THE BUREAU VERITAS AND MILD STEEL FOR SHIPBUILDING.

As early as 1874, the Bureau Veritas, a continental society similar to "Lloyd's," undertook a series of elaborate experiments on American wrought iron and steel, publishing tables of the results they obtained. The directors have continued these tests from time to time, and have issued reports embodying the experience acquired. In the report for last year they observe that as the material composing a ship is subjected alternately to tension and compression, and must also possess the quality of rigidity to enable it to resist transverse strain, full advantage cannot be taken of any superior tensional strength it may possess, unless accompanied by a corresponding increase of ability to resist the other stresses. With regard to tensional resistance, experiments made on Motala mild steel showed an ultimate resistance of 31¾ to 32½ tons per square inch, an elastic limit from 18½ to 20½ tons, and an elongation at fracture of 27 to 33 per cent. These results were compared with those afforded by French iron plates of good brands, which gave an average breaking strain of 25½ tons per square inch, an elastic limit of 15 tons, and an average elongation of 12 per cent. Presuming that with both materials the proof stress approaches the limit of elasticity, and taking the average resistance of ordinary iron plates at 20 tons, with an elastic limit of 9 tons per square inch, there would appear ground for a reduction of 50 per cent. on the scantlings of material exposed only to tensile stress, in steel vessels as compared with iron, while retaining the same working factor, were it not for the greater depreciation of the new material due to corrosion and the working up in the yard. The latter consideration is referred to below; and with regard to the former it is urged that, as vessels are presumed to carry, at the end of twenty years, the same amount of cargo as when new; and as, with a uniform rate of corrosion, a given amount of loss bears a higher proportion to a thin than to a thick plate, a certain excess of initial comparative strength must be allowed.

As regards resistance to transverse stress, experiments to test the comparative rigidity of iron and steel were made by deflecting strips of plate, resting on supports, by means of a load applied in the middle. The thickness of the plates was 12 millimetres (0·472in.); and the results showed that, if the limit of deflection is not to be exceeded, an iron plate of 12 millimetres must be replaced by a steel one of 11 millimetres in thickness. It appears, therefore, that mild steel possesses very little superiority over iron in point of rigidity, a reduction of 8 per cent. being all the advantage on this head attending its substitution for iron. In order to preserve the required rigidity, in allowing any considerable reduction in the frames and reverse frames, the directors recommend that a change should be made in the sections of the angles, and a better arrangement adopted, so as to compensate for the reduced moment of the girder resulting from a reduction of thickness. In substituting steel for iron beams, they are prepared to admit a reduction in the web, as long as the depth remains the same. On account of the limited experience as to the corrosion of steel, they are not prepared at present to make any material reduction on the floors, but would not object to iron floors in vessels otherwise built of steel.

The directors do not regard as settled the amount of depreciation caused to steel plates by punching the rivet holes, because of the few samples tested in all the experiments in this direction that have been published, and also because the ultimate tensile strength varies as much as four tons between different samples from the same charge of steel. If, for instance, a plate injured by punching should happen to have the lowest tensile strength, and an uninjured specimen the highest, an erroneous impression would at once be produced. The depreciation to which steel is subjected by being heated, for bending plates and angles to the required form, the directors regard as much greater than in the case of iron, because a local heating is necessary, and the homogeneity of the metal is destroyed owing to the property possessed by steel of taking a temper. They consider this fact as most disastrous to the superiority of mild steel, and as having been the cause of retarding its application to shipbuilding and other purposes. The deterioration of the metal may arise from the tempering to which it is subject while in contact with the cold blocks or rolls, from the hammering it receives while at a low heat, or from the various parts being left, when finished, to cool in the open air. To restore perfect homogeneity, the pieces which require heating in their working up should subsequently be annealed; but the loss of time, and the possibility of the parts losing the form given to them, constitute objections to this practice. The directors recommend that all plates be annealed; that plates and angles which require bending be bent cold as much as possible; and that parts which cannot be prepared without heating be made of wrought iron. They further recommend that steel rivets, which present no more difficulty of manipulation than those of iron, be used with steel plates. They do not, for the present, propose any change in the proportions of rivets, but advise that treble rivetting be adopted, if not throughout, at least in all particular parts for a certain length amidships, in order to utilise the material to the fullest extent, and to obtain the greatest reduction possible for the regulation scantlings of iron vessels.

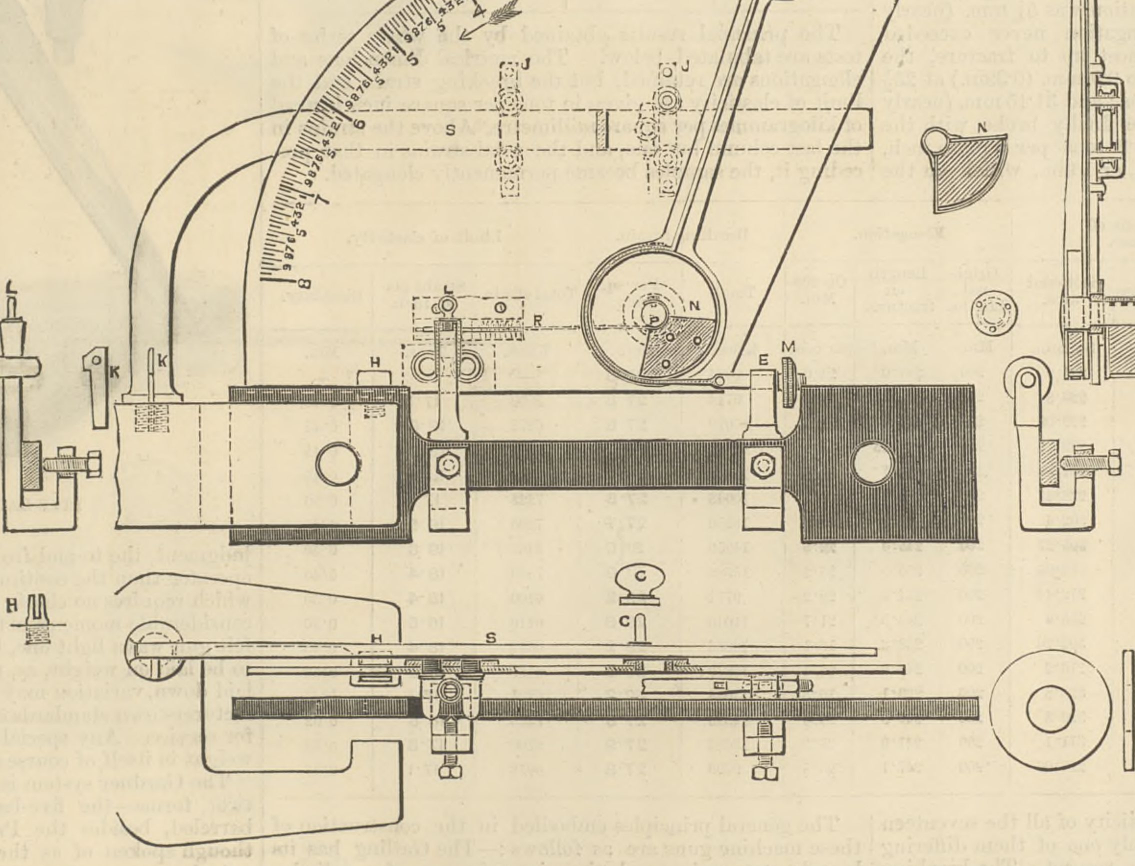
Steel for angle bars is required to be of a milder quality than that for plates, as flanged bars are found to yield more readily than flat.

The directors of the Bureau Veritas intend, for the future, that their definition, "uniform quality" shall signify that all plates, angles, and bulb bars have been subjected to the following temper test, which entails no appreciable addition to the cost of production:—A shearing is heated to a dull red, quenched in water at 28 deg. Cent.—82·4 deg. Fah.—and bent double until the width of the opening near the bend equals three times the thickness. They have fully and carefully examined the question of ductility, both with the view of insuring safety to vessels built under their survey, and also with regard to the international character of the register, and have definitely adopted a maximum of 32 tons per square inch. From the acknowledged inferiority of very soft steel, and considering the excellent character of iron sometimes employed in vessels under their survey, and the comparatively small reductions accorded, a minimum limit of 27 tons per square inch has been adopted. Although the results of experiments and their own experience of mild steel warrant a considerable reduction from the scantlings of iron vessels, the directors are not prepared at present, in consequence of the numerous sections of angles and bulbs in general use, to establish, in tabulated form, the scantlings that they would accept when steel is substituted for iron, but require each part to be calculated separately, so as to retain the moments exacted by the rules, the reduction reaching in some cases 30 per cent., while in others not attaining half that figure. Forged iron will be accepted, in vessels otherwise built of steel, for the keel, stem and stern post, for the rudder head and frame, and for the pillars. Rolled iron of superior quality will be admitted for the watertight bulkheads, the floors, bulbs and frame angles, for the boss plates on the stern post, the bent plates round the quarter, and for the plates joining the heels of stem and stern post, in vessels fitted with flat plate keels. The directors have such confidence in the uniformity of manufacture attained in the new metal as to feel justified in adopting the following reductions from the scantlings of iron vessels, if the parts are made of steel:—18 to 25 per cent. on the outside plating, stringers, ties, keelsons, and watertight bulkheads; and 10 to 15 per cent. on the thickness of the floors, bulbs and angles; and these reductions may be greater when the system of construction followed provides a moment equal to that required in iron vessels. The diameter and spacing of the rivets, and the width of laps and butt strips, follow the rules for iron vessels, but are determined by the reduced thickness of plating. All steel plates and angles are to be legibly stamped with a special mark, indicating the makers' guarantee that the metal is of uniform quality; and this mark is to be so stamped that it will remain on the plate or bar when rivetted up in the vessel.

In carrying out the experiments, a testing machine was formerly employed, in which a weight, multiplied by a beam, acts directly on the sample; but the cylindrical bearings caused an amount of friction which introduced a source of serious error into the results obtained, besides the fact that the ratio is only correct when the lever is in a horizontal position. Accordingly, after much consideration, the directors determined to adopt the machine devised by M. H. Thomasset, of Paris, in which all the bearings are knife edges. This machine was erected in the basement of the chief office, Brussels, in April last, and has since been improved in several details by the engineers of the Bureau Veritas.

Fig. 1, page 50 shows an elevation, and Fig. 2 a plan of the general arrangement, while Fig. 3 is a diagram section illustrating the action. The remaining figures show enlarged details of the elongation indicator, which has since been added. The machine consists essentially of an hydraulic press, the ram of which tends to pull the sample apart, while, at the same time, the strain is communicated, through a bent lever and piston, to a column of mercury. The plunger of the force pump A, on the left side of the general view, is worked gradually down into its barrel by means of the screw. At first it was only provided with hand-wheel and bevel gear multiplying twenty times; but the winch movement has since been added, which increases the power five and a-half times, making one hundred and ten times altogether, while the screw is also of very easy pitch. The consequence is that the increments of strain are put on with the utmost regularity, and a lad at the handle can exert a power of 25 tons on the sample. The water is led, by the small copper pipe, to the hydraulic cylinder B, where it presses on the front of the ram, causing it to move in the direction of the arrow, counter-weights being provided as usual to bring it back when the pressure is taken off. The ram is made hollow to receive the screwed rod, which carries a jaw at one end and a nut at the other for the purpose of adjustment to suit a varying length of sample. The second jaw forms part of a short horizontal bar, provided at the other end with a knife edge which engages in a notch formed in the short arm of the bent lever C. The long arm of this lever has also a knife engaging in a notch in the lug of the piston D of a shallow cylinder, the joint being made by a stout diaphragm of india-rubber cloth. The piston presses directly on water contained in the cylinder; and the pressure is communicated by the small copper pipe to the mercurial gauge E, each division of which represents a total pressure of 50 kilogrammes—nearly 1 cwt. The gauge is provided with an index and stop that can be set to each division, or midway between two divisions if required.

The sample is retained between the jaws in the manner most suitable to its shape. Bolts are held directly by their heads and nuts, the main portion being turned down for a certain length to less than the diameter of the screwed portion. Plate samples are prepared in the usual way, and held by pins passing through them and the jaws, as shown in the engravings, washers being used to fill up the spaces between the sample and the jaws. The apparatus for measuring the elongations is shown at F in the general elevation, and separately in the annexed cut. It consists of a sector cast in brass, provided with a handle C C for convenience of placing, and sliding freely in the groove of the stud H H, with the aid of anti-friction rollers J J, on the arm screwed into one of the jaws, the cotter K K preventing it from turning. Each division of the scale at the edge of the sector is half a millimetre; but the index is provided with a vernier, so that elongations can be read off correctly to one-twentieth of a millimetre, or 0·00195in. Two fingers are clamped to the sample, exactly at the given points between which the length is measured, generally 200 millimetres, or nearly 8in. One of the fingers is held between two studs on the sector, a conical cap L L preventing any play; and the other is attached by a copper riband, adjustable by the screw and nut M, to the boss of the index. A lead counterweight N N, and a spiral spring R attached by a metallic riband, are provided to bring back the index on the pressure being taken off, for observing the elastic elongations. When pressure is put upon the face of the piston, and the sample is being drawn out, the index moves in the direction of the curved arrow. India-rubber cushions are added between the ends of the sample and the jaws, to prevent jar to the machine, and the breakage of the copper riband, when the fracture of the sample takes place.



The directors of the Bureau Veritas have determined to make a thorough and independent study of the capabilities of the new metal for shipbuilding, and the extent to which it can be depended upon, so as to be able to fix definitely the reductions they will be able to allow on the scantlings of vessels. They have recently carried out a series of tests on some plates and angles of mild steel turned out by the Société John Cockerill, of Seraing, by the Bessemer process.

The materials of which samples were tested are for a vessel which is being built entirely of steel by the Cockerill Company, at their Antwerp shipyard, to form one of a fleet of steamers for bringing iron ore from their mines at Somorrostro, in Spain, and which is submitted to the Bureau Veritas for classing. The steel is made from 50 per cent. of charcoal pig, and 50 per cent. of very pure hematite pig from Cumberland. This is melted in the cupola, but not overheated, and then blown in the converter at a relatively low temperature. An addition is made of from 1 to 1½ per cent. of ferro-manganese, containing from 55 to 60 per cent. of manganese. A sample from each pouring is analysed, and all the steel that does not fall between the following limits is applied to some other purpose than shipbuilding:—

Carbon	0·08 to 0·15 per cent.
Silicon...	trace to 0·02 ,,
Sulphur	0·03 to 0·05 ,,
Phosphorus	0·03 to 0·05 ,,
Manganese...	0·30 to 0·60 ,,

Two strips are sheared from each plate, one in the direction of the rolling, and the other across the grain; and the test pieces are worked to the required shape, and draw-filed on the edge. The arriss is also taken off with emery cloth, for the reason that a small notch in the edge would determine fracture in the same way that a nicked bar is easily broken.

Seventeen pieces were tested altogether, so as to afford a good average; they included strips in the direction of the rolling and across the grain, and also angle bars. The pressure was added in single kilogrammes per square millimetre—12½ cwt. per square inch—at a time, until the limit of elasticity was reached, the pressure being taken off at each increment, and two or three minutes allowed for the molecules to return, as far as they would, to their original position. After the limit of elasticity was reached, the pressure was applied in two kilogrammes per square millimetre at a time until fracture ensued. We were present during the testing of two samples, which took up a a whole day, and also observed from time to time the testing of the remainder. The first sample, No. 359 in the general table given below, was taken, in the direction of the rolling, from a plate 12 mm. thick; and the width of the sample was 25·2 mm., giving a sectional area of 302·4 square millimetres—nearly one-half square inch. With a total pressure of 6046 kilos.—5·95 tons—or 20 kilos. per square millimetre—12·7 tons per square inch—of sectional area, the elastic elongation was 0·45 mm.; and the same amount of elastic elongation continued until a strain of 17·8 tons per square inch was reached, when a permanent set was noticed. The sample had been stretched 0·6 mm., but only returned 0·3 mm. At 19 tons per square inch there was only the same elastic elongation, but a permanent set of 0·6 mm., making a total of 0·9 mm. At 19·7 tons, while the elastic elongation was not a millimetre, the total elongation was 5¼ mm. (nearly ¼in.) Though the elastic elongation never exceeded 0·55mm., which was noticed almost up to fracture, the permanent elongation went up to 9·9 mm. (0·39in.) at 23½ tons; 17·7 mm. (0·69in.) at 26 tons; and 31·15 mm. (nearly 1¼in.) at 27·3 tons. The sample finally broke, with the usual dull clang, at a strain of 27·8 tons per square inch, giving an elongation of 49½ mm., or 1·9in., which on the length of 8in. gives 24½ per cent. The final sectional area became 133 square millimetres, showing 54 per cent. of contraction.

The next sample, No. 368, in the general table was taken across the grain, and did not show such different results from the former as might have been expected. The sectional area was 25·5 × 12·2 = 311 square millimetres, and the length experimented upon was as before 8in. The breaking strain was 44 kilogrammes per square millimetre, or 27·9 tons per square inch, and the total elongation 41 mm. (1·6in.), or 20½ per cent., rather less, as might be supposed, than the former, though the breaking strain is practically the same. The final section is 9·1 × 17·8 = 162 square millimetres, giving 48 per cent. of contraction, rather less than the previous sample. The breaking strain compared with the final area is 84 kilogrammes per square millimetre, or 53 tons per square inch. The subjoined table, showing the successive elongations, both elastic and permanent, at the several increments of strain, cannot fail to be found instructive:—

Strain in tons per square inch.	Elongation in millimetres.		
	Elastic.	Permanent.	Total.
13·9	0·2	—	0·2
15·2	0·25	—	0·25
16·5	0·3	—	0·3
17·8	0·35	—	0·35
19·0	0·1	0·8	0·9
19·7	0·1	3·85	3·95
20·3	0·2	4·75	4·95
20·9	0·25	5·15	5·4
21·6	0·25	5·6	5·85
22·2	0·25	6·05	6·30
22·8	0·30	7·05	7·35
23·5	0·35	8·1	8·45
24·1	0·45	9·3	9·75
24·7	0·45	10·85	11·30
25·4	0·45	12·75	13·2
26·0	0·45	14·8	15·25
26·7	0·40	18·2	18·6
27·3	0·40	23·3	23·7
27·9	—	—	41·0

The principal results obtained by the whole series of tests are tabulated below. The metrical dimensions and elongations are retained, but the breaking strain and the limit of elasticity are given in tons per square inch instead of kilogrammes per square millimetre. Above the strains in the last column but one, and the total strains in that preceding it, the samples became permanently elongated.

No. of Test.	Description.	Dimensions of test-piece.			Elongation.			Breaking Strain.		Limit of elasticity.		
		Breadth.	Thickness	Sectional area.	Original lengths.	Length on fracture.	On 200 Mm.	Total.	Per sq. inch.	Total strain.	Strain per sq. inch.	Elasticity.
		Mm.	Mm.	Sq. mm.	Mm.	Mm.	per cent	Kilos.	Tons.	Kilos.	Tons.	Mm.
353	Longitudinal.	25·1	9·0	225·9	200	248·0	24·0	9694	27·3	—	—	—
354	Transverse.	18·4	12·0	220·8	200	248·3	24·1	9714	27·8	5960	17·1	0·45
355	Transverse.	24·9	9·2	229·08	200	248·0	24·0	10079	27·8	6873	19·0	0·45
356	Transverse.	25·9	11·8	299·72	200	237·25	18·6	14383	30·5	8992	19·0	0·45
357	Angle.	25·6	11·4	291·84	200	242·7	21·3	13417	29·2	8469	18·4	0·45
358	Transverse.	25·1	9·1	228·41	200	241·6	20·8	10048	27·8	7223	17·1	0·50
359	Longitudinal.	25·2	12·0	302·4	200	249·5	24·7	13250	27·7	7860	16·5	0·45
360	Longitudinal.	34·3	8·9	305·27	200	245·0	22·5	14959	31·0	9463	19·6	0·50
361	Transverse.	34·5	9·1	313·95	200	250·5	25·2	15388	31·0	7530	18·4	0·45
362	Angle.	18·8	11·3	212·44	200	244·5	22·2	9771	29·2	6160	18·4	0·50
363	Transverse.	25·0	9·4	235·0	200	243·5	21·7	11045	29·8	6110	16·5	0·50
364	Longitudinal.	25·4	11·9	302·26	200	238·2	19·1	13903	29·2	6044	18·4	0·45
365	Angle.	18·8	11·5	216·2	200	244·8	22·4	10379	30·5	6487	19·0	0·50
366	Longitudinal.	34·4	9·5	326·8	200	233·1	16·5	15028	29·2	6891	17·1	0·45
367	Transverse.	34·4	9·5	326·8	200	249·3	24.6	14380	27·8	8495	16·5	0·52
368	Transverse.	25·5	12·2	311·1	200	241·0	20·5	13685	27·9	8709	17·8	0·35
369	Longitudinal.	18·6	12·1	225·06	200	247·1	23·5	9903	27·8	6078	17·1	0·45

It will be noticed that the elasticity of all the seventeen samples tested is very uniform, only one of them differing appreciably from the rest in this respect. The breaking strain varies about 4 tons per square inch, and the limit of elasticity varies as much as 2·5 tons per square inch. Some of the transverse samples show not only a higher breaking strain, but also a higher limit of elasticity than some of the longitudinal. No. 356—transverse—shows a hard and strong metal with average elastic limit, but a low elongation; it is therefore not so much to be relied on as No. 353—longitudinal—with a lower breaking strain but a higher elongation. The former would be destroyed by an impact of 447 kilogrammetres, while the latter, not so strong, would yield and partially return to its original form, but not break. As a practical result of these tests, the directors of the Bureau Veritas feel inclined to base the sectional area of scantlings rather on the elastic limit than on the ultimate stress.

THE MACHINE GUN COMPETITION.

THE competitive trial of machine guns began at Shoeburyness on Friday, January 13th, the following pieces being brought forward. (1) Two-barreled Gardner, (2) five-barreled Gardner gun, (3) Pratt and Whitney's improved four-barreled Gardner, (4) long ten-barreled Gatling, (5) short ten-barreled Gatling, (6) six-barreled Gatling, (7) five-barreled Nordenfelt gun. The trial is expected to last for some weeks. We propose to give a weekly summary of the trials made, together with descriptions of each class of arm. Most of our readers have been long more or less familiar with the Gatling. The Nordenfelt is of comparatively recent introduction in this country, having chiefly attracted attention from its performances with steel bullets. A short description of it, with a cut, has already appeared in THE ENGINEER. Both the Nordenfelt and Gatling are to be found in our service equipments, the Nordenfelt having been specially supplied to the Royal Navy. The Gardner is in the course of its first trial.

The general principles embodied in the construction of these machine guns are as follows:—The Gatling has its barrels arranged round the circumference of a cylinder opposite to which revolve the ring of chambers, bringing each in succession to the point where it joins the barrel and where it is fired. The action is extraordinarily rapid, even compared with other machine guns. Being strictly successive the piece has no recoil, and under favourable circumstances offers advantages in aiming, because a continuous stream of bullets almost admits of being brought on to an object by feeling the way up to it, in the way a fireman does with the hose of an engine. The arm has proved its powers abundantly, having in this respect the advantage of its rivals. The chief fault we should find with it in principle is the fact that all the barrels are fed by a single stream of cartridges, which limits the rate of loading, a disadvantage that must increase with the number of barrels. Machine guns generally depend on gravity for the feed motion of the cartridges which descend into the chamber at the breech end of each barrel. In the case of the Gatling the cartridges descend in a single stream, either by gravity alone, or supplemented by hand pressure, which causes slight checks in feeding. The result is that the firing of the gun, though successive and in theory continuous, in cases of extreme rapidity, is not a perfectly even stream, but consists of successive bursts of firing, each burst, however rapid, consisting of rounds fired in succession. Major Noble, in his report on the Paris Exhibition in 1876, observed that the five-barreled Gatling had then discharged at the rate of 1000 rounds per minute. This probably refers to a much shorter period than an entire minute, as it is much more rapid than the firing which we here have to report. The Gatling is now taken up by Sir William Armstrong and Co., and may be obtained from them. Mr. Accles has fathered the gun at Shoeburyness during the present trials. Fig. 1 herewith represents the five-barreled Gatling, mounted on tripod stand. It will be seen that the action of firing is rotary, the crank moving either on an axis in prolongation of the axis of the centre spindle round which the barrels are placed, or else to one side.

The Nordenfelt (Fig. 7) has its barrels arranged horizontally in a row. This enables the feed to be supplied to the whole of the barrels simultaneously. Movement is effected by means of a lever projecting to the right side of the breech end of the arm, which is forced backwards and forwards, the whole of the breeches being opened and the extraction, loading, and firing being carried out simultaneously. In these respects, then, this arm is the precise opposite to the Gatling. The inventor urges that the advantage of the to-and-fro motion is more completely under command than the rotary; that it moreover supports the cartridges better while undergoing discharge, for it gains time for each round, inasmuch as the simultaneous discharge gives to each round the entire time occupied by all instead of a fraction of it. He states that in successive action mitrailleuse cartridges with powder still burning in them are liable to be ejected in numbers round the legs of the operator, when the powder from damp or other cause acts imperfectly in any way. He also advocates volley firing, as being the only method suitable for sea service, because the rolling of the ship enables line to be taken for an instant volley discharge, but not for a successive stream of single rounds. As compared with the Gatling, it may be seen that for sea service each system has its advantage, one in a rough and another in a smooth sea. The chief objection that we were able to observe in the Nordenfelt gun was the fact that, in our

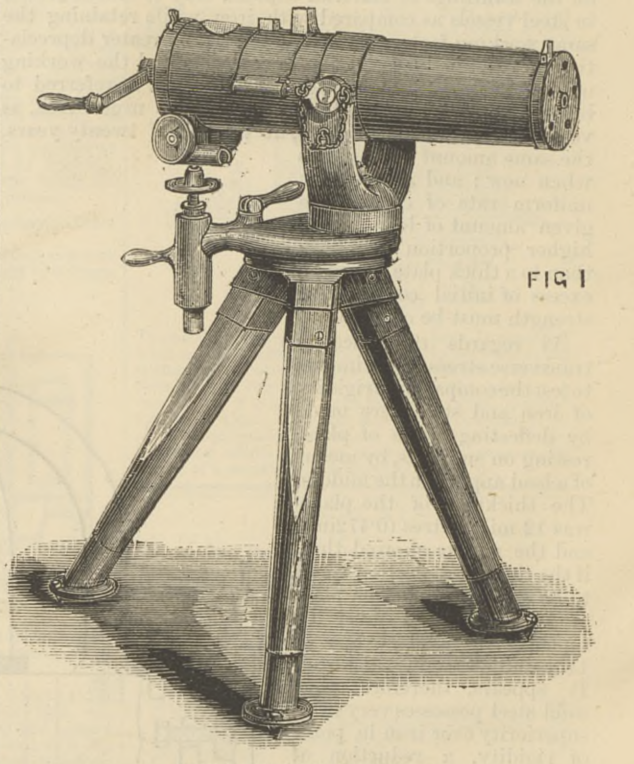


FIG 1

FIVE-BARRELED GATLING.

judgment, the to-and-fro motion is more distressing to an operator than the continuous circular movement of a crank, which requires no check, and which has the advantage of considerable momentum to carry it through. The Nordenfelt gun was a light one, but we question if much stress is to be laid on weight, as, unless some definite conditions are laid down, variation may be due to difference in the manufacturers own standards of the strength deemed desirable for service. Any special feature in either gun entailing weight in itself of course should be noted as a disadvantage.

The Gardner system is represented, as we have said, in two forms—the five-barreled (Fig. 2) and the two-barreled, besides the Pratt-Whitney piece. The latter, though spoken of as the improved Gardner, is in reality not of more recent construction than the others, being, in fact, a modification of an early form of Gardner machine gun. It represents, in fact, Pratt and Whitney's ideas of improving the original Gardner gun as compared with Gardner's own improvements, which are embodied in the two pieces bearing his name only. The barrels in the Gardner arm are like those of the Nordenfelt—in horizontal line, the breeches are opened, closed, and fired by horizontal bolt action, moved by cams fixed on a crank, worked on the right of the breech of the gun. As this action is much less well known than that of either of its rivals, we give figures showing its general character. It will be seen that in its nature it is suited to simultaneous discharges, but by means of varying dimensions of parts the firing can equally well be made successive. Indeed, by an ingenious plan of interchange of parts it can be made in a few minutes either simultaneous or successive in its action. Figs. 3 and 4 give views looking opposite ways of the vertical longitudinal section of the breech action of a single barrel in two positions, Fig. 3 barrel to the right, Fig. 4 barrel to the left. The disc A B—Fig. 3—is worked by the hand crank, the fixed piece A moving the lock C D with breech bolt E and its extractor. It will be seen that at two parts of the complete circle the piece A will leave the piece C stationary, that is, while any portion of the piece A is horizontally either in front or rear of the axis of the crank. At those points it will be practically the same thing as if the disc was entire. This will make the reciprocating motion intermittent, pausing at the firing and the extraction positions. The cam F G on the crank imparts reciprocating motion to the clutch I of the controller bar, and it may be seen that it moves it only at those times when the lock is stationary. Thus in Fig. 3, if the crank were to rotate causing A to move upwards, C would remain immovable while A passed over it, while at the same instant F would be forcing I to move backwards. Between A and B is a piece cut out of the disc, which allows the arm K (see Fig. 4) to move upwards under the pressure of the spring L against

THE GARDNER AND PRATT-WHITNEY MACHINE GUNS.

FIG. 2

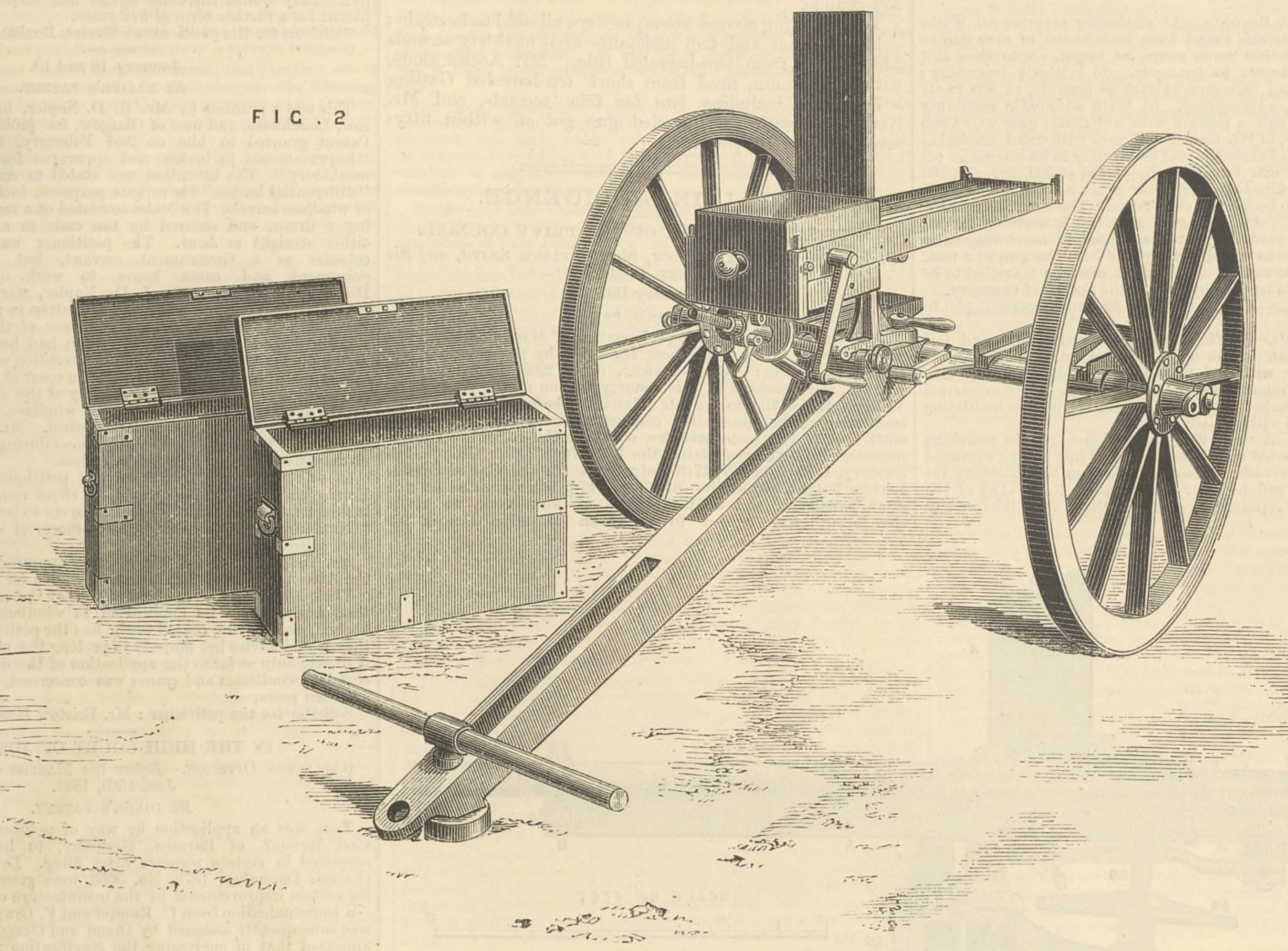


FIG. 3

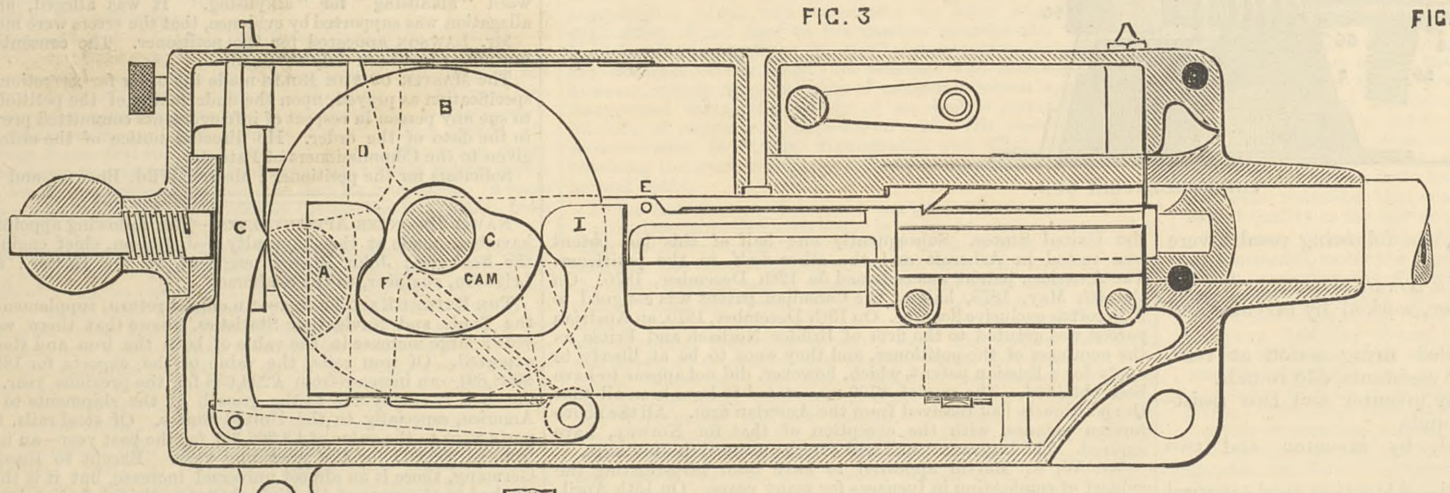


FIG. 5

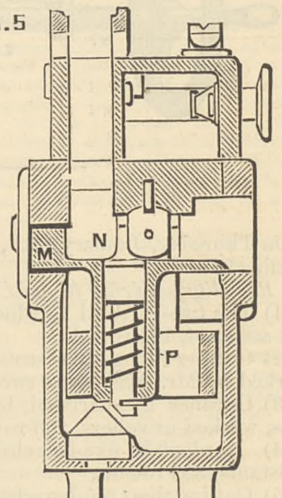


FIG. 4

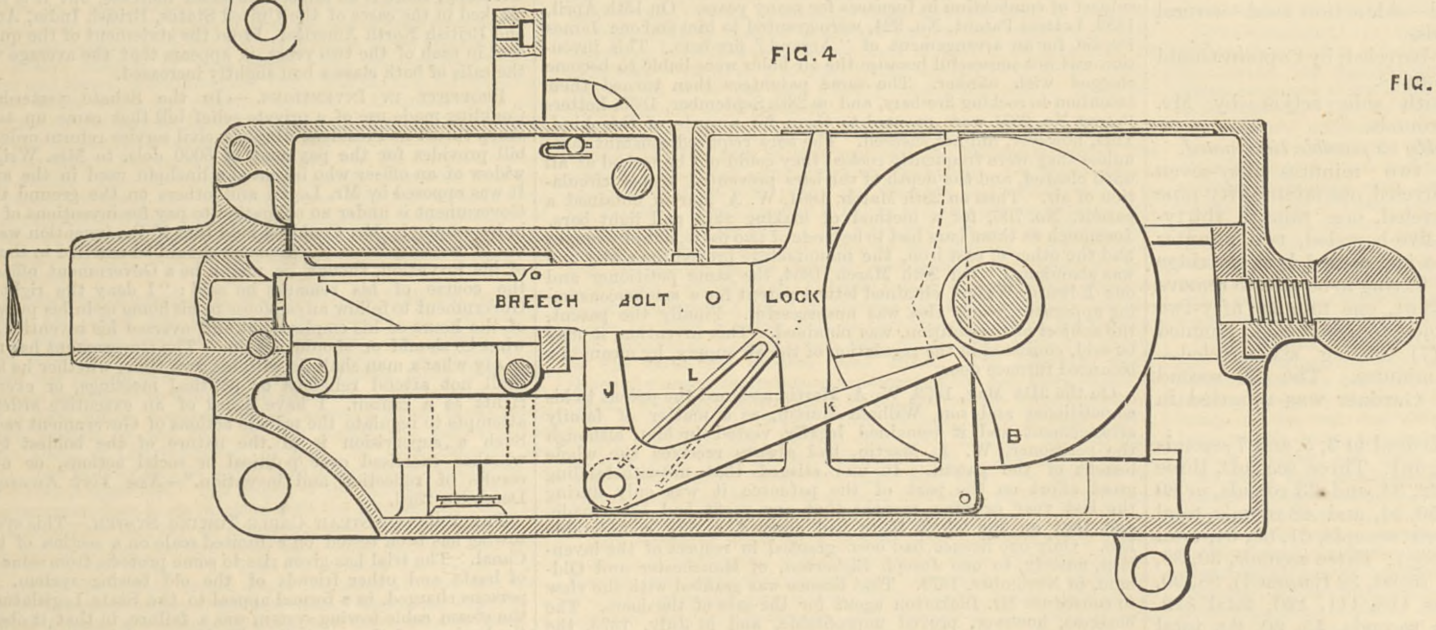
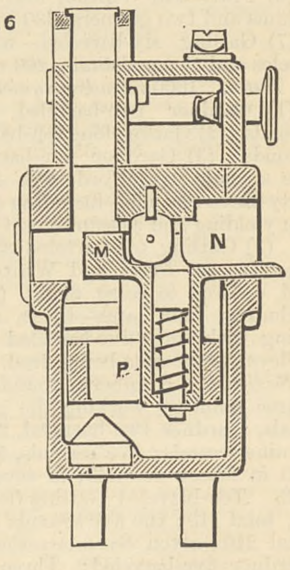


FIG. 6



J, by which the cartridge is fired. Figs. 5 and 6 show cross sections of the lock showing the cartridge carrier M N, with the movable wall N in the two successive positions on opposite sides of the breech of the barrel. Fig. 5 for the reception of cartridges—6 for firing. We do not attempt to give further details. It may be seen from what is said that the action may be described generally as a very simple and ingenious application of rotary motion to work two reciprocating actions alternately, in directions at right angles to each other, namely, the advance and withdrawal of the lock, and the entrance and extraction of the cartridge. There are only two springs, viz., the V firing spring L, and the spiral spring P, acting on the movable wall N. This, however, and the extractor are pressed down by fixed sliding surfaces, not by other springs. The extractor does not close or release its hold, for the cartridge-rim is slid in behind it, and ejected in a similar way. Speaking generally of this system of action, we see no fault to find as yet, but of course there is at present less experience with it than with either of the other systems. To us it appears to promise well; we may have to qualify our opinion after the trial possibly. Mr. Gardner has adapted his system to five barrels to suit the demands of others, but he advocates the two-barreled gun himself. This, he considers, has such perfect action that he would undertake to work it turned over on either side, or vertically upwards and downwards if the cartridges were pressed by hand, so as to do the only work which depends on gravity. It will be observed that we have spoken above chiefly with a view to rapidity of action. This constitutes the first feature in the programme, which is as follows. It should be understood that all the arms must fire the Government supply of ammunition for the 0·45in. bore.

