they passed, the Select Committee explain, among other things, that the Bill does not authorise any new works, the railways having been authorised by the Swindon, Marlborough, and Andover Railway Act, 1882, and the pier by the Act of 1883 having the same title, the railways and pier having been formed into a separate undertaking called the Southern Section Undertaking; that the present Bill seeks to transfer that undertaking to a company, to be called the South Hampshire Railway and Pier Company; and to empower such company to erect an hotel near the pier as well as the railway and pier; and that finding the works cannot be carried out unless interest out of the capital be paid during construction, they recommend that such payment be authorised, subject to the conditions contained in the Bill.

In a similar report on the Lynton Railway Bill, the Committee make the same recommendation in favour of the payment of interest out of capital, being satisfied that the line is projected to develope the traffic of a district at present entirely without railway accommodation, and finding that the scheme is strongly supported by the landowners, several of whom are prepared to give the land required for the construction, and that the railway is not promoted by or in the interest of any contractor.

The Bill to authorise the Corporation of Salford to invest £250,000 of the public money in the Manchester Ship Canal has been rejected, and thereby another indirect blow has been struck at the Canal (Payment of Interest) Bill, whose prospects seemed to be improved a week ago, as already explained. In favour of the Bill it was urged before the House of Commons' Committee by Mr. Pember, among other points, that while the ratepayers had, upon a poll being taken, approved of this proposal, the scheme would by helping the Canal greatly benefit Salford directly, commercially, and indirectly because the Canal would relieve Salford of floods which it would cost the borough about £130,000 to prevent by other measures. Hence there would follow a further benefit in a reduction of rates. The Lancashire and Yorkshire and London and North-Western Railway Companies opposed the Bill on the ground, according to Mr. Pember, that it would assist in setting up a strong competition with themselves; but according to their counsel, because the principle in the Bill would not stop at Salford, but would be extended to other districts, and so would inflict great injustice upon the companies. After a two days' inquiry, the Committee refused to sanction the proposed investment, but passed the other part of the Bill which merely authorised the purchase of certain waste lands in the borough, to which no opposition was offered.

The Bexley Heath Railway Bill has passed the Chairman of Ways and Means unopposed, and been read a third time.

The following Bills have gained the Royal Assent, only just in time to avert the risk of being sacrificed by a dissolution:—Morecambe Tramways Act, East and West India Dock Company's Act, Leamington Corporation Act, Pewsey and Salisbury Railway (Extension of Time) Act; Radstock, Wrington, and Congresbury Junction Railway (Abandonment) Act; Solihull Gas Act, Nuneaton Gas Act, Newport (Monmouthshire) Gas Act, Kirkcaldy and Dysart Waterworks Act, Tyne Improvement Act, Bridlington Gas Act, Loughborough Local Board Act, London, Brighton, and South Coast Railway (Various Powers) Act, Midland Great Western Railway of Ireland Act, Barry Dock and Railways Act, London, Chatham, and Dover Railway Act, Great Northern Railway (Ireland) Act, Scinde, Punjaub, and Delhi Railway Purchase Act, Wrexham Gas Act, Rhondda and Swansea Bay Railway Act, Brighton and Dyke Railway Act, Ballymena and Portglenone Railway, and Ballymena and Ahoghill Tramways (Abandonment) Act, Marple Local Board Gas Act, Liverpool United Gaslight Company's Act, Falkirk Drainage Act, Lanarkshire and Ayrshire Railway Act.

The Southend Local Board, Glasgow Bridges, London and South-Western Railway, and Sutton and Willoughby Railway (Maplethorpe Extension) Bills have been read a second time in the Lords, while the following have received a third reading in the same House:—East London Water, Glasgow and South-Western Railway, Liverpool Corporation, Cleator and Workington Junction Railway (No. 1), Ashton-under-Lyne Improvement, Muswell-hill Estate and Railway; Manchester, Bury, Rochdale, and Oldham Tramways; London, Tilbury, and Southend Railway; Carlisle Corporation, Uxbridge and Rickmansworth Railway; Manchester, Sheffield, and Lincolnshire Railway. The Uxbridge and Rickmansworth Bill extends for two years from the 11th of August next, the time originally granted for constructing the railway to connect the towns of Uxbridge and Rickmansworth by a junction between the Great Western and the London and North-Western Railways. A deviation of the original line for over three miles is also authorised at Rickmansworth, together with the making of a joint station at that place in conjunction with the North-Western Company. The Bill also provides for raising £30,000 additional capital, and for the payment of interest out of capital to the extent of £20,000 during the construction of the railway.

In the House of Commons the Bute Docks Transfer; Eastbourne, Seaford, and Newhaven Railway; St. Helen's and Wigan Junction Railway; Torquay Harbour and Trust; London Street Tramways Extension; Cricklewood, Kilburn, and Harrow-road Tramways; Metropolitan Board of Works, North Metropolitan Tramways, and Stapenhill Bridge Bills have been read a third time, and passed.

The ill-fortune that has hitherto attended the Hull, Barnsley, and West Riding Junction Railway was again brought into striking prominence the other day in the House of Commons. The second reading of the Company's Bill this session being moved, Mr. Coddington, the member for Blackburn, opposed the Bill, and in support of his opposition he entered somewhat into the nature of the new Bill and the history of this undertaking. He explained that in 1884 the company came to Parliament for permission to raise £1,500,000 capital, in the form of debenture stock, but the Committee had decided that it should only be granted in the form of second debenture stock. The company at that time stated its belief that there would be no more money wanted, but it now came to Parliament for another half-million of capital, and in doing so it did not seek to raise it in the ordinary manner by issuing stock to the amount of half a million, but it asked for power to create preference share or stock at such nominal amount as would be sufficient to produce a sum of £500,000. He took it for granted that it would do very well if it raised it at 50 per cent. discount; and if it did that it would have to create another million of preference stock over the ordinary shareholders. It might be, however, that it would have to raise the money at 75 per cent. discount, or even more. This railway was opened for traffic in July, 1885, and at the end of half a year the traffic receipts were £54,000; but of that £48,100 was the estimated expenses of the working of the lines, so that the net receipts of the railway for the first five and a half months after it was opened amounted to only £6700. But that net profit was simply an estimate, after certain expenses which ought to have been charged to revenue had been placed to the capital account. These expenses amounted to £12,700, so that instead of the railway having made a profit of £6700 there had been an absolute loss of £6000, so that the working expenses had been £60,000 more than the absolute receipts. Out of the working expenses of £48,000, over £20,000 went in the managing directors' salaries, and in the pay of secretaries, managers, and clerks, and other office expenses, so that nearly half the whole expenses of the line were consumed in what they might call non-profitable work. He pointed out that the railway had cost an average of £58,000 per mile, notwithstanding that it ran through an agricultural district, while the Lancashire and Yorkshire, which ran through numerous thickly-populated districts, had not cost more; and the North-Eastern, the London and North-Western, and the Great Northern had cost very considerably less. The Hull and Barnsley line therefore must have been very extravagantly constructed, and enormous sums must have gone into the pockets of the contractors. He further pointed out that the million and a-half of ordinary capital of the company was only worth £510,000. The interest on the two debenture stocks amounted to £120,000 a year; and the company proposed to pay out of the money it now sought to raise £108,000 on interest already due, or to become due, on debenture stock. It was clear therefore that the object in view in raising this half-million was to enable the company to pay interest on debenture stock. No doubt, if this money were obtained, it might enable the directors to carry the concern on for another year or two; but clearly it would be doing so at the expense of the original shareholders. He maintained that the passing of this Bill would reduce the value of the original shares, which was now only £500,000, to £100,000. It might be thought incredible that, even if the bill passed, people would be got to subscribe; but they knew how easily the public were gulled, and he therefore thought it his duty as a private member to raise his voice in the House in protest against the bill, and in protection of those who might become investors. Sir Richard Temple, whose interest in the matter was not obvious, supported the rejection of the Bill, and then Major Dickson proposed that the debate be adjourned until Wednesday last, on the ground that the opposition had taken the promoters by surprise; and he reminded the House that the Bill had been passed by the House of Lords. This motion was, however, defeated by 67 to 57; and the discussion being renewed, Sir Joseph Pease protested against the proposal to allow the company to raise extra preference shares, pointing out that it would be to the prejudice of the working classes of Hull, who held a large amount of the original stock. The average amount of holding in this particular railway was £250, whereas in connection with other companies the average amount was £1700. Mr. C. Wilson, on the other hand, supported the Bill, contending that this railway had been made owing to the dissatisfaction of the people of Hull with the operations of the North-Eastern Railway Company. He gave several instances of undue preference granted by that company, to the prejudice of Hull; and submitted that in the Hull and Barnsley Railway the people of the district had endeavoured to break loose from the monopoly of the North-Eastern. No doubt the new line had cost a deal to construct, but that was owing to the bad laws of the country; and, no doubt, the North-Eastern was to some extent responsible. If the Bill were rejected, he said, it might be the means of enabling the North-Eastern Company to increase its monopoly by buying up the rival line at an enormous sacrifice to the original shareholders. Mr. Courtney also spoke in favour of the Bill, holding that it would prevent the Hull and Barnsley Railway from being put into the hands of a receiver and going into bankruptcy. It was likely, he added, that the present proposal might enable the railway to weather the storm, and at last get into smooth water; and eventually the motion for the second reading was agreed to.

The Bill promoted by the East London Water Company, mentioned above, provides for the acquisition of an additional supply of water by means of a well and reservoir in the neighbourhood of Waltham. Powers are also granted to the company to raise £300,000 additional capital by the creation of 4½ per cent. debenture stock, upon the conditions as to the formation of a sinking fund, for the benefit of the public, inserted by the Hybrid Committee of the House of Commons. The two clauses in the Bill empowering the company to compel consumers to affix stopcocks to their service pipes were withdrawn during the discussion on clauses in the Lower House, in consequence of the decision requiring the company to bring West Ham within the metropolitan water area. The effect of these powers being dropped is that West Ham still remains outside the metropolitan water area, and does come within the provisions of Mr. Torrens' Water Act, 1885. All the London water Bills promoted this session have now received the sanction of both Houses.

The object of the Brighton, Rottingdean, and New Haven Railway Bill, which has become unopposed, is to authorise working agreements with the London, Brighton, and South Coast Railway, with which the new line will be connected at Kemp Town station. The Newhaven, Seaford, and Eastbourne Railway Bill having been passed, the two lines will give direct access between Brighton and Eastbourne by a coast line over twenty miles in length.

The Bill for constructing a railway ten miles long between Chale and Freshwater in the Isle of Wight has passed both Houses. It is intended to connect this line with the authorised, though not yet constructed line, from Shanklin to Chale, and so to afford direct communication across the island from Shanklin to Freshwater.

A Select Committee of the House of Lords has passed that portion of the Oldham Corporation Bill which provides for the enlargement of the existing reservoirs, and to obtain an additional supply from the district of Castleshaw. That part of the Bill relating to gas has been deferred for future consideration.

In consequence of the immediate dissolution of Parliament, the Government have withdrawn the Railway Rates Bill.

Following the precedent of 1880, Parliament will resolve that all Private Bills interrupted by the dissolution shall be taken up by the next Parliament at the point at which they were stopped in their progress.

NEW ROLLER FLOUR MILL, BOMBAY.

WITH this impression we commence the illustration of a large new flour mill, on the modern roller mill system, erected for the Bombay Flour Mill Company at Bombay by Mr. Henry Simon, C.E., of Manchester. Our engravings, as will be seen, give plan and sectional views of the building and arrangement of plant, and a view of the engine by which the mill machinery is driven. The engines are compound condensing, by Messrs. Yates, of Blackburn, working with 100 lb. steam, the cylinders being 17in. and 30in. diameter, and the stroke 4ft. In another impression we shall give further engravings and a description of the whole.

FRIENDS of the Panama Canal scheme say that M. de Lesseps is moving heaven and earth to complete the job." "M. de Lesseps," observes the San Francisco *Wasp*, "would get on faster if he would move less heaven and more earth."

now issued, has all the merits of the previous work; it is clear, methodical, well illustrated, and, as far as it goes, accurate.

There is still wanting in English a single reasonably good text-book of Hydraulics. In German there are the very good treatises of Weisbach, Scheffler, Ruhlmann, and Hagen. In French there are the treatises of Phillips, Bresse, Collignon, and Graeff. The French treatises are strikingly similar in their merits and defects. They are systematic, and written with admirable clearness; but it must be confessed that they not seldom evade the more serious difficulties of the science. French hydraulics is a science of an easy-going and unlaborious tendency, very neatly reasoned on assumptions, the unsatisfactory character of which is just hinted at in passing, or referred to in a foot-note. The French writer troubles himself and his reader very little with the more or less discordant experimental values of coefficients, the tabulation and discussion of which form so large and valuable a part of a German treatise. The result is that a student of French hydraulics will be apt to suppose that the science is much easier and more definite than, in fact, it is, and the results of calculation far more accurate than calculations of that kind can possibly be—unless, indeed, the use of the laws stated is supplemented by great judgment and experience in determining the numerical constants to be used.

M. Haton de la Goupilliere follows very closely his French predecessors. His book is as lucid as possible, but it is also a little shallow. Here and there he has more dextrously evaded an erroneous assumption, and to a certain extent he has curtailed the investigation of now obsolete contrivances. The undershot water-wheel with flat radial floats, the "roue à cuve," the "roue à cuillieres, and the "levier de Mannoury d'Ectot," still occupy space which could be better used; but in introducing some account of accumulators, lifts, and hydraulic cranes, an advance on previous works is gained, even although they are treated in a purely descriptive way.

One good feature of this treatise is, that somewhat copious references are given in foot-notes to authorities. Except, however, in the last section, on hydraulic machines, the references are almost exclusively to French authorities. It is not a very important matter, but we should like just to ask in passing, why, when French writers do break their usual rule of ignoring foreigners, they should almost more often than not misspell their names? Here in a few pages we find Weissbach, Roberton, Kutler (for Kutter), Towbridge (for Trowbridge), Josua Field, Hasties (for Hastie), Parson (for Parsons), Cornick (for Cormick), Thompson (for Thomson), Tweddel (for Tweddell). The English reader will not be much puzzled by "overshott" and "undershott," but he must make what he can of the reference to "Lowel and Hydraulics Experiments."

The first part of the treatise deals with "Flow from Orifices," "Head Lost in Shock," "Flow in Pipes," "Flow in Channels," and "Gauging." The theoretical treatment of large orifices is as unsatisfactory as usual, and as the theory of flow over weirs cannot be reduced to satisfactory neatness, the author slides over it in a dextrous way, avoiding anything definite or practical. Francis's and the later American experiments are not even referred to. Passing to the chapter on "Flow in Pipes," the account of fluid friction is fairly satisfactory; but Froude's experiments are not referred to, and the resistance of pipes is too readily confused with simple viscosity. The author avoids some of the difficulties of the ordinary theory by assuming the principle that the resistance depends on the *mean* velocity. But then he is left with no explanation at all of D'Arcy's form of the coefficient of friction. He leans to the use in the solution of problems of St. Venant's equation—

$$\phi\,(u) = A\,u^{\frac{1.9}{7}};$$

but he has no knowledge of the later investigations of this form of the equation for the resistance, and does not indicate that the index varies for different surfaces. Even D'Arcy's values of the coefficients are very imperfectly given. On the other hand, the theory of pipe distribution, when there are branch mains, is given somewhat more clearly than is usual. Flow in channels is also treated in a rather general way, except the usual French theory of varied motion, which is very clearly given. In the chapter on "Gauging" there is a useful account of some forms of water-meters which ought to be described in a treatise on hydraulics, but have been generally omitted. On the other hand, the account of ordinary gauging instruments —such as current meters and floats—is far too general and superficial to be of practical use.

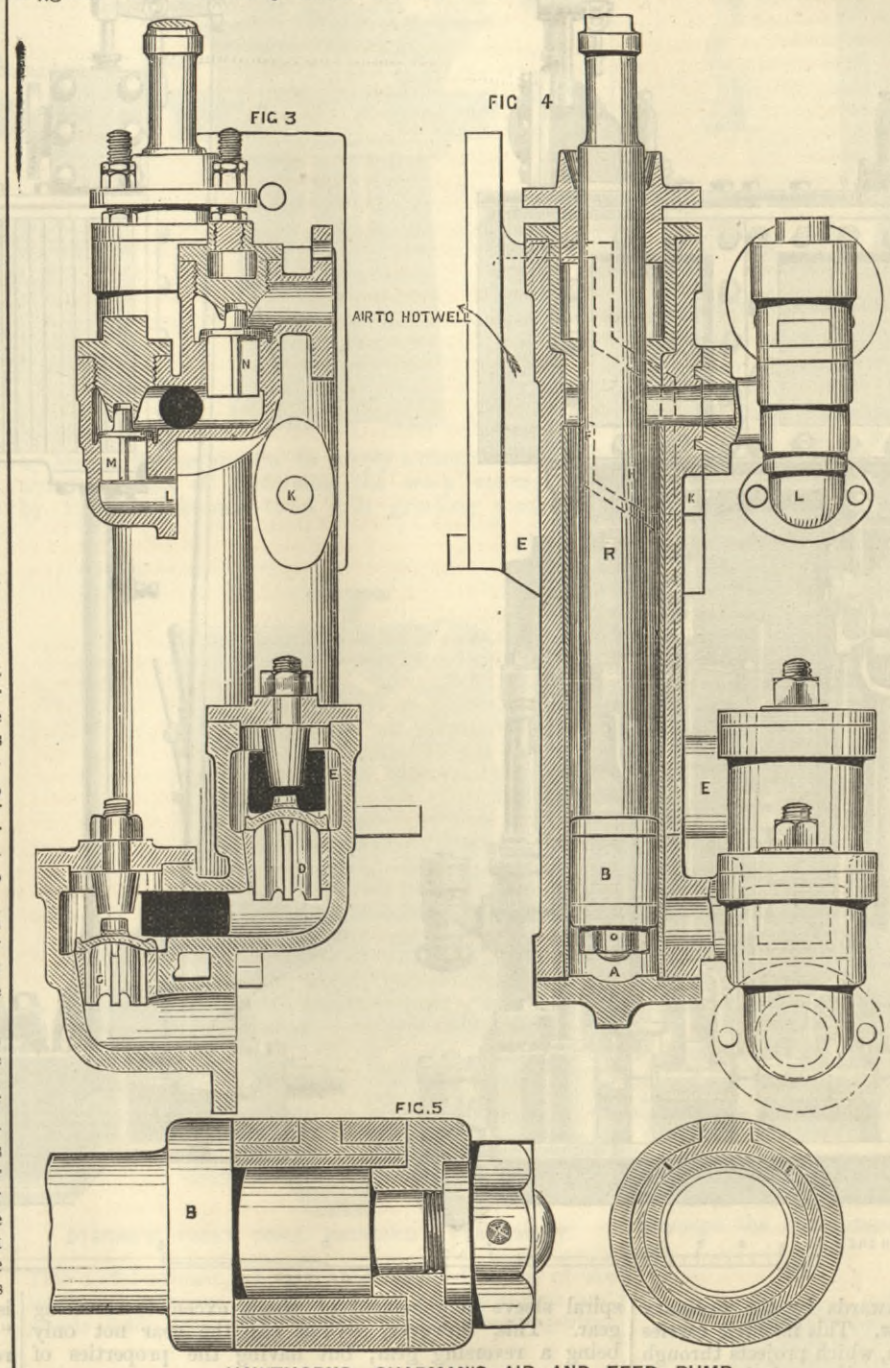
We should pity very much the practical engineer who attempted to determine the constants for a current meter with the help of the instructions under the heading, *Tarraudage des appareils*. As to the useful hook gauge, we have never seen it referred to in a French treatise. The second, and rather shorter part of the treatise, deals with hydraulic machines. To give fifty pages to water-wheels and thirty-five to turbines is not at all in accordance with the present relative importance of the two classes of motors. The account given of the curious hydromotor of Jagn, a long chain of canvas cones or parachutes, shows that modern inventions are not entirely ignored. In the chapter on turbines some modern American forms are described and figured. But the fundamental difference in the action of the water in pressure and impulse turbines is not referred to. Different modes of regulation are described, but the importance of this in relation to the efficiency of the turbine is not indicated, and the really essential differences in the action of the regulators are not stated.

Some forms of accumulator and hydraulic cranes and lifts are described, the differential accumulator not being omitted. Canal lifts, including those at Anderton, and the very much larger one now under construction at Fontinettes, are briefly described. The Caligny lock, in which advantage is taken of the impulse of an oscillating fluid column, will be new to many readers. It is curious, however, that amongst hydraulic machines, pumps of all kinds find no place.

THE EDINBURGH INTERNATIONAL EXHIBITION.

