A STRANGE FAILURE OF STEEL BOILERS.

By ARTHUR J. MAGINNIS, Memb. Inst. N.A.

SINCE the introduction of steel for marine boilers, much has been written and discussed about the peculiar behaviour of the material at various stages of its manufacture, and during the time boilers were being constructed; but, so far as the writer can learn, no similar experience to that about to be described has yet been brought forward, and as it presents a most serious feature, a full description and discussion on the facts may be the means of revealing yet another of the hidden secrets which have retarded the general adoption of this useful material.

The peculiarity of the steel boilers under consideration consisted in the fact that—(1) The material used for two different sets of boilers, each set consisting of three circular boilers with horizontal steam chests, passed all tests required by the Board of Trade and Lloyd's. (2) The material stood without the slightest defect the ordinary work of the boiler shop, including welding, &c. (3) Each set of boilers worked most satisfactorily at sea for a period of two and a-half years, after which they then exhibited signs that a complete change had taken place in the nature of the steel.

As may be seen by Figs. 1, 2, and 3, page 449, the design of the boilers was such as to give no reasons whatever for the strange behaviour of the material, being the ordinary double-ended circular type, with three plain welded furnaces opening into a separate chamber for the set of three at each end and having on top of each boiler an ordinary cylindrical receiver.

From the commencement of the working of these boilers the usual treatment was adopted, zinc being used in blocks of the Admiralty pattern, and special attention was given to careful scaling, especially of the backs of the combustion chamber, as, owing to experience gained on earlier iron boilers of the same construction, it was found that bulging was likely to occur if the scale was allowed to get more than a full sixteenth thick. The trade in which both steamers were engaged was the Transatlantic and Colonial, and it was when on the latter that the first signs of change were noticed. These commenced with an extensive crack in one of the combustion chamber plates on steamer No. 1, and as may be seen by Fig. 10, it was of serious extent, being about 2ft. 6in. long, $\frac{1}{8}$in. open at the bottom, and a bare $\frac{1}{16}$in. at the top, just before going into the rivet holes. The crack occurred spontaneously in the month of August, about three weeks after the boilers had been blown down, and at the time no work was being done, excepting the usual scaling.

The next strange occurrence was of a somewhat similar nature, but happened in steamer No. 2, when the boilers had just reached the same period of working as those on steamer No. 1. This extensive crack—which is shown in Fig. 6—was 2ft. 3in. long, and occurred in a corresponding plate in the combustion chamber to the first one, during the month of October, thirteen days after steam had been let down. The report was so loud as to almost deafen a boilermaker who was doing some work about the bridges in the chamber at the time.

Owing to this crack being similar to the first one, it was decided to test the other plates of the chamber by blows with a 7-lb. hammer, with the result that three of the other similar plates were cracked either vertically or horizontally as shown in Figs. 5, 7, and 8. Some of these cracks commenced at first by showing a peculiar black shade, about $\frac{1}{2}$in. broad, in the direction the crack was likely to occur, and after another blow a faint score, like a hair, became visible, which without any further blows could be seen gradually opening and extending, until fully developed; others cracked almost simultaneously with the blow, but none with the loud report of the originals. About this time also small cracks were found occasionally between the rivet holes of various landings, such as the furnace fronts and backs, saddle plates, &c.; so that it was evident something unusual was taking place, as, previous to this, no signs of brittleness had ever been found.

In the January and February following, the next crack occurred on steamer No. 2, when under steam on a long passage home from the colonies. It was first noticed at sea by the water flowing from the ashpit, and as no report was heard, or sudden leak took place, it was surmised that this crack had opened gradually, and salted up as it extended.

In the same February, in steamer No. 1, the most serious defect occurred, when lying in a colonial port a few days after steam had been let off, in the shape of an extensive circumferential crack in one of the wing furnaces. This crack, which is shown at A, Fig. 2, took place with a loud report before breakfast hour, and immediately under a lad who was sitting on the furnace scaling it. The report was so alarming as to cause word to be sent to the chief engineer that one of the boilers had exploded, although not under steam. As may be noticed, the crack commenced 4in. below the line of bars, extending upwards about 22in., and at a distance of 2ft. in from the boiler front.

Previous to receipt of this news a series of extensive tests which are given in the appendix had been made in the presence of a Board of Trade official on strips taken from the cracked portions of the plates which had been cut out of both vessels, but as may be seen from them, and also from the chemical tests which were made separately in the laboratory of one of the principal steel works, no definite signs of entire change in the material were discovered which would account for the cracks, or justify the more serious and costly step of removing the boilers, although brittle portions had been found here and there. It may also be noticed that the analyst reports of the steel, "that chemically speaking it is not at all objectionable, being a material of good average quality."

Another example of the peculiar behaviour of the material was experienced twice over, when testing the result of striking the cracked portions of the plates—Fig. 9—one side of the crack being held firmly, and the other struck by an ordinary sledge hammer, so as to endeavour to extend the crack. With one plate the first blow extended it about 4in.—Fig. 9—leaving only 2½in. more of solid plate; this remaining portion was then hammered flat down and again straightened, without in the least extending the crack. With the second plate the first blow extended the crack about 1in., and afterwards the plate was hammered flat down in line of the crack, then straightened and put flat on the other side without extending it in the smallest degree; on the other hand, the projecting piece of the same plate, which is shown shaded on Fig. 9, was struck one blow and snapped off like glass.

Another instance of the peculiar nature of the steel was found on the last voyage made with the boilers, and consisted of two bulges on the furnace crowns close to the back end, each bulge being about 6in. diameter and 1in. deep; the plates in the neighbourhood of these bulges showed no signs whatever of brittleness, even when they were put back, whereas numerous cracks were found between the rivet holes at each end, both prior to and after the putting back.

Owing to these occurrences it became a matter of serious consideration whether the boilers, or at least the interiors, must not be condemned, as these unaccountable cracks continued to occur, and also those between the rivet holes of the saddle, furnace, and other plates, and as no preceding cases of a similar kind could be found, considerable difficulty was experienced as to which was the best course to take—whether to replace the interiors only, or go for new boilers. After considerable discussion it was eventually decided to have new steel boilers, mainly owing to the action of the superintendent engineer, who gave it as his opinion that if new interiors were fitted they would have to be condemned soon afterwards with the boilers, as it was only a question of time until the boiler-shells and fronts would commence cracking in the same unaccountable way.

This opinion was shortly afterwards fully confirmed, when the work of breaking up the old boilers commenced, the results being most startling and of such interest as to bear an extended description. The first start was made by knocking off the rivet heads on the connecting pipes between the boilers and steam chest, but after a few blows it was discovered that the pipes were cracking in all directions, and to such an extent eventually that not one of the nine connecting pipes from No. 2 steamer came off whole; then after the chest had been removed from one boiler a portion of one of the pipe flanges was being wedged from the boiler, as shown in Fig. 14 when the shell plate suddenly cracked for about 10in. from the opening, although it was set by the wedge only about $\frac{1}{16}$in. in 5in. Soon after this, when the boiler shell was reached, one of the butt straps cracked almost right across between the rivet holes, although only set 3in. in 3ft., and later on, when the furnaces and front plates were started upon, a general smash was experienced, the front plates cracking and starring and the flanges breaking off, as shown by the lines on Fig. 1, the furnaces at the same time acting in just the same manner, and going through the rivet holes to such an extent as to allow the ends to come off whole, and so form hoops for the lads to play with in the meal hour, an opportunity which, it is needless to add, they quickly availed themselves of.

The last remarkable case to occur was that shown on Fig. 7, which happened to one of the upper shell plates, ¾in. thick. After the rivets had been cut out, the plate was turned over and allowed to fall upon the ground, with the result that the shock broke the plate across the centre, as shown at 1 1. The end without the hole was then placed hollow side up and a ton weight dropped upon it from a height of 7ft., this broke the plate again at 2 2 and 3 3, and also cracked the centre piece C where shown at 4 4. After this the plate B was then put on two wooden blocks, and at the second blow it broke across at 5 5, at the same time bending it considerably.

During the construction of the boilers no special means were adopted, the steel—which was made by the Bessemer process at the works of a well-known east-coast steel and iron company—working in a most satisfactory way, welding, flanging, and bending without the least trouble, the holes in the shell and other circular portions being drilled, and those in the straight landings punched, the furnaces, after being welded, were carefully annealed to the special instructions of the Board of Trade, the work throughout being regularly inspected by their surveyors and those of Lloyd's Registry, the material having also been periodically tested at the manufacturers by both these Boards.

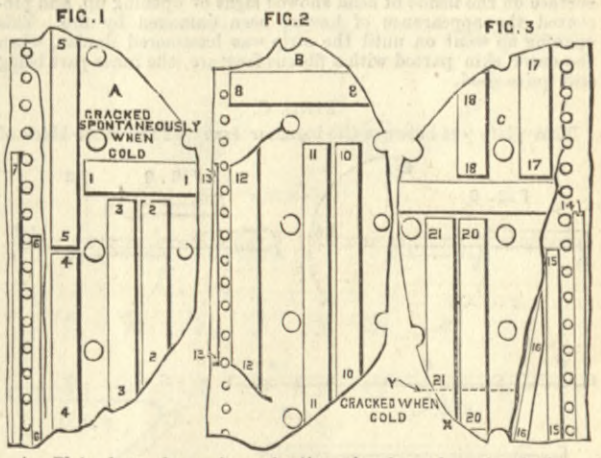
It will now be interesting to endeavour to obtain, if possible, some satisfactory reasons for the failure of these boilers, otherwise the unpleasant fact must be acknowledged, that it is yet possible for material to be put into boilers which after a time will become treacherous, notwithstanding the extensive tests and rigid inspections now made. But that mild steel has advanced beyond the tentative state is generally conceded, and the owners of these steamers, under advice from their builders and superintendent engineer, decided to again have steel boilers in lieu of those just described, although they had been put to great inconvenience and annoyance, which, together with the serious and unexpected cost, would but a few years ago have been the means of throwing almost insurmountable difficulties in the way of the general adoption of this valuable material, which may be looked upon as one of the highest achievements yet attained by engineering science in its endeavour "to adapt to the use and convenience of man the wondrous sources of power in nature."

APPENDIX.

Test of Plates before leaving Works.

Cast No.	Dimensions.	Area.	Stress in lbs.	Stress in lbs. per sq. in., and in tons.	Elongation in 10in.	Elongation per cent.	Remarks.
2738A	1·2 × ·41	·49	32500	66326 29·6 tons	2·025	20¼	Steam chest.
2741A	1·25 × ·41	·51	33000	64705 28·8 tons	2·	20	Do.
2542	1·25 × ·57	·71	41500	58450 26·08 tons	2½	25	Furnace comn.
2551	1·25 × ·55	·69	43000	62319 27·8 tons	2·	20	Do.
2660	1·62 × ·49	·79	48000	60759 27·1 tons	2·455	24½	Fire-box back.
2672A	1·2 × ·55	·66	38500	58332 26·04 tons	2·2	22	Fire-box bott'm
2561	1·76 × ·66	1·16	70500	60776 27·1 tons	2·3	23	Shell.
2431	1·13 × ·74	·83	52000	62600 27·9 tons	2·2	22	Do.
2333	1·22 × ·69	·84	51000	60714 27·1 tons	2·4	24	Front plate.
2720	1·22 × ·71	·87	55000	63218 28·2 tons	2·125	21·25	Do.
2696	1·25 × ·54	·68	41500	61029 27·2 tons	2·25	22·5	Furnace crown.
2576	1·25 × ·54	·68	42000	61735 27·5 tons	2·1	21	Do.
2697	1·25 × ·53	·66	40000	60606 27·05 tons	2·2	22	Do.
2777	1·24 × ·42	·52	32000	61538 27·49 tons	2·15	21½	Steam chest.
2782A	1·30 × ·53	·69	42000	60869 27·2 tons	2·6	26	Do. ends.
2655	1·30 × ·53	·69	44000	63768 28·46 tons	2·3	23	Do.
2782	1·25 × ·5	·630	41000	65079 29·05 tons	2·2	22	Do.
2657	1·3 × ·62	·81	49000	60483 27·0 tons	2·2	22	Do. neck.
2784	1·30 × ·62	·81	49000	60483 27·0 tons	2·6	26	Do.
2777	1·32 × ·51	·67	44500	66417 29·6 tons	1·975	19¾	Butt straps.
2788	1·3 × ·51	·66	40000	60605 27·05 tons	2·6	26	Do.
2772	1·25 × ·69	·86	56000	65116 29·06 tons	2·4	24	Shell.
2476	1·23 × ·74	·91	55500	60997 27·2 tons	2·1	21	Do.
2533	1·24 × ·74	·92	56000	60869 27·1 tons	2·7	27	Do.
2791	1·25 × ·73	·91	56000	61758 27·5 tons	2·3	23	Do.
2783	1·25 × ·59	·74	47000	63513 28·3 tons	2·4	24	Steam chest.
2753	1·23 × ·71	·87	53000	60919 27·2 tons	2·2	22	Shell.
2399	1·18 × ·714	·84	52000	61904 27·6 tons	2·15	21½	Do.
2736A	1·75 × ·45	·787	46500	59085 26·37 tons	2·5	25	Fire C. back.
No. 3	1·78 × ·645	1·15	69000	60000 26·7 tons	2·5	25	F. tube plate.
No. 2	1·8 × ·657	1·182	76000	64290 28·6 tons	2·05	20½	B. tube plate.
2741	1·75 × ·555	·971	57000	58702 26·2 tons	2·	20	Furnace.
No. 1	1·75 × ·725	1·27	85000	66929 29·8 tons	2·175	21¾	Shell end plate.
No. 4	1·75 × ·695	1·216	72000	59210 26·4 tons	2·4	24	F. tube plate.
2532	1·77 × ·522	·924	54500	58982 26·37 tons	2·05	20½	Furnace.
2418	1·8 × ·673	1·21	75000	61983 27·67 tons	2·5	25	F. tube plate.
2579	1·8 × ·633	1·14	71100	62368 27·83 tons	2·1	21	Do.
2356	1·8 × ·585	1·05	71500	68095 30·3 tons	2·3	23	End plate.
2739	1·82 × ·528	·96	56000	58333 26·03 tons	2·3	23	Furnace.
2727	1·82 × ·482	·877	56000	63854 28·28 tons	2·525	25¼	Fire-box back.

Plates cut from boilers of steamers Nos. 1 and 2. Diagram showing from what parts of plates the test strips were cut.



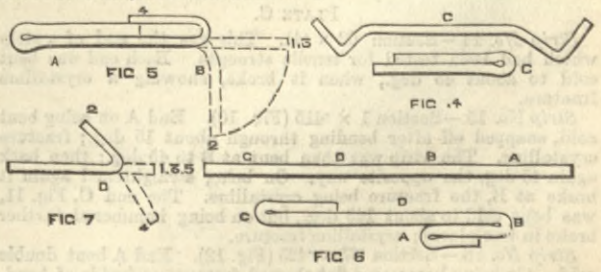
A.—Plate from forward combustion chamber of centre boiler of steamer No. 2. B.—Plate from after combustion chamber of starboard boiler of steamer No. 2. C.—Plate from forward combustion chamber of starboard boiler of steamer No. 1.

Bending Tests of Plates cut from Combustion Chambers of Steamers Nos. 1 and 2.

PLATE A.

Strip No. 3.—Section 2·25 × ·44 (Fig. 4). Bent cold to abou 90 deg. without fracture, but, on attempting to bring it back again fractured—fibrous—on the inside of bend. Both ends behaved exactly the same way. The strip was then bent double at the centre and hammed flat without sign of fracture.

Strip No. 4.—Section 2·28 × ·43 (Fig. 5). End A bent double—cold—about 1in. radius, and then hammered flat, without fracture. End B was bent 90 deg., then back the opposite way, and finally hammered flat, all without fracture.



Strip No. 7.—Section ·5 × ·415 (Fig. 6). End A bent cold round nose of anvil, at about 2¼in. diameter, until double, and then

hammered flat, all without fracture. The same end was then raised to a "black heat"—say 500 deg. Fah.—and bent in the same manner at B. It stood this until it was hammered quite flat, when it showed a slight sign of fracture at outer edge. The end C was then bent sharply round the square edge of the anvil, and then hammered flat without sign of fracture. The strip was then bent cold at D to about 100 deg., and then back again to 45 deg. the opposite way, and finally straightened out again. All of these tests it stood without the least sign of breaking anywhere.

Tests for Tensile Strength and Elongation of Plates cut from Combustion Chambers of Steamers Nos. 1 and 2.

	Ref. No.	Length between dabs. in.	Area of section.	Break load. Tons.	Break load per sq. in.	Elongation. Commencing. Per cent.	Elongation. Commencing. Tons.	Elongation. Final. Per cent.	Area of fracture.	Ratio of area contained original.	Remarks.
A	1	6	1 × ·435 = ·435	11·25	25·86*	3	8	15	—	—	* Broke across eye-hole with a section of ·408 (original).
	2	8	2·25 × ·44 = ·99	24	24·24	·375	17·75	24·5	·498	·503	Fibrous, silky fracture.
	5	8	2·187 × ·42 = ·9187	23·25	25·32	·5	10	22	·492	·535	Fibrous, silky, fine.
	6	8	·635 × ·415 = ·2842	7·25	25·5	2·25	5	17·25	·1388	·477	Fibrous, silky, fine.
B	8	4	·995 × ·45 = ·447	12	26·84	4	10	26	·214	·478	Fibrous, silky, fine.
	11	8	1·81 × ·45 = 1·026	27·5	26·8	1·25	20	26·75	·47	·46	Fibrous, silky, fine.
	3	6	·71 × ·43 = ·3053	7·75	25·38	1	5	8	·185	·6	Fibrous, silky, fine.
C	14	8	·62 × ·41 = ·254	11·75	46·2	·5	8	8	·216	·85	Fine crystalline. Slight flaw at point of fracture.
	17	4	1 × ·43 = ·43	20·45	47·5	12	16	7·75	—	—	Fine crystalline.
	19	4	1·15 × ·45 = ·5175	21	40·5	2	15	13	·292	·564	Fine crystalline.
	21	6	2·25 × ·45 = 1·012	47	46·44	·5	12·5	15	·818	·808	Fine crystalline.

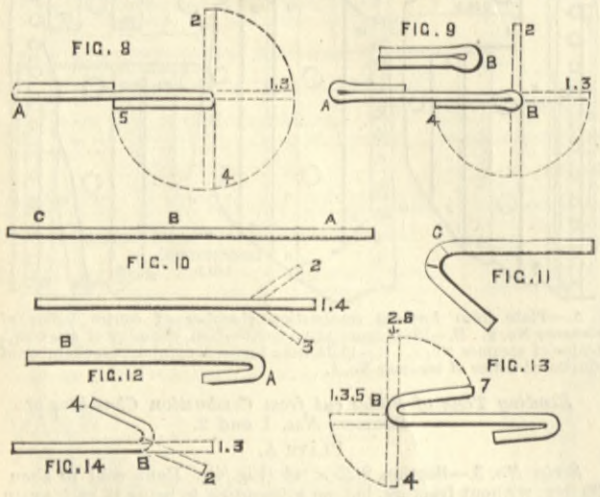
PLATE B.

Strip No. 10.—Section 2·031 × ·46 = ·934 (Fig. 8). End A cold bent double—1in. radius—and then hammered flat, without fracture. Other end bent 90 deg., then back the opposite way, and finally hammered flat, all without fracture.

Strip No. 12.—Section 2·25 × ·44 (Fig. 9). End A bent double cold—about 1in. radius—and then hammered flat, without fracture. End B was bent 90 deg., and then back. Finally it was hammered flat the opposite way. Between positions 2 and 3 the surface on the inside of bend showed signs of opening up, and presented the appearance of having been damaged by fire. This opening up went on until the strip was hammered double, when the outer skin parted with a fibrous fracture, the inner part being still quite good.

PLATE C.

This plate put between the hammer face and the anvil block of



the 10-cwt. hammer, with the corner *x* projecting over. After two or three blows with a striker's hammer the piece snapped off suddenly, showing a crystalline fracture. The plate was then allowed to project still farther over to *y*, and again struck. After about a dozen blows, by which the corner was bent about 45 deg., it also broke off, showing a similar fracture.

PLATE C.

Strip No. 14.—Section ·62 × ·41. This was the end of a strip which had been tested for tensile strength Each end was bent cold to about 45 deg., when it broke, showing a crystalline fracture.

Strip No. 15.—Section 1 × ·415 (Fig. 10). End A on being bent cold, snapped off after bending through about 15 deg.; fracture crystalline. The strip was then bent at B to 45 deg.; then back again 45 deg. the opposite way. On being straightened again it broke at B, the fracture being crystalline. The end C, Fig. 11, was bent cold to about 145 deg., but on being hammered further broke in two places; crystalline fracture.

Strip No. 16.—Section ·67 × ·425 (Fig. 12). End A bent double cold. On being hammered flat showed fracture on inside of bend. End B was bent 45 deg., and then straightened and bent 90 deg. in the opposite way. It was again straightened and bent back 180 deg. till nearly double, as shown in Fig. 13. On being hammered flat it broke, with a fine crystalline fracture.

Strip No. 18.—Section 1 × ·445. Bent at centre cold. Broke at 45 deg.; fine crystalline fracture.

Strip No. 20.—Section 2·29 × ·45 (Fig. 14). End A bent round to about 150 deg.; then broke suddenly; fine crystalline fracture. End B bent to 45 deg.; then straightened and bent the opposite way, breaking when bent about 145 deg., with a fine crystalline fracture.

Chemical Laboratory.

I. *Laboratory report.*—Portion of combustion chamber plate cut out of main boilers, steamer No. 1. Cracked spontaneously about three days after boilers had been blown down. The drillings gave on analysis the following results:—

	Per cent.
Carbon	·125
Silicon	·005
Manganese	·320
Sulphur	·051
Phosphorus	·060
Iron, 1 by diff.	99·449
	100·000

Chemically speaking, is not at all objectionable, being a material of good average quality.

II. *Laboratory report.*—Portion of back plate of combustion chamber cut from steamer No. 2. The drillings gave on analysis the following results:—

	Per cent.
Carbon	·175
Silicon	·018
Manganese	·370
Sulphur	·045
Phosphorus	·068
Iron	99·324
	100·0.0

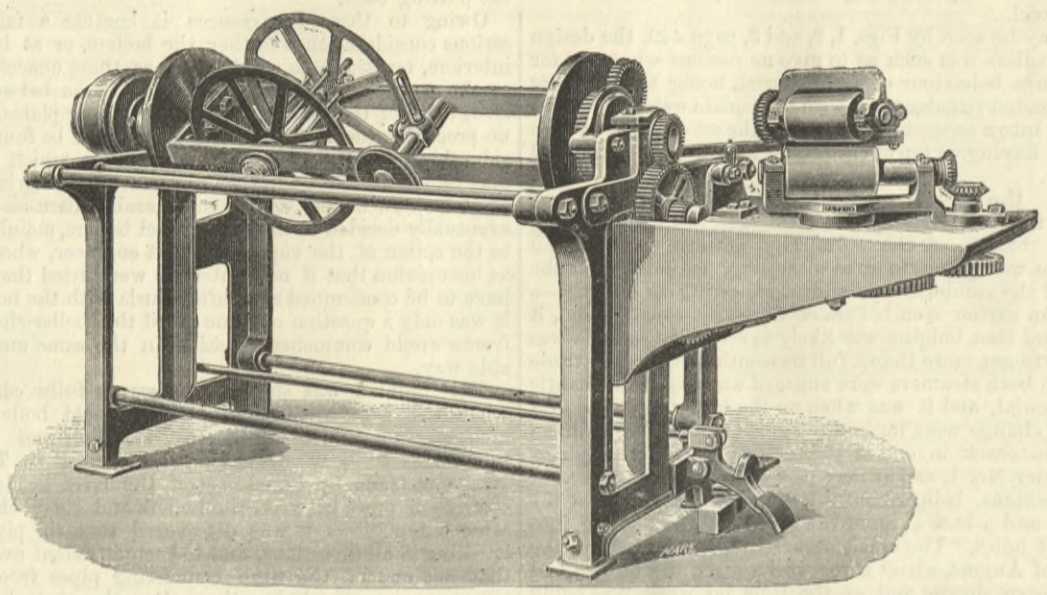
Material of good average quality, closely resembling portion No. I.

III. *Laboratory report.*—Portion of furnace plate cut from wing furnace of steamer No. 1. One side is side of spontaneous crack, which took place with loud report about four days after boilers were blown down. The drillings gave on analysis the following results:—

	Per cent.
Carbon	·125
Silicon	·018
Manganese	·530
Sulphur	·043
Phosphorus	·061
Iron (diff.)	99·223
	100·000

Quality very similar to portions I. and II.

FURNESS AND CO.'S TOBACCO SPINNING MACHINE.

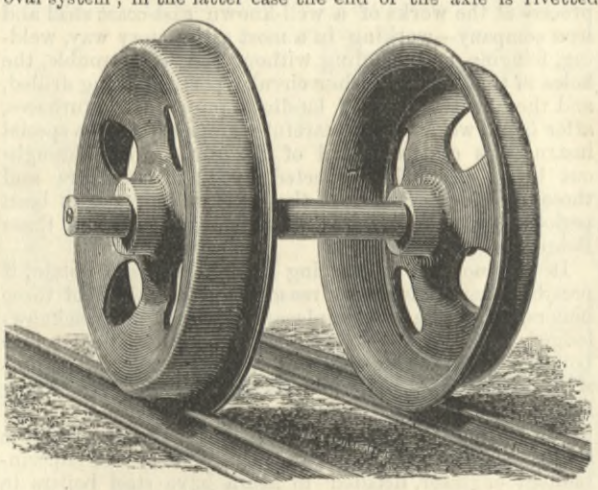


W. FURNESS AND CO.'S TOBACCO SPINNING MACHINE.

The machine illustrated is made by Messrs. W. Furness and Co., of Globe Works, Bankhall, Liverpool. It has been invented with the object of providing a machine equally adapted for thick or thin twist, and readily altered from one size to another. The principal novelty of this machine is the alteration of speed and angle to which the wrapping rollers may be changed, enabling the operator to use the covering leaf to the greatest advantage in the various sizes of twist; and all the motions being rotary, and not sliding, by means of segmental rollers and cams, the machine runs smoothly and at a quick speed, with the minimum of wear and tear. The twisting frame is light, evenly balanced, and has three rates of speed by means of a cone pulley. It can be instantly stopped or started by foot lever, which withdraws a clutch and automatically applies a brake. The coiling reels are quickly removed and replaced, and have a revolving motion given to them which can be instantly regulated by a delicately adjustable brake, just giving sufficient tension on the twisted tobacco. The working table is not shown in the engraving, as it would hide the mechanical details.

SOLID FORGED STEEL WHEELS.

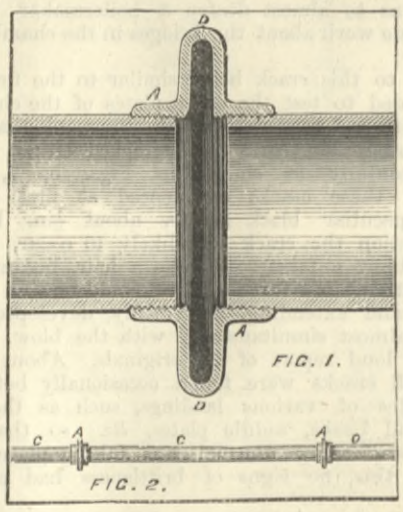
The accompanying engraving represents Eyre's new patent solid forged steel wheels made by Messrs. John Brown and Co., Atlas Steel and Iron Works, Sheffield. They are more especially made for collieries and tramways, and it need hardly be said secure absolute freedom from breakage. The wheels are made fast or loose, and also for inside or outside bearings. The bosses are solid, not welded on, the entire wheel being forged to shape out of a steel bloom. In fast wheels, the wheel may either be shrunk on the axle and keyed, or secured to the axle by Eyre's oval system; in the latter case the end of the axle is rivetted



over the boss. An accidental incident at a Scotch colliery recently showed the good qualities of these wheels. A train of wagons had been accidentally allowed to escape from the top of a steep incline, and when brought up with a bang at the bottom, the manager of the colliery says, "the whole affair had gone to pieces except your steel wheels which happened to be on some of the wagons. The wheels on all the other wagons—of the ordinary cast steel type—were broken and destroyed completely, while yours were not a bit the worse." Some tests of which the figures have been sent us prove these wheels to be remarkably strong.

EXPANSION COUPLING.

The engraving below, which we reproduce from the American *Sanitary Engineer*, shows a novel pipe coupling invented by Mr. Frederick E. Young, of Allegheny City, Pa., for use with iron or brass screwed pipe that is subject to slight changes of length by warming and cooling. It is formed from a single piece of elastic metal, which has a screw thread at each end and an annular outward corrugation A A of considerable depth at its centre midway



between its ends. The walls of the groove or corrugation are made nearly parallel, and of sufficient strength to withstand the twisting strain of screwing the ends of the pipes into it, but having sufficient elasticity to accommodate itself to lateral thrust sufficiently often not to be compressed or elongated beyond the limit of elasticity of the metal employed in its manufacture. Fig. 1 is a longitudinal section, and Fig. 2 shows the appearance when used with screwed pipe.

The Tower of London.—The pumping engines and accumulator which have hitherto worked the lifts and cranes in the military stores, and in the White Tower, are about to be removed, as it has been decided by the War-office to work them for the future from the mains of the London Hydraulic Power Company, and by which it is anticipated that a considerable economy in the cost of working will be effected.

Carron Science and Art Classes.—On Tuesday evening, the 24th ult., the prizes and certificates awarded by the Science and Art Department for the work done in the art classes, and the local prizes awarded for work done in the shorthand class last session, were presented in Carron Company's School at Carron, Falkirk, by T. D. Brodie, Esq., of Gairdoch, one of the partners of Carron Company. Mr. Brodie said that it was a very great pleasure to him and those connected with him to put their hands and their shoulders to the work of supporting the technical classes in connection with Carron Works. The Rev. John McLaren, chairman of Larbert School Board, then addressed some encouraging remarks to the scholars, in the course of which he said the present meeting was evidence that Carron Company had done a very wise thing in retaining the management of Carron School in its own hands, instead of handing it over to the School Board, and that it had not failed to provide for the education of its employés in advanced and special subjects, as well as in the more elementary subjects taught in the day-school.

CRACKED STEEL BOILERS.

(*For description see page 447*

FIG. 1

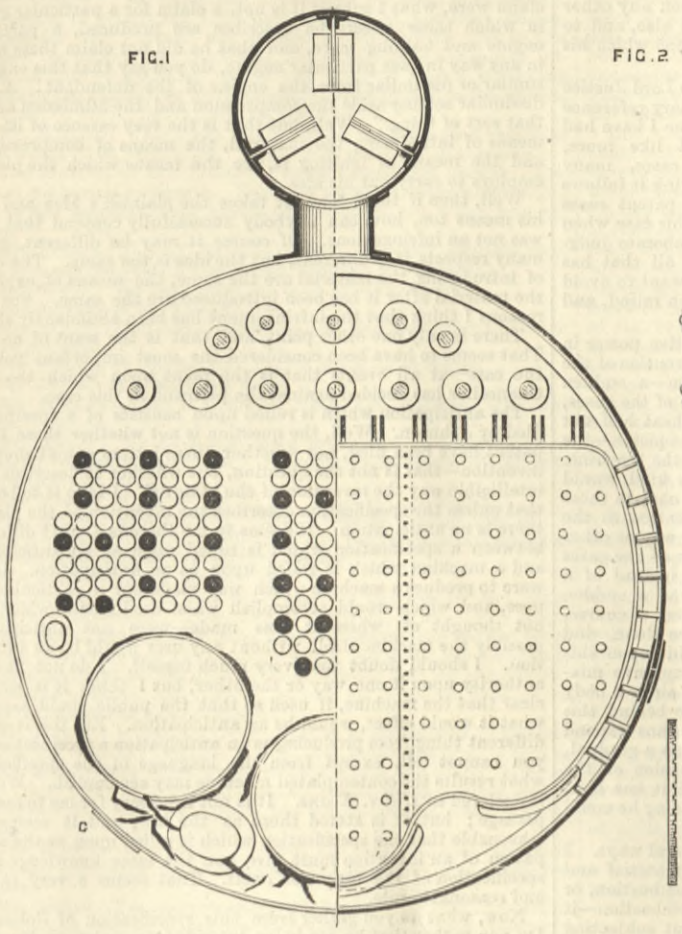


FIG. 2

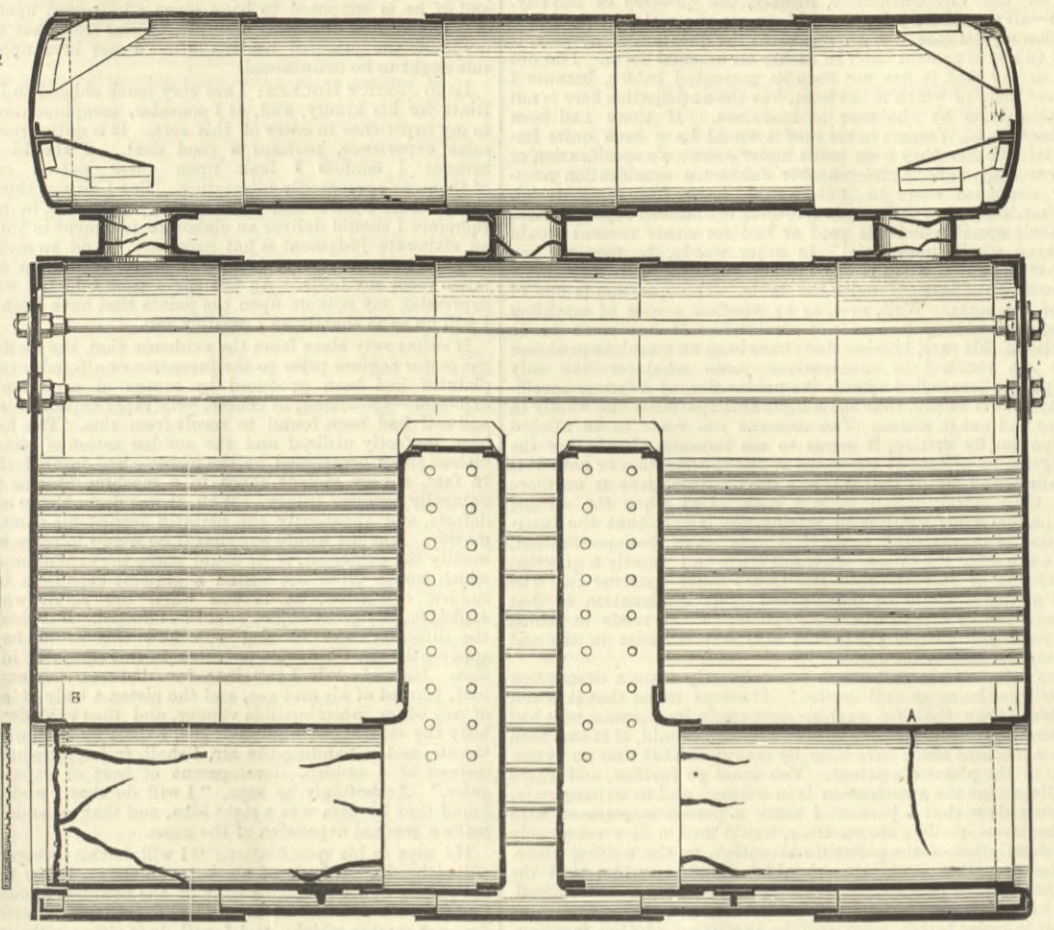


FIG. 3

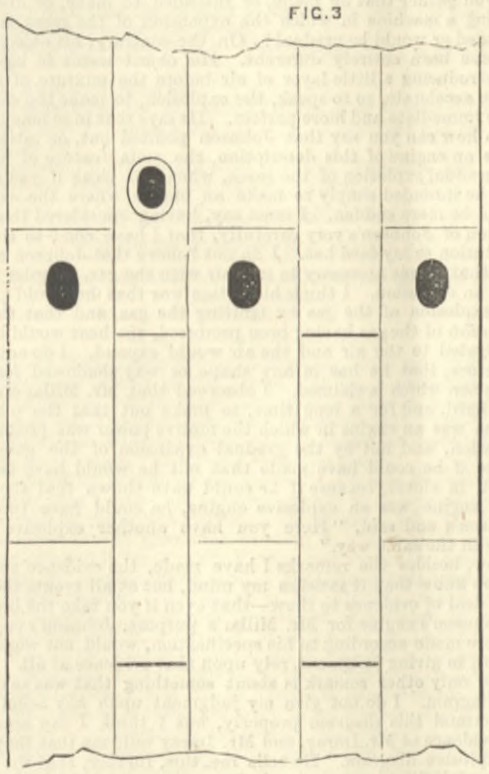


FIG. 4.