PROGRAMME FOR COMPETITIVE TRIAL OF MACHINE GUNS.

(1) *For Rapidity.*—The following trials to be carried out from each gun :—(*a*) Fire for half a minute ; number of rounds fired to be noted.* (*b*) Fire 1000 rounds. Time to be noted, including all delays. (*c*) Ascertain the number of rounds that can be fired in three, five, and seven seconds. (*d*) Ascertain the number of continuous rounds that can be fired by one man without assistance. Time to be noted. (*e*) Ascertain the number of rounds that can be fired by one man in one minute without assistance. The above may be fired by inventors or their assistants.

(2) *Accuracy with deliberation.*—(*a*) The guns to be mounted on their own carriages, and one barrel of each fired for accuracy;

* Misfires and other accidents to the cartridge will be noted in all the trials.

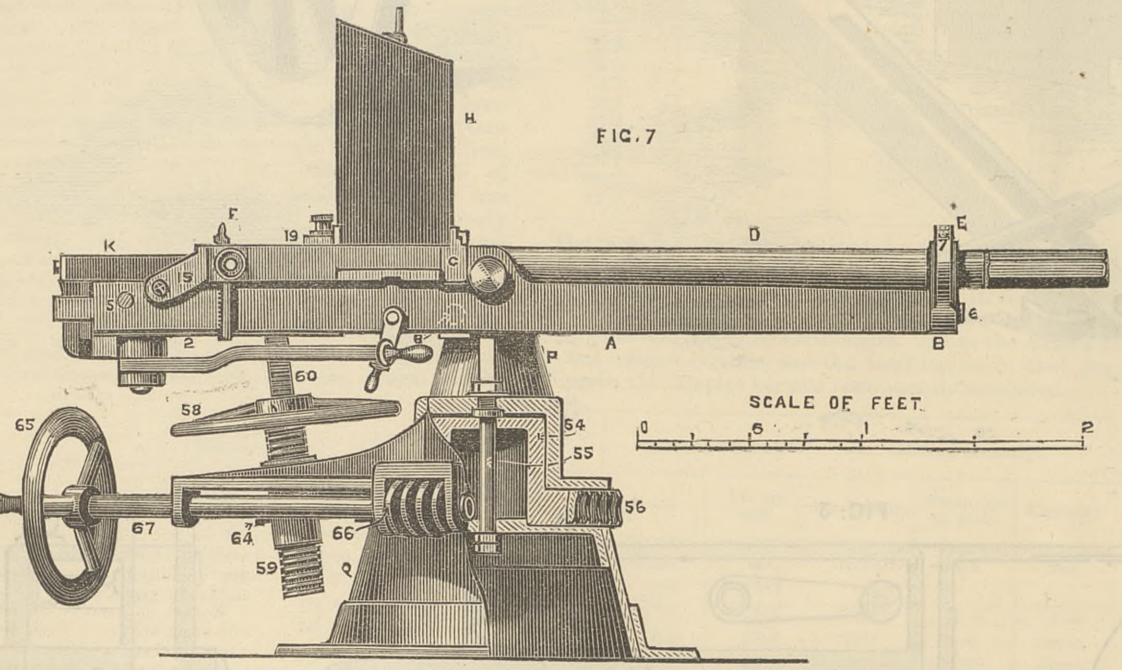
three targets of 20 rounds each at 300, 500, 900, 1500, and 2000 yards to be made, a different barrel being used each time. The higher ranges to be subjected to modification. (*b*) Fire 40 rounds from each gun, for figure of merit, at a target at 500 yards range, three targets to be made. To be fired by men of the School of Gunnery.

(3) *Accuracy with Rapidity.*—At stationary targets: (*a*) Without traversing: Fire one round from each barrel of each gun as fast as possible, at 500 yards range, at target. Note time and accuracy. Three targets to be made. (*b*) Without traversing: Fire 80 rounds from each gun, as fast as possible, at 500 yards range. Note time and accuracy. (*c*) With automatic scattering motion: Fire for half a minute with automatic gear on, at 500 yards range, at rows of 9ft. targets. Repeat with hand scattering gear. The number of throughs and lodges only to be counted. (*d*) Three fixed 6ft. by 6ft. targets to be placed at 300, 500, and 700 yards, in different directions, as wide apart as the ground will allow. 40 rounds to be fired at each target. The time and number of hits to be noted. At moving target: (*e*) A movable target, 6ft. by 12ft., at 800 yards range, to be caused to move diagonally across the line of fire to a point 400 yards from the gun at a trot. Number of hits to be noted. The lateral distance travelled to be about 400 yards. To be fired by men of the School of Gunnery.

(4) *Velocity Trials.*—Muzzle velocity of 10 rounds from each gun to be taken.

(5) *Exposure Trials.*—(*a*) Guns to be wiped clean, and left uncovered for a week in the open. Before firing, half-a-minute allowed for cleaning, with such material as would be found with the carriage. Continuous firing for half-a-minute to be then carried out. (*b*) Each gun to be fired for half-a-minute under an oscillating overhead sieve filled with dry silver sand.

(6) *Rough Usage.*—A rough usage trial of each gun in marching order will also be carried out. The details of this will be arranged by the committee hereafter. Further trials as to suitability for boat and ship work will be afterwards made. N.B.—Any of the above trials may be repeated as often as the Committee consider desirable.



THE NORDENFELT GUN.

On Thursday, January 13th, the following results were obtained:—

(1) *Rapidity (a) firing for half a minute.*

(1) The two-barreled Gardner, worked by inventor and one assistant, 195 rounds.

(2) Gatling long ten-barreled firing action at rear, worked by Mr. Accles and two assistants, 330 rounds.

(3) Gardner five-barreled, by inventor and two assistants, worked in volleys, 286 rounds.

(4) Nordenfelt five-barreled, by inventor and two assistants, 308 rounds.

(5) Gatling short ten-barreled—side action used—several hitches in extraction, 326 rounds.

(6) Pratt and Whitney four-barreled, by Captain Gould Adams and two gunners, 330 rounds.

(7) Gatling six-barreled—with side action—by Mr. Accles and two assistants, 269 rounds.

Test b. 1000 *rounds as quickly as possible time noted.*

(1) Gardner two-barreled, two minutes fifty-seven seconds. (2) Gatling long ten-barreled, one minute fifty-nine seconds. (3) Gardner five-barreled, one minute thirty-five seconds. (4) Nordenfelt five-barreled, two minutes forty-three seconds—including a jam caused by a cartridge rim yielding and a cleaning rod having to be used to remove it. (5) Gatling ten-barreled short, one minute fifty-two seconds. (6) Pratt and Whitney four-barreled, jammed and ordered to cease firing. (7) Gatling six-barreled—including four jams—three minutes. The 30 second firing with the five-barreled Gardner was repeated in volleys, 330 rounds being fired.

Section C.—Number of rounds fired in 3, 5, and 7 seconds (three numbers working the gun): Three seconds, three trials, Gardner two-barreled, 22, 34, and 33 rounds, or 89 in nine seconds; five seconds, 50, 51, and 48 rounds, total 149 in fifteen seconds; in seven seconds, 61, 68, 64, total 193. Ten-barreled Gatling (long): Three seconds, 30, 39, 50, total 119; the five seconds series, 32 (jammed), 88, 90, total 210; seven seconds series, 118, 111, 120, total 329. Gardner five-barreled: Three seconds, 45, 60, 60, total 165; five seconds, 75, 50, 90, total 245; seven seconds, 110, 110, 115, total 335. The Nordenfelt five-barreled: Three seconds, 50, 60, 50, total 160; five seconds, 75, 75, 70, total 220; seven seconds, 100, 95, 100, total 295. Ten-barreled short Gatling: Three seconds, 54, 41, 54 rounds, total 149; five seconds, 75, 87, and 83, total 245; seven seconds, 108, 108, and 42 (ending by jamming), total 258. The Pratt and Whitney, fired by Capt. Gould Adams: Three seconds 54, 60, 48, total 162; five seconds, 101, 88, 90, total 279; seven seconds, 100, 117, 114, total 331. Gatling six-barreled: Three seconds, 30, 44, 49, total 123; five seconds, 74, 52, 59, total 185; seven seconds, 90, 82, 80, total 252.

Section E.—The number of rounds fired by one man in one minute, unassisted: Gardner five-barreled, fired by Gardner, 339 rounds; long ten-barreled Gatling, 359 rounds; Gatling short ten-barreled, 193, including three jams; Gatling six-barreled, 267, stopped by jam twenty-five seconds short of time; Nordenfelt five-barreled, 230 rounds, hopper upset at about the half minute; Pratt and Whitney, 356 rounds.

The following second attempts were allowed to be made:—Mr. Gardner and two assistants fired in thirty seconds 236 rounds from two-barreled rifle. Mr. Accles alone, within a minute, fired from short ten-barreled Gatling 387 rounds, including jam for four seconds, and Mr. Nordenfelt with five-barreled gun got off within fifty-seven seconds 348 shots.

LEGAL INTELLIGENCE.

JUDICIAL COMMITTEE OF THE PRIVY COUNCIL.

(*Present:* Sir BARNES PEACOCK, Sir MONTAGUE SMITH, *and* Sir ROBERT COLLIER.)

January 18th.

Re MARTIN'S PATENT.

THIS was a petition for the prolongation of Martin's well-known patent for fire-doors. The facts appearing by the petition were shortly as follows:—Letters Patent, dated 22nd January, 1867, No. 158, were granted in this country to one of the petitioners, William Arena Martin, for his "Improvements in apparatus for consuming smoke, promoting combustion, and feeding furnaces with fuel." The same patentee obtained the following foreign patents, viz., in France, dated the 17th June, 1868; Canada, 9th January, 1875; Norway, 17th July, 1876. In the United States, Letters Patent, dated the 5th May, 1874, were granted to the same petitioner, and John Ashcroft, of New York, to whom the former had agreed to grant an exclusive licence for the United States. Subsequently one half of this last patent was vested in Ashcroft and the other half in the petitioner. The American patent was re-issued on 12th December, 1876. On the 4th May, 1875, half of the Canadian patent was assigned to Ashcroft as exclusive licensee. On 13th December, 1875, an Austrian patent was granted to the firm of Brüder Norbach and Fritze as the nominees of the petitioner, and they were to be at liberty to apply for a Russian patent, which, however, did not appear to have been obtained. The sum of £100 was stated to have been all that the petitioners had received from the Austrian firm. All the above foreign patents, with the exception of that for Norway, have expired. The last mentioned will expire on the 17th July next.

Mr. W. A. Martin appeared to have been investigating the subject of combustion in furnaces for many years. On 13th April, 1859, Letters Patent, No. 924, were granted to him and one James Purdie, for an arrangement of "Argand" fire-bars. This invention was not successful because the air holes were liable to become clogged with clinker. The same patentees then turned their attention to rocking fire-bars, and on 28th September, 1860, Letters Patent No. 2351 were granted to them for a grate of this kind. This, however, did not succeed. The bars required constant care; unless they were frequently rocked they could not be rocked at all until cleared, and the depth of the bars prevented proper circulation of air. Then on 28th March, 1864, W. A. Martin obtained a patent, No. 706, for a method of making thin and light bars. Inasmuch as these bars had to be made of two parts, one of wrought and the other of cast iron, the manufacture proved too costly and was abandoned. On 28th March, 1864, the same petitioner and one Edward Wylam obtained letters patent for a smoke-consuming apparatus, which also was unsuccessful. Finally the patent, the subject of the petition, was obtained. This invention, it may be said, consisted in the regulation of the air supply, by means of a balanced furnace door.

On the 31st May, 1873, W. A. Martin assigned the patent to his co-petitioner and son, William Martin, as a matter of family arrangement and it remained legally vested in him, although the petitioner, W. A. Martin, had always received the whole benefit of the patent. It was alleged that notwithstanding great effort on the part of the patentee it was only during the last year or nine months that any profit had been made, and that on the whole there had accrued a very considerable loss. Only one licence had been granted in respect of the invention, namely, to one Joseph Bickerton, of Manchester and Oldham, in November, 1873. That licence was granted with the view to constitute Mr. Bickerton agent for the sale of the doors. The business, however, proved unprofitable, and in July, 1875, the licence was revoked. It was stated that in consequence of the number of contrivances before the public, great difficulty had been experienced in inducing persons to give the invention a trial. Latterly its merit had been acknowledged, and steam users had adopted the practice of requiring boilers made for them to be fitted with these doors, and insisting upon their supply. The Admiralty also had adopted the invention for use in the Navy and in the dockyards, and in consequence there had of late been an increasing demand, with a diminution in the expense of working the invention.

Mr. Aston, Q.C., and Mr. Lawson appeared for the petitioners, and the Attorney-General and Mr. A. L. Smith for the Crown.

Witnesses were examined in support of the case of the petitioners, and on behalf of the Crown the matter was submitted to their Lordships' discretion. The Attorney-General stated that there appeared to have been every effort to introduce the invention, and he did not wish to oppose patentees of meritorious inventions.

Their LORDSHIPS said the merit and utility of the invention had not been disputed. They were of opinion that everything had been done that could be done on the part of the patentee to introduce the improvement, and that there had not been sufficient remuneration having regard to the expense to which he had been put. They would therefore advise her Majesty to prolong the patent for a further term of five years.

Solicitors for the petitioners: Messrs. Buchanan and Rogers.

January 18 and 19.

Re NAPIER'S PATENT.

This was a petition by Mr. R. D. Napier, formerly of Churchrow, Limehouse, and now of Glasgow, for prolongation of Letters Patent granted to him on 2nd February, 1867, No. 299, for "improvements in brakes and apparatus for giving motion to machinery." The invention was stated to consist in the use of "differential brakes" for various purposes, including the working of windlass barrels. The brake consisted of a metal band surrounding a drum, and secured by the ends to a differential lever either straight or bent. The petitioner was formerly in the colonies as a Government servant, but gave up his appointment and came home to work out his invention. He and his brother, Mr. J. D. Napier, started in business as engineers, and encountered great difficulties in pushing the invention. It was not until the eleventh year of the patent that the tide turned, and latterly the invention had been very successful. A notable instance of the use of the invention was referred to. Out of a considerable fleet of vessels off the coast of Zanzibar during a gale, only one rode out, and the safety of the ship was put down by her master to the use of a Napier windlass, which enabled the cables to be held under complete control. Mr. J. D. Napier died last year. The accounts of the business during the fourteen years of the patent showed a considerable loss.

It was stated on behalf of the petitioner's case that the Employers' Liability Act would in effect render the use of his brakes a matter of necessity to employers to lessen their risks.

Numerous witnesses—engineers, officers of ships, and others—were called in support.

Mr. Aston, Q.C., and Mr. Macrory appeared for the petitioner; the Attorney-General and Mr. A. L. Smith for the Crown.

Their LORDSHIPS were of opinion that the merit of the invention, especially in its application to windlasses, had been established, and, having regard to the loss the petitioner had sustained, they would advise her Majesty to prolong the patent in part—that is to say, only so far as the application of the differential brake or clutch to windlasses and cranes was concerned, for a further term of seven years.

Solicitor for the petitioner: Mr. Bristow Hunt.

IN THE HIGH COURT OF JUSTICE.

(CHANCERY DIVISION.—*Before the* MASTER OF THE ROLLS.)

Jan. 15th, 1881.

Re DIXON'S PATENT.

THIS was an application by way of petition, on behalf of Mr. Carl Rumpff, of Barmen, Germany, to have a specification corrected in certain respects after filing. Letters Patent, dated the 6th December, 1879, No. 5003, were granted to J. A. Dixon for certain improvements in the manufacture of colouring matters—a communication from C. Rumpff and F. Graessler. This patent was subsequently assigned by Dixon and Graessler to Rumpff. It appeared that in engrossing the specification from the draft, the word "sulphonic" had been substituted for "sulphuric," and the word "alkalising" for "alkylising." It was alleged, and the allegation was supported by evidence, that the errors were material.

Mr. LAWSON appeared for the petitioner. The consent of the law officer had been duly obtained.

The MASTER OF THE ROLLS made the order for correction of the specification as prayed, upon the undertaking of the petitioner not to sue any person in respect of infringements committed previously to the date of the order. He directed notice of the order to be given to the Commissioners of Patents.

Solicitors for the petitioner: Messrs. Wild, Browne, and Wild.

NAVAL ENGINEER APPOINTMENTS.—The following appointments have been made at the Admiralty:—J. Nelson, chief engineer, to the Seahorse; John Brown, engineer, to the Hector; and J. Leighton, engineer, to the Seahorse.

THE EXPORT RAIL TRADE.—An official return, supplementary to the Trade and Navigation Statistics, shows that there was last year a large increase in the value of both the iron and steel rails exported. Of iron rails, the value of the exports for 1880 was £908,891—an increase from £293,658 for the previous year. This increase is chiefly due to the growth of the shipments to North America, especially to the United States. Of steel rails, the exports were to the value of £3,306,367 for the past year—an increase from £1,950,805 for the preceding year. Except to Russia and Germany, there is an almost universal increase, but it is the most marked in the cases of the United States, British India, Australia, and British North America. From the statement of the quantities sent in each of the two years, it appears that the average value of the rails of both classes had slightly increased.

PROPERTY IN INVENTIONS.—In the Senate yesterday Mr. Conkling made use of a private relief bill that came up to give a sharp thrust at President Hayes's civil service reform order. The bill provides for the payment of 5000 dols. to Mrs. Wright, the widow of an officer who invented a linchpin used in the artillery. It was opposed by Mr. Logan and others on the ground that the Government is under no obligation to pay for inventions of persons in its employ. Mr. Conkling held that if the invention was made out of working hours the inventor should be entitled to the benefit of his invention, though he might be a Government officer. In the course of his remarks he said: "I deny the right of the Government to follow an *employé* to his home or in his pursuits out of the hours of his employment and oversee his invention, or say what he should or should not do. The Government has no right to say what a man shall do with his own time, whether he shall or shall not attend religious or political meetings, or exercise his rights as a citizen. I have heard of an executive order which attempts to regulate the private actions of Government *employés.* Such a supervision is in the nature of the boldest tyranny, whether exercised over political or social actions, or over the results of reflection and invention."—*New York Evening Post,* December 23rd.

THE BELGIAN STEAM CABLE TOWING SYSTEM.—This system of towing has been tested on a limited scale on a section of the Erie Canal. The trial has given rise to some protests from some owners of boats and other friends of the old towing system. These persons charged, in a formal appeal to the State Legislature, that the steam cable towing system was a failure, in that it obstructed the business of the canal, &c. The facts and figures respecting the traffic of the canal thus far during the year do not seem to warrant this arraignment, as the following summary from the official returns received at the Produce Exchange will show, inasmuch as they demonstrate that from the time of the opening of traffic on the canal to August 14th of the present year, the total traffic on the canal has been fully 30 per cent. greater than for the same period of the preceding year, namely:

	1879.		1880.
Total tons	2,210,450	..	3,258,896
Total miles boats cleared..	3,093,725	..	5,325,649
Total tolls .. .. dols.	343,537	..	504,259

Much of this increase is not unreasonably attributed to the speed and economy of the cable service. Several hundred boats have, the *American Manufacturer and Builder* says, abandoned the old towage system for the new, and it is claimed that the increased speed of the steam towing system has increased the capacity of the canal fully 15 per cent., while the boat-owners, by being able to make more trips, have enjoyed increased profits.

RAILWAY MATTERS.

IT is said that the Japanese make first-class engine-drivers, and for the future it is intended to dispense with a further proportion of the foreign staff employed for this purpose.

AT a recent public meeting at Nanaimo, British Columbia, it was urged that the Government should take the construction of the island railway into their own hands, so that a valuable coal and mineral belt shall not pass into the hands of a private company.

THE Oldbury Local Board have sanctioned the carrying out of the two tramway schemes proposed for that district—the Birmingham and Western District, and the Birmingham and Dudley. Application will at once be made to the Local Government Board for permission to lay down the lines.

RECENTLY a train which was running from Giessen to Deutz and Cologne was overwhelmed by a landslip. The accident took place between Betzdorf and Wissen in a steep cutting. Two post officials and four railway servants were more or less severely hurt. The fall of earth caused the train to leave the metals, and the post-office van was ruined.

THE South Metropolitan Tramways Company has recently opened nearly two miles of the new lines sanctioned last Session. This section commences at the western end of Nine Elms, and runs the whole length of Battersea-park-road. A further section of the line will give a through transit from the Vauxhall end of Nine Elms to Clapham Junction, where 1400 passenger trains arrive and depart daily.

SIR JOHN HAWKSHAW, Mr. Barlow, Mr. Gregory, and other engineers, have inspected the site of the proposed new Tay Bridge, and a consultation has been held with the directors of the North British Railway Company as to the scheme generally. Mr. Law, C.E., London, and his partner, Mr. Chatterton, were in Dundee for several days last week, testing the currents in the river, and conducting other investigations of a like character.

THE Governor of Bombay on December 30th drove the last spike of the Western Rajputana State Railway, and declared the line open. In his speech at the luncheon afterwards, given by the Maharajah of Jodhpur, Sir James Fergusson referred to the importance of the line as a connecting link between Bombay and Northern India; but, he said emphatically, its construction on the narrow gauge system was a great mistake. It would be extremely expensive in working, and he did not think that the system was likely to endure long for the main line communication.

THE Massachusetts Railroad Company, having investigated the explosion of a locomotive boiler on the Fall River Railroad on November 3rd, have made a report in which they find that there was a crack extending the whole length of the fire-box—about 4½ft. —which they consider was the cause of the explosion. While attaching no blame to anyone and saying that it is a common practice to run locomotives with cracked sheets in the fire-box, they think the practice a bad one, and consider that the master mechanic should not have sent out the engine with the cracked sheet.

AFTER a long debate in committee of the Dominion House of Commons on the terms granted by the Government to the Pacific Railway Syndicate, the Ministerial resolutions were agreed to without a vote at one o'clock on the morning of the 13th inst., in accordance with the arrangement made between ministers and the leaders of the opposition. When the Ministerial resolutions ratifying the terms of the agreement with the Pacific Railway Syndicate come before the House of Commons from the committee, a debate of two weeks is expected. The opposition intend to move a series of amendments.

THE experiment of lighting the Hoosac tunnel by electricity is said to have been a success. The generator of 4000 candle-power was operated by an engine of 20-horse power, and each of the burners was of 2000 candle-power. In the parts of the tunnel free from smoke the light thrown was strong enough to do track work over 500ft. away, and driving spikes and shovelling 1000ft. off. Between the central shaft and the east portal, where the smoke was so dense that an ordinary locomotive light would not be visible 10ft. away, the electric light could be seen for over 100ft. In some parts of the tunnel one could read by the electric light 250ft. from the car.

MR. JOHN PARTINGTON, of the Audit Department of the London and North-Western Railway, has published a circular giving the details of a scheme—which has, it is said, been tried for effecting economy in the issue of tickets. The system seems to consist in making all tickets half the present size, two being printed on one as returns are now, so that existing ticket issuing and holding boxes and apparatus may still be used. Mr. Partington's economy is apparently on the "cheap and nasty" system, at least it will be anything but agreeable to have always to use tickets of just the right size for losing, merely for the sake of saving a little paper.

MUCH trouble with strikes is experienced in different parts of Australia. Early in November about three hundred navvies employed on a new railway which is being constructed into the hills from Adelaide suddenly threw themselves out of good remunerative employment because they wanted eight hours to be regarded as a day's labour instead of nine hours. The contractors—Messrs. Walker and Swan—were, however, firm; and the men forfeited two or three weeks' wages and returned to work. A similar strike also took place on the Terowie Railway, a line which was being carried on rapidly by the Government to meet the requirements of farmers at harvest time. The eight hours' demand was the ostensible cause of the strike. The Government immediately instructed that the men should be paid off, and the works stopped—a somewhat drastic expedient, which will, says the Adelaide correspondent of the *Colonies and India*, cause inconvenience to the farmers, but one which ought to teach men who are in good employment a lesson of contentment.

THE ceremony of turning the first sod of the Hull and Barnsley Railway and Dock was performed on Saturday by Lieutenant-Colonel Smith, the chairman of the company, the occasion being one of unusual rejoicing and holiday making. Although snow covered the ground to a depth of several inches, many thousands of persons assembled to witness the ceremony. At its conclusion a choir of 2000 voices, accompanied by about a dozen bands, sang an ode written by the Rev. H. W. Kemp, the master of the Maison Dieu, or Charter-house, at Hull, to commemorate the event. The railway and its object were described in our impression for the 13th August last. The length of the railway from the site of the proposed dock to its junction with the Manchester, Sheffield, and Lincolnshire Railway at Stairfoot, near Barnsley will be 56 miles, and including junction lines with other railways, the total length will be 66½ miles. The Hull Corporation have sold to the company, on favourable terms, about 126 acres of land and foreshore for the construction of the new dock. The dock, which it is intended to name the Alexandra Dock, will have a water space of 46 acres, or nearly double the area of the Albert Dock, the largest of the present docks at Hull. It will be 2300ft. in length and 1000ft. in width, and will have a minimum depth of 30ft. at the ordinary high-water spring tides. It will be entered by a lock 500ft. in length and 75ft. in width, with a depth of 34ft. of water over the sill. The dock will be surrounded by spacious quays, 80 acres in extent, and will be provided with the most modern appliances, worked by hydraulic machinery, for the rapid and economical shipment of coal, and the loading and discharging of cargoes. It is also proposed to construct two graving docks, one of which will be capable of accommodating any of the large vessels coming to Hull, which at present have to go to Grimsby or other places for repairs or survey. The engineers are—For the railway, Mr. William Shelford, M. Inst. C.E., F.G.S., London; Mr. George Bohn, Hull; for the dock, Mr. James Abernethy, M. Inst. C.E., London; Messrs. Oldham and Bohn, M. Inst. C.E., Hull, acting engineers. The contractors are Messrs. Lucas and Aird, who have undertaken to complete the works within a period of four years.

NOTES AND MEMORANDA.

M. A. FUNARO has shown that the highest proportion of clay in clay soils does not exceed 33 per cent.

THE depth of Loch Lomond is very great, and it is consequently very seldom frozen over. It is, however, frozen over now.

TO ascertain if water is hard or soft procure a small quantity of soap dissolved in alcohol, and let a few drops of it fall into a glass of the water to be tried. If the water becomes milky it is hard; but if little or no milkiness results, the water may be said to be soft.

DR. POL, a Russian, recommends the following mixture as a bath for rubber goods which have lost their elasticity:—Water of ammonia, one part; water, two parts; in this the articles should be immersed for a length of time, varying from a few minutes to one-half or one hour, until they resume their former elasticity, smoothness, and softness.

IN the year 1880 there was published in this country 4293 books of all sorts. Of these, theology, sermons, &c., head the list as to numbers—as they generally do—but not by so formidable an excess as in previous years. Juvenile works are next numerous, and those under the head of arts, sciences, and illustrated works were nearly 33 per cent. larger in number in 1880 than in 1879.

THE cultivation of pampas grass, now so much used for decorative purposes, has become a profitable industry in Southern California. Three-quarters of an acre planted, says the *Scientific American*, in pampas grass yielded, at 2½ cents per head, 500 dols. Another grower sold all he could raise at 7½ cents per head. Last year 10,000 heads or plumes of this grass were sold from that region.

MR. F. L. SLOCUM has examined the ink for writing on glass, to which we recently referred, and, according to the *Am. Journ. Pharm.*, reports that it is made by mixing barium sulphate, three parts; ammonium fluoride, ony part; and sulphuric acid q.s. to decompose the ammonium fluoride and make the mixture of a semi-fluid consistence. It should be prepared in a leaden dish, and kept in a gutta-percha or leaden bottle.

A REMARKABLE batch of serious accidents was reported from New York on the 8th inst. Thirteen persons perished by the burning down of the main building of the Stranferd County Poor Farm, in New Hampshire. Nine persons were killed, and three fatally injured by an explosion at a rolling mill at Allentown, Pennsylvania. Three others were killed at Newark, New Jersey, by an explosion at the smelting works in that town, and four more perished by an explosion in a brewery in New York.

THE specific gravity of ozocerite is 0·94 to 0·97. According to Dana the specific gravity of mineral waxes ranges from 0·85 to 0·90. The melting points are variously given by different writers as follows:—The Moldavian, 84 deg., Malaguti; Urpeth mineral, 60 deg., Johnson; Galacian, 60 deg., Höfstadter; Utah, 61(·5) deg., Newberry; Moldavian, 62 deg., Schrötter; from Slanik, 62 deg., Glocker; Galacian, 63 deg., Wagner. The boiling point is also differently given by the authorities:—Urpeth mineral, 121 deg., Johnson; Moldavian, 210 deg., Schrötter; Moldavian, 300 deg., Malaguti; Utah, between 300 and 380 deg., Newberry.

A NEW compound of oxygen and nitrogen has been described by Messrs. Hautefeuille and Chapuis to the French Academy of Sciences. It contains more oxygen than azotic acid, and has been named by the French chemists per-azotic acid. It is well known that on passing an electric current through oxygen a portion of the oxygen is transformed into ozone. If the ozone be mixed with nitrogen, the spectrum indicates the presence of a body characterised by black bands. The bands disappear when the gaseous compound is mixed with water, and the latter is acidified. The application of red heat to the gaseous mixture also causes the black bands to disappear. M. Berthelot some time since suspected the existence of the body. Its presence was indicated to him, however, merely by phenomena of coloration which appeared and disappeared during the passage of an electric current through a mixture of oxygen and hypo-azotic acid. His observations were communicated to Messrs. Hautefeuille and Chapuis, who, by obtaining the spectrum, have placed the existence of the new acid beyond doubt.

IN the manufacture of mineral wax products the crude mineral —ozocerite—is melted with water in order to remove any sand or other earthy impurities with which it is likely to be mixed. It is then run into cakes weighing about 2 lb. each. By another process the crude hydrocarbon is first melted and then drawn off; the residue boiled with water, to the surface of which any remaining ozocerite rises; the whole allowed to stand for several hours for any suspended impurities to settle out. The melted wax which was drawn off is poured into moulds, which hold from 100 lb. to 120 lb. These cakes are then shipped to the various factories in England, Moldavia, and Vienna, where it is purified and converted into illuminating oils and paraffin. A portion of it is directly treated on the island of Swatoi Astrow, in the Caspian Sea, near the Peninsula of Apscheron. There it is distilled in flat-bottomed iron retorts provided with leaden worms, each of these retorts holding from 1500 lb. to 2000 lb. Sixty-eight per cent. of distillate is obtained, sixty parts of which are paraffin and eighty parts oil. According to Grabowsky, the products of such a working may be as follows:—Benzine, 2 to 8 per cent.; naptha, 15 to 20 per cent.; paraffin, 36 to 50 per cent.; heavy lubricating oils, 15 to 20 per cent.; coke, 10 to 20 per cent.

IT may be of interest to record some of the temperatures recorded during the latter part of last week and the commencement of the present. The frost commenced very suddenly. On Wednesday a severe snow storm took place, and then the thermometer began to fall rapidly. On Thursday it fell to 17 Fah., but on Friday night it fell in Hyde Park to 12. In Fleet-street it fell to 10 deg., the lowest ever registered in London by Mr. Steward. At Brockley and Wimbledon on the night of Friday the thermometer fell to 9 and 11 deg., whilst at the Crystal Palace the minimum thermometer registered 13 deg. On Sunday night the minimum thermometer recorded 8·5 deg. Fah. at Camberwell. There has been no such weather in London since 1861, when many trees and shrubs in the parks and gardens were killed. The following table shows the lowest temperature registered at the Receiving House in Hyde Park each year since 1870 by Mr. Sutton, the Superintendent. 1870, 17 deg.; 1871, 19 deg.; 1872, 28 deg.; 1873, 23 deg.; 1874, 20 deg.; 1875, 26 deg.; 1876, 21 deg.; 1877, 25 deg.; 1878, 23 deg.; 1879, 16 deg.; 1880, 19 deg.; 1881, 12 deg. The present frost when it had lasted barely five days, had been the severest for twelve years, the days being quite as cold as the nights during some of the winters which have been considered severe.