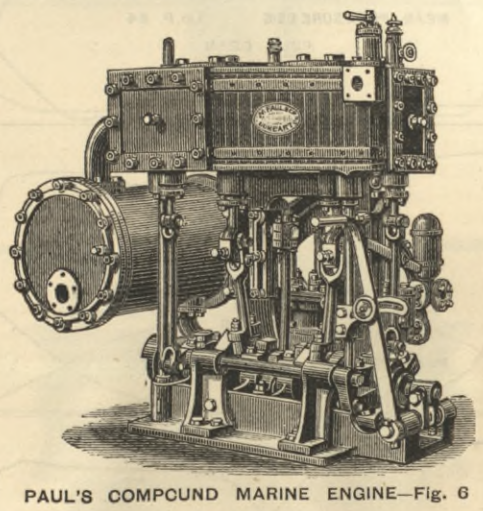
No. IV.

HAVING completed a general survey of the Exhibition, it is left for us to take up in detail, and as opportunity offers, those exhibits which strike us as worthy of more special notice than can be given them in a general survey of the Exhibition as a whole, and to mention shortly those exhibits which have been placed subsequent to our first visits. This we propose doing in successive articles headed as above, or in separate notices, as convenience suggests. The machinery section is rich in exhibits of engines distinguished for one or another form of gear for controlling the admission of steam into the cylinders, and of securing variable expansion according to the amount of work to be performed.



HAWTHORNS, CHAPMAN'S AIR AND FEED PUMP.

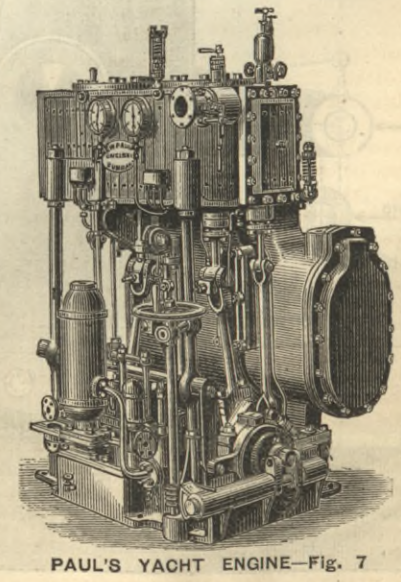
Messrs. Hawthorns and Co., engineers and shipbuilders, of Leith, exhibit in motion at their stand a good example of their special engines for yachts, line fishing vessels, &c., which we herewith describe and illustrate. The general



PAUL'S COMPOUND MARINE ENGINE—Fig. 6

design of the engines will be seen from Figs. 1 and 2, p. 488. The engines are compound surface-condensing. The high pressure cylinder is 9in., and the low-pressure cylinder 18in. diameter and stroke 12in. The slide valves are on the front of the cylinders, and are easily got at for examination. The valve gear, which gives better results than the ordinary link motion, is of the Hackworth type, having only one excentric to each engine. The levers and inclined bars are of cast steel, and all the working parts have adjustable brasses. The engines are entirely controlled by one handle, which reverses the valve motion and opens and shuts the steam regulator valve, though, of course, the usual stop valve may be applied. The condenser tube plates and tubes are of brass, and the latter are packed with india-rubber packing rings. The engines are fitted with Chapman's patent combined air and feed pump and hot well air extractor, as shown in section by Figs. 3 and 4. The air and feed pump is double-acting. The part A below the piston B is used as the air pump, and the part round the ram R and above the piston B is the feed pump. The action of the part of the pump below the piston is on the up stroke to draw the water and air from the condenser through the section valve C, and by the down stroke to force it up through the valve D into the passage E; the water rising to the top of the division F falls into the pocket H. The branch K at the bottom of this pocket is connected by a cock to the suction branch L of the upper or feed action; thus, by the down stroke of the piston the water from the pocket H is drawn through the valve M on the upper side of the piston B, then by the up stroke this water is forced up through the valve N to boiler. As the water falls into the pocket H on being delivered from the air-pump, the air is freed and passes by an opening in the back of the pump into the hot well P, thence through the discharge or relief pipe S, and by a small branch pipe T to a suction valve U on the side of the circulating pump valve chest; it is then taken away by the action of this pump and discharged with the circulating water. There is a small cock and pipe which connects the top of the feed action with the hot well, so that the vacuum may be equal in each, thereby allowing the water to flow into the pump by its own gravitation. Fig. 5 is an enlarged view of the end of the ram and piston B, showing the metallic packing and the steel spring rings. The material and workmanship of these engines is of the best description. Ten have been fitted to line-fishing vessels, &c., and have proved thoroughly efficient.

The exhibits of Messrs. M. Paul and Co., Dumbarton, already mentioned in our general survey of the machinery section, include examples of single-cylinder launch engines; also a pair of compound surface condensing launch engines—all noteworthy on account of their being fitted with the patent single excentric valve gear, now receiving rather extended application in the engines turned out by this firm. Our illustration represents two double-cylinder and one single-cylinder engines, that with the oval condenser, Fig. 7, being a pair of compound condensing screw engines, which are the duplicate, as regards arrangement, of those shown at Messrs. Paul and Co.'s stand, which have cylinders 7½in. and 15in. diameter by 8in. stroke. The engines, which are suitable



PAUL'S YACHT ENGINE—Fig. 7

for a yacht 50ft. long, are shown with air, circulating, feed, and bilge pumps complete, the feature of greatest interest, of course, being the excentric reversing gear. By means of this gear, the general arrangement of which may be gathered from our engine illustrations, but which is exhibited in more detail by Figs. 8, 9, and 10. Engines can be reversed, or the cut-off varied, with only one excentric for two or three cylinders. Briefly, the arrangement is as follows:—The shaft end is bored out to fit a mandril,

THE EDINBURGH EXHIBITION.—COMPOUND YACHT ENGINES.

MESSRS. HAWTHORNS AND CO., LEITH, ENGINEERS.

(*For description see page* 487.)

FIG. 1

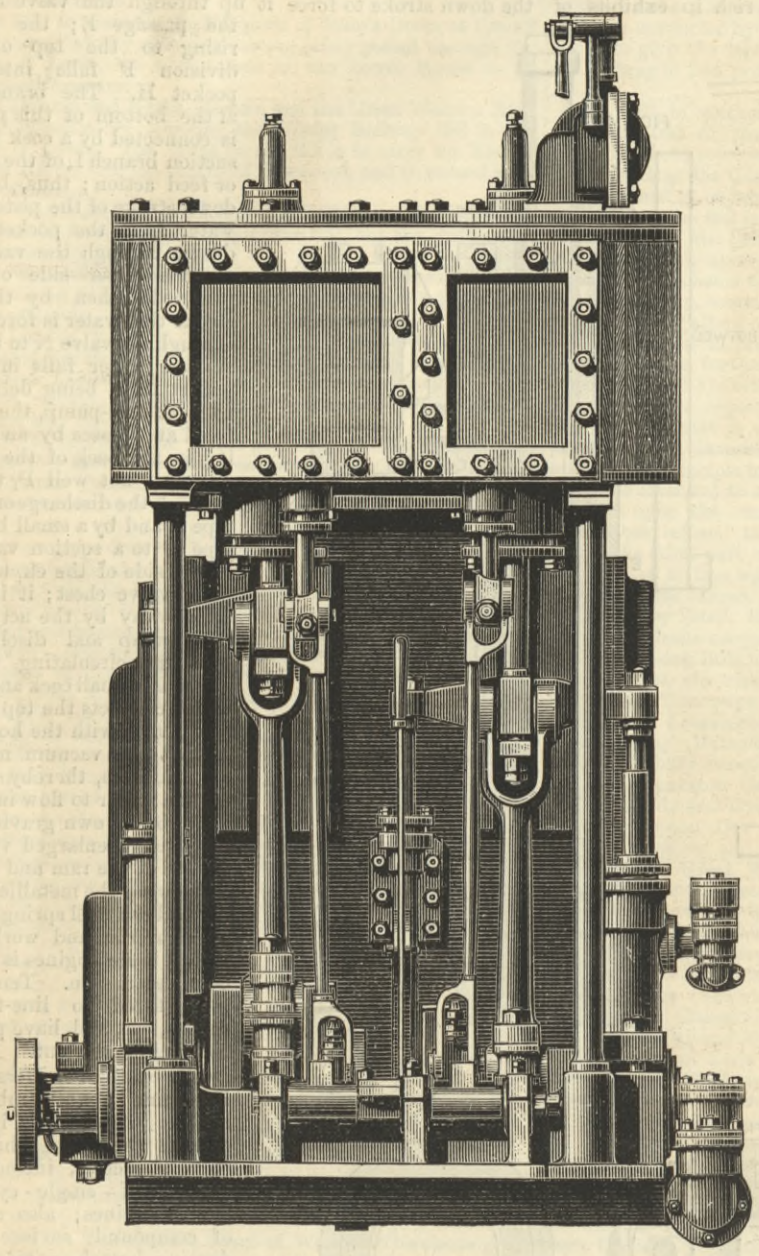
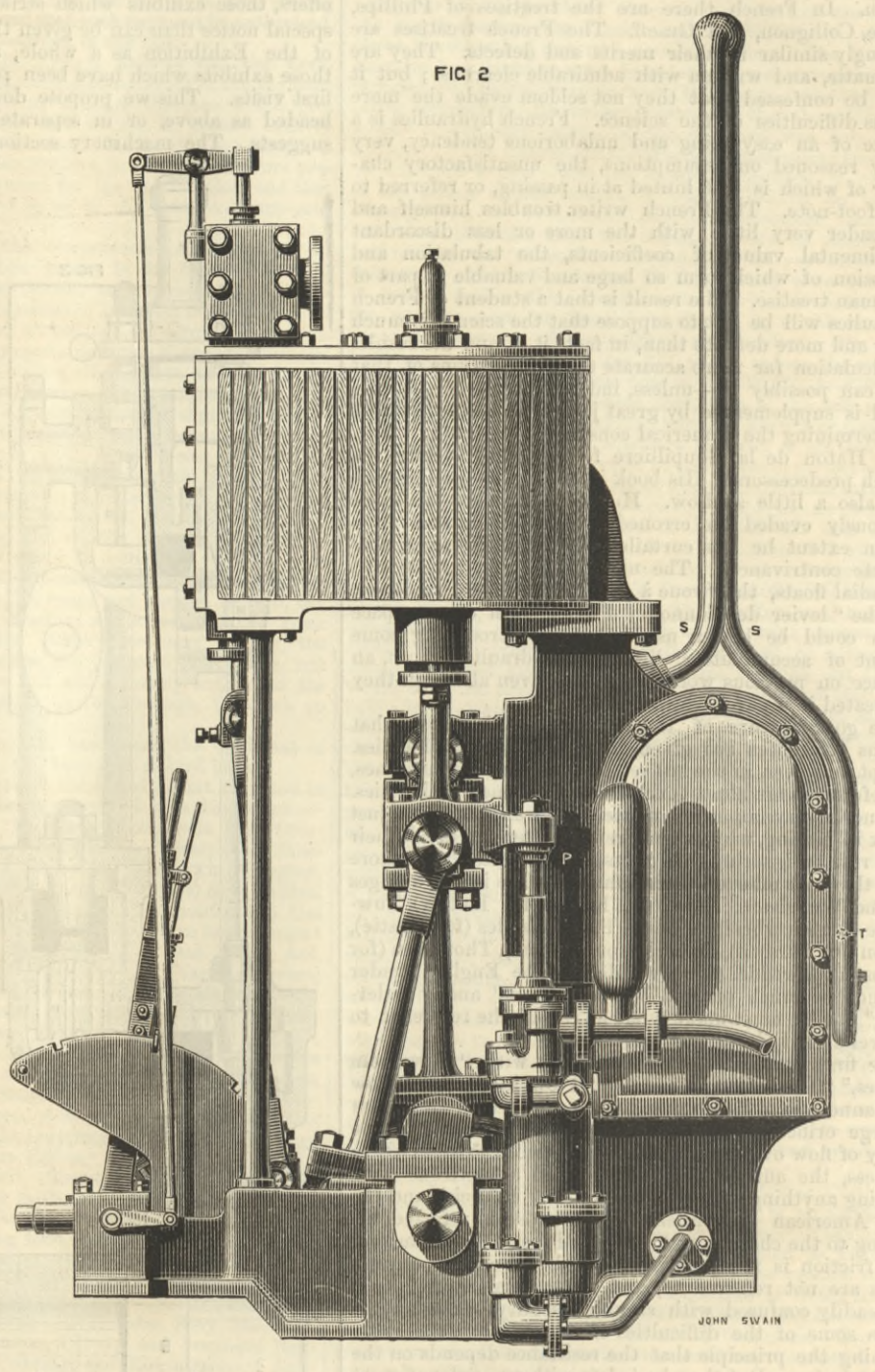


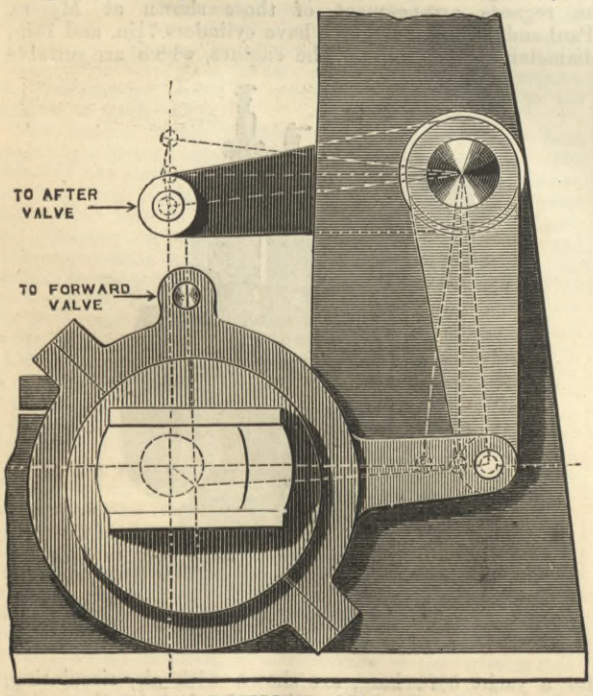
FIG 2



INCHES 12 4 6 3 0 1 2 3 4 5

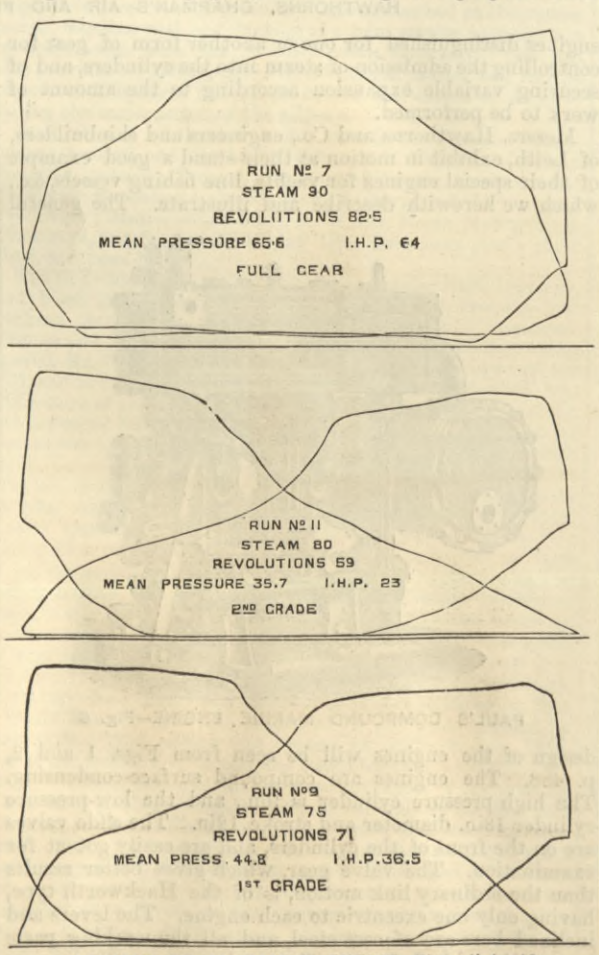
SCALE OF FEET

which is shifted outwards or inwards by the ordinary reversing lever or wheel and screw. This mandril carries on its inner end a steel vertical pin, which projects through longitudinal slots in the shaft into diagonal slots cut in steel plates fitted on the top and bottom of the excentric eye, which bear upon the flat of the shaft when the excentric is moved across. The pressure of this vertical pin, which being actuated by the reversing handle and mandril, on



PAUL'S REVERSING GEAR, Fig. 8.

the sides of the diagonal slots in the steel plates mentioned, causes these to move across the flat of the shaft, carrying, of course, the excentric with them. The plates and excentric are prevented moving endways on the shaft by suitable washers and collars. From the general outline and similarity of the manual movement of the gear thus roughly described, it would seem to those who look at it casually, to be identical with, or similar to, the common spiral sleeve arrangement of single excentric reversing gear. This, however, is not so; the gear not only being a reversing gear, but having the properties of



DIAGRAMS FROM PAUL'S ENGINE, Figs. 11 to 13.

variable cut-off and uniform lead as perfect as in the best link motion arrangements. The excentric setting is correct not only for "full speed ahead" and "full speed astern" positions, but the lap and lead remain constant while the travel, and therefore the cut-off, varies. The means by which the single excentric

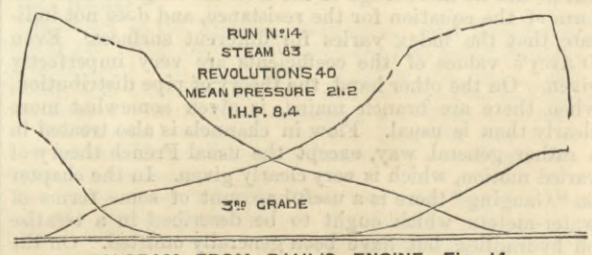
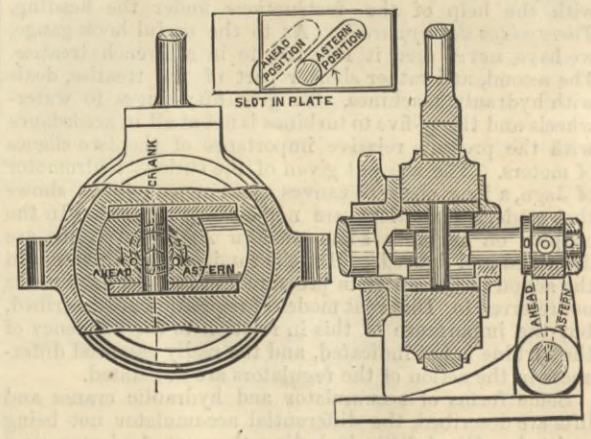


DIAGRAM FROM PAUL'S ENGINE, Fig. 14.

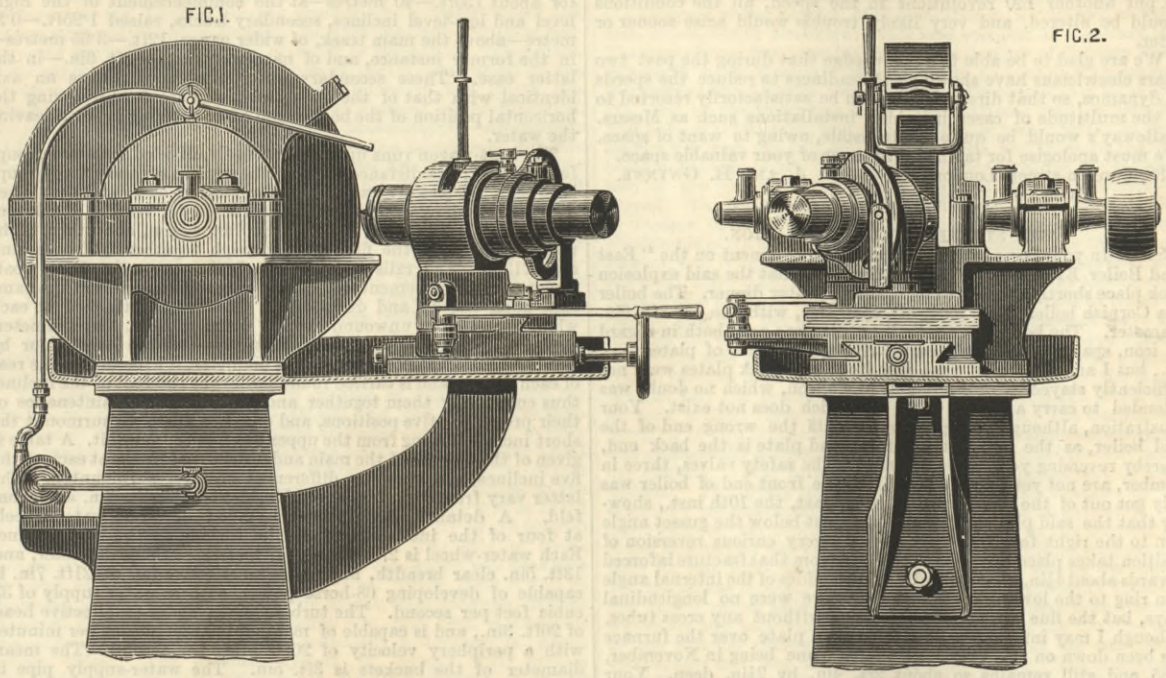
controls the several valves of a two or three-cylinder engine are: the forward valve is coupled direct to the excentric strap by a link, and the after valve is worked



PAUL'S REVERSING GEAR, Fig. 9.