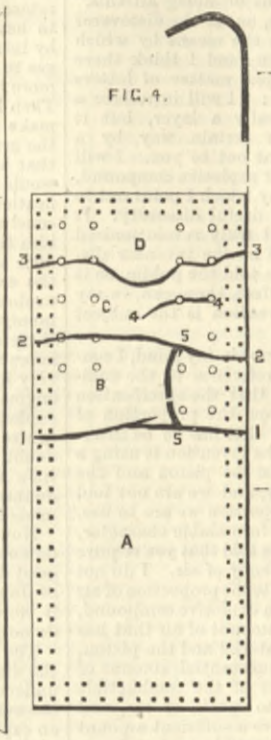


FIG. 5

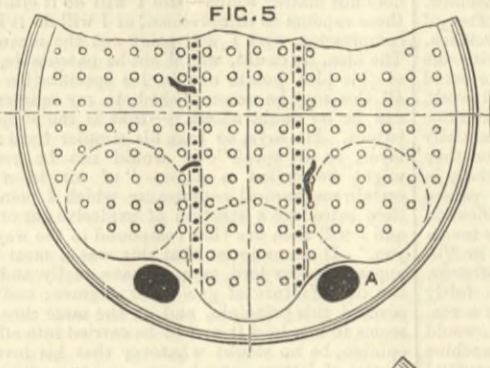


FIG. 6

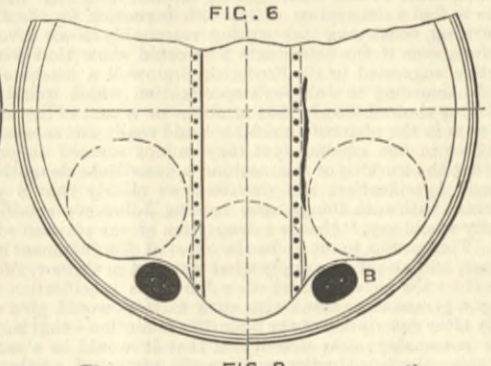


FIG. 7

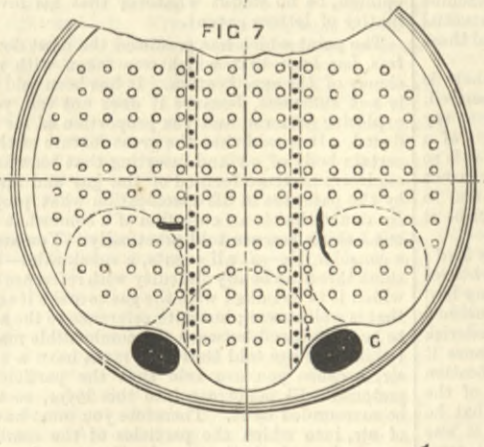


FIG. 8

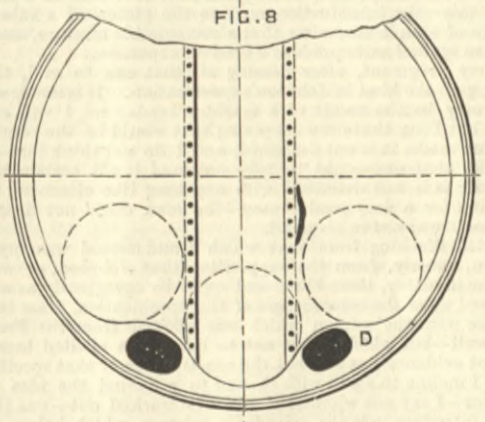


FIG. 9

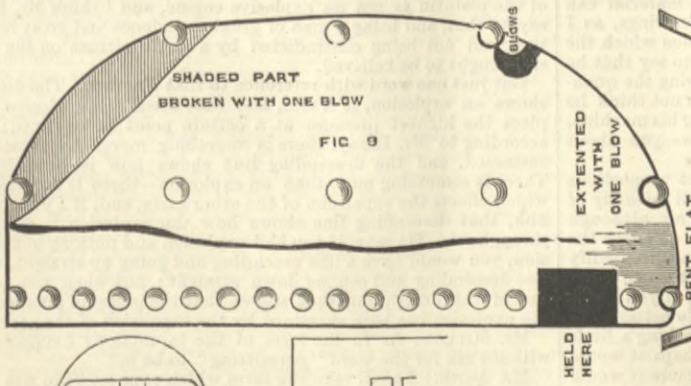


FIG. 10

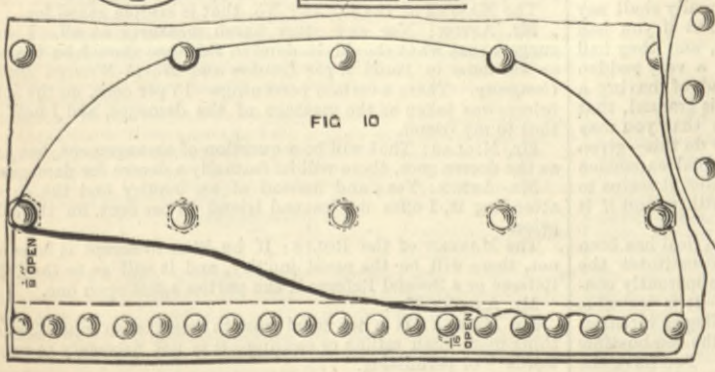


FIG. 11

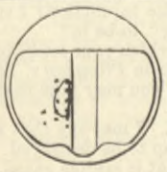


FIG. 12

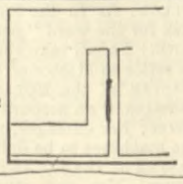


FIG. 13

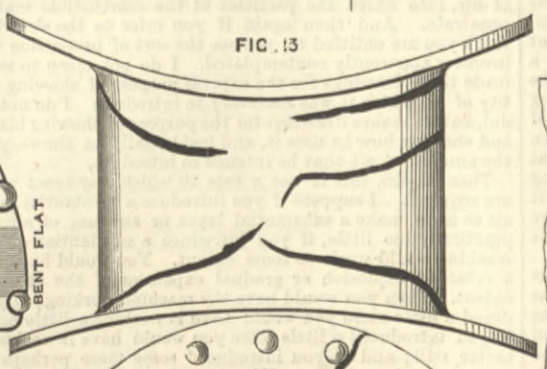


FIG. 14

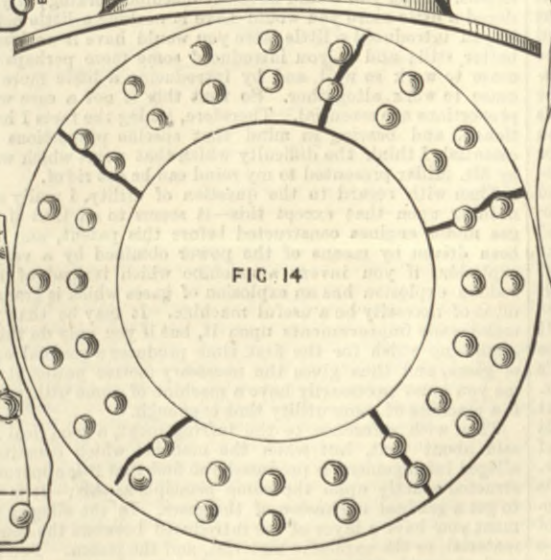
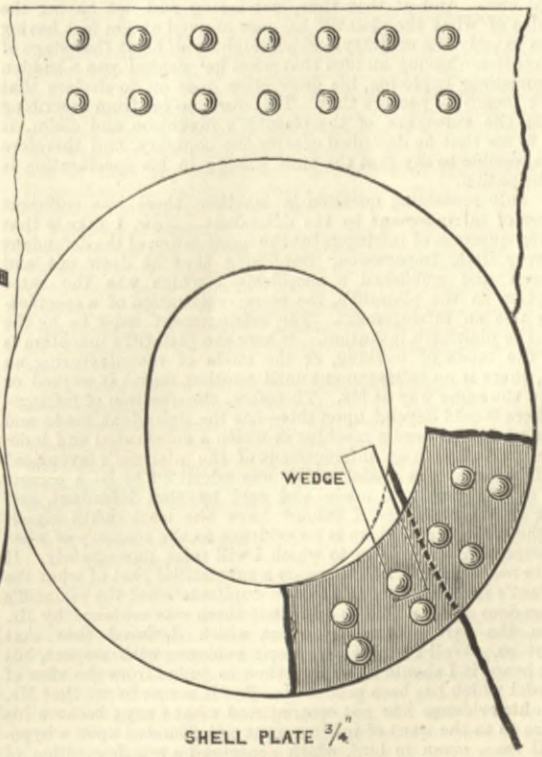


FIG. 15



OTTO *v.* LINFORD.

We this week conclude the re-publication of the judgment in this celebrated case.

Well, then, you come to that which is the ground of the judgment of the Vice-Chancellor, namely, the question of novelty, which—all the others being mere fringe—is the real subject of construction in this case. With regard to the question of novelty, it seems to me to present itself in rather an unusual form. I do not mean to say that it has not been so presented before, because I recollect cases in which it has been, but the anticipation here is not an anticipation by the user of machines. If there had been machines made, it seems to me that it would have been quite immaterial whether they were made under Johnson's specification or however they were made—whether Johnson's specification accurately described them or not would have been immaterial. Whether, supposing them made according to Johnson's specification, Johnson's specification was good or bad for other reasons would have been wholly immaterial. In other words, the moment you say that the anticipation is the user of machines, you may throw all former specifications under the table. The question is one of user of machines. Well, now, as to whether a user of machines has been an anticipation or not—and when it has come to be material in this case, because there have been no machines produced which are vouched as anticipations, none whatever—the only anticipation here relied upon is the publication of a former specification; that is to say, that the alleged anticipation is one wholly in writing and not in action. The moment you come to an alleged anticipation by writing, it seems to me immaterial whether the description in writing is contained in the specification or not—it is the same—and saying that it is in a specification gives it no more effect than saying that it is in a book. But when the alleged anticipation is one which is in writing, the law is that the interpretation of that writing, or the interpretation of that specification, is a question for the Court. It is not truly and strictly a question of evidence of fact at all. The Court must construe it. The Court no doubt would be much aided by an explanation of that writing given by skilled witnesses, and as to the mode in which that writing if carried out would act, but it must in the end construe the matter for itself.

Then what is the rule when you rely only upon a description in writing as being an anticipation? It seems to me that it is not sufficient to say that if a machine were made by a person who had read that writing, something in that machine would, if it had been really a machine used, have been by reason of that user an anticipation of the plaintiff's patent. You must go further, and where you allege that the anticipation is in writing, and in writing only, you must show that a person—I mean a person conversant with such matters—reading that writing, would find in it a reasonably clear description of the plaintiff's invention, in the writing alone. If it requires that a machine should be made in order that the anticipation may be seen, the subsequent inventor is not obliged, when his attention is called to a mere writing, to make a machine from it in order to see what will be the effect of that machine. He has to find a description of his own invention on the face of that writing, construing that writing reasonably as an invention. Therefore, even if the defendants here could show that with the correction suggested by Sir Frederick Bramwell a machine could be made according to Johnson's specification which would work, and if they showed that in that machine, or a part of it, the same effect as is in the plaintiff's machine would really and substantially take effect in the machine, yet they cannot succeed unless they show that the working of the machine is described substantially in Johnson's specification, and described so clearly that a person conversant with such things upon reading Johnson's specification carefully would say, "that is a description of the plaintiff's invention." That seems to me to be the effect of the judgment in *Hill* v. *Evans*, and also if you apply what was said in *Betts* v. *Menzies*.

Therefore the question is whether Johnson's specification fairly read by a person conversant with such matters would give a reasonably clear description of the plaintiff's invention—that is, would give a reasonably clear description that it would in a machine effect this—the introduction next to the piston of a substantial column of simple air; after that a combustible mixture, and those being so ignited as to produce a gradual expansion.

In my judgment, after hearing all that can be said, there is nothing of the kind in Johnson's specification. It is not described. That may be the result of a machine made—no, I will not say that; but I say that even supposing that would be the result of a machine made, it is not described, and I do not think that it is so material that one ought to take notice of it; it certainly is not claimed; it is not described with anything like clearness, and to my mind for a very good reason—the man could not describe it because it was not in his mind.

A little flinching from that which I understood was my lord's opinion, namely, from the supposition that Johnson, or whoever was the inventor, there blundered quite so egregiously as my lord supposed upon the construction of the specification, I am inclined to agree with the opinion which was elicited from Sir Frederick Bramwell—but which ought not to have been elicited because it was not evidence—as to what the construction of that specification was. I incline to agree with it, and to my mind the idea of the inventor—I say not whether it could be worked out—was that he would introduce into the cylinder a mixture which before it was ignited would become homogeneous, and that that would be a combustible mixture, and that it would by the ignition explode at once—it would be a sudden explosion and expansion, and not a gradual one. And at that time, not seeing and not having the least idea of what the plaintiff has now arrived at—in fact having an idea exactly the contrary—which might well be at that stage of the invention—having an idea that what he wanted was a sudden and immediate explosion, his description goes on to declare that he took means to procure that. Therefore, so far from describing what is the substance of the plaintiff's invention and claim, it seems to me that he described exactly the contrary, and therefore it is impossible to say that the mere writing in his specification is an anticipation.

The only remaining question is whether there was sufficient evidence of infringement by the defendant. Now, I take it that upon the question of infringement the specification of the defendant is of very little importance. Supposing that he drew out and registered and published a specification which was the same description as the plaintiff's, the mere registration of a specification is not an infringement. The infringement must be by the use of the plaintiff's invention. Where the plaintiff's invention is really the mode of working, or the mode of manufacturing an engine, there is no infringement until another engine is worked or made in the same way as his. Therefore, the question of infringement here would depend upon this—has the defendant made and sold, or made and used a machine in which a substantial and independent part of it is an infringement of the plaintiff's invention? Now, looking at the model which was admitted to be a correct model of the machines made and sold by the defendant, and looking at the machines, I cannot have the least doubt myself upon the subject, and there is no evidence to the contrary of what I say, excepting one matter to which I will refer immediately. It seems to me clear that at all events a substantial part of what the defendant's machine does is to do in duplicate what the plaintiff's machine does singly. It was said that there was evidence by Mr. May on the part of the defendant which declared that that was not so. Well I accept Mr. May's evidence with respect, but having heard it I should be obliged then to judge from the view of the model which has been produced. But it seems to me that Mr. May in his evidence has not contradicted what I say; because his evidence as to the want of infringement was founded upon a hypothetical case, given to him, which contained a mis-description of the plaintiff's invention, and, adopting that mis-description, he says: "If that is the plaintiff's invention, I do not think the defendant's machine is an infringement of it." It may be that it is not, but that is not evidence which ought to countervail the evidence of the plaintiff's witnesses.

Therefore, having given the best attention to this case, and it having been so completely argued out before us, I, with great deference, and with great reluctance, am obliged to differ from the judgment given by the Vice-Chancellor as to this want of novelty, and if he is supposed to have given a judgment upon any other of the points against the plaintiff, I differ from that also, and to my mind the plaintiff has made out a case here upon which his suit ought to be maintained.

Lord Justice Holker: I am very much obliged to Lord Justice Brett for his kindly, and, as I consider, complimentary reference to my experience in cases of this sort. It is quite true I have had some experience, perhaps a good deal. I should like more, because I confess I look upon these patent cases, many of them, as exceedingly interesting. But I do not think it follows that because I have had considerable experience in patent cases therefore I should deliver an elaborate judgment in this case when an elaborate judgment is not necessary. And an elaborate judgment is not necessary, because I agree entirely in all that has fallen from my lords. At the same time I do not want to avoid expressing my opinion upon the points that have been raised, and I will do so as shortly as I possibly can.

It seems very clear from the evidence that the motive power in gas motor engines prior to the invention or alleged invention of the plaintiff had been produced by means of explosion—a sudden explosion—producing, of course, very rapid expansion of the gases, and evil had been found to result from this. The heat had not been perfectly utilised and the sudden action of the piston—the violent shock occasioned by the piston—had injured the machine. In fact, a very violent shock in a machine of this kind would naturally produce injury. Well, it was desirable to obviate these defects, and apparently the plaintiff turned his attention to the matter. Anyone would say that if he would in some way or other modify the explosion, if he could make the expansion of the gases which would drive the piston a gradual expansion instead of a sudden expansion, as it was when the result was a sudden explosion, the great object would be effected. But then, of course, the difficulty was to find out how this could be done, and apparently Mr. Otto, the patentee in this case, did hit upon this idea. He said: "If I can introduce between the explosive mixture, formed of air and gas, and the piston a body of air or a body of any other incombustible vapour, and then explode behind this body the stratum of explosive gas, I shall by that means expand the air, and expanding the air, I shall, in fact, produce a gradual, instead of a sudden, development of heat or expansion of the gases." Accordingly he says, "I will do that," and it has been found that his idea was a right idea, and that by so doing he could make a gradual expansion of the gases.

He says in his specification: "I will do this in several ways. I will either have a body of air between the explosive material and the piston, or I will have a body of the products of combustion, or I will have a mixture of air and the products of combustion—it does not matter which—and I will do it either without subjecting these vapours to compression, or I will do it by subjecting them to compression, and I will point out the means of doing all this." The idea, no doubt, would not be patentable, but if the discoverer of this idea points out in his specification the means by which all this may be accomplished, in my opinion—and I think there can be no doubt about it—that is the subject matter of letters patent. He says, to take his simpler form: "I will introduce a layer, so to speak"—it would not be really a layer, but it might be called a layer—"of air in a certain way by a certain mechanical contrivance which I point out to you. I will then introduce a stratum of explosive gas or explosive compound, and I will then fire that compound in the way which I point out to you." It seems to me that this was a most useful discovery. It appears, as my lord says, to have really and truly revolutionised the manufacture of gas-motor engines; and as the inventor discovered this principle, and at the same time told the public, as it seems to me, how it was to be carried into effect, there can, in my opinion, be no doubt whatever that his invention is the subject matter of letters patent.

The point which has produced the most doubt in my mind, I confess, has been that which was taken with reference to the sufficiency of the specification. It has been said that the specification is not sufficient, because it does not tell you the proportion of explosive material and the proportion of air that has to be introduced. It is said that the great feature of the invention is using a certain body of air and inserting that between the piston and the explosive mixture formed of the gas and air, and we are not told by the patentee in his specification what proportion we are to use. No doubt that is an objection of a somewhat formidable character, but I think you are told practically. You are told that you require a considerable—at all events, a substantial—body of air. I do not think there can be any difficulty with reference to the proportion of air which is to be mixed with the gas to make it an explosive compound, that is well known; but with reference to the amount of air that has to be introduced between the combustible material and the piston, I think you are told that you must have a substantial amount of air, because you are told that the particles of the combustible material will penetrate into this layer, so to speak, of air, and be surrounded by it. Therefore you must have a sufficient amount of air, into which the particles of the combustible material can penetrate. And then again if you refer to the drawings, as I think you are entitled to, you see the sort of proportion which the inventor apparently contemplated. I do not mean to say that he made these drawings for the express purpose of showing the quantity of air which it was necessary to introduce. I do not think he did, but he makes drawings for the purpose of showing his machine, and showing how he uses it, and incidentally he shows you about the amount of air that he intends to introduce.

Then, again, this is not a case in which any exact proportions are required. I suppose if you introduce a substantial quantity of air so as to make a substantial layer or stratum of air, although practically too little, if you introduce a substantial quantity the machine would work to some extent. You would have to modify a retarded explosion or gradual expansion of the gases to some extent. Then you would have the machine working; if you introduced a little more you would have it working a little better; and if you introduced a little more you would have it working a little better still; and if you introduced some more perhaps it would cease to work so well, and by introducing a little more it would cease to work altogether. So that this is not a case where the proportions are essential. Therefore, taking the facts I have mentioned, and bearing in mind that specific proportions are not essential, I think the difficulty which that point which was raised by Mr. Millar presented to my mind can be got rid of.

Then with regard to the question of utility, I really shall say nothing upon that except this—it seems to me that if you had gas motor engines constructed before this patent, and they had been driven by means of the power obtained by a very sudden explosion, if you invent a machine which instead of having a sudden explosion has an explosion of gases which is gradual, that must of necessity be a useful machine. It may be that you may make many improvements upon it, but if you only do this—given a machine which for the first time produces a gradual expansion of gases, and thus gives the necessary motive power, it seems to me you must necessarily have a machine of some utility, and if it is a machine of some utility that is enough.

Then with reference to the infringement, a good deal has been said about that, but when the machine which constitutes the alleged infringement is produced you find that it is apparently constructed exactly upon the same principle as this:—It is desirable to get a gradual expansion of the gases. In the alleged infringement you have a layer of air introduced between the combustible material, or the explosive material, and the piston. You have the explosive material then introduced, at the densest or richest part, as it has been called, of the explosive material you have the means of firing. All that you find in the plaintiff's specification; indeed, it is the essence of his invention.

But then it may be said that the alleged infringement is not an infringement because the machines are different; and we have this piece of evidence given by Mr. May. He is examined by Mr. Kay in this way:—"I want you to follow me in supposing the plaintiff's claim were, what I submit it is not, a claim for a particular engine in which these effects he describes are produced, a particular engine and nothing more, and that he did not claim these effects in any way in that particular engine, do you say that this engine is similar or dissimilar from the engine of the defendant! A. It is dissimilar setting aside the compression and the admission and all that sort of thing." Well, but that is the very essence of it. The means of introducing the material, the means of compressing it, and the means of igniting it, are the means which the plaintiff employs to carry out his idea.

Well, then if the defendant takes the plaintiff's idea and takes his means too, how can anybody successfully contend that there was not an infringement. Of course it may be different, and in many respects it is different, but the idea is the same. The means of introducing the material are the same, the means of exploding the material after it has been introduced are the same. For these reasons I think that the infringement has been abundantly shown.

There is only one other point, and that is the want of novelty. That seems to have been considered the most important point in the case—at all events that is the point upon which the Vice-Chancellor has decided against the plaintiff in this case.

The anticipation which is relied upon consists of a specification filed by Johnson. Well, the question is not whether these letters patent have been filed, not whether these letters patent show any invention—that is not the question, but whether it describes in an intelligible way the invention of the plaintiff. I take it to be clear that unless the specification describes the invention of the plaintiff there is no anticipation. It seems to me there is a great difference between a specification which is relied upon as an anticipation, and a machine which is relied upon as an anticipation. If you were to produce a machine which was made for a particular purpose, and which would accomplish when used results which were not thought of when it was made—were not anticipated—possibly the machine itself without any user would be an anticipation. I should doubt that very much myself. I do not find any authority upon it one way or the other, but I think it is perfectly clear that the machine, if used so that the public could ascertain what it would effect, would be an anticipation. But this is quite a different thing from producing as an anticipation a specification, for you cannot tell, except from the language of the specification, what results the contemplated machine may accomplish. We have it declared in *Hill* v. *Evans*. It is not necessary for me to read the passage; but it is stated there as the law, and it seems very reasonable that the specification which is relied upon as the anticipation of an invention must give you the same knowledge as the specification of the invention itself. That seems a very sensible and reasonable rule.

Now, what do you gather from this specification of Johnson's? Do you gather that he made, or intended to make, or dreamt of making a machine in which the expansion of the gases would be retarded or would be gradual? On the contrary, his object seems to have been entirely different. His object seems to have been by introducing a little layer of air before the mixture of air and gas to accelerate, so to speak, the explosion, to make the explosion more immediate and more perfect. He says that in so many words. Then how can you say that Johnson pointed out, or intended to make an engine of this description, the main feature of which is the gradual explosion of the gases, when it is clear if you read it, that he intended simply to make an engine where the explosion would be more sudden. I must say, having considered this specification of Johnson's very carefully, that I have come to the same conclusion as my lord has. I do not believe that Johnson had any idea that it was necessary to mix air with the gas, in order to produce an explosion. I think his notion was that he would produce the explosion of the gas by igniting the gas, and that then the explosion of the gas having been produced, the heat would be communicated to the air and the air would expand. I do not think, therefore, that he has in any shape or way shadowed forth the invention which is claimed. I observed that Mr. Millar struggled very hard, and for a long time, to make out that the plaintiff's engine was an engine in which the motive power was produced by explosion, and not by the gradual expansion of the gases. Of course if he could have made that out he would have been, no doubt, in clover, because if he could have shown that the plaintiff's engine was an explosive engine, he could have turned to Johnson's and said, "Here you have another explosive engine made in the same way."

Now, besides the remarks I have made, the evidence shows—I do not know that it satisfies my mind, but at all events there is a good deal of evidence to show—that even if you take the best view of Johnson's engine for Mr. Millar's purpose, Johnson's engine, if it were made according to his specification, would not work, but I do not, in giving judgment, rely upon that evidence at all.

The only other remark is about something that was said as to the diagram. I do not give my judgment upon any belief that I understand this diagram properly, but I think I can appreciate the evidence of Mr. Imray, and Mr. Imray tells me that that is not an explosive diagram. He tells me this, further, that the engine of the plaintiff is not an explosive engine, and I think Mr. Imray saying that, and being a man of great experience and great reputation, and not being contradicted by a single witness on the other side, ought to be believed.

But just one word with reference to that diagram. The diagram shows an explosion, it is said, and that when the explosion takes place the highest pressure at a certain point is obtained; but, according to Mr. Imray, there is something more, that pressure is sustained, and the descending line shows how it is sustained. There is something more than an explosion—there is an explosion which effects the expansion of the other gases, and, if I understand him, that descending line shows how the explosion is sustained throughout. He says, if you had explosion and nothing but explosion, you would have a line ascending and going up straight, and a line descending and coming down straight; but when you have a line of this description that shows that the pressure produced by the explosion has been sustained by the expansion of the gases.

Mr. Millar: As to the form of the injunction; I suppose you will not ask for the word "permitting" to be in?

Mr. Aston: I shall take the form which your lordship was good enough to settle as Master of the Rolls in *Plimpton* v. *Malcolmson*.

The Master of the Rolls: Yes, you may take that. Do you ask for damages or an account?

Mr. Aston: For damages, my lord. I may say that we will not ask for the machines to be delivered up to be destroyed.

The Master of the Rolls: No, that is seldom asked for.

Mr. Aston: Nor any other harsh measures at all. I would suggest that what should be done in this case should be the same as was done in *Smith* v. *the London and North-Western Railway Company*. There a certain percentage—15 per cent. on the selling price—was taken as the measure of the damages, and I now offer that to my friend.

Mr. Millar: That will be a question of arrangement, but as far as the decree goes, there will be formally a decree for damages.

Mr. Aston: Yes; and instead of an inquiry and the expense attending it, I offer my learned friend 15 per cent. on the selling price.

The Master of the Rolls: If he likes to accept it he can; if not, there will be the usual inquiry, and it will go to the Official Referee or a Special Referee if the parties agree upon one.

Mr. Aston: Yes.

Mr. Millar: It is not usual now to insert in an injunction anything more than selling or causing—it is not necessary to use the words "or permitting."

The Master of the Rolls: I settled the form in *Plimpton* v. *Malcolmson*, and I should desire to adhere to it.

Mr. ASTON: The order in *Plimpton* v. *Malcolmson* does contain the word "permitting."

Mr. MILLAR: But I do not think that that is now usual.

Mr. ASTON: Yes; that is the latest form.

The MASTER of the ROLLS: Will you read it, Mr. Aston?

Mr. ASTON: "An injunction to restrain from using or exercising, or causing or permitting to be used or exercised, and from selling, letting for hire"—I will not trouble my friend with that in this case—"or making any profitable use or permitting the sale or letting for hire or profitable use, of any roller or runner skates not made by the plaintiff or his licensees." That applied to the articles in question there, but it does not apply here.

Mr. MILLAR: Well I was going to say the same with regard to the words, "or permitting." That does not apply in this case.

The MASTER of the ROLLS: Yes, you must not permit. You must not permit by agents. You have made machines which might be in the hands of your agents or consignees, and which you can stop.

Mr. MILLAR: If your lordship pleases. Nobody suggests that we have any, so that, if that is the meaning, it is innocent.

Mr. ASTON: We shall have the costs here and below?

The MASTER of the ROLLS: Yes.

Mr. ASTON: They have been paid, and therefore they will have to be returned.

The MASTER of the ROLLS: That is a matter of course.

Mr. ASTON: And within a week.

Mr. MILLAR: That is a matter which the Registrar will deal with.

Mr. ASTON: We have also paid into Court a certain sum as security for costs, as we are a foreigner residing abroad, and we want that returned.

The MASTER of the ROLLS: Yes. What is the amount?

Mr. ASTON: £100 I think. Then there is another matter. I want a certificate that the validity of the patent came into question and that the plaintiff proved his breaches.

The MASTER of the ROLLS: Yes.

Mr. ASTON: By the Act that ought to be given by the judge who tried the action. There was an omission in the Court below to ask for it, but if I may be at liberty to inform the learned judge in the Court below of the decision which this Court has arrived at, I have no doubt he will give us the certificate that the validity did come into question, and that we proved our breaches, because he was not against us as to breaches.

Mr. DAVEY: Is not this Court entitled to give it to us? Because under the rules the Court of Appeal may make whatever order the judge in the Court below ought to have made, and if the judge in the Court below who tried the action ought to have given you a certificate, the Court of Appeal has jurisdiction to grant it in its place.

The MASTER of the ROLLS: But the Act of Parliament says that the certificate must be given by the judge who tried the action.

Mr. ASTON: Yes, unfortunately that is so. "It shall be lawful for the judge before whom any such action shall be tried to certify on the record that the validity of the letters patent in the declaration mentioned came in question."

The MASTER of the ROLLS: That he will give you as a matter of course.

Mr. ASTON: I think so.

The MASTER of the ROLLS: It will be safer to take it from him.

Mr. ASTON: I thought so, my lord. Then that will be all that we apply for.

Solicitors for the appellants, Messrs. Faithfull and Owen; solicitor for the respondents, Mr. C. J. Eyre.

LETTERS TO THE EDITOR.

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

ZINC IN MARINE BOILERS.

SIR,—In THE ENGINEER of November 27th you published a lengthy letter written by Mr. David Phillips, a gentleman I never heard of before, but one who, like myself, takes an interest in the subject of boiler preservation, &c. He states that I am "not the only individual who has from time to time set forth claims of having done things" to which I "had no claim."

Will you, Sir, permit me to inform Mr. Phillips and your readers generally that I made no pretence whatever to originality in the paper read by me at Sunderland in March last. Like Mr. Phillips, I was aware of the ignorance existing on this subject, and, after having studied it for a year or two, endeavoured to make others see with my mental vision, and I hope the efforts were not altogether unsuccessful. But so far as Mr. Phillips' claim to originality is concerned, perhaps what ideas of importance he attaches to his labours will be somewhat lowered when he learns that able men were in this sphere of usefulness a generation before he was born. But first, before referring to the originator of zinc-protection of marine boilers, I wish to do justice to one to whom justice is due. Mr. Hannay, of Glasgow, was, in my opinion, the first in this generation to scientifically investigate the subject and explain it thoroughly. Moreover, the fact disputed by Mr. Phillips, that the evolution of hydrogen from the negative surface removes the lime deposits layer by layer as they form, is an indisputable fact, and one which is not only in harmony with known electrical phenomena, but one which Mr. Hannay has demonstrated to be true again and again. This removal of scale by the oxidation of zinc is well known to be a fact by many superintending engineers, and some years ago when inspecting a steamer owned by Messrs. Wilson, of Hull, I was delighted with the appearance of the boilers which were free from adherent scale, and were protected from corrosiom by numerous slabs of zinc distributed over their surfaces; and the colour of the boilers was a pale buff, a colour usually seen in marine boilers when the zinc is doing its duty. Credit, then, is due to Mr. Hannay for the light he has thrown on this subject; credit appears to be likewise due to Mr. Phillips for his labours, which, alas, appear to have been unremunerative; credit is due to the Admiralty officials who made exhaustive inquiries into the question of boiler corrosion, and conducted many important and useful experiments, and, acting under Admiralty authority, I had the privilege to use zinc in marine boilers five or six years before Mr. Phillips appears to have studied the subject. Having now in a fair and honest way recognised the claims of these rivals for scientific honours, let me call your readers' attention to the achievements of one greater than they all put together. In 1824, on the 30th January, Sir Humphrey Davy penned the following letter to his brother John:—

MY DEAR JOHN,—I have lately made a discovery, of which you will for many reasons be glad. I have found a complete method of preserving the copper sheeting of ships, which now readily corrodes. It is by rendering it negatively electrical. My results are of the most beautiful and unequivocal kind; a mass of tin renders a surface of copper two hundred or three hundred times its own size sufficiently electrical to have no action on sea water.

I was led to this discovery by principle, as you will easily imagine; and the saving to Government and the country by it will be immense. I am going to apply it immediately to the Navy. I might have made an immense fortune by a patent for this discovery, but I have given it to my country; for in everything connected with interest, I am resolved to live and die at least "*sans tâche*." I am, dear John,

Very sincerely,

Your affectionate Friend and Brother.

H. DAVY.

His brother John, writing of this discovery says: "No sooner was the beautiful principle of metallic protection discovered, than various economical appliances of it were obvious, for the purpose of preserving iron, steel, tin, brass, and other useful metals, both in delicate instruments, in powerful machinery, and in great constructions designed for permanency."

Sir Humphrey made scores of interesting and instructive experiments on the preservation of metals by electro-chemical means, and read four papers before the Royal Society on this subject between 1823 and 1826. If space were allowed me, I should be glad to copy from the work before me some of his experiments, but I hesitate to claim so much of your attention, and will only refer to one which demonstrates how a negative metal is preserved by the corrosion of another metal positive to itself. "A small piece of zinc was fastened to the top of a plate of polished copper, and a piece of iron of a much larger size was soldered at the bottom, and the combination placed in sea water. Not only was the copper preserved on both sides in the same manner as in the other experiments, but even the iron; and, after a fortnight, both the polish of copper and the iron remained unimpaired."

But perhaps Mr. Phillips, though admitting Sir Humphrey's claim to the discovery of the principle of metallic preservation by electro-chemical means, will say:—"But he never suggested protecting marine boilers by an electro-positive metal?" Let us see. On pages 342 and 343 of the sixth volume of his works, he writes as follows:—"I have pointed out in my former papers some of the cases of electro-chemical protection, which, I have no doubt, when the principles are well understood, will be generally adopted; and others are constantly occurring. I shall mention one—the preservation of the iron boilers of steam engines by introducing a piece of zinc or tin. This, in the case of steamboats, particularly when salt water is used, may be of the greatest advantage, and prevent the danger of explosion, which generally arises from the wear of one part of the boiler."

Now, Sir, I trust that Mr. Phillips is satisfied that other minds besides his own have endeavoured to solve the problem of boiler protection, and I am glad that he has furnished me this opportunity to call public attention to the works of Sir H. Davy, which abound in useful information in all that relates to the preservation of metals. When I wrote my paper I was not in possession of the valuable books which now form part of my library, otherwise the facts quoted from Sir Humphrey's book would most assuredly have been embodied in the paper.

In conclusion, Sir, let me urge upon engineers the necessity of the use of zinc or some other electro-positive metal to preserve boilers from decay, and not only boilers, but the iron and steel hulls of vessels, especially thin launches and torpedo vessels. One or two small pieces of zinc, soldered in the bilges of these crafts, would preserve them for years, and the strips, when wasted, could be easily renewed. Only a few days ago I stood in a launch built after the Admiralty type, and looking to her bilges at my feet, I observed some of the frames and plates so corroded that before many months are over they will need renewal. I thought then, as I think now, "What a pity it is that ignorance or prejudice should prevent the application of a remedy as safe as Cockle's pills, and far more agreeable." But where ignorance is enjoyed and a source of pride, why should one waste his breath? JOHN A. ROWE.

11, Spring-terrace, North Shields.

P.S.—If Mr. Phillips will send me his address, I will forward him a copy of the paper you were good enough to quote from.

HUDDERSFIELD STATION ROOF.

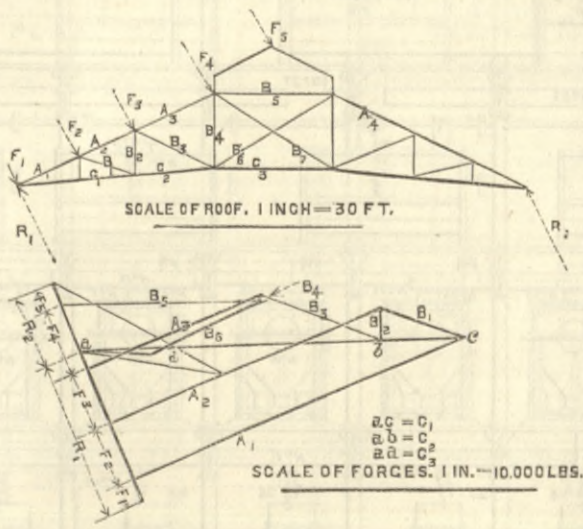
SIR,—I had hoped to have elicited from Mr. McCleary some more facts as to the real cause of failure; but he appears by his last letter to intend preserving a dignified silence. As the report at present stands, it gives one the idea of an inquest upon a child who was accidentally killed, the verdict being that, "if it had lived to maturity, it would probably have died from physical debility." Amusing as such a verdict would be, it is equalled by the statement that the assumptions for calculation include "a weight of snow," when the failure took place in August! and "resultant forces from wind," when the roof covering was not there for the wind to act upon.

These assumptions are thoroughly unsatisfactory—first, because they do not represent the state of things at time of failure; second, because they never can represent the action of all the members of the truss. For many years not only eminent but also ordinary engineers calculate their roofs with separate diagrams—(1) for the roof covering; (2) for snow; (3) for a wind force alternately on the right and left. From these diagrams a table of maximum stresses is prepared, greatly differing from one prepared on the ideal rough approximation of 40 lb. per foot super.

An illustration of the absolute necessity of a wind diagram is at once seen by Mr. McCleary's Fig. 14, in your issue of November 13th. The tie-rods H J, H^1 J^1 are shown, one buckled and the other elongated by the resultant strains from a side wind. We are given to understand that the design is ill-adapted *by its form* to resist such an action from the wind—an utter mistake—and are told that these two central tie-rods would be strained to a considerable degree. In point of fact, they only are put there to be strained like any other members of the truss. Unfortunately, however, Mr. McCleary's 40 lb. assumption only supposes vertical and uniform loading, which gives no clue whatever to the amount of these strains in the central tie-rods.

It is just these two tie-rods which complete the bracing of the truss. The roof is not only *not* a collar-beam roof, as Mr. McCleary first supposed, but it is a completely braced queenpost truss, quite as completely braced as one in which the rafters meet at the apex.

The following diagram, prepared by one of the students attending my Applied Mechanics' class at Exeter Hall, shows these tie-rods to be counterbraces acting alternately as the wind is on the right



or left. The truss cannot possibly assume the distortion illustrated by Mr. McCleary's Fig. 14, or anything approaching to it, until one or other of these counterbraces fails. The amount of strain which a 1¼in. diameter rod will safely bear, even though the ends were not upset, is about 9000 lb., but the utmost strain that can come upon it with a horizontal wind force of 50 lb. per square foot is 6500 lb. Professor Unwin considers a force of 40 lb. horizontal wind sufficient for nearly all cases, so if these tie-rods are properly attached to the rest of the structure they should be safe enough.

I must not be understood to defend the truss as constructed. Mr. McCleary justly observes that a displaced pin, &c., might cause total failure, and never having seen the structure, I do not attempt a diagnosis. But I most emphatically defend the general form of queenpost truss against the aspersions of its critic, and as to its not being in common use for iron roofs. I passed under one almost the counterpart of the roof in question to-day. It has covered the Passenger Terminus of the North London Railway for years.

I think that to preface a report by relating how four men were killed by the disaster, and then to fasten the blame upon the design by means of incorrect assumptions which do not faithfully represent the strains in all the members of the truss, is very unfair, and I hope the jury were not guided by it.

The diagram being drawn to a very small scale, is only intended to show the maximum strain on the counterbrace.

Spring-gardens, December 3rd. T. GRAHAM GRIBBLE.

TRADES UNIONS AND PIECEWORK.

SIR,—In reply to the second letter from "A London Master," I am willing to admit that other firms besides the one mentioned pay any balance due after a man has left them. On the other hand, I will cite one of my own personal experiences, and a regular occurrence, and as I keep a diary can give dates with exactness, but refrain from mentioning names. On the 6th June, 1882, I asked one of the foremen of the largest gas engine making concerns in the kingdom for employment as a fitter, and he engaged me without stating whether the work was by the piece or by the day. He took me inside and placed me with a leading hand, from whom I received all my instructions, who told me that it was piecework and the time that I must do the work in to make it pay, which said work was fitting caps on the crank shaft pedestals cast on the bed-plates. Another man started the day before me, but the leading hand got him removed as he was too slow, or perhaps would not exert himself to the extent which I did. I did not draw any balance at first, because we were paid piece money if due every three weeks, and for every set of ten finished gas engines, so that it would not be for six weeks before I would draw any "settlings." After a time my foreman put me on to day work, and I drew back piecemoney on every settling day during that time. On October 31st I left to work elsewhere at a higher rate, and on November 11th, the next settling day, I went to the pay window and respectfully asked for the piece money due, when the cashier, who has a slight interest in the concern, shut down the window, gruffly saying, "Nothing for you."

Now, your correspondent suggests legal proceedings, and I will endeavour to show what a poor prospect I would have had of recovering the amount. In the first instance, my foreman engaged me at so much per week, this I always received, and although my employers—who, by the way, devote their spare time to preaching—are in honour bound to pay me any balance, I had not a written contract to support me. Secondly, I was quite ignorant of the prices; everything was managed by the leading hand—to his own profit I have not the slightest doubt. He took care not to enlighten me, and indeed confessed that he was working partly in the dark, for in some cases the foreman would tell him that he was piecework, and that was all. However, the chargeman just before settling day could tell you to a shilling how much you would draw. The only witness that I could have got would be the chargeman, and although he told me the amount, I did not care to trust to him in a law court, as he was making too good a thing out of the job to lose it by going against his employers. Your correspondent may remark that it was possible for him to cheat his fellow-workmen, but he could not do so to a great extent, as we drew our money according to our rates, and the calculations were made in the office.

I must object to "A London Master's" statement that the Trades Unions are managed for the benefit of the worthless at the expense of the good. In the first instance, a man must come up to a certain standard of excellence before he is admitted. This is strictly adhered to in ours, which is only five thousand strong, as opposed to the fifty thousand members of the Amalgamated Society of Engineers; and I presume that he refers to the minimum rate at which no man must work under, and tell him that he can pay the good man as much above this as he pleases, although I can quite understand in his natural desire not to pay more than he can help, that he should object to pay all men alike. Again, your correspondent states that the good man can almost always obtain employment. Granted, if work can be had. Let him picture to himself the case on the Clyde a few months since, and the cases on the Tyne, Wear, and Tees at present. The stocks are bare, and the men, whether good, bad, or indifferent, must remain out of work until the hoped-for revival of trade, commencing on the other side of the Atlantic, reaches these shores.

As far as my own case is concerned, I hope I may say, without vanity, that I have testimonials from previous employers, in two of which they state that I am a good workman, and having been for the first time in my life lately desiring work, and not been able to get it, have had to remain idle for seven weeks, and have only now got temporary employment till Christmas, and consider myself lucky when I know better and more experienced men who are idle. I thank him for his advice about leaving the Union and taking piecework, and tell him that I can still work piecework, and have done so where it already exists, but cannot commence piecework where it has never before been instituted. I thank you, Mr. Editor, for your courtesy in inserting my second letter.

Manchester, December 7th. YOUNG FITTER.

LONDON WATER SUPPLY.

SIR,—From various passages in some of your contemporaries we gather that the report on the examination of the metropolitan water supply by means of the gelatine method, as published in the Water Examiner's Report for October, has been much misunderstood, and that some explanation of the scope and meaning of this method of examination is desirable.

We have had recourse to this method of examination in order to detect the organised matter present in the London water supply; it must not, however, be supposed that this living matter is necessarily either the result of sewage contamination or prejudicial to health. On the other hand, it is obviously desirable to have water for domestic use as free from all living organic matter as possible, and inasmuch as the processes of subsidence and filtration to which the water is subjected before delivery to the consumer have, for one of their objects at least, the removal of such matter, it is of importance to ascertain whether, and to what extent, these processes of purification are efficient.

The results obtained for the months of September and October by the gelatine method, and published for the first time in the October report, show that, whilst the Thames water at the intakes of the companies contained upwards of 1000 organisms, the average number found in the samples taken from the main amounted to twenty-eight. This result speaks for itself as to the efficiency of the companies' treatment of the raw material with which they have to deal.

Any public alarm which the misapprehension of our reports may have caused will doubtless be allayed by a consideration of the fact that micro-organisms are not only present in nearly all natural waters, but that they are inhaled by every inspiration from the air. This being so, it is eminently satisfactory to find that the water supplied to London contains so small a quantity of organised matter, and that filtration has such a power of removing these micro-organisms.

4, The Sanctuary, S.W., December 3rd. FRANCIS BOLTON, PERCY G. FRANKLAND.