THE following notes on a curious fluid exhibited at a recent meeting of the Société d'Encouragement, Paris, by a Russian gentleman, are from the *Chemist and Druggist*. The substance, is a very light and very volatile hydrocarbon, boiling between 30 deg. and 40 deg. Centigrade, and volatile at the ordinary temperature. It burns at a very low temperature, but yields a singularly brilliant white light. The product is perfectly harmless. A quantity of it was spread all over the table and set fire to, but a very gentle puff of breath sufficed to extinguish it. The experimenter dipped his handkerchief into the fluid, lighted it, and was at once provided with a useful torch. He blew out the flame, and no trace of fire had passed on to the tissue. Light gloves and delicate silk ribbons were treated in a similar manner, and were equally unaffected. Lamps for this oil are so constructed that the light is extinguished by the act of falling. Lighted lamps were thrown among dry hay without danger. An explosive mixture with air and the vapour of this hydrocarbon can only be made with difficulty, and this gives rise to nothing more than a slight puff. The liquid has a slight and not unpleasant odour; it can be sold for a franc a kilogramme, which is sufficient for a large lamp for twenty hours. The production of the substance, according to its present keeper, is unlimited.

MISCELLANEA.

THE Municipality of Zurich has refused permission for the placing of telephone wires on the public buildings of the city, on the ground that they are attractors of lightning, and therefore dangerous.

THE Walsall Town Council have decided to oppose the Birmingham, Walsall, Cannock Chase, and North Staffordshire Railway scheme, on the ground that it would adversely affect thoroughfares in their district.

NOTICES have been posted at Festiniog and other slate quarries in Merionethshire to the effect that full time would be immediately commenced for some months. They have been working only four days weekly.

THE Piat oscillating furnace for melting steel, iron for malleable castings, brass and other metals, as illustrated and described in our impression of the 9th of April last, is now we learn being made by the Plumbago Crucible Company, Battersea.

ARRANGEMENTS have just been completed for the experimental lighting of certain important parts of the General Post-office, St. Martin's-le-Grand. The first series of the experiments will be conducted by the British Electric Light Company, in the telegraph instrument galleries.

ONE of the results of the meeting of the Iron and Steel Association in Düsseldorf has been the formation of a similar society in Germany, under the name of Das Verein Deutscher Eisenhüttenleute. A circular has been issued by the secretary, Mr. F. Osann, Düsseldorf, giving all particulars of the society.

A LECTURE on water supply and filtration will be delivered in the Parkes Museum of Hygiene, University College, Gower-street, to-morrow afternoon at 3.30, by Professor W. H. Corfield. Lectures on drainage, by Mr. Rogers Field, M.I.C.E., and on water-closets, sinks, and baths, by Professor Corfield, on the two following Saturdays at the above time.

M. C. CLAMOND, of Paris, has patented a new method of producing an intense white light. Air, to mix with the gas-supply, is passed through a refractory chamber, which is heated by small jets of gas, themselves supplied with hot air. The gas-supply meets the hot air just as it has reached the end of the refractory chamber, when both form a jet of intense heat directed upon a cylinder of lime.

THE first bale of Egyptian jute has arrived in Dundee, and was seen on the 17th by a number of merchants and manufacturers, who have personally assisted in contributing to the cost of the experiments which have been made in Egypt under the supervision of Mr. William Grant. The bale now in Dundee was grown by Mr. Murdoch, who had to contend with native prejudice and neglect. A finer sample, grown on the Domain lands under the care of coolies from Bengal, is now on its way to this country.

NO body of workmen in the North of England sooner reaped the benefit of the improved state of trade at the close of 1879 than did the ironstone miners of Cleveland. It is thought by some in the North the 1880 output of ironstone has not reached the maximum quantity attained in the year 1876, when more than 6½ millions of tons were won; but it may be suggested that as the iron production in Cleveland was several hundred thousand tons less in 1876 than in 1880, the quantity will be more than above mentioned. Rock-drilling machines are now coming more into general use. Each set of men, with machine, is capable of winning something like 50 tons per day, as against five tons per day won by a miner working by hand. There are now employed in the Cleveland mines between 8000 and 9000 men.

THE Building Acts are actually put in operation now and then to prevent people using mud instead of mortar for houses. At the Edmonton Sessions, Andrew Nichols, builder, of Shacklewell-lane, was charged upon two summonses with using material as mortar in the construction of two houses in Daleview-road, Eastbournia, Stamford-hill, not of a character to solidly bind the bricks together. The Bench ordered the defendant to pay £5, and a continuing penalty of 2s. 6d. per day for 40 days in respect of each house (£20 altogether) and costs, intimating that they were determined to assist local authorities in enforcing their bye-laws. People who want to build or buy cheap and nasty dissolving-from-view houses, had better remember that even the £5 would have paid for a good deal of quality in the mortar used.

THE mean illuminating power of the gas supplied by the three gas companies, under the supervision of the Metropolitan Board of Works, excepting the Cannel gas supplied to Westminster, was during the week ending the 12th inst., from 16·6 to 17·3 candles, the highest being in the Old Ford district of the Commercial Gas Company, and the lowest in the Dalston and Kingsland-road district of the Gas Light and Coke Company. The greatest mean quantity of sulphur was in the gas of the last-named company supplied to Chelsea, each 100 cubic feet of the gas containing 17·5 grains. The same company's gas contained the largest mean quantity of ammonia, namely, 0·7 grain per 100 cubic feet at Bow. The weekly report to the Board by Mr. T. W. Keates, consulting chemist, also shows that sulphuretted hydrogen was again entirely absent and the pressure in excess.

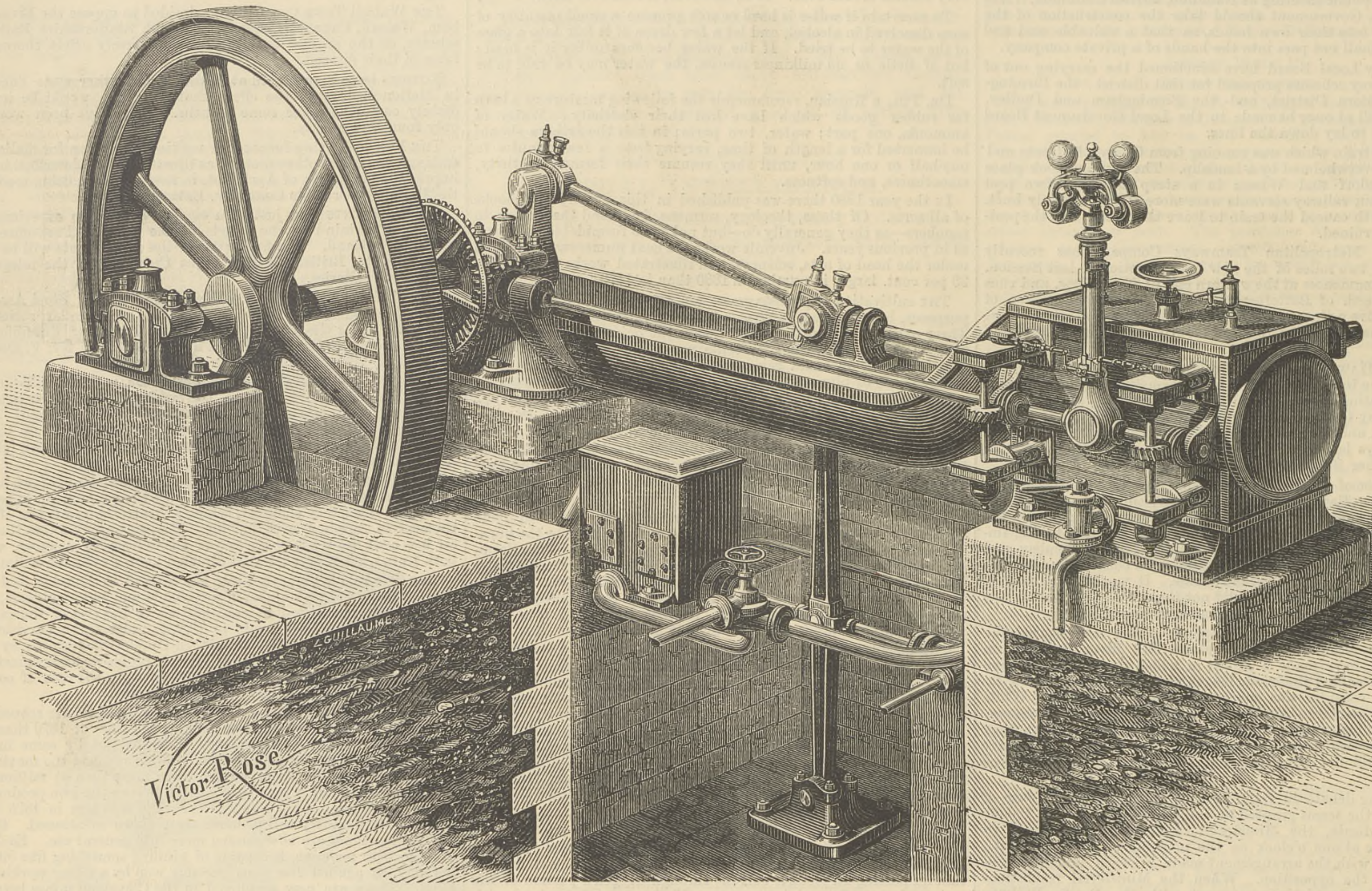
SOME complaints were made as to the delay in clearing London streets of snow, but none could reasonably be made in the City. Mr. Swale, the superintendent of scavengers, anticipating the storm, remained at his office all Tuesday night, and had 100 men in the streets. The snowfall commenced at quarter to five a.m. One hundred additional men were immediately sent out, and by eight o'clock, when the storm ceased, after lasting with great severity for over three hours, there were on duty, in excess of the ordinary scavenging staff, no fewer than 450 men and boys, and during the day 250 more were sent out. The hydrants were used for a time to facilitate the work, and the streets were strewn with rock-salt to prevent the horses from slipping. In fact, everything was done that was possible in the emergency, It is manifestly impossible, with so sudden and heavy a snowfall, to clear the great street area of the City without the lapse of a certain period of time, which in this case, the *City Press* says, was unusually limited.

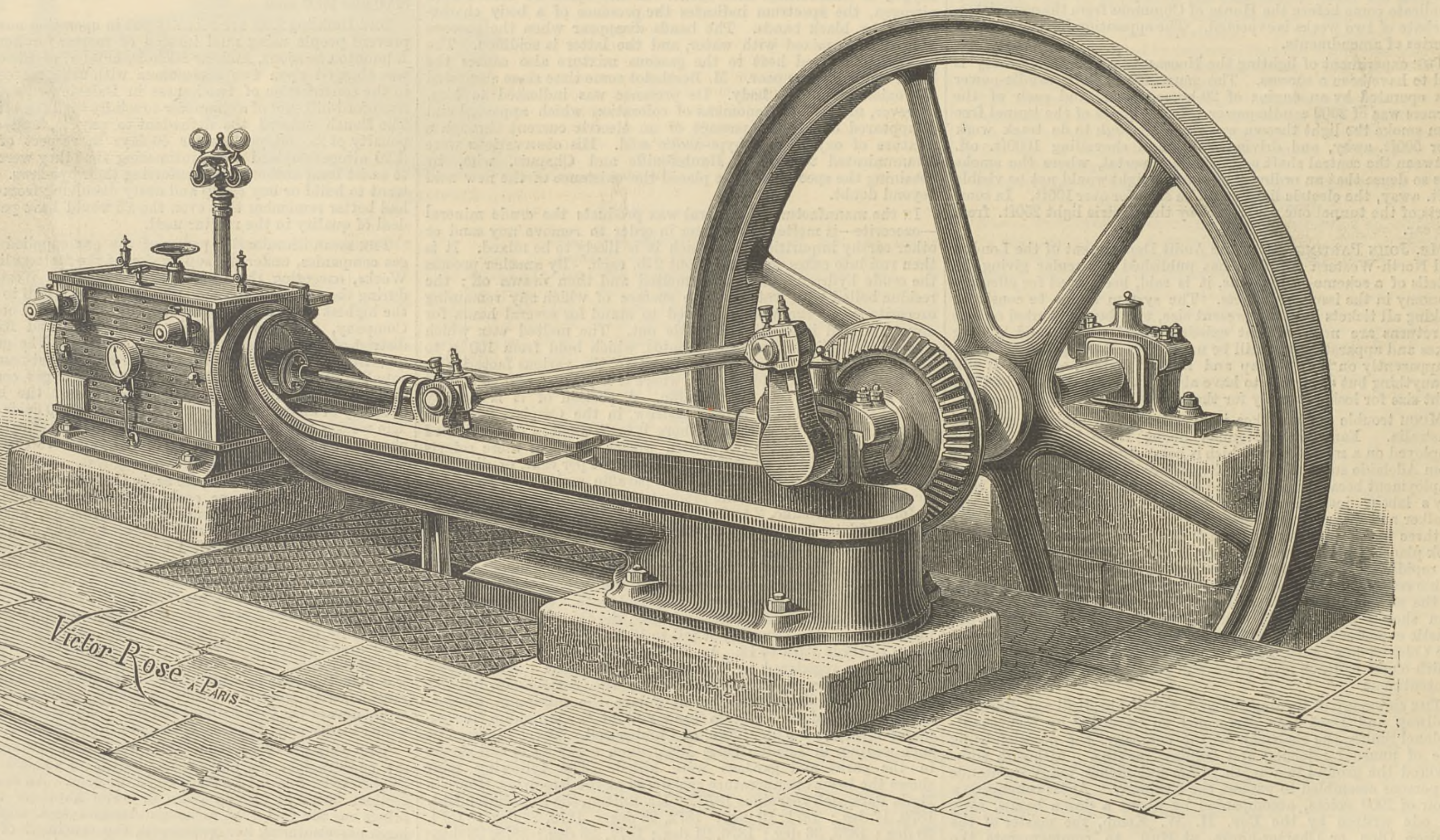
THE statistics of Scotch exports of pig iron to foreign countries are encouraging, the exports amounting to 440,200 tons against 340,385 tons, or a net increase of 99,815 tons. An analysis of this section, given in Messrs. John E. Swan Brothers' trade report, brings out the fact that although America took unprecedentedly large parcels during her excitement, the continent of Europe, the British colonies, and many outlying places, have ordered much more freely than usual, and as long as our quotations for iron and transits remain reasonable, there is every ground to anticipate not only a continuance of this but a valuable improvement in these and other directions, despite the many unnatural barriers raised by ill-advised tariffs in subversion of true economic principles. About 10,000 tons of hematite or spiegeleisen sent here for transhipment, are not included in the foregoing statistics. The quantities dispatched coastwise have not varied to any extent and are 200,848 tons against 200,133 tons, or 715 tons more than in 1879

THERE are in the United States 279 firms engaged in the silk manufacture, there being factories in fourteen different States, though the bulk of the business is in New York, New Jersey, Pennsylvania, Connecticut, and Massachusetts; capital to the amount of 18,000,000 dols. is invested; 18,000 operatives are employed, 6,000,000 dols. in wages are annually distributed, and 27,000,000 dols. worth of goods produced. "Nearly every variety of silk manufacture is represented in this country, and the quality of the work—the *American Manufacturer* says—is in some respects superior to that of any other country in the world. American silk ribbons are largely imitated abroad, and much 'French' silk is sold in this country to persons who are blissfully ignorant that Paterson, N.J., is the nearest point to France that the goods ever saw. The remarkable development of this industry is due to the improvements in machinery which the wicked tariff made possible. Who wishes this vast industry to be destroyed simply to gratify foreign manufacturers and certain importers?"

HORIZONTAL ENGINES WITH AUTOMATIC EXPANSION GEAR.

MESSRS. BUFFAUD FRERES, PARIS, ENGINEERS.





CONSIDERING the predominating application of the ordinary flat slide valve, it is a matter of little surprise that practical men have shown a decided preference for this well-known type. Hence, numerous attempts have been made to modify it, so that it might embody all the working conditions of automatic variable expansion gear. This practical activity has brought to light a variety of constructions, which unite, as it were, the so-called Corliss gears with the flat slide gears. It must be admitted the outcome of many of the attempts is in no way inferior to the original Corliss valve gears. This remark certainly applies to the horizontal condensing engines illustrated above, in which the principle of the four-fold steam-distributing gear and the form of the engine frame are borrowed from the Corliss patterns, whereas the valves are of the ordinary flat slide type with a disengagement mechanism similar to the Bide and Farcot valve gear.

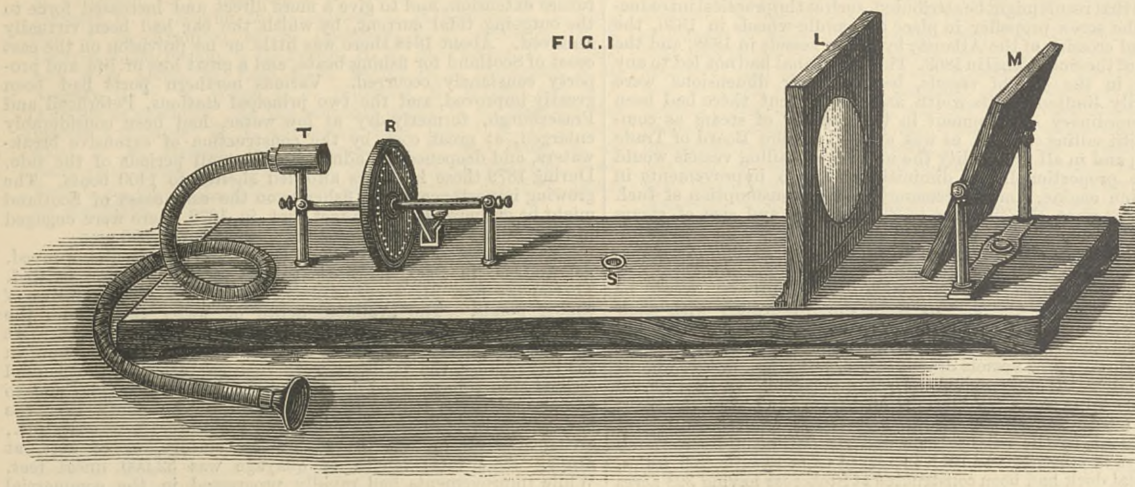
The engine frame, cast hollow, receives the crank shaft bearing at one end, whilst its other extremity of peculiar form is bolted to the cylinder. The latter is completely surrounded—excepting the end-covers—with a double jacket of steam and hot air; it is moreover protected from all external cooling by a non-conducting layer covered again by a wooden lagging. The cylinder is greased by two lubricators placed on the steam-pipe. Contrary to the practice of several engine-makers, who allow the steam to circulate in the jacket before it enters the cylinder proper, in the example before us, live steam is taken direct from the boiler for this jacket. The little condensed steam which accumulates is blown back into the boiler by an automatic water discharge cock. The cylinder rests on a broad solid base, which forms one of the two points of support of the engine frame. Ample space is left between these two supports for placing the air and feed pumps, which are worked by a swing lever articulated from the piston rod cross-head. The fulcrum of this lever is about 4ft. below the floor line in an engine of 25 horse-power.

The air pump offers little that is new. The valves are of india-rubber, and its piston-rod is connected with that of the feed-pump by a strong iron strap, whence an alternate motion is obtained by the interventions of an oscillating bearing controlled by the forementioned swing lever. The sliding surface of the piston cross-head is made adjustable by means of wedges, which serve to rectify any undue wear and tear. The crank-pin and its shaft are of wrought iron, whereas cast steel is employed for the crank-pin, as well as for the steam distributing organs. The brasses of the crank pedestal are in three pieces, and are fitted with tightening-up wedges. The connecting rod is made with an open strap-end and closed butt-end; still the advantages of the closed end are sought to be obtained at the strap-end, by a special arrangement of cotters, which always ensures the brasses being equally distant from their centres. The distribution of the steam is obtained by four flat gridiron valves, placed transversely across the cylinder, with the two admission valves above the two exhaust valves. A lay shaft running parallel to the engine centre line is caused to rotate by mitre gear off the crank shaft, and it transmits its rotary movement on to two vertical spindles by worm and wheel gear; the spindles are fitted with cams at their ends, the uppermost of which drive the inlet valves, whilst the bottom pair work the exhaust valves. As in the Bide and Farcot gear, so in the present arrangement, a trip gear is introduced which works precisely the same way. The Buss governor is fixed at the side of the cylinder, and works by suitable link combination the disengagement gear. The rapid shut-off of the inlet valves is effected by a spiral spring, which simultaneously acts as a cushion. The external valve gear is enclosed in a casing which protects it from dust and dirt, and also forms an oil receptacle.

Messrs. Buffaud Frères, however, also adapt the Rider valve gear to their engines. The same general arrangement is retained, so that we need only refer to the valve gear mechanism. In the Rider valve gear, which is an improvement on the well-known Meyer arrangement, the two slides are worked by two separate excentrics. The distributing slide has its back hollowed out in a cylindrical form, having its centre in the axis of the expansion

BELL'S PHOTOPHONE.

FIG. 1



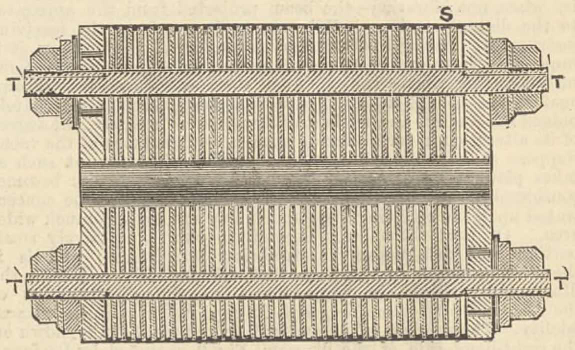


FIG. 3

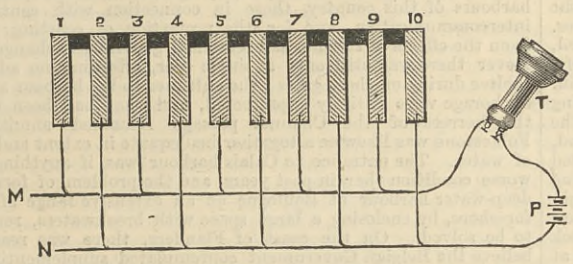


FIG. 4. DIAGRAM SHOWING THE ACTION OF THE SELENIUM RECEIVER

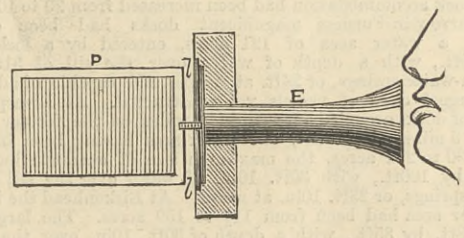


FIG. 7. SLOTTED TRANSMITTER

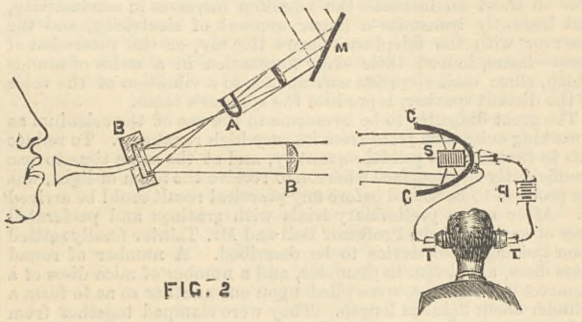


FIG. 2

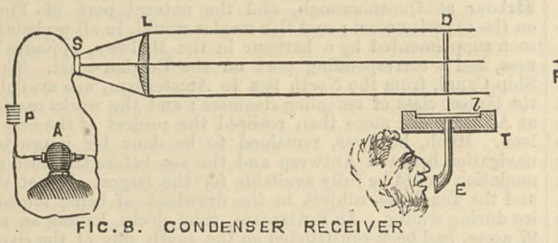


FIG. 8. CONDENSER RECEIVER

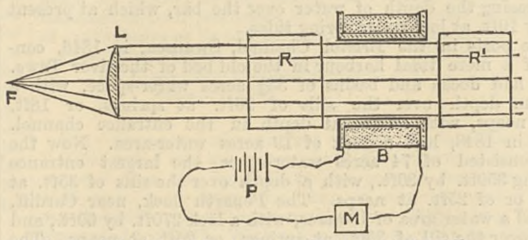


FIG. 9 POLARIZED LIGHT TRANSMITTER

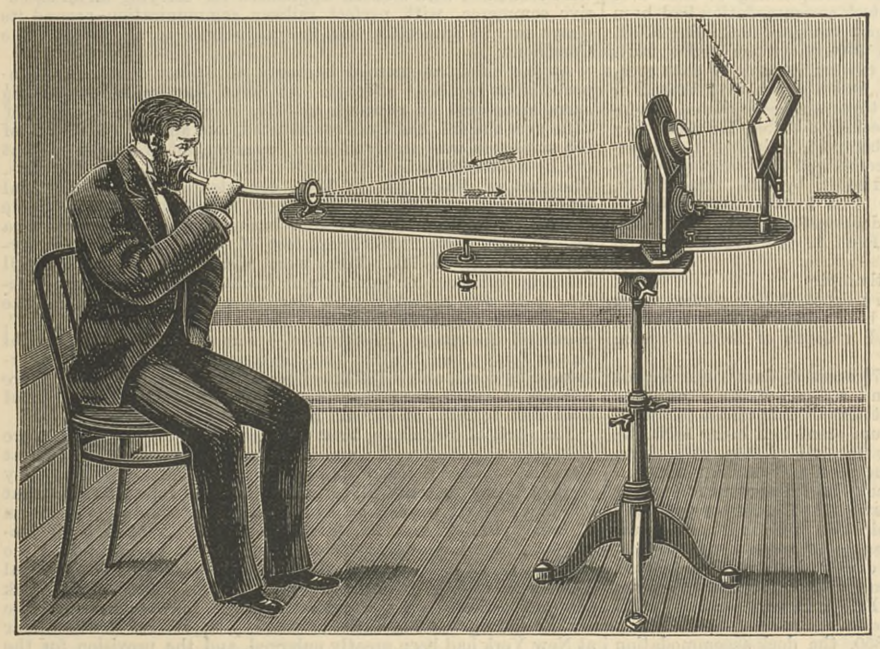


FIG. 5

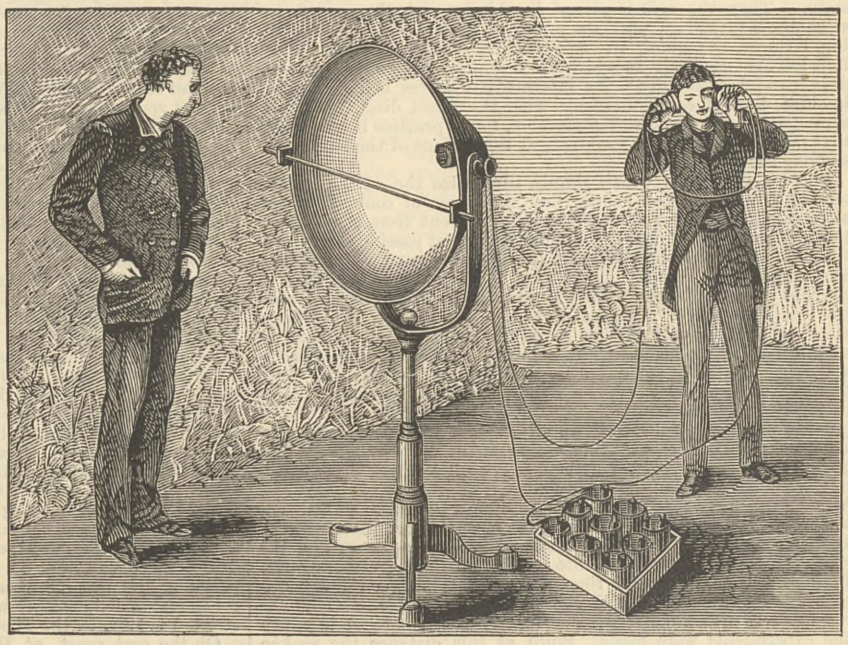


FIG 6

valve; the expansion valve, also equally cylindrical, applies itself over the distributing slide, and in addition to its longitudinal motion, the governor can transmit a rotary motion to the same. The steam passages of the main valve have an inclined position, converging towards one side, and the expansion valve corresponding thereto, the rotation of the latter will determine a larger or smaller steam passage area at the admission periods, according to the extent of the rotations of the expansion valve.

BELL'S PHOTOPHONE.

DURING a recent visit to Paris, Professor Graham Bell favoured *La Nature* with an extended account of the investigations and discoveries which led to and resulted from his late remarkable invention, the photophone. He also supplied our scientific contemporary with certain details not previously made public, together with drawings of his apparatus and experiments, the engravings of which we here reproduce, with a translation of the account given by *La Nature*.

Our readers are already aware that the object of the photophone is the transmission of sounds both musical and vocal to a distance by the agency of a beam of light of varying intensity; and that the first successful attempts made Professor Bell and his co-labourer, Mr. Sumner Tainter, were based upon the known property of the element selenium, the electric resistance of which varies with the degree of illumination to which it is exposed. Hence, given a transmitting instrument, such as a flexible mirror, by which the vibrations of a sound could throw into vibration a beam of light, a receiver, consisting of sensitive selenium, forming part of an electric circuit with a battery and a telephone, should suffice to translate the varying intensities of light into corresponding varying intensities of electric current, and finally into vibrations of the telephone disc audible once more as sound. This fundamental conception dates from 1878, when in lecturing before the Royal Institution, Professor Bell announced the possibility of hearing a shadow fall upon a piece of selenium included in a telephone circuit. The photophone, however, outgrew the particular electrical combination that suggested it; for not the least of the remarkable points in this research is the discovery that audible vibrations are set up in thin discs of almost every kind of material by merely throwing upon them an intermittent light. With the photophone as with the telephone, there are instruments of different degrees of perfection. The original telephone of Philip Reis could only transmit musical tones, because it worked by rapid abrupt interruptions of the electric current; while the articulating telephone of Graham Bell was able to transmit speech, since by its essential construction it was able to send undulating currents to the distant receiving station.

We may in like manner classify the forms of photophone under two heads, as (1) articulating photophones, and (2) musical photophones.

Up to the present time, Professor Bell informs us, the simple receiving disc of ebonite or hard rubber has only served for a musical photophone; the reproduction of the tones of the voice by its means has not yet been demonstrated in practice—at least to its satisfaction. For while it produced unmistakable musical tones by the direct action of an intermittent light, in the experiments made hitherto with articulate speech the instruments have by necessity been so near to one another that the voice of the speaker was audible through the air. Under these circumstances it is extremely difficult to say whether the sounds that are heard proceed from the diaphragm, or whether they merely come through the air to the ear; and if they come from the diaphragm, whether they are really the result of the varying light, and not mere sound vibrations taken up by the disc from the speaker's voice crossing the air. Professor Bell hopes soon to settle this point, however, by appeal to experiment on a larger scale with the receiving and transmitting instruments at greater distances apart, and with glass windows in between to shut off all sounds.

In Fig. 1 we illustrate the simple musical photophone of Bell and Tainter. It might perhaps be described without injustice as an optical siren, producing sounds from intermittent beams of light, as the siren of Cagniard de Latour produces them from intermittent puffs of air. A beam of light from the sun or from a powerful artificial source, such as an electric lamp, falls upon a mirror M, and is reflected through a large lens L, which concentrates the rays to a focus. Just at the focus is interposed a disc pierced with holes—forty or so in number—arranged in a circle. This disc can be rotated so that the light is interrupted from one to five or six hundred times per second. The intermittent beam thus produced is received by a lens T, or a pair of lenses upon a common support, whose function is to render the beam once more parallel, or to concentrate it upon the disc of ebonite placed immediately behind, but not quite touching them. From the disc a tube conveys the sounds to the ear. We may remind our readers here that this apparent direct conversion of light into sound takes place, as Professor Bell found, in discs of all kinds of substances — hard rubber, zinc, antimony, selenium, ivory, parchment, wood — and that he has lately found that discs of carbon and of thin glass, which he formerly thought exceptions to this property, do also behave in the same way. We may, perhaps, remark without impropriety that it is extremely improbable that the apparent conversion of light into sound is by any means a direct process. It is well known that luminiferous rays, when absorbed at the surface of a medium, warm that surface slightly, and must therefore produce physical and molecular actions in its structure. If it can be shown that this warming effect and an intermediate cooling by conduction can go on with such excessive rapidity that beams of light falling on the surface at intervals less than the hundredth of a second apart produce a discontinuous molecular action of alternate expansion and contraction, then the mysterious property of matter revealed by these experiments is accounted for.

However this may be, the musical photophone, as represented in Fig. 1, produces very distinct sounds, of whose existence and dependence for their production on the light the listener may satisfy himself by cutting off the light at any moment with the little opaque disc fixed on the end of the little lever just in front of the holes in disc R, and which can be worked by a Morse key like a telegraph instrument, thus producing at will alternate sounds and silences. With this musical telephone sounds have been carried by an interrupted beam of light for a distance exceeding a mile; there appears, indeed, no reason why a much greater range might not be attained.

The articulating photophone is that to which hitherto public attention has been most largely directed, and in which a selenium receiver plays a part. Fig. 2 gives in diagram form the essential parts of this arrangement. A mirror M reflects a beam of light as before through a lens, and—if desired for the purpose of experimentally cutting off the heat rays—through a cell A containing alum water, and casts it upon the transmitter B. This transmitter, shown again in Fig. 5, consists of a little disc of thin glass, silvered on the front, of about the size of the disc of an ordinary telephone, and mounted in a frame, with a flexible india-rubber tube about 16in. long leading to a mouthpiece. A second lens R interposed in the beam of light after reflection at the little mirror renders the rays approximately parallel. The general view of the transmitting apparatus given in Fig. 5 enables the relative sizes and positions of the various parts—minus the alum cell, which is omitted—to be seen. The screw adjustments of the support serve to direct the beam of light in the desired direction.

It may be well to explain once for all how the vibrations of the voice can affect the intensity of the reflected beam far away. The lenses are so adjusted that when the disc B, is flat—that is, when not vibrating—the beam projected from the apparatus to the distant station shall be nearly focussed on the receiving instrument. Owing to the optical difficulties of the problem it is impossible that the focussing can be more than approximate. Now, matters being thus arranged, when the speaker's voice is thrown against the disc B it is set into vibration, becomes alternately bulged out and in, and made slightly convex or concave, the degree of its alteration in form varying with every vibration of the voice. Suppose at any instant—say by a sudden displacement such as takes place when the letter "T" is sounded—the disc becomes considerably convex, the beam of light will no longer be concentrated upon the receiving instrument, but will cover a much wider area. Of the whole beam, therefore, only a relatively small portion will fall upon the receiving instrument; and is is therefore possible to conceive that, if perfectly adjusted, the illumination should be proportional to the displacement of the disc, and vary, therefore, with every vibration with the utmost fidelity. The receiver of the articulating photophone is shown on the right-hand side of the diagram, Fig. 2, sketched by Professor Bell. A mirror of parabolic curve, C C, serves to concentrate the beam, and to reflect it down upon the selenium cell S, which is included in the circuit of a battery P, along with a pair of telephones, T and T. Here again a general view, like that given in Fig. 6, facilitates the comprehension of the principal parts of the apparatus. The sensitive silenium cell is seen in the hollow of the parabolic mirror, which is mounted so as to be turned in any desired direction. The battery standing upon the ground furnishes a current which flows through the selenium cell and through the telephones. When a ray of light falls on the selenium—be it for ever so short an instant—the selenium increases in conductivity, and instantly transmits a larger amount of electricity, and the observer with the telephones hears the ray, or the succession of them—hears, indeed, their every fluctuation in a series of sounds which, since each vibration corresponds to a vibration of the voice of the distant speaker, reproduce the speaker's tones.

The great difficulty to be overcome in the use of the selenium as a working substance arose from its very high resistance. To reduce this to the smallest possible quantity, and at the same time to use a sufficiently large surface whereon to receive the beam of light, was the problem to be solved before any practical result could be arrived at. After many preliminary trials with gratings and perforated discs of various kinds, Professor Bell and Mr. Tainter finally settled upon the ingenious device to be described. A number of round brass discs, about 2in. in diameter, and a number of mica discs of a diameter slightly less, were piled upon one another so as to form a cylinder about $2\frac{1}{2}$in. in length. They were clamped together from end to end, the clamping rods also serving to unite the discs of brass electrically in two sets, alternate discs being joined, the 1st, 3rd, 5th, &c., being united together, and the 2nd, 4th, 6th, &c., being united in another series. This done, the edges between the brass discs were next filled with selenium, which was rubbed in at a temperature sufficiently high to reach the melting point of selenium. After this the selenium was carefully annealed to bring it into the sensitive crystalline state. Then the cell is placed in a lathe and the superfluous selenium is turned off until the edges of the brass discs are bared. Fig. 3 shows, in section, the construction of such a shell. Prof. Bell has also used cells in which the selenium filled only the alternate spaces between discs, the intermediate spaces being occupied by mica discs of equal diameter with the brass discs. But this arrangement was in no way preferable, for in practice it was found that moisture was apt to penetrate at the surface of the bare mica, spoiling the effect.