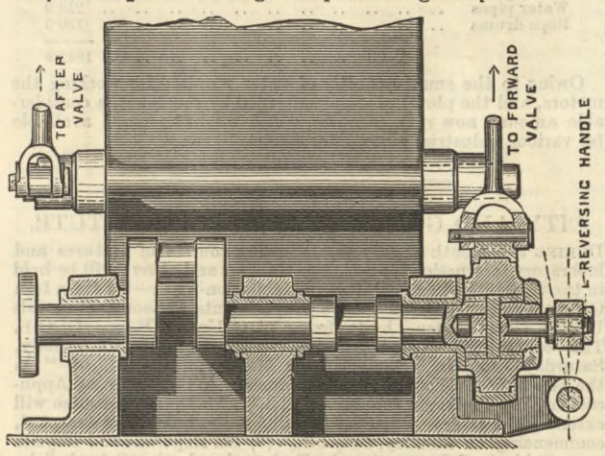
through the intervention of a shaft and wypers, the motion for the same being taken off the strap at right angles to the point of attachment between forward valve link and strap. For three-cylinder engines having cranks set at 120 deg., the motion for the wyper shafts is taken from the strap at points 120 deg. apart from the afore-

STERNE'S TWIST DRILL GRINDING ATTACHMENT



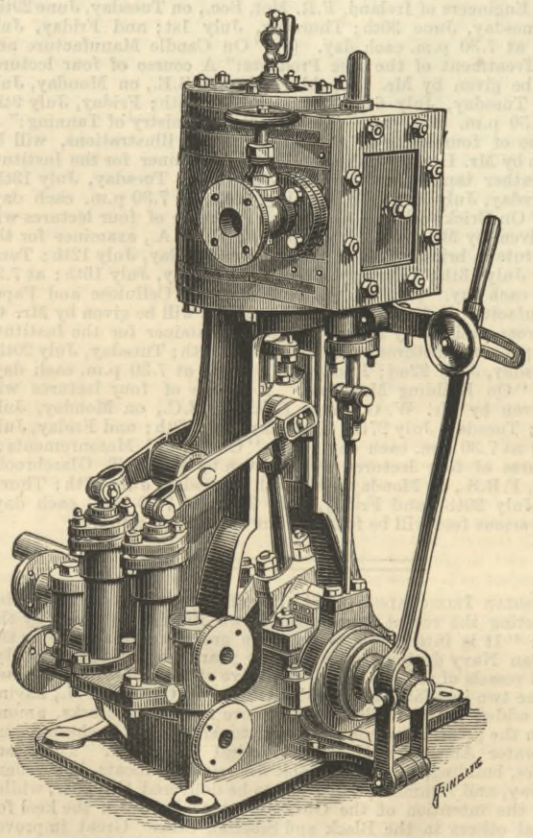
mentioned point of attachment, one shaft being carried in front and one at back of engines.

The diagrams, Figs. 11, 12, 13, and 14, page 488, are taken from double-cylinder non-condensing paddle engines fitted with the single excentric reversing gear above noticed. From the diagrams it will be seen that the cut-off remains equal at different ranges, and the lead also, though very high compression marks the early cut-off, a compression much too high for paddle engine speed.



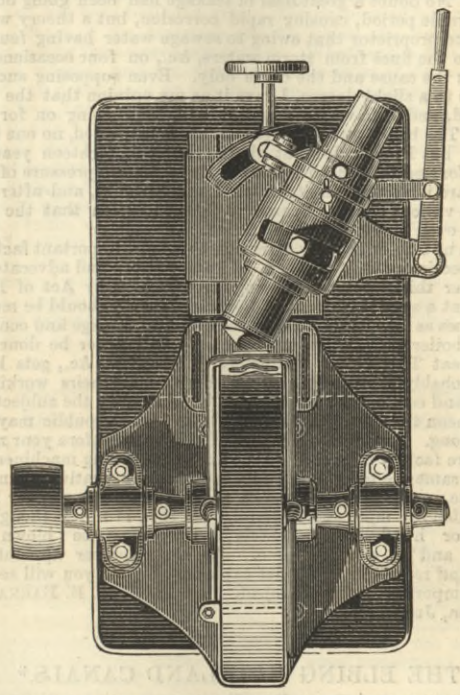
PAUL'S REVERSING GEAR—Fig. 10

Messrs. L. Sterne and Co., of the Crown Ironworks, Glasgow, exhibit, amongst other of their well-known specialities, several examples of their tool grinding machines, some of which we illustrate. The engravings, Figs. 1, 2, 3, p. 489, show a compact tool grinder, with twist



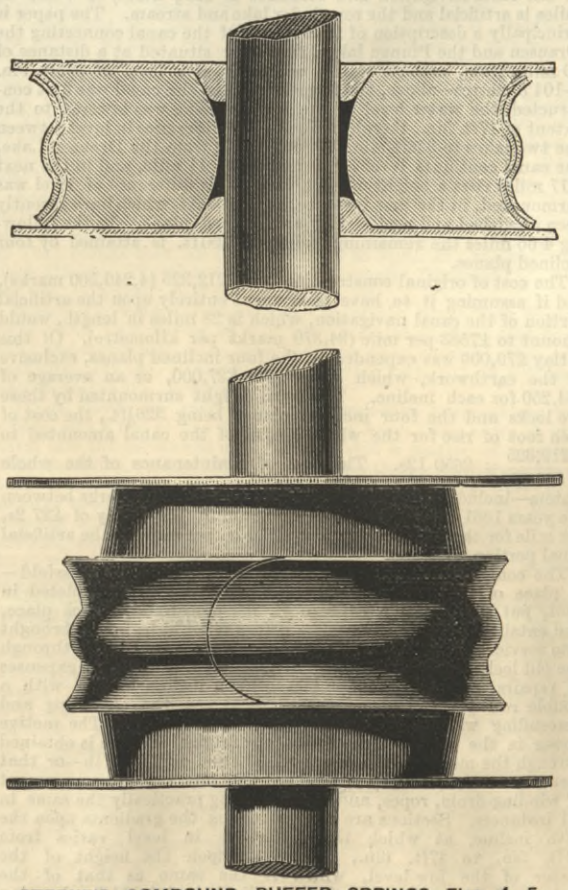
PAUL'S SINGLE CYLINDER YACHT ENGINE—Fig. 15

drill attachment in place. The machine has a patent consolidated emery wheel 20in. diameter, 2½in. broad, and is suitable for grinding almost all ordinary sizes of tools. To preserve the temper of the tools while being ground, a small centrifugal pump is fitted, which delivers a constant supply of water to the emery wheel from a tank in the frame of the machine. The machine contains its own counter-gear with fast and loose pulleys and belt shifter, and is complete in every respect. The twist drill grinding attachment is a noteworthy feature, and has been designed by Messrs. Sterne and Co. to supply a cheaper apparatus equally capable of performing the work accomplished by their well-known twist drill grinding machinery.



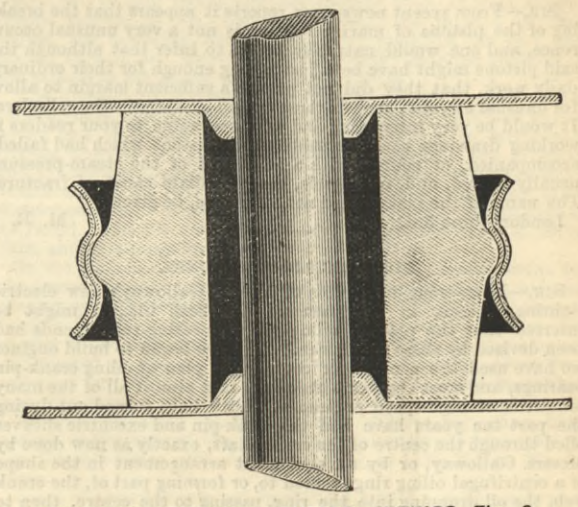
STERNE'S TWIST DRILL GRINDING ATTACHMENT.

This useful adjunct, which can be attached to any of the firm's tool grinders, is adjustable in every direction, and grinds drills from ¼in. to 3in. diameter with perfect



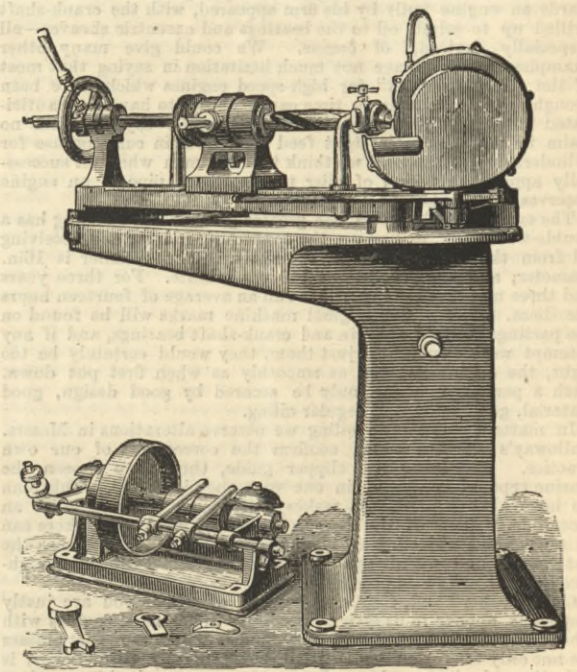
STERNE'S COMPOUND BUFFER SPRINGS—Figs. 4, 5

accuracy. Fig. 7 above illustrates a twist drill grinder which Messrs. Sterne have also on exhibition. It is constructed to grind drills mathematically true, both twist and flat, from ⅛in. to 1½in. diameter, the emery wheel being 8½in. diameter by 1¼in. broad, having a water supply as in the above case. Fig. 8 represents Messrs. Sterne's No. 4 emery tool grinder designed for joiners', pattern-makers',



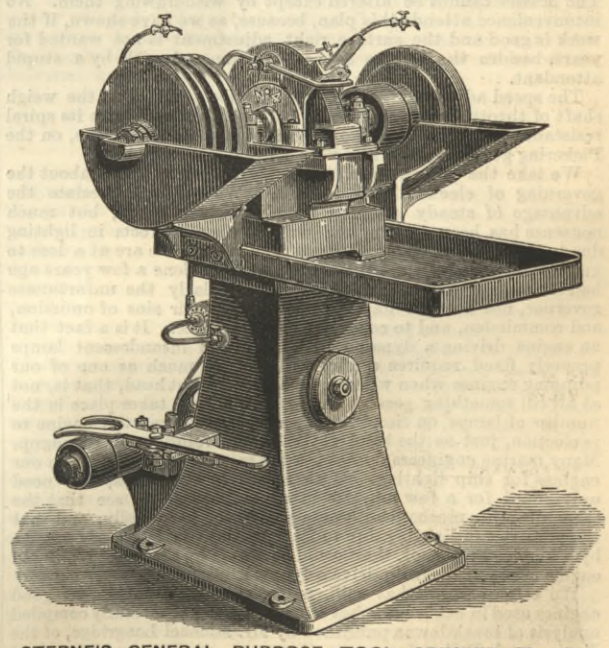
STERNE'S COMPOUND BUFFER SPRINGS—Fig. 6

and general wood-workers' use, fitted with six emery wheels 12in. diameter, four of which are assorted for gouges, moulding irons, &c., one with square face, 2in. broad, for plane irons, chisels, &c., and one emery hone



STERNE'S TWIST DRILL GRINDER—Fig. 7

to replace Water of Ayr stone. This, like the other machine noticed, is thoroughly self-contained, ready to be put down and driven from the running shaft of the shop. Amongst the other items shown by this firm are No. 2



STERNE'S GENERAL PURPOSE TOOL GRINDER—Fig. 8

universal grinder, improved saw sharpener, an assortment of spiral springs, volute springs, compound buffer and draw springs, including Sterne's patent combined rubber and steel belt buffer spring shown by the annexed engravings, emery wheels, and the work they accomplish, also a case of fittings made in the new metal, "Arguzoid," with which the name of this firm is associated.

THE BERLIN INDUSTRIAL NATIONAL EXHIBITION, which it is proposed to hold in 1888, is estimated to cost 8,000,000 marks. Of this sum it is calculated that 3,500,000 marks will be covered by receipts, while the city of Berlin has resolved to contribute 2,000,000 marks, and it is not improbable that the remainder will be given by the Imperial Government. The Berlin correspondent of the *Times* says an analysis of national opinion on the subject of the proposed exhibition shows that the idea is decidedly favoured by the smaller class of producers—*Mittel-und Kleinindustrie*—while the great bulk of the bigger manufacturers—*Grossindustriellen*—are as decidedly against it.

LETTERS TO THE EDITOR.

(*Continued from page* 478.)

THE BREAKAGE OF PISTONS.

Sir,—From recent newspaper reports it appears that the breaking of the pistons of marine engines is not a very unusual occurrence, and one would naturally be led to infer that although the said pistons might have been just strong enough for their ordinary daily work, that they did not possess a sufficient margin to allow for unusual stresses, such as those caused by water in the cylinders. It would be very interesting and of much value to your readers if working drawings could be published of pistons which had failed, accompanied, of course, with a statement of the steam-pressure usually carried, and, if possible, the immediate cause of fracture. The name of the maker need not, of course, be given.

London, June 3rd. M. R.

ELECTRIC LIGHT ENGINES.

Sir,—From your description of Messrs. Galloway's new electric lighting engines, in your issue of the 28th ult., it might be inferred that the plan of oiling the connecting-rod big ends had been devised by these gentlemen. Since we began to build engines we have used the central, or centrifugal, plan of oiling crank-pin bearings, and most engineers are aware that almost all of the many hundreds of high-speed engines which we have turned out during the past ten years have had the crank-pin and excentric sheaves oiled through the centre of the crank-shaft, exactly as now done by Messrs. Galloway, or by an equivalent arrangement in the shape of a centrifugal oiling ring secured to, or forming part of, the crank web, the oil dropping into the ring, passing to the centre, then to the surface of the crank-pin.

So far as we know, these methods of oiling crank bearings originated with us. At all events, we can find no evidence of anticipation. On the contrary, they have been freely copied in their various forms, and described as new devices. Some years ago we showed the details of our engines to a member of a French firm, who informed us that he intended to buy engines. Shortly afterwards an engine built by his firm appeared, with the crank-shaft drilled up to admit oil to the bearings and excentric sheaves—all "specially devised," of course. We could give many other examples, and we have not much hesitation in saying that most of the oiling "dodges" for high-speed engines which have been brought out from time to time can be shown to have been anticipated in our drawing office. We need hardly say we make no claim to the admirable sight feed oiler now in common use for cylinders and valves, and we think that the man who first successfully applied this kind of oiler to the steam pipe of an engine deserves the thanks of all engineers.

The engine which drives the greater part of our shafting has a double-web crank, drilled up, the connecting-rod big end receiving oil from the extreme end of the shaft. The cylinder is 16in. diameter, and the revolutions 140 per minute. For three years and three months this engine has run an average of fourteen hours per diem. To-day the original machine marks will be found on the partings of the crank-pin and crank-shaft bearings, and if any attempt were made to adjust them, they would certainly be too tight, the engine running as smoothly as when first put down. Such a performance can only be secured by good design, good material, good work, and regular oiling.

In matters other than oiling we observe alterations in Messrs. Galloway's engines which confirm the correctness of our own practice. Retaining the slipper guide, they have chosen the marine type of crosshead, in one with the piston-rod. This plan we have always used. It makes a thorough job, and gives an accessible engine. If the forging is of really good steel, there can be no possible objection to having the crosshead in one with the piston-rod; and we always aim at making the joints in a high-speed engine as few as possible.

On the other hand, four part brasses, of which you are justly suspicious, appear to us strictly necessary in horizonal engines with a heavy fly-wheel load close to the cranks. These four part brasses are not only too often badly fitted, but generally their design is bad, the side brasses have frequently no proper backing, and no proper provision is made to hold the joints firmly in place. All our long stroke horizontal engines have four part brasses, but the sections when in place are held as firmly as if they formed a tube driven into a bored hole in a cast iron block. They have flat seats and are backed with solid metal bearings over their whole surface. All this is rather different from the methods used in cheap engines. The brasses cannot be altered except by withdrawing them. No inconvenience attends this plan, because, as we have shown, if the work is good and the surface right, adjustment is not wanted for years, besides the brasses cannot be tampered with by a stupid attendant.

The speed adjustment which you describe as fitted to the weigh shaft of throttle valve on Messrs. Galloway's engine, with its spiral resistance coil, wheel and worm, first appeared, we believe, on the Pickering governor, and is a very convenient appliance.

We take the present opportunity to say a few words about the governing of electric light engines. We quite appreciate the advantage of steady running for all kinds of work, but much nonsense has been spoken and written about defects in lighting due to imperfect governing in steam engines. We are at a loss to know what our electrical friends would have done a few years ago had the steam engine, and more particularly the unfortunate governor, not been at hand to answer for their sins of omission, and commission, and to cover their inexperience. It is a fact that an engine driving a dynamo with a crowd of incandescent lamps properly fixed requires a governor just as much as one of our pumping engines when working under a constant head, that is, not at all till something goes wrong, or a big change takes place in the number of lamps on circuit. The dynamo governs the engine to perfection, just as the head governs the revolutions of the pump. Many marine engineers do not use the governors provided with our engines for ship lighting. With regard to arc lamps, one need only stand for a few minutes in a public place to see that the carbon feeding mechanism wants a governor very badly, and that irregularities in lighting due to imperfections in lamps are greater by a hundred per cent. than could be caused by the worst regulated engine ever put down to drive a dynamo.

We cannot admit that mill engines give less trouble than good engines used in other branches of industry. The carefully compiled analysis of breakdowns published by Mr. Michael Longridge, of the Engine and Boiler Insurance Company, every year, gives most instructive evidence on this point, as we presume that most of the engines which fail belong to mills in Lancashire and Yorkshire. Among mill owners, as among other steam users, there are some men far seeing enough to look beyond the mere first cost of their machinery. Such men go to builders of high reputation and great experience, pay a good price, and secure engines which give them no trouble. The skill and experience necessary to produce good engines for electric lighting are not now lacking, and if buyers will allow for a margin of power beyond their probable or calculated requirements, prepare themselves to pay a good price, then go to an engineer who has a reputation to lose, not to an engine-maker, and leave all details in his hands, they will be provided with engines which will run as well as the best mill engines ever produced.

Outside of defects in the electrical department, the causes of engine failures have been obvious enough. The chief of these is over-driving; cheap and badly-designed engines put down too small, and driven at a pace which kills them; well-designed and well-made engines put down too small, because the power is underestimated, and driven at speeds which scientific investigation shows to be injudiciously high for smooth and permanent working. It must not be inferred from the foregoing statements that there is any difficulty in making an engine run at very high speed with perfect safety; we merely mean that there is a speed for every engine, beyond which it may not be driven with impunity. We have engines with 10in. cylinders running beautifully all day long, fully loaded, at 450 revolutions per minute, simply because they are specially designed to run properly up to this speed. Were we to put another 150 revolutions to the speed, all the conditions would be altered, and very likely trouble would arise sooner or later.

We are glad to be able to acknowledge that during the past two years electricians have shown great readiness to reduce the speeds of dynamos, so that direct driving can be satisfactorily resorted to in the multitude of cases in which installations such as Messrs. Galloway's would be quite inadmissible, owing to want of space. We must apologise for taking up so much of your valuable space.

89, Cannon-street, London. J. and H. Gwynne.

June 9th.

THE STEPNEY BOILER EXPLOSION.