ORIGINALITY AND PRIORITY OF INVENTIONS *v.* LAW.

SIR,—Your able summing up—THE ENGINEER, December 4th, p. 440—needs little comment beyond indicating how other troubles are multiplied by inconsistent practice. Thus, can the following be business? A. patents a pump, not a perfect one, but still a mechanical device. Z. avers, "A.'s pump is nothing more or less than M.'s, plus a zinc or brass alloy handle and spout and coat of grass-green paint." A. rejoins, "Suppose Z. were correct, is A. to be debarred from reproducing M.'s invention improved, where fair trade or progress have developed a legitimate demand, because M.'s patents are in Egypt, or where no such demand exists at all?"

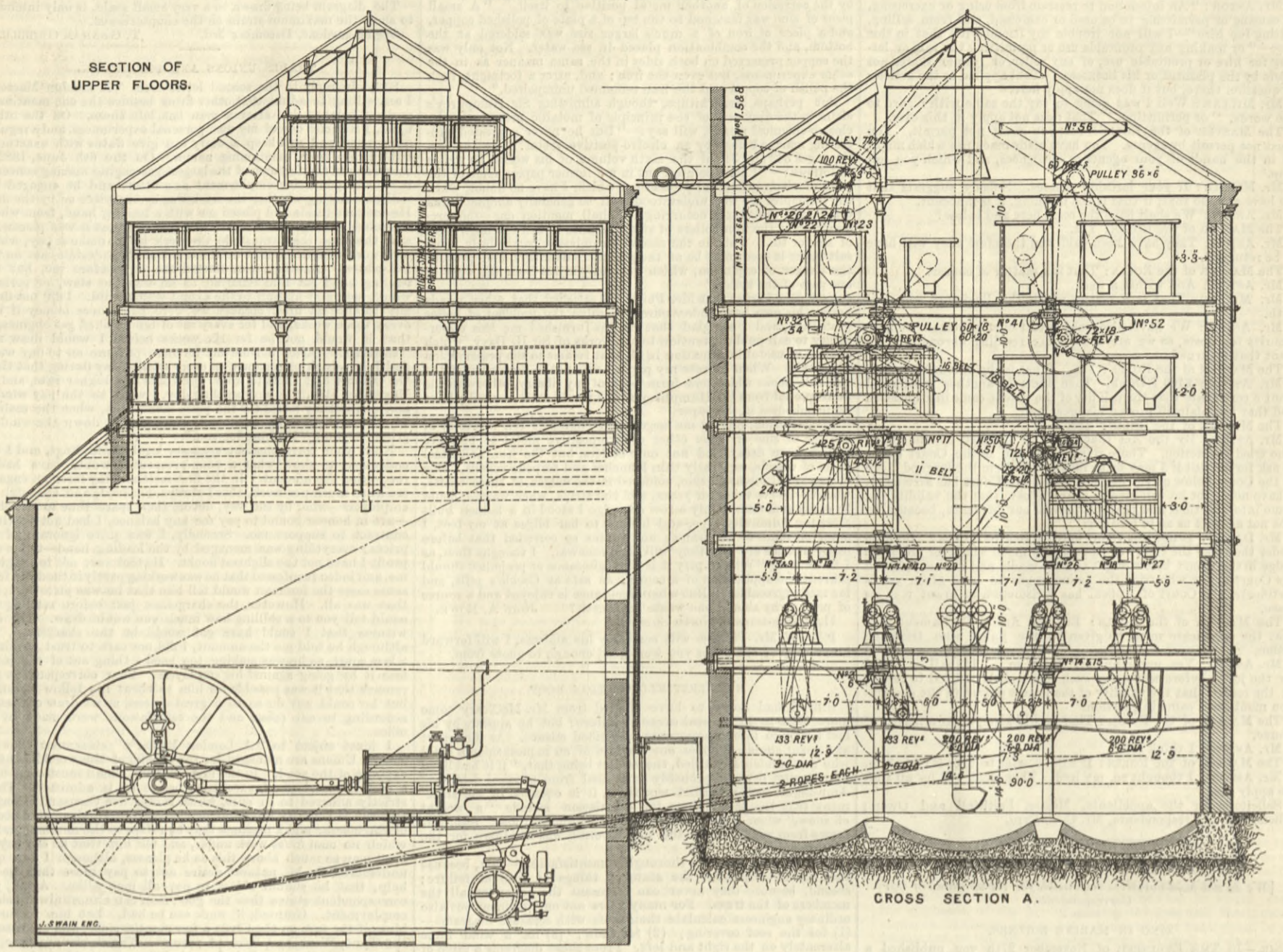
ISYLO.

[*For continuation of Letters see page* 454.]

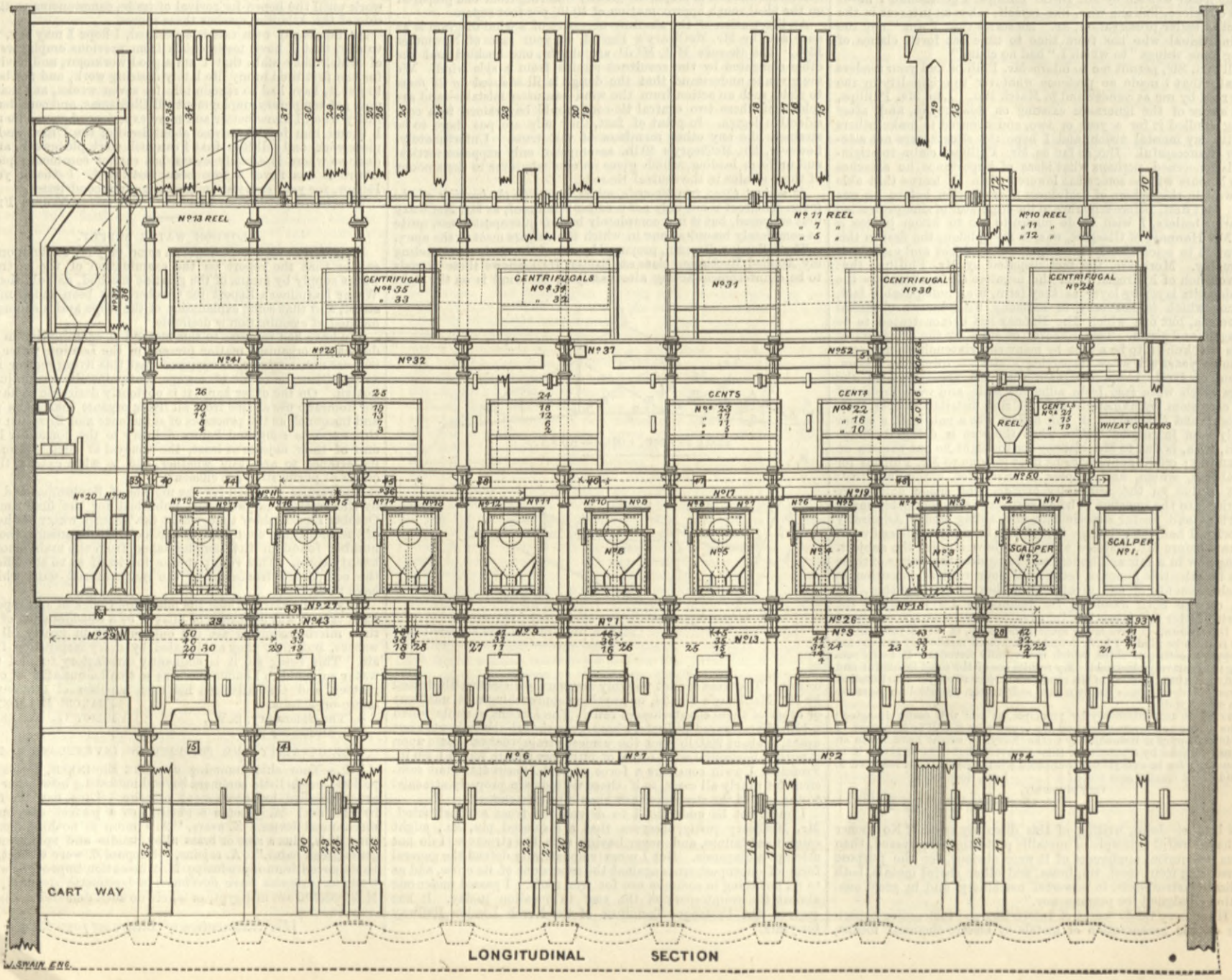
THE PHŒNIX FLOUR MILLS, NEWCASTLE-ON-TYNE.

MR. J. H. CARTER, LONDON, ENGINEER.

SECTION OF UPPER FLOORS.



CROSS SECTION A.



LONGITUDINAL SECTION

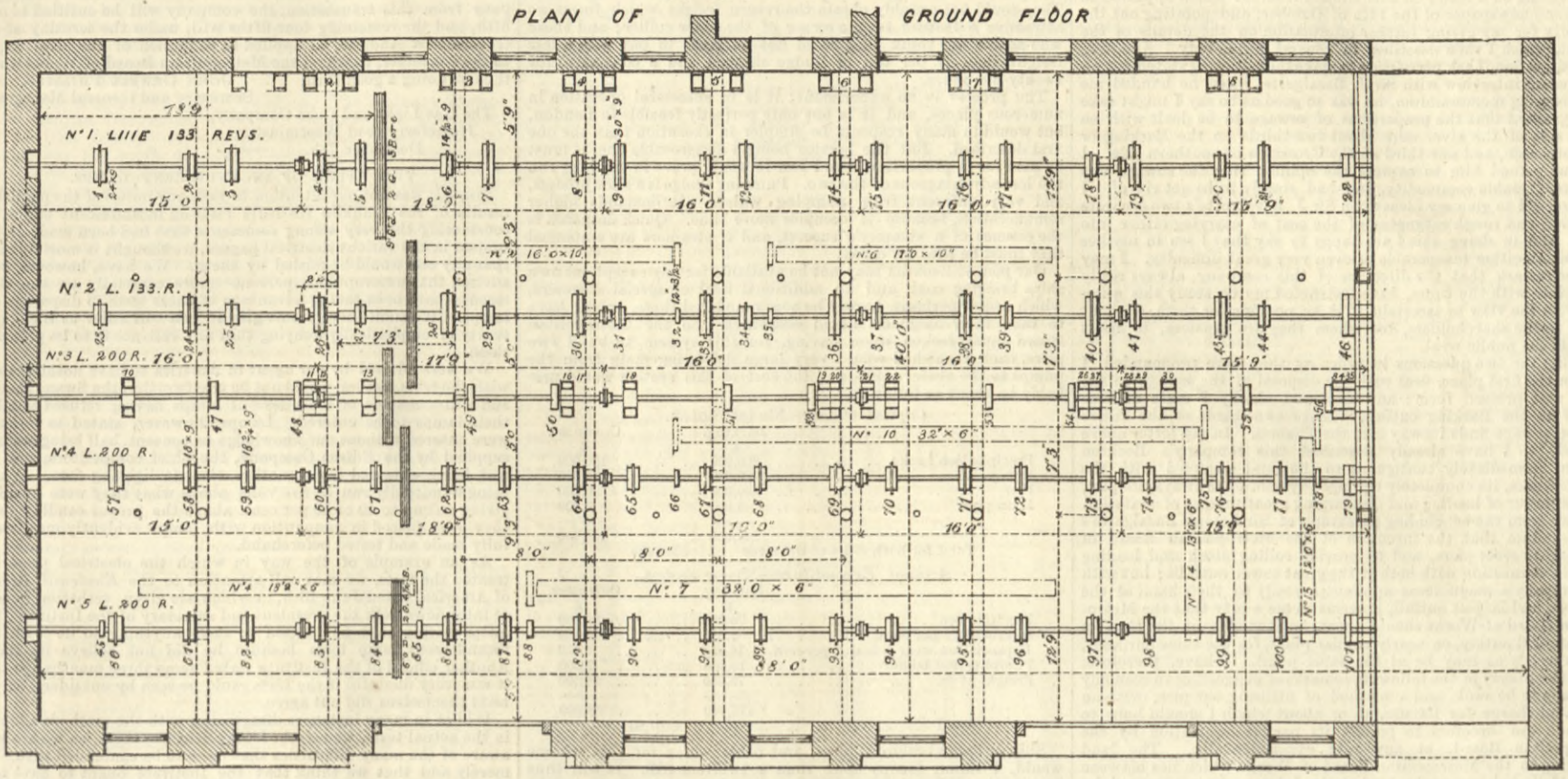
J. SWAIN ENG.

THE PHŒNIX FLOUR MILLS, NEWCASTLE-ON-TYNE.

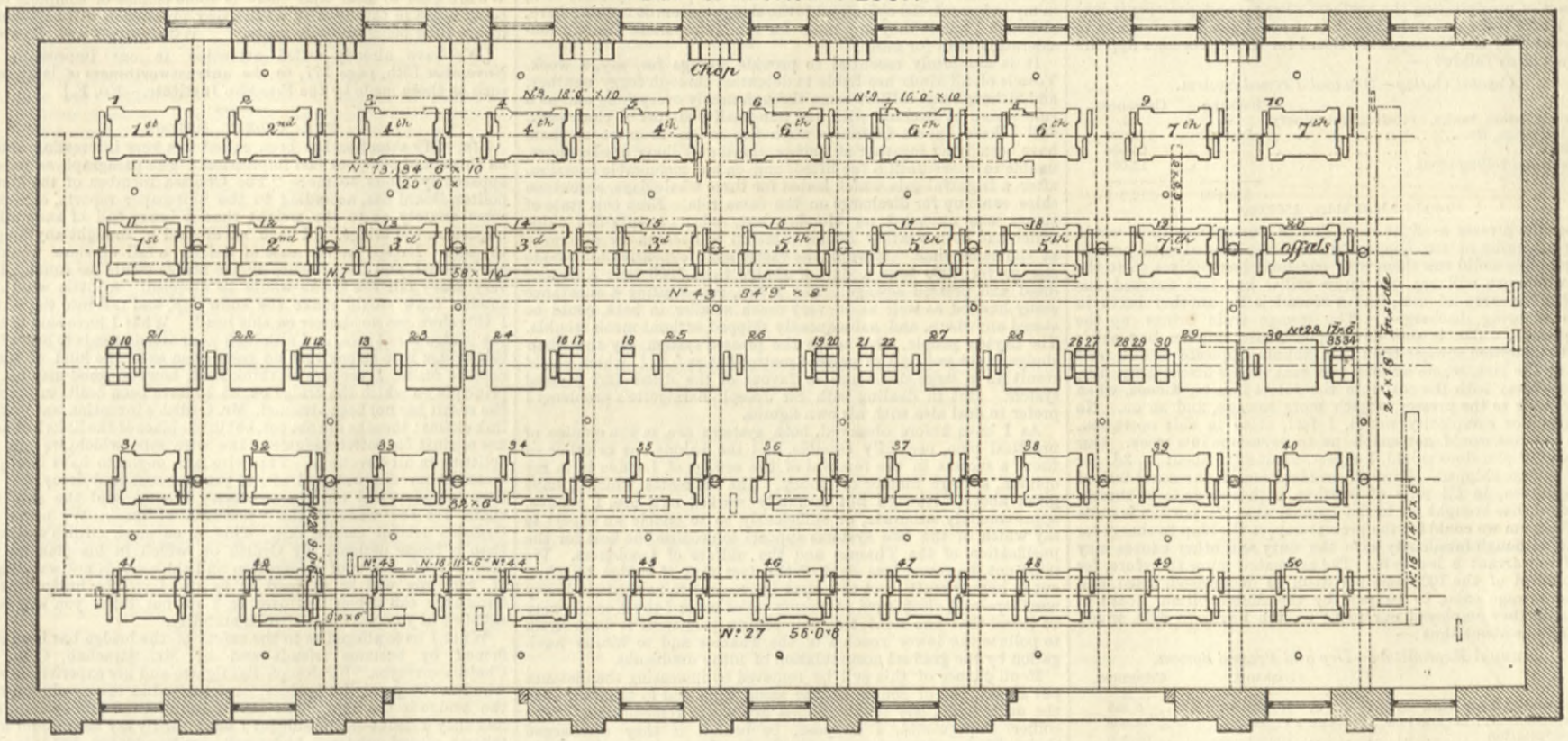
MR. J. H. CARTER, LONDON, ENGINEER.

(*For description see page* 461.

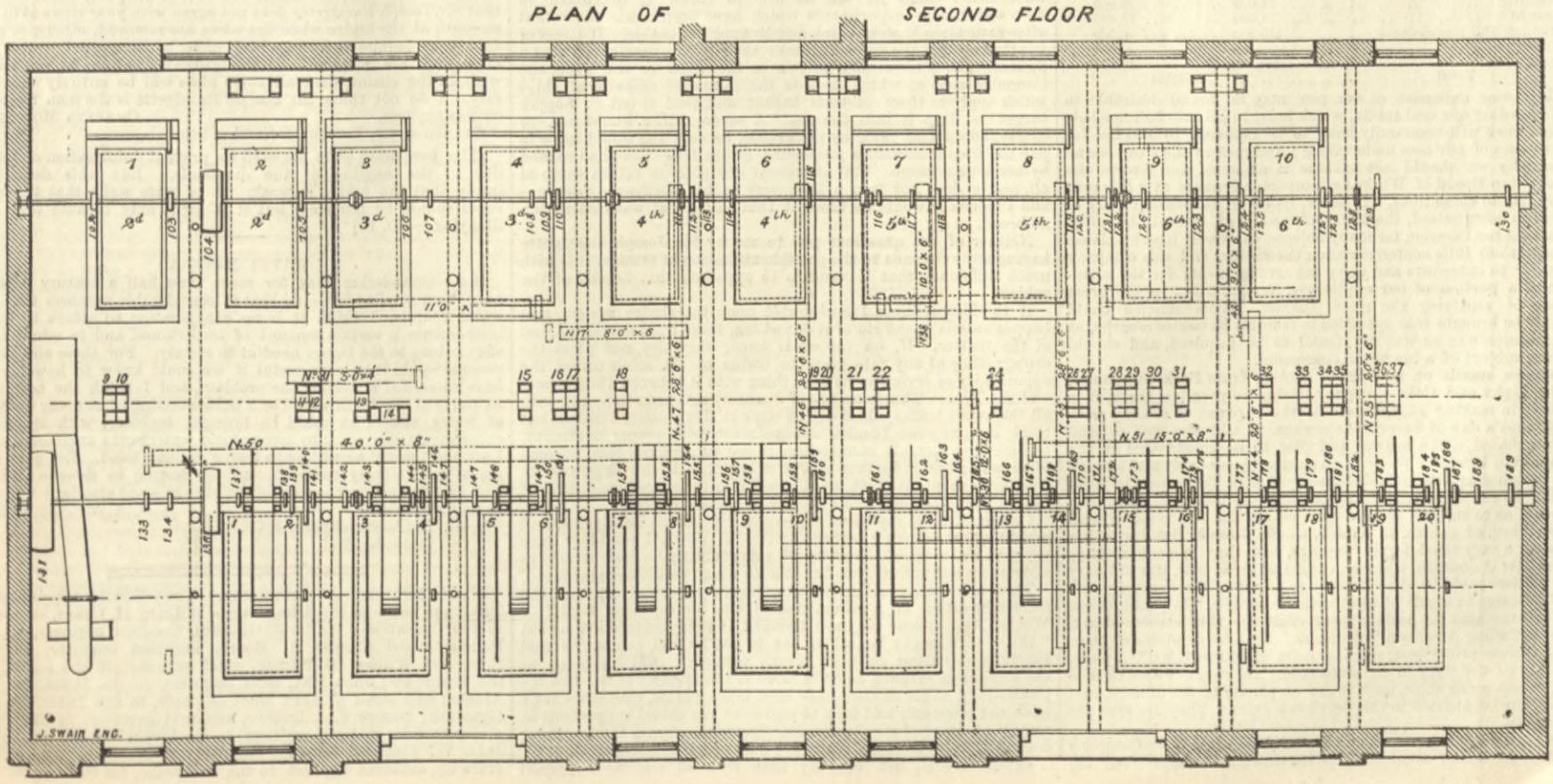
PLAN OF GROUND FLOOR



PLAN OF FIRST FLOOR



PLAN OF SECOND FLOOR



LETTERS TO THE EDITOR.

(*Continued from page* 451.)

LONDON DRAINAGE.

Sir,—My attention has been called to an article in The Engineer commenting on a letter on this subject from me which appeared in the *Times* newspaper of the 14th of October, and pointing out the necessity for my giving further information on the details of the project, which I then described in general terms only. Adopting your suggestion, I ask permission to make the following statement:—At a recent interview with Sir J. Bazalgette, when he handed me the foregoing memorandum, he was so good as to say I might take it for granted that the proportions of sewage to be dealt with on either side of the river were about two-thirds on the Barking or northern side, and one-third on the Crossness or southern side. I also understood him to express the opinion that the sewage was not a marketable commodity, and had simply to be got rid of. I now proceed to give my ideas upon Sir J. Bazalgette's two separate inquiries, and rough estimates of the cost of carrying either into effect, and in doing this I am happy to say that I see in neither proposition either insuperable or even very great difficulty. I may further remark that the directors of this company, always ready to advance with the times, have instructed me to study this question with the view to ascertain if it be possible for them, without injury to the shareholders, for whom they are trustees, to assist towards the public weal.

Taking the two questions in order as they were propounded, I will, in the first place, deal with the disposal of the sewage in the dried and pressed form; and first and chiefly I must address myself to the Barking outfall, whence two-thirds of the entire London sewage finds its way into the Thames. In my letter above alluded to, I have already described this company's Beckton station, immediately contiguous to the land occupied with the outfall works, its completely equipped system of railways, its pier, and its power of loading and discharging great masses of material. I gather from the concluding paragraph of Sir Joseph Bazalgette's memorandum that the intention of the Metropolitan Board of Works is to erect piers, and to provide rolling stock and loading plant in connection with both of the great sewer outfalls; but with the company's magnificent appliances ready to their hand at the northern and largest outfall, it seems to me a pity that the Metropolitan Board of Works should incur, on that side of the river, a fresh capital outlay, on nearly similar plant, for the same purposes, and as nearly as may be at the same point. I have, therefore, taken the liberty in the following remarks of suggesting an economy in money to be sunk, and a method of utilising our pier, with an estimated charge for its use, at or about which I should hope to persuade the directors to permit its partial occupation by the Metropolitan Board, at any rate experimentally. The land belonging to the Metropolitan Board of Works which lies between the outfall and our works having, as I learn, been accepted by others who have deeply studied the question, as sufficient for the purposes of precipitating the northern sewage, and pressing it into cake, I take it for granted that it is so; and the cost of works to be executed by the Metropolitan Board for those processes appears to be about as follows:—

Capital Outlay—Dry and Pressed System.

	Barking.	Crossness.
	£	£
Precipitation tanks, pressing machinery, buildings, &c.	350,000	175,000
Pier	—	25,000
Rails and rolling stock	—	12,000
	350,000	212,000

Total for both sides, £562,000.

From the presses a slight extension of our railway lines would admit of trains of our hopper trucks being loaded with pressed sewage. We could run them with our own locomotives on to the pier, where we will say one screw collier has just finished discharging her cargo of coal, and a second is in another berth in course of being discharged. The sewage train brings up the pressed cake, which is shot down spouts into number one ship's hold, the emptied sewage train then shunts opposite to the next berth on the pier, where number two coal ship is discharging, fills, and goes away with the coal into the retort houses, thence, when empty, back to the presses to fetch more sewage, and so on. No difficulty nor complexity would, I feel, arise in this operation, which practice would not enable us to overcome in a week. Our railway and pier dues would, I expect, amount to about 1s. 3d. per ton of sewage shipped. Earnest consideration of the novel task of dealing at sea, in all sorts of weather, with a cargo to be thrown overboard, has brought me to the opinion that 2s. per ton is quite the minimum we could for the present expect the ship to charge for freight, although familiarity with the duty and other causes may hereafter warrant a less rate. The estimated sum, therefore, for the removal of the 1000 tons per diem of deodorised, dried, and pressed sewage cake, to be paid by the Metropolitan Board of Works, if they employed our plant on the northern side, would appear to be about thus:—

Annual Expenditure—Dry and Pressed System.

	Barking.	Crossness.
	£	£
Interest at 3 per cent.	10,500	6,360
Depreciation, wear and tear, 5 per cent.	17,500	10,600
Precipitation	70,000	35,000
Pressing	30,000	15,000
Freight	24,090	12,045
Haulage and pier charges	15,056	6,000
	167,146	85,005
Total	£252,151	

Possibly some extension of our pier may be found desirable to avoid crowding our coal traffic, which must in no case be impeded; but this work will necessarily have to be incurred by-and-bye for the purposes of our own undertaking; and meanwhile I can see no reason why we should not execute it at once, and accept the Metropolitan Board of Works as temporary tenants at a fair rent if they like to come to us. In order, however, to prevent a cry of *ultra vires* being raised, the Metropolitan Board, who will be before Parliament next session for many objects, can easily insert a clause in one of their Bills conferring upon themselves and this company the power to enter into and carry out arrangements for the adaptation of a portion of our appliances, temporarily, to the great purpose of purifying the river Thames. This scheme could probably be brought into operation in from six to twelve months, as pier extension was or was not found to be required, and should form the subject of a ten years' concession.

Crossness stands on a different footing from Beckton because, the Gas Light and Coke Company having no premises there, it is necessary in making an estimate of the expense of dealing with the 340 tons a day of Surrey-side sewage, to add the cost of land to be purchased, and a railway and pier to be constructed by the Metropolitan Board of Works, and occupying probably also a year's time; which done, the only disbursement to be there made by them would be to the shipowner the agreed sum per ton for freight.

Second, as to the wet sewage mud or sludge. In dealing with this we have, of course, to handle, as Sir Joseph Bazalgette has indicated, a very much larger tonnage, and that in such a shape as to render it doubtful whether, except at great cost, our ordinary screw colliers could be altered so as to admit of the breaking bulk of a fluid cargo in a gale of wind without danger. It would, therefore, be expedient to build hopper craft for this express object. These, including American "Dumpers," are of several descriptions and of various prime cost, ranging from £5000 to £20,000 a piece, according to the duty to be performed. In rough water outside the Nore sea-going ships, such as are employed in the Mersey, are, I think, the best suited to this peculiar service. They are also the most costly.

The Parliamentary powers of the Gas Light and Coke Company do not permit the application of its capital to other than the purposes of our own undertaking. Unless, therefore, the Metropolitan Board of Works themselves perform the duty, it would become necessary to make a change in the contracting body by incorporating an independent company—for the formation of which I have all the elements at my disposal—with power to raise the necessary capital. The vessels to be built—be they barges, or dumpers, or steamships—must be devoted entirely to sewage work. They could not possibly obtain the return freight which forms so attractive a feature to the owner of the screw collier; and those who advise me think they could not be made to pay with a less freight than 2s. per ton of sludge shipped, and a concession for twenty-five years.

The process is no experiment; it is in successful operation in numerous places, and it is not only perfectly feasible in London, but would in many respects be simpler in execution than the one first described. But the service being a disagreeable one, it must be paid for in proportion, and I fear it would prove in the long run the less advantageous of the two. Pumping sludge is a slow process, and very different from pumping water. It demands higher remuneration, because it occupies more time. Quick despatch is the essence of a steamer's success, and if steamers are employed they must be paid for delay.

Our pier at Beckton may not be available for any except our own ships bringing coal, and an additional fleet of special steamers, which could, perhaps, hardly be accommodated there, might have to take their cargo on board elsewhere. So the Metropolitan Board must reckon upon having, for this system, to build two piers, each furnished with a very large delivering main from the pumps to the vessel's side, and the cost of this system would probably be about as follows:—

Capital Outlay—Sludge System.

	Barking.	Crossness.
	£	£
Precipitation tanks	200,000	100,000
Pumps	20,000	10,000
Pier	20,000	20,000
Main pipe	5,000	5,000
	245,000	135,000
Total for both sides of the river	£380,000	

Annual Expenditure—Sludge System.

	Barking.	Crossness.
	£	£
Precipitation	70,000	35,000
Interest at 3 per cent.	7,350	4,050
Depreciation, wear & tear, 5 per cent.	12,250	6 750
Pumping and labour	15,000	7,500
Freight at 2s.	73,000	36,500
	177,600	89,800
Total	£267,400	

Ship or barge building, piers, and other works for this scheme would, I think, occupy more than a twelvemonth. It will thus be seen that if I am right the annual outlay on the sludge would be somewhat larger than I estimate it on the present system; and, in my judgment, the objections to the sludge system do not stop here, although I admit they are more for the Metropolitan Board's consideration than for mine.

It is absolutely essential to provide storage for, say, a week. Vessels of all kinds are liable to detention through foggy weather, and although our colliers come through nearly everything and as a rule arrive at Beckton with the punctuality almost of clockwork, still I have known instances when five or six or more of them have been lying together at anchor, down at Tilbury or elsewhere, unable to move until a fog lifted, and on one memorable occasion, after a frightful gale which lasted for three whole days, seventeen ships came up for discharge on the same tide. Even this state of things was exceeded on Monday last, when twenty-five ships which had been weather bound came up to Beckton for discharge at the same time. It would be vastly more expensive to provide storage for 3000 tons a day of sludge than 1000 tons a day of dried and pressed sewage. The latter, representing a substance easily handed as well as so very much smaller in bulk, could be stored anywhere, and subsequently shipped without much trouble. The Leyton people, who adopt the pressed system, say that their sludge is not as 3 to 1 of pressed matter but as 5 to 1, which would result in a large difference in favour of the dried and pressed system. But in dealing with Sir Joseph Bazalgette's problems I prefer to deal also with his own figures.

As I have before observed, both systems are, in the opinion of practical men, perfectly feasible, and the making one or other of them a success in the removal of the sewage of London is, in my opinion, a mere matter of money. The estimates which I have given above, although not minutely worked out, are, I believe, approximately accurate, or sufficiently so to enable an expert to say which of the two systems appears to promise the best for the purification of the Thames and the welfare of Londoners. We must not, however, lose sight of the fact that if sludge be taken out in hopper craft—not the most convenient to navigate in heavy weather—and discharged at twenty miles beyond the Nore, it may be found that the next tide will bring a portion of it back again to pollute the lower reaches of the Thames and to hinder navigation by the gradual accumulation of filthy mudbanks.

If all chance of this evil be removed by increasing the distance out at sea, you of course at the same time add to the cost. On the other hand, one or two points are worth remembering. The collier ships would, I suppose, be bound, if they discharged their dried cargo at sea at all, to throw it overboard in deep water only—experiments which have been made show that after saturation it would sink and be unobjectionable. If stress of weather obliged the ships to make their whole passage without a discharge, they have only to run to the Wear or the Tyne, the Commissioners of which provide the means of relieving all ships which apply to them of their ballast, and send it out in hopper barges and drop it into the sea. A screw collier would not, of course, adopt this plan by preference, because she would have to pay the Commissioners a proportion of the freight she had earned by her sewage cargo. But at present she gets no return cargo at all, and so does not earn a halfpenny on her northward voyage—and I believe it would be thought that half a loaf was better than no bread.

Neither of the questions put to me by Sir Joseph Bazalgette having any reference to the possible utilisation of sewage, it is with much diffidence that I venture to approach that branch of the subject.

If the Metropolitan Board decide upon the sludge system, and hopper vessels to get rid of it out at sea, there is, of course, an end of the matter. If, on the other hand, they dry and press the sewage, they at any rate give the owner of the screw collier the opportunity of trying to do something with it between the Thames and the Tyne. This is an age of discovery and invention, and with all the active brains which are at work in this matter, I cannot but think in time even London sewage must, with proper treatment, become a marketable commodity, if not as manure, then in some other way; and it further occurs to me that if the shipowner in time makes a profit of it, an alteration in the agreed conditions of freight would become a fair subject for reconsideration.

I communicated my ideas as above to Sir Joseph Bazalgette, and told him that on being favoured with his views, I would at once apply to the court of directors of this company for instructions to address myself minutely to the scheme which he the most favoured.

These alternative schemes have, however, been rejected on the recommendation of a committee of the Metropolitan Board of Works, who appear to have thought that my suggestion is that "the sludge might be taken out to sea by the company's coal steamers as ballast on their return voyages." But inasmuch as the committee's report, as epitomised in the minutes of the Board's proceedings, so far as they have been made public, conveys what I have not proposed, and fails to represent my actual suggestions in respect of either of Sir Joseph Bazalgette's inquiries, the foregoing description of what they really are may prevent misconception.

In conclusion, let me say that it must not be supposed that the Gas Light and Coke Company, if it assumes the duties and responsibilities above described, will derive large pecuniary benefit. Under the sliding scale of price of gas and shareholders' dividend, all metropolitan gas companies divide all profit beyond 10 per cent. with the gas consumers, the latter getting four-fifths and the company only one-fifth of the excess. Of whatever profits, therefore, which accrue to the company from this transaction, the company will be entitled to one-fifth, and the remaining four-fifths will, under the scrutiny of the Government Auditor, be applied in reduction of the price of gas to the consumer, to whom the Metropolitan Board of Works would thus be doing a good turn.

John Orwell Phillips,
Secretary and General Manager.

The Gas Light and Coke Company,
Horseferry-road Westminster,
December 7th.

THE VALUE OF INCANDESCENT LAMPS.

Sir,—It was not our intention to take any notice of the published results of the Franklin Institute tests on incandescent lamps, as, considering the very strong comments that had been made on the subject in the various electrical papers, we thought it most unlikely that any one would be misled by them. We have, however, been advised that unscrupulous persons—more especially on the Continent—have been taking advantage of these tests to disparage our lamps. We shall therefore be glad if you will allow us the opportunity of emphatically denying that any reliance is to be placed in them.

We were advised by our agent in America to have nothing to do with the tests, as they would not be trustworthy, the Swan, Maxim, and other makers of incandescent lamps having refused to allow their lamps to be entered. Lamps, however, stated to be ours, were entered without our knowledge or consent, half being actually supplied by the Edison Company, the chief competitors, and the rest being obtained from another electric lighting firm. Whilst being admittedly run at five volts above what they were labelled, giving out up to 40 or 50 per cent. above the proper candle-power, they were placed in competition with lamps evidently most carefully made and tested beforehand.

As an example of the way in which the electrical press has treated the tests, we may call attention to the *Electrical Review* of America, dated June 13th, in which are given verbatim reports of interviews with the president and secretary of the Institute, the latter stating that he refused to have anything to do with the incandescent lamp tests because he did not believe in them. Another official of the Institute stated some three months ago that it was very doubtful if the tests could be seen by outsiders, as the tests themselves did not agree.

Whilst in many instances disagreeing with the methods adopted in the actual tests, we refrain from criticising them, as we are well aware of the many difficulties that have to be contended with. We merely add that we think that the Institute ought to have seen that we were properly protected and advised of what was going on. We are glad to hear that there is some chance of complete tests being made in this country when every precaution will be taken to insure their being properly made.

Woodhouse and Rawson.

[We have already called attention in our impression for November 13th, page 377, to the untrustworthiness of lamp tests such as those made by the Franklin Institute.—Ed. E.]

THE ALBERT BRIDGE.

Sir,—My attention has been called to a very interesting article on this subject in your last impression. The paragraph as follows apparently refers to me:—"The Chelsea member of the Metropolitan Board has, according to the newspaper reports, expressed some anxiety as to the weight that a heavy fall of snow might impose on the bridge." I have never said or thought anything of the sort. Except in the case of a drift, a fall of snow would be fairly equal, and the pressure on the bridge would be equal. In a very heavy fall the traffic would be stopped. A little wind or a sudden thaw would make the snow slip, and fall into the water. I therefore see no danger on this head. What I have said is that the bridge is not safe, and although your article tends to prove that this bridge is so strong that no restriction as to the kind of traffic need be made, I venture to think that, however good may be the principle on which the bridge ought to have been built, in practice the result has not been attained. Mr. Ordish's intention was to have link chains; these he did not get, but in the place of the links he had to use against his better judgment the wire rope which we now see splitting in all directions. This wire rope ought to have been protected from the wet and air, to prevent rust and decay, but the then company had not the necessary money, and the ship was spoilt for the want of the "pen'orth of tar." We never got Ordish's scheme carried out. This is no more Ordish's scheme than a house designed by Ordish on which in his plan he put proper roofs, the roof is forgotten and the house is not watertight. If, Sir, you will be so good as to stand on the bridge when a handsome cab drives fast over it, I do not think you will be so satisfied as you are now as to its stability.

What I have alleged as to the safety of the bridge has been confirmed by business friends and by Mr. Strachan, C.E., the Chelsea surveyor. Sir Joseph Bazalgette and his experienced son, who has charge of the bridges, have arrived at the conclusion that the bridge is not safe. The Board has adopted this opinion, and had they a doubt on the subject I need hardly say they would have taken a second opinion. Links will now be adopted, but it is clear that Sir Joseph Bazalgette does not agree with your views as to the strength of the bridge when the wires are removed, otherwise why should he require the temporary piers to be erected whilst the alterations are going on? If the bridge is as strong as you allege without the chains, then all these piers will be entirely unnecessary. I do not think Sir Joseph Bazalgette is the man to incur useless expense.

Charles Mossop.

Cannon-street, London, December 9th.

[The temporary piers are used to prevent deformation of form, due to the sagging of the diagonals. But this does not imply that the bridge is weak. It is quite right that the wire ropes should be removed, but it is right only because they are decaying.—Ed. E.]

WATER METERS.

Sir,—Considering that for more than half a century patents have been applied for—and that in considerable numbers too—for water meters, I think it is no exaggeration to attach to these instruments a certain amount of importance, and to admit that they belong to the things needful to society. For these and other reasons would it be very useful if we could know in how far we have succeeded in solving the problem, and I think the best way to arrive at the truth would be a public testing of as many systems of water meters as could be brought together, with searching experiments conducted by some of our waterworks engineers, who, I am sure, would be willing to lend a helping hand. Let gold and medal be rigorously excluded, and the testing be done in all fairness and honour for the sake of arriving at some standard value of these instruments.

J. A. Muller, C.E.

6, St. Paul's-churchyard, E.C.,
December 2nd.

Naval Engineer Appointments.—The following appointments have been made at the Admiralty:—William H. Grant, engineer, to the Cockatrice; Walter J. Graham, assistant engineer, to the Belleisle; and Charles A. Moore, assistant engineer, to the Inflexible; William E. Pilcher, chief engineer, to the Indus, for the Invincible; John Pitt, chief engineer, to the Indus, for the Archer; and John a'Court, chief engineer, to the Indus, for the Hyacinth; George T. J. Ludlow, assistant engineer, to the Polyphemus; John S. Rees, engineer, to the Pembroke, for the Hero; John W. Pleming, assistant engineer, to the Ajax; and F. G. Harding, assistant engineer, to the Pembroke, for the Severn.

RAILWAY MATTERS.

TWO trains on the cable railway across East River Bridge, New York, came into collision on Saturday. Six passengers were severely hurt, and others less seriously. A defective "grip" caused the accident.

THE passenger train from Normanton, due at Leeds at 2.15 a.m., on the Midland Railway, met with an accident on Tuesday, and ran hard into the buffers at the station. The buffers were displaced, and much damage was done to the stone and earthwork. The permanent way was injured, engine damaged, and passengers injured—one seriously.

IT appears from a work by M. Nicolai, on "The Railways Worked by the Belgian Government," that of the forty-nine years from 1835 to 1883 twenty-one were profitable and twenty-eight the reverse, but the profit of 161,747,150f. during the good years leaves, over the 81,784,430f. of loss, a balance to the good of 19,962,720f., or £798,508. The last few years were the least productive, the deficit having continued without remission since 1872.

THE following cases were reported to the Board of Trade as accidents on our railways, which, during the nine months ending September, involved no personal injury:—24 cases of trains running through gates at level crossings; 640 failures of tyres; 1 failure of a wheel; 3 failures of ropes used in working inclines; 2 failures of bridges; 206 broken rails; 5 flooding of the permanent way; 5 slips in cuttings or embankments; 9 fires in trains; 6 fires at stations or involving injury to bridges or viaducts; and 2 other accidents.

AT a special meeting of the shareholders of the Birmingham Tramways and Omnibus Company, held at Birmingham on Tuesday, to consider the desirability of selling the company's business and profits to the Birmingham Central Tramways Company, the resolution: "That the terms of the provisional agreement, dated November 18, 1885, for the sale of the company's business and property to the Birmingham Central Tramways Company, be approved," was adopted, and formal resolutions were passed without comment, deciding to wind up the company voluntarily and giving the necessary powers to the liquidators.

AT departure of recent mail the annual report of the Railway Commissioners of Victoria had been laid before Parliament. It dealt with the working of the railways since the Commissioners took office eighteen months ago. The result of the first six months of management showed the net earnings to be equal to 2 per cent. on the capital expended upon the construction of railways, namely, £21,893,386. The gross revenue for the financial year 1885 was £2,181,932, and the working expenses £1,277,425, leaving a net revenue of £904,507, which was equal to 3·95 per cent. on the capital of railways open for traffic, and 4·54 per cent. upon the expenditure out of debenture capital upon railways open for traffic.