Fig. 4 is a diagram which simply illustrates the action of the selenium receiver, and shows, first, the way of connecting the alternate discs; and, secondly, that the current from the battery P cannot go round the telephone circuit without passing somewhere through selenium from one brass disc to the next. The special advantages of the "cell" devised by Professor Bell are, that in the first place the thickness of the selenium that the current must traverse is nowhere very great; that in the second, this photo-electrical action of light on selenium being almost entirely a surface action, the arrangement by which all the selenium used is a thin surface film could hardly be improved upon; and that, thirdly, the symmetry of the cylindrical cells specially adapts it for use in the barabolic mirror. These details will be of great interest, especially to those who desire to repeat for themselves the experimental transmission of sound by light. The greatest distance to which articulate speech has yet been transmitted by the selenium-cell photophone is 213 meters, or 233 yards. When sunlight is not available recourse must be had to an artificial source of sufficient power. During the recent experiments made by Professor Bell, in Paris, the weather has been adverse, and the electric light has been called into requisition in the *ateliers* of M. Bregnet. The distance in these experiments between the transmitting diaphragm B, and the parabolic reflecter C C of the receiver was fifteen meters, the entire length of the room in which the experiments were made. Since at this distance the spoken words were themselves perfectly audible across the air, the telephones connected with the selenium cell were placed in another apartment, where voices were heard without difficulty and without doubt as to the means of transmission. The transmitter shown in Fig. 7 consists of a fixed plate P, provided with numerous slots and of a like movable plate attached to the diaphragm *l l*, mounted in a frame provided with a mouthpiece E. The vibration of the movable plate varies the intensity of the light passing through it. In Fig. 8 the transmitter is shown as used in combination with a collecting lens L, in place of the parabolic reflector. In Fig. 9 a transmitter is shown which is based upon the effect of electricity on polarised light. A lens L throws the beam of a light F, upon a Nicol polarising prism R, and the polarised beams traverse an analyser R'. A helix B is placed between the two prisms and in the circuit of an ordinary microphone M. By speaking, the intensity of the current traversing the helix is varied, and this causes the plane of polarisation of the rays to be turned more or less, and consequently more or less rays are extinguished by the analyser R. Of the earlier and less perfect forms of the photophone little need be said. One device, which in Professor Bell's hands worked very successfully over a distance of eighty-six yards, consisted in letting the beam of light pass through a double grating of parallel slits lying close to one another, one of which was fixed, the other movable and attached to a vibrating diaphragm. When these were placed exactly one in front of the other the light could traverse the apparatus, but as the movable grating slid more or less in front of the fixed one, more or less of the light was cut off. Speaking to the diaphragm, therefore, caused vibrations which shut or opened, as it were, a door for the beam of light, and altered its intensity. The mirror transmitter of thin glass silvered was, however, found superior to all others; and it is hard to see how it could be improved upon, unless, possibly, by the use of a thin disc of silver, itself accurately surfaced and polished.

Whatever be the future before the photophone, it assuredly deserves to rank in estimation beside the now familiar names of the telephone and the phonograph.

THE INSTITUTION OF CIVIL ENGINEERS.

PRESIDENT'S ADDRESS.

AT the ordinary meeting on Tuesday, the 11th of January, Mr. Abernethy, F.R.S.E., delivered an inaugural address as President. He referred, in the first place, to the progress made within recent years in the character and extent of our mercantile marine, and the consequent increased development of inter-communication between this country and all parts of the globe. The great impetus given to commercial enterprise by the construction of railways tended inevitably to the extension of ocean navigation; but there were other causes to which that result might be attributed, such as the practical introduction of the screw-propeller in place of paddle-wheels in 1836, the successful crossing of the Atlantic by steam vessels in 1838, and the opening of the Suez Canal in 1869. The Suez Canal had not led to any increase in the size of vessels, because their dimensions were necessarily limited by its width and depth; but there had been an extraordinary development in the number of steam as compared with sailing vessels, as was evinced by the Board of Trade returns; and in all probability the number of sailing vessels would continue proportionally to diminish, owing to improvements in the marine engine, and to economy in the consumption of fuel. Consequent upon the increase in the number and size of steam vessels, it had become necessary to enlarge and materially to improve the accommodation afforded by the various harbours throughout the kingdom. Selecting a few prominent examples, the President contrasted their condition in 1848-50, when he visited them under instructions from the Admiralty, with their present state. Commencing on the west coast, he said that only vessels drawing 17ft. could navigate the Clyde at the former period, whereas now vessels drawing 22ft. left Glasgow three hours before high water and reached the sea in one tide. In the interval 23,000,000 cubic yards had been dredged from the bed of the river, and the Clyde was one of the best instances of successful river improvement, by the enlargement and regulation of its channel. The quays at Glasgow had been increased from $1\frac{5}{8}$ mile to 3 miles, and a tidal dock had been constructed at Stobcross having $32\frac{1}{2}$ acres water-space, with a depth at low water of 20ft. At Greenock the tidal dock accommodation had been increased from 20 to 100 acres. At Barrow-in-Furness magnificent docks had been created, having a water area of 121 acres, entered by a lock 700ft. by 100ft., with a depth of water over the sill of 31ft. 6in. at high-water springs, or 24ft. at neaps, and capable of admitting the largest class of vessels yet constructed. At Liverpool the range of docks occupied a length of 3 miles at the former period, and of 6 miles at present, the water-area having been increased from 130 to 274 acres, the maximum size of entrance lock being 498ft. by 100ft., with 30ft. 10in. of water over the sill at high-water springs, or 23ft. 10in. at neaps. At Birkenhead the increase of water area had been from $11\frac{1}{2}$ to 159 acres. The largest lock was 398ft. by 85ft., with a depth of 30ft. 10in. over the sills at high-water springs, or 23ft. 10in. at neaps. The navigation through the entrance sea channels of the river Mersey had not been improved to a corresponding extent. Much remained to be done for increasing the depth of water over the bar, which at present was only 10ft. at low-water spring tides.

Of the ports in the Bristol Channel, Swansea, in 1848, consisted of a mere tidal harbour in the old bed of the river Tawe. Now it had docks and basins of $33\frac{1}{4}$ acres water-space, with a maximum depth over the sills of 26ft. at springs, or 18ft. 6in. at neaps, with an equal depth in the entrance channel. Cardiff, in 1848, had a dock of 19 acres water-area. Now the docks consisted of 74 acres water-space, the largest entrance lock being 350ft. by 80ft., with a depth over the sills of 35ft. at springs, or of 25ft. at neaps. The Penarth dock, near Cardiff, contained a water area of 18 acres, with a lock 270ft. by 60ft., and a depth over the sill of 35ft. at springs, or 25ft. at neaps. The various entrance channels leading to the docks had been improved and deepened by dredging to a depth corresponding to that over the deepest sills. At Newport the dock accommodation had been increased from 4 to 40 acres, the largest entrance lock being 350ft. by 65ft., with a depth over the sill of 35ft. at springs, and of 25ft. at neaps. At Bristol, in 1849, there existed 68 acres of dock area, with an entrance lock 200ft. by 63ft., and a depth over the sill of 32ft. at springs, and 23ft. at neaps; these were exceptional dimensions at that period, having been specially adapted for admitting the "Great Western" steamer. This port, including the Avonmouth and Portishead docks, now comprised 104 acres of water-space, with locks 454ft. by 70ft., and 444ft. by 66ft., respectively, and 39ft. of water over their sills. The tortuous navigation to Bristol had been avoided by the deep-water entrances leading direct from the anchorage of King Road to the Avonmouth and Portishead docks.

The great packet station of Southampton in 1848 had a tidal harbour of 16 acres water space, with a depth of 18ft. at low water spring tides. Since then a dock had been added of 10 acres area, with an entrance 60ft. in width, and a depth of 28ft. at spring tides, or of 24ft. 6in. at neaps.

In 1848 the port of London had $197\frac{1}{2}$ acres of docks, the largest entrance lock being 191ft. by 45ft., and a depth of 24·7ft. of water over its sill at springs, or of 20·7ft. at neaps. At present the docks had an area of 491 acres, the maximum sized lock being 550ft. by 80ft., with a depth of water over the sill of 30ft. at springs, or of 25ft. at neaps. Many of the shoals had been removed from the bed of the river Thames, and improvements to a limited extent were being carried out by the Conservancy Board; but it was extraordinary that while minor navigable rivers had been deepened so as to admit of the passage of large vessels at low water, there was only an available depth of about 15ft. at that period of the tide between Gravesend and Woolwich, and for a considerable distance below London Bridge it was practically restricted to 12ft. by the Thames Tunnel.

On the east coast, at Hull, in 1850, the dock accommodation amounted to $38\frac{3}{4}$ acres area, the widest entrance being 50ft., with a depth over the sill of 26ft. 2in. at springs, or of 20ft. 2in. at neaps. Now the docks occupied an area of $81\frac{1}{4}$ acres, the largest lock being 320ft. by 80ft., with 28ft. 3in. over its sill at spring tides, or 22ft. 3in. at neaps. Considerable improvements were contemplated for dredging the channel leading from a new dock entrance to the deep low-water anchorage of Hull Road. Favoured by its geographical position, and situated on one of the finest navigable rivers in the kingdom, Hull was now the third port in relation to the value of its exports and imports. The entrances to the eastern and western systems of docks at Hartlepool in 1848 were unprotected from easterly seas. Now they were sheltered by a breakwater 400 yards in length; the total area of the docks was 79 acres, the widest entrance being 60ft., with a depth over the sill of 26ft. at springs, or of 23ft. at neaps. At Sunderland the dock space had been increased from 6 to $55\frac{1}{4}$ acres, with an entrance lock 475ft. by 60ft., having a depth over the sill of 29ft. 6in. at springs, or of 26ft. at neaps, the entrance channel having been dredged to the same depth. Like the Clyde, the Tyne was a remarkable instance of the successful treatment of a navigable river. In 1850 extensive shoals existed which impeded the navigation. The depth of water over the bar was 21ft. at springs, or 6ft. at neaps, with varying depths up to Newcastle bridge, immediately below which the depth was from 12ft. to 17ft. at springs, or 12ft. to 7ft. at neaps. All these shoals had been removed, the indents which formerly existed on the shores had been filled up, and a nearly continuous line had been formed along each bank, while upwards of 62,000,000 tons had been dredged from the channel. The present depth over the bar was 35ft. at springs, or 30ft. at neaps, and up to old Newcastle bridge there was a depth of 20ft. at low-water. The improvement of the Tyne, as of other navigable rivers in Great Britain, was due to the enlargement of its channel, which was treated as a tidal reservoir, and thus was created a current sufficiently powerful to sweep away the bar that originally existed when its tidal capacity was less, and the force of the outgoing current was proportionally weak. At Leith, since 1850, the docks had been enlarged from $10\frac{1}{4}$ to 53 acres, the largest entrance lock being 350ft. by 60ft., with a depth of 25ft. over the sill at springs, or of 21ft. 3in. at neaps. The sea-channels and protective works outside had been proportionately improved. Dundee, in 1847, had but $11\frac{3}{4}$ acres of dock completed or in course of construction. It now possessed $39\frac{3}{4}$ acres, the largest lock being 300ft. by 60ft., with a depth over its sill of 25ft. at springs, or of 21ft. at neaps. Aberdeen had no docks until 1848, when the whole of the tidal harbour in front of the town was converted into a dock of 37 acres, having a lock of 250ft. by 60ft., with a depth over the sill of 22ft. at high-water springs. The river Dee had since been diverted into a new channel, to provide for future extension, and to give a more direct and increased force to the outgoing tidal current, by which the bar had been virtually removed. About 1848 there was little or no provision on the east coast of Scotland for fishing boats, and a great loss of life and property constantly occurred. Various northern ports had been greatly improved, and the two principal stations, Peterhead and Fraserburgh, formerly dry at low water, had been considerably enlarged, at great cost, by the construction of extensive breakwaters, and deepened to admit boats at all periods of the tide. During 1879 these harbours afforded shelter to 1400 boats. The growing importance of the fisheries on the east coast of Scotland might be gathered from the fact that, in 1879, there were engaged in this trade 4110 boats, employing upwards of 24,000 men.

The harbours of Ireland had of late years been much improved. At Belfast, in 1850, no floating dock accommodation existed. There were now $31\frac{1}{2}$ acres of docks and tidal basins, exclusive of timber ponds. The available depth of water throughout the channel was 22ft. 6in. at springs, and 21ft. 6in. at neaps. At Dublin, by the construction of deep-water quays and dredging in the river Liffey, the facilities were such as to enable the channel steamers to sail at fixed hours, irrespective of the tide, and to accommodate the largest class of vessels. The depth over the bar, which in 1849 was only 12ft. at low-water, was now 16ft., giving a depth of 28ft. at high-water springs, or of 25ft. at neaps. The total length of quayage was 32,000 lineal feet. While improvements had rapidly progressed in the commercial harbours of this country, those in connection with continental intercommunication, and for the protection of coasting vessels from the effects of storms, had remained generally unchanged. At Dover there was still only a single pier, affording no adequate shelter during on-shore gales; the entrance to the harbour and the anchorage were entirely unprotected, and what had been termed the horrors of the Channel passage remained unmitigated. Folkestone was likewise altogether inadequate in extent and depth of water. The entrance to Calais harbour was, if anything, in a worse condition than in past years, and the problem of forming a deep-water harbour at Boulogne on an extensive range of sandy foreshore, by enclosing a large space with breakwaters, remained to be solved. On the coast of Flanders, there was reason to believe the Belgian Government contemplated supplementing the harbour at Ostend by one capable of affording shelter at all periods of the tide. Although efficient harbours were wanted for the short Channel service, nevertheless, communication with the continent, particularly with Germany, was carried out by the deep-water harbour at Queenborough, and the natural port of Flushing, on the opposite coast; and this service would, in all probability, be soon supplemented by a harbour in the Medway, opposite Sheerness, and a corresponding port on the Belgian coast. The New Ship Canal, from the North Sea to Amsterdam, was available for the largest class of sea-going steamers; and the works carried out at Antwerp had more than realised the project of the first Napoleon. Much, however, remained to be done for improving the navigation between Antwerp and the sea before the dock accommodation would be fully available for the largest class of vessels, and the Texel was subject to the drawback of being impeded by ice during winter. At Rotterdam, tidal docks, having an area of 97 acres, had been constructed on the south side of the river, and were furnished with modern appliances for carrying on an extensive commerce, with perfect railway communication around its quays, and in connection with the main lines to all parts of the Continent.

At the chief commercial harbours of France considerable improvements had been effected. At Saint Nazaire, a dock of $25\frac{1}{2}$ acres area, with an entrance of 82ft. in width, and a depth of 24ft. over the sill, had been constructed, and an additional dock of $55\frac{1}{2}$ acres area was nearly finished, opening out from the present one by a lock 426ft. by 82ft., with a depth of 24ft. over the sills. The port of Marseilles, in 1848, consisted simply of the tidal basin termed the Vieux Port. Now, under the shelter of the great breakwater, there were four basins in addition, of an area of $376\frac{1}{2}$ acres, with 22,960 lineal feet of quays, and a depth varying from 23ft. to 33ft. There were also graving docks and all modern appliances for loading and discharging cargoes in connection with the railways, and Marseilles had become one of the principal harbours in Europe. The port of Havre, about 1847, consisted of entrance harbours of 4 acres area, with 2,132 lineal feet of quays, and of three basins entered by gates having a water-area of $5\frac{1}{4}$ acres, and 9,185 lineal feet of quay. At present there were eight basins, having an area of $21\frac{1}{2}$ acres, with a depth of from 23ft. to 26ft., and 29,421 lineal feet of quays.

The ports of Barcelona, Trieste, Odessa, and St. Petersburg were then severally dealt with; and the great improvements effected at the embouchures of the Danube and of the Mississippi rivers, by works tending to concentrate and direct the force of their great volumes of fresh water for the removal of obstructions in the form of bars and sandbanks, were mentioned. The breakwaters in progress at Table Bay and at Colombo were next noticed; then the harbour works at Kurrachee, Bombay, and Madras; and the tidal harbour now being made at Quebec. In the United States, dock accommodation was in general not required, in consequence of the sheltered deep-water facilities afforded by the rivers. The harbour at New York had been greatly enlarged, and the provision for the shipment of grain by floating elevators was of an extensive character. The facilities for shipping at Boston, Philadelphia, and Baltimore were described.

Great as had been the advantages of the Suez Canal, and the increased facilities it afforded for intercourse with the East, they would in all probability be exceeded by the construction of a ship canal to connect the Pacific and Atlantic Oceans. For many years numerous routes had been more or less examined; but eventually the question had been reduced to two projects, termed the Nicaraguan and the Panama schemes. The first of these had long been favourably entertained by eminent engineers in the United States; but although presenting no extraordinary engineering difficulties, yet the salient objections were its length of 120 miles, the number of locks required, and more particularly the defective condition of the harbour of Greytown on the Atlantic Ocean, and of that of Brito on the Pacific. The project determined upon by Count de Lesseps was the Panama route, near the existing line of railway. The experience gained during the construction of the Suez Canal would not be applicable in forming the Panama Canal. The Suez Canal was carried across a nearly level desert, with a very limited rainfall, free from rivers on its route, and it connected comparatively tideless seas; while in the Isthmus of Panama there existed an extensive rainfall discharging into the Chagres river and its tributaries. At the ocean level the canal must be considerably below the river, and therefore provision was necessary for receiving the drainage of a large tract of country. Another difficulty was that the range of tide in the Atlantic was only from $7\frac{1}{2}$in. to 19in., whereas at the roadstead of Panama the range was from 8ft. to $21\frac{1}{4}$ft.; consequently without locks there would be a considerable tidal current in the latter direction. These somewhat formidable obstacles had been considered, and were proposed to be met by the construction of reservoirs of sufficient capacity to collect the greatest floods, and channels on each side of the canal to convey the waters to sea, and of a lock at Panama with three independent chambers. In conclusion, the president alluded to the floods which of late years had inundated the low-lying lands of the midland and Fen districts of this country. Confining his remarks to the chronic cases of the rivers Ouse, Witham, Nene, and Welland, he said there were obvious causes for these inundations. The remedial measures required were the improvement of the outlets, the enlargement of the river beds, the formation of subsidiary flood channels, the removal of obstructions, and the construction of reservoirs to impound the flood waters, which might be used for irrigation purposes during seasons of drought.

It was announced that the Council had recently transferred C.

S. Allott, E. K. Berstal, J. M. Dobson, F. Garrett, A. J. Hamilton-Smythe, B.A., T. Hewson, and E. E. Sawyer, M.A., to the class of members; and had admitted R. Anderson, F. Bluett, J. J. Bourne, F. W. Bricknell, H. F. Crawford, J. E. Crickmay, H. A. Cutler, R. C. Dyson, L. P. Garrett, J. G. Gërds, S. Henderson, D. W. Herbert, G. B. Jenyns, H. A. Johnson, G. H. Kessler, Z. H. Kingdon, J. H. Kinipple, H. E. Lockhart, F. T. Nicholes, G. T. Ogilvie, J. H. Parkin, S. de Perrot, H. V. M. Phelips, P. J. Pinkney, F. W. Quick, W. Reid, G. M. Taylor, H. J. Thompson, A. M. Tippett, E. W. W. Waite, C. J. Williams, H. Wright, and A. J. Yorston as students. At the monthly ballot E. G. Sheward was elected a member; G. N. Abernethy, Stud. Inst. C.E., D. F. Goddard, J. H. Hanson, G. E. Jarvis, R. A. Mac Brair, A. de Saubergue, Stud. Inst. C.E., E. P. Seaton, G. H. Stephens, Stud. Inst. C.E., and C. F. Wike, Associate Members; and F. E. Banes an Associate.

LETTERS TO THE EDITOR.

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

SWAN'S ELECTRIC LAMPS.

SIR,—The following particulars of a successful application of Swan's electric lamps to the lighting of a country residence will probably be interesting to many of your readers. The case possesses novelty not only in the application of this mode of lighting to domestic use, but also in the derivation of the producing power from a natural source—a neighbouring brook being turned to account for that purpose. The brook in fact lights the house, and there is no consumption of any material in the process.

The generator used is one of Siemens's dynamo-electric machines, and the motor is a turbine which gives off 6-horse power. The distance of the turbine and generator from the house is 1500 yards. The conducting wire is of copper, and its section is that of No. 1 Birmingham wire gauge. A return wire of the same material and section is used, so that the current has to pass through 3000 yards of this wire to complete the circuit. The number of lamps in the house is forty-five, but as I can switch off the current from room to room, I never require to have more than thirty-seven in light at once. For this number of lamps 6-horse power proves to be amply sufficient, notwithstanding the great length of the conducting wire.

The library, which is a room of 33ft. by 20ft., with a large recess on one side, is well lighted by eight lamps. Four of these are clustered in one globe of ground grass suspended from the ceiling in the recess, and the remainder are placed singly and in globes in various parts of the room, upon vases which were previously used as stands for duplex kerosine lamps. These vases being enamels on copper are themselves conductors, and serve for carrying the return current from the incandescent carbon to a metallic base in connection with the main return wire. The entering current is brought by a branch wire to a small insulated mercury cup in the centre of the base, and is carried forward to the lamp by a piece of insulated wire which passes through a hole in the bottom of the vase, and thence, through the interior, to the lamp on the top. The protruding end of this wire is naked, and dips into the mercury cup when the vase is set down. Thus the lamp may be extinguished and re-lighted at pleasure merely by removing the vase from its seat or setting it down again.

The dining-room is also lighted by eight lamps, six of which are grouped together in one glass shade suspended over the centre of the table, and the other two are used singly as bracket lamps, one at each side of the room.

A picture-gallery, which is also used as a drawing-room, is lighted by twelve overhead lamps; but when the eight lamps in the dining-room are no longer wanted the current supplying them is shunted to the gallery for lighting eight additional lamps, making twenty in all. The gallery is agreeably lighted even with the twelve lamps, and with the full illumination the pictures are seen as distinctly as in daylight.

In the passages and stairs the lamps are for the most part used without glass shades, and present a very beautiful star-like appearance, not so bright as to pain the eye in passing, and very efficient for lighting the way.

Each single lamp is about equal to a duplex kerosine lamp well turned up, and this I believe is equivalent to twenty-five candles, so that my 6-horse power in supporting thirty-seven lamps gives me an illuminating effect equal to 925 candles. The same power applied to the production of light by the "electric arc," instead of by incandescence, would give vastly more light, but the arc light being only divisible to a small extent, could not be made nearly so serviceable for the distributed lighting of a house. Besides, the light produced by incandescence is free from all the disagreeable attributes of the arc light. It is perfectly steady and noiseless. It is free from harsh glare and dark shadows. It casts no ghastly hue on the countenance, and shows everything in true colours. Being unattended with combustion, and out of contact with the atmosphere, it differs from all other lights in having no vitiating effect on the air of a room. In short, nothing can be better than this light for domestic use.

I have not yet had sufficient experience of Mr. Swan's lamps to judge of their durability, but with the exception of a few that failed by overheating in my first trials, I have lost none since I began to use them about a month ago. They have not, however, been in constant use during that time, and the test of their duration remains incomplete. But whatever their durability may be at present, it is almost certain to be increased by progressive improvement in manufacture, and when they are systematically made in large numbers the cost of renewing them will probably be small.

The lamps are connected with the main leading wire by branch wires, in what is called "multiple arc," so that if one fails the others are unaffected. To connect them in "series" would have some advantages, but would require a much greater electro-motive force to drive the current through, and this would probably involve some difficulty.

It is important to the preservation of the lamps that the amount of motive power applied should always be proportioned to the number of lamps in light at one time. In my case I escape the necessity of varying the motive power by using a resistance coil to represent the resistance of each section of lamps which it is desirable to have the option of throwing out of use. By means of these coils the number of lamps in light at one time may be greatly varied without affecting the work of the generator, because the resistance to the current is the same, whether it passes through the coils or the lamps. This method is wasteful of power, but I can afford to waste that which costs me nothing, and is always sufficient in quantity. If steam or gas engines were employed the case would be different, and there might be difficulty in effecting such momentary adjustments of power as would save the lamps from disturbance, where the number in use was liable to great and sudden variation.

In the daytime the turbine and generator are occasionally used for the transmission of motive power to a second dynamo machine acting as a motor to drive a sawing machine. This it does with good effect, but I am not prepared to say how much of the original power is realised, or what should be the proportions between the generator and the motor to give the best effect.

Cragside, Rothbury, January 17th. W. G. ARMSTRONG.

CHEAP PATENTS.

SIR,—We see with pleasure that you are opening your columns to discussion upon the reform of the patent law, and we should be glad if you will insert a few remarks in reply to "P. J.," whom we recognise as a well-known patent agent.

All parties must agree that the large surplus carried from the Patent-office to the general Exchequer is an injustice to a highly important portion of the community and a mistake in political economy; but great divergence of opinion exists as to the manner in which the whole patent law is to be re-modelled. "P. J's" recommendation not to obtain what he terms a small advantage unless we can at once succeed in all the needed reforms in the patent laws, reminds us of the man who left a broken slate in his roof, because he hoped some day to replace the whole roof with a new one. We would deprecate the loss of valuable time in the futile endeavour to reconcile divergent views of the question, and suggest that such be set temporarily aside as obstacles to an immediately successful end, and that all should combine in an unanimous endeavour to obtain reform upon the great points where no difference of opinion exists, and give their support to any simple and reasonable proposition such as that of Mr. Standfield, which should promise immediate relief from the present iniquitous tax. There are doubtless many alterations required in our present system, but we think their immediate expediency, in the face of the delay which their discussion would inevitably cause, is questionable to a degree. Our practice convinces us that the period between the provisional and final specifications is of infinite value to the patentee for the perfection of his invention, and is, if anything, too short. Protection being ensured from the date of filing the petition and provisional specification—according to a recent decision of Lord Cairns—much of the hide-and-seek character of the present stage of opposition might be removed by full publicity of the provisional specifications. This again, were it made the rule to refuse patents which the opponent showed to be wanting in novelty, would remove any necessity for official examination. If all publicity were given to the latest applications, it would be the patentee's own fault if he did not make an exhaustive search before application. It is the duty of a conscientious patent agent to acquaint his client with the necessity for a preliminary search, and many patent agents will corroborate us in the statement that a considerable percentage of proposed applications are withdrawn by their advice upon the result of such search. We fail to see where any advantage would accrue to the inventor by official examination and possible refusal. We occasionally find in our practice that meritorious inventions are refused by the United States and German Patent-offices—especially the latter—on exceedingly arbitrary grounds. Even they who like "P. J." advocate official examination, suggest that final option to proceed should remain with the inventor. The official examination would appear, then, to us to be without further practical value than the advice of a properly qualified patent agent.

The foregoing is an instance of the diversity of opinion which reigns even among those who, from their close acquaintance with the working of the present defective patent law, might be supposed to know the best remedies. Let us, however, put aside useless argument, and by unanimous effort effect such reform as is undeniably wanting. We think patentees would benefit quite as much by united action among the patent agents to raise the standard of their profession by the establishment of some standard of competence as by any reform of the law itself.

City Patent Office, FELL AND WILDING.
23, Rood-lane, Fenchurch-street, E.C.,
January 12th.

SIR,—On page 5 of your first number for this year you inquire, "What will I and others say about the oppressed inventors, when we read that the applications for patents for inventions during 1880 were more numerous than in any previous year, having reached 5517. In 1879 the number was 5338, while in 1878 they amounted to 5343? With a few slight fluctuations, there has been a steady increase of business since the passing of the Patent Law Amendment Act in 1852, when a very sudden and extensive upward tendency manifested itself. In 1850 the number of patents granted reaches 523 only; in 1860 the applications were 3196, and in 1870 they had increased to 3405."

From your above quoted remarks we learn that the effect of the Patent Law Amendment Act of 1852 was so beneficial as to cause the applications for patents to increase so that in 1860 they reached the number of 3196, of which number, I may add, 2063 were sealed. But the case is very much stronger than you put it, as this enormous increase took place immediately on the passing of the Act. In 1853 the applications were 3045, of which 2187 were sealed or granted. Comparing this with the 253 granted in 1850, we find the Act caused an increase of 400 per cent. in the first year. Our prosperity was then very greatly augmented by the removal of only a portion of the oppressive and special taxes on invention, because science was allowed somewhat more freely to develop our resources. That Act caused much latent invention to be brought out, and a considerable increase of national wealth rapidly followed. As the Act of 1852 proved so great a benefit to the country by removing a portion of the unwise taxes on the seeds and germs of our trade, why not pursue a similar course now, and remove a further portion of these still crushing taxes, still leaving the stamp duties more than sufficiently high to defray the expenses of the Patent-office?

At the present moment, through not investigating this subject, our legislators are keeping us handicapped 25 to 1 in favour of our chief competitors. I am convinced that our engineer and other inventors would, by the removal of the present obstructive stamp duties, be enabled to bring out many latent inventions, and that great prosperity would rapidly follow, and that several thousands of the lives would be saved which are now annually lost for want of efficient and cheap life-saving appliances. In another paragraph in the same column it is stated that "the low price of coal is not due to decrease in the growth of demand, but to greatly increased means of production;" evidently this fact is the result of patented improvements which have made coal raising cheaper and safer, yet not by any means so cheap and safe as it might be if our inventors were not so greatly handicapped and heavily fined for making improvements. We see that our present stamp duties on patents are one of the greatest obstacles to our national progress, it is therefore our duty to do our utmost to have them removed as soon as possible. JOHN STANDFIELD.

Westminster, January 18th.

[Will Mr. Standfield kindly name the patented inventions now in use in coal mines, which have so much reduced the cost of winning coal? Some of the patents have no doubt expired, but this does not matter if the inventions are still used. To make the statement complete and telling, the approximate pecuniary advantage derived from each invention ought to be given.—ED. E.]

LIGHT TRACTION ENGINES.

SIR,—The letter signed "Draughtsman" in your issue of the 14th inst. is one full of good sense, and treats fully and very ably a subject which, at the present time, is occupying the attention of agricultural engineers in this and other countries. How to make a lighter traction engine?—that is the question. The answer embodied in the letter of your correspondent is full of promise. Some may be found to question his statements, but none, I venture to think, will be able to set them aside. They are practical and unmistakeable facts, as many who are to-day using these engines can testify. Much prejudice, however, exists amongst engineers against traction engines with road gear fitted with pitch chains in the way "Draughtsman" describes; but why is this? It does seem very stupid for makers to force upon their customers heavy and clumsy engines—heavy on the roads, which they cut up and damage, to the annoyance of owners and the highway authorities, heavy on our bridges and culverts, which in any case have given way, causing loss of life and limb; and they are expensive in first cost, repairs, and in fuel.

We must have lighter and smaller engines, but to obtain great hauling power without excessive weight, larger and narrower main driving-wheels are wanted. Boilers can be made smaller by using smaller tubes and more of them, and lighter by making them of steel plates. We can do with 120 lb. pressure, but to use this safely it would be wise to have plates that will bear a little greater tensile-breaking strain than 20 tons per square inch. The arrangement of chains for driving, however, considerably lessens the strains on the boiler as compared with gearing as now used.

I hope, Sir, to see this subject well ventilated, for it is of great importance, and those firms who can produce the lightest, best, and cheapest traction engines will not only secure a good share of the trade of this country, but will stand a chance of supplying the wants of our colonies, and possibly some would find their way to the United States, as they seem to be very backward in this department.

No doubt "Draughtsman" gave particulars of his experience of chain engines made many years ago, and possibly those also made recently, but not embodying all the improvements which his present experience, as I gather from his letter, would suggest; so that many others, as well as the writer, would be glad to see in your valuable columns, and with your permission, an outline drawing by "Draughtsman" of a traction engine arranged on the improved and simplified manner that he has suggested.

January 18th. AGRICULTURALIST.

APPOINTMENT OF CITY ENGINEER IN CORK.

SIR,—In your notice of this matter in last week's issue—influenced, no doubt, by the concluding sentence of the examiner's report—you couple my name as equal with Messrs. Lynam and Moynan. In an official copy of this report, with which I have been furnished by the Town Council, my name stands first, Messrs. Lynam and Moynan—equal—following. I shall feel obliged by your kindly correcting this.

It may be interesting to add, on the authority of a letter of the 22nd ult., accompanying the above copy of the report, that the Local Government Board has sanctioned Mr. McMullan's appointment. JOHN HORAN.

Rosslare Harbour, Wexford, January 17th.

AMERICAN AND FAIRLIE ENGINES.

SIR,—As I am aware that you desire all statements in your columns to be as accurate as possible, I venture to correct a trifling mistake in your article of October 1st, on American and Fairlie engines, as working on the Dunedin and Oamaru Railway, New Zealand. You state in effect that these engines alternately take the express train from Dunedin to Oamaru—seventy-eight miles—and back the same day; total distance 156 miles. This is not the case. The Dunedin engines only run as far north as Palmerston, a distance of 40 miles 43 chains, returning the same day and making a total distance of 81 miles 6 chains instead of 156 miles. A Christchurch engine, always an American, takes on the train from Palmerston to Oamaru—37 miles 40 chains—and back same day; a third engine, also always an American, completing the remaining long run of 152 miles thence to Christchurch.

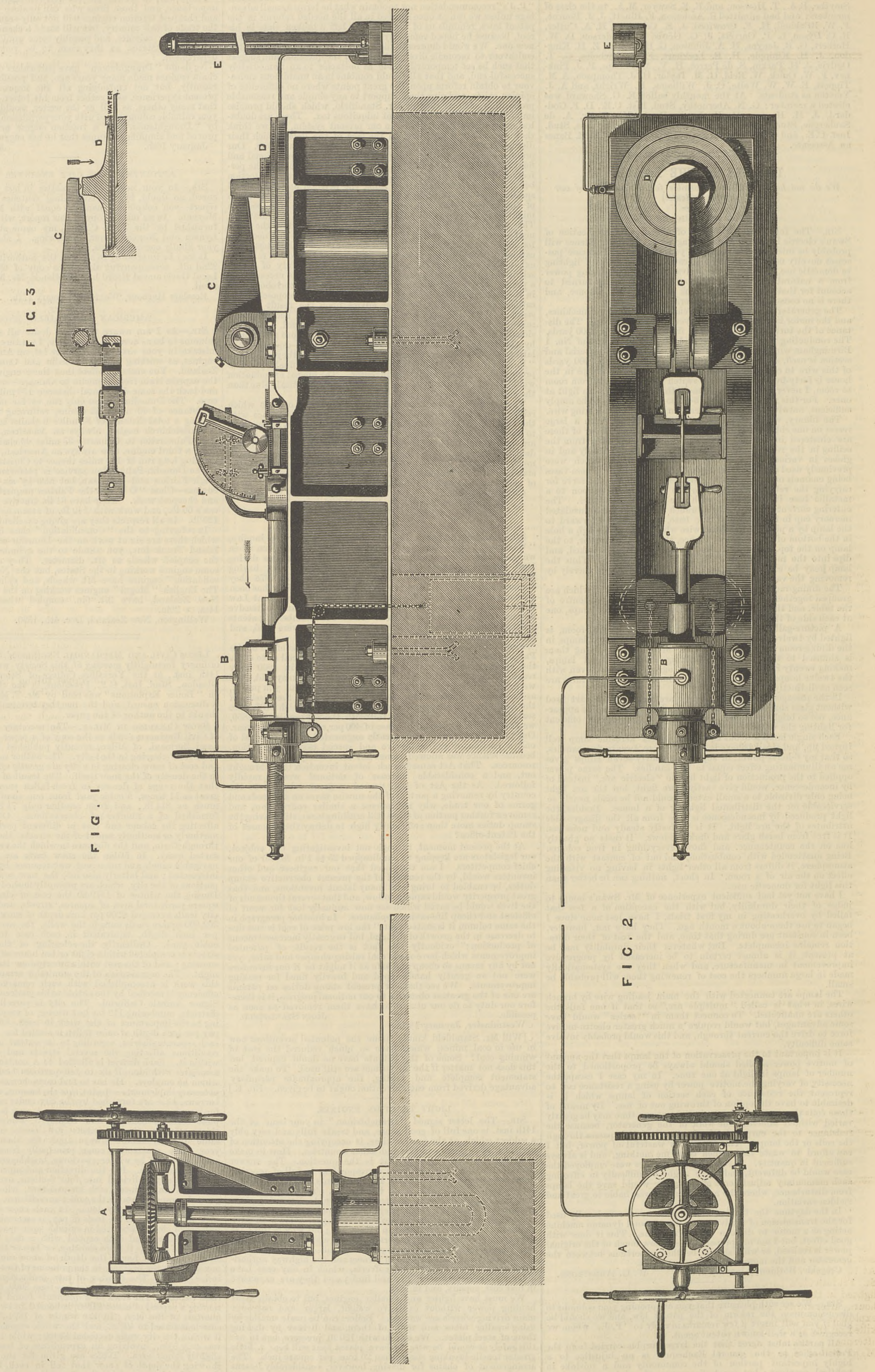
The Dunedin-Palmerston service is performed not only by the single Fairlies and American, but also by six-wheel-coupled tank engines—Class "O"—but the Fairlies unquestionably do the best and cheapest work. They have 64 lb. tractive force to the American's 60 lb., and work with 140 lb. of steam as against the other's 120 lb. In all respects they are giving excellent results.