Sir,—In your issue of the 4th inst. you comment on the "East End Boiler Explosion." I may inform you that the said explosion took place shortly after 10 o'clock, and not after dinner. The boiler is a Cornish boiler, 12ft. long, 5ft. diameter, with one flue 2ft. 9in. diameter. The boiler, as originally made, was good both in regard to iron, spacing and thickness of rivets, thickness of plates $\frac{8}{16}$in., &c., but I am of opinion that the front and back plates were not sufficiently stayed by only a double angle iron, which no doubt was intended to carry a gusset plate, but which does not exist. Your illustration, although very good, represents the wrong end of the said boiler, as the part marked front end plate is the back end, thereby reversing your elevation also. The safety valves, three in number, are not yet found. Now, Sir, the front end of boiler was only got out of the *débris* on Thursday last, the 10th inst., showing that the said plate was blown out just below the gusset angle iron to the right for about 18in., when a very curious reversion of position takes place, viz., that the plate from that fracture is forced inwards about 4½in. and stripped from both sides of the internal angle iron ring to the lower part of boiler. There were no longitudinal stays, but the flue was sufficiently strong without any cross tubes, although I may inform you that the crown plate over the furnace has been down on two occasions, the last one being in November, 1885, and still remains so about 2ft. 4in. by 2½in. deep. Your other comments are correct as to where the fracture took place, the thinning of the plates, beginning on the seam of the second ring, as also on the back plate seam, ran down to about $\frac{7}{16}$in. thick, and in one or two places daylight was to be seen through the said plates. No doubt a great deal of leakage had been going on for a considerable period, causing rapid corrosion, but a theory was set up by the proprietor that owing to sewage water having found its way into the flues from storm waters, &c., on four occasions, that this was the cause and the cause only. Even supposing such was the case to a slight degree, I gave it as my opinion that the corrosion had, and I have no doubt it had, been going on for many years. The boiler was never tested, never inspected, no one knows its age; but I put it down at about sixteen to eighteen years old. I am informed that just previous to its bursting a pressure of 40 lb. per square inch was on it, which I much doubt, and after going into the various details, I came to the conclusion that the boiler was not even in a workable condition.

I wish now to draw your attention to a most important fact, viz., the inspection of steam boilers. I have written and advocated the same over thirty years as making it a necessity by Act of Parliament that a special internal and external survey should be made at such times as may be thought fit according to the age and condition of such boiler or boilers, but suppose it will never be done until some great Tom Noddy millowner, mineowner, &c., gets killed; then probably we might hear of some of his heirs working up heaven and earth and bringing M.P.'s to bear on the subject; but in the mean time the mill hands and the British public may go to Hong Kong. Again, one little fact I will bring before your notice. There are factory inspectors to see that all working machinery and parts of same are to be covered in, so that the operatives do not get limbs, &c., endangered. So well so good; but the powder magazine, which can mine and undermine all this, is never thought of. Scores or hundreds of human beings may be blown into eternity and no one to blame. As the engineer appointed to survey and report on this boiler explosion, I trust you will see with me the importance of this subject. E. B. Barnard.

London, June 14th.

THE ELBING HIGHLAND CANALS.*

By — Von Fragstein.

This system of canals, constructed between the years 1844 and 1860, connects the group of lakes around Mohrungen and Preussiche, Holland, at a height of about 328ft. above the Baltic, with the Drausen Lake, whence flows the river Elbing, emptying itself into the Frische Haff, on the Gulf of Dantzic. The whole length of the canal navigation and branches is 123½ miles, of which 28 miles is artificial and the remainder lake and stream. The paper is principally a description of that length of the canal connecting the Drausen and the Pinnau lakes, the latter situated at a distance of 10 miles from, and its waters originally at a level of 343ft. 9in. —104·8 metres—above, the former. When the canal was first constructed, the water level of the Pinnau Lake was lowered to the extent of 17ft. 5in., thereby reducing the difference in level between the two lakes to 326ft. 4in. Commencing from the Drausen Lake, the canal continues level for a length of 1¼ mile, and in the next 2·17 miles rises a height of 45ft. 3in. This difference of level was surmounted, in the first instance, by five locks, which have recently been abolished and replaced by an inclined plane. In the following 4·66 miles the remaining height of 281ft. is attained by four inclined planes.

The cost of original construction was £212,325 (4,246,500 marks), and if assuming it to have been spent entirely upon the artificial portion of the canal navigation, which is 28 miles in length, would amount to £7583 per mile (94,376 marks per kilometre). Of this outlay £70,000 was expended on the four inclined planes, exclusive of the earthwork, which latter cost £27,000, or an average of £24,250 for each incline. The total height surmounted by these five locks and the four inclined planes being 326¼ft., the cost of each foot of rise for the whole length of the canal amounted to $£\frac{212,325}{326{\cdot}33} = £650\ 12s.$ The cost of maintenance of the whole system—including the lake portion—of canal and works between the years 1861 and 1875 averaged annually an outlay of £27 2s. per mile for the lake portion, and £120 4s. per mile for the artificial canal portion.

The construction of the fifth inclined plane—at New Kussfeld—in place of the five locks already referred to, was completed in 1881, but soon after a rupture of the embankment took place, and entailed a delay of two years before it could be finally brought into service. In the meantime, the traffic was carried on through the old locks. The cost of this incline, together with the expenses of repairs, amounted to £45,000. Each incline is laid with a double rail track, and on these tracks run the ascending and descending wagons transporting the canal boats. The motive power in the case of each of the four original inclines is obtained through the medium of a water-wheel, and in the fifth—or that recently constructed—by a turbine, the intervening arrangement of winding-drum, ropes, and sheaves being practically the same in all instances. Sections are given, showing the gradients upon the fifth incline, at which the difference in level varies from 41ft. 5in. to 47ft. 6in., dependent upon the height of the water of the low-level, which is the same as that of the Drausen Lake. The principal gradient is 1 in 11·6, changing into 1 in 24 on the lower portion of the incline leading to the low level, and the dip from the summit—formed by a curve struck with a vertical radius of 370ft. radius—into the upper level basin is 1 in 24. There are two parallel lines of rail at the inclines, and each of these lines is laid with a continuous through track of 10ft. 9in. gauge, leading from the lower basin up to and over the summit, down into the bed of the upper basin. In addition there is laid, for about 130ft.—40 metres—at the commencement of the high-level and low-level inclines, secondary tracks, raised 1·25ft.—0·38 metre—above the main track, of wider gauge, 12ft.—3·65 metres—in the former instance, and of narrower gauge—9ft. 6in.—in the latter case. These secondary differential tracks have an axis identical with that of the main track, and are for preserving the horizontal position of the boat wagon after entering or until leaving the water.

The boat-wagon runs upon eight wheels, divided into two groups fore and aft; the distance between the centres of these two groups is 29·85ft. There are two of these wagons at each incline. They are 65ft. 7in. long over all, and constructed for vessels of 60 tons gross tonnage, or a total weight, including wagon, of 86 tons. The two wagons upon the fifth incline weigh together 52·0 tons, and cost £1390. The rails weigh about 76 lb. per yard. Both boat-wagons are in movement in opposite directions at one and the same time upon the up and down track. A rope is attached to each which is wound or unwound upon a drum of 12ft. 4in. diameter, actuated at the fifth incline by a turbine—at the other four by water-wheels. A third rope, of less diameter, is attached to the rear of each wagon, and is carried round pulleys at the foot of the incline, thus connecting them together and ensuring the maintenance of their proper relative positions, and enabling them to surmount the short incline leading from the upper basin to the summit. A table is given of the lengths of the main and differential tracks at each of the five inclines, and also the differences of level surmounted. The latter vary from 41ft. 5in.—Neu Kussfeld—to 80ft. 4in. at Schonfeld. A detailed description is given of the water-wheels at four of the inclines, and of the turbine at the fifth incline. Each water-wheel is 27ft. 9in.—8·47 metres—outside diameter, and 13ft. 5in. clear breadth, and under an effective fall of 21ft. 7in. is capable of developing 68-horse power, with a water supply of 37 cubic feet per second. The turbine works under an effective head of 26ft. 3in., and is capable of making 140 revolutions per minute, with a periphery velocity of 26ft. 11in. per second. The mean diameter of the buckets is 3ft. 5in. The water-supply pipe is 3ft. 5in. in diameter. Drawings of the turbine, &c., are given. The ropes are of galvanised charcoal-iron wire. The back rope is of 1⅛in. diameter, and the traction rope of 1⅜in. diameter; the weight of wire rope at the fifth incline is 7 tons, and cost £200. The total cost of the metal work at the five inclines, exclusive of the wire rope, is as follows:—

	tons.
Railway tracks	637·5
Rope pulleys and rollers	127·7
Boat wagons	231·5
Hydraulic motors	155·3
Wheel gear	141·5
Water pipes	218·3
Rope drums	130·5
Total	1642·3

Owing to the small quantity of water required for working the motors, and the plentiful supply afforded by the lakes, a considerable amount now runs to waste, which might be made available for various industrial purposes or electric lighting.

* Proc. Inst. Civ. Eing. Abstract from "Zeitschrift für Bauwesen."

CITY AND GUILDS OF LONDON INSTITUTE.

During the month of July the following courses of lectures and laboratory instruction for technical teachers and others will be held in the Institute's new buildings in Exhibition-road:—(1) "On Iron Girder Bridge Designing, with Experiments on some Materials Used in Construction," by Professor W. C. Unwin, B.Sc., M.I.C.E. This course will extend over two weeks, from 10 till 5 daily, Saturdays excepted, commencing on Monday, July 5th. (2) "On the Teaching of Chemistry as Introductory to its Technical Applications," by Professor Armstrong, F.R.S., Ph.D. This course will extend over two weeks, from 10 till 5 daily, Saturdays excepted, commencing on Monday, July 5th. (3) On Experimental Physics as a Subject of Instruction in Technical and other Schools," by Professor W. E. Ayrton, F.R.S. This course will extend over two weeks, from 10 till 5 daily, Saturdays excepted, commencing on Monday, July 19th. (4) "On Graphical Statics," by Professor O. Henrici, Ph.D., LL.D., F.R.S. This course will extend over two weeks, from 10 till 5 daily, Saturdays excepted, commencing on Monday, July 19th. (5) "On Plumbing:" A course of four lectures will be given by Mr. W. R. Maguire, Associate of the Institute of Civil Engineers of Ireland, F.R. Met. Soc., on Tuesday, June 29th; Wednesday, June 30th; Thursday, July 1st; and Friday, July 2nd; at 7.30 p.m. each day. (6) "On Candle Manufacture and the Treatment of the Bye Products:" A course of four lectures will be given by Mr. Leopold Field, F.R.S.E., on Monday, July 5th; Tuesday, July 6th; Thursday, July 8th; Friday, July 9th; at 7.30 p.m. each day. (7) "On the Chemistry of Tanning:" A course of four lectures, with experimental illustrations, will be given by Mr. Henry R. Procter, F.C.S., examiner for the Institute in leather tanning, on Monday, July 12th; Tuesday, July 13th; Thursday, July 15th; Friday, July 16th; at 7.30 p.m. each day. (8) "On Brickwork and Masonry:" A course of four lectures will be given by Mr. John Slater, B.A., F.R.I.B.A., examiner for the Institute in brickwork and masonry, on Monday, July 12th; Tuesday, July 13th; Thursday, July 15th; Friday, July 16th; at 7.30 p.m. each day. (9) "On the Technology of Cellulose and Paper Manufacture:" A course of four lectures will be given by Mr. C F. Cross, assisted by Mr. E. T. Bevan, examiner for the Institute in paper manufactures, on Monday, July 19th; Tuesday, July 20th; Thursday, July 22nd; Friday, July 23rd; at 7.30 p.m. each day. (10) "On Building Materials:" A course of four lectures will be given by Mr. W. G. Dent, F.C.S., F.I.C., on Monday, July 26th; Tuesday, July 27th; Thursday, July 29th; and Friday, July 30th; at 7.30 p.m. each day. (11) "On Optical Measurements:" A course of four lectures will be given by Mr. R. T. Glazebrook, M.A., F.R.S., on Monday, July 26th; Tuesday, July 27th; Thursday, July 29th; and Friday, July 30th; at 7.30 p.m. each day. The various fees will be found in our advertising columns.

Russian Ironclads.—A St. Petersburg correspondent writes respecting the recent launching of two Russian ironclads by the Czar: "It is interesting to note the great progress made by the Russian Navy during the last three years, no less than twenty-seven vessels of various kinds—exclusive of torpedo-boats—including the two just launched, the Tschesme and Catherine II., having been added to it, whilst several more are on the stocks, among which the great ironclads Sinope, sister ship to the Tschesme, and Imperator Alexander II., and Admiral Nachimoff. There are besides, building, three formidable first-class gunboats, in Sweden, Norway, and Denmark, which are to be delivered this year, whilst it is the intention of the Government to lay down the keel for several others in the Black and Siberian Seas. Great improvements are also being made in the two naval stations, Cronstadt and Sebastopol. In the former place granite quays and breakwaters are being constructed, whilst at Sebastopol the two naval docks recently inspected by the Czar, and which were destroyed in the Crimean War, are so far completed that they will be opened for use this year. The cost of each of these will be £300,000, and the Russian Admiralty states that they are the first undertaking of the kind in which the actual cost has not exceeded the estimate. The plan which has been before the Admiralty some time of making Libau a naval port has been abandoned, but it has been decided to make it the station of the Baltic Fleet. In connection with the name, it may also be mentioned that the Obrichoff Steel-plate Works and the Ishorscic iron-plate foundries have recently been improved and enlarged,'

WATER SUPPLY OF AMSTERDAM.

IN 1582 a Dutch engineer, Peter Morice, constructed the first waterworks for London by the erection of a water-wheel and pump under old London Bridge. In 1853 English engineers constructed works for the supply of water in the city of Amsterdam. This supply was by means of a series of canals constructed in the dunes or sandhills adjacent to the borders of the North Sea beyond Haarlem, whence the water is pumped, after filtration, direct into the city. The Duin Water Maatschappij—Amsterdam Hill Water Company—was formed under the auspices of the late Mr. Leo Schuster as its first chairman, and has from time to time extended its works to keep pace with the growing demand for water. Owing to the enormous increase in the requirements for manufacturing and sanitary purposes, a further and greatly extended supply became necessary. The municipality therefore granted to the same company an exclusive concession for obtaining an additional supply of water from the river Vecht, a branch of the Rhine. One important condition, however, is attached to the concession, and that is that the water from the sandhills shall in future be reserved for domestic use, the new supply being devoted to public and industrial purposes, thus constituting a dual supply.

The new works, which will be capable of supplying from the first a minimum quantity of 9,000,000 gals. per diem, were commenced in August last year. They comprise the laying of a 48in. inlet conduit pipe, almost three miles in length, from the river Vecht to the site of the pumping and filtering station, which is within the new lines of fortifications now in course of construction by the Dutch military authorities. At this point the water will be lifted into depositing reservoirs, having a united capacity of 18,000,000 gals. After having been filtered through filter-beds of novel construction, designed by the engineers, the water will pass into a series of covered pure water reservoirs. From these it will be pumped up a stand-pipe 232ft. in height, and conveyed thence through two lines of parallel mains, 27in. and 24in. in diameter respectively, into the city of Amsterdam, a distance of about seven miles. The separate system of supply will involve the laying of upwards of 120 miles of distributing pipes, including the difficult work of crossing under no fewer than one hundred of the canals with which Amsterdam abounds, some of which are of great width and depth. By the terms of the concession, the entire series of works has to be completed by the autumn of 1887, and no time has therefore been lost in carrying them out with the utmost promptitude and vigour. Notwithstanding the difficulties met with owing to the treacherous character of the peaty subsoil so frequently encountered in Holland, considerable progress has already been made. Messrs. John Aird and Sons are the contractors for the construction of the whole of the works, with the exception of the pipes, of which there are 25,000 tons, and the pumping engines, which are of 800-horse power. The contract for the pipes has been entrusted to the Staveley Iron and Coal Company, and that for the engines to Messrs. Easton and Anderson. These we shall illustrate in an early impression. The engineers for the works are Messrs. Joseph Quick and Son, of Great George-street, Westminster.

THE FLOODS OF MAY, 1886.—At the meeting of the Meteorological Society, on the 16th inst., a paper was read by Mr. F. Gaster and Mr. W. Marriott on the floods of May last. The month of May, 1886, will be long remembered for the heavy rains that occurred between the 11th and the 13th, and the floods they produced over the greater part of the West and Midland Counties of England. In fact, at Worcester the flood was higher than any that have occurred there since 1770. On the 11th and 12th heavy rain fell over the East of Ireland, there being over 3in. during these two days at several places in Counties Down, Dublin, and Wexford; the greatest reported being 3·52in. at Kilkeel, County Down. Over the other parts of the United Kingdom the rainfall on the 11th was under 1in. Rain, however, commenced falling about noon on Tuesday over the Midland Counties, and continued with increasing intensity till Friday morning, the duration at most places being about 60 hours. The heaviest rainfall occurred in Shropshire, where over 6in. fell at several stations, while at Burwarton as much as 7·09in. was recorded; the amounts for each day being 0·60in. on the 11th, 3·10in. on the 12th, and 3·39in. on the 13th. Very serious floods followed these heavy rains. At Shrewsbury the extreme height of the flood on the Severn was 16ft., and at Worcester 17ft. 1in. above the average summer level. At Ross the flood on the Wye was 14ft., at Nottingham the rise of the water in the Trent was 12¼ft., at Rotherham the flood was 8ft. 5in., and in North-east Yorkshire the Derwent rose to nearly 11ft. above summer level. These floods caused great damage to property and loss of life. Bridges were washed away, railway traffic suspended, and thousands of workmen thrown idle. In several places the waterworks were flooded, and the towns' water supply was consequently cut off. Mr. Gaster drew attention to the complex character of the pressure distribution during the time referred to, and showed how the region of maximum rainfall followed certain of the shallow depressions which appeared over the British Islands. He drew attention to the peculiarities of this type of depression, showing how in many, if not in most cases, the rainfall was heaviest in their rear, and was brought by the easterly and not by the westerly wind. He also referred to some previous instances of heavy floods, in which similar atmospheric conditions prevailed, and explained how it was that, as the disturbance passed off, snow fell instead of rain, this in its turn being followed by severe cold, and in some cases frost.

SHIPBUILDING AT STOCKHOLM.—At the Government dockyard at Stockholm more than 500 men are now employed, the principal work in hand being the completion of the corvette Freja, launched at the Kockum Works last year, which is to be commissioned for sea very shortly; the armouring, &c., of the new first-class gunboat Svea, launched at the Lindholmen Works last December, the heavy plates for which have been manufactured at Creusot; and the building of two first-class and two second-class torpedo-boats, to be delivered towards the end of the year. The Government have decided upon building a new first-class gunboat, the cost of which is estimated at £150,000, two more second-class torpedo-boats, at £5000 each, and one first-class one, to cost £7000, the latter being the amount saved in the building of two such vessels in 1884-85 in Sweden instead of England. For torpedoes, &c., £15,000 have been voted. The ordnance of the navy was augmented last year with four 45 cm., eleven 12 cm., one 8 cm., and four 38 mm. guns; and there are now in manufacture in Sweden and abroad for this service two 25 cm., four 15 cm., eight 12 cm., and nine 8 cm. guns, as well as six mitrailleuses. At the private yards equal activity prevails, one firm, for instance, having received an order from the Russian Government for ten steamers with shallow draught, and thirty steam launches, all to be used for the transport of soldiers and war material on lakes and rivers. Another works—the well-known Notala Engineering Works—recently secured the greatest order for machinery ever placed in Sweden, the contract for which was concluded in London, and for which tenders had been received from several leading English firms. The order covers the complete machinery for three large steamers now being built at Odessa by the Russian Navigating and Trading Company, which built the ironclad Tschesma, recently launched by the Czar. The value of the order is about £45,000, and the machinery is to be delivered in eight and a-half months. The Bergsund Engineering Works have also their hands full, more than 500 men being now employed. The principal orders under execution are two first-class torpedo-boats—referred to above—117ft. long and 12¾ft. broad, built of thin galvanised steel plates for the Swedish Government, and a first-class twin-screw steel gunboat, 206ft. long, 35ft. broad, and drawing 10½ft. of water, with engines of 1300-horse power, to give her a speed of 13 knots. The vessel is to be delivered in the autumn complete, with the exception of her guns, which are being manufactured at the Russian Government factory on the river Amoor.

THE NEW RACING SLOOP YACHT ATLANTIC.

THE yacht Atlantic was recently successfully launched from the shipyard of her builder, Mr. John Mumm, at the foot of Fifty-fifth-street, South Brooklyn. Her keel was laid in February last. The new clipper has been built after the designs of Captain Philip Ellsworth by a syndicate of yachtsmen composed of prominent members of the Atlantic Yacht Club. Her length over all is 95ft. 7in., and on the water line 84ft. Her extreme beam is 23ft. 2in. The hold is 10½ft deep, and the draught of water 8½ft. In cross section her lines are full and well rounded, the angle at the keel being noticeably blunt. The characteristic feature in the construction of the yacht is the extreme lightness of the materials employed. The frame is made of oak and black larch, and the ceiling of Oregon pine. Her clamps are of yellow pine. Her outside planking is of Oregon pine, with the exception of the three upper strakes, and is 2½in. in thickness. Many of these planks have been cut from mast stuff, and are 50ft. to 60ft. long. In the interior, metal knees made of cast steel, 4in. by 1¼in., are used to resist the racking strain of her spars. Wooden hanging knees on each side support the strains on her deck. A shelf of yellow pine running round her side and under her beam ends will meet the torsional strains brought to bear upon her frame. At the time of the launch she had only her bowsprit in, and had a mean draught of 6ft. 4in.; 34 tons of lead form the ballast on her keel. The casting and handling of this immense piece was a matter of some difficulty, but was successfully accomplished by building a mould directly under her timbers. It is estimated that the total ballast will be about 45 tons. The lively interest excited in yachting matters by last summer's international race was shown by the large crowds that have watched her evolution and were on hand at the christening. Much admiration was expressed for the graceful lines, and particularly for her light flotation. Her sail power will be very large. The mainmast is 50ft., with a gaff of 47ft. and a boom of 76ft. 6in. Her suit of racing sails numbers fifteen. They have been specially woven for the Atlantic, and vary in weight from the heaviest duck to the lightest cotton drillings. The spread of the mainsail is 4000 square feet, and that of the large jib 1150ft. The club topsail adds 1560ft. to her sail area, and the balloon jib topsail, intended for gentle breezes, 4180 square feet. Her spinnaker boom is 72ft. long, and carries a sail of 4400 square feet.