THE contract for the construction of the ironwork of bridges on the Hergott and Strangways Springs Railway, South Australia, had, at departure of recent mail, been let to a colonial tenderer, Mr. Edwin Smith, of Port Adelaide, the price being £15,554 1s. 9d. Five South Australian firms tendered for the work, Mr. R. Lindsay heading the list with £20,174 1s. 6d. The names of the English tenderers were not given in the *Government Gazette*, but it is said there was a remarkable coincidence in the official estimates and the home tenders. The want of these bridges has materially delayed the construction of the railway, and the *Colonies and India* says it will be the middle of next year before any of the bridge ironwork will be ready for erection.

THE following affords another remarkable illustration of the value of automatic brakes. On Sunday, November 15th, an accident happened to the Indian Mail train on a piece of straight road at a distance of about 4 kilos. from Aiguebelle on the Modane-Chamberg line of the Paris, Lyons, and Mediterranean Railway. The whole train, with the exception of the engine, left the rails when travelling at a speed of at least 70 kilos. an hour, the cause being attributed to the spreading of the permanent way. Owing to the fracture of a screw coupling the Westinghouse brake was automatically applied and brought the train to a stand in a distance of 200 metres. But notwithstanding this, three of the mail vans were very much damaged, two being overturned and thrown some 30 metres from the line. The large bogie sleeping car which was in the train, although it left the rails, was not damaged, nor were any of the passengers injured; the only person hurt was the rear guard.

IN a report to the Board of Trade on the accident which occurred on the 21st September last in the Thames Tunnel, on the East London Railway, Major General Hutchinson says:—"The occurrence of this accident must be attributed to high speed on a light road unsuited for high speeds, especially with tank engines of the heavy character employed in working the traffic on the Metropolitan and District Railways. A permanent way of the description in question—consisting of steel rails originally 78 lb. to the yard, but deteriorated by wear to only 66 lb. to the yard, secured in 25 lb. chairs, fastened by two spikes and trenails in each chair to longitudinal timber 13in. or 14in. wide by 7in. thick, the chairs being at an average central interval of 2ft. 7½in.—was certainly far too light a one for the running over it at high speed of heavy engines of the class employed by the Metropolitan and District Railway Companies, and the fastenings of the chairs to the longitudinals was specially unsatisfactory, as it left only from 1½in. to 2in. between the centre of the spike holes and the edges of the longitudinals, affording but very poor resistance to pressure outwards arising from oscillation or any other cause. Since the accident the South-Eastern Company has been engaged in relaying both lines of the tunnel with a new permanent way of a much heavier character than the old one, cross sleepers being substituted for longitudinal ones. The speed also has been restricted to fifteen miles an hour. Too much attention cannot be bestowed upon keeping in a high state of efficiency the permanent way in so dangerous a part of the line as the Thames Tunnel." Surely the extravagance of constructing a good line must have been incurred without the knowledge of Sir E. Watkin.

MR. WILLIAM H. VANDERBILT, the well-known "Railway King," dropped down dead on Tuesday at his residence in New York. The cause of death was paralysis of the brain. The event took place at three o'clock, and was not announced until after the Stock Exchange was closed. The news of Mr. Vanderbilt's death is most unexpected and startling. Some time ago he resigned the presidency of the New York Central and Hudson River Railroad Company, retaining, however, a seat on the board, and continuing to take an active part in the affairs of the company, which seems to indicate that, though still vigorous, he did not feel himself quite equal to arduous routine work. Either the decision to relieve himself of part of his duties was taken too late or the strain of the last two years had been too much for him. A Philadelphia correspondent remarks that he had been in precarious health for some time. Some years ago, before the great "war of rates" in 1881, Mr. W. H. Vanderbilt was certainly the richest man in the world. The exact amount he was worth was not, of course, known, but the general belief was that he had inherited property equal to something like sixteen millions sterling on his father's death and had since doubled it. It is said that he invested ten millions sterling in United States Government Stock about the time when he ceased to be the nominal president of the New York Central, possibly as a precaution against a rainy day. Mr. Vanderbilt was the second son of Mr. Cornelius Vanderbilt. He was born about 1821, on Staten Island. He received only the ordinary education of an American youth, and did not show much ability until he was approaching thirty years of age. His father had regarded him as quite unfit to follow in his own footsteps, but "The Commodore" found out eventually that his son was by no means stupid though he had developed slowly. Mr. W. H. Vanderbilt married Miss Kissum, a lady of Dutch origin, who influenced him and stirred his ambition.

NOTES AND MEMORANDA.

IN the American Post-office the legal ounce is fixed at thirty grammes.

IN Greater London last week, 3424 births, and 1915 deaths were registered, equal to annual rates of 34·4 and 19·2 per 1000 of the population.

ACCORDING to a census taken on December 1st, the population of Berlin now numbers no less than 1,316,382, which thus shows an increase of about 200,000 since the last census, taken just five years ago.

THE Shaw Savill and Albion Company's steamer, Arawa, 5025 tons, is keeping up her reputation for speed. She has recently arrived at Plymouth after another very fast run, having accomplished the voyage from Auckland, New Zealand, in 38 days 10 hours 48 minutes, with a frozen meat cargo in splendid condition for the market.

THE deaths registered for the week ending December 5th in twenty-eight great towns of England and Wales correspond to an annual rate of 20·2 per 1000 of their aggregate population, which is estimated at 8,906,446 persons in the middle of this year. The six healthiest places were Birkenhead, Sheffield, Huddersfield, Plymouth, Birmingham, and Hull.

IN some experiments with Leclanché batteries, Dr. Emil Boettcher used for the negative element plates consisting of 40 per cent. of retort carbon, 55 per cent. of manganese, and 5 per cent. of binding medium, the whole being combined under a hydraulic pressure of 200 atmospheres. The dimensions of the plates were 12 cm. long, 4·2 cm. wide, and 2 cm. thick.

IN London last week, 2656 births and 1544 deaths were registered. The annual death-rate per 1000 from all causes, which had increased in the five preceding weeks from 17·5 to 20·6, declined again last week to 19·7. During the first nine weeks of the current quarter the death-rate averaged 18·7, and was 2·1 below the mean rate in the corresponding periods in the nine years 1876-84.

AT a recent meeting of the Paris Academy of Sciences a paper possibly of importance in electric cable manufacture was read on the gutta-percha of *Bassia*—Butyrospermum—*parkii*, G. Don, and its chemical composition, by MM. Ed. Heckel and Fr. Schlagdenhauffen. The gutta-percha obtained from this plant is said to be in every respect comparable to, and in structure almost identical with, that yielded by the better-known *Isonandra gutta*, Hooker.

FROM statistics just published, it appears that the production of all descriptions of steel in the United States since 1874 has been as follows:—1874, 241,614 net tons; 1875, 436,575 tons; 1876, 597,174 tons; 1877, 637,972 tons; 1878, 819,814 tons; 1879, 1,047,586 tons; 1880, 1,397,015 tons; 1881, 1,778,912 tons; 1882, 1,945,095 tons; 1883, 1,874,359 tons; 1884, 1,736,985 tons. The principal steel manufacturing State of the Union is Pennsylvania, which, of the 1,736,985 tons of steel made last year, produced 1,157,376 tons.

A RETURN has been issued of the number of factories authorised to be inspected under the Workshops and Factories Acts, with the number of persons employed in each industry. It appears that 7465 factories are under inspection in the United Kingdom—namely, 6359 in England and Wales, 776 in Scotland, and 330 in Ireland. These factories give employment to 1,034,261 persons, of whom 405,013 are males, and 629,248 females. The total number of throwing spindles and spinning spindles is 47,831,855; of doubling spindles, 5,256,969; and of power looms, 773,704.

DURING the year ended the 30th June, 1884, there were 3647 shipping casualties on our shores; but, although this number is terribly large, it was exceeded during the preceding year by seven wrecks. While the casualties of the year ended the 30th June, 1883, entailed the loss of 1020 lives, those of the year ending June, 1884, resulted in the loss of 661 lives only, or a decrease of no less than 359. The 3647 wrecks include all classes of casualties—total loss, of which there were 407, partial loss, collisions, &c.—and when the total is subdivided it is found that the more serious cases of wrecks fell from 551 to 473, leaving a balance of 3174 to represent minor accidents.

ACCORDING to experiments by M. Senff, the yield of crude pyroligneous acid, tar, charcoal, and gas is almost the same with the most different woods. But the richness of the acid waters in acetic acid, and consequently the yield of dehydrated acid, vary greatly. In this respect the wood of coniferous trees is the least valuable. The wood of the trunk furnishes more acid than that of the branches. The wood yields more acid than the bark, and sound wood more than dead wood. Rapid calcination yields more gas at the expense of the condensed products and of the charcoal; it yields also the weakest acid waters, and the charcoal is more hygroscopic than that furnished by a gradual action.

IN the report which has been recently issued by the General Superintendent of the Life-saving Service, for the fiscal year ended June 30th, 1884, it is stated that there were then 201 life-saving stations under their management, 156 being on the Atlantic, 37 on the lakes, seven on the Pacific, and one at the Falls of the Ohio, Louisville, Ky. There were 156 disasters in the course of the year to documented vessels within the field of station operations. There were 4253 persons on board these vessels, of whom 4237 were saved, and only 16 lost. The number of vessels totally lost was 64. In addition, there were 102 disasters to smaller craft, such as sailboats, row-boats, &c., on which were 179 persons, 175 of whom were saved and four lost.

THE synthesis of saccharose having been accomplished by Messrs. Aubert and Giraud, it is anticipated, says a contemporary, that the discovery may prove most important to the sugar industry. Amylaceous matter obtained from the potato, having been converted into glucose in the usual manner, is submitted to the action of an electric current equal to about seventy-five volts. The electrodes were immersed in the solution, and the current reversed from time to time. In about two hours the reaction terminated, as indicated by the liquid no longer giving the characteristic colour with tincture of iodine or a precipitate with alcohol. The liquid was then defecated with lime, which was subsequently removed by carbonic anhydride, and the syrup was decolorised and crystallised. On analysis it yielded 88·38 per cent. of saccharose, but was far from being cane sugar. It is questionable whether the reaction consists in the dehydration of glucose, the union of a molecule of dextrine with one of glucose, or the hydration of dextrine.

ACCORDING to a paper in the *Chemical Society's Journal* "On the Chemical Action of Light," by J. M. Eder, when a solution of potassium ferricyanide is decomposed by light, potassium ferrocyanide, soluble Prussian blue, and hydrocyanic acid are formed. The rate of decomposition is increased by the addition of potassium oxalate or citrate, uranic sulphate, or mercuric chloride. Ammonium ferricyanide is more easily decomposed than the potassium salt. A mixture of ferric chloride and potassium ferricyanide decomposes much more rapidly in the presence than in the absence of light. Sodium nitroprusside is twenty times as sensitive as the ferricyanide. A mixture of nitroprusside and ferric chloride is almost as sensitive as ferric oxalate. Solutions of potassium and ammonium copper oxalates are stable, but sodium copper oxalate blackens on exposure to light, without alteration in weight. Fehling's solution deposits cuprous oxide on exposure to the light. The addition of ammonium oxalate to sodium sulphindigotate renders the latter sensitive to light. Chlorine-water on exposure to light decomposes from six to twelve times as rapidly as bromine-water of the same strength, and is about 1000 times as sensitive as an alcoholic tincture of iodine; tartaric and citric acids increase the rate of decomposition. A solution of ammonium dichromate in absolute alcohol decomposes more rapidly than a solution in 50 per cent. alcohol. Mercurous iodide is very sensitive to light. Neither iodine nor hydriodic acid is liberated. According to the author, the following reaction takes place:—$3Hg_2I_2 = 2Hg + Hg_4I_6$.

MISCELLANEA.

MESSRS. WM. LEVETT AND CO., Limited, cement manufacturers, of 81, Gracechurch-street, London, E.C., have secured an order from a Sydney firm for the supply of 120,000 casks of Portland cement. We understand the cement is principally for Government contracts.

IT is reported that a number of St. Petersburg capitalists have combined for the formation of a joint-stock company for refining sugar by the American Friend electrical process. It is said to be beyond doubt that the process will considerably reduce the cost of Russian refined sugar.

MESSRS. J. H. PECK AND CO., of 4, Goree, Liverpool, are making a new, simple, effective, and cheap ambulance for use in mines, and in any places where accidents are not unusual. It is so made as to be attachable quickly to any vehicle or to be carried by two men, and is already widely approved.

THE engineering employers of Sunderland have received a notice from the secretary of the local district committee, Amalgamated Society of Engineers, Sunderland, saying that he is instructed by this committee to inform them that the strike circular of June, 1883, is withdrawn by them from the 28th day of November, 1885.

A TERRIFIC storm broke over Colon on Wednesday and Thursday, the 2nd and 3rd inst., and caused great damage. Fourteen vessels were sunk and many persons were drowned. The docks of the Royal Mail Company and of the Pacific Mail Company were seriously damaged. The Royal Mail office was dislodged from its foundations by the heavy seas dashing against it. Portions of the Panama Railway were submerged and traffic was suspended.

MESSRS. JOHN AND HENRY GWYNNE have just shipped a complete installation of their "Invincible" pumping machinery, to be put down for the Russian Government to empty the new Government graving dock at Sebastopol. The plant consists of two main pumping engines, jointly able to raise 100 to 120 tons of water per minute 45ft. high; one auxiliary engine, to raise 10 tons per minute 48ft. high; four auxiliary engines, for drainage and boiler-feeding purposes; and five magnificent boilers of locomotive type.

MR. A. M. CHAMBERS—Messrs. Newton, Chambers, and Co., Thorncliffe—delivered his inaugural address at the Royal Victoria Hotel, Sheffield, on Tuesday, as president of the Midland Institute of Mining, Civil, and Mechanical Engineers. He advocated the establishment of a mining college in every important mining district, at which not only mining students could get the training they needed, but where popular elementary lectures were delivered, at which miners, especially young men, who desired to become officials in the mines, might obtain some insight into the difficulties and dangers of mining operations, and the means to solve the one and avert the other.

MR. J. D. ELLIS, C.E., chairman of Messrs. John Brown and Co., Sheffield, presided on Saturday evening at the twentieth annual dinner of the Leeds Association of Foremen Engineers and Draughtsmen. He stated that the iron trade was not in a flourishing condition either in Leeds, in Cleveland, or in Staffordshire, while in Sheffield it was very far from being satisfactory. If they had not taken full advantage of the developments in machinery the iron trade of Sheffield would scarcely exist at all now. The state of the iron and steel trade he regarded as critical, owing to the transition which was taking place in regard to both. On steel castings Mr. Ellis strongly urged the importance of giving as much time as possible, for it was important that steel should be heated slowly, remain heated a long time, and cool slowly. Therefore, if anybody told them he could make a 40-ton casting and deliver it in a fortnight, they must depend upon it he could do nothing of the kind.

AT the half-yearly general meeting of the Lambeth Waterworks Company held last week at Brixton-hill, as usual, reporters for newspapers were refused admission, this company being the only metropolitan water company besides the Kent Company which still excludes the representatives of the Press from its meetings. The report of the directors for the half-year ended September 30th last, submitted to the meeting, stated that during that period 1503 houses and other supplies of water, producing an annual water rental of £4201, had been connected with the company's works, as against 1649 houses, yielding a rental of £4410, in the corresponding period of 1884. During the half-year £24,696 had been spent on capital account, making, since the passing of the Metropolis Water Act in 1871, a totally outlay on new works, &c., of £682,785. The revenue account exhibited increases of £2394 in the water rents, &c., and of £3144 in the expenditure as compared with the six months ended September 30th, 1884. During the half-year 2680 houses had been changed from intermittent to constant service. The total number of houses, &c., having a constant supply of water at high pressure was now 39,796. After paying debenture stock interest there was an available sum of £60,555, and a dividend at the rate of 7½ per cent. per annum was recommended.

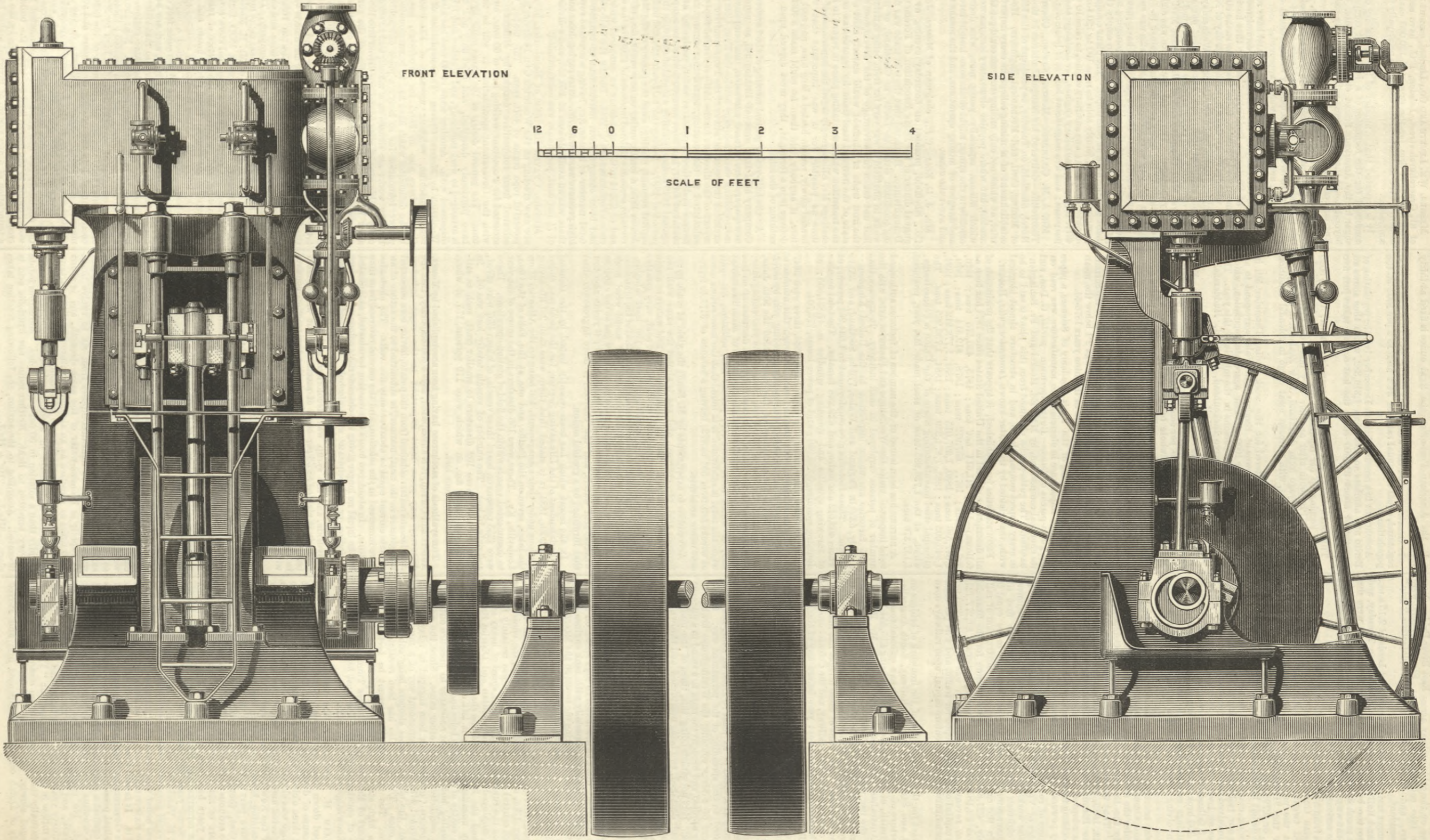
MESSRS. CRAVEN BROTHER, of Manchester, have delivered and are now erecting at the Woolwich Gun Factories an exceptionally powerful rope crane of 46ft. span. This crane, which has been selected from competitive designs by different makes, is constructed for a constant working load of 60 tons, but in accordance with the Government specifications it will be tested up to 120 tons. The general design of the cranes made by Messrs. Craven have previously described, and need only add that this crane is arranged to work noislessly, and clutches and friction cones are dispensed with. Another crane of 30 tons has also been made for Woolwich by Messrs. Craven The completion of the large gun-boring machine, weighing upwards of 150 tons, that Messrs. Craven have also in hand for Woolwich, has been delayed by the difficulties which have had to be surmounted in preparing a proper foundation for so heavy a piece of machinery. The Gun Factory works are situate on a marsh, and to surmount this difficulty double rows of piles have been driven into the ground; these, after being sawn off within about 6in. of the surface, have been covered over with a substantial foundation of cement and concrete, which has been allowed to rest for several months so that there may be a perfect consolidation. Over this foundation strong iron cross girders have been laid down, and between these girders a further layer of cement and concrete has been filled in, the whole forming the foundation upon which the boring machine is to be erected.

MESSRS. R. AND J. DEMPSTER, of Newton Heath, Manchester, have just completed important alterations and extensions at the Grangetown works of the Cardiff Gas Company. These extensions, which have been in progress for the past eight months, and have been carried out from the designs of Mr. H. Morley, the engineer to the company, embrace a new retort 133ft. long by 51ft. wide, containing 100 retorts, with a large coal store running parallel to this building, and prepared for the erection of railway sidings the full length of the stores. Both retort house and coal stores are covered by iron roofs, having a specially designed system of smoke ventilation. There has also been erected a duplicate set of exhausters, each capable of passing 70,000 cubic feet of gas per hour; these exhausters are of the rotary type, and are arranged with a horizontal steam engine in the centre, so that either one or both of the exhausters can be worked by the same engine, the connection being made by improved coupling boxes. Near the exhauster house a set of new condensers has been erected; these consist of six annular columns of wrought iron 30ft. high by 3ft. 6in. diameter of the outer tube and 2ft. 6in. diameter of the inner. These have been connected to the existing condensers and surmounted by a massive ornamental cornice. Adjacent to the condensers are erected two of Messrs. R. and J. Dempster's patent tower scrubbers 10ft. diameter by 50ft. high, fitted with boards, and having handsome machinery rooms, balcony, and spiral staircase. Mr. Morley the engineer, had one great difficulty connected with the above work, owing to the marsh land on which the buildings had to be erected, but this was successfully overcome by the introduction as a foundation of a new system of inverted arches built in cement,

COMPOUND "INVINCIBLE" ENGINE—FIRST AVENUE HOTEL.

MESSRS. J. AND H. GWYNNE AND CO., HAMMERSMITH, ENGINEERS.

(*For description see page 462.*)



FOREIGN AGENTS FOR THE SALE OF THE ENGINEER.

PARIS.—Madame BOYVEAU, *Rue de la Banque.*
BERLIN.—ASHER and Co., 5, *Unter den Linden.*
VIENNA.—Messrs. GEROLD and Co., *Booksellers.*
LEIPSIC.—A. TWIETMEYER, *Bookseller.*
NEW YORK.—THE WILLMER and ROGERS NEWS COMPANY, 31, *Beekman-street.*

TO CORRESPONDENTS.

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

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

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

A. W. N. (Lewes).—*With steam* 50 *lb. pressure, the engine will make about* 1½*-horse power at* 300 *revolutions per minute.*

J. W. T.—*We do not know the address of the secretary of the Inventor's Syndicate. Perhaps some of our readers can tell you.*

J. H.—*The temperature at which water boils depends on the pressure of the steam above it. Thus, in a locomotive carrying* 165 *lb. steam, the water boils at not* 212 *deg., but* 373 *deg.*

Z. A.—*There is no one book that will meet your requirements. The best books for your use are, perhaps, "Electricity: its Theory, Sources, and Applications," by J. T. Sprague, published by Spon,* 125, *Strand; "Elementary Lessons in Electricity and Magnetism," by Silvanus P. Thompson, published by Macmillan and Co. You should also have "Practical Electric Units," by James Swinburne, published by Spon; and "Electric Light Arithmetic," by R. E. Day, published by Macmillan and Co.*

CASTING PULLEYS.

(To the Editor of The Engineer.)

SIR,—The arms of my band pulleys or drums—especially light rims and heavy bosses—sometimes break, when the castings are cooling, from contraction. Is there any special metal or other material that could be used to join by fusion or burning the broken or cracked arms, and make a good job of the casting? I hear this is usually done where numbers of pulleys are made. FOUNDER.

December 2nd.

[The arms should be curved to give some elasticity. Some hematite added to the mixture from which they are cast will give toughness and prevent fracture. The arms can be joined together by what is called burning with ordinary cast iron by a clever foundryman. It is possible, in certain cases, to cast the rims a little before the arms, the latter, with the boss, being supplied from the runners in the rim. This tends to produce equal contraction.—ED. E.]

SUBSCRIPTIONS.

THE ENGINEER *can be had, by order, from any newsagent in town or country at the various railway stations; or it can, if preferred, be supplied direct from the office on the following terms (paid in advance):—*

Half-yearly (including double numbers) .. .. .. £0 14s. 6d.
Yearly (including two double numbers) .. .. .. £1 9s. 0d.

If credit occur, an extra charge of two shillings and sixpence per annum will be made. THE ENGINEER *is registered for transmission abroad.*

Cloth cases for binding THE ENGINEER *Volume, price* 2s. 6d. *each.*

A complete set of THE ENGINEER *can be had on application.*

Foreign Subscriptions for Thin Paper Copies will, until further notice, be received at the rates given below:—Foreign Subscribers paying in advance at the published rates will receive THE ENGINEER *weekly and post-free. Subscriptions sent by Post-office order must be accompanied by letter of advice to the Publisher. Thick Paper Copies may be had, if preferred, at increased rates.*

Remittance by Post-office order. — Australia, Belgium, Brazil, British Columbia, British Guiana, Canada, Cape of Good Hope, Denmark, Egypt, France, Germany, Gibraltar, Italy, Malta, Natal, Netherlands, New Brunswick, Newfoundland, New South Wales, New Zealand, Portugal, Roumania, Switzerland, Tasmania, Turkey, United States, West Coast of Africa, West Indies, Cyprus, £1 16s. China, Japan, India, £2 0s. 6d.

Remittance by Bill in London. — Austria, Buenos Ayres and Algeria, Greece, Ionian Islands, Norway, Panama, Peru, Russia, Spain, Sweden, Chili £1 16s. Borneo, Ceylon, Java, and Singapore, £2 0s. 6d. Manilla, Mauritius, Sandwich Isles, £2 5s.

ADVERTISEMENTS.

*** *The charge for Advertisements of four lines and under is three shillings, for every two lines afterwards one shilling and sixpence; odd lines are charged one shilling. The line averages seven words. When an advertisement measures an inch or more the charge is ten shillings per inch. All single advertisements from the country must be accompanied by a Post-office order in payment. Alternate advertisements will be inserted with all practical regularity, but regularity cannot be guaranteed in any such case. All except weekly advertisements are taken subject to this condition.*

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

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

MEETINGS NEXT WEEK.

THE INSTITUTION OF CIVIL ENGINEERS, 25, Great George-street, Westminster.—Tuesday, Dec. 15th, at 8 p.m.: Ordinary meeting. Further discussion, in conclusion, "On High-speed Motors," by Mr. John Imray, M.A., M. Inst. C.E. "Continuous-current Dynamo-electric Machines, and their Engines," by Mr. Gisbert Kapp, Assoc. M. Inst. C.E. Friday, Dec. 18th, at 7.30 p.m: Students' meeting. Paper to be read and discussed: "The Propulsion of Tramcars and Launches by Secondary Batteries," by Mr. F. Geere Howard, Stud. Inst. C.E. Mr. Preece, F.R.S., Member of Council, in the chair.

CLEVELAND INSTITUTION OF ENGINEERS.—Monday, Dec. 14th, at 8 p.m.: List of elections since last meeting. Adjourned discussion upon "Modern Practice in Slide Valves," being paper read at last meeting by Mr. Tom Westgarth, Middlesbrough. Paper "On the Tower Spherical Engine," by Mr. R. H. Heenan, M.I.C.E., M.I.M.E., Manchester. Discussion on the above.

SOCIETY OF ARCHITECTS.—A special general meeting will be held in the Freemasons' Tavern, Great Queen-street, on Tuesday, Dec. 15th, at 7 p.m., to consider the proposed alterations in the rules of the Society.

ROYAL METEOROLOGICAL SOCIETY, 25, Great George-street, Westminster, S.W.—On Wednesday, Dec. 16th, at 7 p.m., the following papers will be read: "The Influence of Forests upon Climate," by Dr. A. Woeikof, Hon. Mem. R. Met. Soc. "Report on the Phenological Observations for 1885," by the Rev. T. A. Preston, M.A., F.R. Met. Soc. "Etudes sur les Crépuscules Rosées," by Professor A. Ricco. "The Storm of October 15th, 1885, at Partenkirchen, Bavaria," by Col. M. F. Ward, F.R. Met. Soc., F.R.S.

SOCIETY OF ARTS, John-street, Adelphi, London, W.C.—Monday, Dec. 14th, at 8 p.m.: Cantor Lectures. "The Microscope," by Mr. John Mayall, jun. Lecture IV.—Objectives, oculars, and accessory apparatus. Wednesday, Dec. 16th, at 8 p.m.: Fifth ordinary meeting. "Burmah, Present and Future," by Mr. Holt S. Hallett.

THE ENGINEER.

DECEMBER 11, 1885.

STEEL BOILERS.

THE makers of basic Bessemer steel will read without satisfaction the remarkable narrative of Mr. Maginnis, which will be found on another page. It is an important chapter in the history of steel. To a very great extent his experiences are abnormal. On more than one occasion steel plates have manifested a treacherous disposition; but they have manifested it early in their career. Unable to conceal their duplicity, if we may use the metaphor, they have betrayed themselves almost before they were put to the proof. In the case described by Mr. Maginnis the boilers were put to work not only without suspicion, but with perfect confidence. For two years and a-half they gave satisfactory results. At the end of that time the owners discovered that glass boilers would probably have been quite as safe. No doubt for a considerable period the crew of the ships in which the boilers were went with their lives in their hands. With the pressures now carried the failure of a boiler shell would mean prompt destruction; because there is no reason to doubt that the inside would practically be blown out of a ship in which took place such a boiler explosion as we contemplate. We hear but too often of the disappearance of steamers which start on a voyage and are never more seen, and the unpleasant surmise will arise that a boiler shell has given way, with the inevitable result of forcing a huge hole in the hull of the ship, sending her straightway to the bottom. We fear that it will be more difficult than ever to argue that such things cannot take place with Mr. Maginnis's story before us.

The failure of these boilers is remarkable for its thoroughness. There is a tale told concerning a man who held that the reason why his gig broke, now a shaft, then a spring, was simply that one part was weaker than another. He drew a practical lesson from this theory, and had a gig built equally strong all over. He used it without repairs for a quarter of a century, then a wheel gave way, and all parts being equally strong everything else broke at the same moment, leaving the lucky owner of the gig seated in the middle of the road on a heap of fragments. The boilers cited by Mr. Maginnis behaved very nearly like this traditional gig; no part seems to have been stronger than the rest. To what cause are we to attribute the rapid deterioration of these boilers? There can, we think, be but one answer—internal strains led to total disruption. The truth is, that we live in a world of mystery—no man knows to what the tensile strength of steel or any other material is due. The molecular theory tells us that the steel plates of such boilers are composed of so many grains, so to speak, of steel sand, held together by a force of the nature of which we are totally ignorant. The grains appear to have lost their cohesion pretty thoroughly in this case. The laboratory analysis of the metal throws no light on the subject. We should not call the steel of first-class quality, but it was very good—so good that it passed every test in a very satisfactory way. Indeed, there is no reason to suppose that it was not good when it went into the boilers. What took place subsequently? Our theory is that the plates all had initial stresses operating in them, and tending to cause fracture. It is quite well known that such stresses do exist, and that they have caused the self-fracture of plates lying in a yard; and there is every reason to believe that these stresses bear a distinct relation to the size of the plates. No one ever heard of a small sample of mild steel cracking of itself, but it is a noteworthy circumstance that small samples of very hard cast steel will fly, apparently without cause. Many years ago the footstep of a turbine gave great trouble—no unusual thing. In the attempt to cure the evil a footstep was made of cast steel, hardened in water. The turbine was small, and the step only weighed a couple of pounds. Some time after it was made, and just before it was put to work, it flew in pieces with a loud report, one of the fragments, if we recollect aright, killing a workman at the bench on which the step was lying. But mild steel specimens never do anything of this kind. The reason why steel fire-boxes succeed in American locomotives, and not with us is, it is said, that small plates are used in the States and large plates here. We try to make a fire-box with three plates; they do not hesitate to use seven in the United States. If our view be correct, and that every large plate of steel may have heavy initial stresses existing within it, it will be seen that the ordinary system of testing small samples cut from the plate gives but a faint indication of the true strength or quality of the metal, because such specimens can in the nature of things have no initial stresses operating to fracture them. They tell us, no doubt, a good deal of the quality of the material, but they give us no clue to the influence of form and size on strength. These two factors are systematically overlooked. We cut a slip an inch wide from the edge of a plate 12ft. long and 4ft. wide. We put it in the testing machine, pull it asunder, and say that the result shows the quality of the plate. It shows the quality of the *steel* but not the strength of the *plate*, which may be, we maintain, an entirely different thing. To put this in a different shape, let us suppose that a girder is made of cast iron, with a heavy bottom flange. A specimen is taken from the same cast, and made into a test bar. Now, it is well known that such a girder as we name may have—indeed, most likely will have—cavities and blow holes about the junction of the flange with the web. It is also known that all sorts of cross stresses due to unequal contraction may exist. Can it be safe to load such a girder in accordance with the results obtained from the test bar? There can, we think, be but one answer. Those who wish to go further into this question will do well to read Mallet's treatise on artillery. Again, we remember a case in which a large number of pulleys was cast from very good sound iron. These left the foundry all right. Not two per cent. of them bore turning. As soon as the outer skin was cut off in the lathe they broke; some at the boss, others through the curved arms, others through the rims. No result got from a test bar gave the smallest indication of the ultimate strength of the pulley. We entirely forget the influence of form in too many cases on the strength of materials.

It will be asked, Why is it that iron does not manifest the treacherous properties of steel? The answer is that iron plates and bars are not homogeneous, and that steel is. An iron plate consists of layers of bundles of fibre held together with small quantities of cinder. There is no more resemblance between a bar of iron and a bar of steel than there is between a strip of linen and a wax candle. A rent may take place through one or more fibres of the bar of iron, but it will not necessarily extend. How often, for example, do we find a crack in a plate of iron which does not go through? When is such a crack found in a steel plate? We may say without contradiction—*never*. There need be no doubt or uncertainty. It is the fibrous nature of iron that mainly contributes to give it a trustworthiness which is not possessed by steel. The phenomena of cracking are common to all homogeneous materials. Take, for instance, earthenware. We know that cups and plates will crack apparently as a result very often of mere lapse of time. No one ever heard of the spontaneous rupture of a fibrous material, such as a rope.

It will be asked, How and why is it that heavy initial stresses may exist in steel plates? We assume that they are not peculiar to steel, but that they exist in all bodies whose natural tendency is to crystallise, if they are prevented from crystallising. It is worth while to try to make this statement clear. A plate of steel comes from the mill, it is free from fibre—homogeneous, in fact. Now it is known that if this metal was melted and certain conditions were present it would crystallise. There are those who hold, indeed, that all homogeneous plates are more or less crystalline. This we do not hold. This plate may be quite free from initial self-strains. In the course of its career it is subjected to heat and vibration. These forces are sufficient, it is generally held, to set up crystallisation; but crystallisation means a new arrangement of parts—it means a change of shape. If it occurs more fully in one part of a plate than another, then stresses must be established. It is possible that there were no initial stresses in the plates of Mr. Maginnis's boilers; but it is certain that self-strains must have subsequently arisen, simply due to the desire of the steel plate to change its shape. Crystallisation is a very mysterious phenomenon. In an evaporating solution it will take place suddenly. It has been shown by Mr. Kircaldy that it may be brought about instantaneously in a metal so rigid as iron; but it cannot be produced, we maintain, without a change of shape. How much crystallisation has had to do with the failure of the plates of Mr. Maginnis's boiler we cannot pretend to say. The broad fact to be remembered is that, in dealing with the strength of materials, we must take count of the cause of that strength. Mr. Hughes has shown that in presence of magnetic forces a bar of iron is but a rope of sand. The influence of many things has to be considered, and the influence of some is all-important. The testing machine can throw no light on this question, as it is at present used. What is now wanted is a gigantic machine capable of pulling huge plates in pieces—something that will take in a plate 4ft. wide, 12ft. long, and 1¼in. thick. A hundred such plates might be broken before we came across one which initial strains had rendered weak. The lesson taught would be costly, but worth the money.

DOCKYARD MANAGEMENT.

THE appointment of Professor Elgar to the newly-created position of Director of Dockyards is a measure of the earnestness of the present administration at the Admiralty in their desire to make our naval arsenals efficient. The labours of Admiral Graham's Committee are so far meeting the success they deserve. To anyone who has had the opportunity and has taken the trouble to inquire into the system of dockyard management, it is inconceivable that such a state of things should have been allowed to continue so long. In a country such as ours, where fierce competition has made it necessary in almost all branches of manufacture to exercise the greatest care and economy in management; where only by the minutest subdivision of labour; and by the careful keeping of, and the constant microscopical examination into accounts, have we been able to make steady progress; in such a country it seems incredible that in its largest Government establishments no such scientific system exists, and no attempt from within these establishments is ever made to adopt, or even to know anything about, the methods of management in our commercial manufactories. Now that a really serious intention seems to exist to modernise the management of our dockyards, it is only necessary to remember enough of past shortcomings to serve as landmarks to measure present and future progress by.

Before satisfactory progress can be made it will be necessary surely to determine the causes which have led to the present state of matters. Dockyards exist to build, equip, and maintain our fleets. These fleets exist for the purpose of fighting the enemies of the country, and in order that the men who direct the fighting should have the greatest possible power at command, they must have, directly or indirectly, the control of the dockyards. It has consequently come about that the Controller of our Navy is a fighting officer, and the superintendents or controlling officers of our dockyards are also fighting officers. But it is one thing to be a controller and another to be a dictator; and one of the causes of the want of economy in our dockyards is that the naval fighting controller and his fighting subordinates have introduced into the management of our marine manufactories the dictatorial controlling spirit of a man of war. Had this spirit been always accompanied by an intelligent and general knowledge of the details of war-ship construction and equipment, and also of manufactory management, it is probable that the results would have been within a measurable distance of modern requirements. But when all the inelasticity of the absolute obedience system is combined—as it has been in many cases—with an utter ignorance on the part of the dictator of the duties and capabilities of the men whom he rules over, the result cannot fail to be confusion and waste. What proprietor of a private shipbuilding yard would select an old ships' captain as his works' manager? He might take him into partnership, but he would never allow him to exercise arbitrary and absolute control in the detail management of his works. The ship captain's opinion would be very valuable upon a great many questions; but his suggestions would all be tested by the fierce fire of comparative cost. We believe that in the last four or five years the power of interference

and direction which is vested in the admiral and captain superintendents of the dockyards has not been nearly so much used as it formerly was; but it is to be hoped that it will be thoroughly recognised by the new Controller of the Navy and the new Director of Dockyards that the naval officers who are superintendents are not, and in the nature of things never can be, the business managers of these large establishments. They could only become good and efficient superintendents by a course of training, of such a length as to completely incapacitate them for active command in the navy, and of such a cost to the country as to probably make the remedy worse than the disease. Considerations of naval etiquette and dignity, of the desirability of having some posts of honour and emolument as rewards to deserving officers, and of the necessity of having a dockyard in war time under the command of a fighting man, all may tend to make it convenient to retain the position of dockyard superintendents unaltered in dignity and pay. But, before all things, it will be necessary to have the real power in the hands of men whose actions will be based upon the same feelings as are those of a manager of a profit-making manufactory, whose constant question is how will it pay? The men selected for these positions should be young men who have been trained in the service schools and colleges, but who are not old enough to be wedded to the traditions of circumlocution; or if men of sufficient ability cannot be found in the service it, will be better to get men from private establishments at once rather than run into further expense by continuing the present system. Men can readily be found who have had experience in managing shipbuilding and engineering establishments where war ships have been built economically and rapidly; and such men, if as successful in building economically in the dockyards, would in a very short time repay their salaries, however large they might be.