In referring to the "Consolidation" class of goods engines, of which there are six at work on the Dunedin section of the South Island Trunk line, you allude to the cylinders as 20 × 24, and the coupled wheels as 4ft. diameter. They are so, I know, in some engines working in the States, but the New Zealand "Consolidation" engines have 3ft. wheels, and cylinders 15in. × 18in. The English "Mogul" engines working on the Canterbury Plains, New Zealand, have 3ft. 6in. coupled wheels, and cylinders 14in. × 20in. C. R. M.

Wellington, New Zealand, Dec. 4th, 1880.

LEEDS CIVIL AND MECHANICAL ENGINEERS' SOCIETY.—The first ordinary fortnightly meeting of this Society was held on Friday, 14th inst., at the Yorkshire College of Science, Leeds, Mr. F. Gleadon, Stud. Inst. C.E., President, in the chair, when a paper on "Boiler Explosions" was read by Mr. T. Marsden Demetriadi. A discussion ensued, and the meeting terminated with a vote of thanks to the author of the paper.

SNOW CLEARING IN MILAN.—The secretary of the Institution of Civil Engineers sends us the copy of a paper by Signor E. Bignami Sormani, of Milan, recently published by the institution, upon snow clearing in that city. The author says that the labour and cost of snow clearing in a city are greatly affected by variations in the density of the snow itself. The result of observations shows that the range of density in fresh-fallen snow is found to be as great as 11 times, a cubic yard from one snowstorm weighing as much as 814 lb., and from another only 71 lb.; the records are furnished of a number of observations. Other circumstances affecting the labour and cost in different parts of a city are the northerly or southerly aspect of the streets, the amount of traffic through them, and the distance to which the swept snow has to be carted away. In Milan the snow carts are emptied into the navigable canals and numerous watercourses by which the city is intersected; and latterly also into the new sewers in the central portions of the city, which are promptly flushed whenever it snows. During the winter of 1879-80 the cost of clearing the 1,656,200 square yards total area of squares, streets, and lanes within the city walls averaged £200 per inch depth of snow fallen, and for the 302,800 square yards outside the walls, the average cost was £62 per inch depth, equivalent in each case to about 1·05d. per cubic yard. Ordinarily the clearing of the more-frequented streets is completed within eight or ten hours after it has stopped snowing; and of the rest within twenty-four hours, not reckoning night. The organisation of the admirable arrangements by which this work is accomplished with such remarkable despatch and efficiency is ascribed by the author to his predecessor in its direction, Signor Anibale Gafforini. The city is parcelled out into small districts, numbering 112 for last winter, of varying extent, according to the importance of the work in each. An average rate of pay per inch depth of snow fallen is settled for the whole area of each separate district, according to its extent and the particular conditions affecting the several streets and squares comprised within it. Each district is allotted to a contractor, who usually associates with himself six to ten partners besides the labourers whom he employs. He has to find carts, horses, and carters; the necessary implements—spades, shovels, brooms, scrapers, mattocks, barrows, &c.—are furnished by the city under suitable stipulations for insuring proper care in their use. A copy is given of the complete form of contract now employed, comprising upwards of thirty clauses; the contracts are made annually, and the same persons almost always apply for them again year after year. The contractors come principally from the trades that are interrupted by winter—paviours, bricklayers, and masons, and gravel quarrymen. For the direction and supervision of the work the whole city is divided into four sections, over each of which is appointed an engineer with an assistant, who are aided in the general arrangements by the police surveillance. Payment is made only for work effectually done. In each snow storm the depth of snow fallen, which is the basis of pay, is ascertained by means of a number of stone posts fixed in suitable open spaces clear of shelter from buildings, and each capped with a flat, horizontal slab of stone. As soon as it stops snowing, or two or three times during a storm of several hours, the depth of snow caught on the slabs is measured by the engineer in the presence of two of the contractors in his section. The number of men ordinarily engaged in snow-clearing on a winter's day is not less than 2000, and has sometimes risen to 3000. The stock of implements found by the city, representing a capital of about £1600, is housed in two stores in opposite quarters of the city. In the winter of 1874-75 the total fall of snow amounted to 40¾in., and the whole expenditure for clearing it within the city walls exceeded £8400; while in 1877-78 the fall was only 5¼in., involving an expenditure of less than £1040 for a slightly larger area. Tables are given for the last ten winters, showing the depth of snow that fell in each, the extent of area cleared inside and outside the city walls, and the cost of clearing.



STEEL TESTING MACHINE FOR THE BUREAU VERITAS.

DESIGNED BY MONS. H. THOMASSET, PARIS.

(*For description see page 41.*)

PUBLISHER'S NOTICE.

*** *Next week a Double Number of* THE ENGINEER *will be published containing the Index to the Fiftieth Volume. The Index will include a Complete Classified List of Applications for and Grants of Patents during the past six months. Price of the Double Number,* 1s.

TO CORRESPONDENTS.

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

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

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

F. J. L.—*Percy's "Metallurgy—Iron" will suit your purpose.*
A. W. (Eckenfoerde).—*We have written to you by post.*

GANISTER BRICKS.

(To the Editor of The Engineer.)

SIR,—Can any reader tell me what chemicals are used in the manufacture of best Ganister bricks, as made in Sheffield?
January 19th. A CONSTANT READER OF THE ENGINEER.

PACKING MACHINERY.

(To the Editor of The Engineer.)

SIR,—Can any of your readers give me the names of manufacturers of packing machines for putting up small packets, such as are used in packing cocoa or mustard? Any one knowing of a good second-hand one would oblige by letting me have particulars, but it must be in thorough working order and little worse than new. G. M.
Gateshead, January 18th.

ALLOYS OF ANTIMONY AND ZINC.

(To the Editor of The Engineer.)

SIR,—Will you allow me to repeat a question I was permitted to ask in your paper some four or five months since, to which I unfortunately obtained no reply? In making an alloy of antimony and zinc for thermo-electric batteries, I find it extremely difficult to obtain similar castings from even the same pouring from the crucible; the E. M. F. of the bars vary from about $\frac{1}{18}$ to $\frac{1}{30}$ of a volt. I have tried melting the castings two or three times without any good results. I shall be very glad if some of your correspondents could assist me. J. H. K.
Farnham, January 10th.

MEETINGS NEXT WEEK.

THE INSTITUTION OF CIVIL ENGINEERS.—Tuesday, Jan. 25th, at 8 p.m.: Discussion on "Deep Winning of Coal in South Wales."

SOCIETY OF TELEGRAPH ENGINEERS AND ELECTRICIANS.—Wednesday, Jan. 26th: Inaugural address by the President, Professor G. C. Foster, F.R.S.; after which the following paper will be read:—"Some Experiments on Induction with the Telephone," by A. W. Heaviside, Member.

THE ENGINEER.

JANUARY 21, 1881.

KITCHEN BOILER EXPLOSIONS.

WE have had one week of severe frost, and already three fatal kitchen ooiler explosions have taken place. At Southport a cook has suffered injuries resulting in death. At 10 o'clock on Saturday morning a boiler exploded in St. Frideswide's parsonage house, Oxford. The fire was lighted in the usual way in the morning, and a couple of hours afterwards what is described as a tremendous explosion took place, and the cook, named Pavier, was killed on the spot. The kitchen was wrecked. On Sunday afternoon a similar catastrophe occurred in the house of Major Gillies, Spencer-street, Carlisle. A private soldier, a servant of Major Gillies, who was in the kitchen at the time, was killed instantaneously; his head being dashed against the wall and shattered. We are not rash enough to say that these are the only accidents of the kind that may be looked for before the winter is over. Such explosions are very lamentable in their effects. If anything of the kind takes place in a factory or other establishment where steam-power is used, it is regarded as, in a sense, an inseparable concomitant of the lives led by the operatives; something for the possibility of the occurrence of which they, in a certain sense and to a certain extent, bargain. But an explosion in a private house is a very different thing, and the shock caused to the nerves of possibly delicate women by the tremendous crashing report, the filling of the house with dust, and smoke, and steam, and possibly fire; the ghastly sight which meets the eye of the mistress when at last she makes her way to the kitchen, and sees an unfortunate human being, but a minute before full of health, and now a mangled corpse, blackened, shattered, and blood-stained, cannot fail to be dangerous and fraught with evil consequences. So that the damage is not to be reckoned up in a few words, "Kitchen range wrecked, furniture destroyed, cook killed; estimated cost of repairs £40 5s. 10d." All explosions are to be denounced, avoided, deprecated, prevented; but no explosions are more to be avoided, or looked on with greater horror, even in anticipation, than the bursting of the little vessel at the back of the kitchen fire, holding, perhaps, at the most a cubic foot of water. We have written words of warning before now concerning the management of kitchen boilers. Mr. Fletcher, Mr. Longridge, Mr. Marten, almost, in one word, every boiler inspector in the kingdom has spoken, and written, and suggested, and urged caution, and the fitting of safety valves on house boilers, and so far as can be seen without doing much good. Once more we deal with the subject, not so much in the hope that anything will be gained, or that there will be one explosion the less, as with the intention of freeing ourselves from all responsibility and placing it on the proper shoulders, namely, those of the ignorant, reckless builders, whom it is infinitely to be regretted the law does not seem to be able to touch.

Within the last five or six years it has become the fashion with builders to fit up all the houses they build with a bath-room and hot water service, and this service is very often carried into several rooms. Houses letting for £40 a year in the suburbs, and containing six small rooms and a kitchen, are so fitted now. The walls of these houses are often built without any lime, the bricks being laid in burnt ballast ground in a mortar mill with water to a smooth paste. The joints are afterwards raked and pointed outside with lime mortar, and inside the plaster is supposed to hold the bricks together. Economy is pushed so far that no wall plates are used, the joists resting on the bricks. These houses are, however, very showily finished. Stained glass, wooden mantel-pieces, and some green paint and a little gilding, give them the Queen Anne tone so much to be desired, and they let and sell well. Let any engineer walk into one of these houses while in course of construction and examine the hot water boiler and pipes, and if he be not accustomed to such work he will learn something; if nothing else, then how much may be done with red lead and putty, when the supply is unlimited and the workman competent. When we say that the fittings are fully equal in honesty of purpose and in carrying out to the walls of the showy mansion in which they are found, we have said all that need be said. No precaution whatever is taken against explosion, and explosions do not occur by the score simply because as a rule such houses are left without water the second day of sharp frost, the service pipe from the main being frozen hard. The boiler is burned out in all probability, but there is no explosion. Another automatic safety valve exists in the shape of weak pipes or bad joints, which give way the moment the slightest extra pressure is put on. We warn our readers, however, that in every house, whether a suburban villa or a mansion in Belgravia, fitted with hot water apparatus, unless there is an efficient safety valve on the boiler, the servants go with their lives in their hands during sharp frosts.

It may be as well to explain what takes place. As commonly made, a hot water service is thus arranged. On an upper floor is placed a tank or cistern which will hold from 10 to 200 or 300 gallons, according to the size of the house; 25 gallons is a very usual size in "Jerry" villas. From this run two lengths of wrought iron gas pipe 1in. bore, sometimes less, which enter a small cast iron boiler fixed at the back or side of the kitchen fire. This boiler is usually, but not invariably, provided with a tap by which water may be drawn off for use in the kitchen. A ball cock is fitted on the tank at the top of the house, or at least of the service, by which whatever is drawn off below is replaced above from the principal house tank. The pipes are so arranged that the boiler at the back of the grate may be regarded as an enlargement of the rising branch of the service. When the fire is lighted, the boiler and pipes being full, circulation takes place; the water heated and made lighter, ascending in one line of pipes to the tank above and descending in the other. The tank is always full of heated water, from which a supply may be drawn. While the circulation goes on no accident can take place, because the pipes are open at the top into the tank above, and even if steam was formed in the boiler it would blow the water out of the pipes and escape. Now the tank above, and the pipes leading immediately into it, are often put in a very cold place. We have met with them set just under the slates, in the roof, or in a bath-room, which is really a kind of excrescence on the house and never heated. The kitchen fire is allowed to burn out early in the evening, the water rapidly cools down, and in the course of a few hours plugs of ice form in the hot water pipes, generally high up near the open ends, the boiler remaining full. As soon as the first plug has been formed, all circulation is stopped, and the plugs rapidly increase in length. They are especially likely to form at bends. Next day the fire is lighted and the water is heated; very probably no steam is made, but the pressure of the heated water rapidly augments, and at last bursts the boiler. Then a portion of the heated liquid flashes into steam, expands like gunpowder gas, and spreads death and destruction all round. The way to avoid all this risk, in the simplest way, is to take care that all the hot water pipes are kept inside the house in such a situation that they will not freeze. But to do this properly is more than can be expected from the modern builder. We have heard of a case in which the pipes were carefully kept indoors until a certain point was reached, by taking the pipes out through one wall and in through another. A length of about 2ft. would be outside. If this plan was not adopted a length of about 14ft. additional of pipes would have to be put in. We need not say what course was pursued; and the very first year the house was occupied the water froze in the out-of-door length of pipes, which were fortunately split thereby. The split was detected, and the water drawn off, and no harm was done; and before the boiler was again filled the pipes were re-arranged. Another measure of precaution is to fit under the small tank or cistern a gas jet, which can be kept burning on cold nights, and so prevent the freezing of the water in the tank, and the blocking up of one or both of the circulating pipes at the point where they enter the tank. Another plan is to keep the kitchen fire constantly alight, night and day, during the frost. Another is to empty the whole apparatus, a suggestion which will not commend itself to everyone, because it deprives a household of hot water just when it is most wanted. The only remaining plan to secure immunity from explosion, is to fit the boiler with a safety valve. It must be clearly understood that the valve must be put on the boiler, and not, as is sometimes done, on one of the pipes, where it can be of no possible use.

Various kinds of safety valve have been suggested and applied, some of them good, some bad, some indifferent. It is by no means as easy as may appear at first sight to fit a kitchen boiler with a proper valve. There is no very suitable place for one available. It must not leak, even a drop of water; it is sure to get covered with soot; and cannot very easily be got at to be tested; it may remain untouched for years, and of course be found useless at the last moment. To get over this difficulty it has been proposed to fit kitchen boilers with fusible plugs which shall melt out the moment the pressure becomes too great; but such plugs have often been tried as safety valves for steam boilers, and they have always failed. It is practically impossible to make two plugs so much alike, even if cast out of the same pot, that their fusing points will not vary 10 or 12 degrees, representing a difference of 7 lb. or 8 lb. in the pressure, or if the water be rigidly confined possibly very much more; and such a rise in pressure if permitted would in a great many cases suffice to burst the flimsy boilers only too much used. We suggest a very simple safety arrangement which will not cost more than a few shillings, will never give trouble in any way, and is certain in its action. Into some suitable part of the boiler let a nipple be screwed, and on to this nipple is in turn to be screwed a length of about 3in. of thin copper tubing 1in. in diameter, brazed into a tapped brass ring to take the nipple at one end, and stopped by a thin disc, brazed on, at the other end. If the pressure rises too high the tube will burst and relieve it with no more harmful consequences than the escape of a little water and the putting out of the fire. We need hardly say that it is quite possible to make such tubes by the hundred, the bursting strength of which will be the same for all within a pound or two. Similar devices will suggest themselves to our readers. Another, for example, consists in the use of a short length of thin brass tubing on the top of which rests a disc directly supporting a weight. The disc is soldered to the top of the brass tube, and all the solder is turned away so as to be a mere filament. The disc is kept down by the weight. As soon as the pressure gets too high the weight is overcome, the feeble resistance of the solder is as nothing, and the water escapes. The solder is used only to make the joint water-tight. Again, a thin disc of metal may be employed, which will burst when the pressure becomes too high. There is a good opening for any inventor who will work out some of these ideas into a form which will commend itself to the builder and the householder. To please the first it must be very cheap, to please the last it must be very simple and give no trouble, and this end can be best fulfilled, perhaps, by so contriving the valve that, like a percussion cap, it will end its existence in the performance of its duty.

THE EXPLOSION OF HEATED WATER.

WHEN writing about the Maidstone boiler explosion we stated that we should consider at a future time the causes of the violence of that explosion, and we now proceed to redeem that promise. Nothing has perhaps supplied more food for speculation than the terrible energy with which a boiler is rent into pieces, buildings thrown down, and men beaten out of the semblance of humanity by the shower of missiles driven in all directions. That a boiler should be rent or broken when the pressure within exceeded some known amount is just what would be anticipated; but that the rending or breaking should be performed with great violence is a thing which could not be predicated, and which still perplexes many persons. Dozens of theories have been put forward to explain the facts; some of them near the truth, some far removed from it; none quite conclusive or satisfactory. As, however, our knowledge of molecular physics extends, it becomes daily more clear that there is no necessity for theorising about boiler explosions, and that given certain circumstances, an explosion must take place, the violence of which will depend solely on certain very simple conditions which can be explained in a very few words. If our readers will follow carefully what we are about to say, we venture to think that they will have no further difficulty in understanding why a boiler explosion should resemble a gunpowder or dynamite explosion more or less closely.

We showed in our last impression in an article on "Hot Ice" that pressure plays a most important part in maintaining matter in given states. The same truth is put forward in all text-books of natural philosophy; but the formation of hot ice supplies the most elegant and the most forcible illustration of a great truth that we can bring forward, and therefore we cite it here. So powerful is the action of heat in causing the separation of the molecules of water, that when pressure is removed almost altogether, ice instead of passing through the transition stage of water, becomes steam of, it is true, very low tension at once. We desire the fact should be carefully kept in mind, that whatever the pressure to which water is subjected, a tendency exists in the water to become steam. It is impossible to reduce the pressure considerably when water is hot without causing the conversion of a large portion of the water into steam. It would take up more space than we think it necessary to give to this subject to continue to deal in general terms with it. Therefore we shall confine our attention for the moment to water heated to 328 deg. Fah. In order that water may have this temperature it must be subjected to a pressure of 100 lb. on the square inch. In an ordinary boiler this pressure is supplied by steam formed from part of the water, but it might just as well be obtained by enclosing the water in a vessel which it completely filled, so that no steam whatever was produced, and for convenience we shall assume that this is the case with 1 lb. of water, whose behaviour we are about to consider. The temperature of water under a pressure of 14·7 lb. on the square inch is 212 deg. Now if the pressure on 1 lb. of water under a pressure of 100 lb. were reduced to 14·7 lb., its temperature would at once fall to 212 deg., and 328 deg. — 212 deg. = 116 deg. would become available to convert a portion of the water into steam of 212 deg. temperature, and 14·7 lb. pressure. One pound of steam at 212 deg. contains 966 deg. of latent heat, and the 116 deg. of sensible heat available for the purpose would therefore suffice to convert rather more than one-eighth of a pound of water into steam of atmospheric pressure. It will be remembered that pressures and temperatures always go together; consequently the moment pressure is reduced temperature tends to fall, but it only falls because the molecules of the water fly apart and assume the condition of steam. This much having been premised, we now come to a very important question. We have said that if pressure be reduced then the molecules of water are driven further apart, and steam is produced. At what rate can this conversion of heated water into steam take place? This question has never been directly answered, but no doubt it admits of being answered if only the vibrating range of a molecule of steam, its weight, and its velocity are given. So far as is known, the production of steam on the reduction of pressure is very nearly instantaneous, but not quite. Although the action may be so rapid as almost to elude every attempt to mark the time occupied; yet it is certain that the pressure must first be reduced before there can be any flashing into steam. The latter process is a consequence of the establishment of the given antecedent condition. They do not go together; one must precede the other. But the reduction of pressure can, in the nature of things, seldom be instantaneous. The production of steam from heated water can take place as fast as the pressure is reduced, but no faster — save under conditions to which we shall refer presently—and the rate of reduction of pressure is, in practice, the factor which determines the rate at which heated water shall be converted into steam. Thus when, the fire being drawn, a safety valve is eased off, steam blows away, and the pressure falls, and more and more water is boiled off by its own stored-up heat, until the pressure falls to that of the atmosphere; but the rate of boiling away depends altogether on the rate at which steam is permitted to escape and the pressure to fall.

It may, however, under certain conditions, be possible to reduce pressure at a greater velocity than water will initially flash into steam. We shall then have a very peculiar and exceptional condition set up. If we suppose that all pressure were suddenly removed from one pound or other weight of heated water, then the molecules of water would be repelled from each other at a certain velocity; and there can be no doubt but that this velocity would be definite. What it would be is indicated by the rate at which steam of a given pressure will flow into a vacuum. At the first instant of liberty the molecules would move very slowly, just as the speed of a cannon ball increases from nothing to 2000ft. or so per second. If now the process of conversion of water into steam be once fairly started, it seems to be clear that a certain momentum may be acquired, so to speak, by the molecules which will result in the production of a greater pressure than would otherwise have been set up. Let us suppose, for example, that one pound of heated water is enclosed in one vessel which it nearly fills, and that a pipe and stop-cock will establish communication between the first vessel and a second at pleasure. If now the cock be opened and steam permitted to move into the empty vessel, only a small reduction of pressure can take place, because the conversion of successive quantities of water into steam will go on step by step with the withdrawal of steam, and the pressure and the temperatures will always coincide. If, however, it were possible to open a very large stop-cock fully, so as to reduce the pressure in the first vessel to practically nothing, the result would be that after an interval of apparent delay imperceptible to the senses, the water would begin to flash into steam. If now the cock were suddenly closed, then the flashing ought to stop; but it would, there is every reason to think, do nothing of the kind; on the contrary, it would continue; pressure would rise above that due to the conditions, the water would continue to fall in temperature, and an explosion would result, the vessel which originally contained the heated water being shattered. Assuming this to be true, we have at once the clue to the explanation of certain facts now looked upon as mysterious. For example, it is well known that nothing is more common than for a boiler explosion to take place when the engine has just been started. The Maidstone catastrophe is a case in point. We have under the conditions a sudden reduction of pressure, which is followed at once by the commencement of flashing, and the momentum of the process carries it on and suddenly runs up the pressure and bursts the boiler. Again, when one boiler in a bed bursts others often go at the same time. The result is due to the breakage away of connections, the sudden reduction of pressure, and the setting up of flashing which is not stopped by the re-establishment of pressure on the surface of the water.

That water can be made to explode is quite certain. It is very difficult by experiment suddenly to reduce the pressure in a boiler so that the water may be much hotter than the temperature due to the pressure. But it is evident that if we can by any means, while leaving the pressure unaltered, superheat the water or raise its temperature above that proper to the pressure, we shall have established the conditions we require. In other words, whether we reduce the pressure or raise the temperature the effect is the same. There are two or three ways of doing what we want. Water, for example, may be heated cautiously in a perfectly clean glass test tube above the boiling point. If it be then agitated a portion of it will be converted into steam with explosive violence. Water suspended in oil, for some reason not clearly understood may be heated to a very high temperature—as much, according to the late Dr. Frost, as 500 deg. without ebullition. At last a critical point is reached, and the drop of water explodes with great violence. We have before us a letter from a correspondent who states that about two years ago he filled a glass flask to a depth of 4in. with water, and covered the surface with an inch of oil. The flask was then heated with a Bunsen burner. Not seeing ebullition as soon as he expected, our correspondent put in a thermometer to ascertain the temperature. The moment the instrument touched the bottom of the flask the water exploded, shattering the flask into atoms. Again, the truth may be demonstrated in another way, which, although indirect, is not less conclusive. We wish to prove that if the process of converting water into steam be once set going under certain conditions, it will not be arrested by a considerable rise in pressure. It is essential to this end that the formation of the steam, be it little or much, should take place with great rapidity. To this end heat must be transferred to the water with the speed of lightning. If the heat is already in the water, latent, we have all we want; but in the experiment we are now about to describe it shall not be in the water beforehand. Let a quantity of wet steam, that is, steam not only saturated but abounding in suspended water, be contained in a flask in which a small quantity of water is kept boiling. Then let a current of highly superheated steam be turned into the flask, and the latter will almost always be shattered, obviously by the sudden augmentation of pressure due to the transfer of heat from the superheated steam to the water of saturation. No doubt many other circumstances and phenomena will suggest themselves to our readers all tending to the same end, and showing that if the rapid production of steam is once set on foot it cannot be instantly arrested by the concomitant rise in pressure, or fall in temperature. We are not aware that any serious argument can be adduced against this view of the matter, but our readers will do well to bear in mind that in considering this question they have to deal with periods of time which, however real, probably bear about the same relation to a second that a second bears to a month; and that it is quite possible to have at one place in a boiler the atmospheric pressure and at another a few feet off as much as 100 lb. on the square inch. Of course the disparity is but momentary. Those who doubt the possibility of its existence will do well to bear in mind that in a gun chamber a pressure of 18 tons on the inch may exist at one place, and one of 13 tons within a few inches of it at the same instant.

The cause of the violence of a boiler explosion is the liberation from the heated water in a very minute space of time of a very considerable volume of the elastic fluid called steam, and the action of water in this respect is strictly analogous to that of gunpowder and other explosives, which liberate large volumes of nitrogen and other gases. In very many cases nothing more is required than a pressure less than that which caused the explosion to produce the required effect. In other cases, however, what ought to be merely the opening of a rent and the escape of steam, without very serious consequences, becomes a violent explosion, because the local sudden removal of pressure has initiated the flashing of water into steam, and this flashing has gone on until a pressure was reached which burst the boiler with tremendous violence. In this view of the matter there is nothing opposed to known truths, or anything mysterious, recondite, or inconsistent with the latest developments of molecular science.

SNOW AND FLOODS IN LONDON.

THE streets of the metropolis are blocked up with snow; the question in every one's mouth is, "How are we to get rid of it?" The old reproach is urged against the authorities that they have made no preparation for such a snowstorm as that of Tuesday. But the authorities are but men, and not one of those who complain most probably ever thought of making the smallest preparations himself. It is admitted on all sides that no such storm has occurred in England for at least thirty years, and it would hardly be prudent to construct hundreds of snow carts, and to purchase as many horses in anticipation of an event which may not happen again for a generation. Where snowstorms occur annually precautions can be and wisely taken against these consequences. As an example, we would refer our readers to an account of the way in which snow is dealt with at Milan, which will be found in another page. In London the great puzzle is to know what to do with many thousands of tons of snow. In case of streets moderately near the river the snow can be carted into the Thames; but the whole of North London, the West End, and much of South London, is too far from the river to permit this expedient to be adopted. To throw the snow into the sewers, thawing it as it goes, has been tried and with moderate success when small quantities are dealt with; but the appliances do not exist for doing this now, and any attempt in this direction would, even if successful, cost much money. If the snow was simply carted into the great main sewers, it would to a large extent be thawed and washed away, for sewers are always comparatively warm; but there is the risk that the snow would cool down the sewers and make a block, the consequences of which would be very serious. Some forty years ago, under circumstances not unlike the present, the snow from West End streets was carted into the squares, where it formed huge masses, which did not thaw till March. People who live in squares do not admire this practice. A great deal of snow might, however, be taken to waste ground, and even into the parks. It would be rash to say what the weather may be in the immediate future, but there is some reason to think the frost will last; if it does the snow must be carted somewhere out of the streets. Although the City authorities at all events must be held to have done their best under the circumstances, so much cannot be said of the Metropolitan Board of Works in its dealings with the high tides which have flooded the district round Upper Ground-street, Blackfriars. It is perfectly well known, and has been known for years, that certain low walls and other works, the cost of which would not exceed a very few thousand pounds, are absolutely necessary to keep the river from flooding a poor neighbourhood; yet the walls are not built, nor is anything done to carry out the necessary works. It is to be regretted, that those who have lost their all by the floods of this winter, have no right of action for compensation against those who are really to blame.

THE METROPOLITAN RAILWAY.

AMONGST the earliest of the railway reports which are issued for the last half of last year is that of the Metropolitan, and though some of the facts have recently been glanced at in THE ENGINEER, so far as the past of the company is concerned, yet in the report of this unique company there is still much that is worthy of consideration. It appears that in the whole of last year the Metropolitan Railway has carried 63,759,573 passengers—or over five millions monthly on the average, the increase in the number last year being one of the largest known in any recent year. It is to be regretted that we have no particulars of the classes of the passengers, or rather of the proportions of each of the three classes. It is worthy of notice that out of the gross income of the company for the half-year—£280,133—there is the large proportion of £247,124 derived from the passenger traffic; whilst rent at stations, &c., supplies the bulk of the remainder. Out of the gross revenue, over £83,000 may be said to be the real working expenses; in addition to which there is the moderate sum of £182 for compensation, and the company pays £15,800 per half year for rates, taxes, and Government duty. In the past half-year, when compared with its correspondent predecessor, there was a very large increase in the mileage run by passenger trains—from 594,546 to 721,865 miles—which is probably traceable in very considerable degree to the opening of the extension to Harrow in August last. It may be here fittingly said that whilst the mileage of the line worked is 12 miles 40 chains, that authorised is not less than 22 miles 17 chains, so that it will be seen that it will be some time before the completion of the system. One of the marvels of the Metropolitan is the fact that it carries so immense a number of passengers with so small a rolling stock. It has in the past half-year added 18 locomotives and carriages, but it still owns only 266 locomotives and carriages of different classes. In the half-year that has been entered upon the Metropolitan proposes to expend £108,400 on capital account—£6000 on lines open for traffic, £80,000 on lines in course of construction, and the rest in new carriage shops, working stock, &c. It is evident, then, from these facts that the Metropolitan is preparing still further to occupy its own special field, and to execute some of the works that are needed to give completion to it as a system. There is still before it the completion of the last link in the Inner Circle system, which would enable it not only to tap large streams of new traffic, but would conduce to the cheaper working of the system. The volume of traffic is now large, but it is capable of very great extension, and as some new links are added to the chain of communication in and around the metropolis, it is to be expected that the great passenger traffic of the Metropolitan Railway will further grow.

QUINTUPLE TELEGRAPHY.

THE improvements effected in extending the carrying capacity of telegraph wire have during recent years been numerous. Duplex and quadruplex messages are very common, the latter, indeed, being customary even in long cable circuits. A modification of Elisha Gray's telephone has recently been tried between New York and Boston in order still further to increase this carrying capacity; and it is said that for some six weeks five messages have been successfully sent and received over one wire. On December 21st, 1880, with five operators at each end, the rate of sending and receiving was forty messages per hour, but of the average length of such messages we have no information. If the current from a battery is allowed to enter the line wire in accordance with the vibrations of a tuning fork, a similarly pitched tuning fork can be caused to vibrate at the other end of the circuit. The improvement indicated is in using five tuning forks of different pitch at the one end to influence the admission of current there, while the apparatus at the other end partly consists of five similar tuning forks. When one or more of the sending forks are in action the sound is reproduced at the receiving end, so that five musical tones are received, if need be, at once over the same wire. The volume of sound is increased by the use of sounding boxes on which the forks are placed, so that it is not difficult for the operator to distinguish the sound of his special fork. For a long time public opinion was in favour of recording instruments, but of late the large increase of sounders, both in America and England, has shown that no loss accrues from their use, and a great increase of speed is obtained.

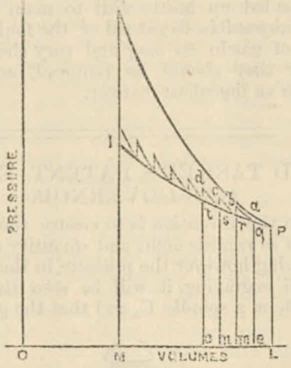
LITERATURE.

Steam and the Steam Engine: Land, Marine, and Locomotive. By H. EVERS, LL.D. London: W. Collins, Sons, & Co. 1880.

THIS is one volume of "Collins' Advanced Science Series," which has apparently reached several editions, and is now revised and enlarged. It is written under the check which the author has self-imposed of including, as an important part of the book, a large number of exercises, chiefly from examination papers, and also about thirty pages of questions for students to work and answer. Being generally of a practical character, comprehensive, and well selected, these exercises and the questions, with their worked answers, form a good guide to the learner, but they are of the further use that they enforce upon the author the necessity of seeing that his book contains the instruction which must be given to enable the learner to answer the questions. That it is not an easy task to write a useful elementary treatise on the steam engine in its different forms is amply proved by the many failures that have followed the attempt. To write a book with a well-selected series of questions in view as texts is, perhaps, therefore, the best mode of procedure that could be adopted. This, however, makes it necessary to exercise great care in avoiding the compilation of a mere ready reckoner or examination cram book. This it may be admitted Mr. Evers has succeeded in doing. The matter is very well arranged, commencing with chapters dealing with steam and its properties, and with heat generally. The following chapters are descriptive of various kinds of engines and their parts, and boilers, the descriptions including remarks on the action of steam in engines and the performance of work. The number of pages of questions occupying the end of the book form, at the same time, the instructions for performing the calculations relating to the parts elsewhere described, and it is intended that the student should study these as he proceeds with the early chapters. Altogether Mr. Evers's book is one of the best yet written as a comprehensive elementary or rudimentary introduction to the steam engine. There are, however, several points in which it may be and needs to be improved. The diagrams illustrative of different types of engines and their parts are unsatisfactory. They are not purely diagrams, but are something more, practical details being partly given without being really illustrative of that to which they relate. They are thus puzzling, and in some cases misleading, to the young student. Thus a diagram showing a cylinder and steam chest in section and a connecting rod and crank, is in most parts complete, or what would in theatrical mechanics be called "practicable." But as a diagram it contains too much, while on the other hand it contains too little as an illustration. The student, for instance, who notices that the top cylinder cover and the top end of the cylinder are properly flanged for connecting by means he will readily think of, will be puzzled to see that the cylinder bottom is cast on the cylinder on one side and flanged on the other, that the stuffing-box is simply stuck into the cylinder cover and the piston rod apparently fastened in the same way into the piston. The steam chest cover is held in its place in some miraculous way, and the slide valve rod, which seems to need no stuffing-box, moves the valve on one stroke by magnetic attraction or some equally immaterial connection. If we imagine the section generally to represent a toy model in which solder is freely used it would be possible to account for what is indicated; but Mr. Evers does not say that this is the class of engine from which his diagrams are prepared, and it is elsewhere evident that they really are not. These remarks might be made as referring to several diagrams. It is in the hands of a practical draughtsman just as easy to make these diagrams accurate and in no way misleading, as to make these half-correct things, and it is a pity to spoil a book with bad diagrams. In several instances the author's descriptive phraseology is not so clear as it might be, as, for instance, in speaking of cushioning, he says, "when steam is shut in before the end of the stroke the piston acts against it as a cushion," and there is nothing very specific or satisfactory in the statement in reference to the use of the pyrometer that Mr. Houldsmith established the *fact* that "a regular and continuous supply of air to the furnace increases its heating powers $33\frac{1}{3}$ per cent." With respect to arrangement of the matter, it might be better to give that which relates to and describes thermometers, before dwelling on the properties of steam and the action of heat on solids and liquids. Generally, temperature is given in Centigrade units, but as Fahrenheit is also used the table of coefficients of expansion of solids should be accompanied with some indication as to which unit is employed. Though the initiated can see that the coefficients are too large to be Fahrenheit, the student would have to refer to a text-book to know this.

THE COMPRESSION OF AIR.