Such are the main dimensions and features of New York's representative clipper yacht. She is to all appearances a thorough-going racer, and has been built for work. The purpose of her existence is the defence of the America's cup, for which the British cutter Galatea is now the avowed competitor. Whether the Atlantic will fulfil her mission, and win the honourable office of defending the cup, will be determined by the preliminary races between the four competitive American clippers, the Puritan, Priscilla, Mayflower, and Atlantic. Each boat has its champions, but they are all so admirable that the most experienced yachtsmen hesitate to express any opinion about the result of the forthcoming trials. The success of the Puritan has made the superiority of the centreboard over the cutter a foregone conclusion in the minds of nearly all American yacht owners. This confidence has made the interest in the national contest much more lively at present than in the real contest between the American champion and the British challenger. Apparently, everything possible has been done to make the successful clipper, whichever she may be, a worthy representative of the most advanced principles of American yacht building.—*Scientific American.*

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

(*From our own Correspondent.*)

IRON production is this week down at the minimum, a fact which is rather matter for congratulation, considering the over-abundant supplies with which the market has lately had to deal. Most of the finished ironworks have been idle all this week in consequence of the holidays, while the few that have done anything have not run more than the last three days. No pressure for deliveries is being put upon ironmasters, and there has been no inducement for them to attempt to foreshorten the holidays. On the contrary, specifications are very difficult to get in since consumers are only prepared to take small supplies.

Those firms will be the earliest to resume operations who receive much of their custom from the colonies and other shipping markets. Prominent among those are certain of the thin sheet and tin-plate makers. Orders are reaching those concerns briskly from Australia, the United States, Canada, Germany, France, Italy, and the West Indies, and the result is that more is doing by such concerns than by many others. Prices in this branch are stronger upon the week in consequence of the firmer condition of the tin market.

Thin sheets, the manufacture of Messrs. E. P. and W. Baldwin, are named by that firm, for sheets up to 20 gauge, as follows:—"Shield" brand, £9; "Severn," £10; "Baldwin, Wilden," £11; double best, £12; treble best, £13; charcoal, £15 10s.; best charcoal, £18 10s.; and double best charcoal, £20 10s. per ton. Sheets of 21 to 24 gauge are quoted 30s. above singles, and sheets of 25 to 27 gauge 30s. above doubles. Tin-plates the firm quote: "Wilden" charcoal brand, 20s. per box for I.C. qualities; "Unicorn" charcoal brand, 19s.; "Arley Crown" tin, 18s.; and "Stour" coke, 17s.

Messrs. John Knight and Co. quote working-up sheets £10 10s.; soft steel sheets, £12 10s.; and charcoal sheets, £19 10s. Doubles are 30s. extra, and lattens 60s. extra. Crown bars they quote £7 10s.; plough bars, £9 10s.; angles up to 3½in., £7; and charcoal bars, £15 10s. Tin-plates the same firm quote: Charcoal I.C., 23s. per box, Liverpool; and coke sorts, 19s. 6d.

Messrs. Crowther Brothers and Co., of the Stour Vale Works, price their Vale sheets at £10 10s.; S.B. brand, £11; best best, £12; and treble best, £13; semi-charcoal, £14; charcoal, £15; and best ditto, £16 10s. Their steel sheets vary from £11 to £12 10s., and on to £13 10s., according to quality.

Black sheets for galvanising and merchant purposes are not active, still a few of the makers are very busy. The entry of new firms into the galvanised sheet trade is still a matter of considerable discussion. Australian orders in particular will be matter of keen competition. If only the Australian market were in a healthy condition there should be plenty of room for the laying down of additional galvanising vats and sheet rolling mills in this district, since the consumption of galvanised iron will go on largely increasing. But at the present time the Australian market is flooded with goods on consignment.

Galvanised corrugated sheets rolled at the Lion Galvanising Works of Messrs. Morewood are quoted:—"Red Star" brand, 18 to 20 B.G., £10 10s.; 24 g., £10 15s.; 26 g., £12 5s.; 28 g., £13 5s., and 30 g., £15 5s. per ton. The "Lion" brand is £11, £11 5s., £12 15s., £13 15s., and £15 15s. per ton, according to gauge. The "Wheatsheaf" brand of flat sheets, packed in cases, is £13 for 20 g., £13 10s. for 24 g., £15 10s. for 26 g., and £16 10s. for 28 g. The "Woodford Crown" brand is £14 10s., £15, £16, and £18 respectively; while the "Anchor" brand of flat tinned sheets in cases is £17, £18, £20, and £21, according to gauge.

Concerning bars and other small merchant sections, it is to be reported that in shoe and tire bars of the best qualities there is a fair demand, and rivet iron is also showing a slight improvement. Angle, tee, and channel bars are in fair request for the home trade, especially the heavy sections for constructive work; girder bars are also being inquired for on Government account. Business in hoops shows no change. Orders for tube strips are slightly better. Nail and wire rods are in quiet demand.

At one or two of the chief bar works substantial orders are on hand from Australian buyers, as also a good sprinkling of orders from America. Welsh iron is being delivered at Staffordshire chain works at, in some cases, prices below £4 12s. 6d. per ton for bars, notwithstanding the freightage charges. Marked bars of native manufacture are mostly quoted at £7; second-class branded sorts, £6; and common, £5 5s. down to £4 15s. per ton.

The present prices of the "Mitre" brand of marked iron are understood to be—rounds, flats, or squares, £6 15s. per ton; strips, from 2½in. to 6in. broad, and not thinner than 14 w.g., £7 5s; sheets, singles, £7 15s.; doubles, £8 10s.; and lattens, £9 10s.; angles, not exceeding 8in., £7 5s.; best qualities, £8 5s.; and plating bars, £7 5s. The "Wednesbury Oak" branded qualities of the same firm are £1 per ton less than "Mitre."

The demand for Bessemer and steel of similar temper in the form of bars, blooms, billets, and slabs, keeps up well, and buyers never had a better opportunity of purchasing to advantage. Orders, however, are small, purchasers declining to buy forward, and the business does not, therefore, figure into a very large total. Welsh makers are still offering supplies at rates which no other district can beat. Bessemer blooms and billets may be had here at £4 7s. 6d. to £4 10s. for ordinary sizes, while other sizes of slabs, flats, and bars range from £5 2s. 6d. up to £5 10s.

In the pig iron trade the recent considerable buying seems for the present to have mostly satisfied buyers' requirements, and purchasing operations are this week suspended. There are, however, further buyers in the market, who may be induced to operate shortly if they can make their own terms. Good Derbyshire are still quoted at 34s. to 35s. at stations, Lincolnshires about 38s., and good hematites at an average of 52s. 6d. Some hematites, however, touch a minimum of 50s., and on the other hand, for the Ulverstone hematites 54s. is demanded. Native pigs show little change on the basis of 52s. 6d. to 55s. for hot air all-mine; 35s. to 40s. for part-mines; 32s. 6d. for foundry, and 27s. 6d. to 30s. for forge.

Some of the engineers and machinists report a moderately good lot of foreign orders, and there is an active inquiry for dynamo machines and electrical appliances.

Bridge builders note with satisfaction that the Indian Midland Railway Company is in the market for the steel and ironwork for bridges of 60ft. to 40ft. clear span, and also for bridges of 20ft. and 40ft. span, with a supply of railway wheels and axles, hydraulic jacks, and other manufactures. Wheels and axles are also needed by the Indian State Railways. Railway carriage builders are receiving accessions to the work previously in hand slowly yet steadily. It is hoped that the contract offered for his Highness the Nizam's railway for the iron underframes and ironwork for the bodies of 100 goods wagons, and other carriages, may come to this district.

Iron pipe-founders are not busy, and they still experience a good deal of competition from founders in other parts of the kingdom. A couple of contracts just now on the market are likely to be sharply contested. One is for a supply of about 16,500 yards of water mains, varying from 3in. to 5in. in diameter, to the corporate authorities at Wakefield, and the other is for 140 tons of 12in. pipes needed by the Corporation of Cork.

Orders for cultivating and edge tools, on export account, keep up remarkably well, and some firms who recently were very slack are now well engaged.

Germany and some other of the continental countries are, to an increasing extent, becoming large manufacturers of all descriptions of locks. Illustration of this circumstance is found in the heavy quantities of pressed iron key-blanks, of large size, which continue to be sent from Willenhall to Germany, where they are finished and used up by the continental makers. The establishment in the Birmingham district, and other parts of the kingdom, of German merchant houses, has undoubtedly much assisted in bringing German and French manufactures to the front.

A magnificent exhibit has just been dispatched to the Liverpool Exhibition by Messrs. Edwards and Sons, of the Griffin Works, Wolverhampton. The show is a very large one, and contains an immense variety of highly finished edge tools and other articles. The centre-piece—a star—is surrounded by nicely polished adzes, axes, trowels, hatchets, pickaxes, railway beaters, spades, shovels, hammers, drills, hoes, and other tools applicable for use in almost every branch of industry, and peculiar to the requirements of every country in the world. Amongst the spades is one lately patented by the proprietors, the improvement being in the adjustment of a new steel tread. There is also shown a quantity of the best Crown brand horse-shoes, of which the firm were the original makers, together with a small case of polished fancy shoes, and a variety of finished plates for all classes of horses.

The establishment in Bromsgrove of a co-operative nail warehouse is, the operatives confidently believe, an accomplished fact. They have made arrangements as to the number of shares to be issued, and how the money will be banked, but there, apparently, the matter will end. Shares of £1 each, to be paid in subscriptions of 3d. a week, do not afford very brilliant prospects to the promoters. Meetings will shortly be held, when addresses on the subject will be delivered, and the association enrolled.

NOTES FROM LANCASHIRE.

(*From our own Correspondent.*)

Manchester.—Whitsuntide is so altogther a holiday season in this district that there is almost a complete cessation of business for nearly the whole of the week. At the engineering and the ironworks and at the collieries in the neighbourhood of Manchester there is practically a full week's suspension of operations, and as regards business, although the usual 'Change meetings are held on the Tuesday, they are little more than nominal markets, and for the remainder of the week no further attempt is made.

With only a thin attendance on the Manchester iron market on Tuesday, and with little or nothing doing to afford any actual test of values, prices can only be said to remain nominally unchanged. There is, however, so much low-priced iron being pressed for sale here, that anything like a really firm tone is impossible except where makers are prepared to stand absolutely out of the market, unless they can get the prices they ask. Although the firmer tone reported from Glasgow and Middlesbrough would seem to indicate a belief in the iron centres of Scotland and the North of England that prices have touched their lowest point, the tone in this market continues quite as weak as ever. For Lancashire pig iron makers quote 37s. 6d., and for one or two Lincolnshire brands 36s. 6d., less 2½, delivered equal to Manchester; but these figures do not at all represent the actual selling prices in the market. There is plenty of iron to be bought at considerably less money, and in some of the district brands there are sellers at 2s. 6d. to 3s. per ton under the prices above quoted.

For manufactured iron there is still only a wretchedly poor demand, and although prices have got down to a point at which any possible margin for a concession has long since disappeared, the necessity for securing orders is, in some instances, so pressing, that where anything like a favourable specification for prompt delivery is to be got, there are sellers who are prepared to cut below the minimum current rates. Delivered into the Manchester district the average quoted prices remain at about £4 17s. 6d. to £5 per ton for bars, £5 7s. 6d. to £5 10s. for hoops, and about £6 10s. per ton for sheets.

In the engineering trades works enter upon the holidays with but very poor prospects for the future when operations are resumed. The returns of the workmen's organisations, it is true, would still seem to indicate a slightly better state of things so far as employment is concerned, and for the past month they are again of a more favourable character as regards the number of men who are actually in receipt of out-of-work support. The report of the Steam Engine Makers' Society is again encouraging in its tone, and the statements from the various districts are more cheerful as to the employment of its members. There is still no tangible sign of improvement in the district trade reports, and it would be difficult to point out where trade can be said to be actually any better, but the number of unemployed again shows a slight decrease. Of much the same character are the reports received from the various branches of the Amalgamated Society of Engineers; the returns

continue to show a decrease in the number of members on the books in receipt of out-of-work support, and in the Manchester district one encouraging feature is a considerable reduction in the number of pattern-makers who have recently been out of employment. These more favourable returns as to the state of employment are, however, misleading as to the actual condition of trade. Although it may be true that just at present there are not quite so many men out of work, those that are kept in employment are for the most part only going on short time, and, as a matter of fact, the amount of wages that the men are actually earning is on the decrease rather than the increase; and apart from the reductions which were recently made, is very considerably less than it was at this time last year. Most of the big concerns have hesitated about discharging men, because they have been hoping for better times; but this hope is getting fainter and fainter. Locomotive builders generally are only very indifferently employed. In some cases they are on short time, and there is no new work of any weight coming in. Makers of rolling stock are also getting no new orders or inquiries for orders of any weight. Tool makers are pretty fairly employed finishing work in hand, but it is only in exceptional cases where they have orders which will carry them very far ahead. In heavy engineering work, some of the shops are about steadily employed, but they have not many new orders coming in. Engine builders are in most cases badly off for work. Amongst cotton machinists trade is only very moderate, and what prospects they have are chiefly in connection with continental orders. Taking the engineering trades all through, the outlook for the ensuing winter, so far as it can be gauged at present, is very discouraging.

I understand there has been some sort of a movement amongst the men employed at the Lancashire and Yorkshire Railway locomotive shops to secure, if possible, a return of the 10 per cent. which was taken off their wages a short time back. The men were requested to work overtime, and this being against the decision come to when the reduction in wages was made, that no overtime should be worked at the reduced rate of wages, a meeting was held, and by a large majority it was decided not to work the overtime requested by the company unless the 10 per cent. reduction in wages were returned. As a counter move to this, I understand the company has posted notices that after June 24th the men will be put on five days a week.

Messrs. W. H. Bailey and Co., of the Albion Works, Salford, have just constructed, for the use of the South Australian Government Telegraph Department, a wire tester on an improved principle, specially designed by Mr. W. H. Bailey. The tensile strength of the wire is tested in an ingenious manner by means of a column of mercury, and when the wire breaks a back-pressure valve prevents the return of the mercury, so that the breaking strength of the wire is thus exactly indicated. There is also a diagram attachment used with the machine which indicates on metallic paper the elongation of the wire before the maximum breaking strain of the wire is reached. The arrangements of the machine are so simple that levers and springs are entirely dispensed with.

In the coal trade there has been a little extra pressure, just prior to the holidays, to secure extra supplies in anticipation of the usual stoppages of the pits, but this has been followed by a complete lull, and for the last two or three days there has been absolutely nothing doing. Prices are without quotable alteration, but with the exception of a firm tone which is maintained in some classes of engine fuel, the general tendency is in the direction of weakness, especially in the common classes of round coal, which are pressed for sale in quantities at excessively low figures. At the pit mouth best coal averages 8s. 6d.; seconds, 7s. to 7s. 6d.; common coal, 4s. 9d. to 5s. 3d.; burgy, 4s. 3d. to 4s. 9d.; best slack, 3s. 9d. to 4s. 3d.; and common sorts, 2s. 6d. to 3s. per ton.

For shipment there has been only a very poor demand, and steam coal delivered at the Garston Docks or the high level, Liverpool, is to be got as low as 6s. 6d. to 6s. 9d. per ton.

Barrow.—There is no alteration to note in the condition of the hematite pig iron trade of this district, and the holiday season has not in any way tended to bring about any improvement in the general commercial position. The inquiry from America and from Russia for pig iron has been steadily maintained, and some good orders are expected from these quarters. Although it is questionable yet whether they can be secured at the prices which are now current, and which makers and sellers alike are firm in maintaining, 42s. per ton for pig iron of mixed Bessemer numbers is still the quotation, 41s. for No. 3 forge and foundry iron net at works, prompt delivery. The orders held by makers are comparatively numerous, and it is probable they will furnish employment for three months. Stocks are rather less than they have been, and a further reduction may be expected. The steel trade shows no new feature. Orders are coming to hand from America and the Continent, and also from home buyers, but there is a disinclination on the part of buyers to place their orders unless easier terms can be given, and these, makers are firm at present in resisting. The rail mills are busy, and the tin-plate bar mills are fully employed. The inquiry for the latter is strong and vigorous, and a much fuller business could be done if makers had increased facilities of production. The work in the hands of makers represents employment for three or more months at the rate of 1000 tons per week. There is a steady business in the wire trade. Shipbuilders are still on the look-out for new orders, but only a few are offering. There is great open space observable at the yards of the various builders, and this is likely to be increased soon if new orders do not come in. The work of rigging the Pacific steamer Orizaba at Barrow is proceeding satisfactorily, and the boilers and engines are being fitted, with a view to the steamer being ready to go on her station in the course of a couple of months. A sister steamer of equal tonnage is also building at the same yard. Engineers are very quiet, and the only department in which there is any activity is the marine department, and the briskness here observable is only of a temporary character. Iron ore quiet. Coal and coke steady. Shipping very busily employed on metal exports.

THE SHEFFIELD DISTRICT.

(*From our own Correspondent.*)

The official return of the quantity of coal sent by rail and water to Hull for the month of May shows a marked increase from the Yorkshire collieries, largely due to the extra tonnage sent from Wombwell, Mexbro', Wath, Rotherham, and Barnsley. In May the tonnage was nearly double that forwarded in the corresponding month of 1885. The railways seem to be monopolising the coal traffic. Last month 42,032 tons were sent by water, and 81,672 tons by rail, or a total of 123,704 tons, against 63,088 tons in May, 1885, showing an increase of 60,616 tons. The quantity sent for the five months of the present year is 490,392 tons, against 429,664 tons in the first five months of 1885. The exports have largely increased, chiefly to North Russia and Germany, the weight last month being 74,515 tons, against 23,633 tons for June, 1885. Denaby Main, which was *nil* last year owing to the strike, last month forwarded 13,160 tons; Manvers Main is next with 11,064 tons, against 416 last year. Carlton Main, on the Hull and Barnsley route, shows a tonnage of 4896, against nothing last year. Kiveton Park sent 1176 tons; Mitchell Main, 1400 tons; Hemsworth collieries, 2144 tons; Wombwell Main, 2488 tons; Corton Wood, 2256 tons; Call House, 1224 tons; Darfield Main, 2960 tons; Aldwarke Main, 3632 tons. All these collieries were blank in the return for May of 1885. Thrybergh Hall, on the other hand, has diminished to 3168 from 5400 tons; Kilnhurst, to 1968 from 4256. Generally, the West Riding collieries have not done so well as in May of 1885.

Discouraging reports continue to reach me of the condition of the iron industry in this district. On inquiry I find the rumour that a large coal and iron company intended to cease making pig, for a time is not true. Though the company has greatly restricted production it has no intention of taking the strong measure advocated by several ironmasters, to bring the supply down to the level of the demand. While the make in this district continues to decline, there is no falling off to report in the tonnage imported from other districts. Although the production is far below the capabilities of the district, it is more than adeduate to supply the existing demand. Bars, hoops, plates, angles and tees are all in indifferent request. The plate mills are exceptionally dull, owing to competitors in other districts sending low priced goods into the local parts.

The foreign demand for steel continues to be fairly brisk, particularly for the United States markets. Though the higher qualities are freely ordered by several makers for special purposes, it is pretty evident from the price per ton that a large weight of the cheaper crucible steels, as well as of other kinds, is being sent across the Atlantic. The home demand continues very dull, the Midland districts being singularly dull, according to the reports made by various good houses.

Messrs. Newton, Chambers, and Co., Thorncliffe Ironworks, have found it necessary to ask the moulders engaged in the production of hot water pipe fittings to grant a reduction of wages. Recently the firm rearranged their wage lists in other departments, and it is not anticipated that the present request will lead to any inconvenience.