But the naval superintendents are not the only cause of the present state of matters. The Controller of the Navy controls the whole of the dockyards. But he has many other duties to perform, amongst which is the controlling of the constructive and purchase departments of the Admiralty. Consequently a great part of the real control of the dockyards, which it has been possible to concentrate at Whitehall, is vested in the constructors. Naturally, the whole of the naval construction of the country must be under the control of the Director of Naval Construction, but it is hardly reasonable to expect a man of the scientific attainments of the present, or of the late holder of that office, to spend his time in managing the dockyards as they should be managed. Yet, a great portion of both these gentlemen's time must have been taken up with the administration of dockyards. It is not to be wondered that complaints are made as to ships not being of good designs, and of dockyards not being well managed. The wonder rather is that the ships have been as well designed as we find them. In the Navy List we see that on the constructive staff are Examiners of dockyard accounts; but unless the system of keeping these accounts is very different from what we believe it to be, the examination by these gentlemen cannot give to the responsible officers the detailed and early information which a competent manufactory manager finds absolutely necessary for financial control. We are of opinion that herein lie two causes which have contributed to the present want of economy. The first is that the directing of naval construction and the business management of the dockyards have been both attempted to be done by one person. The second is that no system of accounts has been kept by which the costs of ships could be compared in detail, ship with ship, yard with yard, and builder with builder, as the ship progressed. It is true that, some years after a ship is finished, the dockyard officers may be asked to account for an apparent want of equality between the cost of a portion of that ship and that of another similar vessel built elsewhere. But if punishment and reward are to be of any use in these cases, they certainly should be speedy. The Inflexible was commenced in Portsmouth in 1872, and completed in 1882. It could serve no reasonable purpose to ask in 1883 why the sternpost of the Inflexible cost eighteen pounds per ton more than that of the Devastation, which was made in 1870. But it would have served as a great incentive to economy if the same question had been asked within a month of the completion of that sternpost; and this system of examination of accounts should not be confined to special officers comfortably closeted in Whitehall, but arrangements should be made to give each person who has the least responsibility or control of money, early and full information as to costs, so that he may become his own examiner of accounts, and may commend or condemn himself more frequently than any official examiner possibly could. In this way the inferior officers of a dockyard would be able to know whether the systems of conducting work which each pursued was as economical as that of his *confrères*. There is nothing that is novel in these suggestions; for large shipbuilding establishments, such as Barrow, Thomson's, Denny's, and Palmer's are worked on this system. Another indirect cause of inefficiency is the great centralisation which the present system involves. The most trivial details have to go through the hands of the Director of Naval Construction and the Controller of the Navy. Uniformity and consistency are ensured at the expense of efficiency, economy, and despatch. All the dockyards must make meat-hooks of the same pattern, and the Controller of the Navy must spend some of his valuable time in giving each dockyard information upon this important matter. The proposal made by Lord Ravensworth's Committee that all ships should be built by contract, and that nothing but repairs should be done in the dockyards, is not now likely to be fully adopted. But in order that the reasons for making the proposal may not have as much force in five years time as they have now, there must be such a change that practically the object to be attained by that committee's suggestions will have been fulfilled. But the only way to fulfil these objects will be to build ships in the dockyards on the economical systems adopted in private yards. What these are can be easily found out by those who are most interested in the question.

It seems to us quite clear that in order to carry out reforms fully it will be necessary for the Admiralty most carefully to select competent dockyard managers who shall have the real superintending of all work; to relieve the constructive staff at the Admiralty of all detail management of the dockyards; to revise the method of keeping the accounts, so that early and detailed imformation as to costs is given to all whom it may concern; to adopt the systems of private establishments, in particular the system of making every official's worth in the eyes of his employer depend upon the economy with which he manages his department; and to let each dockyard manage its own affairs much more independently of Whitehall control than is the case at present. If these changes be initiated shortly under the direction of Admiral Graham and Professor Elgar and be carried out thoroughly, we shall hear much less in the future about paper ships and phantom fleets.

THE ROYAL ENGINEERS.

In our issue of January 11th, 1884, we directed attention to certain circumstances which appeared to us to account in great measure for the disinclination manifested to compete for commissions in the Royal Engineers. We then pointed out that there were grounds for fearing that unless those circumstances were ameliorated it would soon be found to be impossible to secure the number of qualified men required to meet the demand for officers of the Royal Engineers made by our Indian and Colonial possessions. It has now become evident—and at a much earlier date even than we ourselves had anticipated—that that difficulty has increased to an extent which has compelled the authorities at the Horse Guards to offer commissions in the corps to outsiders—*i.e.*, to any men found capable of passing certain examinations, whether they have been through the curriculum of study at Woolwich or not. Now we have so repeatedly and strongly pronounced ourselves in opposition to the practice of superseding civil engineers in the higher posts of the Indian Public Works Department by military men, that we shall not be suspected of an undue leaning if we survey this, our present subject, from an opposite standpoint. With the single exception which occurred at the time of the Crimean war, when the drain of officers was great, we believe it has never previously been the case that commissions in the Royal Engineers have been filled up by any but passed Woolwich men. At that time, too, the War-office was compelled to raise a special body —the Army Works Corps—which was entirely officered by civil engineers. It is not too much to say that it was to that corps that the preservation of our army during the second winter passed by it before Sebastopol was largely due. Many, both of its officers and men, were engaged on works under fire, and were otherwise fully exposed to the dangers encountered by their brethren of the regular army, and it was in contemplation, we believe, had the war longer continued, to have incorporated the corps with the Royal Engineers. But no data obtained from such an exceptional instance can have bearing upon the case which now presents itself for consideration. The gentlemen who have entered upon the training, and prepared themselves at great expense and labour to enter the Royal Engineers, find themselves at the outset of their career exposed to a threatened competition which must largely militate against their success in the profession they have chosen. We doubt exceedingly if it will prove to be wise thus to disgust those whose object it has been from the first to qualify for this particular service, rather than by so improving the advantages offered to ensure once again the steady flow of men through Woolwich which was always secured in the past.

It will be interesting to consider what causes have been operative towards checking that flow. An officer who once served in the Royal Engineers, and retired from the service mainly on account of the want of prospect it now offers, thus writes to us:—"The reason the War-office is offering direct commissions in the Royal Engineers and Royal Artillery is that they are short of officers, partly because many are required in Egypt, and also because so many were sent to India two years ago. These were not wanted there; and in fact it was only a financial trick to force the Indian Government to pay its share of the cost of the corps; and there is another reason, perhaps the most important. It is found that men will not go in for Woolwich now, as it takes eleven years to get a captaincy in the Royal Engineers and about nine years in the Royal Artillery; whereas, by going into the line, they can become captains in six or seven years. Moreover, it is much easier to get into the Staff College from the line, as only a very few places in it are given to Royal Artillery and Royal Engineer officers. Often four or five Royal Engineers and Royal Artillery are at the top of the list for entrance examinations, but are not admitted, as only two places are given to the Royal Engineer, and but three or four to the Royal Artillery. Consequently, line officers are admitted over their heads. Having passed through the Staff College, they—the liners—get a much larger number of staff appointments than the Royal Engineers." There can be no contesting the seriousness of the disabilities under which Woolwich officers labour as pointed out in this communication, and we will now proceed to examine their results.

We understand that at the last examination for Woolwich there were fifty vacancies. For these there presented themselves but seventy candidates, only forty-five of whom could pass the full test of the qualifying examination. Consequently, five unqualified men had to be admitted to fill the full number of vacancies. What a contrast does this fact present to what we can remember but fifteen years ago. Then for forty vacancies there were no less than 200 candidates! For the line regiments there is still a great, almost undue competition. If we are correctly informed—and our authority is of high character and standing—there are at the present time 700 young men preparing themselves to compete for commissions in the line. One celebrated "cramming" establishment has no less than 200 of these under strong preparation. A commentary is thus afforded as to the relative and comparative advantages held out by the two branches of the service. The scientific branches are, it is evident, being starved, while there is a plethora of men desirous of entering the other departments of the service. It was not so very long back that the same objection to enter the army was manifested as to its medical department. The inducements were increased, and now no difficulty is experienced in obtaining the desired number of qualified men. So, we believe, it will be found as to cadetships at Woolwich if the disabilities we have referred to both above and in our previous article named are removed. The correspondent we have quoted has mentioned the fact that the officers of the Royal Engineers sent out to India two years back were not required there. It is within our knowledge that when one of these officers reported his arrival at Bombay, the remark was made to him that the authorities did not know what to do with him; and that during the period of his stay—but a brief one only—he scarcely did a single day's duty. There was none, indeed, for him to do. Now we can imagine the disgust of an active-minded and intelligent man at thus finding himself made the shuttlecock of a financial battledore; called upon at very great expense to break up his home, and to leave the comforts and associations of England to—do nothing. If it is thus that the officers of the Royal Engineers have been treated in the past, who can wonder that while our training schools are crammed with intending competitors for commissions in the line, Woolwich finds itself unable to keep up its full complement, or that resort has to be had to offering commissions to men who have not passed through its training? There is no doubt but that the time and money to be spent in going through Woolwich is an important factor in the case. The expenditure of both far exceeds what is required for the line, but this fact only strengthens our argument that the inducements must be made commensurate to the outlay involved.

It has been named to us that cadets now at Woolwich are to be allowed to compete for the commissions in the Royal Engineers now offered to open competition; but if they do so they will start in the race under great disadvantages. Such cadets have, of course, already devoted much time to the study of technical subjects, such as fortification, &c., which will not be included in the examinations qualifying for these direct commissions; and another result must also be that those cadets who have only just entered Woolwich will have a better chance than their seniors at that college. This is manifestly unfair, and should demand the reconsideration of the whole subject. It is an open question as to whether those officers who received direct commissions in the Royal Engineers at the time of the Crimean war have turned out as well as those who obtained them through Woolwich. That some have done so there can be no doubt, but a considerable number most certainly were tempted only by the love of "soldiering," inherent with young Englishmen. They did not, as did the Woolwich men, adopt the branch of the profession from a natural taste for engineering, and hence it may be doubted if in an important and much to be desired particular they have proved to be as generally efficient as their comrades who entered the corps through a course of study at Woolwich. The gentleman we have above quoted further writes to us on this point:—"I believe that there will be a considerable falling off in the technical knowledge of the more advanced kind and in discipline in the new direct R.E. officers, although for military duties with companies, and the more quickly acquired accomplishments of field fortification and military sketching, they will probably do well enough. Hundreds of officers and non-commissioned officers of the line now pass every year through the R.E. Schools at Chatham, and pick up a smattering of these subjects; but it is absurd to call them engineers. The new R.E. officers will, I fear, belong to this class."

Reviewing what we have written, we are led to these conclusions:—The course now proposed cannot insure to the distinguished corps, with which we have a professional brotherhood, the same high qualities which have always hitherto characterised its officers. It further places such men as have qualified for entering it by the straight road under an unjustifiable disadvantage, and the necessity for its adoption reveals to us that there is a want of inducement to enter the corps commensurate with the labour and expense such entrance entails. Evidently it follows therefrom that the sooner the whole question of the establishment at Woolwich and its outcome is revised the better it will be for the good of the service, the advancement of our profession, and the interests of the public.

PATENT LAW ADMINISTRATION: A KNOTTY POINT.

Some most astonishing instances of incapacity for fulfilling official duties have marked the ruffled course of Patent-office affairs during the last two years; but even these have been surpassed by the Deputy-Comptroller, who has surpassed himself in one of the most recent of his comically annoying misconceptions of duty. It can scarcely ever have been the lot of man to have been placed in a position demanding occasional action and knowledge, and to possess so little knowledge of how to act, as this official has recently displayed in an aggravated and perverse manner in the case to which we refer. Without any knowledge that would enable him to judge of the thing invented, he has dictated to an inventor an alteration in specification wording, and in drawing. This is not only a course unwarranted by any clause in the Act, but it is one which is an act of injustice to inventor and public, and one which, at the least, might make a patent useless. Even if the alterations made happened to add to the value of the patent, it would be an accidental result which the Deputy-Comptroller brought about by stepping outside his duty, and might be as much the cause of litigation as if the inventor had included in the final specification something quite foreign to that indicated in the provisional.

In February, 1884, Mrs. E. S. Swainson lodged a provisional specification for a patent for "Improvements in Life-saving Apparatus for use in connection with Ships and Boats," and in due time the final specification, dated 4th November, 1884, was lodged with the necessary draw-

ings. This described long rectangular boxes carrying cork-covered surfaces and hinged flaps, also cork-covered, flasks for containing water, spirits, and oil being inserted in the thickness of these flaps. It also mentioned that the oil receptacles might be in the form of collapsible bags, and that the body of the apparatus might also be provided with oil receptacles, which would be available if the flaps became accidentally detached and carried away the others. In February, 1884, a provisional specification was lodged for "Improvements in Rafts, applicable also for use as Pontoons," by T. A. F. Hall and H. T. Clanchy, the final specification being dated 25th July, 1884. So far, all seems to have gone along happily enough, but it would appear that it was the happiness of boys when the schoolmaster is away. The eagle eye of the Deputy-Comptroller had not caught sight of Mrs. Swainson's drawings, and his inventive talent had not been brought into requisition. The time, however, came. Messrs. Hall and Clanchy thought they observed that Mrs. Swainson's final specification contained something which might be said to be insufficiently foreshadowed in her provisional, and which might encroach upon their invention. Mrs. Swainson then, through her agent, Mr. Lloyd Wise, who was also the agent of Messrs. Hall and Clanchy, applied for leave to amend and to strike out the words referring to collapsible bags. Subsequently, however, probably under advice, Mr. Lloyd Wise withdrew this application, and Mrs. Swainson and Messrs. Hall and Clanchy made application to be heard by the Comptroller. Then came the time for activity displayed with such rare acumen by the Deputy Comptroller, Mr. J. Clark Hall. He saw Mrs. Swainson's drawings and he heard the disputants. Mrs. Swainson appeared in person. The drawings to her specification comprised sectional views of the apparatus, in which the boards with which the body is constructed appeared in section, giving the idea of boards about 1in. in thickness. In several places the lines drawn by the draughtsman to indicate the grain of the wood, showed knots in the usual way. One of these knots—which appear in the printed specifications as blotches—happens to be placed near the centre of the board forming the top of the box-seat, and about in the middle of the thickness of 1in., or at most 1¼in. These knots were espied by the Deputy-Comptroller, the quickness of whose perceptions soon showed him that the drawing to this specification was intentionally ambiguous, and that these knots were not knots, but were pipes, or would be pipes, if the inventor found necessity for pipes. Pipes, therefore, they should be, and he had them made into pipes, Mrs. Swainson being apparently guided by his superior advice and knowledge as to what she meant the knots to be. She, therefore, assented to alterations by which in the reprint of her specifications and in the amended original, the flasks of oil in the flaps are converted into *tins* of oil, and the collapsible bags become *leather tubes*, and in order that Mrs. Swainson should know what she meant when she said in her specification that "the central portion or body *m* of the apparatus may also be provided with oil receptacles," she was kindly induced to add the words, "one of which is shown at *x* in Fig. 5." Now any reader will have gathered an idea of what Mrs. Swainson may have been supposed to mean when she said the body *m* of the apparatus may be provided with oil receptacles so as to be available should the other oil vessels carry away; but by the Deputy-Comptroller's alteration, it is not only impossible to find out what is meant, but Mrs. Swainson has been forced to forego the receptacles at *x*, for there is no *x* in the printed specification, and the *x* which has been put into the original drawing in red ink points by a line to the "leather tubes," and these leather tubes, invented by the Deputy-Comptroller, run edgeways through the board forming the seat of the apparatus. The new words in the specification speak of leather tubes and oil receptacles shown at *x*, but the drawing shows at *x* a knot. Mrs. Swainson said it was a knot, but the Deputy-Comptroller thought she did not know what it meant, and he *did* know that it was a tube. If "the gentleman at the Patent-office" knew it to be a tube, of course it was a tube, and although Mrs. Swainson would probably be very much puzzled to get a leather tube of any capacity through an inch board edgeways without cutting the board in two, she probably thought that Mr. J. Clark Hall would be able to show her that too, and so allowed the alteration to be made. She may also have thought that if she is to be deprived of the receptacles, except as shown by the knot at *x*, it did not much matter whether the people at the Patent-office called the faint irregular circle on the original drawing a knot or a tube. She will be somewhat puzzled, however, when she finds that her specification drawing is now being published without the *x*, and therefore without the tube, inasmuch as a tube is not shown and a knot is. This, however, may be another little evidence of the far-seeing capacity of the Deputy-Comptroller. He may have found by this time that Mrs. Swainson may say that that particular knot is not the tube she meant, but the tube she did mean is one of the other knots. It is not clear whether Mrs. Swainson will be able under her patent to place oil receptacles in the body of the apparatus as she had described, or whether she will be forced to make the top board of her long boxes about 6in. thick so as to get in a leather tube of, say, 4in. diameter as receptacle. To settle these little difficulties, however, she will probably appeal to Mr. Hall. It may be of advantage to some amateur inventors to send in a rough specification to be put right, where they themselves do not quite understand it, by the Deputy-Comptroller, but most inventors prefer to know what there is in their specifications and drawings, and what they mean by these things, before the assistance of the Deputy-Comptroller is sought or by ill-luck forced upon them.

The subject is, however, a very serious one. If a patentee's specification is to be tampered with in this way, it will soon be impossible to be sure of obtaining a valid patent. When it is considered that the validity of a patent, however valuable it might be, often hangs upon a very few words and strokes, it is not too much to say that the demand for the immediate removal of any servant of the Patent-office who does such things, either actually or indirectly by persuasion, ought to be acceded. Officers from the Board of Trade do not shine in the Patent-office.

The case referred to is one in which the specification and drawings emanated from the office of one of the leading London patent agents, thus showing that, whether handed in by inventors or by agents, the specifications are liable to be rejected on trivial and absurd objections.

THE LIVERPOOL WATERWORKS.

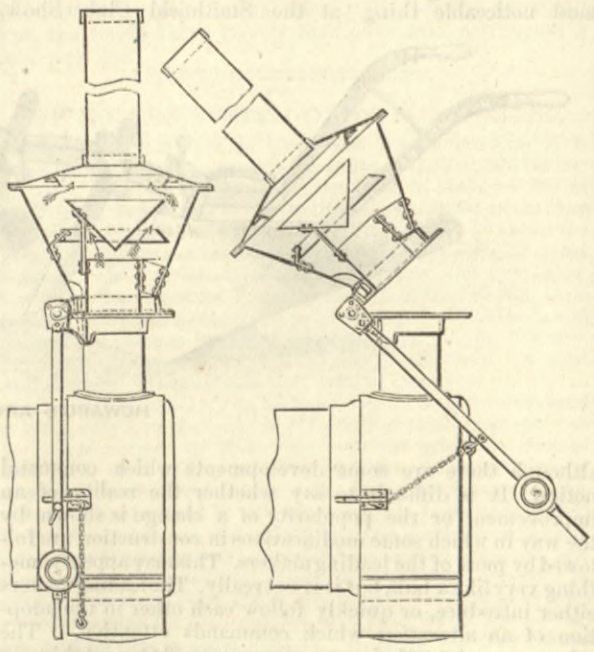
THIS unfortunate undertaking has assumed a new phase. Grave doubts having been expressed as to the stability of the gigantic masonry dam now in course of construction, the Corporation applied in vain to many eminent civil engineers to report upon the safety of the work in question. All the gentlemen applied to have declined the delicate and onerous duty of reporting upon a work designed by so eminent a member of their profession as Mr. Hawkesley, and at last the committee appealed to Major-General Sir Andrew Clarke, R.E., Inspector-General of Fortifications. The gallant officer threw himself into the breach which his more cautious civil compeers hesitated to attack, and is now actively engaged upon an undertaking involving a tremendous amount of responsibility. The question naturally presents itself as to how far an officer, holding one of the most important military positions at the Horse Guards, is justified in neglecting the duties of that office, in order to engage in private practice as a civil engineer, thus competing with those civil engineers in private practice who might otherwise be engaged. As to the wisdom displayed by the Corporation in calling in a military officer, whose practical experience in reservoir construction must of necessity be very limited as compared with that of engineers who have devoted their lives to such works, it is to say the least of it more than doubtful, and Liverpool rumour asserts that a member of the committee wishes to stand well with the Inspector-General of Fortifications.

PUMPING THE STAFFORDSHIRE MINES.

CONTINUED success is attending the pumping of the South Staffordshire Mines Drainage Commissioners. They are effecting valuable economies in the conduct of their operations. By the driving of underground levels they are connecting various pumping stations, and are bringing the water more and more into large central areas where it can be raised at the minimum of cost. From a report presented to the Commissioners on Wednesday by the engineer to the Tipton district, it appears that within the past two or three weeks the Horseley pumping engine has been put to stand, the completion of one of the levels having enabled the powerful new engine at the Moat Colliery to do the work formerly divided between the two plants. A saving of £1400 per annum is thus effected. This Moat engine is now pumping water which twelve months ago it took five engines to raise. The result of this successful engineering accomplishment is declared to be a saving to the Commissioners of £6000 a-year. A further economy is anticipated from the early intended stoppage of the Thorneycroft engine, an event which will be rendered possible by the finishing of another underground level. Simultaneously a level 400 yards in length, which will largely minister to the drainage of the mines in the Bilston district, that are at present submerged, is being pushed on. It is now half through, and when completed will convey the Bilston water to certain of the Tipton pumps already in operation.

THE SMITHFIELD CLUB SHOW.

THE Smithfield Club annual show opened on Monday. The weather was propitious; the cattle, sheep, and pigs numerous and fat; the attendance of visitors not too large for comfort. If our readers will turn to THE ENGINEER for December 14th, vol. lvi., or for December 12th, vol. lviii., they will find articles on the Smithfield Club shows of 1883 and 1884, which would apply just as well to the show of 1885. There are a great many steam engines exhibited, and these are well finished, carefully designed, and nicely painted. We saw more than one traction engine painted a delicate blush rose tint, which struck us as an altogether admirable selection. This is just the colour which we would ourselves select for our own traction engines,



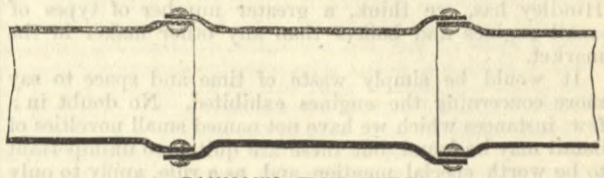
GARRETT'S SPARK ARRESTER.

if we had them, although we confess that we have some leaning to the dainty cream tint adopted by another firm for the same purpose. We would provide ivory handled shovels for the firemen, however, and all our coal should be whitewashed, and the oil used for lubrication the best scented macassar. A Turkish rug on the foot-plate might perhaps be regarded as an extravagance, but it would add to the general æsthetic effect.

Messrs. Richard Garrett and Sons, of Leiston, show a compound portable very similar to that a report on the performance of which recently appeared in THE ENGINEER. Also a simple engine similar to that which competed with it. This last engine is fitted with the best spring governor yet brought out. It will repay inspection. One of the engines is fitted with a spark arrester, the construction of which is illustrated by the accompanying self-explanatory engraving. Messrs. Garrett have cut the Gordian knot of chimney raising by fitting a hand lever to the chimney identical with that used on the penny boats on the Thames. There is no patent, and it works as well as the most elaborate and costly mechanism.

The novelties admit of being described very briefly. Messrs. Brown and May, of Devizes, show an 8-horse power portable engine, with a centrifugal pump fixed at the back of the fire-box. The furnace door is a little to one side to clear the pump. This is driven by two belts from the two fly-wheels with which the engine is provided. The pump has a delivery valve just above the fan. This can be closed by a handle from the outside, and an ejector is used to make a vacuum in the pump, and so enable it to start. This is all strong and well designed, self-contained, and, we think, likely to prove very handy and useful to contractors.

Messrs. Davey, Paxman, and Co., of Colchester, show a new vertical boiler, which we shall illustrate in an early impression, and a section of a new flue for Cornish and Lancashire boilers, which Mr. Paxman patented a few months ago, and has since used extensively with admirable results. The tube is built up of welded sections; each section is bell-mouthed at each end, the bell-mouth of one fitting within the bell-mouth of the next, and then rivetted up with a circumferential seam of rivets. These appear to us to be the best solution of the furnace flue difficulty yet produced. It is known that such flues are not safe unless they are provided with stiffening rings in some form or other or Galloway tubes. The various methods of providing stiffeners which have been used we need not



PAXMAN'S FLUE TUBE.

describe, as they are quite familiar to engineers. The Paxman flue is, of course, stiffened by the bell-mouths, and two great advantages are gained; the first is a certain amount of longitudinal elasticity; and secondly, the rivet heads are kept well out of the heat. We shall be much surprised if this flue does not meet with extended adoption. The same firm also show a small horizontal engine with automatic expansion gear, very suitable for driving a small electric light plant, where great uniformity of speed is essential.

Messrs. Aveling and Porter show traction engines, not painted rose colour. To one of these is fitted the steering gear which we shall illustrate in our next impression. Instead of chains, two rods are employed, one pushing and the other pulling, by which all the jerking and snatching which takes place when chains get slack is avoided. A great point in favour of this arrangement is that should one chain break, an accident is very likely to happen, as the engine may at once run into the ditch at the other side; but the rods provide two strings, so to speak, to the bow. The method of making the leading axle is ingenious, and worth examination. One of the traction engines is fitted with the spring wheels of which we spoke in our notice of the Preston Show in high terms. The opinion we then formed of it is justified by the fact that Messrs. Burrell, of Thetford, and John Fowler and Co., of Leeds, have both adopted it. No higher testimony can be adduced in its favour.

Messrs. Burrell and Co., of Thetford, show a fine traction engine, fitted with these wheels. Messrs. Fowler show several engines, one non-compound traction engine, and one compound. A wide diversity of opinion exists concerning the relative merits of simple and compound traction engines. Messrs. Fowler hold that they are right, Messrs. Aveling and Porter that they are wrong; and we believe that Messrs. Fowler are alone in their opinion. Messrs. Aveling and Porter have spent several thousands of pounds in experimenting with compound engines. The conclusion at which they have arrived is practically identical with that which we have enunciated concerning railway locomotives, namely, that the compound system can only be used with advantage when the load is nearly constant, and that best adapted to the capacity of the engine. A traction engine has to run up hill and down dale, and its exerted power is never the same for two minutes together, consequently it is not suitable for compounding. We may say here incidentally that Messrs. McLaren, of Leeds, have recently constructed a compound engine for service in India, which has been tested in this country with great success. We shall illustrate it in an early impression. We may say, however, that the engine is intended to run at eight miles an hour on a nearly level smooth road, so that there is a difference between it and ordinary traction engines.

Messrs. Hornsby and Co., of Grantham, show a very fine semi-portable with a small condenser attached, the air pump of which is driven by a prolongation of the high-pressure piston rod.

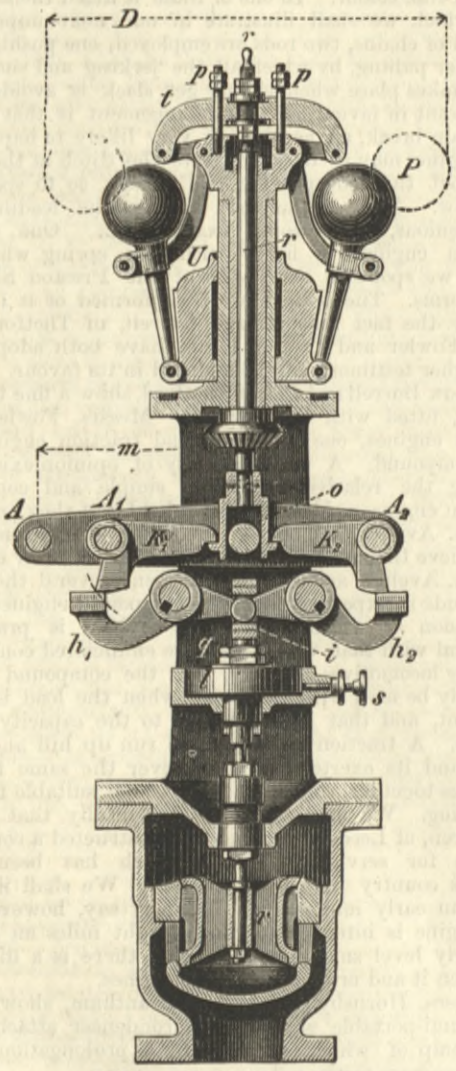
Messrs. Marshall, Sons, and Co. show some fine engines. It goes without saying that the Gainsborough firm provide plenty of surface and plenty of metal, while the finish leaves nothing to be desired. A semi-portable by this firm is fitted with a feed-water heater, consisting of a vertical cylinder about 15in. in diameter and 5ft. high, traversed by vertical tubes, and covered with Russian sheet iron. This makes a neat and no doubt effective addition to the engine. A chimney lifter is attached to a portable engine shown by the same firm; it is very simple, and was illustrated in our notice of the Preston show last summer. A screw couples two brackets, one on the fixed base of the chimney, the other just above it, bolted to the upper or hinged portion. By turning the screw the chimney can be raised or lowered with great facility.

At the stands of most of the makers may be found very good engines, portable and fixed, presenting no novel features worth notice, but all maintaining the high reputation of English engineers for this class of work. Among these we may mention Messrs. Ruston, Proctor, and Co.; the Reading Ironworks Company; Messrs. Robey and Co.; Messrs. Farmer, Robey, Brown, and Co.; Ransomes, Sims, and Co.; Foster and Co.; William Allchin; E. R. and F. Turner, &c. Messrs. Eddington and Stevenson show a portable engine with removable lagging, which can be taken off and replaced with facility in order that the boiler may be examined.

A very neatly-arranged small portable engine is exhibited by Messrs. E. R. and F. Turner. The cylinder and guides are of the Gippeswyk type placed on the boiler, the crank shaft brackets being of the ordinary pattern. The feed pump is arranged so that steam tapped from the exhaust pipe meets a jet of water, mixes with it, and heats it in the feed tank from which the pump draws. The engine is fitted with the Hartnell-Turner automatic cut-off expansion gear, and it is noteworthy that every engine made by this firm is fitted with this automatic expansion gear.

The number of small engines exhibited this year does not seem to us to be as large as usual. Mr. E. S. Hindley has, however, in the gallery a noteworthy display of the excellent little engines of which he must have produced an astonishing number during the last dozen years. The price of these engines places them within the reach of almost every one. Thus, a 2-horse engine and boiler complete ready for work for £55, leaves a small margin, we should think, for competition in the matter of price. This is a well-made, well-designed little engine, with a 4in. cylinder, 6in. stroke, weighing complete 16 cwt. Mr. Hindley has, we think, a greater number of types of small engines and boilers than any other maker in the market.

It would be simply waste of time and space to say more concerning the engines exhibited. No doubt in a few instances which we have not named small novelties of detail may be found, but these are quite too unimportant to be worth special mention, and, as a rule, apply to only one class of engine, that to which they are fitted, so that they have no general interest, so far as can be seen. The engines built by the firms which exhibit year after year at agricultural shows have now settled down to a dead level, and no further novelties are to be expected; improvement and invention have alike come to an end. The only departure from this rut that we have found is to be seen at the stand of Messrs. Robey and Co., of Lincoln, who have brought the novelty from abroad. We refer to Proel's valve gear, a species of trip gear which we illustrated and described in our impression for August 5th. In a modified form we illustrate it by the accompanying engine.

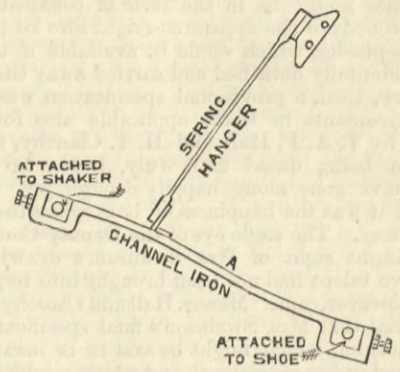


PROEL EXPANSION GEAR.

The action of the Proel gear will be readily understood. The oscillation of the lever A caused by the excentric, is transferred to the two cut-off arms K_1 K_2, carried loosely on it, which alternately have a downward movement and depress the outer end of the corresponding lifter h_1 or h_2, thus causing the inner end to raise and open the valve v. As soon as the steel nose of K_1 or K_2—which being carried with the lever A nearly in a circle round the fulcrum within the fork o—passes the edge of the face of the lifter h_1 or h_2, the valve is released, and is shut gently by the spiral tension of the spring m. The variation of the cut-off is effected by the governor raising or depressing the fork o, thereby altering the position of the cut-off arms K_1 K_2, it being clear that the duration of the opening of the valve is controlled by the period during which the nose of K_1 K_2 is in contact with the steel face of the outer end of the lifters h_1 h_2. As shown in Fig. 2, the governor rod r traverses the hollow spindle of the governor and is suspended from cross-bar t, which latter receives its movements from the two bell cranks, whose longer arms form the hanging straps of the governor. If the revolutions of the governor, at a variation of say 1 per cent., produce an energy of 1 lb. in the governor, then as this energy is quadrupled by the proportions of the bell cranks, there is a resulting force of 4 lb. in the governor rod, available for the purpose of varying the relative position of the cut-off arms. The air screw s serves to regulate the closing of the air cushion l, by which the valve v is made to seat itself gently. The spiral tension of the spring m—by which the valve is brought to its seat—may be determined by turning the hexagonal nut y, by which one end of the spring is held, and by locking the nut by means of the set screw z.

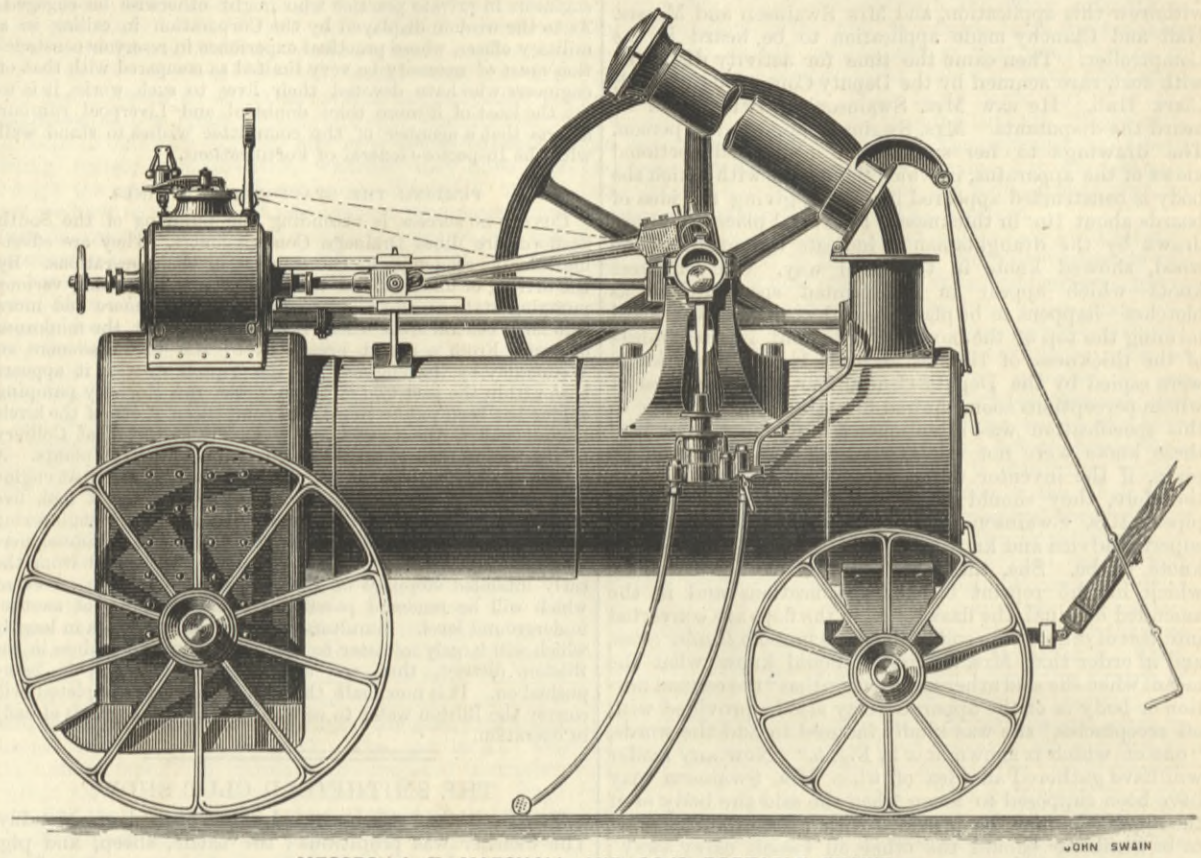
Messrs. J. T. Marshall and Co., of Nottingham, show an excellent portable engine, which we illustrate below. It is fitted with a novel chimney lifter. The *modus operandi* is as follows:—The horse having been taken out of the shafts, the latter are raised to a convenient angle, and the loose connecting rod hitched on to a pin provided in the shaft about 15in. from the splinter bars. The weight of the chimney is now more or less balanced by the shafts, and a very moderate pressure suffices to depress them and consequently to raise the chimney. The lift, however, is divided into two parts, and the shafts are raised a second time to complete the process, the chimney, by a simple device, remaining meanwhile where it was left, at an angle of about 45 deg., the whole process being completed in less than half a minute by one man.

A continued improvement in the workmanship and finish in farming machines and implements is perhaps the most noticeable thing at the Smithfield Club Show, although there are some developments which command notice. It is difficult to say whether the reality of an improvement or the popularity of a change is shown by the way in which some modifications in construction are followed by most of the leading makers. This may appear something very like a bull, but it is not really. The leading makers either introduce, or quickly follow each other in the adoption of an alteration which commands attention. The others appeal to their experience; say, "Our machine or implement, as now made, has answered well for years, and the advantage of this or that new thing is hardly worth the trouble and cost involved in making another set of patterns and starting a new series." This is an argument that is difficult to refute, although it is well known that a purchaser rarely buys a new machine without inquiring for the "improvements." So long as the machine he possesses will work or can be repaired, or so long as he does not want a second machine, the old one is good enough; but in nine cases out of ten he will depart from this belief as soon as he decides that a new machine must be bought. Hence the introduction of improvements pays; but this does not always prove that the old is bettered by the new modifications. Thrashing machine makers are not easily prevailed upon to launch upon the unknown sea of trouble which an alteration may involve; but each show now adds to the number of makers who have discarded double-crank shakers for the single-crank arrangement, or to the use of

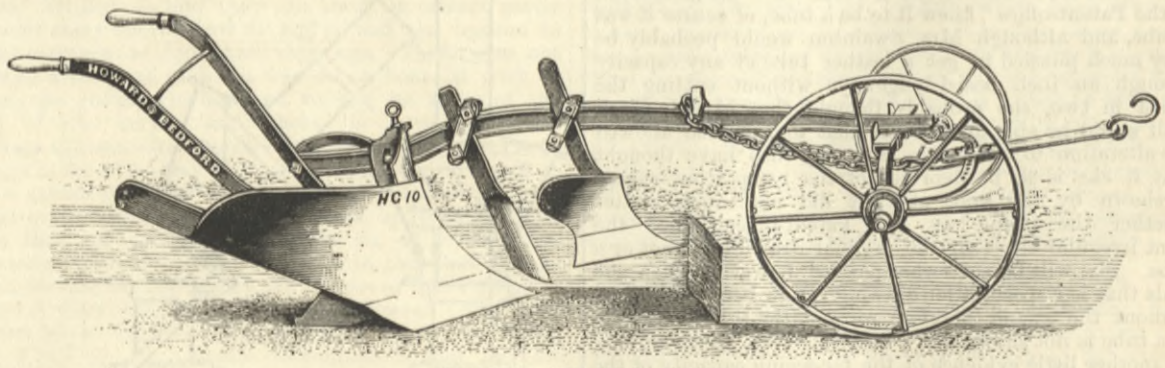


MARSHALL'S SHAKER GEAR.

but one crank in the machine. Messrs. Ruston, Proctor and Co. have no crank in theirs, but they have the equivalent in excentrics—that is to say, equivalent mechanically—though, perhaps, the plain shaft with excentrics is better in some respects than a crank. At Islington Messrs. Marshall, Sons, and Co. have a fine well-made machine in which but one crank is used, and that works main shoe, riddles, and shakers. The arrangement may be gathered from the above sketch. One crank is placed at the rear of the machine, and the main shoe worked direct from this. Attached to a spindle bearer on the shoe on each side of the machine is one end of the piece A, made of channel iron bent to grasp the bearings as shown. The upper end of the piece A grasps the end of a bar, which gives motion to two of the shaker boxes. A similar arrangement towards the front end of the machine gives motion to a spindle carrying the front end of three of the shaker boxes, there being five in all. By this arrangement Messrs. Marshall lessen the number of bearers in their machine by twelve, the machine has one belt and pulley less, and there is no doubt of the advantages obtained.



MESSRS. J. T. MARSHALL AND CO.'S PORTABLE ENGINE.



HOWARD'S ARC-AXLE PLOUGH.

On the stand of Messrs. Allchin, Linnell, and Co. is a thrashing machine fitted with Spoke's attachment for giving a final dressing by means of a blast separation instead of by a screen, although the machine shown is fitted with a screen also. The last sieve on the second dressing shoe delivers the corn over a long lip in an even stream, and here it is met by a blast which carries the different grains a greater or less distance dependent upon the relation between their surface and mass, and causes them to drop into one of three compartments formed by thin boards dividing an opening below the sieve. This promises to be a useful attachment, but unless it takes the place of instead of merely supplementing the screen, it will only add to the complicated puzzle box of machinery and dodges which a thrashing machine at present constitutes.