AMONG the letters we have recently published on the Theory of Cold Air Machines, there are some which, whether correct or not in themselves, appear likely to create a confusion as to the effect which the compression of a gas has on its temperature. It has been laid down strongly that speed has nothing to do with the question. Of course it is true that if we fix beforehand, by some means or other, the conditions under which compression takes place—say that the temperature shall be constant throughout—then those conditions cannot be varied by the speed of compression, or by anything else. But the practical problem generally is given the speed of compression, what will be its effect in varying the conditions of the gas, such as temperature? We are thus introduced to the two kinds of compression—the isothermal and the adiabatic—and the question arises, is isothermal compression possible? Speaking theoretically, the answer must be that it is possible only when the speed is infinitely small; for any compression of a finite amount in a finite time will increase the intensity of disturbance of the particles amongst themselves—in other words, will increase the temperature. But something approaching as closely as we please to isothermal compression may be obtained, if the cylinder be surrounded with a cooling medium, or even without this, provided that its walls be rapid conductors of heat, and the speed sufficiently slow. For we may divide the time of compression into any number of small intervals, and suppose the compression to take place by sudden starts at the beginning of each interval. Every such start will produce a certain small increase in the temperature; but we may suppose the interval just long enough to remove that increase in temperature by conduction through the cylinder. The next start will, therefore, be made at the same temperature as the first, that is, at the constant temperature of the isothermal line, and so on throughout. The effect of this process is shown on the diagram, where P I is the isothermal and P A the adiabatic curve for a gas starting with the original volume O L and pressure P L. Here L *l*, *l n*, *m n*, *n o*, &c., represent the equal small stages into which the compression is divided. P *a* is the first instantaneous start, which is therefore a portion of the adiabatic curve P A. From *a* the pressure falls, with the falling temperature, to *q* on the isothermal P I, the volume O L remaining constant. The second start is represented by the line *q b*; the pressure then falls again to *r*, from which it rises again along the line *r c*, and so on. Each of the triangles P *a q*, *q b r*, *r c s*, &c., represents, of course, a certain amount of work done on the gas, which is lost by the subsequent removal of the heat in conduction; but it is obvious that if we make the successive starts sufficiently small, and the intervals between them long enough to ensure the return to the original temperature, we may make the sum of these triangles as small as we please, and that the true outline P *a q b r c s* will then be as near as we please to the isothermal curve P I. This may easily be carried so far—in other words,



the speed may be made so slow—that an ordinary thermometer attached to the cylinder shall show no appreciable rise. It was in this way that the question was stated in a former article of ours on "Compressed Air Locomotives"—an article which was not designed to give a strictly accurate theoretical view, but to put the limiting conditions of air compression in a plain form for practical purposes.

The same diagram shows very clearly the chief point insisted upon in that article, viz., the great waste of power occasioned by a very rapid compression of air; for in that case the heat will have little or no time to escape by conduction, and the line of compression will therefore approach somewhere very close to the adiabatic line P A. If it be afterwards allowed to cool to the original temperature (as is generally unavoidable) the descent of the pressure will be along the vertical line A I, and the whole area P A I will then represent work expended uselessly, as against the sum of the small triangles, *P a q*, *q b r*, &c., referred to previously.

There is one other question which may fairly be asked as to compression of air, and which may equally be solved by reference to the diagram above. Of course the whole of the work done upon the air in compression is not converted into heat. Part of it goes to diminish the mean distance of the particles from each other, and so impart to them that store of energy which they give out when the air is expanded; in other words, it is changed from actual energy in the piston to potential energy, or energy of position, in the air. Now it might be supposed that the ratio between the amount of the total work done that is converted into heat, and the amount that is converted into potential energy, varies according to the speed at which the compression takes place. There does not seem anything *à priori* impossible in such a supposition; but there can be no doubt that, as a matter of fact, it is not true. For recurring to the diagram, we see that whatever be the conditions of the case, each start of compression will take the form of an arc of an adiabatic curve. And the distribution of the expended energy between potential energy and heat must clearly be the same for any such arc, whether it be part of one continuous curve, such as P A, or of a serrated line, such as P *a q b*. . . The distribution once made, the subsequent cooling, and consequent fall in pressure, cannot make any difference in it. The same thing is shown perhaps more simply by the undoubted fact that a gas, at a given volume and temperature, is always found to possess the same pressure. For if the speed of compression made a difference in the distribution of energy, then a quantity of gas which had been compressed rapidly would contain either more or less potential energy than the same quantity which had been compressed slowly; and this would show itself by a greater or less pressure. But nothing of the kind has ever been observed. We are therefore justified in concluding that no variation in the distribution of energy takes place, and therefore the ratio of the potential energy stored up to the total energy expended will be measured simply by the ratio of the area P I M L to the area which is included between P L and A M, and is bounded by the outline, whatever it be, which represents graphically the mode in which the gas has been compressed.

DEATH OF MR. WILLIAM McNAUGHT.

THIS gentleman died at his residence in Manchester on the 8th inst., after a long and patiently-borne illness, in his 68th year. His body was removed to Glasgow, where a large party met in the Queen's Hotel, on the 13th inst., to accompany his remains to the family burying place at Sighthill Cemetery, amongst the party was Sir Peter Coats, of Paisley, who had encouraged Mr. McNaught throughout his whole career to perseverance and progress. The funeral ceremonies were conducted by the Rev. John Orr, of the Tron Parish Church, Glasgow, formerly of Liverpool, and an old friend of the deceased.

Mr. William McNaught was born in Paisley on the 27th May, 1813. His parents removed into Glasgow in 1820, where he received a good education. Being desirous of following out the calling of an engineer, which was also the profession of his father, he was duly apprenticed to the late Mr. Robert Napier, of the Vulcan Works, Washington-street, Glasgow, ere he had quite completed his fourteenth year, working diligently at his trade by day, and attending the science classes of the Andersonian University in the evenings. He had acquired such a knowledge of his business, that at the age of nineteen, on the termination of his apprenticeship, he was offered the charge of the Fort-Gloster Mills on the Hooghly, which offer he at once accepted and immediately set out on his way to India. His health, however, becoming affected by the climate, he was obliged to return to his native country in 1836. Some years prior to this, his father, Mr. John McNaught, had invented the revolving cylinder as an attachment to the steam engine indicator, for which he had received the silver medal of the Society of Arts for Scotland in the year 1830, and had begun to manufacture these indicators in connection with his business of a consulting engineer. The McNaught indicator was a very great improvement over what had been hitherto used for the same purpose. It will be remembered that the first instrument known as Watt's indicator did not describe a diagram of the action of the steam in the cylinder; it had, however, the miniature cylinder connected to the main cylinder, and the small piston with spiral spring attatched. An index finger was fixed to the top of the piston rod of the indicator which pointed to a scale marked off on a frame contiguous to the instrument, the variations taking place inside of the main cylinder. This indicator was greatly improved by substituting a lead pencil for the index finger and causing the frame with a card fixed to it, to move simultaneously with the main piston, the return stroke being effected by means of a back balanced weight attached to the other end of the frame. By this means an exact picture was drawn on the card of the performance of the steam in the cylinder, but Mr. John McNaught's invention of the revolving cylinder and other improvements simplified and extended the use of the indicator so as to make it as useful to the engineering profession as the stethescope is to the medical profession. Mr. William McNaught joined his father in 1838 in this business in Robertson-street, Glasgow, where it is carried on to this day.

Glasgow at this time was extensively engaged in the cotton manufacture, the general type of engine employed being the beam single cylinder condensing class, working with a boiler pressure seldom exceeding 7 lb. per square inch. Additions constantly being made to the number of spindles and looms, demanded more power, and in their efforts to attain that, serious breakdowns were the inevitable result.

Mr. Wm. McNaught being consulted by the manufacturers on the subject, gave the matter his closest attention, which resulted in his application of an auxiliary cylinder situated midway between the crank shaft and the main centre. This arrangement he patented in December, 1845, and its first application to an engine at the Barrowfield Cotton Mills, Glasgow, is at work to this present day. This change at the same time converted the engine into one of the compound principle, and was a safer arrangement than those made under Woolf's patent, the latter exerting a very severe pressure at the main centre bearings, which Mr. McNaught's arrangement rendered almost nominal. The saving of fuel resulting from this method of compounding, and the other advantages it possessed, brought it speedily into favour, and in 1849 Mr. McNaught had to remove his headquarters to Manchester, his Lancashire orders being so numerous and the field being much wider for the application of his improvements. There he continued to reside up till his death.

He was also one of the original promoters of the Boiler Insurance and Steam Power Company, Limited, and was on the board of directors since 1859, the year of its formation, and acted as chairman from 1865 till within a short time of his decease. The insurance of steam engines, which was carried out for some time by this company, and which it has recently again put in operation, originated with Mr. McNaught. All through life he proved himself the worthy son of a worthy sire, and both father and son have left their names honourably inscribed on the roll with those who, by their useful inventions, have left the world better than they found it.

He leaves a widow and grown-up family to mourn his loss.

THE POETRY OF THE LOCOMOTIVE.—A correspondent sends us *à propos* of our notice of Mr. Reynold's "Engine-driving Life," the following lines, forming part of an inscription on a tombstone in Bromsgrove churchyard, to the memory of Thomas Scaife, a driver who was killed by the explosion of his engine:—

"My engine now is cold and still,
No water does my boiler fill;
My coke affords it's flame no more,
My days of usefulness are o'er.
My wheels deny their noted speed,
No more my guiding hands they need;
My whistle, too, has lost its tone,
It's shrill and thrilling sounds are gone.
My valves are now thrown open wide,
My flanges all refuse to guide.
My clacks also, though once so strong,
Refuse to aid the busy throng;
No more I feel each urging breath,
My steam is all condensed in death,
Life's railways o'er, each station's past,
In death I'm stopped and rest at last."

This inscription is also to be found at Whickham, near Gateshead, where it commemorates a driver who met his death during the execution of his duty. It is stated in both cases that the lines were composed by "an unknown friend." Some very good verses by the late Professor Rankine, "The Engine-driver to his Engine," appeared in *Blackwood*, for December, 1862, and were reprinted in the *Builder* of the 27th of that month. They have a stirring refrain of this sort:—

"Dash along, crash along,
Sixty miles an hour."

But after all, perhaps the best thing of the sort was *Punch's* inscription on an old locomotive:—

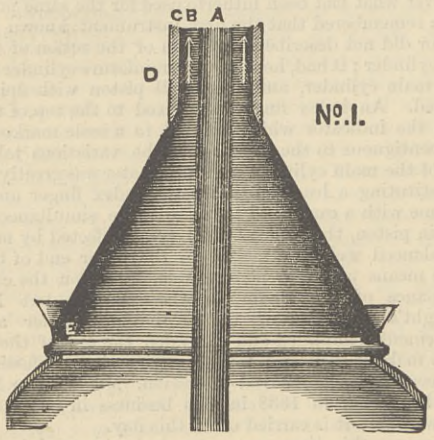
"Collisions sore, long time I bore,
Signals *was* in vain,
Grown old and rusted, my *biler* busted,
And smashed th' excursion train."

STEAM BOILER EXPLOSIONS IN GERMANY.—Notwithstanding additional precautions which have been taken in recent years, the number of boiler explosions in Germany show no diminution. In 1877 there were twenty explosions, killing twenty-one persons and injuring thirty-seven others, fourteen of the latter being seriously mutilated. In 1878 there were eighteen explosions, causing ten deaths and injuring twenty-two persons, five very seriously. In 1879, the last year for which the statistics have yet been made up, there were eighteen explosions, in which thirty-six persons lost their lives and forty-two others were injured, ten being seriously mutilated.

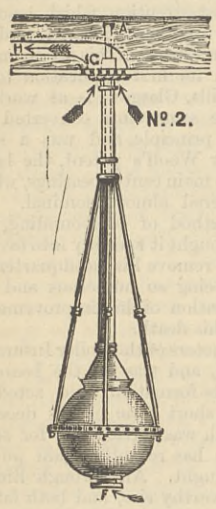
FATAL BOILER EXPLOSIONS.—At Wheal Eliza Mine, St. Austell, Cornwall, on Saturday, a boiler attached to the pumping engine exploded, and John Peters, the engineman, received such injuries that he died on Sunday. On Saturday a boy aged two years was killed at Southport by a boiler explosion, and on Sunday, at the same place, a cook received such fearful injuries from a similar occurrence that it is feared she will not live. On Wednesday evening there was a most disastrous explosion of a Lancashire boiler in a woollen factory between Heckmondwicke and Batley, the property of Messrs. Graham and Hirst. A number of the workpeople had collected in a tentering house adjoining the boiler house for the comfort of the warmth there, and while they were there the explosion took place, completely destroying the boiler house and tentering house, killing eleven people and most severely wounding sixteen others, many being girls and women.

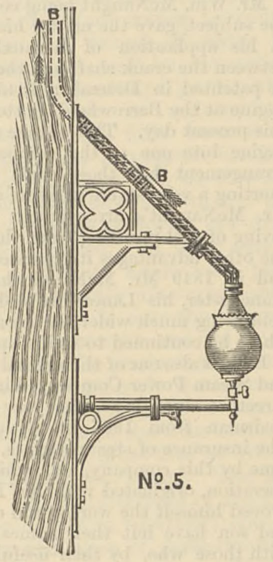
BOYLE'S VENTILATING GAS FIXTURES.

THE idea of using pipes to draw off the products of combustion and heat from gas is not new, but when single pipes are used for the purpose they act to some extent as heaters; more especially when applied to billiard rooms, owing to the amount of piping used. Messrs. Boyle and Son, of Glasgow and London, overcome this difficulty by using double pipes one within the other, with a non-conducting material packed in the space between the pipes; this

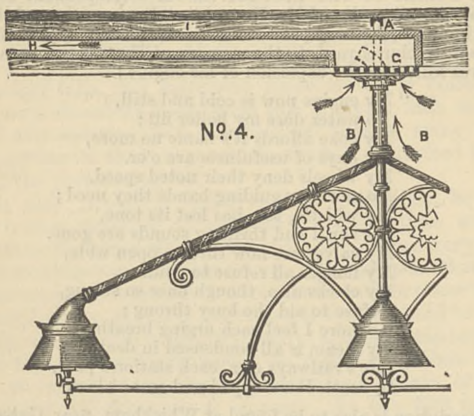


arrangement not only effectually prevents radiation, but also reduces the condensation on the pipes to a minimum, as the inner pipe is so much hotter than the air passing up. There is, however, provision made to receive and dispose of any condensation which may ensue. Fig. 1 shows a section of a hall pendant. A is the gas supply pipe; B1 1in. ventilating pipe

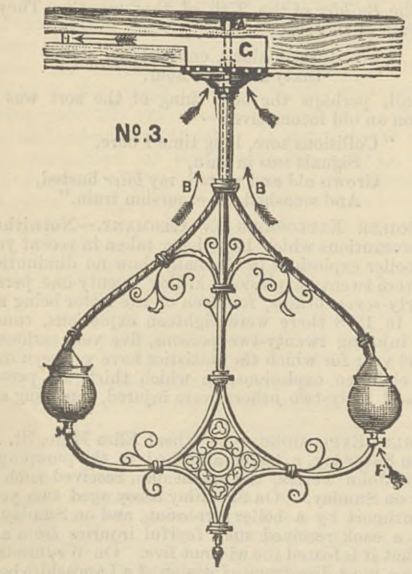




for drawing off the heat and products of combustion; C non-conducting packing between inner and outer pipes; D, 1½in. outer pipe; E gutter on bottom of cone above globe to receive any condensed vapour which may be formed in the pipes. There is no



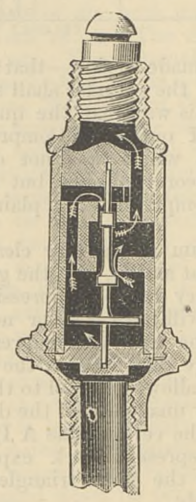
possibility of this gutter ever becoming full and causing an overflow, as the strong and continuous rush of air up the ventilating pipe created by the air pump ventilator on the top will cause it to evaporate and carry it off. Fig. 2 shows the external appear-



ance of the pendant. Fig. 3 shows the application of the principle in an ornamental form to gaseliers. In this F is an inlet at the bottom of the globe to support combustion; G foul air chamber above ventilating centre flower; H ventilating pipe to draw off the heat from the gas and the vitiated air from the room. This pipe is led between the joists to the wall and continued up to the roof, where it is connected with an air pump ventilator which creates a powerful upward current and effectually prevents down draught. Fig 4 represents the application of the arrangement over the lights of a billiard table. This the inventors consider of much importance, as it is in billiard rooms where this means of carrying off the burnt air is most required, and would be found most useful. The ventilating pipe B is bent towards and into the mouth of the extracting shaft, so that it acts like a hot blast, and materially assists the ventilation, double casing with non-conducting packing to prevent any chance of fire occurring through the ventilating pipe getting over-heated. Fig. 5 illustrates a bracket light, showing ventilating pipe led up inside wall to main ventilating shaft. It is, perhaps, impossible to get rid of the foul air and products of combustion of gas in an easy and very cheap way, but it is very necessary they should be removed, and Messrs. Boyle accomplish it in an ingenious manner.

THORP AND TASKER'S PATENT EQUILIBRIUM GAS GOVERNOR.

THE object of this invention is to ensure the most economical use of gas, both as regards light and quantity consumed, and to prevent any flaring however the pressure in the mains may vary. On reference to engraving it will be seen that there are two valves, A and B, on a spindle C, and that the gas on passing the



lower valve, A, is moving in an upward direction, while that passing the upper valve, B, in a downward direction. It will also be seen that the gas passages in the footstep are oblique, the gas impinges on the disc, causing it to rotate, thereby keeping the disc, D, on which the regulation depends, in equilibrium, and delicately sensitive to any increase or decrease of pressure, and so opening or closing the valves as required. The sole maker and licensee is Mr. Thos. G. Marsh, Bank Meter Works, Oldham.

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

(From our own Correspondent.)

TO-DAY—Thursday—in Birmingham, and yesterday in Wolverhampton, ironmasters were busy comparing notes upon the business outcome of the quarterly meetings last week. It cannot be reported that the result was especially gratifying. The negotiations opened had not in the majority of instances a buying ring. Merchants and consumers were all desirous to secure a position of advantage in the event of the market strengthening further on in the year, but few only were ready to give out specifications, either at once or with guaranteed regularity as the quarter advances. Makers were therefore reluctant to quote, and the negotiations since the meetings have proved to be scarcely more substantial. Indeed, it was the pronounced conviction of leading firms, as well in the raw as in the rolled iron trade, that the first week of few quarters has, in their experience, resulted in less satisfactory orders than the week which ends with the close of 'Change to-day. Consequently, at the meeting in Wolverhampton and in Birmingham alike, advances towards buyers were made by the majority of sellers with less shyness than had been noticeable in the last few weeks. In most cases in which a specification could be distributed or permission to deliver given, purchases could have been made a trifle more in buyers' favour than would have been possible last week. At the same time there were instances in which for small lots of certain classes of pigs needed for mixtures, more money would have been given for iron that could be delivered immediately. This latter state of things was due to the severe winterly weather having impeded, and in some localities wholly closed navigation upon the canals, while the drifted snow of Tuesday and yesterday has made it difficult also to continue the use of some of the railway sidings. The activity at the forges and at the pits has from these causes been lessened this week. Finished ironworks have been partly stopped for want of coal, and pits unable to send away the much-needed mineral have been put to short work.

Accumulating stocks of pigs were indicated by the abandonment here and there to-day, when buying for consumption seemed likely, of the slight increase which some local smelters were asking last week. It transpired that in only rare instances would the output, in any case, be going into consumption, even if the canals were open; while the frost has made smelters' position somewhat worse. Few proprietors of mills and forges, or the owners of foundries, would yesterday look at such quotations as 42s. 6d. for pigs of "common" quality; and those who knew that last week they should have had no difficulty in buying at 40s., were seeking to satisfy their requirements at a figure within that price, which left very little margin in makers' favour, compared with the business doing when "cinder" iron was not difficult to buy at 37s. 6d. per ton. But nothing under 40s. would be taken when delivery was not prompt.

All-mine iron was quoted up to £3 7s. 6d. for hot blast, but only one or two firms asked more than £3 5s. That figure was not, however, quoted with the confidence shown last week, and there were firms who would have readily accepted £3 2s. 6d., and a few others £3 for present delivery. Cold-blast iron was in less supply than for several weeks past. A quality produced in the East Worcestershire district specially intended to take a deep chill, that had accumulated in stock through the lessened demand of the chilled roll makers, has just been in demand on Government account for the casting of chilled projectiles. The stock has been cleared off, and the current output is for a time pledged. Blaenavon cold-blast iron was strong at a rise of 10s. per ton. As much as £6 5s. was confidently asked for that description, which is still in request for use in German arsenal work as well as for high-class machine turning bars at home. Hematite iron was not to be had under the terms implied in the open market quotation of £3 15s. for Barrow grey forge minimum quality. This was a rise of 2s. 6d. Agents received instructions on Saturday last to stop all sales, and all negotiations at any lower rates. These negotiations, opened on the basis of £3 12s. 6d. at the quarterly meeting last Thursday, which it had been expected would be closed to-day, fell through. The smelters are aware that at that figure no business can be done in this district, yet they decline to give way or to encourage the expectation of buyers that less money will soon be taken. They aver that such is their experience in the steel branch, that buyers must look for steady advances rather than reductions. And it is notable that compared with the quotations of a twelvemonth ago the figures I have cited are a reduction of from £2 5s. to £2 7s. 6d., since at the earlier date no less than £6 a ton was asked for the same quality of raw iron smelted from red ore. But there is no record of business here at such a figure. This week the firmness of vendors has not been shaken by the little business done at the quarterly meetings, or by the continued refusal of the consumers of forge sorts to buy at vendors' terms. Blaina hematites also were £3 15s.; Tredegar sorts were to be bought at £3 12s. 6d. easy. Yet this last quotation did not secure business.

Round Oak bars were firm to-day, as yesterday, at the Earl's circular prices of £8 2s. 6d. for common qualities. An encouraging demand is still experienced for shafting rounds, for artillery plates, for smithy bars for export to the Australias and to meet the requirements of the West of England markets at home; but much more of this iron might be rolled if the demand called for it. "Marked" bars of the other leading firms at £7 10s. is not rapidly increasing in demand, though the firms report a better business doing this week than previously this year. Certain firms of this order are once more humouring the market by taking orders for unbranded iron at prices appreciably under their marked bar quotations. Bars of £5 15s. and upwards were quite as easy to buy as at any time these three months. Small rounds were plentifully offered by two or three small firms, who accepted prices which firms of longer standing promptly rejected. Strips were abundant. Occasionally for bedstead purposes they were obtainable at £5 12s. 6d, but tube strip ranged to-day at from £6 down to £5 17s. 6d. and £5 15s.

The plate trade was dull in Birmingham. Firms who had booked orders on account of bridge and roofing requirements were some of them complaining that specifications were being withheld because of the difficulty of continuing work in the erection yards during the inclement weather. Tank plates were in larger output, some to be used black and to be galvanised upon the completion of the rivetting, and some to be worked up in a galvanised state. Ungalvanised they might have been bought at from £8 down to £7 10s. per ton. Consequent upon the quarterly meeting business a trifle more is this week being done in boiler plates.

Sheets varied in price according to the state of makers' order books. Firms who are better off for work now than last week asked to-day a further 5s. per ton, making singles £7 15s., doubles £8 15s., and latens £10 5s. Consumers would not, however, give the money. Those consumers who were galvanisers made known that they were selling galvanised corrugated roofing sheets of 24 w.g., some of them at as low as £13 to £13 10s. for minimum qualities, delivered in Liverpool. Sheets for tray stamping were from £12 for medium, up to £12 10s. for best qualities.

Tin-plates were a little stronger, though the low rates at which the Welsh houses are delivering to Liverpool merchants leave the firms hereabouts but little chance of making a profit on any but best qualities.

Pottery mine or calcined ore from North Staffordshire is in larger demand this week, and it is worth 6d. a ton more at the lowest. High class local stone increases in value and demand by the steadily advancing rates of the hematite ores.

Coke sold better to-day, for the blast furnaces are now reduced to consume coke almost exclusively, through the suspension in the delivery of coal by canal. Most qualities showed a tendency to rise alike yesterday and to-day.

Coal was obtainable at from 6s. 6d. for Cannock forge to 7s. for Tipton forge qualities; but an order for 1000 tons would have been taken at 6s. for Cannock sorts. Activity in the household branches in particular is increased by the colliers' strike in West Lancashire. Furnace coal was offered to-day at from 8s. 6d. to 9s. per ton.

The ironmasters in this district have now completed the scheme which they will submit to the ironworkers in lieu of the Employers' Liability Act. It is proposed to embrace alike the manufactured and the raw iron trade. An Insurance Fund is to be established as a separate branch of the Mill and Forge Wages Board, and it is to be under a special board of management. There are to be two classes of contributions—first, ironworkers, whose wages are regulated by the sliding scale, are to pay one penny per month as contributions to the Wages Board, in addition to the premium for insurance; and second, persons whose wages are not regulated by the sliding scale are to pay only the premium for insurance. It is proposed to insure against death from accident, or to provide a weekly allowance in cases of disablement, and to find medical attendance. The scale of payments, it is proposed, shall be left to the Committee of Management to settle, but it is to be a principle of the scheme that both masters and men shall pay part of the premiums, and that the employers should pay as their contributions to the Wages Board a sum equal to that paid by the operatives. A representative meeting of the ironworkers is to be held to consider the scheme.

At a mass meeting of ironworkers held at West Bromwich early this week to consider the wages question, the men were advised by the operative secretary to the Wages Board to do nothing to disturb the present amicable arrangements existing between themselves and their masters. At the same time Mr. Capper contended that the men were not bound to have their wages regulated upon the basis of a single class of iron, as was now the case. The men decided to continue working under the sliding scale upon the understanding that at the end of March an effort should be made to obtain a reconstruction of the basis of the scale.

The operative chainmakers in the Cradley Heath and surrounding districts are again agitating for an advance of wages.

A meeting of brass-workers, to protest against "the continued reductions" in prices and wages attempted by Messrs. Smith and Chamberlain, Birmingham, was held on Tuesday. It was stated that female labour had been introduced into the factory, and that the process of manufacturing high-pressure water taps which Messrs. Smith and Chamberlain adopted meant a reduction of 30 per cent. upon the lowest prices paid in the trade. A price-list for making hinges had also been agreed upon by the trade, but Messrs. Smith and Chamberlain had—so the speakers urged—been underselling the "list." It was decided to instruct all brass-workers to refrain from making application to the firm for employment, and a resolution protesting against the reductions was unanimously passed.

The operative casters in the employ of Messrs. T. and C. Clarke and Co., of the Shakespeare Foundry, Wolverhampton, are upon strike against a proposal of the masters to increase, at a given point, the ratio of reduction from their pay hitherto made on account of spoilt castings. It is not likely that the men will remain out long.

An order for 1000 revolvers for the use of the Irish constabulary has just been executed in Birmingham. Apart from this order several thousand revolvers not for constabulary use have been sent to Ireland within the past few months. Prices are said to have risen 15 per cent. The market price of the unconverted Enfield revolver has risen from two or three shillings to 7s. 6d. and 10s. It is stated that an order for 450 converted Sniders has just been declined by a Birmingham house.

The chief accident during the gale on Tuesday calling for notice here was one at Dudley, where a chimney 136ft. high, at the iron founding works of Messrs. Harper, of Wadham's Pool, Hall-street, was blown down. The engine-house, cistern, and shopping, were completely wrecked, and damage estimated at between £1500 and £1800 was done. No one was injured.

NOTES FROM LANCASHIRE.

(*From our own Correspondent.*)

Manchester.—The strike in the Lancashire coal trade seems now to be drawing towards a close. In the Manchester district the men are returning to work, and since Wednesday the collieries owned by the principal firms have again been getting into operation. The pits, of course, have been opened under the Employers' Liability Act, but with regard to the question of wages the advance of about ten per cent. asked for by the men is being held in abeyance until it is seen what action is taken in the West Lancashire districts, and also whether the Manchester colliery proprietors can maintain an advance in prices, the masters pointing out to the men that in December last they had granted an advance of wages equal to about ten per cent. which had not yet been followed in other districts with which they had to compete, whilst the prices they were now obtaining practically only placed them in the same position in which they stood previous to the last reduction in wages. In the Ashton and Oldham districts the miners have also returned to work, but here the masters have conceded the advance in wages asked for by the men, and a similar course has been adopted in the Skelmersdale district where the pits got to work again at the close of last week. In the important West Lancashire districts, however, the strike continues, and has resolved itself purely into a struggle for an advance of wages, the colliery proprietors having given way on the question of the adoption of the Employers' Liability Act. With regard to this question, which primarily has been the cause of the almost general stoppage of work at the pits throughout the whole of Lancashire, I may mention that the colliery proprietors distinctly disclaim any intention of bringing pressure to bear upon the miners in order to compel them to contract out of the Act. They urge that the proposal for the adoption of a system of mutual insurance emanated in fact, in the first place, from the miners themselves, and that the arrangements for carrying out this proposal were consequent upon the voluntary agreements entered into by the men at many of the collieries. Although the masters still think the miners would receive more substantial benefits from the system of mutual insurance than through the precarious remedies provided by the Act, now that the men, acting under the advice of the Trades' Union Leaders, have insisted upon working only under the provisions of the Employers' Liability Act, the colliery proprietors have readily consented to work their pits under these conditions. The employers, however, who have previously contributed liberally to the funds of the relief societies, and had offered to still further increase their contributions, will now have to reconsider their position with regard to these societies which have hitherto proved of considerable benefit to the mining population, but whose existence on a sound basis is more than doubtful without the pecuniary assistance of the employers.

A strike of so extensive a character as that which has been carried out through Lancashire could scarcely be expected to be entirely free from some exhibitions of violence. Intimidation has been resorted to at some of the collieries to compel the men to cease work, and one or two collieries have been attacked by the men on strike to prevent the filling up out of stocks. But although the general cessation of the output of coal throughout Lancashire has naturally affected seriously, so far as the extra cost and increased difficulty of obtaining supplies are concerned, the important manufacturing industries of the district, and in some cases mills and works have been stopped for want of fuel, it is remarkable how little actual scarcity of coal has been experienced. The strike indeed has demonstrated the important fact that the trade throughout the country has not yet developed into a general state of activity, but that there are still in the neighbouring coalfields sufficient surplus supplies of coal to meet the requirements of Lancashire consumers almost independently of the enormous output of the Lancashire collieries. The temptation of a temporary advance in prices, which consumers here have been willing to pay to secure supplies for their present requirements, has drawn large quantities of coal into the district from Yorkshire, Derbyshire, Nottinghamshire, and Staffordshire, and the close of the strike will, no doubt, leave heavy consignments on the hands of some of the speculative dealers. Prices at present are, of course, scarcely quotable, as they have varied according to circumstances, but in many cases the advances asked, coupled with the extra cost of delivery, have necessitated the payment on the part of consumers of about double the ordinary rates to secure temporary supplies.

There has been only a very limited amount of business doing in the trade of the district during the past week, but prices generally are steady, any indication of weakness being chiefly in outside brands, where advanced rates have recently been asked. Buyers, however, who are mostly well covered for the next two or three months, do not show any anxiety to give out further orders, and as a rule are only making offers for long forward deliveries on the basis of present prices, which makers do not care to entertain.

Lancashire makers of pig iron have during the week booked a fair number of orders over the next three or four months at late rates, which for delivery into the Manchester distriet remain at 46s. 6d. for No. 4 forge, and 47s. 6d. for No. 3 foundry less 2½ per cent., and at these prices, which are slightly under those now quoted for Lincolnshire and Derbyshire brands coming into the district, local makers are very firm.

The finished iron trade generally is only dull, and local manufacturers are still only very moderately employed. In heavy rails for shipment, and in hoops and sheets, a business has, however, been done, but no material advance upon late rates has been obtainable. Bars do not meet with much inquiry, and although £6 per ton is about the average quotation for delivery into the Manchester district, a few transactions are still reported at slightly under this figure.

Cotton machinists are reported to be not quite so busy as they were, but engineers and tool makers seem to be still fairly employed.

Barrow.—The chief event of importance in the North Lancashire district this week is the threatened stoppage of supplies of coal from the Wigan district, and the consequent advance in prices to the extent of from 1s. to 2s. per ton delivered. The activity of the iron and steel works throughout the district is maintained, and makers, while busily employed in the production of metal to meet delivery engagements to home and foreign consumers, are in daily receipt of orders and enquiries from all parts of the world Hematite pig iron is in request, more especially for the purpose of conversion into Bessemer and other kinds of steel. The steel trade itself is, perhaps, in a more active position than it has been known to be for some time, and this year promises to be a much more active period than any of its predecessors. Engineers are well supplied with orders, and especially in the marine department, and shipbuilders are very busily employed on contracts which will guarantee a continuance of activity for many months to come. Indeed, for two years there is reason to believe there will be plenty of work in shipbuilding. Finished iron is in good demand. Throughout the district there is a general tendency in the direction of an improvement in prices.

THE SHEFFIELD DISTRICT.

(*From our own Correspondent.*)

THERE has been a brisk demand for coal from the whole of South Yorkshire and from Derbyshire for the Lancashire districts, but this, of course, will not be a trade of any prolonged duration. Eight train-loads—over 2000 tons to a train—have been sent off each day since the strike commenced, and the result is that heavier orders are placed with the local coalowners than they see their way to execute. The strike which was threatened in the South Yorkshire district has not quite collapsed, as the report went the round of the papers the other day. The men do not seem very enthusiastic over the matter; but the Miners' Association at Barnsley seem reluctant to let the affair drop. Fresh resolutions have been passed calling upon those miners who have not given notice to do so at once. I do not anticipate, however, that there will be any extensive strike in this district. The miners have not forgotten the suffering they endured on the last occasion, and they know their union is not wealthy enough to maintain them if they go out. The coalowners state most positively that they will not concede the 10 per cent. advance demanded by the men. They declare that the price of coal will not permit of any increase in wages, and they add further that the twenty-eight days' notice given by the men is illegal, and cannot be acted upon.

In addition to the orders for railway material noted last week, I find that the Caledonian Railway Company has ordered 1000 wagons from Mr. S. J. Claye, of Barrow-in-Furness, and another 500 wagons are being tendered for on account of the same company. The Glasgow and South-Western Railway have ordered 300 pairs of axles and wheels from Messrs. Craven Brothers, Darnall Works, Darnall, Sheffield, and Messrs. Baker and Burnett, Conisborough. The Lancashire and Yorkshire Railway have placed an order for 580 pairs of wheels and axles from the Leeds Wheel and Axle Company, and have invited tenders for 1500 more pairs. 1100 wagons are at present in course of construction for the North British Railway by local and other builders. Heavy traffics must be anticipated by these Scotch companies.

At this season of the year the agricultural machine and implement makers give out their contracts for the year, and the greater part of the work has come to Sheffield, as in former years. There is a particularly brisk demand for boiler plates on this account.

I have to note an important change in the building of our warships. An order has been received by the Atlas and Cyclops Works for two-inch composite deck plates for H.M.S. Collingwood. Up to this order the deck or skin plates have been made of iron or steel; but the Admiralty, after experiments, have discovered certain advantages in composite plates for decks, and have resolved to apply the same principle to decks as to the sides of war-ships. In oblique firing it has been found that shot will almost glance off a composite plate, while it would enter or crack an ordinary plate of iron, and maybe of steel. This information about the "new departure" of the Admiralty in the adoption of composite plates comes to me from a reliable quarter, and may be accepted as authentic.

The severe frost of the last fortnight has proved a good thing for skate makers. Three capital seasons—1877-8, 1879-80, 1880-81—have enabled the manufacturers to make up for adverse years when frost was rare, and did not last long enough to "move" the accumulations on their shelves. This season the demand has been something extraordinary, and it has not been confined to English-made skates, but to the American and other inventions.

A meeting of the shareholders in the Sheepbridge Coal and Iron Company, Limited, was held here on Monday. The resolutions referred to in my last—to increase the share capital by £245,000, and subdivide £100 stock into £25 shares—were agreed to. Mr. H. D. Pochin, of Conway, who presided, stated that the company was formed in 1864, with a capital of £500,000. The works at Sheepbridge then consisted of four blast furnaces, two acres of coal—nearly the whole of which was sub-let to tenants—some ironstone mines in different districts, and also a foundry. At that time their furnaces were producing less than 200 tons of pig iron per week each, or 800 tons per week as the maximum production. The coal that could then be drawn from the Sheepbridge pits did not exceed 200 tons a-day. They had now seven blast furnaces, producing very nearly 1500 tons of iron per week, and there was another blast furnace which could be put into operation at a very early date. In addition they have now a forge for producing wrought iron, brick works, coke ovens, and other additions which had cost the company £232,000. The chairman further explained that the new capital was necessary for the vigorous working of the new ironstone field and collieries they had acquired. At Newstead they proposed to double the get of coal, at Langwith to get 1000 tons a day instead of 400, and at Glapwell they proposed to spend £50,000 to £60,000. With the remainder they proposed to pay off, as far as they could, the debentures of the company. The meeting was a very unanimous one, and the proposals of the directors appeared to be generally satisfactory to the shareholders. With a return of good times there is no reason why Sheepbridge should not be as profitable a concern as it was a few years ago.