At Norwood Colliery, near Killarnagh, on Saturday morning, two men were killed. They were engaged on a scaffold which was being let down the cupola shaft to be ready for the workmen to finish bricking the shaft. The stage, which was lowered by a crab, was 11ft. 6in. diameter. When it had been lowered a distance of forty yards the crab got out of gear, causing the men at the handles to lose all control over the machine, and the stage, with the two men on it, was precipitated a depth of 125 yards, where it was stopped by some rails which stretched across the shaft. When the stage was checked, the wire rope, weighing 15 cwt., broke from the drum and fell on the top of the unfortunate men, who when taken up were quite dead.

The Dore and Chinley Railway Bill is part of the salvage saved from the wreck of the Session. It was passed positively at the eleventh hour through the Committee stage, and was reported to the House for the third reading. Sanction was given to pay 3 per cent. out of capital during construction, the only obstacle which remained in the way of the line being proceeded with.

Mr. Frederick Herbert, who has taught with satisfactory results the mechanical class at the Sheffield School of Art, has been appointed to the management of the engineering works of Messrs. Jordan and Sons, Newport, Mon.

THE NORTH OF ENGLAND.

(*From our own Correspondent.*)

Business in Cleveland pig iron was almost at a standstill at the beginning of the week owing to the Whitsuntide holidays, and the market was postponed from Tuesday to Wednesday morning. Inquiries have been more numerous of late than for months past, but the quantity of iron sold has not been large. Sellers seem to be holding back now that they think there is a chance of a rise in prices. Merchants ask 29s. 6d. per ton for No. 3 G.M.B. for prompt delivery, which is 1½d. per ton more than the price last week. For delivery to the end of August they ask 6d. per ton more. Makers are not pressing their iron on the market just now. They decline to quote for forward delivery, and will not take less than 30s. per ton for immediate delivery. There is not much doing in forge iron, but prices are firmer, and stand at 28s. 6d. to 28s. 9d. per ton.

Warrants are more firmly held, holders thinking there is a reasonable prospect of making a little profit on them. The usual price is 29s. 9d. per ton.

Finished iron is in no better demand, and there is no likelihood that any of the idle works will be re-opened for some time to come. Prices are as last quoted.

The directors of the Darlington Steel and Iron Company have just issued their annual report. They state that they have erected a steel sleeper-making plant within the works, and that it has been in operation since March. The profit on the year's working amounts to £8355 7s. 6d., which is to be disposed of as follows:—Dividend on 7 per cent. preference shares, £3266 18s.; carried to reserve account, £3000; carried forward to next year's account, £2088 9s. 6d.

The Middlesbrough Corporation, acting through their Streets Committee, have decided to form the roadway of a number of new streets, and to employ for that purpose as many as possible of the men recently thrown idle by the closing of the stoneyards. This will be a great boon to the poor fellows and their starving families.

A large and apparently increasing proportion of the export trade in coals is done in foreign ships. These are almost always sailing ships, deeply laden, and manned with foreign sailors at very low wages. It is said also that the commissariat department is carried on much more in the interest of the owners than of the sailors. Under these circumstances it is scarcely to be wondered at that coal is conveyed abroad very cheaply, and that British owners find it ever more and more difficult to compete.

The funeral of the late Mr. Edward Williams took place at Marton churchyard, near Middlesbrough, on Saturday afternoon last. There was a very large attendance. Besides the Middlesbrough Corporation, of which the deceased gentlemen was alderman, ex-mayor, and chairman of the watch committee, several several other public bodies were represented. The Iron and Steel Institute, the Institution of Civil Engineers, the Institution of Mechanical Engineers, the Ironmasters' Association, the Iron Manufacturers' Association, the Cleveland Institution of Engineers, and other societies to which he belonged, and in the proceedings of which he took an active part, had representatives present. Some gentlemen came even from South Wales to attend the funeral. Mr. Williams was only in his 61st year, and his loss will be deeply felt far beyond the precincts of his family circle.

NOTES FROM SCOTLAND.

(*From our own Correspondent.*)

There has been a better feeling in the pig iron market. Towards the close of last week it was reported that a good business had been done by certain ironmasters who had intimated an increase in their prices, and as the production is now being very materially reduced, it was felt that matters on the whole looked a little more hopeful. As the ironmasters were reported to be more cautious sellers, the speculative market also became firmer, and warrants advanced about 6d. a ton. The Scotch shipments were somewhat discouraging, amounting as they did to only 6946 tons, as compared with 9592 in the preceding week, and 9916 in the corresponding week of 1885. There are 84 furnaces in blast, as compared with 91 at the same date last year. Between 2000 and 3000 tons of pigs were in the course of the week added to the stock in Messrs. Connal and Co.'s stores.

Business was done in the warrant market on Friday at 38s. 11d. to 39s. 2d. cash. There was no market on Whit Monday. On Tuesday transactions occurred at 39s. 1d. to 39s. 2½d. cash. The market was firm on Wednesday, at 39s. 4d. to 39s. 6d. cash. To-day—Thursday—prices fell to 39s. 0½d. cash.

The current values of makers' iron, most of which are higher than last week, are as follow:—Gartsherrie, f.o.b. at Glasgow, per ton, No. 1, 43s.; No. 3, 41s. 3d.; Coltness, 47s. and 43s. 6d.; Langloan, 44s. and 41s. 6d.; Calder, 46s. and 41s.; Summerlee, 45s. 6d. and 41s. 6d.; Clyde, 42s. and 39s. 6d.; Carnbroe, 42s. and 39s. 6d.; G.M.B., 39s. 6d. and 36s.; M. and C., 39s. and 37s.; Glengarnock, f.o.b., at Ardrossan, 42s. 6d. and 40s.; Eglinton, 39s. 6d. and 36s. 9d.; Dalmellington, 41s. and 37s. 6d.; Shotts, f.o.b., at Leith, 44s. 6d. and 44s.; Kinneil, at Bo'ness, 43s. and 42s.; Carron, at Grangemouth, 46s. and 45s.

Some fair sales of hematite pigs have been made within the last few days to Scotch steel makers. There has of late been a material reduction in the output of hematite, but where some firms are not requiring all the production, others are finding it necessary to increase it to a small extent.

The past week's shipments of iron and steel goods from Glasgow included locomotives to the value of £12,000 to Bombay and £3300 to Calcutta; machinery, £2200; sewing machines, despatched in parts, £731; steel goods, £5700; and general iron manufactures, £20,200, of which £7600 represented sleepers, bars, and boilers for Bombay, and £7580 plates, angles, pipes, and tubes, for Italy.

There has been a marked activity in the shipping department of the coal trade in the past week, the quantities despatched being, at Glasgow, 29,880 tons; Greenock, 441; Ayr, 10,333; Irvine, 2975; Troon, 7240; Burntisland, 15,506; Leith, 1838; Grangemouth, 13,000; and Bo'ness, 5829 tons. Coalmasters complain much of the very low prices that prevail, and they do not at present see any chance of an improvement.

In consequence of continued low prices, coalmasters are obliged to make further reductions in the colliers' wages. Notice of a 10 per cent. reduction has been posted at a number of the collieries in the Glasgow district, and it is thought that the reduction will become general. At the Blairball Colliery of the Coltness Iron Company, in Fifeshire, the reductions intimated are stated at from 12 to 15 per cent., bringing down the average earnings to 2s. 6d. a day. The case of these miners was under the consideration of the Wages Committee of the Fife and Clackmannan Miners' Association, when the men were advised to resist the reduction, and give notice to leave their work in the course of a fortnight.

The miners of the Hamilton district—which is almost the only place where a Union exists in the West of Scotland—held a mass meeting on Monday to consider the wages' question. They were in favour of restriction as a means of arresting the fall in wages; but there is almost no chance of their views being carried into practical effect.

WALES AND ADJOINING COUNTIES.

(*From our own Correspondent.*)

It may fairly be assumed that the coal trade is better. The exports, for instance, are maintained, and new companies are being floated. The Llantwit Colliery, which has been idle for nearly twelve months, is to be started by a new company, and the management by Mr. G. Jenkins. I have hopes too of the Crumlin Valley collieries, especially now that house coal is showing better form. Prices are a trifle more stiff in most varieties. No. 3 Rhondda commands 8s. 6d., secondary kinds of Rhondda coal range from 7s. 6d. Steam coal may be had, according to quality, from 7s. 6d., and best small steam at 5s.

I am sorry to note, however, a falling off in the French coal exports from Swansea. To other destinations a fair average has been maintained, and the whole total for last week from that port was slightly over 26,000 tons, Africa, South America, and Italy being the largest buyers.

That the coal trade has passed through extreme depression is a fact that statistics will endorse in the most unmistakeable manner. Take the coal traffic to London, for example, and the railway totals when made up for the first half, and the contrast to the good times once enjoyed will be manifest. The month just completed—May—shows a turn, if I am not much mistaken. The Aberdare Iron Company sent to London last month 5800 tons, and the Plymouth Company, which has kept marvellously well all the year, 3600 tons. Bwllfa pits in the Dare Valley sent, *viâ* Great Western, 4000 tons, Fforchaman 3400 tons, Nixon's Navigation 3500 tons, Aberaman 2000 tons, and Aberdare Merthyr 1300 tons. By the London and North-Western Bwllfa sent 1300 tons, Aberdare Company 1300 tons, Cwmdare 2200 tons, Fforchaman 2600 tons. The district now suffering the most is part of Aberdare, where several places are stopped, one or two collieries in the Rhondda, and the Cyfarthfa collieries, which are quieter than usual.

I have been glad to see some large clearances at Cardiff, such as 2500 to India, 1500 to Genoa, 2400 to St. Vincent, 1000 to Bilbao, 1300 to St. Nazaire; and from Newport, 1000 tons to Bordeaux, 1050 to Salerno, 1900 to St. Nazaire, 1500 to Malta, and several ranging close to a thousand tons. Cargoes of a thousand and upwards are always regarded with interest by shippers and captains.

The patent fuel trade is steadily improving. Large cargoes were sent from Cardiff last week, and Swansea sent away close upon 9000 tons, making one think that its 10,000 tons weekly average was coming back again.

I have little to chronicle in regard to the iron trade. Treforest, with its admirably adapted arrangements, remains hopelessly quiet. There is no alternative, I imagine, but to adapt again to new requirements, and then its closeness to port will give it advantages. Steel bar is the principal article in demand, though I have seen some fair consignments of steel rails. Dowlais is working nearer full time than it has, so wages are better. At Tondu notice is out for a 10 per cent. reduction.

Foreign ore is at a low figure; some is being consigned *viâ* Cardiff at 10s. 3d. Large purchases have been made of late, and Rhymney, Dowlais, Blaenavon, Ebbw Vale, and other works have received good cargoes.

Pitwood, a trade which keeps in unison with the ups and downs of coal, maintains its advance, and quality which could be had for 13s. now commands 16s.

In tin-plate a good deal is being done at late quotations, few qualities even of the best brand of cokes reaching to 14s., though Siemens, as a rule, commands a slightly higher figure. The May total shows a slight falling off, but since then there has been an improvement, and judging from the steamers to clear this week at Swansea, the week's total will be a good one. Some of the old works will soon be re-started, and before the end of the year Ystalyfera is expected to be in full operation again.

New Steamers for the Anglo-Belgian Mail Service.—On the 2nd inst. the Prince Albert, the first of three steamers ordered by the Belgian Government for the mail service between Ostend and Dover, was launched from the Cockerill Company's Hoboken shipyard, near Antwerp, in the presence of the Belgian Minister for railways, posts, and telegraphs. The second steamer, the Ville de Douvres, is to be launched on the 17th inst., and the third in three months' time. These steamers will unite a slight draught of water, so as to enter the harbours at all states of the tide, with a high speed, in order to reduce to a minimum the time occupied by the passage. The length between perpendiculars is 255ft., breadth over paddle-boxes 34ft. 6in., and draught only 8ft. 6in., the builder's measurement being 1062 tons. The steamers are being built and fitted out by the Cockerill Company from materials entirely produced at Seraing. The hull and boilers are of Siemens-Martin steel, but the flue tubes and rivets of wrought iron. The compound engines are of a type common on the Volga, the diagonal high-pressure cylinder being 5ft. 3in. in diameter, and the horizontal low-pressure cylinder 8ft., with a stroke of 5ft., with 120 lb. of steam in the four boilers; the engines are calculated to give out 3000-horse power, making forty-two revolutions a minute. The stipulated speed is 17½ knots at sea, but the designer, Mr. Rickard, manager of the Hoboken yard, confidently expects to attain 18 knots at the trial, thus gaining a premium of £500, being at the rate of £50 for every tenth of a knot over 17½. The paddle shafts, of Siemens-Martin steel, are made hollow for lightness. In case of mishap, the steam steering gear on the bridge can be disconnected instantaneously, and the vessel steered by wheel at the stern. The steamers will be lighted throughout by ninety incandescent lamps of varying powers, and also be provided with two special deck lights, each consisting of eight 50-candle incandescent lamps.

AMERICAN NOTES.

(From our own Correspondent.)

NEW YORK, June 5th.

THE week's transaction in iron, coal, lumber, steel, and in the textile products, indicates a slight improvement over the business of the previous week. Trade combinations continue to be formed, and employers generally are strengthening themselves in associations intended to act against trade union associations. The Knights of Labour have just adjourned in Cleveland, Ohio, after a seven days' session. The result of the meeting is that the executive committee has been enlarged, and that its authority has been increased; that strikes cannot be entered upon without its authority. Overtures have been made to the 400,000 trade unionists to enter that organisation, but the feeling of this body of men is utterly opposed to any such combination. Several strikes have occurred in New York, Chicago, and St. Louis this week, involving a large number of men. The demands are for eight hours. In a general way labour disturbances are at an end, although there is considerable discontent. In Philadelphia a movement has been started for free wool, which is a surprise to manufacturers. In Western Pennsylvania, the Amalgamated Association of Iron and Steel Workers have been in session four days, but as yet have not made a demand for 10 per cent. This, however, will be done, and the workmen in the East will follow suit with a demand for 7 per cent. The iron and steel mills in the country are working a little less than full time. The indication points to an improving summer demand to compensate for the inactivity of the past six weeks. Railroad building will be prosecuted after July 4th. Several large contracts for rails were placed this week, amounting to between 20,000 and 25,000 tons; the large orders being at 34 dols. 50c. and small orders 35 dols. and 35 dols. 50c., for delivery running through the summer as wanted. Very little Bessemer, spiegeleisen, or Scotch iron has been ordered, and stocks are fair. Heavy arrivals of foreign ore continue, and the domestic mines are being worked to almost their fullest capacity. Nearly the entire ore requirements of the West have been filled with Lake Superior ore. Extensive improvements continue to be made in iron and steel establishments, and confidence prevails that the demand during the coming twelve months will fully justify every extension made. Forge iron is selling at 15 dols. 50c. for Southern to 16 dols. to 16 dols. 50c. for Pennsylvania; Bessemer iron, 18 dols. for American, and 19 dols. to 19 dols. 50c. for English; Pennsylvania foundry, 17 dols. to 19 dols., according to quality, with an indifferent demand just at present. A heavy production of 100,000 tons per week still continues, and buyers are anticipating a little weakness in inferior makes on account of the sluggish demand of the past few weeks. However, the entire product is being shipped as fast as made to fill orders earlier in the season. The bar iron makers report only a moderate demand. Locomotive builders have been booking a few orders, sufficient to guarantee them steady work during the summer. The car works continue to receive fair orders, and only two or three of the larger establishments are not running full time. The change of gauge in the Southern roads made last week has created a very heavy demand for bolts, railway appliances, lumber, and all material necessary to complete that change from the broad to the ordinary gauge.

NEW COMPANIES.

THE following companies have just been registered:—

Austin and Dodson, Limited.

This is the conversion to a company of the business of merchants and manufacturers of steel, files, and general goods carried on by Messrs. Austin and Dodson at Cambria Works, Sheffield. It was registered on the 7th inst. with a capital of £20,000, in £10 shares. The subscribers are:—

	Shares.
H. H. Knill, 37, Cheapside, accountant	1
Edgar Aldous, 2, Elmhurst, Upton-lane, Forest-gate, engineer	1
C. E. Cobb, 22, Fenchurch-street, financial agent	1
J. R. Beckitt Dodson, Cambria Works, Sheffield, manufacturer	1
W. A. Colls, 57, Moorgate-street, accountant	1
H. S. Trehearne, 57, Moorgate-street, agent	1
A. A. King, 141, Isledon-road, N., commission agent	1

The number of directors is not to be less than three nor more than eight; the subscribers are to appoint the first and act *ad interim*; the company in general meeting will determine remuneration. Mr. J. R. Beckitt Dodson is appointed managing director for five years at a salary of not less than £300 per annum. The company will pay the vendor £70 in cash to be applied in full payment of the shares subscribed for by the above signatories.

Henry Lamplough and Co., Limited.

This is the conversion to a company of the business of wholesale and retail chemist carried on by Mr. Henry Lamplough, the purchase including the proprietary rights of "Lamplough's Pyretic Saline" and other well-known preparations. It was registered on the 5th inst. with a capital of £100,000, in £5 shares, with the following as first subscribers:—

	Shares.
J. Tillman, Sumatra-road, West Hampstead, stationer	1
W. C. Day, 95, Grosvenor Park, Camberwell, agent	1
W. N. Tucker, 34, Talma-road, Brixton, commercial traveller	1
W. de B. Seagrave, 37, Colfe-road, Forest-hill, accountant	1
J. Henderson, 58, Romola-road, Herne-hill, journalist	1
A. Elson, Ancona-road, Highbury, accountant	1
W. H. Fielding, 91, Wakehurst-road, Wandsworth, lithographer	1

The number of directors is not to be less than three nor more than five; qualification, 40 shares; the first are Messrs. James Inch, Alexander Brown, J. W. Cooper (managing director), and Henry Lamplough. The managing director is appointed for seven years at a salary of £1000 per annum, and in addition will be entitled to participate with the other directors—who will each receive fifty guineas per annum—in a division of one-fourth of the profits remaining after payment of 10 per cent. dividend.

Bright Platinum Plating Company.

This company proposes to acquire and work an invention for improvements in the deposition of platinum by electricity—for which protection has been obtained by Mr. William Arthur Thoms, dated 1st April, 1886, No. 4553—and to carry on business as electro-platers. It was registered on the 8th inst. with a capital of £1800, in £1 shares, with power to increase. The subscribers are:—

	Shares.
A. E. Sarti, 108, St. Paul's-road, Canonbury, electrician	100
A. W. Herve, 152, Farringdon-road, screw manufacturer	100
H. Parminter, 27, Clement's-lane, financial agent	100
F. Wingrove, 33, Aschurch-grove, Shepherd's-bush	25
H. A. Rene Moen, 38, Old Jewry	200
R. Sanford, 6, Wharton-terrace, West Kensington, merchant	100
P. Parminter, 6, Sunninghill-terrace, St. John's	25

The number of directors is not to be less than three nor more than seven; the subscribers are to appoint the first and act *ad interim*; qualification, 100 shares; the remuneration of the board will be determined at the statutory meeting.

Fontaine Needle and Pin Manufacturing Company, Limited.

This company proposes to carry into effect an unregistered agreement of the 20th ult. between Henri Eugène Fontaine, of the Queen's Hotel, St. Martin's-le-grand, engineer, and William Williams, of 13 and 14, King-street, of one part, and B. R. Wood, of 38, Mildmay-road, N., of the other part, for the purchase of inventions for improvements in the process of manufacturing sewing and other needles and pins, and the machinery employed therefor. It was incorporated on the 8th inst. with a capital of £50,000, in £1 shares, with the following as first subscribers:—

	Shares.
J. Todd, 14, Wentworth-road, Manor Park, Essex, engineer	1
J. Sadler Wood, 13, King-street, chartered accountant	1
A. Edwards, 147A, Aldersgate-street, merchant	1
J. Savory, Wakehurst-road, Wandsworth-common, articled clerk	1
G. Buckley, 14, King-street, E.C., merchant	1
J. L. Blaxland, 7, Queen Victoria-street, solicitor	1
B. Rowland Wood, 38, Mildmay-road, N., accountant	1

Registered without special articles.

Cornelian Gold Company, Limited.

This company proposes to purchase from Robert Makepeace, of 85, Gresham-street, the whole of the leases, machinery, plant, and stores of the Hawkin's Hill Consolidated Gold Mining Company, Limited, in liquidation, situate in the colony of New South Wales. It was registered on the 3rd inst. with a capital of £50,000, in £1 shares. The vendor has agreed to purchase the property for £800, and will transfer the same to the company for £20,000 fully-paid shares, and 24,619 shares, to be allotted as fully-paid on or after 31st December, provided 3s. be paid to the company in respect of each of such shares. The vendor is to defray the preliminary costs of the company, and also the expenses of management up to the 31st December next. The subscribers are:—

	Shares.
A. F. Wild, 34, Clement's-lane, clerk	1
*H. W. Maynard, 34, Gracechurch-street	1
G. W. P. Woodroff, 1, East India-avenue, merchant	1
J. D. E. Ewing, 9, Fenchurch-avenue, merchant	1
G. Maynard, 9, Upper George-street	1
H. M. Beart, 34, Gracechurch-street	1
Stewart Pixley, 27, Old Broad-street, bullion broker	1
Walter Sanderson, 27, Old Broad-street, clerk	1

The number of directors is not to be less than three nor more than five; the first are Mr. H. W. Maynard, Captain H. F. Nicholson, C.B., N.R., and Robert Makepeace; qualification, £250 in shares or stock; the remuneration of the board will be determined after the first general meeting.