Messrs. Farmer, Robey, Brown, and Co. show a fine well-made machine, the frame of which has strong top and bottom cills of oak stayed and braced by angle irons. The machine is arranged with the awner on the main fan spindle, so that the awning is done before the grain is elevated to the top of the machine, and some trouble in the cup elevators is thus avoided. The blast from the first dressing fan is split, and directed below both the chaff sieves of the first dressing shoe, so that the grain is separated from all rubbish before elevation to the second dressing shoe. The shakers are worked by two cranks, and set at such angles that the five shaker boxes have the greatest possible relative velocity.

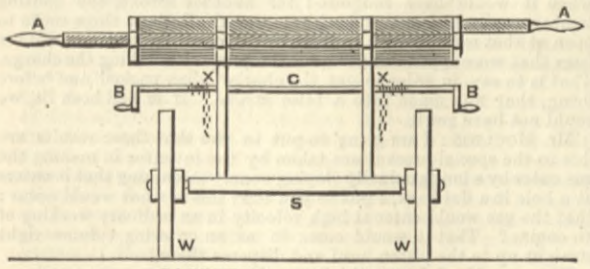
Messrs. Nalder and Nalder show one of their very small simplex single crank finishing thrashers, which they make in three sizes, namely, 2ft., 2ft. 6in., and 3ft. They are small machines, but by using a large—for the length—size of drum, any straw can be dealt with by them, and by making the machine longer in proportion to its width than the large machine a considerable riddling and shaker area is obtained. The whole of the second dressing apparatus, including a screen, is contained in a flat box placed on one side of the machine built as a single blast machine, an arrangement which has the advantage of leaving the whole of the machine, though small, quite accessible. These machines will no doubt rapidly take the place of the poorly built and inefficient machines made in countries we need not name.

Messrs. Ruston and Proctor show their crankless thrashing machine referred to above, the results of the working of which are, we are informed, exceedingly satisfactory.

To meet the growing demand for machines to prepare maize for feeding purposes, Messrs. E. R. and F. Turner show a rolling mill with strong rollers, plain cylinders except for slight grooves at about an inch apart cut spirally. The rollers are pressed together by tension screws pulling the bearings together through the medium of strong spiral springs. These machines are not only valuable for preparing maize for stock feeding, but for preparing it to go into mills for making flour, and thus reducing the heavy wear caused by maize of the more expensive machines.

Messrs. Ransomes, Sims, and Head exhibit a new self-delivery horse-rake, the arrangement for self-delivery being very simple and strong, and the teeth held in a very effective manner in the head castings by means of a clip.

Messrs. Richard Garrett and Sons show a seed drill, with a very neat arrangement by which the seed spout raising barrel is utilised as a means of lifting the drill wheels off the ground instantaneously for greasing or making gear-wheel changes. The framing of the drill is chiefly of wrought iron, and the steering gear is provided with a spindle and handles by which the steering wheels may be held firmly, and yet leave the steering gear free to move. The accompanying diagram will serve to show the principle. The axletree S of the wheels W W support the standards carrying the handles A A, which slide one over the other so as to lengthen or shorten the leverage and command of the steerer, and below these handles is a light spindle C with handles B, and light chains at X X. These chains extend back to the frame of the drill. When the handles B or B are not



GARRETT'S DRILL STEER.

held, the steering by the levers A A is as usual, but when the steersman holds handle A in one hand and handle B in the other, the whole steering gear is very firmly held by the chains, and the fatigue caused by the difficulty of holding the handles A is avoided. Messrs. Garrett and Sons also show one of their single fan double dressing thrashers with a new form of chaff sifting and bagging apparatus, consisting partly of an extension of part of the lower dressing shoe covered by a dust grating and ending in the chaffshoots.

Messrs. J. and F. Howard show an improvement of much importance in their sheaf-binding knotter. As we cannot explain this without a knotter, we must leave it for another occasion. Meanwhile we may refer to their new plough, which they call their "arc axle" plough. The accompanying illustration will make description easy.

Fig. 2

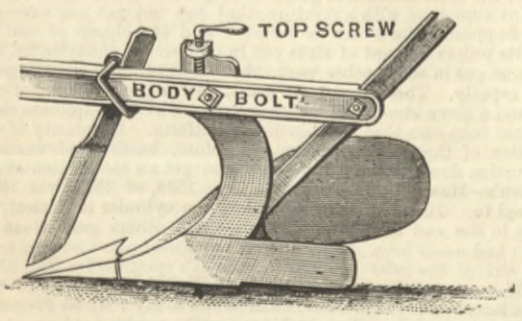
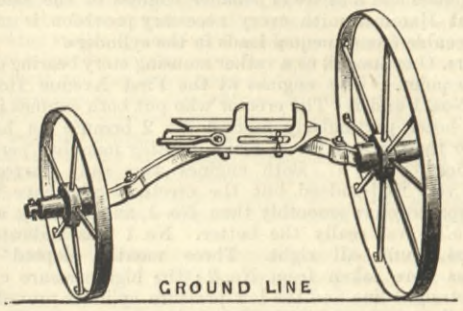


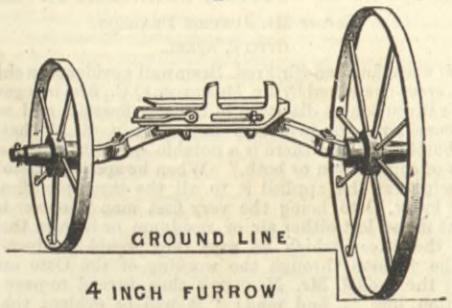
Fig. 1 gives a general view of the plough; Figs. 2, 3, 4, 5 show the arc axle and fittings in different positions. The end of the beam, which rests on the saddle attached to the arc axle of the fore carriage, is flat and wide. The draught chain being led under the axle and over the beam causes the pull on the chain to pull the beam hard down on the saddle, and thus to cause the plough to work much the same as a plough with fixed head gear, while the arrangement secures the great advantage of separate fore carriage. At the headland, the pull on the draught chain having ceased, the plough is easily thrown over on its side, resting on the bow shown on the land side of the body, and turning is done with the ease of the old gallows plough. It is thus a plough which is very steady in working and very easily worked at the headlands. The plough, as shown, is fitted with the chilled breast largely used in Eastern

Fig. 3



Europe and elsewhere abroad, and rapidly growing in favour in some parts of the United Kingdom. Beside the adjustment obtained at the fore carriage, the depth of the ploughing is adjusted by the body bolt and top screw shown in Fig. 2. Fig. 3 shows the position of the saddle or bearer plate on the arc axle when the plough is set for standing in level ground or for making the opening

Fig. 4



furrow; the horn plate shown is for keeping the beam head in the necessary position and for adjusting the width of the furrow, the position of this being adjustable. In this position the plough is level, and will, of course, make a level bottomed furrow, although the wheels are both on one level. After the first furrow is made the furrow wheel takes its place therein, as shown in Fig. 4, the bearer

Fig. 5

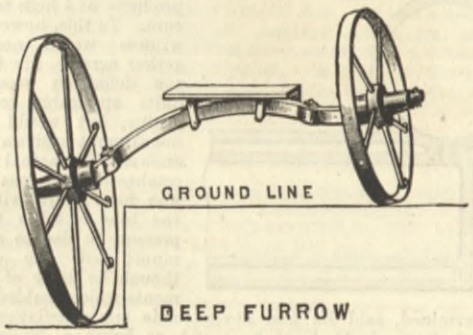


plate and width gauge being shifted accordingly. Fig. 5 shows the extreme position, and ease of adjustment for deep ploughing. The plough and its parts are simple and strong, and is rapidly growing in favour even where ploughs of the kind have hitherto been little used. Messrs. Howard also show a new horse-rake, light but of large size. The wheels are of the suspension bicycle type, and the teeth are simple round steel rod after the American type, the heads being merely bent over and carried on a wood axletree.

THE ROLLER SYSTEM OF FLOUR MILLING.

It is remarkable that in those arts whose function it is primarily to sustain life, namely, agriculture, milling, and baking, the period during which invention remained in abeyance was of greater duration than in any other of the arts. Down to the close of the last century, the farmer tilled the soil and thrashed the grain by methods and implements most of which were of great antiquity. It was the same with the miller and the baker. But that order of mental development which makes the nineteenth century the mechanical age has changed, the methods and apparatus in these as in other industries. In milling, however, the change, though delayed, has unquestionally been the most revolutionary. The millstone and bolting system which was in vogue until the year 1879 in England was, it is now considered by some, only a mechanical improvement of small magnitude on the course pursued by those who used the quern and dressed their grain on a rudely constructed sieve. The outburst of inventiveness which characterised the two first decades of this century did not extend to milling, and it has been only within the last five years that the revolution has been accomplished. All at once the heritage of imperfections became apparent, and all at once an unlimited field of improvement was revealed. In milling, as in many other industries, Britain has to acknowledge her indebtedness for the inventive hint from which the revolution took its rise, to other nations. England has been said to have focussed all the mechanical discoveries of the nations, and enhanced their utility. Of milling at least this observation is true, but though the industrial genius of England in this respect awoke late, at one stride it distanced all competitors, and in about five years had placed the English roller milling machinery and system ahead of all others.

An objection made in England to the American and continental systems was the great expense in working the mills, due to the large amount of manual labour they entailed in carrying the products from the preliminary machines, to be treated on the subsequent machines in the process. So expensive a factor in production bore heavily on the home miller in competition, inasmuch as this labour cost him much more than it did his continental neighbour, while he had to pay a much higher price for the grain than the American miller, it became a matter of course that a new system should be invented to place the British miller on the best possible footing. The honour of inventing such a system is claimed for Mr. J. Harrison Carter, of Mark-lane. In 1880 he designed a roller mill plant, the first in the world we are informed that worked entirely automatically, and finished off all the products in one continuous operation. The idea of an entirely automatic plant was looked upon with misgiving alike by millers and milling engineers; but already it appears that every roller plant is carried out on the lines of the English system.

The Phœnix Mills at Newcastle-on-Tyne, which we illustrate, have just been completed on the Carter system. In our article on the large Carter plant at Blackburn we remarked that the North of England has always been in the front as regards milling progress, and although the South is now waking up to the necessities of modern milling, the North still leads. Newcastle probably suffers as little from the competition of American flour as any large city in the kingdom, but German new process flour has for some years found a lucrative market there, as well as Hungarian and some other foreign made flours, and it is quite to be expected that roller millers in neighbouring towns also found a market for their fine flour. Thus, although the Phœnix Mills were among the best millstone plants in England, and had the reputation of making the finest flour that could be made with stones, having adapted all the latest improvements, such as thorough purification and the reduction of middlings on rolls, still they found it necessary to comply with the growing demand for absolutely pure white bread, such as could only be made by roller flour.

Consequently, some months ago the owners determined to build an entirely new mill adjoining their old mill, and erect a complete roller system. Mr. Carter was entrused with the contract. There is no stint of machines in any part of the process, but, notwithstanding, the huge mill works with the greatest smoothness and regularity. As an instance of the various phases of roller milling, we may notice that whilst in some new mills porcelain rolls are still used, here we find an abundance of them cast aside, in favour of their rival, the smooth chilled iron roller mill. As we have before remarked, all these improvements did not avail before the rapid spread of gradual reduction milling. Therefore, Mr. Davidson determined last year to adopt a full and complete gradual reduction roller system, and build a new mill for the purpose, the old mill being retained as a warehouse and flour store. The establishment, of which we publish several illustrations, now consists of a block of three buildings, namely, the new mill, the old mill, and a building between them, the upper part of which is used as a dust house, the lower containing the boilers. The whole block of buildings has a splendid frontage to the quay, to which the wheat is brought direct by the Tyne, and which contains a travelling steam crane along its full length. The new mill is built on the site of some old warehouses, and in passing it may be mentioned that on digging the foundations, the old wall for the defence of the town, which is shown in an old quaint drawing in the British Museum, was found in a very perfect state, with its arched doorways and secret covered way leading to the river. The new building is five stories in height, built with red bricks and stone dressings, the interior being lined with white enamelled bricks, and the whole appearance is grand in the extreme. The several floors are carried on rolled iron girders, supported by cast iron columns, which rest upon a deep foundation of concrete and inverted arches. The whole of the interior woodwork is dressed and painted with asbestos fire-proof paint. The basement floor contains principally the rope pulleys from the engine, driving five lines of shafts, which in their turn drive fifty roller mills. The first floor contains 100 pairs of roller mills, and the effect produced by the long vista of novel machines, identical in appearance, is very striking. The second floor is occupied—see page 453—with the scalpers in one row, and the sieve purifers in another on the opposite side. The third floor is utilised for the twenty-two gravity purifiers and centrifugals.

In our description of the Carter plant of Messrs. John Greenwood and Sons, Blackburn, which appeared in The Engineer of January 16th, 1885, we stated that we were not at liberty to describe the *modus operandi* or path by which the wheat passed through the various machines, neither are we able to do so now, but an outline description of the method followed in the manufacture of flour by the English roller system is thus given by the inventor, to whom we are indebted for it. The wheat is cleaned in the same manner as was done for the millstone system, but instead of being suddenly reduced on millstones, it goes gradually through the following process. The wheat from the clean wheat bin is elevated to the fourth floor, and shot on to the grader, seen in the engraving at page 452 and page 453, which separates it into four sizes, the larger grains passing to and being broken on rolls coarsely fluted, and the smaller grains on rolls with flutes somewhat finer. The flutes on the first brake rolls are eight, nine, ten, and eleven per inch respectively, with a diagonal twist across the roll of 15 deg. The second break rolls are fluted twelve, the third break fourteen, the fourth break sixteen, the fifth break eighteen, the sixth break twenty, and the seventh break rolls twenty-four flutes per inch. In all there are forty pairs of fluted rolls 9in. diameter by 30in. long used to break down the wheat. The wheat in passing through the rolls of the first break machines is slightly touched, so as to open it along the crease, and the slightly broken wheat is conveyed to a scalping reel, seen in engraving, page 453, clothed with suitable wire. The outsiftings of this scalper are dressed through another reel clothed with silk, and the crease dirt removed. The overtails of the scalper covered with wire, which are still over ninety-nine per cent. of the cleaned wheat, pass to the second break rolls, page 452, which are adjusted a little closer than the first break rolls, and have, as stated above, finer flutes. The product from the roller goes again to a scalping reel, which takes out the middlings and flour, and the coarse portion which comes over the tail of the scalping reel is returned to the third break rolls for further reduction and scalping, and the same process is followed until the wheat has passed through seven "breaks" and scalping reels. The course of the grain and products may be followed by the reader by following the numbers of the elevator boxes given on the several engravings in sectional plan and elevation. The scalpers and purifiers are seen on the second floor plan, page 452.

The product of the seventh or last break is almost wholly bran, while the products of the first six scalping reels which have been collected together will be found to be the internal part of the wheat berry, separated from the skin or bran. The internal part of the wheat berry at this stage consists of germ, coarse and fine middlings, and clear flour made in the "break" process. This product is called "meal" or "chop." The outsiftings of the last scalper are sent to a centrifugal to be treated separately from the outsiftings of all the other scalpers, as the middlings from this scalper are an inferior class. The breaking process is followed by the separating and crushing process. The entire product from the breaking process—except the outsiftings of the sixth break scalper, and the outsiftings of the branduster and bran—is sent to the dusting reels, see page 453, covered

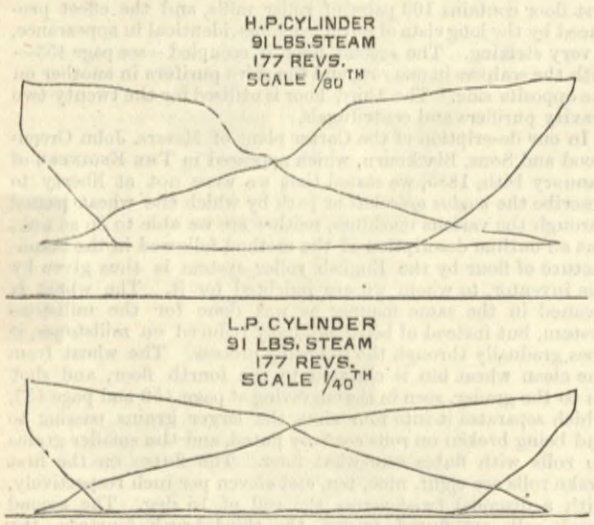
with suitable silks, which divide the semolina from the fine middlings and flour. The fine middlings and flour pass through the silk, while the coarse middlings pass over the tail, the former going to a centrifugal, page 452, clothed with fine silk, and the flour is dressed out while the middlings pass over the tail of the centrifugal, are again dusted, and are next treated on the sieve purifiers, page 453. The semolina is graded on reels into eight sizes, which feed eight of the twenty-two gravity purifiers, which are perhaps the most ingenious machines in the mill, and perform a most important part in the process, as they separate and purify the semolina or large middlings into about seventy sizes by means of an exhaust, which, coming up through each of the legs of the machine, carries the lighter brany particles to the back division, the next in gravity dropping through the middle spout, and the large semolina falls into the front spout. In this mill the process is repeated on the stuff coming from the middle spouts, and this repurifying of the coarse middlings is one of Mr. Carter's latest improvements. The material is returned to a third set of these purifiers, and still repeated on the product of the middle spout of the second purification. Thus the semolina is perfectly cleaned, and after being slightly reduced or sized on the smooth rolls, it is in a better state to be further repurified on the sieve purifiers.

We saw a similar line of purifiers at work during our visit to the large Carter roller plant at the mills of Messrs. John Greenwood and Sons, Blackburn, and we then described them as exceedingly simple and efficient. The fine middlings are treated on the sieve purifiers and reduced on smooth rolls, followed by centrifugal reels, suitably clothed to dress out the flour.

This is a brief sketch of the system of roller milling, as designed by Mr. J. Harrison Carter, to meet the wants of British and Irish millers, and when carried out in the complete manner adopted at the Phœnix Mills will, no doubt, enable them to hold their own against the flour made by the American and continental roller systems. The large mill is completely automatic, and is arranged to make various grades of flour. The enormous imports of American flour have been checked, and the millers of the United Kingdom seem determined to retain the manufacture in their own hands, so that wheat, but not the flour, shall be imported. Mr. Carter is now exporting his machines largely to South America, India, and Australia. The Germans and Americans for a few years had a monopoly of the trade in flour mill machinery, but the English-made machines are now finding large markets both at home and abroad.

ELECTRIC LIGHT ENGINES—FIRST AVENUE HOTEL, HOLBORN.

We publish this week, on page 456, engravings of one of a pair of "Invincible" compound Woolf engines, erected at First Avenue Hotel, Holborn, by Messrs. John and Henry Gwynne, Hammersmith Ironworks, to provide motive power for the electric lighting of the whole building by incandescent lamps. This installation is at this date probably the most perfect and successful yet carried out by private enterprise, We are now accustomed to the electric light in public buildings and large dining halls, but we believe that at the Avenue Hotel the incandescent lamp was first introduced to private apartments and bed-rooms. The electric current is provided by two dynamos of Ferranti type, each driven by its own engine, without countershafts, and with two broad bands from wrought iron pulleys on an extension of the crank shaft. We understand that the number of lamps within this hotel building is over 1000.



The engines are designed to run up to 300 revolutions per minute, and each is capable of indicating 120-horse power, with 100 lb. steam. The steam cylinders are 11in. and 17in. diameter, with 13in. stroke. Steam is provided by two very fine steel boilers, built by Messrs. Adamson; their diameter is 7ft.; length, 27ft.; and daily working pressure, 100 lb. per square inch. One boiler usually supplies steam to both engines. The exhaust steam passes through a large feed-water heater before going to waste. The heater also serves to deaden the beat of the engines, but as the steam is well expanded the noise of the exhaust is slight. During the evening both engines work together, and in these dark days, one or other is constantly at work during the twenty-four hours.

Under present arrangements the speed required of these engines is only 180 to 200 revolutions per minute, and we print above *fac simile* cards taken from one engine when making 177 revolutions.

Since the opening of First Avenue Hotel, over two years ago, not the smallest mishap or breakage has occurred, and no stoppage of machinery has ever been caused by any fault whatever in the engines. During the early days of the installation, before the wiring had been perfected, the engines were most severely tried; more than once when making 280 revolutions per minute they were suddenly brought to a standstill with full steam on, and to-day they work as smoothly and perfectly as when first started. This result has been secured partly by very careful designing, and for the rest by putting in workmanship and material as perfect as the most fastidious can desire. Indeed, the most casual examination of the engines reveals careful and independent thought.

The moving parts are the fewest possible for a compound engine, consistent with an economical distribution of steam. The surfaces are most abnormally large—some engineers might say absurdly large—but Messrs. J. and H. Gwynne are probably well able to judge as to the requirements of this class of engine. All the moving parts are of steel, the fly-wheel discs are forced on the crank webs, then balanced by exact experiment. The plan of connecting two piston-rods to one crosshead and using one connecting rod only is not novel, but in these engines the arrangement has been carried out in a very workmanlike manner. Nevertheless the connection has more than once been dubbed "unmechanical" by critics, "and sure to give trouble." The initial load is obviously far from equal in both cylinders; the average load may be equal, in practice it is seldom equal, and constantly varies with the total load. Messrs. J. and H. Gwynne do not advance the design as suitable for large engines, but in engines like those under notice and a series of smaller engines of the same type made at Hammersmith every necessary provision is made to avoid trouble from unequal loads in the cylinders.

Messrs. Gwynne tell us a rather amusing story bearing directly on this point. The engines at the First Avenue Hotel are called Nos. 1 and 2. The erector who put both engines in place at the hotel particularly fancied No. 2 because he had put together the parts of No. 2, while another man had performed this office for No. 1. Both engines were duly started, both worked very well indeed, but the erector would have it that No. 2 worked more smoothly than No. 1, and granting a difference No. 2 was really the better. No. 1 was indicated and diagrams found all right. Three months elapsed before diagrams were taken from No. 2: the high-pressure cylinder gave a straight line and the low-pressure cylinder proved to be giving all the power which the engine developed. The high-pressure slide of erector's favourite, No. 2, owing to a most trifling oversight, did not reach its face, and for three months the low-pressure cylinder did all the work. So much for the critics.

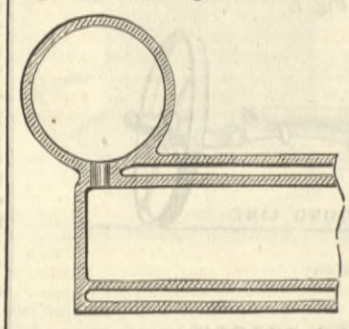
LEGAL INTELLIGENCE.

HIGH COURT OF JUSTICE, CHANCERY DIVISION.

Before Mr. Justice Pearson.

OTTO *v.* STEEL.

We last week finished Sir Fred. Bramwell's evidence in chief. He was then cross-examined by Mr. Moulton, Q.C., first in regard to the plaintiff's invention as disclosed in the specification, and what the witness considered the invention to consist in, viz., "that besides the combustible charge there is a notable quantity of either air or products of combustion or both." When he spoke of Otto's invention as being new he applied it to all the three modifications so far as he knew, Otto being the very first man who ever told anybody that if you left either air or residuum or both in they would produce the effect which he says they would produce. After taking the witness through the working of the Otto engine, as shown by the model, Mr. Moulton then turned to page 5 of the specification, line 24, and read: "It will be evident that if the space A^1 or a separate chamber, such as an air vessel communicating therewith, be made sufficiently large to contain the whole quantity of incombustible fluid requisite for each charge, no fresh charge of air need be drawn in at the commencement of the stroke." He then put to the witness whether the following sketch shows fairly what would be understood by those words. This was assented to. A great deal of discussion then took place on the meaning of the word "explosion," Mr. Moulton suggesting that an explosion is the rapid combustion of a highly inflammable substance forming new gaseous products at a high temperature. To this, however, the witness would not altogether agree. He thought the definition would be quite applicable to a gas engine, but would rather not attempt to give a general answer. The actual time of combustion in a gas engine was next dealt with, *i.e.*, the time it takes for the pressure to rise to a maximum; but the witness, though he knew of experiments which enabled this to be determined, said he had never made any calculations. He accepted from $\frac{1}{37}$ to $\frac{1}{40}$ of a second as being a likely time. With regard to the Lenoir gas engine, witness knew that it had been made in considerable numbers before the date of the plaintiff's patent. He had seen one at Petworth which has worked for something like twenty years. They, too, had their combustible charge which was ignited, and they, too, must have had the pressure rising to the maximum amount; but he could not tell how long it took for the pressure to rise to its maximum; he had never calculated out the time. He had never measured the time that it took to rise to the maximum pressure in the Hugon engine. He had taken one diagram from a Hugon engine, or on one occasion at least; that was many years before the date of the plaintiff's patent—on an occasion when he was called in by Mr. Aston, who was the arbitrator, as a sort of mechanical assessor. He did not then measure the time that it took to rise to the maximum pressure, but only remembered the diagram as one of great suddenness. Supposing it is shown that the time taken for the rise of the pressure in the Hugon and Lenoir is about the same as in the Otto, but that the actual rise of pressure in the Otto is three times as great as that in the Hugon and Lenoir, he did not think it would be right to say that it is three times as explosive. There is nothing to show that when the maximum pressure is attained in the Otto engine the combustion is then completed, and his notion of explosion is that which happens by the rapid combustion of all that there is to burn—that is to say, the explosive burning—and it did not to his mind at all follow that the maximum pressure in the Otto engine—where the capacity of the cylinder, owing to the movement of the piston, is increasing from time to time—indicates that that engine is more explosive, or as explosive as another one. The mere question as to what the maximum pressure may be is, he thought, a fallacious mode of ascertaining whether one is more explosive than the other. If you are to consider whether the thing is explosive or not, you must consider whether it burns all at once or burns by degrees. Mr. Moulton then led the witness through a series of calculations to show that when working with a mixture of 1 of gas to 8 of air, which he took as being a rich combustible mixture, there was 6½ volumes of inert nitrogen. If the mixture was 1 to 11 there would be 9 volumes of inert nitrogen. The witness was then asked if he did not consider this a "notable" quantity of inert gas. Answer: Yes, it is a notable quantity of inert gas; but I understand the patentee to be speaking of a notable quantity in excess of that which must happen when you use atmospheric air in lieu of pure oxygen. Another set of calculations was then made to find out the proportion of inert gas in an Otto charge, on the assumption that the clearance space which would be filled with residuum was one-third the space of the cylinder, and that the combustible mixture was 1 of gas to 8 of air. To arrive at a result Mr. Moulton made a number of assumptions to which the witness would not agree, and finally arrived at the conclusion that the complete charge would consist of 13 parts of combustible and 47 parts inert gas, which was practically the same as ascertained in the Lenoir calculation. Reference was then made to the sketch showing the vessel for receiving the residuum in the side of the cylinder, the witness explaining the effect of firing a charge in such a cylinder thus:—First of all, the charge not being diluted with the residuum, would fire with certainty, and consequently, when it did fire, and the expansion was obtained from the heat arising from the combustion, that expansion, instead of having to relieve itself, either by heating up the walls of the cylinder, or by endeavouring to drive the piston, which it cannot drive at any very great rate at that point, because it is attached by the connecting-rod to the crank—relieves itself by the compression of that residuum which is in the vessel sketched there, and also to a certain extent will heat up that residuum, although he should imagine not so well as if the residuum were more immediately in the neighbourhood of the charge.



Mr. Moulton: I perfectly agree with that description of what the action would be, and therefore the action would be rapid combustion due to the undilute state of the charge; extreme development of heat due to that, but the compression of the air in that air vessel relieving the extra pressure on the piston. Is not that so?

Witness: Yes, and a storing-up pressure to be given out in working the piston during the latter parts of the stroke. Q. And that would not produce a gradual combustion then? A. As sketched there, I do not think it would.

The Witness: I am not quite clear whether I have not given a too hasty answer upon that matter. If this applies to a compression engine, I certainly have; but, supposing that this is a compression engine, and that vessel contains the residuum at atmospheric pressure, then the charge is drawn in, and then, when the piston makes the compression stroke, a portion of that charge will enter that vessel; that is to say, there would be in the chamber itself the shading off that he speaks of in the cylinder. The examination then turned on the question as to whether the residuum in one of Otto's ordinary engines would keep its place behind the piston when the latter was drawn forward, the witness stating that he was clear that there would be a marked distinction between the condition of the charge next to the piston and the condition next to the back of the cylinder. He had proved this by experiment, viz.: Trying to ignite at the back of the cylinder, where he believed the charge to be the richest; and trying to ignite in that part of the cylinder just behind the piston. The results showed to his mind that substantially there did remain that difference, because while the ignition was always certain and prompt at the back of the cylinder, it was uncertain and slow just behind the piston. The flame at the end was applied just where the passage is by which the inflammable charge passes into the cylinder. The side light was immediately behind the piston when at the end of its instroke. Another reason for his saying so was that in an engine of Sterne's construction where the materials are fed in by a pump, and where they have therefore more opportunity of being mixed up than they have in this direct feeding in, there the materials were taken out, and were tried by combustion in the eudiometer with the electric spark, showing a marked distinction in their nature at the part where the patentee supposes they would be richest, and the part where he supposes they would not be.

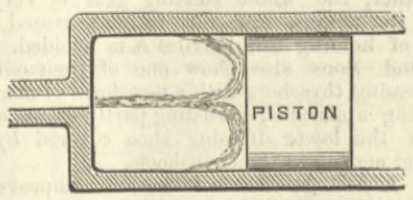
Mr. Justice Pearson: I know nothing about Sterne's engines at present, but I understand what he means is this: that whereas in that engine before me the combustible mixture was put in at the bottom, and the flame was applied as you say in the passage, in Sterne's engines the mixture is pumped in, and being pumped in, as I understand it, there is more motion communicated to the fluid that comes in than there is in that one; consequently there is a greater possibility at all events of the fluid as it is pumped in mixing with the residuum. Then, as I understand further, what Sir Frederick Bramwell said was that in order to make this experiment he took out from the part of the cylinder next to the piston, just before the explosion, some of the mixture which he found there as well as some of the mixture from the bottom.

Asked by Mr. Moulton if it was not a fact that in Sterne's engine special precautions were taken to prevent mixing, witness replied that he did not know, but he should like to tell his lordship that in Sterne's engine not only does the pump pump in the mixture, but it also pumps in a separate stratum of air, and also pumps in the products of combustion. They all three come in by the agency of the pump, and are found in the cylinder, and three samples were taken from that packed charge just before it would have been ignited, and were tested; one from the part where the mixture was supposed to be, one from the part where the air was supposed to be, and one next to the piston from the part where the products of combustion were supposed to be. The witness then explained the apparatus and manner in which the samples had been taken. The engine was in ordinary working, and then at the time when it would have re-ignited for another stroke, the igniting lights were turned out, and a lever caused all those three cocks to open at that moment and to deliver their contents into india-rubber bags that were applied to them for the purpose of taking the charge. That is to say, in order to get the charge when packed and before firing, that was made into a false stroke. If it had been lit, we could not have got it.

Mr. Moulton: I am going to put to you that these results are due to the special precautions taken by the inventor in making the gas enter by a long gradually sloping cone. Assuming that it enters at a hole in a flat back, I put to you that this is what would occur; that the gas would enter at high velocity in an ordinary working of an engine? That it would come in as an entering column right straight up to the piston-head and disperse there?

Witness: No, I do not think so.

A diagram shown by the following sketch was then handed up. With side ignition the diagrams show that it took a very long time indeed before the complete ignition was effected, whereas the back diagrams show nothing of the sort. Therefore it is argued



that anything which took place at the side did not prevent igrition altogether; but that when it did ignite it burnt in a totally different manner, which can only be consistent with there being a different condition of things at that part of the cylinder from that which prevailed at the back end of the cylinder.

On the subject of gradual combustion, Sir Frederick Bramwell agreed with Mr. Moulton that supposing the charge is equally mixed, the combustion will go on with a certain amount of slowness, as compared with a mixture that has not got any excess of air. Supposing the excess is isolated and the charge of coal gas with its proper amount of air is put in one part of the cylinder, and the inert gas in some other part, the combustion then will go on more rapidly. Therefore, if we want, with a given amount of coal gas, and a given amount of other gas, to make the explosion slow, we must take care that the dilution is uniform. Regularity of distribution of the burning charge, therefore, tends to slowness of combustion down to the point when you get no combustion at all. Newton's—Bisschof's—specification No. 1594, of 1872, was then referred to. This is a case in which the cylinder is vertical, six valves in the end admitting air and three others gas. Such an engine had never been made, and no particular point seemed to be made out of the reference to it. Wright's specification No. 6525, of 1833, was next discussed. We shall give the drawings of this engine later. For the present it will suffice to say that Sir Frederick gave it as his opinion that such an engine could not be made to work at all, the whole thing being "absurd" and "contemptible." Newton's—Million's—specification No. 1840, of 1861, was then brought forward, the following being the parts particularly referred to:—Page 8, line 32, "In the engine above described the mixtures are introduced under pressure into the motor cylinder. This is one of the characteristic features of this invention, and I claim the exclusive right to the principle upon which this engine is constructed and operated whatever may be the explosive mixtures employed and whatever may be their pressure." Page 10, line 4, "Instead of introducing cold gases into the cylinders during a cer-

tain portion of the stroke and igniting them afterwards when the induction ceases, which takes place according to the firstly described method, another arrangement might be adopted. The motive cylinder might be made longer than necessary in order that the piston shall always leave between it and the end of the cylinder a greater or less space according to the pleasure of the constructor, such as one-fourth, or one-third, or less of the volume generated by the motive piston." Calling this space a "cartridge," in the words of the patentee, "On opening the slide valve the gases would be allowed to enter suddenly from the pressure reservoir into this cartridge towards the dead point." The witness agreed that so far as the mere space was concerned, Million's "cartridge" corresponded with Otto's clearance, but did not admit that the results obtained would be the same in both cases, because Million said the charge should be introduced at a pressure of from six to eight atmospheres. The result would be, therefore, that when this mixture at six to eight atmospheres came into this space where the residuum was at atmospheric pressure, it would compress it until it was only one-sixth or one-eighth of the whole contents. Neither did Million disclose to the public that there would be the slightest use in leaving any portion of the residuum at all. With two to three atmospheres he might have left as much residuum as represented what would be, he supposed, within Otto.

Mr. MOULTON then pointed out that Million did not contemplate always working at such a high pressure, and put it to the witness whether that was not the case. Q. Does not it follow from that that he contemplates not having to work at the high pressure, and therefore only having one pump? A. Yes; but it also shows that he contemplates working at the high pressure which would make the whole thing inoperative in your view that he was disclosing something.

Mr. JUSTICE PEARSON: It is perfectly clear from this specification that what Sir Frederick Bramwell says on the specification is right. If Million had thought there was a great benefit in keeping a notable quantity of residuum as a buffer, so to speak, between the piston and the charge when he spoke of the higher atmospheres he would have said, "This is not so good as the lower?"

Mr. MOULTON: Quite so.

Mr. JUSTICE PEARSON: In the very first part he says you must have for working his patent one or two pumps for compressing the air. You may have one or two pumps, but if you want to work at higher pressure you must have two pumps.

Mr. MOULTON: I quite understand. I am prepared to go so far as to say, though it is not necessary for the purpose of the argument, that the idea that the residuum is any good is a pure delusion.

Mr. JUSTICE PEARSON: That is another thing. I am only speaking now of the words of the specification.

Mr. MOULTON (To the witness): This is an instance of a person who admits a charge into a cylinder with a considerable amount of residuum in it?—Considerable before it is subject to the pressure that will come on it when the compressed charge is put in.

Mr. ASTON: If my friend will give up the residuum in his gas engines we will not interfere with him.

Mr. MOULTON: Oh, but residuum is no more than anything else.

Mr. ASTON: That is another point. You said you did not think it was of any use.

Mr. MOULTON: Nor do I.

Mr. ASTON: Then if you give it up we will leave you alone.

The witness was next asked in regard to the amount of clearances in the Lenoir and Hugon engines at South Kensington Museum. The Hugon engine at the South Kensington Museum had, he believed, only got a full $\frac{1}{16}$in. clearance at each end of the piston, the least you can put in substantially. He should be very much surprised to hear that 30 per cent. of the total volume occupied by the charge was filled with residuum, as he thought it was about the minimum quantity that would be used. He said the minimum quantity because of the connecting rod, which, owing to its construction, does not alter its length, as the brasses wear, whereas in the Lenoir, where it does alter its length, we are compelled to leave more clearance at one end.

Barnett's specification, No. 7615, of 1838, was next dealt with. We shall give the drawings of this engine next week. The witness followed through the mode of working as described, and gave it as his opinion that the engine could not be made to work at all, as from the construction the charge would be admitted into the top of the cylinder when it was wanted in the bottom, and *vice versâ*.

The witness was then cross-examined on the Lenoir engine, the point to which special attention was directed being the arrangement of the slides, which, according to the specification, would admit first air, then gas and air mixed, and finally air. The quantity of air first admitted would be less than that drawn in at the end, for the piston was moving at a greater velocity during the latter period, while the valve would be opened for the same time in each case. Ignition was by an electric spark, either at the side of the cylinder or else at both ends. In addition to the small quantity of air in front, there would be the products of combustion from the clearance spaces, whatever they were worth, distributed over the surface of the piston.

Some discussion then took place as to whether the intention was to permit the piston to travel forward some distance before the air-port was opened, Mr. Moulton contending that this was the correct interpretation, while Sir F. Bramwell maintained that the port had to be opened simultaneously with the commencement of the stroke. Were it otherwise, he said, the piston would be dragged forward against the whole pressure of the atmosphere, and then gas and air is to be let in behind it, so that he gets no work out of it all. It would be so much taken off the useful effect of the engine.

The specification states that "the object of introducing a supply of air into the cylinder before the gas is allowed to enter is to neutralise the effect of the carbonic acid gas formed by the combustion of the first portion of the inflammable gas, as the carbonic acid gas, without being thus neutralised, might prevent the ignition of the remainder of the inflammable gas."

The witness then pointed out that if the igniter was put at the side of the cylinder, it would then have to ignite the film of air behind the piston; but if, as the patentee does, you put the igniter at the end of the cylinder, then the thing the igniter would meet would be this large mass of air brought in after the charge.

Mr. JUSTICE PEARSON: I should like to ask a question with regard to this ignition. Is it your theory, then, that the three strata, if I may so call them—the air in front, the charge, and the air behind—mix to such an extent that they would not ignite? Witness: No, I mean because they would not mix to such an extent that they would ignite—that is to say, that the thing which the igniter at the end of the cylinder would find next to it would be the charge of air.

In answer to Mr. Moulton, the witness then stated that he had seen the Lenoir and Hugon engines at South Kensington, and that both worked with shock as soon as work was put upon them. He admitted that if you stood and looked at them "twiddling" themselves round there was no shock. He did not know if the pressure that comes upon the piston of these engines was anything like what it was in the Otto.

Mr. MOULTON: Will you now kindly look at the second claim of the Otto specification: "Compressing by one instroke of the piston a charge of combustible and incombustible fluid drawn into the cylinder by its previous outstroke, so that the compressed charge when ignited propels the piston during the next outstroke and the products of combustion are expelled by the next instroke of the piston, substantially as herein described." Now I take it that that is a claim to what is generally called the cycle, is it not?—Witness: I suppose so.

Mr. MOULTON: Now I want to call your attention to one of the anticipations in the original list——

Mr. ASTON: Now, my lord, I shall be obliged to take that objection, which I must take at some time or other, to the introduction of these publications, unless they are proved to have become part and parcel of the stock of public knowledge within the decisions with which your lordship is familiar. It will not be sufficient for my friend to say that they were in existence before.

The alleged anticipation of the cycle is by Beau de Rochas, in a theoretical consideration of the best means for securing economy in working gas engines. Much discussion ensued as to whether this publication should be admitted, it being finally arranged that Sir Frederick Bramwell should be cross-examined on it to save time, on the understanding that it was left for Mr. Moulton to prove publication afterwards. Beau de Rochas says: "Then on the same side of the cylinder we are naturally led to execute the following variations in the period of four consecutive strokes: suction during the entire stroke of the piston, compression during the following stroke, ignition at the dead point, and expansion during the third stroke, forcing out the burnt gases from the cylinder on the fourth and last return stroke." We gave the whole last week.

In reference to this, the witness admitted that apart from the question as to whether Otto's second claim includes the presence of a separate charge of residuum or air, it exactly described that second claim. It was exactly the sequence described in Claim 2. A somewhat similar discussion ensued on Atwater's specification—a United States publication—but as Mr. Moulton was not very clear as to what his evidence in this would be, all questions on it were deferred.

This concluded the cross-examination of Sir Frederick Bramwell.

(To be continued.)

SOCIETY OF ENGINEERS.

THE DEPHOSPHORISATION OF IRON IN THE PUDDLING FURNACE.

AT a meeting of the Society of Engineers, held on Monday evening, December 7th, at the Town Hall, Caxton-street, Westminster, Mr. Charles Gandon, President, in the chair, a paper by Mr. Philip S. Justice, was read on "The Dephosphorisation of Iron in the Puddling Furnace."