At the Canal Steel Casting Works, Blast Lane, since October last, Messrs. Hansell and Co. have effected considerable alterations, and erected several improved steel furnaces and foundries for the manufacture solely of genuine crucible cast steel castings for machinery and mining purposes. For these the firm claim special excellence for soundness, with toughness. These works have been partly used for this trade for some time back, but are now entirely devoted to their "special" steel casting business.

THE NORTH OF ENGLAND.

(*From our own Correspondent.*)

THE attendance at Middlesbrough iron market was, on Tuesday, quite up to the average, but the amount of business actually done was very small indeed. The severity of the weather has been telling a tale, in the way of stopping consumption and distribution. Owing to the closing, by ice, of the North of Europe sea ports, and of the Forth of Clyde canal, shipments, foreign and coastwise, have fallen off considerably. The result is an increased accumulation of stocks, especially of those belonging to smelters, and a tendency towards weaker prices. Warrant purchasers have also become scarce for the moment, for all such expect, by waiting, to do better from their point of view. The shipyards and manufactured ironworks have been seriously impeded by the frost. At the former it has been almost impossible to proceed with outdoor work. Men cannot safely handle iron when the thermometer stands at zero or thereabouts. It takes the skin off the hands just as excessive heat would, and, indeed, the effect is described by the artisans as "scalding." At the rolling mills there have been two difficulties, viz., firstly, the usual one of burst, or stopped up, water pipes; and, secondly, the scarcity of coal. The latter arises from the lessened quantity brought to bank at the pits, and from extra difficulty in working the railway traffic. Engines coming from the collieries have all been bringing lessened tram-loads, and a temporary scarcity at the points of consumption is the natural result. The effect of these impediments upon the pig iron market has been to flatten it, because the blast furnaces continue unerringly to turn out their daily quantities whatever may be the position of consumers. The same causes have, doubtless, been producing the same effects at Glasgow, and the consequent flatness of that market has not helped its Middlesbrough rival. No. 3 foundry iron may be said to be 40s. 9d. for prompt delivery and 42s. over the first three months. Still more is asked for the second quarter. In fact, in the present state of mind of most producers, every additional month of postponement is worth some addition to the selling price. Connal's Middlesbrough stores now contain 132,434 tons, or 1690 tons more than a week since. At Glasgow their stock is 507,854 tons, and is said to be increasing by 900 tons daily.

In finished iron the market is quiet and steady. The price of plates varies from £6 15s. at works for shipbuilding iron in large lots to £7 per ton at works for smaller lots or less favourable specifications. Few sales are, however, being made, though there is not a little inquiry. Producers and consumers have, to a great extent, both completed their arrangements for the first and second quarters, and they cannot agree about price for the second and third quarters. Angle iron is £5 17s. 6d. to £6 at works, and bar iron £5 15s. to £5 17s. 6d. Mr. Walterhouse's returns for the sliding scale will be issued shortly, and it is expected by those who are most intimately acquainted with the trade that they will result in a reduction of wages, though not to a great extent. There seems to be little doubt that the average value of the contracts of last quarter was less than of those of the preceding quarter. The Cleveland Ironmasters' Association has elected Mr. William Hanson, of the firm of B. Samuelson and Co., president for the current year. Mr. Hanson is well fitted for such a post, and his appointment has given general satisfaction.

Notwithstanding the extraordinarily prosperous state of the North-Eastern Railway, the directors have so far refused to listen to the petition of the Middlesbrough Town Council and the Middlesbrough Chamber of Commerce, to remit or defer the proposed increase of rates on mineral traffic. It has now been determined to send a deputation of ironmasters and mineowners to wait upon them, and to induce them if possible to modify their decision. Meanwhile the extraordinary success of the Hull and Barnsley project, and the irritation which exists against the North-Eastern Company on the above and other accounts, is causing a feeling to arise in favour of inviting the Midland Railway Company to extend its lines into the Cleveland district, as it is said this might easily be done; and there seems every reason to believe it will be attempted unless the North-Eastern Company show a more conciliatory spirit, and are a little less exorbitant in their idea of profits.

The miners at Brotton, in Cleveland, are doing their very best to bring arbitration into disrepute, and to leave their employers no resource but coercion. A dispute arose some time since as to the tonnage rate at which they were to be paid for working ironstone. The general rate of the district varies by a sliding scale mutually adopted about twelve months since. At the last adjustment there was a slight reduction, which the Brotton men resisted on the ground of the special difficulty of working certain parts of that mine. The matter was referred to the final decision of Mr. G. B. Foster, a well-known mining engineer at Newcastle-on-Tyne. After hearing all the arguments on both sides, Mr. Foster gave his decision a few days since. This does not appear to have pleased the men, who at once struck work. Meetings have been held, and their representatives, Messrs. Toyne and Dunn, have done their utmost to point out the injustice and folly of the position they are adopting. All was, however, of no avail. After listening quietly to the speeches of their officers, they decided, by 166 to 35, to continue the strike. The disposition so frequently shown by English workmen to break away from contracts into which they have voluntarily entered is a sad and a serious thing. In the above, and similar cases, they practically constitute themselves into a court of appeal to review the decisions of the referee, notwithstanding that they are parties to the dispute. They not only do this, but they straightway put their own sentence, in their own favour, into execution. Such proceedings are so absurd that they would not be intelligible on any other ground than the ignorance and imperfect civilisation of the perpetrators. In exhibiting themselves in this light to the world, they are injuring themselves in more ways than one. They are not only losing their wages and crippling their pay-masters, but they are helping amazingly their political antagonists. When the approaching attempt at extending household franchise to the counties is really made, there will not be wanting those who point to Brotton, and say with much force, "Are such men as these worthy of the franchise?"

The "Hunning" telephone has been for some time on trial in Middlesbrough. It was laid down about ten months since between the offices of Messrs. Stevenson, Jaques, and Co., and their furnaces at North Acklam, which are one mile, and their mines at Boosbeck, which are fourteen miles distant. So satisfactory has been the result that it has now been decided to extend the wires to the inmost recesses of the mines. The Gower-Bell telephone, the one adopted by the Government postal department, has also been exhibited at Redcar. There is no question as to the efficiency of either of the above for use within certain limits of distance. The disadvantage is likely to be the absence of any record of messages passing, and therefore the greater need to have only attendants who are absolutely trustworthy.

NOTES FROM SCOTLAND.

(*From our own Correspondent.*)

THE Glasgow iron market has again fluctuated this week, and it still continues to feel the burden of the large and constantly increasing stocks. There is undoubtedly a strong feeling, however, among speculators that the prospects of the trade are such as to justify investments in warrants at present prices. Large transferences of warrants have accordingly taken place, and it is reported that the bankers do not hesitate to accept warrants just now as very reputable securities. Since last report close upon 4000 tons of pig iron have been added to the stock in Messrs. Connal and Co.'s stores, which now contain upwards of 508,000 tons. There are 123 furnaces in blast, as against 104 at the same date last year, the production thus being much larger, while the exports are not so good as in January, 1880. The last return of the pig-iron shipments shows them a little better than in the preceding week, although they are yet below the mark. The arrivals from Middlesbrough having been interfered with by the freezing of the Forth and Clyde Canal, are smaller than they were last week, and show a total decrease since Christmas of about 8000 tons. Some merchants report a rather improved inquiry for pig iron from the Continent, where prices are higher; but the trade with the United States just now is small, and comparatively unremunerative.

Business was done in the warrant market on Friday forenoon at from 53s. 5d. to 53s. 6d. cash and 53s. 7d. to 53s. 8d. one month; the afternoon quotations being 53s. 6d. cash and from 53s. 7½d. to 53s. 8d. one month. The market was flat on Monday, with quotations down to 52s. 6d. cash and 52s. 8d. one month. Tuesday's business was from 52s. 5d. cash and 52s. 7d. one month to 52s. 11d. cash and 53s. one month. The market was flat on Wednesday, and to-day—Thursday—it was marked by a quiet feeling, with business from 53s. 1d. cash to 52s. 2½d. one month, and 52s. 11d. cash to 53s. 1d. one month.

The quotations for makers' iron are rather firmer. There has been a good demand for No. 3. Gartsherrie, free on board at Glasgow, No. 1, is quoted by merchants at 63s.; No. 3, 54s.; Coltness, 63s. 6d. and 54s.; Langloan, 63s. and 54s.; Summerlee, 63s. and 54s.; Calder, 62s. 6d. and 54s. 6d.; Carnbroe, 59s. and 54s.; Clyde, 54s. 6d. and 52s.; Monkland, 54s. and 52s.; Quarter, do. do.; Govan at Broomielaw, 54s. and 52s.; Shotts at Leith, 63s. 6d. and 55s.; Carron at Grangemouth, No. 1, 55s. 6d.; ditto, specially selected, 57s.; No. 3, 53s. 6d; Kinniel at Bo'ness, 54s. 6d. and 51s. 6d.; Glengarnock at Ardrossan, 59s. and 54s. 6d.; Eglinton, 54s. and 51s.; Dalmellington, 54s. and 51s.

The malleable works are well employed and the steel works are likewise busy, but there is no change in the values of manufactured iron and steel.

At present there is a large trade in coals, but it is not very remunerative owing to the excessive competition, and the heavy output expenses necessitated by too many pits being in operation. The domestic inquiry has been good and the shipments are increasing. A large quantity of coals is consumed at the ironworks, but the inquiry for steam coals is not quite so brisk. The shipping trade in coals at some of the eastern ports has been rather backward whilst in the west it is generally good.

At a conference of miners' delegates in Glasgow on Monday—Mr. Gillespie, of Stirling and Linlithgow, presiding—it was reported that in the districts represented, the colliers were, as a rule, getting steady employment. The conference adopted a resolution strongly advising the men not to agree to contract themselves out of the Employers' Liability Act, and also counselled the miners to press their employers for an immediate advance of wages to the extent of 6d. per day.

The Mining Institute of Scotland met at Hamilton a few days ago under the presidency of Mr. Ralph Moore, inspector of mines, when discussions took place on a paper by Mr. J. T. Robson.

assistant inspector, "On Accidents by Falls from Roof and Sides of Coalpits," and a paper by Mr. Robert Calderwood, descriptive of the South Staffordshire thick coal. Mr. J. S. Dixon, mining engineer, subsequently contributed a paper on a system of screening coal, and the president called attention to the waste of labour incurred by the present mode of trimming the tops of wagons.

The shipbuilding trade of the Clyde continues active, and fresh contracts are being received. Among the latest booked are those obtained by Messrs. Scott and Co., of Cartsdyke, Greenock, for several vessels to different parties, aggregating 6000 tons.

The exports of gunpowder from Glasgow during the past year amounted to 1,434,000 lb., valued at £30,150, of which 395,000 lb. went to Melbourne, 310,000 lb. to Sydney, 70,000 lb. to Adelaide, 150,000 lb. to South America, and 50,000 lb. to Singapore.

WALES & ADJOINING COUNTIES.

(*From our own Correspondent.*)

Trade is stopped this week. On Tuesday evening most of the trains were discontinued, the Brecon train failed to start for its destination; Swansea and Neath traffic was almost closed, and a greater part of the London and North-Western. The same evening the Cyfarthfa colliers were unable to leave the pits for home until near 8 p.m., and then only by a passenger train on the Taff Vale line. The same condition of things prevails all over the country, so that the weekly totals will be seriously lessened. All vessels weather bound.

Last week there was one of the biggest totals known at Cardiff, 103,000 tons alone were cleared for foreign destinations, leaving out bunker coal and coastwise which would have made up another 30,000 tons. On one day, Friday last, the Cardiff Customs'-house entry was 30,000 tons, one of the largest one day's totals known. Similar briskness in proportion marked the coal trade at Newport and Swansea. The French trade is in a healthy state, and large demands are coming in from the East Indies, Brazils, and River Plate. Prices very firm.

The iron, steel, and other branches of trade are in a good brisk condition. Prices are firm and are decidedly looking up.

I have just heard that an American buyer who speculated largely at the last "boom," has notified to his agents in Wales that he is on his way again to this country, and I happen to know that large transactions have already taken place on the strength of his coming. Hematite pig has been sold freely at £3 7s. 6d. f.o.b., and good orders are in hand. Pig is at present in free demand, but some works are better placed than others, the old-fashioned iron pig containing too much phosphorus for tin-plate operations, raising blisters, for instance, on the plate. Within a fraction, 5000 tons of iron and steel left the Welsh ports last week.

I hear of possible extensions at Dowlais, possibly on a large scale. The great sinking at Bedlinog still continues unsatisfactory. The intention seems to be to plod on until some good workable seam is reached. Operations have been suspended on the Caerphilly, Newport, and Rhondda line, also on the Clydach. A petition has been lodged against the junction of the Taff, Midland, and London and North-Western. This is in connection with the Rhondda. The Swansea railway movement in connection with this famous coal district is going on hopefully.

I had an interview with the secretary of the Miners' Permanent Fund a day or two ago, and was glad to learn that it is being slowly but hopefully established. Lord Bute has paid his first contribution to the society, and other sums are coming in from employers and honorary members. Nor is this all, four workmen are already recipients of weekly payments from the society. Its thorough establishment is only a question of time. That it is imperatively needed I have fullest evidence to show. More than a thousand accidents happened in Welsh collieries in 1879, and this in spite of enactment and personal care.

One of the largest managers in the Rhondda district describing the appliances at work, and the vast amount of gas which has to be contended with, says we cannot expect to avoid accidents, or to escape these disastrous explosions. The only thing we can do, with our best efforts, is to keep them at a minimum.

The employers are now vigorously prosecuting all reckless colliers. Two cases occurred this week, one at Pentre, the other at one of the Powells Duffryn collieries at Mountain Ash—men found with pipes and matches in their possession. In all cases fines were inflicted. There is to be no screening from just punishment in future. Since employers are to be liable for accidents due to any proved shortcomings on their part, they will see that the shortcomings of the men shall be minutely watched.

As my despatch is leaving, I hear of great damage at the Welsh ports—steamers and sailing ships blown ashore, and the loss already in the case of Cardiff shipping has been estimated at many thousands of pounds sterling.

The patent fuel trade is well maintained, and over 3000 tons left Cardiff last week. In answer to inquiries, there are several leading works at Cardiff or in the neighbourhood. One of the principal is the "Crown." This week the company was fined for "smoke nuisance."

Rails, steel, are firm at £6 7s. 6d. to £6 12s. 6d.; bars, £5 to £5 5s. Good orders on Indian account booked at these figures.

"Warning" has again been issued to the colliers, suggesting extreme care on account of barometrical depressions.

South Kensington Museum.—Visitors during the week ending Jan. 15th, 1881:—On Monday, Tuesday, and Saturday, free, from 10 a.m. to 10 p.m., Museum, 11,483; mercantile marine, building materials, and other collections, 3734. On Wednesday, Thursday, and Friday, admission 6d., from 10 a.m. till 4 p.m., Museum, 1687; mercantile marine, building materials, and other collections, 387. Total, 17,291. Average of corresponding week in former years, 16,209. Total from the opening of the Museum, 19,649,961.

THE PATENT JOURNAL.

Condensed from the Journal of the Commissioners of Patents.

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

Applications for Letters Patent.

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

11th January, 1881.

121. Furnaces, W. P. Thompson.—(*J. G. McAuley, Denver.*)
122. Balloons, T. Martin, Guildford.
123. Fastening Handles, F. Ryland, West Bromwich.
124. Raising, &c., Apparatus, H. Meinecke, Breslaw.
125. Gas Engines, H. J. Haddan.—(*H. Nix and C. O. Helbig, Lindenau-Leipzig.*)
126. Eyelet Tape, W. Pretty, jun., Ipswich.
127. Revolving Shutters, J. Stones, T. Kirby, and E. Phillips, Lancashire.
128. Fastenings, W. H. Chase, London.
129. Galvanic Batteries, J. H. Johnson.—(*C. Faure, Paris.*)
130. Pail, W. Martin, Manchester.
131. Valves, J. N. Rowe, Tuebrook.
132. Harbours, &c., S. Lake & T. W. Taylor, London.
133. Caissons, &c., S. Lake and T. W. Taylor, London.

12th January, 1881.

134. Tools, &c., J. M. Bibbins, London.
135. Stone-breaking Machines, W. Taylor, Leicester.
136. Paving, W. Page, London.
137. Withdrawing, &c., Plugs, J. Reffit and W. Irwin, Leeds.
138. Treating Textile Materials, H. J. Haddan.—(*S. Godchaux, Luxemburg.*)
139. Relieving Strains, C. Mace, Sunderland.
140. Preserving Substances, T. F. Wilkins, London.
141. Kilns, J. Briggs, Clitheroe.
142. Treating Seaweeds, E. C. C. Stanford, Glasgow.
143. Picks, Axes, &c., T. Brown, Sheffield.
144. Waterproof, &c., Fabrics, W. R. Lake.—(*D. M. Lamb, New York, U.S.*)
145. Covering Water-closet Seats, W. R. Lake.—(*M. Bounefond, Paris.*)
146. Heating Feed-water, R. Cundall, Thornton.
147. Securing Apparatus, J. Betjemann, London.
148. Venetian Blinds, J. Friborg, London.
149. Rowlocks, S. S. Hazeland, Cornwall.
150. Propelling Apparatus, R. C. Nicholl, Streatham.
151. Microscopes, F. H. Wenham, London.
152. Electric Batteries, J. A. Lund, London.
153. Lamps, A. Muirhead and J. Hopkinson, London.
154. Iron and Steel, J. A. Huggett, London.
155. Tools, I. Whitehouse, Bridgtown.
156. Furnaces, J. H. Johnson.—(*M. Perret, Paris.*)
157. Colouring Materials, J. Young, jun., Kelly.
158. Ornaments, &c., L. A. Groth, London.

13th January, 1881.

159. Checking, &c., Apparatus, S. Fynn, London.
160. Carriages, R. B. Butcher, Frome.
161. Regulating Tension of Fabrics, W. Birch, Salford.
162. Ventilating Apparatus, T. Rowan, Ryde.
163. Boats, H. E. Newton.—(*N. Barney, Bergen Point.*)
164. Glazing Roofs, J. Mellowes, Sheffield.
164. Carpet Cleaning Machines, J. H. Johnson.—(*W. McArthur, Philadelphia, U.S.*)
166. Stoppers for Bottles, J. Wilkinson, Swinton.
167. Packing, C. A. Maynard.—(*F. Walton, Lyons.*)
168. Packings, H. J. Haddan.—(*C. C. Jerome, Chicago.*)
169. Planing, &c., Wood, G. Richards, Manchester.
170. Finishing Round Bars, W. H. Brown, Sheffield.
171. Furnace Bars, C. Whitfield, Newcastle-on-Tyne.
172. Drying Cloth, W. L. Wise.—(*J. Varinet, Paris.*)
173. Waterproof, &c., Materials, W. R. Lake.—(*D. M. Lamb, New York, U.S.*)
174. Knife, J. Briggs, Leeds.
175. Heating Apparatus, R. Jackson, Leeds.
176. Hand Stamps, G. K. Cooke and E. Hurles.—(*E. Gumbs, New York, U.S.*)

14th January, 1881.

177. Motive-power, J. Imray, London.
178. Sifting Apparatus, C. Pieper.—(*A. Nagel and R. Kaemp, Hamburg.*)
179. Food, &c., E. Jackson and J. Kershaw, London.
180. Gas Engines, W. Foulis, Glasgow.
181. Husking Rice, J. H. C. Martin, Walthamstow.
182. Metallic Compounds, H. Hutchinson, Dulwich.
183. Fastening Doors, A. Ross and S Palmer, Larne.
184. Carbonate of Potassium, E. P. Alexander.—(*C. R. Engel, Paris.*)
185. Furnaces, G. Love, jun., Lanchester.
186. Wood Screws, A. M. Clark.—(*J. Eckford, San Antonio, U.S.*)
187. Masting and Rigging Boats, &c., A. M. Clark.—(*J. McLeod, New York, U.S.*)
188. Sewing Machines, J. C. Mewburn.—(*E. Antoine, France.*)
189. Taps or Valves, J. K. Starley, Coventry.
190. Treating Caoutchouc, &c., E. Edmonds.—(*G. M. Mowbray, North Adams, U.S.*)
191. Looms, J. Northrop, Millholm Shed.
192. Spinning, &c., Cotton, J. Mounsey, Bolton.
193. Variable Speed, &c., W. Mather.—(*Shaeffer, Lalance, and Co., Lutterbach.*)
194. Cakes, &c., W. R. Lake.—(*J. H. Mitchell, Philadelphia, U.S.*)
195. Close Stoves, H. Doulton & W. P. Rix, London.
196. Flue Tubes, J. A. & J. Hopkinson, Huddersfield.
197. Treating Saccharine Liquids, W. R. Lake.—(*G. B. Boomer, New York, U.S.*)

15th January, 1880.

198. Sheaf-binding, &c., Machines, E. G. C. Bomford, Fladbury, and H. J. H. King, Newmarket.
199. Steering Gear, J. K. Kilbourn, Brixton, and G. Fossick, Stockton-on-Tees.
200. Electricity, J. Imray.—(*G. E. Cabanellas, Paris.*)
201. Mills, H. J. Haddan.—(*B. Touya, France.*)
202. Fog Signals, H. A. Bonneville.—(*F. Brown, New York, U.S.*)
203. Stop Valves, J. Dewrance & G. H. Wall, London.
204. Brake Gear, B. Lefebure, South Lambeth.
205. Condensing, &c., Apparatus, T. Rayner, London.
206. Furnaces, E. A. Barry, Clewer.
207. Steam Engines, &c., T. Robertson, Glasgow.
208. Textile Fabrics, R. W. Morrell, Bradford, and J. Shaw, Wakefield.
209. Candles, &c., E. G. Brewer.—(*F. M. Joly, Paris.*)
210. Beds or Couches, G. Lowry, Salford.
211. Sizing, &c., Worsted, C. Anderson, Leeds.

17th January, 1881.

212. Revolving Flats, J. Waterhouse, Bolton.
213. Bobbins, H. Boden and S. Whitehurst, Derby.
214. Furnaces, H. Tooth & A. Wilson, Middlesbrough.
215. Boring, &c., Machinery, B. Sutcliffe, Halifax.
216. Engines, J. F. Dyson, Stainland.
217. Separating Cinders & Ashes, T. Williams, London.
248. Electric Light, J. E. H. Gordon, Dorking.
219. Digging Land, W. E. Crossby, Chelmsford.

Grants and Dates of Provisional Protection for Six Months.

3514. Cylinders, &c., W. Payton, Masbro-road, Brook-green, London, and A. Wilson, Wandsworth-road, London.—*30th August*, 1880.
4040. Holding Flight Feathers, M. Arnold, Whitethorns, Acton.—A communication from P. Voitellier, Mantes, France.—*5th October*, 1880.
4134. Signalling Apparatus, E. Guende, Cavaillon, France.—*12th October*, 1880.
4242. Regulating Apparatus, W. R. Lake, Southampton-buildings, London.—A communication from M. G. Wilder, Brooklyn, U.S.—*18th October*, 1880.
4546. Switches, &c., of Railways, C. W. Hartley, Bradford.—*6th November*, 1880.
4722. Bricks, F. Wirth, Germany.—A communication from C. Grünzweig and P. Hartmann, Germany.—*16th November*, 1880.
4784. Alimentary Material, J. McWilliam, Mansion House-chambers, London.—A communication from A. W. Armstrong, New York.—*19th November*, 1880.
5071. Light-preserving Composition, N. Chevalier, Hyde Park, London.—*6th December*, 1880.
5082. Velocipedes, A. Kirby, Harpur-place, Bedford.—*6th December*, 1880.
5087. Separating Apparatus, G. Wilson, Parliament-street, Westminster.—*7th December*, 1880.
5253. Gun Carriages, F. C. Glaser, Berlin.—A communication from O. Krell, Russia.—*15th December*, 1880.
5255. Spinning, &c., Wool, J. B. Farrar, Halifax, and W. Lumb, Mytholmroyd.—*15th December*, 1880.
5257. Burners, &c., J. L. Corbett, Glasgow.—*15th December*, 1880.
5259. Cutters or Tools, C. G. Elrick, Aberdeen.—*15th December*, 1880.
5261. Preparing Cotton, &c., for Spinning, R. Southworth, Bolton.—*15th December*, 1880.
5263. Colouring Matters, J. H. Johnson, Lincoln's-inn-fields, London.—A communication from A. Baeyer, Munich University.—*15th December* 1880.
5265. Sheathing Metal Busks, W. R. Lake, Southampton-buildings, London.—A communication from M. H. Fouillet-Chevance, Paris.—*15th December*, 1880.
5267. Fastenings for Neckties, &c., E. de Pass, Fleet-street, London.—A commuication from S. Hayem, Boulevard St. Denis, Paris.—*15th December*, 1880.
5269. Locomotive Engines, J. R. Wigham, Capel-street, Dublin.—*15th December*, 1880.
5271. Registering Apparatus, W. R. Lake, Southampton-buildings, London.—A communication from T. M. Vieillemard, Paris.—*15th December*, 1880.
5275. Electric Lighting, D. G. FitzGerald, Brixton.—*16th December*, 1880.
5277. Churns, C. E. Ahlborn, Hildesheim, Germany.—*16th December*, 1880.
5279. Drying, &c., Yarn or Thread, T. P. Miller, Cambuslang Dye Works.—*16th December*, 1880.
5281. Working Traffic, J. S. Hughes, Portmadoc.—*16th December*, 1880.
5283. Pulley Blocks, W. R. Lake, Southampton-buildings, London. — A communication from H. Loud, Everett, U.S.—*16th December*, 1880.
5285. Tricycles, &c., J. Steele, Birmingham.—*16th December*, 1880.
5287. Sulphate of Alumina, B. E. R. Newlands, East Ham.—*17th December*, 1880.
5289. Wheel Brake, G. M. F. Molesworth, Northdown Hall, Bideford.—*17th December*, 1880.
5291. Shuttles, J. H. Pickles, Burnley.—*17th December*, 1880.
5293. Furnaces, &c., E. P. Alexander, Southampton-buildings, London.—A communication jrom C. Nikiphoroff, Paris.—*17th December*, 1880.
5295. Window Sashes, &c., W. Phillips, Leeds.—*17th December*, 1880.
5297. Tramways, W. F. Clarke, Lucan, and A. Ward, Hawarden.—*17th December*, 1880.
5299. Caloric Engines, M. P. W. Boulton, Tew Park, Oxford.—*17th December*, 1880.
5301. Motive-power, E. W. Hughes, the Grove, Camberwell, London.—*17th December*, 1880.
5303. Ventilating Apparatus, T. Rowan, Ryde.—*17th December*, 1880.
5305. Sheet Metal, H. R. Minns, Southampton-buildings, London.—*17th December*, 1880.
5307. Rotary, &c., Motion, J. Frearson, Birmingham.—*18th December*, 1880.
5309. Compound for Decorating Vitreous Surfaces, O. Vallette, Paris.—*18th December*, 1880.
5311. Cans, &c., W. W. Marsden, Wirksworth.—*18th December*, 1880.
5313. Metallic Alloys, &c., G. A. Dick, Cannon-street, London.—Partly a communication from C. J. A. Dick, Philadelphia, U.S.—*18th December*, 1880.
5315. Tacks, &c., E. P. Alexander, Southampton-buildings, London.—A communication from W. R. Clough, Newark, U.S.—*18th December*, 1880.
5317. Tram Rails, &c., C. Dunscombe, Liverpool.—*18th December*, 1880.
5323. Protecting Copper Pipes, T. Redwood, Bloomsbury-square, London, and T. F. Blackwell, Soho-square, London.—*18th December*, 1880.
5325. Feeding Racks, C. Y. Campbell, Barbreck.—*18th December*, 1880.
5329. Jacquard Apparatus, J. Irving, Barnsley.—*30th December*, 1880.
5331. Shaping, &c., Felt Bats, J. Eaton, Stockport.—*20th December*, 1880.
5333. Valves and Shafts, &c., C. R. Stevens, Lewisham.—*20th December*, 1880.
5339. Finishing Silk Hats, D. M. Easton, Arcola, U.S.,—*20th December*, 1880.
5341. Imitation Leather, G. W. von Nawrocki, Germany.—A communication from E. Fischer, M. E. Cohn, and Wollheim, Germany.—*20th December*, 1880.
5343. Weighing Machines, &c., W. B. Avery, Birmingham.—*20th December*, 1880.
5347. Engines, S. Robinson, Westbromwich.—*21st December*, 1880.
5349. Castrating Instruments, J. Scott, Craigends.—Partly a communication from G. L. Matthew, New York, U.S.—*21st December*, 1880.
5351. Surface Condensers, I. R. Blumenberg, Chancery-lane, London.—*21st December*, 1880.
5353. Cases or Tubes, E. M. Dixon, Newton Heath.—*21st December*, 1880.
5355. Converter Linings, H. Wedekind, Fenchurch-street, London.—A communication from H. Bollinger, Milan.—*21st December*, 1880.
5357. Boxes, &c., P. Lawrence, Farringdon-road, London.—*21st December*, 1880.
5359. Boots and Shoes, L. F. de Cuignièr and J. N. Lang, Hoxton, London.—*21st December*, 1880.
5361. Wood-turning Machine, W. R. Lake, Southampton-buildings, London.—A communication from F. Hanson, Hollis Maine, U.S.—*21st December*, 1880.
5365. Basic Fire-bricks, &c., A. M. Clark, Chancery-lane, London.—A communication from J. B. M. P. Closson, Paris.—*21st December*, 1880.
5367. Wood-turning Machinery, W. R. Lake, Southampton-buildings, London.—A communication from F. Hanson, Hollis Maine, U.S.—*22nd December*, 1880.
5369. Combing Machinery, A. Smith, Bradford.—*22nd December*, 1880.
5371. Valves, Cocks, &c., J. B. Denans, Paris.—*22nd December*, 1880.
5373. Spades, &c., J. M. Parsons, Wolverhampton.—*22nd December*, 1880.
5375. Looms, E. Smethurst, Manchester.—*22nd December*, 1880.
5379. Scissors, J. F. E. Mullett, Ivy Lodge, East Acton.—*22nd December*, 1880.
5381. Barrels, W. Morgan-Brown, Southampton-buildings, London.—A communication from E. and B. Holmes, Buffalo, U.S.—*22nd December*, 1880.
5383. Ships, &c., J. Tangye, Birmingham, and R. J. Cunnack, Helston.—*22nd December*, 1880.
5385. Extracting Gold, W. R. Lake, Southampton-buildings, London. — A communication from O. Bailey, White Cloud, U.S.—*22nd December*, 1880.
5387. Micro-transmitters, W. Johnson, Sheffield.—*22nd December*, 1880.
5389. Extracting Apparatus, A. M. Clark, Chancery-lane, London.—A communication from B. Odio, New York, and F. Perozo, Brooklyn.—*22nd December*, 1880.
5391. Cleaning Roads, &c., F. H. F. Engel, Hamburg.—A communication from O. C. Barchmann, Hamburg.—*22nd December*, 1880.
4222. Treating Coffee, E. G. Brewer, Chancery-lane, London.—A communication from P. Pesier, Valenciennes, France.—*16th October*, 1880.
4804. Gridirons, A. C. Henderson, Southampton-buildings, London.—A communication from L. P. Mallée, Paris.—*20th November*, 1880.
4808. Closing Apparatus, G. W. von Nawrocki, Berlin.—A communication from G. T. Fischer, Stuttgart.—*20th November*, 1880.
4824. Sauces, &c., D. Henderson, Birkenhead.—*22nd November*, 1880.
4886. Dynamo-electric Machines, J. Hopkinson, Westminster-chambers, and A. Muirhead, Regency-street, Westminster.—*24th November*, 1880.
4898. Casting Metals, L. A. Groth, Finsbury-pavement, London.—A communication from F. Tellander, Stockholm.—*25th November*, 1880.
5016. Waxed Threads, J. C. Mewburn, Fleet-street, London.—A communication from E. Guillemaud, La Madeleine, France.—*2nd December*, 1880.
5056. Treating Varicose Veins, J. R. A. Douglas Hounslow.—*4th December*, 1880.
5066. Sugar, M. de la Vega and L. D'Oliveira, New York, U.S.—*4th December*, 1880.
5096. Supporting Saddles of Bicycles, J. A. Lamplugh, Birmingham.—*7th December*, 1880.
5108. Securing Ends of Wire, H. Eyre and E. Heathfield, Leadenhall-street, London.—*7th December*, 1880.
5238. Consuming Smoke, W. Hilton and T. T. Pearson, jun., Bolton.—*14th December*, 1880.
5248. Bats, S. W. Trimmings, Tufnell Park-road, London.—*14th December*, 1880.
5254. Constructing Foundations, F. W. Reeves, Eardley-crescent, London.—*15th December*, 1880.
5282. Preparing Vaniline, &c., G. de Laire, Rue St. Charles, Paris.—*16th December*, 1880.
5298. Moulding Gunpowder, &c., J. James, Princes-street, Lambeth.—*17th December*, 1880.
5304. Sewing Machines, W. L. Bigelow, Chancery-lane, London.—A communication from J. Bigelow, Philadelphia.—*17th December*, 1880.
5306. Preventing Waste of Water, T. H. Goodson, Chancery-lane, London.—A communication from H. E. T. Goodson, Berlin.—*17th December*, 1880.
5312. Heating Apparatus, W. P. Thompson, High Holborn, London.—A communication from J. Leiterr, Vienna.—*18th December*, 1880.
5314 Regulating Apparatus, F. E. A. Büsche, Schwelm, Germany.—*18th December*, 1880.
5326. Rails and Chairs, W. Brown, Smethwick.—*18th December*, 1880.
5328. Skates, T. B. Drybrough, Edinburgh.—*20th December*, 1880.
5330. Steam Engines, J. Humphrys, Barrow-in-Furness, and D. Joy, Anerley.—*20th December*, 1880.
5334. Burnishing Boots, H. J. Haddan, Strand, London. — A communication from B. F. Larrabee, Boston, U.S.—*20th December*, 1880.
5338. Bundling Chips, &c., M. Glover, Leeds.—*20th December*, 1880.
5340. Signal Apparatus, W. Morgan-Brown, Southampton-buildings, London.—A communication from G. H. Bliss, Pitsfield, U.S.—*20th December*, 1880.
5342. Motive Power Engines, E. Edwards, Southampton-buildings, London.—A communication from G. E. Böhmer, Dresden.—*20th December*, 1880.
5344. Moulding Machines, H. Wren and J. Hopkinson, Manchester.—Partly a communication from G. Sebold and F. Neff, Germany.—*20th December*, 1880.
5346. Ventilating Rooms, J. Smith, Liverpool.—*21st December*, 1880.
5348. Discharging Coal, &c., J. H. Johnson, Lincoln's-inn-fields, London.—A communication from G- W. Wood, Faribault, U.S—*21st December*, 1880.
5356. Furniture, E. de Pass, Fleet-street, London.—A communication from A. Avon, Boulevard St. Martin, Paris.—*21st December*, 1880.
5358. Protecting Corrosion, F. M. Lyte, Putney.—*21st December*, 1880.
5360. Producing Designs, &c., A. Guattari, Chancery-lane, London.—*21st December*, 1880.
5362. Regulating Apparatus, J. D. Churchill, Langdon-road, London.—*21st December*, 1880.
5364. Manganiferous Iron, P. M. Justice, Chancery-lane, London.—A communication from A. Jaumain, Monceau-sur-Sambre, Belgium.—*21st December*, 1880.
5370. Disengaging Hook, &c., J. Brown, Water-street, Liverpool.—*22nd December*, 1880.
5376. Padlocks, A. Linley, Great St. Helens, London.—A communication from G. Cooper, Buenos Ayres.—*22nd December*, 1880.
5378. Chaff-cutting Machines, C. T. Burgess, Brentwood, Essex.—*22nd December*, 1880.
5380. Wood Pulp, E. C. T. Blake, Brixton.—*22nd December*, 1880.
5382. Spectacles, G. W. von Nawrocki, Berlin.—A communication from P. Goerz, Stuttgart.—*22nd December*, 1880.
5384. Machine Guns, W. Gardner, Southampton-buildings, London.—*22nd December*, 1880.
5386. Practical Meteorology, F. H. F. Engel, Hamburg. — A communication from W. Klinkerfues, Göttingen.—*22nd December*, 1880.
5388. Wire Fencing, J. Shaw, Sheffield.—*22nd December*, 1880.
5390. Utilising Unconsumed Gases, R. Paulson, Streatfield-street, London.—*22nd December*, 1880.
5394. Bicarbonate of Soda, W. Weldon, Rede Hall, Burstow, Surrey.—A communication from A. R. Pechiney, France.—*23rd December*, 1880.
5396. Treating Ores, &c., J. H. Johnson, Lincoln's-inn-fields, London.—A communication from P. G. L. G. Designolle, Paris.—*23rd December*, 1880.