Pahang Tin and Gold Exploration Syndicate, Limited.

This syndicate proposes to explore for tin, gold, silver, and other mineral deposits in the State of Pahang, in the Malay Peninsula, and to acquire concessions and to work mines. It was registered on the 5th inst. with a capital of £2000, in £25 shares. The subscribers are:—

	Shares.
H. Meissner, 37, Great Tower-street, Liverpool, merchant	4
Henry Nash, 12 and 14, Great Tower-buildings, Liverpool, merchant	4
E. Smith, 12 and 14, Great Tower-buildings, Liverpool	4
F. B. Gilbertson, 10, Harrington-buildings, Liverpool, merchant	2
R. McIlwraith, 138, Leadenhall-street, merchant	6
R. Brown, 11, Rumford-street, Liverpool, broker	1
A. Brown, 11, Rumford-street, Liverpool, merchant	1
D. D. Carroll, 4, Fenchurch-avenue, merchant	4
D. Weston, 138, Leadenhall-street, merchant	2
C. W. Bell, D.L., J.P., East Grinstead	2
G. C. Jewett, 12 and 14, Tower-buildings North, Liverpool	1

Registered without special articles.

Spratt's Patent (Russia), Limited.

This company was registered on the 7th inst. with a capital of £100,000, in £5 shares, to manufacture and trade in food of all kinds suitable for animals. The subscribers are:—

	Shares.
W. Fletcher, 10, Park-street, N., accountant	1
J. B. Snell, The Chestnuts, Chislehurst	1
C. Prickett, 98, Frederick-street, Barnsbury, clerk	1
H. Houching, 138, Mayfield-road, Dalston, accountant	1
W. Fielder, 33, Digby-road, Finsbury Park, clerk	1
J. Pain, 29, Langton-road, North Brixton, clerk	1
E. J. Beattie, 46, Mallinson-road, Clapham Junction, commission agent	1

The number of directors is not to be less than two nor more than five; qualification, shares of the nominal value of £250; the first are Messrs. George Beetham Batchelor, Walter Bird, and Conrad Jörgenson; remuneration, £150 per annum to the chairman and £100 per annum to each other director, and a further sum to each director of the like amount, in every year in which 10 per cent. dividend is paid.

Transatlantic Steam Coal Company, Limited.

This company proposes to purchase and work the Pwllcarn Colliery, situate in the parishes of Bettws and Llangonoyd, county of Glamorgan, and to acquire the business, property, and liabilities of an existing company of the same title. It was registered on the 8th inst. with a capital of £90,000, in £100 shares, with the following as first subscribers:—

	Shares.
*E. Ponsonby, 15, Queen Anne-street, W.	1
*W. Davies, M.P., Haverfordwest, solicitor	1
*Robert Bovey, 156, Leadenhall-street, merchant	1
*Joseph Thomas, Haverfordwest, merchant	1
J. Davies, Bridgend, Glamorgan, colliery proprietor	1
W. Rees Davies, 1A, Frederick's-place, solicitor	1
W. Davies George, Haverfordwest, solicitor	1

The number of directors is not to be less than three nor more than nine; the first are the subscribers denoted by an asterisk and Mr. T. Cory; qualification, £500 in shares; the company in general meeting will determine remuneration.

John Muir and Co., Limited.

This company was registered on the 8th inst. with a capital of £5000, in £5 shares, to acquire the business of timber merchants and sawmill proprietors carried on by Thomas Muir Tyrer and Thomas Walter West, trading as John Muir and Co., at 81, Pembroke-place, Liverpool. The subscribers are:—

	Shares.
T. Muir Tyrer, Seaforth, near Liverpool, timber merchant	1
T. Walter West, Birkdale, Southport, timber merchant	1
Mrs. Martha Tyrer, Great Crosby, near Liverpool, widow	1
Miss M. H. Tyrer, Great Crosby, near Liverpool	1
C. T. Tyrer, Great Crosby, near Liverpool, wood broker	1
J. M. Tyrer, 24, Elizabeth-street, Liverpool, timber salesman	1
F. Hartley, 52, Devonshire-road, Liverpool, solicitor	1

Table A of the Companies' Act, 1862, will apply to the company.

L. Whitaker and Sons, Limited.

This is the conversion to a company of the cotton spinning and manufacturing business carried on by L. Whitaker and Sons, at Holme Spring Mill, Haslingden, Lancaster. It was registered on the 8th inst. with a capital of £10,000, in £10 shares. The subscribers are:—

	Shares.
G. Cunliffe, Haslingden, waste dealer	1
J. R. Cunliffe, Rawtenstall, cloth agent	1
F. Lee, 2, Hopwood-avenue, Manchester, yarn agent	1
R. Charnley, Haslingden, cotton mill manager	1
A. E. Hardman, Burnley, schoolmaster	1
Jane Hardman, Haslingden, spinster	1
Miss E. A. Hardman, Burnley, schoolmistress	1

Registered without special articles.

PROPOSED TUNNEL ACROSS NORTHUMBERLAND STRAITS.—When Prince Edward's Island, Gulf of St. Lawrence, entered the confederation of the Canadian Dominion, one of the articles of the agreement was that communication should be maintained with the mainland of Canada all the year round. In consequence, large sums of money have been thrown away on the Northern Light and other steamers, which, it was expected, could force their way during winter through the fields of Arctic ice which block Northumberland Straits. The result has been a complete failure, and the 125,000 islanders, notwithstanding the agreement, are practically shut off from communication with the outer world in the icy months of winter. It is now proposed to keep up communication all the year round by constructing a tunnel tube resting on the bed of the straits. The plans, which have been accepted by the Government of the island, have been under the consideration of a committee of engineers, submitted to the Dominion Government, and the scheme is to be brought before the Canadian Parliament in the current session. According to the *Times*, four lines have been surveyed across the straits, and a plane or plateau has been found on which the tunnel tube can be successfully laid. It is proposed to build on each side of the straits piers inside of the "bordice" through which the tube is to be driven for some 2800ft., the total length of the huge pipe or tunnel being six and a-half miles, or about five and a-half nautical miles between the piers. The bottom of the straits shows a very good road bed, the depth of water varying from 36ft. on the island side to about 80ft. in the middle of the straits, and thence ashore on the New Brunswick side to 10½ft. The tunnel is to be 18ft. in diameter, and to be constructed of heavy sections of chilled white cast iron, 4in. thick or more, according to depth. Mr. H. H. Hall, of the Submarine Tunnel and Tube Company, of New York, is the patentee of the process of casting the tubes, as well as of the chilled white metal used. It is estimated that, at the present market price, the cost of the iron for the tunnel would be about £17 per linear foot, making the total estimated cost of the work close upon £1,000,000. The metal is stated to be non-corrosive in sea water, as shown by its exposure for twelve years in the harbour of Sydney. The sections are bolted together by inside flanges, making a water-tight rust joint with a smooth exterior. A connection with the surface could be maintained by a vertical shaft if desired; but as a railway could be laid through the tunnel as fast as it is built, all the material used could enter that way, a supply of fresh air be obtained, and communication maintained with the shore. Where the depth of water will allow of the obstruction to the channel, the tunnel is to be laid on the natural bottom of the straits; otherwise a channel is to be dredged, in which the tube is to be sunk.

THE PATENT JOURNAL.

Condensed from the Journal of the Commissioners of Patents.

Applications for Letters Patent.

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

June 7th, 1886.

7646. KNITTING MACHINES, H. B. Payne, London.
7647. TILES, H. Diedrich, Liverpool.
7648. PROTECTING the BOTTOMS of SHIPS, B. G. Orchard, Liverpool.
7649. FASTENING of CAPSULES on BOTTLES, A. J. Boult. —(*M. Rotten, Germany.*)
7650. CIRCULAR KNITTING MACHINES, J. Lorrimer and O. Tabberer, London.
7651. CUTTING HAIR from ANIMAL SKINS, A. J. Boult. —(*J. B. G. Borgnis, France.*)

June 8th, 1886.

7652. ELBOWS, TEES, CROSSES, &c., J. Tibbitts, Birmingham.
7653. VALVE GEAR for ENGINES, W. H. Beck.—(*J. C. Turck, France.*)
7654. INDEX for LEDGERS, &c., A. A. Herpinstall, Liverpool.
7655. ORNAMENTING WOVEN FABRICS, J. Platt, Manchester.
7656. WELDLESS CHAIN, W. Scotson, Lemington-on-Tyne.
7657. TOBACCO-PIPES, &c., S. O'Neill and T. P. Perkins, Eccles.
7658. GAS ENGINES, J. R. Nixon, Manchester.
7659. CARTRIDGE FEEDING DEVICES for MACHINE GUNS, L. F. Bruce, Paris.
7660. PICKERS for WEAVING LOOMS, W. Holt and S. Fawcett, Manchester.
7661. SNOW MELTERS, J. Sadler Nottingham.
7662. CLEANING and PURIFYING CARPETS, &c., T. and A. S. Warsop, Nottingham.
7663. BLEACHING COMPOUNDS, C. Toppan, London.
7664. LEVELLING SURFACES, J. Blakey, Leeds.
7665. TIRE FASTENERS, A. E. Hollingsworth and R. T. Woolley, London.
7666. FIXING SHEETS of GLASS, &c., on ROOFS, &c., T. W. Helliwell, Halifax.
7667. WASHING CLOTHES, E. Ward and G. Thorpe, Sheffield.
7668. LOOMS for WEAVING, R. Mercer, Blackburn.
7669. ELECTRIC MOTORS and GENERATORS, E. T. and D. Higham, London.
7670. FASTENINGS for WINDOW SASHES, &c., G. A. Mason.—(*G. F. Shaw, United States.*)
7671. SLIDING TAB for BOOTS and SHOES, J. Meredith, Coventry.
7672. CLEANING the RAILS of TRAMWAYS, A. Dickinson, Birmingham.
7673. INFANTS' FEEDING BOTTLES, W. Brown, Glasgow.
7674. CEMENT, H. Mathey, London.
7675. CEMENT, H. Mathey, London.
7676. COLOURING CEMENT, H. Mathey, London.
7677. BATTING GLOVES, R. F. J. C. Allen, London.
7678. RECEPTACLE for MATCHES, &c., W. E. Richardson, London.
7679. MEASURING the FLOW of WATER in PIPES, G. F. Deacon, Liverpool.
7680. CHAIR SEAT, A. Bruckner, London.
7681. WATER CIRCULATING FIRE-GRATES, J. J. Cam, London.
7682. APPARATUS for CHECKING the RECEIPTS of MONEY, S. Carhart, London.
7683. WEATHER BAR for DOORS and WINDOWS, J. Fawcett, London.
7684. CONNECTING KNOBS to SPINDLES, I. Wall, London.
7685. PERCUSSIVE MACHINERY, &c., J. S. McCoy, London.
7686. LAMPS, F. L. V. Di Marzo, London.
7687. HARMONICAS, A. P. S. Jones, London.
7688. INJECTORS, J. Thiry and G. Chantrenne-Soiron, London.
7689. METALLIC BUOYS, SUBMARINE MINES, &c, H. Lane, London.
7690. ENGINES, C. D. Alexander, London.
7691. STRAIGHTENING METALLIC RAILS, W. P. Thompson.—(*A. J Gustin, United States.*)
7692. TANNING, W. P. Thompson.—(*J. W. Fries, United States.*)
7693. HARVESTERS, W. P. Thompson.—(*C. H. McCormick, jun., United States.*)
7694. BEATING or PULPING MACHINERY, W. Hull and W. B. Walker, Liverpool.
7695. SELF-ACTING CAR COUPLERS, A. J. Boult.—(*T. Davies, Canada.*)
7696. CIRCULAR KNITTING MACHINES, A. J. Boult.—(*G. Davidson and W. W. Clay, Canada.*)
7697. AUTOMATIC CAR COUPLERS, A. J. Boult.—(*W. H. Burkholder, Canada.*)
7698. HORSE COLLARS, A. J. Boult.—(*T. G. Gillespie, Canada.*)
7699. MACHINES for NUMBERING or MARKING PAPER, A. J. Boult.—(*J. R. Carter, Canada.*)
7700. ROTARY ENGINES, J. H. Darragh, London.
7701. CONSTRUCTION of BOILER SHELLS, A. J. Boult.—(*J. B. Prudhon, France.*)
7702. ATTACHABLE SEASON TICKET, A. F. Stokes and W. Davison London.
7703. TORPEDOES, A. Lège, London.
7704. DYNAMO-ELECTRIC MACHINES, E. J. Houghton, London.
7705. LOCKING the HANDLES of GAS RETORT COVERS or LIDS, J. Bartle, London.
7706. GAS PURIFIER CENTRE-VALVES, H. Cockey and F. C. Cockey, London.
7707. REGULATING PRESSURE in STEAM BOILERS, H. H. Lake.—(*H. M. Bigelow, United States.*)
7708. DRAINING of DWELLING-HOUSES, H. H. Lake.—(*H. C Lowrie, United States.*)
7709. DRIVING NAILS in BOOTS and SHOES, H. H. Lake. —(*O. R Chaplain, M. J. Flynn, and G. E. Parker, United States.*)
7710. SPOOLS or BOBINS for YARN, &c., H. H. Lake.— (*G. O. Boynton, United States.*)
7711. FIRE-EXTINGUISHING APPARATUS, J. Sinclair, London.
7712. WINDOW FASTENER, H. H. Denne, London.
7713. CONNECTING ENGINES to DEEP WELL PUMPS, H. Davey, London.

June 9th, 1886.

7714. COLLAPSIBLE and FOLDING-UP PERAMBULATOR, J. E. Fitzgerald and J. Nutter, Irlam.
7715. STEEL SLEEPERS, H. Bean, Wellingborough.
7716. STOPPERING of BOTTLES, J. Greaves, Oldham.
7717. MUSICAL, HUMMING, &c. TOPS, J. H. Sambrook, Manchester.
7718. SECURING TEETH of RAKES, F. H. Keane, Waterford.
7719. CALENDER or DELIVERY ROLLERS of GILL-BOXES, W. Terry and W. Batty, Halifax.
7720. TOBACCO PIPES, &c., M. Pogson and S. Pulman, Manchester.
7721. INTERMEDIATE or COUNTER-SHAFTS, G. Weston, Sheffield.
7722. METAL COMBINATION JOINT for TRIPOD STANDS, G. Roberts and A. Roberts, Birmingham.
7723. EYE of NEEDLES, R. W. Thompson, Newcastle-on-Tyne.
7724. ORTHOPTIC, T. Bennett, Devonshire.
7725. COMBINED BROOCH and FLOWER HOLDER, J. Richards, F. Jenkins, and S. Jenkins. Birmingham.
7726. TRAPPING and VENTILATING WATER-CLOSETS, J. Horrocks, Southport.
7727. CATCHING the DRIPPINGS from TREACLE, &c, CISTERNS, W. Parnall, Bristol.
7728. FOLDING &c., CHAIRS, A. Barr, Glasgow.
7729. ATTACHING NON-CONDUCTORS to the HANDLES of TEAPOTS, J. Brooke, Sheffield.
7730. TREATMENT of SEWAGE, G. V. Alsing, Sheffield.
7731. BICYCLES, J. Aylward, Coventry.
7732. WASHING or CLEANSING PASTE, A. Potts, Sheffield.

7733. MANUFACTURING GAS from BENZOLINE &c., T. Drake, Huddersfield.
7734. SOLITAIRE or FASTENING for DRESSES, &c., C. A. McCalla, Birmingham.
7735. TREATING SILK and SILKEY RAGS, W. M. Archer and J. Archer, Wakefield.
7736. INDUCTION TELEPHONIC REPEATERS, S. F. Shelbourne, New York, U.S.
7737. ELECTRIC ARC LAMPS, H. Moehring, London.
7738. TYPE-DISTRIBUTING MACHINE, H. C. Leland, London.
7739. CANDLE, &c., LAMPS, J. S. Browne, London.
7740. COMBINATION LADDER and FIRE-ESCAPE, G. T. Neville, London.
7741. BUTTONS, C. Seel, Barmen.
7742. LAWN-TENNIS POLES, J. C. P. Aldous, London.
7743. TANNING LIGHT HIDES or SKINS, E. P. Nesbit, London.
7744. TANNING, E. P. Nesbit, London.
7745. COMPOSITION for ARTIFICIAL STONE, &c., H. Poole, London.
7746. CIRCULATING and AIR PUMPS, W. J. Davy, London.
7747. EXPANDING TUBULAR CONNECTIONS in SECTIONAL STEAM GENERATORS, C. A. Knight, Glasgow.
7748. LIGHTNING GUARDS, A. R. Bennett, Glasgow.
7749. TELEPHONIC SWITCHING APPARATUS, A. R. Bennett and C. G. Wright, Glasgow.
7750. TOOLS, J. G. Hudson.—(*L. W. Sharp, Jamaica.*)
7751. DISTANCE INDICATOR for CABS, G. B. Smith, Birmingham.
7752. STEAM GENERATORS, W. Schmidt, London.
7753. MACHINERY for WEIGHING GRAIN, W. A. and C. H. Peters, Liverpool.
7754. URINALS, F. M. Parkes, London.
7755. INJECTOR for FEEDING FURNACES, J. Holden, London.
7756. APPLYING CAPSULES to BOTTLES, H. H. Lake.—(*J. Nicloz and L. Merckling, France.*)
7757. PROPULSION of TRAM-CARS, C. Reeve, London.
7758. DRILL for BORING METALS, C. Tennett, Bradford.
7759. STOPPERING BOTTLES, C. Conti, London.
7760. SELF-LIGHTING GAS BURNERS, G. A. Sweetser, London.
7761. FURNACE FITTINGS for FORCED DRAUGHT, J. Allison and A. Thomson, London.
7762. CALCINATION of PORTLAND CEMENT, H. R. Snelgrove, London.
7763. WHEELS, &c., A. M. Rogers and G. H. Rayner, London.
7764. LETTERPRESS PRINTING MACHINES, H. Bolton, London.
7765. BOXES for SCENT BOTTLES, G. W. Betjemann and C. Ashby, London.
7766. SAFETY MINING LAMPS, The Stanhope Company and W. Kneen, London.
7767. MUSICAL BOXES, G. F. Bentner and A. A. Lateulère, London.
7768. TAPS for GAS and other FLUIDS, A. Paget, London.
7769. COUPLING for GAS PIPES, G. Smith, London.
7770. PRODUCING INTENSE HEAT by GAS, J. Dredge, London.

10th June, 1886.