The author, after referring to the generally depressed condition of the iron manufacture, showed how it bore most hardly on the works which were dependent on the use of phosphoretic pig iron, and on those which, in more favourable times, could work up cinder pig. The presence of even a low percentage of phosphorus in the iron was most injurious to its quality and value, and with the extremely low prices at present ruling, it was impossible to make these inferior qualities at a profit, and the use of phosphoretic ores must be greatly limited, unless some means were found of obtaining from the pig iron made from them a superior plate or bar iron, with cheapened cost of production. Many authorities had said that this was impossible with the ordinary puddling furnace, and that, in the face of the acknowledged success of the Bessemer, Siemens, Thomas-Gilchrist, and other systems of making mild steel, "the days of puddling are gone." But the author contended that this was not the case, and that the process discovered by Mr. Beasley, of Handsworth, and fully tested by two years' working on a considerable scale, met the difficulty by a special treatment of the "fettling" of the puddling furnace, whereby the phosphorus was eliminated during the ordinary process of puddling. The details of this treatment were fully explained, and its results stated to be the production of an iron equal in tensile quality and fibre to the best marked bars. Experience also proved that the weight of iron produced, instead of being as usual less than that of the pig iron charged into the furnace, was actually more, the process extracting the gain of iron from the "fettling" itself, which is usually lost in the slag as a silicate of iron. It was urged that at the present time such results deserved the closest and most thorough investigation, and that the process, if fully substantiated, should meet with general adoption. Samples of the iron were exhibited, showing the character of its fracture and the results of other tests.

LAUNCHES AND TRIAL TRIPS.

ON the 23rd ult. Messrs. Fleming and Ferguson, Paisley, launched a large hopper dredger for the Auckland Harbour Board, New Zealand. The dimensions of hull are 172ft. by 32ft. by 14ft., and the carrying capacity of hoppers is 600 tons. She is capable of dredging 400 tons of clay or gravel from a depth of 30ft., and will steam at a speed of 8 knots per hour. She is fitted with all the latest improvements in hopper dredgers, and has triple-power three-barrel independent steam winches fore and aft. Hoisting gear for lowering and raising bucket ladder is also driven by pair of independent auxiliary engines. The raising of the hopper doors is also done by separate independent engines, by which they can all be closed tight in five minutes from time of discharging. The vessel is self-propelling, being driven by steel twin-screws, having clutches for disconnecting. Her main engines consist of two pairs of independent surface-condensing engines, to indicate 600-horse power. Gearing throughout the vessel is of cast steel, and the machinery generally is similar to that lately fitted by Messrs. Fleming and Ferguson on board the hopper dredger for Ayr harbour, and which vessel is doing her dredging and discharging at the unprecedentedly low cost of a penny per ton. During construction she has been under the supervision of Mr. John Darling, who represents the Auckland Harbour Board in this country.

A small screw steamer 45ft. by 9ft. by 4ft. draught, built for Liverpool merchants for their West Coast of Africa trade, by Mr. William Dickinson, of Birkenhead, performed her trial trip last month. The machinery is on Jensen's patent system, and is supplied by Messrs. Jensen and Co., of Birkenhead. The engines worked exceedingly well, and propelled the boat at a speed of about 10 knots per hour. Weight of engines is only about 6½ cwt., and are contained within 2ft. square.

A paddle steamer 45ft. long by 9ft. 6in. beam, built of steel by Messrs. Beesley and Sons, Barrow-in-Furness, was tried last month. The machinery is supplied by Messrs. Jensen and Co., of Birkenhead, and is Jensen's system applied to paddle engines. The engines worked with their usual ease, and drove the paddles—Beesley's patent—at a speed of 110 revolutions per minute, were handed over, and accepted by the owners.

AMERICAN NOTES.

(From our own Correspondent.)

NEW YORK, November 28th.

THE strong points in the American market to-day may be briefly enumerated as follows:—A heavy demand for Bessemer pig, a moderate demand for steel rails, urgent inquiry for old rails, with deficient supply and advancing prices; a heavy demand for iron and steel nails under a continued suspension of western nail factories, and a prolonged season of building activity in all parts of the country. A moderate demand for sheets, plates, pipe iron, bars and merchant steel; a fair demand for ordinary foundry and forge iron, and an active demand for special and standard brands of both forge and foundry, with prices at the highest point for months; a fair movement of traffic on the trunk line railroads; a more favourable indication for the settlement of chronic quarrelling that has disturbed freight rates throughout the year; a steady inflow of capital from the Northern and Southern states, with a great deal of projected work in the way of shop and mill capacity. Commercial interests are endeavouring to settle questions in advance of the meeting of Congress, in order that national legislation will not be necessary, as the action of Congress, if certain questions are precipitated into it, will not be favourable to the commercial interests. A strong fight will be made on the silver question, but it will likely result in a drawn battle, as both sides are compactly organised, and the interests are so diverse that definite legislation will likely be postponed. The establishment of a national gun works will receive a good deal of attention. Reports from the north-west received this week show that a very great distribution of manufactured products is going on, and manufacturers are purchasing machinery for textile mills, machine shops, railroad shops, and for a great many minor manufacturing purposes. Taking the manufacturing productive capacity of the country as a whole there will be a marked increase in 1886, particularly in the direction of machinery for engines, agricultural implements, wood working machinery, and for the production of textile products. A few new cotton factories will be built in the South, for which contracts for machinery are now let. The prospects for an improvement in the export trade for cotton goods is encouraging a slightly increased investment in such plants. The cotton mills throughout the State with but few exceptions are making fair dividends, and a number of schemes are now under consideration for the erection of new works, as well as for the enlargement of existing capacity.

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

(From our own Correspondent.)

RAW iron is active. Consumers are negotiating their supplies during the first three or six months of next year. Lincolnshire pigs were quoted 40s. to 41s. 6d., according to brand, delivered here; Stanton—Derbyshire—pigs, 40s.; other Derbyshires, 39s.; while Northamptons were 38s. to 38s. 6d. Native all-mines were 55s. to 57s. 6d., and on to 60s.; part-mines, 40s. to 45s.; and cinder pigs, 32s. 6d. to 35s. Hematites were somewhat firmer in consequence of the increased business doing in steel rails and sleepers, and Welsh and West Coast best forge sorts were quoted 53s. to 54s., though buyers stated that they were making some contracts at 52s. 6d.

In finished iron prices are without much alteration upon the week—merchant sheets are £6 5s. to £6 10s.; galvanising sheets, £6 12s. 6d. to £6 15s.; boiler plates, £8 to £9 easy; common bars, £5 to £5 10s.; and hoops, £5 7s. 6d. upwards.

The January quarterly meetings are regarded with interest, and speculation is being indulged as to whether crucial prices will be altered. At present Messrs. William Barrows and Sons' remain at: Bars, round, square, and flat, £7 10s.; best bars, suitable for chain-making or other purposes, £9; double best, suitable for superior chain bars and the like, £10; plating bars, £8; best angle, tee, and rivet iron, £9 10s.; and double best, £10 10s. Boiler plates the firm quote £9, £10, £11, and £15, according to quality; and sheets, £9 for 20 gauge, £10 10s. for 24 gauge, and £12 for 27 gauge. Hoops they quote £8; best, £9 10s.; and wide strips, £9.

Much satisfaction has been occasioned this week by the announcement that the Stour Valley side of the Shrubbery Ironworks, Wolverhampton, formerly owned by the world-famed firm of Messrs. G. B. Thorneycroft and Co., has been purchased by the Wolverhampton Corrugated Iron Company and Mr. Ernest Farnworth, and it is to be re-started for sheet iron manufacture.

This—Thursday—afternoon a meeting of the Iron Trade Wages Board was held at the Council-house, Birmingham, before Alderman Avery, president. Mr. B. Hingley, on behalf of the employers, claimed a reduction of 6d. per ton upon puddlers' and 5 per cent. upon other wages, arguing that the decrease of 5 per cent. in the North rendered essential a corresponding reduction in Staffordshire. He claimed a further reduction of 5 per cent., stating that as owing to depression of trade the system of extras was not now in operation in the North, the lower wages there ceased to be a reasonable rate. Staffordshire ironmasters were being ruined by northern competition. Mr. Capper, for the workmen, protested against rate of wages in Staffordshire being regulated by that in the North, and denied existence of competition between the districts. The arbitrators promised his award at an early date.

Bridge builders note with some interest that the Midland, Glasgow, and South-Western, and certain other of our home railways are just now inquiring for some bridge work.

The strike at the Oldbury Railway Carriage Works has terminated by the resignation of the obnoxious foreman, and on Monday the men resumed work.

The scheme which was formed some time ago for the construction of a railway between Willenhall, Staffordshire, and Bridgenorth, Shropshire, has been abandoned. The scheme was received with great interest when first proposed, and it was felt that the line would largely benefit the district.

NOTES FROM LANCASHIRE.

(From our own Correspondent.)

Manchester.—As is very frequently the case with the close of the year, a more hopeful feeling appears to have come over the market, but on what this is really based it is difficult to ascertain. Generally it seems to be the impression that trade has got past the worst, and that the ensuing year will bring forward an improvement; but except that there is an increased American business doing, which has stimulated an undoubted activity in hematites, there is no present or prospective improvement in the large iron using branches of industry to warrant anticipations of increased consumption in the immediate future. The tendency, if anything, is rather in the direction of diminishing than increasing consumption.

With the subsidence of the political excitement of the elections, the market has got back into something like its normal condition; but the close of the year is too near at hand for any business of weight to be set on foot. The approaching holidays and preparations for stock-taking have now substituted the recent political excitement as reasons for not entering into buying for the present, and although there was a fairly good attendance on the Manchester Iron Exchange on Tuesday, very little business doing was the general report. In pig iron, renewals of contracts for next year have here and there led to moderately large sales being made, with in some instances, where sellers had been exceptionally low, rather better prices being got. These, however, have been exceptional transactions, which have not relieved the market from the tone of general dulness, although, as regards prices, makers in most cases are showing a decided tendency towards firmness. For Lancashire pig iron makers are holding firmly to 39s. for forge, and 39s. 6d. for foundry, less 2½, delivered equal to Manchester; and for the better class district brands, 39s. 6d. to 40s., less 2½, delivered here, is being held for, although there are some makes to be got at 1s. to 1s. 6d. per ton under these figures. North-country irons are not quoted under 41s. 4d. net cash for good named foundry brands delivered equal to Manchester; in these there is very little doing.

Hematites have gone up fully 2s. per ton upon recent prices, and for good foundry qualities delivered here the lowest quotation is now about 53s., less 2½, whilst some makers are asking as much as 55s., less 2½.

The manufactured iron trade remains without material change. There is only a slow hand-to-mouth business doing, and for prompt specification very low figures continue to be taken. For delivery into the Manchester district the average prices are about as under:—Lancashire and North Staffordshire bars, £5 2s. 6d. to £5 5s. per ton; Lancashire hoops, £5 12s. 6d.; local made sheets, £5 17s. 6d.; and good Staffordshire qualities about £7 per ton.

Reports from the various branches of the engineering trades show no very material change in the condition of this industry. Here and there, as I stated last week, some firms are getting rather more work than they were a short time back, but even in these cases they are still only very indifferently employed, and the general prospects as to the future show no improvement. The trades union society's returns as to employment show no decrease in the large percentage of numbers on their books in receipt of out-of-work support, and as to the state of trade, the reports from the various districts continue much the same as those last given, the only direction in which improvement is at all perceptible being in some of the North of England and Scotch shipbuilding centres.

Mr. John Royle, of Manchester, has designed for the new

Victoria Station an ingeniously arranged return steam trap for returning to the boiler the water from the steam-heating apparatus. The waste water is discharged into an open tank, and from this tank it is raised about 15ft., and put into the boiler by a simple arrangement of steam-moved valves.

The election of Mr. Peacock, the well-known locomotive builder, for the Girton division, following upon the return of Mr. Wm. Mather for Salford, has, apart from political considerations, been received with general satisfaction in this district as securing a direct representative in the House of Commons of the important engineering trade interests of Manchester and Salford. It is, however, somewhat amusing to contrast the different grounds upon which satisfaction at the return of these gentlemen is based. The large employers of labour will, of course, have two direct representatives of their interest in Parliament, and they are satisfied. On the other hand, the men are equally satisfied on the ground that these two important employers of labour having been returned to Parliament will be less inclined to take any initiative in reducing wages should such a question come forward, so that on the workmen's side the election of Messrs. Mather and Peacock is regarded as some sort of a guarantee for the protection of their interests.

A fair amount of activity characterises the coal trade of this district, but it is only in exceptional cases that collieries are really under any pressure to meet the requirements of their customers. A large number of the pits are barely working full time, and generally supplies are plentiful. What activity there is in the demand is chiefly confined to house fire coals, other sorts for iron-making, steam, and general manufacturing purposes, still meeting with only a slow sale. Prices remain without alteration, the basis all through being very low, and especially so in the lower classes of fuel. Best coal at the pit mouth only in exceptional cases averages more than 9s. per ton; seconds, 7s. 6d.; common house coals, 5s. 9d. to 6s.; steam and forge coals, 5s. 3d. to 5s. 6d; good qualities of burgy, 4s. 6d. to 4s. 9d., with common sorts to be got as low as 4s.; best qualities of alack, 3s. 6d. to 4s.; and common, 2s. 6d. to 3s. per ton.

In the shipping trade there has been a considerable weight of business doing, but that has been at low prices, averaging 7s. 3d. to 7s. 6d. per ton for steam coal delivered at the high level, Liverpool, or the Garston Docks.

Barrow.—There are much better prospects in the iron trade of this district, and the disposition on the part of users to do a fuller business is shown all round, but as makers have in most instances very little iron to sell owing to the reduced output of their furnaces, and the fact that they are fairly well sold forward, a firmer tone is shown all round, and prices as a consequence have been advanced. The business doing in Bessemer iron shows an improvement on recent experiences, but makers are not doing much in the direction of forge or foundry qualities, which, for the moment, are not in good inquiry. The stocks of Bessemer iron have been reduced in all instances, and if the demand for steel improves in the way it is improving at present, it is certain that makers will be compelled to increase the output of the furnaces. The value of pig iron is steady at 44s. 6d. per ton net for No. 1 descriptions, prompt delivery on trucks at makers' works; No. 2, 44s. per ton; No. 3, 43s. 6d.; No. 3 forge and foundry iron, 42s. to 43s. Forward deliveries in all cases 1s. per ton over these quotations.

Stocks of iron have been largely reduced. Makers are, generally speaking, resisting forward deliveries of iron. American orders for steel rails are expected daily, in addition to those already in the hands of makers.

The shipbuilding trade has shown no improvement of late. Engineers are short of work. Iron ore is in quiet request at late rates.

An arrangement has been effected by the Corporation of Barrow with the contractors of the new Municipal Buildings to pull down the defective tower to its base, put in new foundations, and reconstruct it at a lower level, but on the original lines, for an extra allowance of £3000. This is considered a satisfactory way out of what promised to be a difficult legal proceeding.

THE SHEFFIELD DISTRICT.

(*From our own Correspondent.*)

The Board of Trade returns for November show that the exports of iron and steel, as compared with the corresponding month of 1884, have decreased by £275,451. For the eleven months, as compared with the eleven months of 1884, the decrease amounts to the enormous total of £2,579,334. These are most disappointing results. It is interesting to note that in pig iron last month the decreasing markets were Russia, Germany, Holland, Belgium, France, and the United States, the only countries which exhibited improvement being Italy and British North America.

Bar, angle, and bolt also showed a serious "drop," from £157,454 to £120,090; railroad of all sorts, from £326,931 to £239,068; hoops, sheets, and plates, from £290,274 to £278,934; and steel rails, from £193,512 to £159,445. In the corresponding month of 1883, the value of steel rails exported was £321,472. British East Indies was the only increasing market of any consequence last month, the amount exported there being no less than £73,650 against £37,103 in November, 1884. Australasia, on the other hand, has fallen from £56,366 to £21,421. British East Indies has also been a good customer for railroad material, described in the return as of "all sorts," taking a value of £112,444 against £80,735 in November, 1884.

In hardware and cutlery the total value exported last month was £238,441, against £247,930 in November, 1884. Russia has increased from £3182 to £3633; the United States, from £20,601 to £24,464; Brazil, from £11,519 to £12,512; Argentine Republic, from £9079 to £11,370; British North America, from £6786 to £8098; British East Indies, from £20,921 to £22,160; Foreign West Indies, from £3985 to £4392; Australasia, from £48,154 to £53,477. On the other hand, Germany has decreased from £16,822 to £12,622; Holland, from £7471 to £6552; France, from £12,553 to £12,063; Spain and Canaries, from £7046 to £3695; British Possessions in South Africa, from £5912 to £5272.

In unwrought steel the improvement noted last month is continued. Then, for the first time in two years, the value showed an advance on the corresponding month of the previous year. Last month the total value of steel exported was £96,487, against £86,445 for the corresponding month of 1884, though the value for November, 1883, was still considerably higher, viz., £106,506. France shows a continuous falling off for the three Novembers of 1883-4-5, the values being £12,046, £9756, and £8330; the United States, for similar periods, shows totals of £24,690, £18,512, and £27,781; while other countries rank for £69,770, £58,178, and £60,376. An improvement with the United States, which would seem to have set in, is of all points most to be desired, as it is still the market upon which several of our leading steel establishments rely.

The Burmese war, short and decisive, encourages hopes of new markets in the East, to which our local chamber of commerce is already giving close attention. Mr. C. E. Howard Vincent, M.P. for the Central Division, addressed a letter to the Chamber, strongly urging the importance of sending a Commissioner to British Burmah, to investigate the markets which would be opened up in North Burmah, as well as in Siam and Southern China. Very great hopes are entertained in regard to the successful and all but bloodless campaign against the ex-King Theebaw, and if feebleness does not now paralyse the Imperial Councils, there is little doubt that British commerce will benefit largely by the occupation of Mandalay, and the opening up of the densely-populated adjacent countries.

As I have already anticipated, Derbyshire has followed the lead of Yorkshire in regard to miners' wages. This was evident after Clay Cross had set the example, and now all the other colliers have done likewise. The Council of the Yorkshire Miners' Association, meeting at Barnsley, have held a private meeting to consider the situation, and after congratulating the secretary, Mr. B. Pickard, on becoming member for Normanton division, passed other resolutions, which they decided "not to communicate to the press." This practically means the end of the movement for a general "stoppage" of mines with a view to an advance of 10 per cent. in wages over the whole country.

During November last the total quantity of coal carried to London by rail was 662,665 tons, as compared with 607,081 tons in November, 1884, being an increase of 55,584 tons. For the eleven months from January 1st to November 30th there have been 6,398,221 tons sent by rail to London, as compared with 6,193,375 for the corresponding period of 1884, an increase of 204,846 tons. Messrs. Newton, Chambers, and Co., of Thorncliffe Collieries, continue to head the list of collieries sending by rail, their tonnage to London in November being 33,992, while Clay Cross is second with 29,303 tons, the Grassmoor third with 17,033 tons, and Blackwell fourth with 16,786 tons. Langley Mill and Eckington—J. and G. Wells—stand next with 16,021 and 15,651 tons respectively.

Amongst the eleven newly-elected members of the Institution of Civil Engineers is the name of Mr. John Francis Hall, of Messrs. Wm. Jessop and Sons, Brightside Steel Works. Steel is clearly making rapid way to the front when steel manufacturers are considered eligible to become members of such an extensive body as the Institution of Civil Engineers.

THE NORTH OF ENGLAND.

(*From our own Correspondent.*)

Notwithstanding several fluctuations which have occurred in the price of pig iron in the Glasgow market, and the recent heavy increase of stocks in this district, the value of pig iron remains steady, and there is a decided tendency towards confidence in the future. A fair amount of business was done at the market held at Middlesbrough on Tuesday last at the previous week's prices. It is now generally believed that the long-looked-for revival will take place next spring, and buyers show not a little anxiety to purchase for forward delivery. They are ready to give 33s. per ton for No. 3, g.m.b., for delivery over the first half of next year, and several contracts have been made at that figure. For prompt delivery the price is 32s. 1½d. per ton, but not much is needed for delivery before January.

Forge iron is firm at 31s. 3d. per ton. Warrants are nominally 33s. 3d. per ton; but it is not easy to ascertain their real value, as holders will not sell.

A large quantity of Cleveland pig iron is being sent into Messrs. Connal's store at Middlesbrough. On Monday last the stock was 126,086 tons, representing an increase of 2501 tons during the week. Their Glasgow stock is also steadily increasing, and now amounts to 652,819 tons.

December pig iron shipments are so far disappointing. On Monday last they had reached only 13,945 tons.

No signs of a revival in the finished iron trade are yet apparent, and prices remain unchanged.

The Cleveland ironmasters' statistics for November were issued on the 3rd inst. It appears that ninety-six furnaces are in blast, and that the total make of pig iron for the month was 202,501 tons, being a decrease of 1890 tons in comparison with October. The stocks of pig iron in the whole district now amount to 470,530 tons, which represents an increase of 26,921 tons. The augmentation of stocks since the end of last year is 131,841 tons.

The value of goods exported from Middlesbrough last month, exclusive of coal and coke, was £107,552, being a decrease of £50,887, as compared with November, 1884. The value of exports from Newcastle was £162,849, or a decrease of £111,084.

The distress among the industrial classes, consequent on the long-continued depression of trade, and aggravated by the severe winter weather which has now supervened, is daily forcing itself more and more on public attention. Stone-breaking, at 10s. per week, is doing something to "keep the wolf from the door" in the case of able-bodied men with families. But where there is no father to fight for the children, or where he is sickly, or from long-continued semi-starvation is too weak to do severe labour, or withstand the cold, the family prospects are miserable indeed. In Newcastle last week a poor woman was brought before the magistrates for selling oranges and cakes in the streets without a license, and was let off on payment of costs. She had an asthmatic husband, who had been out of work for months, and several children to keep. Reduced to the verge of starvation, she had pawned certain clothes off her own body for half-a-crown. With this she had bought a few oranges and materials for cakes. She ventured out to sell these, and had only got rid of fourpennyworth when she was pounced on by the police and brought before the magistrates, with the result already stated. How she paid the costs, if she did pay, does not appear. This is only one sample case out of thousands which daily come to light in our Northern towns. A whole family were found sitting down to dinner in Middlesbrough a few days since. The dinner consisted of begged crusts of bread to eat, and hot water to drink. But for the almost inexhaustible cinder heaps around the local ironworks, and which are continually haunted by clusters of grovelling women and children, there would now be no fires for the very poor, and in the above case the drink would have been cold and not even hot water. Penny dinners for children are about to be re-commenced. Great good was done in this way last winter, and experience, assisted by the undoubted cheapness of food materials, enabled the promoters to provide an astonishingly good dinner for the money.

The announcement that the Manchester Corporation are about to proceed with their Thirlmere water supply scheme, and will require an enormous quantity of cast iron pipes, is reviving hope among the Tees-side pipe founders. If they secured even a portion of such an order it would give work to the operatives, and alleviate the intense distress, even if employers got no profit. It is said that as soon as Messrs. Rothschild are certain that Parliamentary sanction will be given to pay interest during construction, they will issue their Manchester Ship Canal shares. Surely everything possible should be done to press forward this enterprise. It affords one of the best prospects at present before us of absorbing a large quantity of unemployed labour, and every week it is delayed means loss by virtual starvation of hundreds of British lives which might otherwise be saved.

NOTES FROM SCOTLAND.

(*From our own Correspondent.*)

There has been less activity in the speculative department of the iron market this week. It appears that there is comparatively little inquiry on the part of investors. Warrants have fluctuated within narrow limits. A fair amount of pigs is said to have been arranged for shipment to America, and 10s. a ton freight to New York is now asked by the steamship lines. The quantity of pig iron sent into store continues unusually large, upwards of 4000 tons having been added in the course of the week to the stock in Messrs. Connal and Co.'s Glasgow stores. There are 92 furnaces in blast, as against 93 at this date in 1884. The past week's shipments of pig iron from Scotch ports amounted to 5896 tons, as compared with 6670 in the past week and 4722 in the corresponding week of last year.

Business was done in the warrant market on Friday at 42s. 9d. cash. A considerable quantity of pigs changed hands on Monday at 42s. 10d. and 42s. 11d. cash. Tuesday's market was less active. In the forenoon transactions took place at 42s. 9½d. to 42s. 10½d., and in the afternoon there was a decline to 42s. 8½d. cash. On Wednesday the market was depressed, with business at 42s. 8½d. to 42s. 6d. To-day—Thursday—there was more doing at 42s. 7½d. to 42s. 5½d., closing at 42s. 8d. cash.

The current values of makers' iron are without much alteration, as follows:—Gartsherrie, f.o.b. at Glasgow, per ton, No. 1, 46s.; No. 3, 43s. 6d.; Coltness, 50s. 6d. and 46s.; Langloan, 47s. 6d. and 45s.; Summerlee, 50s. 6d. and 45s.; Calder, 51s. and 43s. 6d.; Carnbroe, 45s. 6d. and 43s.; Clyde, 46s. and 42s.; Monkland, 43s. and 41s.; Quarter, 42s. 9d. and 40s.; Govan, at Broomielaw, 43s. and 41s.; Shotts, at Leith, 47s. and 46s. 6d.; Carron, at Grangemouth, 51s. and 47s.; Kinneil, at Bo'ness, 43s. 6d. and 43s.; Glengarnock, at Ardrossan, 46s. and 42s. 6d.; Eglinton, 43s. and 39s. 6d.; Dalmellington, 44s. 6d. and 41s.

The total shipments to date are 418,844 tons, as compared with 504,150 tons in the same time last year.

Some of the local papers have lately, through inadvertence, been publishing paragraphs about the improvement in the Clyde shipbuilding trade, in which orders formerly announced have been spoken of as if they were just placed, and thus a wrong impression has been conveyed of the actual state of business. At certain yards there is considerable activity, but taken all over the trade is far from being in a satisfactory state, and many workmen in all the shipbuilding centres are idle. It was stated that Messrs. Denny, of Dumbarton, had booked a contract for five steel steamers, whereas they have only obtained two small river boats, which will not suffice to prevent the impending slackness in the Leven shipyard. The fact is that the over-building of recent years still acts as a serious check to this industry.

The past week's shipments of iron and steel goods from Glasgow embraced four locomotives and duplicates, valued at £12,100, for Bombay, £4400 worth of machinery, £4437 sewing machines, £3661 steel manufactures, and general iron goods to the value of £16,000.

For manufactured iron goods the inquiry is reported dull, and the low quotations are not always readily obtained.

In the coal trade there is rather less business. The severe frost of the early part of the week quickened the inquiry for household sorts, but steam coals are difficult to sell, and the shipping demand is materially slackening. The shipments for the week embraced 19,880 tons from Glasgow, 1851 from Greenock, 7515 from Ayr, 6750 at Troon, 4895 at Grangemouth, 757 at Leith, and 2036 at Irvine. At the eastern ports the number of vessels asking cargoes has been much reduced by the advance of the season, and freights are comparatively poor. At Burntisland, on the other hand, the shipping department has been active, with the result that a good clearance has been made at the collieries. There is no material change in prices.

The Fifeshire miners have made an application for an advance of 6d. a day in wages. In the Lanarkshire districts most of the coalmasters, it now appears, gave the increase of 6d. merely to prevent the employers who first conceded the rise from drawing away the colliers from their pits. They have not really obtained any increase in prices, and they are paying the advance of wages out of their own pockets, at a time when the amount of business is contracting instead of expanding. The coalmasters of Airdrie, Slamannan, and Bathgate have unanimously decided not to give an increase of wages, as the condition of the trade does not justify such a step.

WALES AND ADJOINING COUNTIES.

(*From our own Correspondent.*)

I have little hesitation in stating that the Welsh collier pays more heavily for his election hobby than any other class of labourer. Thus we have had a wretched bad week. Colliers, instead of being at work, have been polling, rioting, or idling, and the result is that the exports show a great falling away. Cardiff shows a difference of nearly 30,000 tons, as compared with the previous week, amounting in round numbers to a decrease of £15,000 sterling in the circulation of the district, and in the valley supplying Cardiff this has told heavily. Newport and Swansea show better totals, principally on account that election feeling was less practically indicated.

The total clearances of coal from the Welsh ports during last week amounted to nearly 164,000 tons.

Small steam is growing in demand slightly, and the prospects of house coal proprietors are a little better. Newport totals show this, 35,000 tons having been despatched last week, as compared with 23,000 tons the week before.

Dowlais and other companies have been getting in good stocks of iron ore lately, and though trade has not shown much of a revival, there are some better signs abroad. The monthly notice, instead of day to day, has been reverted to, and while some few orders are being placed there is a hope of spring business that, I trust, will be realised. Last iron exports were very insignificant—two small cargoes to Cienfugos and Oporto. Home trade is better, and steel makers are supplying steel bar freely to meet requirements of tin-plate makers. Rails, however—our great staple—are not in free request, though a few orders are coming in this direction. Bad as things are, some of my contemporaries are recording it as worse, and Blaenavon is cited as having paid no dividend for a length of time. I am glad that this has received official correction. Things are very quiet at Rhymney; Tredegar and Dowlais are occupied with some requirements for steel sleepers, which really appear to be getting into demand. I should be pleased to see the example of the London and North-Western well followed. New branches might fairly try the new sleeper. The only objection I hear is too much rigidity, but that might be overcome by appliances in laying.

A contemporary notes that there having been changes in the Cardiff Corporation, Sir W. T. Lewis will have more confidence in bringing forward his two Bute Dock Bills. I have a strong impression that, change or no change, the Cardiff Corporation will go with the Bills. Last session they were out in the cold, but the preamble now wisely and with much policy, I think, admits them into the circle.

Present indications show that the coal export totals of 1885 will not be very different to those of 1884. At one time there was expectation that we were going up about two million tons per annum, but this is not verified. Cardiff in the eleven months of 1884 sent away 6,523,306 tons; in same period, 1885, 6,584,616; Newport, 1884, 1,569,891; ditto, 1885, 1,654,727; Swansea, 1884, 900,051; ditto, 1885, 772,254 tons. Now that the statistician is preparing for his annual totals one is able to get an insight into the real state of trade during the year that is coming to a close.

I see that in iron Cardiff sent away during the eleven months of 1885 about 72,000 tons; coke, 45,000 tons; and patent fuel, 202,000 tons round numbers. During the same period Newport sent away 99,000 tons iron and 3000 tons of coke; Swansea 3000 tons iron, 3000 tons coke, 352,000 tons patent fuel.

Most of the tin-plate works are busy. The London Tin-plate Printing Company has been merged into Melyn Tin Works, Neath, and some other changes, restartings, &c., are likely as trade is getting satisfactory. Occasional lulls have taken place, but not of any duration, and orders for less than market rates are not easily booked. Coke plate is firm at 14s. 9d. to 15s. best brands; wasters in good demand from 13s. 3d.; ternes, 14s. 6d. to 15s.; Bessemers, 15s. to 15s. 3d.; Siemens, 15s. 6d. to 15s. 9d.

In order that the arrangement of reduced make may be faithfully carried out, it has been decided to appoint an inspector to examine the books periodically. There has been a whisper afloat that in some quarters the compact has not been duly kept.

Very heavy shipments of plates have taken place at Swansea this week. I note a few: 2000 tons to Baltimore and Philadelphia, 1300 tons to New York, some consignments to Hamburg; total, 49,081 boxes.

Pearce's Friction Still.—By a typical error, the name of the inventor of this still, Mr. Lionel Pearce, was incorrectly spelt in our impression for December 4th.

Electrical Launch for the Italian Government.—Messrs. Yarrow and Co., of Poplar, have lately received an order from the Italian Government for a launch to be propelled by electricity for Spezzia Dockyard, where it will be tested specially with a view to determine the merits of this system of propulsion for torpedo boats.

NEW COMPANIES.

THE following companies have just been registered:—

Transparent Wire Wove Roofing Company, Limited.

This is the conversion to a company of the business of Messrs. Ford and Archer, of Willesden, manufacturers of transparent wire wove roofing. It was registered on the 28th ult. with a capital of £25000, in £10 shares. An agreement of the 27th ult. regulates the purchase, the consideration being £10,000 in fully-paid shares. The machinery, engines, &c., of the vendors, will be purchased by the company at a valuation. The subscribers are:—

	Shares.
Jacob Ayton Archer, Waverley, Lordship-lane	1
Henry Barrett, Menival, North Dulwich	1
A. N. Ford, 27, Harley-street	1
F. H. Ford, 1, Charsley-road, Catford Bridge	1
J. A. De Castro, 92, High-street, Chelmsford	1
G. F. Wells, Crewkerne	1
H. G. Barrett, Menival, North Dulwich	1

Registered without special articles.

Brin Brothers, Limited.

This company proposes to purchase certain patent rights and inventions, of which no particulars are given in the registered documents, but which are referred to as mentioned in an unregistered agreement expressed to be made between Arthur Brin and Leon Quentin Brin of the first part, Samuel Wilkins Cragg of the second part, Ferdinand Rey, the Baron Arnous Rivière and the Baron Rene de Blonay of the third part, and the Company of the fourth part. It was incorporated on the 27th ult. with a capital of £100,000, in shares of £10 each, with the following as first subscribers:—

	Shares.
Pierre Alcide Olivier, 24, Kensington-crescent, merchant	1
J. P. Cavallier, M.E., Clapham Lodge, Clapham-common	1
J. H. Meyer, manager, Holborn Viaduct Hotel	1
T. E. Harris, Dudley House, Crouch End, N., accountant	1
Wm. Horn, Sunnycroft, Woodford, Essex, commission agent	1
C. Turner, 27, St. John's-hill-grove, Wandsworth, clerk	1
C. Jeanningros, 115, Jermyn-street, accountant	1

The number of directors is not to be less than three nor more than seven; qualification, 100 shares or corresponding stock. The first are Ferdinand Rey, Baron Arnous de Rivière, Baron Rene de Blonay, and such other persons not exceeding four in number, whom the subscribers may appoint. The company in general meeting will determine remuneration, but the maximum is to be £800 per annum and 10 per cent. of the net profits in each year in which 10 dividend is declared.

Greenway Breakwater Syndicate, Limited.

Upon terms of an agreement of the 18th ult., this company proposes to purchase the patent of Edward Croft Greenway Thomas for improvements in, and applicable to, breakwaters and harbours, No. 3356, dated the 16th of August, 1881. It was registered on the 27th ult. with a capital of £5000, in £5 shares. The purchase consideration is one-half of the net sum received for sub-letting, sub-licensing, or otherwise dealing with the patent, and in the event of the sale of the same, one-third part of the purchase money, whether in shares or cash. The subscribers are:—

	Shares.
J. H. Wyatt, 20, Wormwood-street, share dealer	1
J. H. Laurence Archer, Umberslade, Bedford Park, engineer	1
P. A. Smith, 2, Grove-terrace, Highgate-road	1
A. W. Chapman, 24, Ethelden-road, Uxbridge-road	1
H. S Heaven, 6, Great St. Helens, forest expert	1
E. H. Symons, 120, Highbury-hill, clerk	1
G. J. Fisher, 58, Balls Pond-road, clerk	1

Registered without special articles.

Hull Oil Manufacturing Company, Limited.

This is the conversion to a company of the business of oil extractor, carried on by Mr. Wm. Aird, at Stoneferry, Kingston-upon-Hull. It was registered on the 1st inst. with a capital of £10,000, in £5 shares. The purchase is regulated by an agreement of the 26th October, the consideration being £800 in cash. The vendor (who is required to hold at least 10 shares) is appointed managing director at a salary of £100 per annum, and a commission of 10 per cent. of the net profits, after payment of rent, working expenses, and other necessary outgoings. The subscribers are:—

	Shares.
*Sydney Wilson MacIlwaine, 43, Doughty-street, W.C., medical student	106
*G. S. MacIlwaine, R.N., Great Yarmouth, commander	50
Wm. Aird, Hull, oil extractor	10
A. M. Jackson, Hull, solicitor	10
Hugh Aird, Bangor, marine engineer	2
J. Cornwall, Widnes, Lancashire, clerk	1
James Winters, Hull, oil extractor	1

The number of directors is not to be less than three nor more than five; qualification, 10 shares; the company in general meeting will determine remuneration. The first two subscribers are the first directors.

Patent Strainer Plate Company, Limited.

This company proposes to acquire and work the letters patent granted to George Tidcombe, jun., for constructing, manufacturing, and resurfacing strainer plates used for straining pulp in the manufacture of paper. It was registered on the 2nd inst. with a capital of £10,000, in £5 shares. The subscribers are:—

	Shares.
John Howard, C.E., 31, Linden-grove, Nunhead	1
R. Baker, 205, Norwood-road, Herne-hill, contractor	1
F. Irvine, 19, Buckingham-street, Strand, printer	1
D. A. Barker, 2, Anne's-place, Middlesex, engineer	1
J. Albert, 5, King's-road, Windsor, clerk	1
E. Cooper, 104, Vauxhall Bridge-road, clerk	1
W. Irvine, 12, Aschurch-grove, Shepherd's-bush, printer, &c.	1

Registered without special articles.

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.

1st December, 1885.

14,709. WARP LIFTERS, &c., L. A. Groth.—(*W. Margraff, Germany.*)
14,710. GYPSUM BOARDS, L. A. Groth.—(*A. Mack, Germany.*)
14,711. FLUID PASSAGE and VENT FAUCETS, W. S. F. Dillon, London.
14,712. AXLE-TREES for ROAD CARRIAGES, &c., J. G. Harrison, Birmingham.
14,713. ARRESTING the DESCENT of CAGES in MINES, C. Gummerson and J. Clough, Wigan.
14,714. ACTIVE HINGE for DOUBLE SWING BACK CAMERA, W. Cheffins, Holbeach.
14,715. IMMEDIATELY ALTERING the COURSE of VESSELS, H. and E. Robins, Landport.
14,716. WATCHES and CLOCKS for the BLIND, J. W. Rattray, Manchester.
14,717. MEASURING LIQUIDS, &c., J. N. Donovan, Manchester.
14,718. AUTOMATICALLY REMOVING WATER from GAS PIPES, G. Thomas, Birmingham.
14,719. TREATING COPPER, &c., for ENGRAVING, J. and G. E. Walker and J. B. Germeuil-Bonnaud, London.
14,720. COKE, H. Simon, London.
14,721. TILL APPARATUS for CONVEYANCES, H. H. Gardiner, London.
14,722. SHUTTLES for WEAVING, S. Whitworth, Rochdale.
14,723. SLIDE VALVES, J. Harrison, R. H. Clayton, W. and J. S. Loynd, Halifax.
14,724. PUMPS, W. Fawcett, Burton Salmon, and A. Thomlinson, Darrington.
14,725. CONCRETE SLABS, &c., R. B. Lee and J. Hodgson, Manchester.
14,726. CONCRETE FIRE-PROOF BUILDING MATERIALS, &c., R. B. Lee and J. Hodgson, Manchester.
14,727. PRODUCING PRINTED PATTERNS on MUSLIN, &c, A. Dux, Manchester.
14,728. BRACES for CHAIRS, &c., T. Bryon, Wolverhampton.
14,729. REEL for HOLDING PILE FABRICS, C. Longbottom, Bradford.
14,730. DOUBLE LOCK and KEY BLOCKS for FLOORS, J. D. Denny, Ruabon.
14,731. DOOR CHECK and SPRING, S. and W. Pickering and J. E. Norton, Manchester.
14,732. FURNACES, J. Woods, London.
14,733. INTERNAL ARRANGEMENTS of STEAM BOILERS, L. Berry, London.
14,734. MARKING CUTTING, and MORTICE GAUGES, J. Marples, London.
14,735. FEEDING and CLENCHING WIRE STAPLES in WIRE STITCHING MACHINES, E. S. Ullmer, London.
14,736. BLAST FURNACES, W. Scott, London.
14,737. UNIVERSAL HOLDFASTS, J. Hearn, London.
14,738. STOP WATCHES, E. G. Colton.—(*P. Nordmann and H. A. Lugrin, United States.*)
14,739. REGULATORS for FEEDING-BOTTLES, D. McIntyre, Glasgow.
14,740. SPINNING and DOUBLING COTTON, &c., S. A. Luke, London.
14,741. DUPLEX CUT-OUT for ELECTRIC CIRCUITS, R. M. Baily, jun., and A. Grundy, London.
14,742. BI-POLAR SWITCH for ELECTRICAL CURRENTS, R. M. Baily, jun., and A. Grundy, London.
14,743. SASH FASTENER, A. G. Howell, London.
14,744. MUSIC TYPE WRITERS, C. Spiro, London.
14,745. BAND APPARATUS for CARRYING GRAIN, T. Lee, London.
14,746. SYSTEM of TEMPERATURE REGULATION, W. S. Johnson, London.
14,747. PROTECTOR for INDIA-RUBBER, R. Willoughby, Liverpool.
14,748. JEWELLERY, G. M. Hathaway and C. de B. Shepard, London.
14,749. LAMP SHADES, J. C. Ward, London.
14,750. MACHINERY for COMPRESSING AIR, A. B. Wilson, London.
14,751. CONSTRUCTION of COMPOUND VALVES, T. Holcroft, London.
14,752. FOOTBALLS, W. Howard, London.
14,753. GOVERNOR MECHANISM for STEAM ENGINES, J. Richardson, London.
14,754. CONSTRUCTION of GRADUATED GLASSES, C. Melin, London.
14,755. AUTOMATIC STOPPER for BOTTLES, W. Samson, Glasgow.
14,756. BICYCLE WHEELS, R. Clayton, sen., R. Clayton, jun., and R. Clayton, London.
14,757. ROTATORS, H. E. Newton.—(*J. and G. H. Bliss, United States*)
14,758. BOILER FURNACES, A. H. Reed.—(*J. Ham, United States.*)
14,759. EMBROIDERING GOLD BRAID, &c., E. W. Vessey, London.
14,760. ESCUTCHEONS for KEY HOLES, G. Haydon, London.
14,761. SAVING of LIFE from FIRE and SHIPWRECKS, P. F. Wohlgemuth, London.
14,762 BEARINGS for SHAFTS, &c., A. Stigler, Liverpool.
14,763. STORAGE of PETROLEUM, &c., P. Molyneux, London.
14,764. PARALLEL RULERS, H. Heberstadt and J. C. Murphy, London.
14,765. ELECTRICAL COMPOUNDS, E. C. C. Stanford and T. J. Jones, London.
17,766. CIGAR BUNCHING MACHINES N. H. Borgfeldt, A. C. Schutz, A. Lewyn, and M. Martin. London.
14,767. WASHING MACHINES, R. H. Lowe, London.
14,768. REGULATING the SUPPLY of GAS, J. Breeden, London.
14,769. LAMPS A. Rayment and G. Prescott, London.
14,770. LIFTING JACKS. W. R. Lake.—(*E. Suckow, U.S.*)
14,771. REGULATING the SUPPLY of GAS, S. Kocherthaler, London.
14,772. NAILS, W. R. Lake.—(*The Russell and Erwin Manufacturing Company, United States.*)
14,773. REGULATING the SUPPLY of WATER, W. R. Lake.—(*W. Scott, United States.*)
14,774. STEAM HAMMERS, C. D. Abel.—(*J. A. Henckels, Germany.*)
14,775. STALL BOARDS of SHOP WINDOWS, R. Legg, London.
14,776. FRILLINGS and RUCHINGS, C. G. Hill, Nottingham.
14,777. BLOWER or ENGINE for PUMPING AIR, T. Nordenfelt, London.
14,778. PERMANENT WAY, J. Walker and T. D. Bear, London.
14,779. SCREENS for WINNOWERS, &c., C. Hayward, London.