7771. CHRISTMAS, &c., SHOW CARDS, M. Krause, Berlin.
7772. QUICKLY CALCULATING COAL CONSUMPTION, W. Phillips, London.
7773. WOVEN FABRICS, J. S. Park, J. W. Lomax, and T. L. Wall, jun., Leyland.
7774. BRAKE for RAILWAY VEHICLES, R. C. Sayer, Newport.
7775. AUTOMATIC SINGLE CHAIN GRABS, A. Musker, Newcastle-on-Tyne.
7776. FURNACES of STEAM BOILERS, R. Chapman and T. L. Murray, Bradford.
7777. PRESERVING IRON and STEEL STRUCTURES from OXIDATION, W. Briggs, Arbroath.
7778. BOILERS, R. W. Hewett, Birmingham.
7779. LEGGINGS or GAITERS, G. Beattie, Glasgow.
7780. DISTANCE and FARE-INDICATING APPARATUS, R. Howarth, C. H. Perkins, and T. R. White, London.
7781. RATCHET BURNERS for OIL LAMPS, R. Wallwork, Manchester.
7782. HYDRAULIC ENGINES, W. Speight, Leeds.
7783. METALLIC BEDSTEADS, COTS, &c., R. G. V. van Avezathe, Erdington.
7784. LAMB KNITTING MACHINES, T. Gadd and J. C. Moore, Leicester.
7785. STUFFING, &c, HORSE SADDLES, R. A. F. A. Coyne, Edinburgh.
7786. METALLIC BEDSTEADS, J. and P. H. Middleton, Edinburgh.
7787. UNIQUE DUAL TOOTH BRUSHES, J. S. Crapper, Staffordshire.
7788. WRIST CUFF ADJUSTER and RETAINER, M. F. C. Baker, Birmingham.
7789. WATER-CLOSET APPARATUS or FITTINGS, W. Beames, Birmingham.
7790. SADDLERS' and SHOEMAKERS' AWLS and HANDLES, J. W. Clark and W. Ackland, Bristol.
7791. PRODUCTION of REEDS used in LOOMS, G. and E Ashworth, Manchester.
7792. FIXING RODS or BARS for CARPETS, &c., J. Toone, Leicester.
7793. HARVESTING MACHINES, J. Wild, Great Grimsby.
7794. COAL SAVERS, T. Redmayne, Sheffield.
7795. ELECTRIC LAMPS, H. N. Bickerton, Ashton-under-Lyne.
7796. DEOXODISING METALS, P. Jensen.—(*The Deoxidised Metal Company, United States.*)
7797. GLAZING APPLICABLE for FIXING SHEETS of METAL, &c., C. F. Elliott, Liverpool.
7798. MANUFACTURE of CRATES, W. Gill and J. Titley, Birmingham.
7799. SHARPENING RAZORS, A. Gerard, London.
7800. CUTTING RAGS, G. F. Busbridge and J. H. Turvey, London.
7801. SALICYLIC ACID, J. Y. Johnson.—(*F. von Heyden, Germany.*)
7802. STEAM INJECTORS, F. G. Fleury, London.
7803. AUTOMATIC RAILWAY COUPLING, H. G. Atkins, London.
7804. KNITTING MACHINES, N. Browne.—(*H. Stärker, Saxony.*)
7805. OPENING GLASS BALL STOPPERED BOTTLES, A. and H. Elliott, London.
7806. PRODUCING INTERMITTENT ELECTRIC LIGHT, P. Jensen.—(*K. Pollak and G. Wehr, Germany.*)
7807. ARTIFICIAL BAIT for ANGLING, &c., H. Livesey, London.
7808. COMBINED INVALID BED-LIFT, COUCH, and CHAIR, F. E. Mohr, London.
7809. SINGLE RAIL ELEVATED RAILWAYS, F. B. Behr.—(*C. F. M. T. Lartigue, France.*)
7810. LOCOMOTIVES for SINGLE RAIL ELEVATED RAILWAYS, F. B. Behr.—(*A. Mallet, France.*)
7811. LIFTS, H. J. Haddan.—(*C. Heyer, Prussia.*)
7812. HAY-MAKERS, E. C. Blackstone, London.
7813. SLEEPERS for RAILWAYS, T. Wrightson and J. MacKenzie, London.
7814. SLIDING WINDOWS of RAILWAY DOORS, W. L. B. Hinde, London.
7815. FOOD for DOGS, &c., G. Porter, London.
7816. ROTARY ENGINE, J. C. Mewburn.—(*C. E. Romanet, France.*)
7817. FIRE KINDLER, W. A. S. Thompson.—(*G. R. Davis, United States.*)
7818. APPARATUS for EXHIBITING ADVERTISEMENTS, L. Tampier, London.

11th June, 1886.

819. IRON for the USE of TAILORS, &c., J. Umbach, London.
7820. DETECTING, &c., DEFECTIVE EYESIGHT, J. J. Wood, Liverpool.
7821. PUMPING LIQUIDS, J. Murrie, Glasgow.
7822. BURGLAR ALARM and SAFETY LOCK, W. Eckersall, Illinois, U.S.
7823. TONE of BANJOS, J. Clamp, Newcastle-upon-Tyne.
7824. CARD-BOARD or WOOD BOXES, J. Magill, Manchester.
7825. STEAM ENGINES, R. Richardson and S. Alley, Glasgow.
7826. MOULDS for CASTING GUTTERS, &c., W. T. Mitchell, Glasgow.
7827. COOKING RANGES, J. McI. Shaw, Glasgow.
7828. STOPPERS for BOTTLES, T. J. Baker, Birmingham.
7829. MARKING BILLIARD SCORES, &c., H. A. Frost, Sunderland.
7830. SOCK for BOOTS and SHOES, T. Barker, Halifax.
7831. MULTIPLE WOVEN FABRIC, W. and J. Terry and F. Rawnsley, Halifax.
7832. EXTERNAL STOPPERS for BOTTLES, B. Morris, Halifax.
7833. FACILITATING MUSICAL EDUCATION, A. A. Ackerman, London.
7834. HARMONIOUS COLOURING, C. H. Wilkinson, Manchester.
7835. WATCH-KEY, J. Darling, Glasgow.
7836. BOILING EGGS, P. Jensen.—(*D. G. Martens, Norway.*)
7837. NAVIGABLE BALLOONS, E. N. Molesworth-Hepworth, Manchester.
7838. CLEANER for TOBACCO PIPES, &c., J. T. Burman, London.
7839. PLANT TUB, D. J. Northwood and T. C. Olney, London.
7840. WINDING, &c., KEYLESS WATCHES, T. Bassnett, Birmingham.
7841. DYEING TEXTILE FABRICS, T. Holliday, London.
7842. FOOD COMPOUND, H. W. Hart, London.
7843. WEIGHING MACHINES, W. Yates, Gorton.
7844. OIL-CAN, T. H. Hawley and E. Jackson, Malton.
7845. BUTTONS, C. Gillett, J. H. Lindsey, and H. R. Viggers, Portsmouth.
7846. BICYCLES, H. Haszkerl, Tooting.
7847. VALVE MOTION of ROCK DRILLS, D. Donald, Penryn.
7848. SECONDARY BATTERIES, C. Smith, London.
7849. VAPOUR GENERATORS, &c., J. Murrie, Glasgow.
7850. REGULATING SUPPLY of COMPRESSED GAS, E. G. B. Barlow and C. W. Poole, London.
7851. TRANSMITTERS, &c., for TELEPHONES, J. Fraser, London.
7852. MULTIPLE GEAR for CYCLES, X. Hutterer, London.
7853. COMBINATION TENT and EXCAVATORS, C. Howe, Colchester.
7854. TEA ROLLING MACHINE, W. Gallon, London.
7855. INJECTOR APPARATUS, P. Tarbutt, London.
7856. FIXING RAIL CHAIRS to METALLIC SLEEPERS, L. Sterne, London.
7857. LOCK STITCH SEWING MACHINE, P. J. L. Onfray, London.
7858. RICK COVERS, &c., H. T. James, London.
7859. EVAPORATING WASTE LYES, &c., B. Dawson, London.
7860. DYNAMO-ELECTRIC MACHINES, S. P. Thompson, London.
7861. TREATING INNOCUOUS LIQUID RESIDUALS, &c, M. Schwab, London.
7862. COCOA and CHOCOLATE, G. Grout, London.
7863. HOISTING HEAVY BODIES, P. Hoppe, London.
7864. CONVEYORS for GRAIN, J. Schlesinger.—(*G. A. Gilbert and R. Wilcox, United States.*)
7865. APPLYING CAPSULES to BOTTLES, M. Prokasky, London.
7866. DOOR BOLTS, J. Banks, London.
7867. PERMANENT WAY of RAILWAYS, J. Somerset, London.
7868. PRODUCING GAS from COAL, &c., G. A. Biddel, London.
7869. HORSE HOES, J. P. Goss and F. Savage, London.
7870. PERMANENT WAY of RAILWAYS, A. M. Clark.—(*A. Chappée, France.*)
7871. PERAMBULATORS, A. M. Clark.—(*W. England, United States.*)
7872. COMBINED BROOCH and COLLAR FASTENER, W. Rohde, London.
7873. TWO-WHEELED VEHICLES, J. Y. Johnson.—(*M. Guset, France.*)
7874. TOBACCO-PIPES, L. F. D. Saget, London.
7875. CLOCK FACES, R. W. Papineau, London.
7876. OBTAINING CIRCULAR from RECIPROCATING MOTION, &c., M. Heslop, London.

12th June, 1886.

7877. WINDOW-SASH FASTENER, J. Peace, Sheffield.
7878. NOTCHED BLOCKS for BUILDING WALLS DOWNWARDS, S. Harrison, Ripon.
7879. LATHES, C. L. Clarke, Manchester.
7880. WATER-WASTE PREVENTING, &c., CISTERNS, J. Armstrong, London.
7881. KEEPING the MOUTH of a PERSON OPEN DURING any OPERATION on the MOUTH or THROAT, J. S. Tayler, Grimsby.
7882. CORRUGATED WATER SUPPLY PIPES, C. Coutts, Barrow-in-Furness.
7883. CARTRIDGES for ORDNANCE, G. Quick, Chipping Campden.
7884. OUTLETS for VENTILATORS, &c., T. G. Normanton and S. E. Major, Barrow-in-Furness.
7885. COMBINED SURFACE and JET CONDENSER for STEAM ENGINES, A. B. Wilson, Holywood.
7886. ENGINES, G. A. C. Bremme, Liverpool.
7887. SURIA VANSA NOTEPAPER all in ONE, and in FIVE DISTINCT USES, S. C. Paul, London.
7888. CEMENT, F. W. S. Stokes, London.
7889. SYRINGES, G. F. Dimmack, Birmingham.
7890. ROPE-DRIVING ARRANGEMENT for CRANES, G. Russell, Motherwell.
7891. CONSTRUCTING FOUNDATIONS for WEIRS, &c., R. J. H. Saunders, Herne Bay.
7892. METALLIC BOXES, &c, W. and C. Crawford, Glasgow.
7893. LIFTING or MOVING HEAVY OBJECTS, H. Büssing, London.
7894. DEVICE for CLOSING BOXES, &c., R. Berkowitz, London.
7895. CAMP BEDSTEAD, W. R. Olivey, London.
7896. WINDOW TAPPING, J. Blake, London.
7897. CRANKS for VELOCIPEDES, &c., S. C. Maguire, London.
7898. SHOWING the QUANTITY of LIQUID CONTAINED in a CASK, &c., J. Fottrell, London.
7899. GUN CARRIAGES, J. Formby, London.
7900. BRACKETS for CORNICE POLES, C. F. Grimmett and J. Cook, Birmingham.
7901. CONVERTIBLE SCHOOL DESKS, H. and S. Addison, Birmingham.
7902. BOILER SHELLS, &c., R. J. White, London.
7903. OBTAINING PRODUCTS from ESSENCE of BIRCH BARK, &c., W. L. Wise.—(*E Mourlot, France.*)
7904. WATERPROOFING and SIZING PAPER, &c., C. Weygang, London.
7905. SECTIONAL WARPING and BEAMING MACHINES, J. H. Stott, Manchester.
7906. SADDLES, A. J. Wheeler, London.
7907. BICYCLES, M. Knowles, London.
7908. WRITING TABLE, W. S. Corris. Liverpool.
7909. DIVIDED BOTTLES, J. Ellis, Kingston-upon-Hull.
7910. AZO-DYEING STUFFS, W. E. Gredge.—(*Messrs. Ewer and Pick, Germany.*)
7911. AMMUNITION, J. Rigby, London.
7912. LOOMS, C. D. Abel.—(*The Flachstuch Gesellschaft, Germany.*)
7913. COUPLING ENGINES and DYNAMOS, R. C. Parsons, London.
7914. SPRING FASTENING for GLOVES, P. A. Raymond, London.
7915. UMBRELLAS, B. Cox, London.
7916. MECHANICAL TELEPHONES, F. J. Mudford, London.
7917. ROSIN, H. F. A. Prinzhorn, London.
7918. MOTIVE-POWER PUMPING ENGINES, D. Johnston, Glasgow.
7919. INCANDESCENT ELECTRIC LAMPS, R. Kennedy and R. Dick, Glasgow.
7920. APPARATUS for GETTING COAL, H. Johnson, Birmingham.—*7th May*, 1886.
7921. LAYING WOOD PAVING, G. Walker, London.
7922. REGULATING the PRESSURE of GAS, &c., J. Dery, London.
7923. RECEPTACLE for COINS, F. L. Harford, London.
7924. CLEANING DECKS and FLOORS, J. J. Carpenter, London.
7925. LOWER FRAMES of LAMPS, T. Heron, London.
7926. EDGES to HANDKERCHIEFS, W. C. Pownall, London.
7927. TREATING WOVEN FABRICS, A. M. Clarke.—(*L. P. Audouard, France.*)
7928. KEYBOARDS for MUSICAL INSTRUMENTS, A. M. Clark.—(*S. Stewart, United States.*)
7929. MACHINERY for WORKING HEAVY GUNS, A. Noble and R. T. Brankston, London.
7930. SCULLING BOATS, A. S. Hardingham, London.
7931. FIRE-ESCAPE, A. Cabanel, London.
7932. CAP for PROTECTING BOLT HEADS, A. B. Perkins, Bradford.
7933. CARRIAGES, &c., G. Hagborg.—(*O. A. Ericsson, Sweden.*)
7934. LASTS for BOOTS, H. H. Lake.—(*A. H. Pareau, Holland.*)

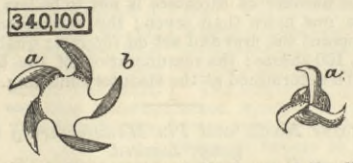
SELECTED AMERICAN PATENTS.

(*From the United States' Patent Office official Gazette.*)

340 100. BORING AND ROUTING BIT, *Truman D. Cook, Topeka, Kans.—Filed July 10th*, 1885.

Claim.—A boring and routing bit constructed with two or more equidistant lateral lips, *a*, with cutting edges *b*, the lips terminating at the working end of the bit in cutting edges extending in the same plane to and meeting at the centre or axis of the bit, or

340,100

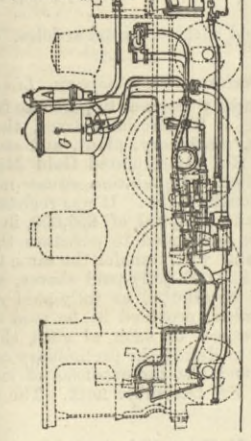


extending only to or near to the bases of the lips *a*, and slightly but uniformly receding toward these bases from the plane of the terminal circumference of the bit, the whole being constructed substantially as and for the purpose hereinbefore described.

340,222. FEEDING LOCOMOTIVES WITH HOT WATER, *Alexandre Lencauchez, Paris, France.—Filed March 5th*, 1886.

Claim.—The combination, with the engine boiler, the engine exhaust pipe, and the cold water pump, of a steam purifier for extracting the grease from the exhaust steam of the engine, a feed-water heater into which is introduced the cold water supplied by the said pump, and into which the exhaust steam is delivered after passing through the said purifier, and a hot water pump for delivering to the boiler from the said heater the hot water resulting from the mixture of cold water and exhaust steam in the said

340,222

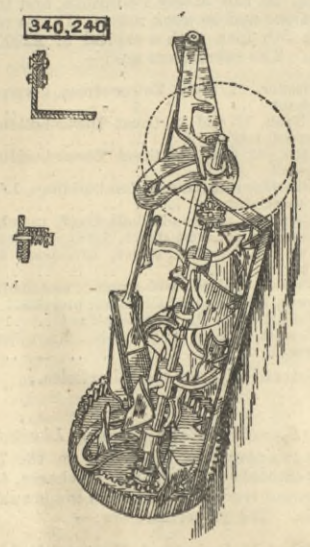


heater, substantially as herein described. The feed-water heater consisting of the combination of the casing G, the contained cylinder composed of a series of ferrules H, having side openings P, the pans I, having central overflow, the interposed pans J, with overflow at the outer margins, the feed pipe L, passing through said cylinder and pans, the exhaust steam pipe *e*, entering said casing below said cylinders and pans, the central pipe M, within the feed pipe, and double safety valve T U, all substantially as herein described.

340,240. LAWN MOWER, *Thomas J. Perrin, Springfield, Ohio.—Filed July 31st*, 1885.

Claim.—(1) The knives made in the triangular or spear-head form, convex on their outer faces from point to heel, and with their cutting edges bent outward, adapting them to be ground on their outer faces, substantially as described. (2) The combination of the triangular or flattened spear-head-shaped cutters with the shaft rotating on a horizontal axis, and a fixed or stationary blade or cutter, substantially as described. (3) The side bars of the main frame, provided with the slotted standards adapted to be adjusted

340,240

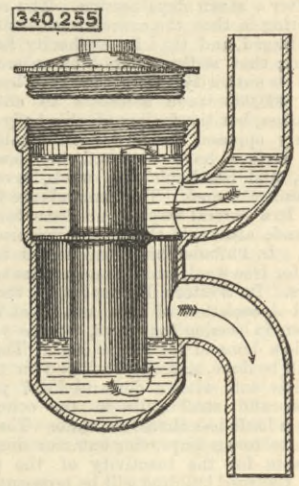


on the drive wheel axle or axle blocks, as described, in combination with the forked lever arms, and means for holding said arms and the frame bars and axle at the desired relative adjustment, substantially as described. (4) The combination of the main frame, the stud axles secured thereto, the forked lever arms for setting and holding the frame and axles at the desired relative adjustment, the rotating cutting shaft mounted in bearings in said frame, and the adjustable stationary cutter secured to said frame, all arranged and operating substantially as described. (5) The stationary cutter or ledger plate provided with the curved tapering fingers, in combination with the curved and rotating spear-head cutters, substantially as described.

340 255. SEWER-GAS AND STENCH TRAP, *Thomas Shehan, Cleveland, Ohio.—Filed March 10th*, 1886.

Claim.—(1) The combination of the trap body, the inlet and outlet pipes, and the removable tubular section making a water-tight joint with the trap body at a point between the inlet and outlet pipes, and extended both above and below said joint far enough with reference to the inlet and outlet openings to hold a water seal at each of its ends, substantially as and for the purposes hereinbefore set forth. (2) The com-

340,255



bination of the trap body, the inlet and outlet pipes, the removable tubular section making a water-tight joint with the trap body at a point between the inlet and outlet pipes, and arranged, substantially as described, to hold a water seal in the trap, and a counterbalanced valve controlling the water passage in said tubular section, substantially as and for the purposes hereinbefore described.

340,291. EXPANDING MANDREL, *Herbert Cottrell, Newark, N. J.—Filed August 26th*, 1885.

Claim.—In an expanding mandrel, the combination, with a main stock, of a bearing piece loosely mounted thereon, a base piece supporting pendent rollers in radial openings in said base piece, said base piece being loosely connected with and having an independent

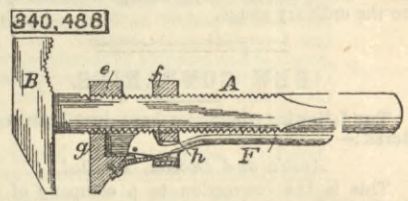
340,291

longitudinal and rotary movement on said bearing piece, a central core having a cone-shaped base, and means of imparting to said core a longitudinal and rotary movement, substantially as set forth and described.

340,488. WRENCH, *Lewis P. Croswell and Charles A. Funk, McLean, Ill.— Filed February 18th*, 1886.

Claim.—The combination, in a wrench, of the body A, having the rigid jaw B, and provided with teeth on its front and rear sides, of a movable jaw or casting D, mounted on said body below said rigid jaw, and

340,488

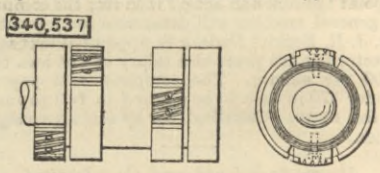


having the integral toothed portions *e f* and plain portions *g h*, and a spring cam head pivotted in said casting, and having teeth to engage the front teeth of the body, and a handle F for said cam head, substantially as set forth.

340,537. COMMUTATOR for DYNAMO-ELECTRIC MACHINES, *Thomas E. Adams, Cleveland, Ohio.—Filed December 5th*, 1885.

Claim.—(1) In combination with the metal plates of a commutator, insulating removable cut-out segments of hard gummy woods. (2) The combination, with the metal plates of a commutator, of the removable cut-out segments of lignum vitæ. (3) In combination with the metal plates of a commutator, the insulating cut-out segment provided with transverse grooves in its wearing surface. (4) In combination with the metal plate of a commutator, the insulating cut-out segments provided with transverse grooves cut diagonally to the axis of the commutator. (5) The com-

340,537

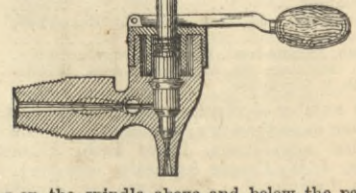


bination, with the metal plates of a commutator, of the removable cut-out segments provided with V-shaped grooves. (6) The combination, with the metal plates of a commutator, of the cut-out segments of insulating material tipped with refractory material at the end. (7) The combination, with the metal plates of a commutator, of insulating cut-out segments formed of wood, and having the end grain presented for wear.

340,582. GAUGE COCK, *T. Beverley Keim, Reading, Pa.—Filed February 16th*, 1886.

Claim.—In a gauge cock, the body having the passage *a b* therethrough and the valve spindle movable across the mouth of passage *a*, the conical bearings *d*

340,582



and *g* on the spindle above and below the passage respectively, and the corresponding seats in the body to receive the two bearings alternately.