2nd December, 1885.

14,780. SULPHURET of CARBON, L. E. L. J. B. Régi and L. M. C. Folie-Desjardins, Paris.
14,781. RAISING CLOTH, &c., R. Sellers and G. Pearson, Bradford.
14,782. SUSPENDING GOODS, &c., from WALLS, E. T. Horsley, Copeley Hill, near Birmingham.
14,783. LUBRICATION of JOURNALS and BEARINGS, A. Stevenson, Chester.
14,784. REVERSING GEAR, W. C. Ingham, Halifax.
14,785. GAS COOKING RANGES, T. Fletcher, Manchester.
14,786. HEALD SHAFTS of LOOMS, R. Field, Halifax.
14,787. PROTECTION of SHIPS of WAR, &c., F. Lee, Manchester.
14,788. STERN-POSTS of VESSELS, W. W. L. Lishman, J. T. Lishman, and W. R. Bootland, Silsden.
14,789. BOTTLING AERATED LIQUIDS, F. G. Riley, London.
14,790. VALVES, &c., A. Green, Birmingham.
14,791. FIXTURE of SHEET METAL KNOB HANDLES for the LIDS of SAUCEPANS, T. Holcroft, H. Holcroft, and A. H. Mould, London.
14,792. FASTENINGS for BOOTS, &c., F. B. Baker, Birmingham.
14,793. APPARATUS for EMBOSSING CANVAS, W. S. Morton, Glasgow.
14,794. APPARATUS for ASCENDING CHIMNEYS, R. W. Anderson, Liverpool.
14,795. APPARATUS for BOILING WATER for SHAVING, W. Whiteley, Halifax.
14,796. PAPER BAG MACHINE, W. A. Lorenz and W. H. Honiss, London.
14,797. SECURING CANDLES in CANDLESTICKS, W. Grey-Wilson, Edinburgh.
14,798. SAVE-ALL APPLIANCE for BOTTLES, A. Thompson and T. H. Watson, London.
14,799. CLOSE CARRIAGES, D. M. Gallagher, London.
14,800. FEEDING BOILERS, F. H. Moldenhauer, London.
14,801. TIE-BARS and CHAIRS for TRAMWAYS, W. P. Stewart, London.
14,802. LAUNDRY BLUE, A. L. Hughes, J. Bartley, and F. Best, London.
14,803. CONSTRUCTION of WHEELS, A. Grounsell and C. Cousins, London.
14,804. CONSTRUCTION of CROSSES for IMMORTELLES, J. Pope, London.
14,805. MACHINES for PRESSING FABRICS, P. M. Justice.—(*G. W. Miller, United States.*)
14,806. CANNON or FIRE-ARMS, P. M. Justice.—(*The Costa Arms and Ammunition Company, United States.*)
14,807. OXYGENATING WATER CONTAMINATED with ORGANIC MATTER, W. F. B. Massey-Mainwaring and J. Edmunds, London.
14,808. STANDARDS and DROPPERS for FENCING, R. R. Main, Glasgow.
14,809. SECURING or FASTENING DOORS, E. P. Alexander.—(*A. M. G. Wehry, France.*)
14,810. SADDLES for BICYCLES, &c., A. C. Henderson.—(*G. Rothgiesier, Germany.*)
14,811. WRITING FRAMES, E. B. Stringer, London.
14,812. CUTTING, &c., STONE, F. Trier, London.
14,813. PRESERVING MILK, K. G. Dahl, London.
14,814. LENSES for SHIP or other LAMPS, J. Gilchrist and D. Ballardie, Glasgow.
14,815. PORTLAND CEMENT, L. White, London.
14,816. FRICTION-CLUTCH for HOLDING WINDOW-SASHES, C. G. Gümpel, London.
14,817. BOGIES, W. Cochrane, London.
14,818. TUBULAR STEAM GENERATORS, L. Petry and W. Walther, London.
14,819. FRICTION CLUTCH for RODS, &c., C. G. Gümpel, London.
14,820. HOLDERS for CARTRIDGES, J. P. Pieri, London.
14,821. MAKING PAPER BARRELS, &c., W. S. Boult, London.
14,822. ACTUATING APPLIANCES for CORKSCREWS, H. H. Hall, Liverpool.
14,823. GRINDING, &c., RODS, W. S. Boult and J. C. W. Stanley, London.
14,824. STUDS, &c., F. McIlvenna and W. Thompson, Liverpool.
14,825. WINDOW-SASH FASTENERS, E. Brennan, Liverpool.
14,826. KNITTING MACHINES, W. R. Lake.—(*T. S. Nowell, United States.*)
14,827. AERIAL VESSELS, W. R. Lake.—(*E. F. Falconnet, United States.*)

3rd December, 1885.

14,828. METALLIC BEDSTEADS, S. I. Whitfield, Birmingham.
14,829. COMBINED POST and CHRISTMAS CARD, W. P. J. Fawcus, London.
14,830. COMBINED FENDER, COAL VASE, &c., W. Eaves, Birmingham.
14,831. COUPLING CARRIAGES, W. H. Foreman, Stoke-on-Trent, and T. Hill, Fenton.
14,832. ROCKING FURNACE BARS, &c, L. Hopcraft, London.
14,833. STRETCHING HOODS of VEHICLES, J. Jackson, Birmingham.
14,834. SHARPENING CUTTERS of MACHINES, R. McGregor, Manchester.
14,835. EXPANDING FABRICS, J., E., and T. O. Arnfield, Manchester.
14,836. BAG FISHING NET, J. Nicholls, Cornwall.
14,837. SHIPS' TELEGRAPHS, O. White, Liverpool.
14,838. KNITTING MACHINES, W. Rothwell, London.
14,839. WARMING CYLINDERS of ENGINES, W. Schmidt, London.
14,840. DYEING WARPS, W. E. Aykroyd and W. W. L. Lishman, Bradford.
14,841. FITTINGS for PERAMBULATORS, A. Roberts, Birmingham.
14,842. MAKING ELECTRIC METERS, G. E. Dorman, Stafford.
14,843. DETACHABLE HUBS, &c., G. H. C. Hughes, Birmingham.
14,844. BROUGHAMS, A. R. Henderson, Glasgow.
14,845. INCANDESCENT LAMPS, W. Maxwell, London.
14,846. VICTORIAN CONSTRUCTION, J. Armstrong, London.
14,847. HANDLE for FLAT-IRONS, F. Marguet, London.
14,848. TROUSERS, H. Smith, London.
14,849. BUCKETS for ELEVATORS, &c., H. E. Söhne, Liverpool.
14,850. FOCUSSING SCREENS of PHOTOGRAPHIC CAMERAS, L. E. Perken, London.
14,851. LIGHTNING CONDUCTORS, R. P. Eldsforth and F. J. Mudford, London.
14,852. SAUCEPANS, T. and H. Holcroft and A. H. Mould London.
14,853. MAGNETIC OIL LAMP, L. Mordant.—(*H. Melhado, United States.*)
14,854. PREPARING GREEN or STEEPED TEXTILE MATERIALS for CARDING, H. Dansette, London.
14,855. INDICATING ELECTRICALLY the QUANTITY or DIRECTION of FLUIDS, J. Sax, London.
14,856. ATTACHING COLLIERY RAILS to STEEL, &c., SLEEPERS, H. W. Martin, London.
14,857. PORTFOLIOS, H. Rickinson. London.
14,858. RAISING and LOWERING VENETIAN BLINDS, V. E. Etienne, London.
14,859. ARTIFICIAL FUEL, J. J. Saltery, London.
14,860. AIR COMPRESSORS, F. W. Scott, London.
14,861. WEBS for BRACES, &c., G. Statham, London.
14,862. NUMBERING SEATS in ROOMS, F. W. Baylis, London.
14,863. UMBRELLAS, &c., T. Brearley, London.
14,864. PRINTING WEB FABRICS, J. Macnab, Glasgow.
14,865. BURNING MINERAL OILS in FURNACES, J. Neil, Glasgow.
14,866. FIREPLACES, R. M. Somers, London.
14,867. PHOTOGRAPHIC CAMERAS, O. Väring, London.
14,868. AERATING and ATTEMPERATING LIQUORS, &c., T. P. Chittenden, London.
14,869. COUPLING for ROPES, A. Kellar, London.
14,870. HOLDFASTS, W. Hitchin, Birmingham.
14,871. MOTOR ENGINE, M. Wolff and R. Pfetzcker, London.
14,872. CENTRIFUGAL MACHINES, S. Pitt.—(*W. B. Espeut, West Indies.*)

4th December, 1885.

14,873. LUBRICATING COCKS, T. and M. Morris, Gateshead.
14,874. CENTRAL LIGHT GASALIERS, R. H. Best, Handsworth.
14,875. KNIVES, W. Freeman, Leicester.
14,876. CARDING ENGINES, T. B. Kay, Manchester.
14,877. CARDING ENGINES, T. B. Kay, Manchester.
14,878. NUT-CRACKERS, M. Schmidt, London.
14,879. SELF-LUBRICATING BEARINGS, J. Matthews, Liverpool.
14,880. DIRECT-ACTING HYDRAULIC TOOLS, H. D. Pearsall, London.
14,881. PORTLAND CEMENT, A. E. Carey and A. J. Jack, Liverpool.
14,882. FEED-PUMP and other CONNECTIONS, J. Weir, Glasgow.
14,883. INTRODUCING CALCINED STEAM in STEAM BOILER FURNACES, J. K. Broadbent, Salford.
14,884. AUTOMATIC FIRE-ALARMS, W. Parker.—(*J. H. Parker, New Zealand.*)
14,885. TEA-PACKING MACHINES, C. C. Windust and A. L. Hutchison, London.
14,886. SPINNING, &c., YARNS, J. Knowles, Blackburn.
14,887. USING FOG SIGNALS, W. Beatson and J. Moore, Rotherham.
14,888. BOTTLES, &c, G. Quarrie, Liverpool.
14,889. CORSET BUSKS and FASTENERS, G. Gent and A. Gent, London.
14,890. ROTARY PUMPS, F. T. Adams, London.
14,891. TRANSMITTING of ELECTRIC SHIPS' TELEGRAPH, W. Skinner, J. Farquharson, and D. W. Lane, Westminster.
14,892. MATERIAL for HORSESHOES, &c., A. B. O'Connor, London.
14,893. PROTECTING the FORE-SIGHT of RIFLES, W. J. Jeffery, London.
14,894. SECURING WIRE FENCING to STANDARDS, F. Ball, Birmingham.
14,895. WELDING BOILER and other TUBES, G. Gaunt, London.
14,896. BILLIARD CUES, E. de Pass.—(*A. H. Sporry, France.*)
14,897. STEERING HANDLES of TRICYCLES, &c., J. M. Starley, London.
14,898. VELOCIPEDES, J. Devey, London.
14,899. LITHOGRAPHIC PRINTING, &c., APPARATUS, F. Betbeder, London.
14,900. STEEL PENS, R. Mitchell, Glasgow.
14,901. DOOR LOCKS, H. Rushbury, Glasgow.
14,902. MERCURIAL BAROMETERS, A. J. Beer, London.
14,903. SHEARING HORSES, &c., C. de Salazar, London.
14,904. COMPRESSING AIR or FLUIDS, R. Matthews London.
14,905. SEPARATING DUST or SOLID PARTICLES SUSPENDED in AIR, &c., H. Simon, London.
14,906. LOCOMOTIVES, &c., J. Fforde, London.
14,907. LAMP-POST, C. E. Hodges, London.
14,908. AUTOMATIC WRENCH, H. Brockas, London.
14,909. BRACKET, T. Brockas, London.
14,910. DRY GAS METERS, J. and S. G. Foxall, London.
14,911. PRINTING, &c., APPARATUS, W. Conquest.—(*R. Hoe and Co., United States.*)
14,912. BATH APPARATUS, W. R. Lake.—(*W. E. Thurs-feld, Austria.*)
14,913. STEAM BOILERS, E. Friedrich and M. Jaffé, London.
14,914. PHOTOGRAPHIC SENSITISED PAPER, C. Wells, London.
14,915. METALLIC PENS and PEN-HOLDERS, C. Wells, London.
14,916. MATCHES, C. Wells, London.
14,917. TELEPHONY and TELEGRAPHY, S. Z. de Ferranti and G. L. Addenbrooke, London.

5th December, 1885.

14,918. TRAP ROLLER TWISTING FRAMES, E. Morley, Halifax.
14,919. BAND BRAKES for VELOCIPEDES, W. Phillips, London.
14,920. BEARINGS for MACHINERY and ROLLING STOCK, M. P. Bale, London.
14,921. CHIMNEY POTS, J. Sephton and J. Evans, Lancashire.
14,922. BREECH-LOADING SMALL-ARMS, W. P. Jones and H. Scott, Birmingham.
14,923. SHIPS' PORT LIGHTS, F. and T. Gill, Sunderland.
14,924. PRODUCING MALLEABLE IRON from ORE, W. P. Thompson.—(*C. Husgafvel, Russia.*)
14,925. TILTING CASKS, R. and J. Williams, London.
14,926. GAS STOVES, W. R. Palmer, Birmingham.
14,927. MACHINES for CLEANING COTTON, W. and W. Lord, Manchester.
14,928. WREATH CASES, W. Ritchie, Glasgow.
14,929. BOTTLE STOPPER, C. Johnson, Sheffield.
14,930. TRICYCLE HOBBY-HORSES, A. Horobin, Wolverhampton.
14,931. SELF-ACTING FIRE EXTINGUISHER, A. Devonshire, Paisley.
14,932. HANDLES of TROWELS, &c., J. E. Vaughan, Birmingham.
14,933. BED CHAMBER CANDLE-STICKS, C. C. A. Cooper, London.
14,934. DISTILLATION of SHALE, &c., J. C. Hamilton, Glasgow.
14,935. LOOMS for WEAVING CARPETS, &c., E. Smith, London.
14,936. WRINGING, &c., MACHINERY, J. and J. Rigby, London.
14,937. YIELDING COUPLINGS for ROTATING SHAFTS, J. and J. Rigby, London.
14,938. PARING HATS, H. Polak, London.
14,939. ALARM APPARATUS, J. Greenhalgh and J. Haydock, London.
14,940. PORTABLE STOVE, &c., G. Fowler and G. H. Haywood, London.
14,941. DRYING COFFEE, GRAIN, &c., S. Beaven, London.
14,942. STOPPERING BOTTLES, T. Turner, London.
14,943 CHURNS, A. Williams, London.
14,944. HEATING CURLING IRONS, &c., W. Bown and G. Capewell, London.
14,945. RIMS of WHEELS, W. Bown and A. T. Andrews, London.
14,946. LATHES, A. Siewerdt, London.
14,947. IGNITING SURFACES on PORCELAIN, &c., A. E. Müller, London.
14,948. WEB PRINTING and FOLDING MACHINES, W. Conquest.—(*R. Hoe and Co., United States.*)
14,949. PREVENTING the SPREAD of FIRE in THEATRES, &c., T. Ransome, Manchester.
14,950. BOX-NAILING MACHINES, J. C. Mewburn.—(*J. H. Swift, United States.*)
14,951. SUPPORTING WINDOW SASHES and SHUTTERS in their FRAMES, J. Davis, London.
14,952. FURNACE BAR, J. Simmons and J. Woodgate, London.
14,953. CUTTING the TEETH of GEAR WHEELS, P. L. C. F. Renouf, London.
14,954 FITTING HANDLES, &c., on VELOCIPEDES, I. W. Boothroyd, P. L. C. F. Renouf, and T. Brockas, London.
14,955. TRAVELLERS' REST, P. Knüppelholz, London.
14,956. TRAMWAY or ROPE ROLLERS for COLLIERIES, J. Wilkes, London.
14,957. TREATING FATTY MATTERS, C. D. Abel.—(*The Fabrik Chemischer Produkte Actien Gesellschaft, Germany.*)
14,958. ELECTRIC BATTERIES, O. Marsh, F. E. Burke, and W. Webster, London.
14,959. STEERING APPARATUS for SHIPS, J. Donald, Glasgow.
14,960. CASTORS, C. Burnett, London.
14,961. PICTURE HANGING APPLIANCES, J. S. Rawle, London.
14,962. COLOURING MATTERS, H. H. Lake.—(*Wirth and Co., Germany.*)
14,963. INDUCTION APPARATUS, S. Schuckert, London.
14,964. LAGGING for the BOILERS of ENGINES, S. Eddington and J. Steevenson, London.
14,965. SHELLING GRAIN and REDUCING it to FLOUR, G. Luther and E. Larsen, London.
14,966. REPAIRING LEAD TUBES, &c., W. J. Bentley, London.
14,967. PLOUGHSHARES, J. E. Ransome, London.

7th December, 1885.

14,968. FRILLING BOXES, J. Helsby, Manchester.
14,969. HORSE-RAKES, S. B. Bamford, Uttoxeter.
14,970. CRUSHING LEMONS, C. Weekes, Dublin.
14,971. DABBING BRUSH, J. H. Exley, Bradford.
14,972. AWLS, R. Spencer, Gainsborough.
14,973. COFFINS, T. Tattersall, Halifax.
14,974. PRINTING SCARFS, A. S. Young, Manchester.
14,975. PRINTING on CALICO, A. S. Young, Manchester.
14,976. LETTERPRESS PRINTERS' METAL QUOIN, T. O. L. Jones, Great Hampton.
14,977. PRODUCING a CURRENT of AIR, C. J. Henderson, Hawick, N.B.
14,978. VENTILATING ROOMS, &c., J. H. Cartland, Birmingham.
14,979. PERFECTING and LETTERPRESS PRINTING MACHINES, G. Newsum, Bradford.

14,980. Raising and Lowering of Chimneys for Portable and other Engines, A. Musker, Bootle.
14,981. Pneumatic Chimney Cowl, W. C. Reed, Landport.
14,982. Fastening Stereotypes to Printing Blocks, H. Corsain, London.
14,983. Tubular Pneumatic Action of Organs, J. Conacher and Sons, Halifax.
14,984. Construction of Parallel Ruler, J. E. Tate, Halifax.
14,985. Open Batting Gloves, E. Brice, Woodstock.
14,986. Electric and Storage Battery, G. J. Atkins, London.
14,987. Lighting Lamps, J. H. Trinder, London.
14,988. Bursting or Rending Rock or Stone, I. Morgan and D. Smith, London.
14,989. Making, &c., Artificial Ice, A. Ingram, London.
14,990. Bottle for Lotions, &c., E. Kent London.
14,991. Racket Bats, W. Hilman, W. H. Herbert, and G. B. Cooper, London.
14,992. Combined Sheets and Envelopes, A. A. Andrew, London.
14,993. Tents, A. S. Tomkins, Caterham.
14,994. Pipe and Cigar Lighters, &c., W. W. Colley, London.
14,995. Propelling Vehicles, C. E. Buell, London.
14,996. Steam Pumps, J. Taylor, London.
14,997. Machinery for Making Buttons, J. M. Carlyle, Birmingham.
14,998. Wire Mats, F. C. Guilleaume, London.
14,999. Steam Boilers, C. A. Knight, Glasgow.
15,000. Gas Pressure Registers, J. Anderson, Glasgow.
15,001. Regulators for Ventilation, &c., J. Cant, Glasgow.
15,002. Fluid-pressure Motive Power Apparatus, S. Milne, Glasgow.
15,003. Chimney-pots, E. S. Benn, London.
15,004. Breech-loading Rifles, P. Jensen.—(*H. Wolffen, Germany.*)
15,005. Grubbing or Weeding Rake, &c., J. H. Cole, London.
15,006. Arc Lamps, G. G. André, London.
15,007. Fire-grates, W. F. Storey, London.
15,008. Valve Gear, G. Fletcher and W. P. Abell, London.
15,009. Making Stair Nosings, &c., G. Bonehill, London.
15,010. Lamp Shade, L. M. Lhuillier and L. A. Barbanchon, London.
15,011. Lamps, J. G. Lorrain, London.
15,012. Treating Animal, &c., Fibres, W. W. Hamilton, London.
15,013. Stair Eye, J. T. Timmins, London.
15,014. Axle-boxes, H. K. Austin, London.
15,015. Securing, &c., Corks, E. Woodham and P. Ockenden, London.
15,016. Domestic Stoves or Fire-places, W. Berridge, London.
15,017. Movable Structures for Ambulances, H. P. de Lastelle, London.
15,018. Lamps, H. H. Doty, London.
15,019. Propelling Apparatus for Ships, C. C. L. Lucht, London.

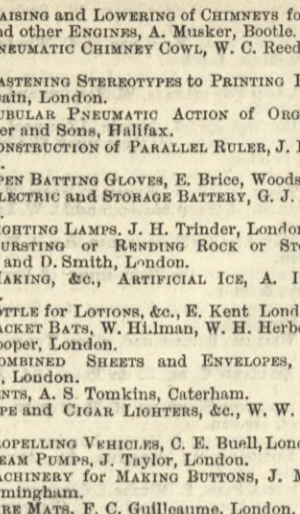
SELECTED AMERICAN PATENTS.

(From the United States' Patent Office Official Gazette.)

327,999. Power Hammer, *Charles M. Brown, Rockford, Ill.—Filed June 18th*, 1885.

Claim.—In a power hammer, the combination, with the main crank-shaft and the hammer helve, of the rock arm, a pitman connecting the rock arm and crank-shaft, and a pitman connecting the rock arm and hammer helve at a point in front of the pivotal bearing of the hammer helve, the above parts being

327,999

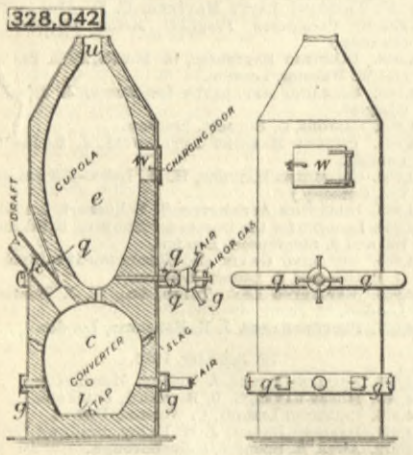


constructed and combined substantially as described, whereby the crank on the main shaft travels more than one-half revolution in elevating the hammer, and less than one-half in lowering the hammer, substantially as set forth.

328,042. Combined Cupola Furnace and Converter, *Martin Lysett, Homestead, Pa.—Filed July 15th*, 1885.

Claim.—The combination of a combined cupola *e*, and converter *c*, in direct communication with each other, and placed the one above the other, and each having a bustle pipe, one *g* and the other *q*, placed above the hearths, and provided with a number of

328,042

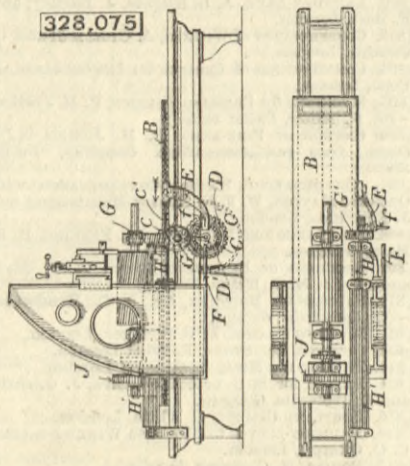


tuyeres, an opening *l*, at the base of the converter *c* for tapping the same, and another *k*, inclined toward the centre at the top to allow the waste products means of escape, a door *w*, in the cupola *e* for charging the same, and draught stack *u*, substantially as and for the purpose described.

328,075. Machine for Grooving Grinding Cylinder, *P. T. Smith, Milwaukee, Wis.—Filed December 21st*, 1882.

Claim.—(1) In a machine for grooving mill rollers, the combination of the gear wheel C^1, running loose upon shaft C, and provided with the perforated flange D, the cup wheel D^1, secured upon said shaft C, and having the bell crank pivotted to it, the spring bolt *d*, provided with a pin engaging with holes in flange D, and the trip bolt E, substantially as described and shown. (2) The combination, with the spring bolt *d*, which connects the cup-wheel to the perforated flange on the gear wheel, of the trip bolt *e*, bell-crank lever d^1, trigger *f*, bed B, bracket E, and stop F, substantially as shown and described. (3) The combination of the driving shaft C, gear wheel B^1, the bed B, having the rack *b* thereon, the gear wheel C^1, having perforated flange D, the cup wheel D^1, having the bell-crank lever pivotted to it, the spring bolt *d*, connecting the cup-wheel to the perforated flange, the trip bolt *e*, trigger *f*, bracket E, and stop F, substantially as described and shown. (4) The combination of the gear wheel C^1, running loose on the driving shaft, and provided with the perforated flange D, the cup wheel D^1, secured upon the said driving shaft, the

328,075

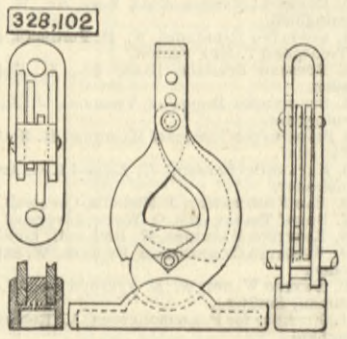


bell-crank lever d^1, trip bolt *e*, spring bolt *d*, having the head d^2, provided with a dovetailed slot and a set screw, and the dovetailed block d^4, to which the connecting pin is attached, substantially as described and shown. (5) The combination of the gear wheel C^1, deriving intermittent motion from the main driving shaft, the pinion c^1, the worm *c*, worm wheel G^1, shaft H, and cylindrical gear H^1, substantially as described and shown. (6) The combination of the bed B, driven continuously in either direction, the gear wheel J, travelling with the bed, the cylindrical gear H^1, journalled in brackets attached to the framing of the machine, and driven by a suitable train of gearing by the pinion c^1, and the wheel C^1, gearing into pinion c^1, and deriving intermittent rotary motion from the same shaft which drives the bed, substantially as shown and described.

328,102. Pipe Vice, *John C. Bauer, Brockley, County of Kent, England.—Filed March 31st*, 1885.

Claim.—A self-gripping pipe vice having one or more movable jaws pivotted to the body of the vice, and shaped at the opposite side to the pivot in such a

328,102

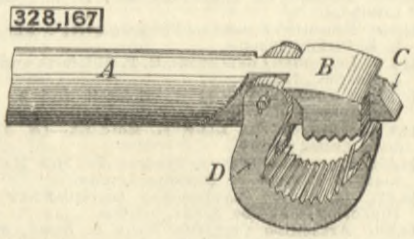


manner that the distance from the said pivot to such opposite side or parts thereof increases or diminishes as the said jaw is being moved on its pivot one way or the other.

328,167. Pipe Wrench, *Richard E. Williams, Modesto, Cal.—Filed July 27th*, 1885.

Claim.—A pipe wrench consisting of the handle or stock A, the fixed jaw B on its forward end, and the lug C on the forward end of the jaw, the curved hook

328,167

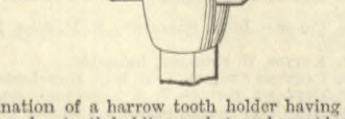


or jaw D, slotted and pivotted on the handle at its rear end and having its forward end slotted or grooved, adapting it to fit and engage the lug C, substantially as herein described.

328,211. Harrow Tooth Holder, *Alfred J. Gillespie, Atlantic, Iowa.—Filed April 18th*, 1884.

Claim.—(1) A harrow tooth holder having in its lower end a tooth-holding socket, and provided with ears projected upward from two of its opposite sides, and having openings formed laterally through said ears, substantially as set forth. (2) A harrow tooth holder having in its lower end a tooth-holding socket provided with straight and inclined walls, and provided with ears projected upward from two of its opposite sides, and having openings formed laterally through said ears, substantially as set forth. (3) The

328,211

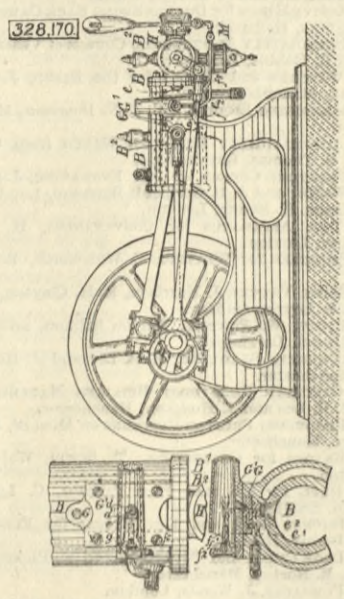


combination of a harrow tooth holder having in its lower end a tooth-holding socket, and provided with ears projected upward from two of its opposite sides, and having openings formed laterally through said ears, an under beam seated between the ears, and a transverse beam passed through the opening in said ears above the under beam, substantially as set forth. (4) In a harrow, the combination, with the frame beam of the holder having in its lower end a tooth-holding socket having closed sides and open at top and bottom, and provided with ears projected upon opposite sides of and above the said beam and secured, substantially as set forth. (5) A harrow tool holder provided with a socket formed with a straight and an inclined wall, and having one of its walls provided with a shoulder or ledge, the said socket being reduced in dimension at its lower end approximately to the size of the tooth and gradually widening toward its upper end, substantially as set forth.

328,170. Gas Engine, *Joseph S. Wood, Brooklyn.—Filed July 6th*, 1885.

Claim.—(1) In a gas engine, the combination of a cylinder B, with a cylindrical valve H, having an inlet passage *a*, and an exhaust passage *b*, separate and apart and arranged on the same plane with each other, with corresponding ports a^1 and b^1, in the head B^1, and ports a^2 and b^2 in the valve casing B^2, together with the gas regulating nipple or tube a^3, substantially as set forth. (2) In a gas engine, in combination, a cylinder B, a cylindrical valve casing B^2, and cylindrical valve H, together with a check valve K, opening outward and connected to the exhaust passage *b*, and the check valve M, opening inward, arranged and connected with the air passage a^5, for the purposes set forth. (3) In a gas engine, in combination, a cylinder B, cylinder head B^1 with a check valve I, and bent lever I^1, for the purposes described. (4) In a gas engine, in combination, a cylinder B, with an igniter slide G arranged on one side and near the back end, this slide having a cover G^1, a conical recess *d*, an ignition orifice d^1, an auxiliary gas chamber *e*, a supply orifice e^1, and a discharge orifice e^3, substantially as described. (5) In a gas engine, in combination, a cylinder B, cylindrical valve H, ignition slide G, and gas jet burner *f*, bracket f^1 in connection with the supply pipe f^2, reducing orifice f^5, and air supply holes *g*, all as substantially described and herein set forth.

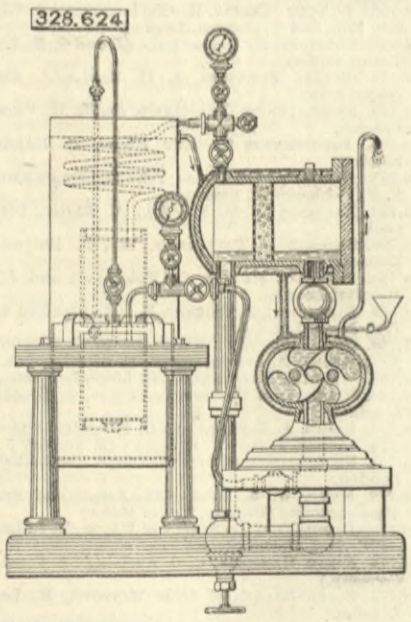
328,170



328,624. Ice Machine, *Oscar Vezin, Elizabeth, N.J.—Filed June 23rd*, 1885.

Claim.—(1) In an ice machine in which a volatile fluid as the refrigerating agent is compressed, condensed, and then vaporised, a rotary pump and its induction and eduction pipes all filled with a liquid as a seal, as described, in combination with a chamber into which the gas mingled with the liquid of the seal is discharged by the pump and therein separates from said liquid, as and for the purpose specified. (2) In an ice machine in which a volatile fluid as the refrigerant agent is compressed, condensed, and then vaporised, a rotary pump and its induction and eduction pipes, in combination with a separator chamber, as described, and a pipe leading from said chamber to said induction pipe, together with a liquid as a seal, as described, filling said pump and said pipes, whereby the gas is discharged into said chamber mingled with the liquid, and therein separates from said liquid, and the liquid of the seal is continuously circulated through said pump and said pipes, as set forth. (3) In an ice machine, the combination, with the chamber to which the refrigerant agent is supplied, and in which it is

328,624

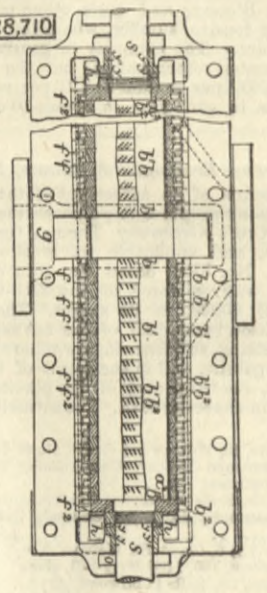


volatilised, of a rotary pump and its induction and eduction pipes, and a liquid as a seal, as described, filling said pump and said pipes, together with a pipe leading from said chamber to said induction pipe, as and for the purpose set forth. (4) In an ice machine, the combination, with the condenser coil, into which the compressed gas employed as the refrigerant agent passes and liquefies of a chamber into which the condensed gas flows and accumulates, together with a chamber suspended in a tank adapted to contain water to be frozen, and a pipe intermediate said chambers, provided with a regulating valve, whereby the condensed gas which is volatilised in the second chamber and accumulates in the first chamber may be passed into the second chamber again, as and for the purpose set forth. (5) In an ice machine, the combination of a rotary pump and its induction and eduction pipes, and a liquid as a seal, as described, filling the same, a chamber into which the gas employed as the refrigerant agent is discharged mingled with said liquid and therein separates from said liquid, a condenser coil having communication with said chamber, a vaporising chamber having communication with said condenser, controlled by a regulating valve, and a pipe leading from said vaporising chamber to the induction pipe of said pump, and provided with a check valve, all as specified. (6) In an ice machine, the combination, with a rotary pump and its induction and eduction pipes, filled with a liquid as a seal, as described, and a chamber into which the gas employed as the refrigerant agent mingled with said liquid is discharged and therein separates from said liquid, of a perforated diaphragm in said chamber located intermediate its gas inlet and outlet, as described. (7) In an ice machine, the combination, with a rotary pump and its induction and eduction pipes, filled with a liquid as a seal, as described, and a chamber into which the gas employed as the refrigerant agent is discharged mingled with said liquid, and therein separates from said liquid, of a water jacket surrounding said pump, and a water jacket surrounding said chamber, together with pipes leading from a water supply to said jackets and giving a water circulation through said jackets, as and for the purpose specified.

328,710. Rotary Motor, *Chas. A. Parsons, Gateshead-on-Tyne, County of Durham, England.—Filed November 14th*, 1884.

Claim.—(1) An inner cylinder having parallel rows of projecting blades on the periphery thereof, each row being in a plane perpendicular to the axis of the cylinder, and each blade being inclined to the axis of the cylinder, and an outer hollow cylinder inclosing said inner cylinder and concentric therewith, one of said cylinders being a rotary one, said outer cylinder being provided on its inner surface with parallel rows of inwardly-projecting blades, each row being in a plane perpendicular to the axis of the cylinder, and each blade being inclined to the axis of the cylinder, and in a direction opposite to the inclination of the blades on the inner cylinder, the rows of blades on the two cylinders being so related that they intermesh, in combination with fluid inlet and discharge passages located at opposite ends of said cylinder, substantially as set forth, whereby the current of the fluid is between the two cylinders and in a direction parallel or substantially parallel with the common axis of the cylinders. (2) A single inner shaft or cylinder having two distinct sets of parallel rows of projecting blades on the periphery thereof, each row being in a plane perpendicular to the axis of the cylinder, and a hollow outer cylinder inclosing said inner cylinder, and concentric therewith, one of said cylinders being a rotary one, said outer cylinder having on its inner surface two distinct sets of parallel rows of inwardly-projecting blades, each row being in a plane perpendicular to the axis of the cylinder and each blade being inclined to the axis of the cylinder in a direction opposite to the inclination of the blades on the inner cylinder, and the rows of blades on the two cylinders being so related that they intermesh, in combination with a fluid inlet passage located centrally in relation to the length of the cylinders and between the two distinct sets of blades on the cylinders, and fluid-discharge passages on the opposite ends of said cylinders, substantially as set forth, whereby the current of the fluid is from the centre in opposite directions to the two ends of the cylinders, thereby balancing the end pressure of the cylinders. (3) In a compound motor, the rotating cylinders provided with the sets of fixed blades increasing in depth by sets from the entrance of the actuating fluid and set at a greater angle at said entrance than at the exhaust

328,710



in combination with the casing provided with the blades inclined in opposite direction to the blades on the rotating cylinders, substantially as and for the purpose described. (4) In a motor, the combination of a hollow cylinder or cylinders furnished with blades on its or their interior, a moving cylinder or cylinders having external blades, and mounted on a shaft to rotate within said hollow cylinder or cylinders, and bearings for said shaft having slight lateral play or elasticity combined with frictional resistance to such play in such a manner as to enable the moving cylinder or cylinders to rotate about its or their centre of gravity or principal axis instead of its or their geometrical centre or axis—if the centre of gravity or geometrical centre be nearly coincident—and to cause the vibration to which the cylinder or cylinders may be subjected to be damped or modified, substantially as described. (5) In a motor, the combination of a hollow cylinder or cylinders furnished with blades on its or their interior, a moving cylinder or cylinders having external blades, a shaft on which said moving cylinder or cylinders is or are mounted, and elastic bearings, each comprising a bush and friction rings or washers pressed tightly together by a spring or springs in such a manner that the bush is capable of slight lateral movement, resisted and controlled by the friction rings or washers, as described and illustrated, for the purpose specified. (6) A motor (or pump) comprising two compound or built-up cylinders, with blades $b\ b^1\ b^2$, a casing *c*, blades $f\ f^1\ f^2$, fixed within said casing, central inlet *g*, exhaust passages *h h*, shaft *s*, bushes *i*, metal rings or washers $k\ k^1$, spiral springs *l*, nuts *m*, drain passages *o o*, ejector or steam nozzle *p*, exhaust pipe *q*, chamber *r*, pump r^2, pipes $r^3\ r^4$, junction piece r^5, fan *t*, with holes $t^1\ t^2$, cavity *u*, a diaphragm rod w^2, arm w^3, spindle w^4, collar or nut w^5, spring w^6, and graduated tap w^8, all substantially as described and illustrated.