Inventions Protected for Six Months on deposit of Complete Specifications.

119. Cloth Tentering Machines, H. H. Lake, Southampton-buildings, London.—A communication from G. P. Wood, Johnston, U.S.—*10th January*, 1881.
138. Treating Textile Materials, H. J. Haddan, Strand, London. — A communication from S. Godchaux, Luxemburg.—*12th January*, 1881.
158. Architectural Ornaments, &c-, L. A. Groth, Finsbury-pavement, London.—*12th January*, 1881.

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

141. Metallic Window Frames, A. W. Itter, Shepherd's-bush.—*11th January*, 1878.
153. Engines, G. Lowry, Salford.—*12th January*, 1878.
156. Spinning, &c., Machinery, J. Dodd, Oldham.—*12th January*, 1878.
470. Screw Stock, P. Everitt, Great Ryburgh.—*5th February*, 1878.
133. Soda, &c., W. Weldon, Rede Hall, Burstow.—*11th January*, 1878.
166. Waterproof Fabrics, W. Abbott, Queen Victoria-street, London.—*14th January*, 1878.
289. Steel, &c., S. G. Thomas, Queen's-road, Battersea.—*22nd January*, 1878.
315. Knitting Machines, A. M. Clark, Chancery-lane, London.—*24th January*, 1878.
317. Glass Tubes, L. Peroni, Hatton-garden, Holborn, London.—*24th January*, 1878.
181. Cutting the Teeth of Files, W. R. Lake, Southampton-buildings, London.—*15th January*, 1878.
182. Forming the Teeth of Rasps, W. R. Lake, Southampton-buildings, London.—*15th January*, 1878.
173. Superheating Steam, B. Hunt, Serle-street, Lincoln's-inn, London.—*14th January*, 1878.
190. Differential Gearing, R. R. Gubbins, Wolverhampton, and J. Whitestone and J. S. W. Allin, London.—*15th January*, 1878.
297. Rolling Stock, W. R. Rowan, Southampton-buildings, London.—*23rd January*, 1878.
377. Wire Rope Tramways, F. Wirth, Frankfort-on-the-Maine, Germany.—*29th January*, 1878.
171. Armour plates, R. Hadfield, Sheffield.—*14th January*, 1878.
174. Treating Paper, &c., A. E. Healey, Willesden Junction.—*14th January*, 1878.
185. Paper, &c., Blocks and Articles, A. E. Healey, Willesden Junction.—*15th January*, 1878.
227. Reeds, H. Smith, Brixton.—*17th January*, 1878.
213. Forging Nuts, J. P. Scott, Manchester.—*17th January*, 1878.

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

153. CHARGING RETORTS, W. Foulis, Glasgow.—*12th January*, 1874.
202. FLOATING DOCKS, &c., J. L. Clark & J. Standfield, Victoria-street, London.—*15th January*, 1874.

Notices of Intention to Proceed with Applications.

Last day for filing opposition 4th February, 1881.

3462. WEIGHING MACHINES, T. Poseck and I. Selten, Berlin.—*26th August*, 1880.
3514. CYLINDERS, &c., W. Payton, Masbro-road, Brook-green, London, and A. Wilson, Wandsworth-road, London.—*30th August*, 1880.
3649. SOLITAIRES, &c., J. Appleby and A. L. Stamps, Birmingham.—*8th September*, 1880.
3671. WRITING INSTRUMENT, J. Nadal, Southampton-row, London.—*10th September*, 1880.
3672. BANDAGES, J. H. de Bussy, Lordship-lane, Dulwich.—Com. from C. de Mooy.—*10th September*, 1880.
3676. PRESSING APPARATUS, W. Marsh, Whitechapel, and J. Morris, Stepney.—*10th September*, 1880.
3680. SUGAR CANDY, T. Morgan, Cockspur-street, Charing Cross, London.—A communication from J. Pitman.—*10th September*, 1880.
3692. DAMASK LOOMS, W. R. Lake, Southampton-buildings, London.—A communication from J. L. Döhner.—*10th September*, 1880.
3695. GAS, J. F. Parker, Gravelly-hill, Birmingham.—*10th September*, 1880.
3703. SCREW THREADS, G. W. von Nawrocki, Berlin.—Com. from W. Erichson.—*11th September*, 1880.
3705. PURIFYING AIR, &c., J. C. W. Stanley, Barnsdale-road, London.—*11th September*, 1880.
3708. SELF-ACTING CASK-TILTERS, J. and H. J. Brookes, and E. Mason, Smethwick.—*11th September*, 1880.
3709. BOTTLES, J. Neal, Aston.—*11th September*, 1880.
3714. BEATING CARPETS, S. Simmons, St. Augustine-road, Camden-square, London.—*11th September*, 1880.
3715. TRICYCLES, S. Chatwood, Cannon-street, London.—*11th September*, 1880.
3716. SEWING MACHINES, T. Chadwick, T. Sugden, and C. Shaw, Oldham.—*13th September*, 1880.
3718. MOTIVE POWER ENGINES, W. Adair, Liverpool.—*13th September*, 1880.
3720. LIQUID METERS, H. J. Haddan, Strand, London.—Com. from P. T. y Puig.—*13th September*, 1880.
3734. SIGNALLING, A. M. Ritchie, Dundee.—*14th September*, 1880.
3736. ROLLING MILLS, G. W. von Nawrocki, Berlin.—Com. from J. Schmidt.—*14th September*, 1880.
3739. STEAM BOILERS, W. R. Lake, Southampton-buildings, London.—A communication from J. Prégardien.—*14th September*, 1880.
3752. TURNING WOOD, &c., L. Vallet, Liverpool.—*15th September*, 1880.
3756. ROLLING STOCK, J. le Clair and J. de Rees, Newport.—*16th September*, 1880.
3806. BUTTONS, H. J. Haddan, Strand, London.—Com. from N. Fritzner.—*20th September*, 1880.
3807. DRIVING BELT, &c., S. A. Dickens, St. Helen's-place, London.—A communication from O. Dickins.—*20th September*, 1880.
3823. BUTTONS, J. Cadbury, Birmingham.—*21st September*, 1880.
3839. HEATING APPARATUS, R. M. Ritchie, Edinburgh.—*22nd September*, 1880.
3873. ROLLING STOCK, G. C. Glaser, Berlin.—A communication from G. Thomas.—*24th September*, 1880.
3883. MOTIVE POWER, W. Prowett, Birmingham.—*25th September*, 1880.
3899. BREWING STOUT, &c., P. L. Manbré, Valenciennes, France.—*25th September*, 1880.
3980. MOTORS, P. Jensen, Chancery-lane, London.—Com. from E. J. Hahn.—*1st October*, 1880.
3982. PAPER, P. Ambjörn, Boulevard St. Denis, Paris.—*1st October*, 1880.
4044. STEAM ENGINES, G. F. Corliss, Rue Scribe, Paris.—Com. from G. H. Corliss.—*5th October*, 1880.
4057. DRESS STANDS, E. Eavestaff, Upper Berkeley-street, London.—*12th November*, 1880.
4706. KNITTING MACHINES, S. Thacker, Nottingham.—*15th November*, 1880.
4852. VALVES, &c., W. Bury, New London-street, Mark-lane, London.—*23rd November*, 1880.
4932. TREATMENT OF ORES, &c., F. M. Lyte, Putney, Surrey.—*26th November*, 1880.
5093. SCREW PROPELLERS, W. Cooke and D. Mylchreest, Liverpool.—*7th December*, 1880.
5272. SAWING MACHINES, R. Rayner, Liverpool.—*16th December*, 1880.

Last day for filing opposition, 22nd February, 1881

3723. LOOMS FOR WEAVING, S. D. Rhodes, Huddersfield.—*13th September*, 1880.
3735. LOCKS, W. H. S. Aubin, Willenhall.—*14th September*, 1880.
3737. EXPANDING BOILER, &c., TUBES, W. Thorburn, Luton.—*14th September*, 1880.
3748. ANNEALING BOXES, C. H. Onions, Queen-street, Wolverhampton.—*15th September*, 1880.
3749. CARDING WOOL, &c., E. Wilkinson, Marsden, Huddersfield.—*15th September*, 1880.
3750. CARBOLIC ACID, G. Wischin, Albion-terrace, Manchester.—*15th September*, 1880.
3768. TUBE-STOPPER, A. M. Clark, Chancery-lane, London.—Com. from L. G. Jobet.—*16th September*, 1880.
3779. PRESSES, C. D. Abel, Southampton-buildings, London.—Com. from W. Lorenz.—*17th September*, 1880.
3781. NAILS, H. Sharrow, Smethwick, and T. King, Birmingham.—*17th September*, 1880.
3803. RAILWAY SWITCHES, &c., W. R. Lake, Southampton-buildings, London.—A communication from J. S. Williams.—*18th September*, 1880.
3863. DAMPING TABLES, J. Harper, Clerkenwell, London.—*23rd September*, 1880.
3904. CASES, T. Heath, Hylton-street, Birmingham.—*27th September*, 1880.
3909. HEATING WATER, W. Standing, Nassau-street, Dublin.—*27th September*, 1880.
3935. TYPE-WRITING MACHINES, A. M. Clark, Chancery-lane, London.—A communication from A. M. de Costa.—*28th September*, 1880.
3936. SHACKLE, &c., INSULATORS, J. W. Fletcher, Stockport.—*28th September*, 1880.
3940. VENTILATING SEWERS, J. S., T. A., and E. R. Walker, Wigan.—*29th September*, 1880.
3999. TAKING IN, &c., CABLES, J. Taylor, Birkenhead.—*2nd October*, 1880.
4002. FURNACES OF STEAM GENERATORS, J. Salter, Manchester.—*2nd October*, 1880.
4076. REGULATING APPARATUS, W. H. Thomas, Parliament-street, London.—*7th October*, 1880.
4186. ROAD LOCOMOTIVES, J. Marshall, Gainsborough.—*14th October*, 1880.
4242. REGULATING FLOW of GAS, &c., W. R. Lake, Southampton-buildings, London.—A communication from M. G. Wilder.—*18th October*, 1880.
4367. FASTENING TUBULAR HANDLES, F. Ryland, West Bromwich.—*26th October*, 1880.
5020. SETTING BRIMS OF HATS, T. L. Sutton, Stockport.—*2nd December*, 1880.
5082. VELOCIPEDES, A. Kirby, Harpur-place, Bedford.—*6th December*, 1880.
5117. DREDGING BUCKETS, R. Hadfield, Bloomsbury, London.—*8th December*, 1880.
5252. OVERHEAD SEWING, A. Storer, Vienna.—A communication from L. Bollmann, jun., and J. Bollmann.—*14th December*, 1880.
5263. COLOURING MATTERS, J. H. Johnson, Lincoln's-inn-fields, London.—A communication from A. Baeyer.—*15th December*, 1880.
5270. ROTARY PROPELLERS, M. P. W. Boulton, Tew Park, Oxford.—*15th December*, 1880.
5279. DRYING YARN, &c., T. P. Miller, Cambuslang Dye Works, Lanark.—*16th December*, 1880.
5283. SNATCH, &c., PULLEY BLOCKS, W. R. Lake, Southampton-buildings, London.—A communication from H. Loud.—*16th December*, 1880.
5291. SHUTTLES, J. H. Pickles, Burnley.—*17th December*, 1880.
5296. SUGAR, C. D. Abel, Southampton-buildings, London.—Com. from N. Rillieux.—*17th December*, 1880.
5299. CALORIC ENGINES, M. P. W. Boulton, Tew Park, Oxford.—*17th December*, 1880.
5318. HEEL PARING MACHINE, F. Cutlau, Cardiff.—*18th December*, 1880.
5361. WOOD TURNING MACHINE, W. R. Lake, Southampton-buildings, London.—A communication from F. Hanson.—*21st December*, 1880.
5367. WOOD-TURNING MACHINERY, W. R. Lake, Southampton-buildings, London.—A communication from F. Hanson.—*22nd December*, 1880.
5390. UTILISING UNCONSUMED GASES, R. Paulson, Streatfield-street, London.—*22nd December*, 1880.
36. WIRE NAILS, H. H. Lake, Southampton-buildings, London.—A communication from J. Hitchcock and D. C. Knowlton.—*4th January*, 1881.
74. DUMPING WAGONS, W. R. Lake, Southampton-buildings, London.—A communication from W. H. Paige.—*6th January*, 1881.
119. CLOTH TENTERING MACHINE, H. H. Lake, Southampton-buildings, London.—A communication from G. P. Wood.—*10th January*, 1881.

Patents Sealed

(*List of Letters Patent which passed the Great Seal on the 14th January*, 1881.)

2556. NAILS, G. W. von Nawrocki, Berlin.—*23rd June*, 1880.
2907. WATER GAUGES, J. Ellis, Gun-square, Houndsditch, London.—*14th July*, 1880.
2933. TRAPPED GULLIES, C. W. Burge, Marylebone-road, London.—*16th July*, 1880.
2940. HEMSTITCHING MACHINES, D. McGlashan, Glasgow.—*17th July*, 1880.
2948. TEAPOT, &c., HANDLES, J. Ridge, Sheffield.—*17th July*, 1880.
2949. SHIPS' WINDLASSES, A. Steenberg, Copenhagen.—*17th July*, 1880.
2959. INFUSIONS, R. U. Etzensberger, St. Pancras, London.—*17th July*, 1880.
2971. METAL EYELETS, &c., W. R. Harris and J. G. Cooper, Manchester.—*19th July*, 1880.
2981. AERATED WATERS, D. J. Fleetwood, Birmingham.—*20th July*, 1880.
2990. STAMPING APPARATUS, A. Scherb, Vienna.—*20th July*, 1880.
3059. SAND-PAPERING WOOD, &c., M. Benson, Southampton-buildings, London.—*24th July*, 1880.
3091. WINDOW SASH, &c., BARS, J. D. MacKenzie, Glasgow.—*27th July*, 1880.
3144. COOKING PANS, &c., W. L. Wise, Whitehall-place, London.—*30th July*, 1880.
3159. WINDING APPARATUS, A. M. Clark, Chancery-lane, London.—*31st July*, 1880.
3253. HALTER ATTACHMENTS, W. Clark, Chancery-lane, London.—*9th August*, 1880.
3322. BUFFERS FOR RAILWAY LOCOMOTIVES, &c., D. N. Arnold, Solihull.—*16th August*, 1880.
3481. LOCOMOTIVE ENGINES, T. Hunt, Manchester.—*27th August*, 1880.
4091. COLOURING MATTERS, J. A. Dixon, West George-street, Glasgow.—*8th October*, 1880.
4477. FORMING JUNCTIONS OF RAILWAYS, R. P. Williams, Parliament-street, London.—*2nd November*, 1880.
4561. FURNACES, &c., F. J. Cheesbrough, Water-street, Liverpool.—*6th November*, 1880.
4599. RAILWAY VEHICLES, W. R. Lake, Southampton-buildings, London.—*9th November*, 1880.
4601. TOY MONEY BOX, W. R. Lake, Southampton-buildings, London.—*9th November*, 1880.
4649. CHAIN CABLES, S. Baxter, Mansion House-buildings, London.—*11th November*, 1880.
4665. FIRE-ARMS, W. R. Lake, Southampton-buildings, London.—*12th November*, 1880.
4753. DRESSING AXLE ARMS, J. B. Savage, Southington, U.S.—*18th November*, 1880.

List of Letters Patent which passed the Great Seal on the 18th January, 1881.)

2490. CURVING RAILWAY BARS, L. Richards, Dowlais.—*8th July*, 1880.
2775. EXPLOSIVE MATTER, A. Hellhoff, Mayence.—*7th July*, 1880.
2984. STEAM BOILERS, A. C. Henderson, Southampton-buildings, London.—*20th July*, 1880.
2986. RING FRAME BOBBINS, H. Southwell, Rochdale.—*20th July*, 1880.
3003. BRICKS, &c., E. J. Shackleton and G. J. Kemp, Dartford.—*21st July*, 1880.
3013. LIFE-SAVING, &c., DRESS, G. B. Thornton, Edinburgh.—*22nd July*, 1880.
3016. TIP-UP and PLUG BASINS, &c., C. F. Clark, Wolverhampton.—*22nd July*, 1880.
3032. CASES OR HOLDERS, C. Cheswright, Parkhurst-road, London.—*23rd July*, 1880.
3067. DOG-CARTS, &c., J. and C. G. McDowell, Warrington.—*26th July*, 1880.
3090. ROTARY ENGINES, &c., M. G., A. M., and S. M. Imschenetzki, Russia.—*27th July*, 1880.
3106. ATTACHING DOOR and other KNOBS, G. Hookham, Birmingham.—*28th July*, 1880.
3148. KNITTING MACHINES, C. Cresswell, Loughborough.—*31st July*, 1880.
3169. BRAKE APPARATUS, H. H. Lake, Southampton-buildings, London.—*2nd August*, 1880.
3458. CLOTHES WASHER and WRINGER, W. Clark, Chancery-lane, London.—*26th August*, 1880.
3563. DANDY ROLLERS, W. Green, Camberwell, London.—*2nd September*, 1880.
3620. STRAINER, &c., APPARATUS, F. N. Miller, Sunderland.—*6th September*, 1880.
3894. ELECTRO-MAGNETIC RAILROADS, P. Jensen, Chancery-lane, London.—*25th September*, 1880.
3915. BLACKING BRUSHES, A. M. Clark, Chancery-lane, London.—*27th September*, 1880.
3978. BORING, &c., MACHINERY, J. A. McKean, Covent-garden, London.—*1st October*, 1880.
4285. REPAIRING CONVERTERS, &c., S. G. Thomas, Chelsea, and P. C. Gilchrist, Redcar.—*21st October*, 1880.
4286. STOP-MOTION DOUBLING FRAMES, I. Briggs, jun., Wakefield.—*21st October*, 1880.
4395. GAS STOVES, C. A. Brodribb, Robertson-street, Hastings.—*27th October*, 1880.
4448. FIRE-GRATES, E. R. Hollands, Stoke Newington-green, London.—*30th October*, 1880.
4496. EXTRACTING METALS, &c., from ORES, W. W. Hughes, Bayswater, London.—*3rd November*, 1880.
4502. FLESH GLOVES, &c., I. Livermore, College-hill, Cannon-street, London.—*3rd November*, 1880.
4514. DEXTRINE, SUGAR, &c., W. F. Nast, Paris.—*4th November*, 1880.
4536. TIPPING WAGONS and VANS, A. G. Margetson and W. S. Hek, Bristol.—*5th November*, 1880.
4556. DRYING, &c., APPARATUS, C. D. Abel, Southampton-buildings, London.—*6th November*, 1880.
4593. FOG HORNS, A. L. Wharton and S. J. Dobson, Great Grimsby.—*9th November*, 1880.
4650. ANCHORS, &c., S. Baxter, Mansion House-buildings, London.—*11th November*, 1880.
4670. SEWING MACHINERY, W. H. Dorman, Stafford.—*12th November*, 1880.
4699. PULP STRAINER, C. Kesseler, Mohren-strasse, Berlin.—*15th November*, 1880.

List of Specifications published during the week ending January 15th, 1881.

5122, 6d.; 1597, 6d.; 1614, 6d.; 1729, 6d.; 1780, 6d.; 1901, 4d.; 1944, 6d.; 1964, 2d.; 2161, 6d.; 2248, 6d.; 2267, 6d.; 2280, 6d.; 2318, 6d.; 2319, 8d.; 2365, 8d.; 2371, 6d.; 2391, 6d.; 2392, 6d.; 2393, 6d.; 2403, 2d.; 2406, 2d.; 2407, 2d.; 2408, 6d.; 2410, 2d.; 2411, 2d.; 2412, 2d.; 2413, 6d.; 2416, 6d.; 2417, 6d.; 2420, 2d.; 2421, 2d.; 2422, 6d.; 2424, 6d.; 2425, 2d.; 2426, 6d.; 2428, 6d.; 2430, 4d.; 2432, 6d.; 2433, 2d.; 2434, 6d.; 2435, 4d.; 2436, 2d.; 2438, 2d.; 2439, 6d.; 2440, 8d.; 2441, 6d.; 2443, 4d.; 2446, 4d.; 2447, 2d.; 2448, 6d.; 2449, 6d.; 2450, 2d.; 2451, 2d.; 2452, 2d.; 2456, 6d.; 2457, 6d.; 2458, 6d.; 2460, 2d.; 2462, 6d.; 2463, 2d.; 2464, 4d.; 2466, 6d.; 2467, 2d.; 2468, 6d.; 2470, 2d.; 2471, 2d.; 2472, 6d.; 2473, 6d.; 2474, 6d.; 2476, 2d.; 2478, 2d.; 2482, 6d.; 2484, 2d.; 2485, 2d.; 2487, 2d.; 2488, 6d.; 2489, 2d.; 2492, 2d.; 2493, 6d.; 2496, 2d.; 2497, 4d.; 2499, 6d.; 2523, 6d.; 2563, 6d.; 2589, 6d.; 2630, 6d.; 2937, 6d.; 4130, 6d.; 4320, 4d.; 4345, 4d.

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

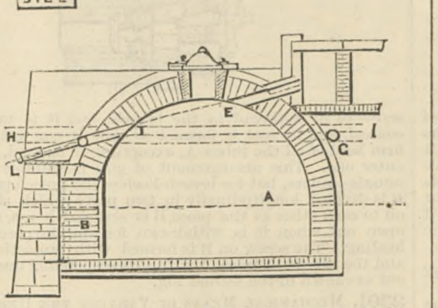
ABSTRACTS OF SPECIFICATIONS.

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

5122. OVENS FOR MAKING COKE, *A. M. Chambers.*—*Dated 15th December*, 1879. 6d.

This consists in the employment of a pipe for the admission of hot air into the coke oven, such pipe being provided with a regulating inlet valve, and its inner end being directed across the oven exactly to the centre of the exit opening to the latter, so that a single current of heated air is admitted, and traverses the oven in unbroken volume. Also, in combination with such pipe so arranged, a smaller pipe through which the condition and temperature of

5122

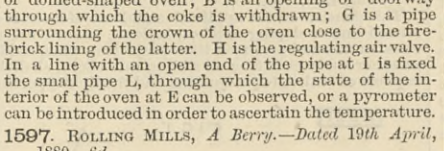


the oven are ascertained. A is the body of the beehive or domed-shaped oven; B is an opening or doorway through which the coke is withdrawn; G is a pipe surrounding the crown of the oven close to the fire-brick lining of the latter. H is the regulating air valve. In a line with an open end of the pipe at I is fixed the small pipe L, through which the state of the interior of the oven at E can be observed, or a pyrometer can be introduced in order to ascertain the temperature.

1597. ROLLING MILLS, *A. Berry.*—*Dated 19th April*, 1880. 6d.

This consists essentially in the employment of one or more twisted or rifled pipes, troughs, or boxes to cover the billet or bar from one pair or set of rolls to a second pair or set of rolls, and turn the said billet

1597

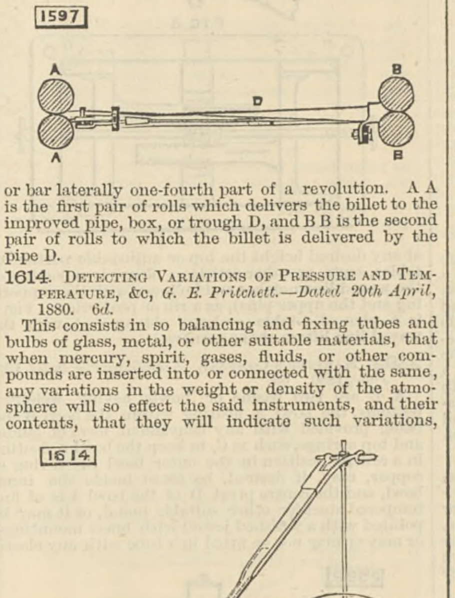


or bar laterally one-fourth part of a revolution. A A is the first pair of rolls which delivers the billet to the improved pipe, box, or trough D, and B B is the second pair of rolls to which the billet is delivered by the pipe D.

1614. DETECTING VARIATIONS OF PRESSURE AND TEMPERATURE, &c, *G. E. Pritchett.*—*Dated 20th April*, 1880. 6d.

This consists in so balancing and fixing tubes and bulbs of glass, metal, or other suitable materials, that when mercury, spirit, gases, fluids, or other compounds are inserted into or connected with the same, any variations in the weight or density of the atmosphere will so effect the said instruments, and their contents, that they will indicate such variations,

1614

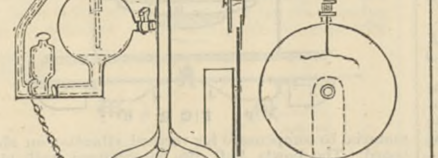


automatically or otherwise, for barometrical, thermometrical, and laboratory purposes, and other observations. Indexes or dials, or both, are attached to the said instruments, and are actuated by the motion, alteration of balance, or change of position of the instruments, and by magnetic or electric currents.

1780. APPARATUS FOR THE REMOVAL OF EARTH IN GETTING IRONSTONE, ORES, &c., *H. Rider.*—*Dated 30th April*, 1880. 6d.

A rope is strained across the space over which earth is to be transported by means of the anchor C, to which one end is attached, and near to which is a trestle D to raise the rope to a convenient height. E is a post at the other end of the space to be traversed,

1780

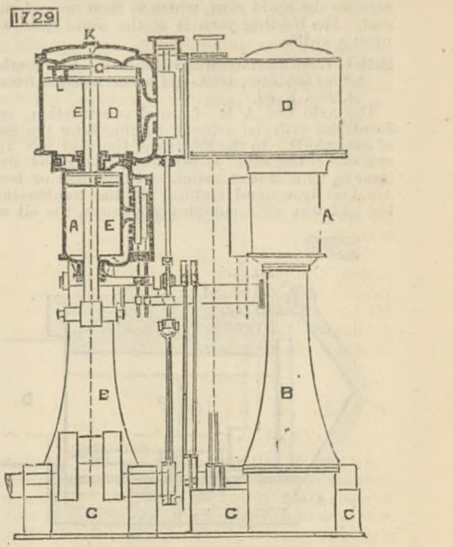


carrying a slide H, to which the other end of rope B is made fast, and capable of being moved vertically on the post E. A tub receives the earth, and it is hung from pulleys or wheels, which run on the rope. To send the tub towards anchor C, the slide H is raised by means of a chain, and for its return the slide is lowered.

1729. MARINE STEAM ENGINES, *H. B. Young.*—*Dated 28th April*, 1880. 6d.

In the drawing A is the high-pressure cylinder fixed upon the vertical frames B, which are mounted upon the engine base plate C. The low-pressure cylinder D

1729



is fixed upon the high-pressure cylinder A. E is the piston rod, upon which the high and low-pressure pistons F G are fixed. K is the low-pressure cylinder cover. A manhole with its lid L is provided in the low pressure piston.

1830. RESERVOIR LAMPS, *O. Sweeney.*—*Dated 5th May*, 1880.—(*Void.*) 2d.

The oil reservoir has at top a nozzle through which the oil enters, and fitted with a cap having a vent. Surrounding and extending some distance beneath the reservoir is a casing, between which and the reservoir is an annular space, and a chamber is formed between the bottom of the case and the reservoir, such chamber communicating with the reservoir, and through a hollow block and pipes with a lamp tube fitted with suitable burners. Within the chamber is a float free to move on a central hollow stem to which a valve is fitted.

1901. GAS-LIGHTING APPARATUS, *J. T. Dann.*—*Date 10th May*, 1880.—(*A communication from W. Effer.*)—(*Void.*) 4d.

This relates to apparatus for automatically lighting and extinguishing street and other gas lamps, in which the ignition and extinction are produced by the alternate increase and decrease of the pressure of the gas in the main.

1944. LEAD AND CRAYON HOLDERS, *M. Weill* (*administrator of J. Alfelder.*)—*Dated 12th May*, 1880. 6d.

The lead and crayon holders are constructed with the inner jaws of conical or tapered form, so that leads or crayons of various sizes may pass through and be held therein. The lead or crayon is contained in a longitudinal containing tube or channel in the case of the body of the holder, and the jaws are acted upon by the tube or sleeve, which is moved longitudinally by means of wires connected with a spring.

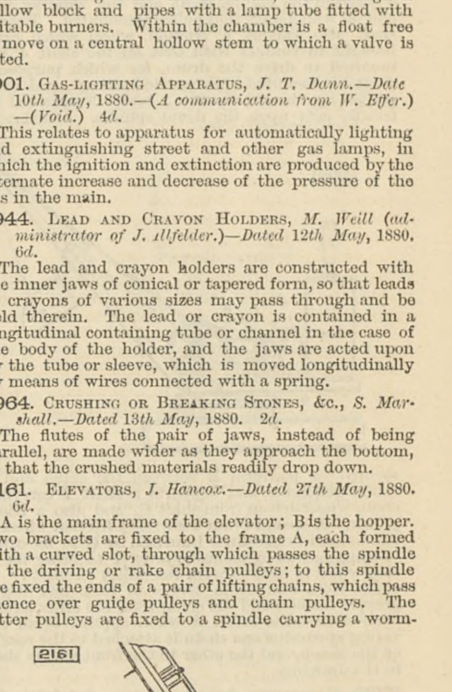
1964. CRUSHING OR BREAKING STONES, &c., *S. Marshall.*—*Dated 13th May*, 1880. 2d.

The flutes of the pair of jaws, instead of being parallel, are made wider as they approach the bottom, so that the crushed materials readily drop down.

2161. ELEVATORS, *J. Hancox.*—*Dated 27th May*, 1880. 6d.

A is the main frame of the elevator; B is the hopper. Two brackets are fixed to the frame A, each formed with a curved slot, through which passes the spindle of the driving or rake chain pulleys; to this spindle are fixed the ends of a pair of lifting chains, which pass thence over guide pulleys and chain pulleys. The latter pulleys are fixed to a spindle carrying a worm-

2161



wheel K; thus by winding up the chain by a worm gearing with the worm-wheel the trough is lifted up the slots in the brackets, the upper part of the trough being supported on pulleys L, fixed to the tops of the raising arms M, and the hopper supported or hung at the bottom on two pivots moving in iron bearings, whilst at the top are fixed hooks and chains for regulating the height of the hopper to suit different thrashing machines.

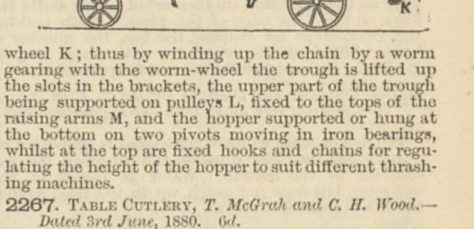
2267. TABLE CUTLERY, *T. McGrah and C. H. Wood.*—*Dated 3rd June*, 1880. 6d.

This consists partly in making the whole or part of the tangs or stems of table blades and forks of a flat or oval form, and in making the holes in the handles intended to receive the tangs or stems of a corresponding shape, so as to prevent the tangs, when inserted, from turning round in the handles.

2280. INCUBATING APPARATUS, *M. Arnold.*—*Dated 4th June*, 1880. 6d.

In the case A is placed a hot-water tank B. The hatching chamber F is within the water tank, and at its bottom is a layer of sand, covered by a layer of chaff, on which the eggs are placed. The sand allows

2280



all moisture to find its way through holes in a sliding tube H into a well I, and the chaff allows air for chickens hatched downwards to breathe. The ventilation of chamber F is effected by wooden plugs O, perforated in a special manner.

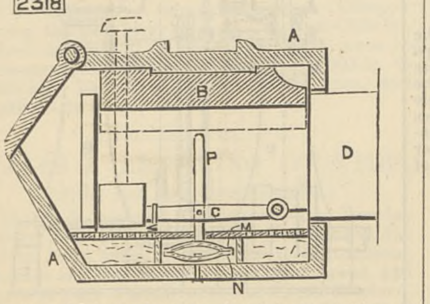
2297. RECOVERING USEFUL MATTERS FROM DISCARDED HEALDS, *H. Booth.*—*Dated 7th June*, 1880.—(*Not proceeded with.*) 2d.

Two yarns are used in the formation of a heald, one being knotted and the other looped. The former is cut away, and the other is subjected to the action of an apparatus which unwinds the binding yarn, and so releases the heald yarn, which is then wound upon a reel. The binding yarn is at the same time wound upon a swift.

2318. LUBRICATING MECHANISM, *G. E. Vaughan.—Dated 9th June, 1880.—(A communication from C. J. A. Dick.)* 6d.

The axle box A is of usual construction, and is furnished with the ordinary bearing B for the journal of the axle D. In the interior of the said box and to one side of the same is pivotted a weighted arm or lever G, by means of a stud, and this arm or lever is acted on by a spiral spring. By the combination of the said arm with pumping appliances, the oil which

2318

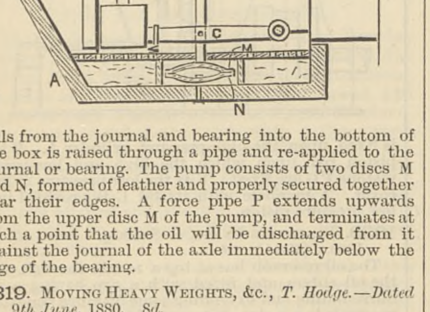


falls from the journal and bearing into the bottom of the box is raised through a pipe and re-applied to the journal or bearing. The pump consists of two discs M and N, formed of leather and properly secured together near their edges. A force pipe P extends upwards from the upper disc M of the pump, and terminates at such a point that the oil will be discharged from it against the journal of the axle immediately below the edge of the bearing.

2319. MOVING HEAVY WEIGHTS, &c., *T. Hodge.—Dated 9th June, 1880.* 8d.

The platform B is free to revolve on a centre. The shaft G is driven from the engines, and carries a pinion gearing with a wheel on the intermediate shaft J between the engine shaft and the winding drum, and on which a friction pulley is mounted. The drum shaft also carries a friction wheel which can be brought in contact with that on the shaft J when required to drive the drum, for which purpose the shaft J is mounted in excentric bearings, and can be shifted by a hand lever P. A brake N operated by a treadle acts upon the drum spindle. A frame Q is

2319



secured on platform B between the crane and the steam generator, and supports a shaft T carrying a chain wheel driven from shaft G, and also a friction pulley. A second drum V carries a friction wheel and is mounted in excentric bearings, so as to be capable of being moved by means of lever Y to bring its friction wheel in contact with the pulley on shaft T. The chain from one drum serves to raise and lower a grapple bucket, and the chain from the other serves to open or close the same, or when applied to an excavating apparatus one chain is attached to the rear end of the scoop, and the other to the front end as shown in the drawing.

2337. GASALIERS, &c., *R. Phelps.—Dated 9th June, 1880.—(Not proceeded with.)* 2d.

To the outside tube of a gasalier where the water cup is usually affixed, are placed two horizontal studs, while outside the tube is a second tube with one or more slots in which the studs travel. The slots have apertures at intervals into which the studs may enter so as to hold the gasalier in any desired position.

2350. STOCKINGS AND SOCKS, *L. Woodward.—Dated 10th June, 1880.* 6d.

Single narrowings are made at the instep and near the toe of the foot piece at a distance in from the selvage nearly equal to the length of the side of the heel pieces. One broad set of points containing nearly as many points as there are loops in the side of the heel takes the loops of this broad band of fabric, from the needles at one edge of the piece, and after shifting them inwards lands them on to other needles. Similarly on the other side another set of points shifts the loops on the other edge of the piece. When making the narrowings for shaping the toe, the number of loops shifted at the successive narrowings may be gradually decreased as the toe end is approached.

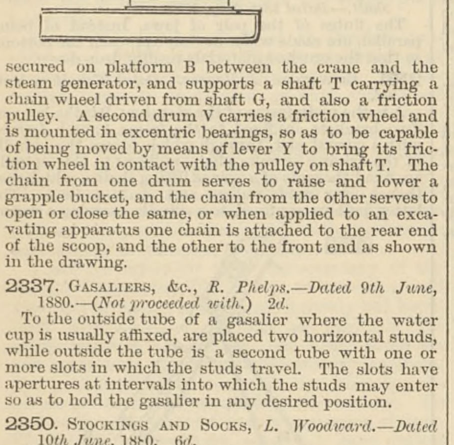
2358. COOKING AND DISHING UP MEAT, FISH, &c., *J. Hall.—Dated 10th June, 1880.—(Not proceeded with.)* 2d.

The fish or meat while being cooked is supported on perforated tray placed inside the saucepan but not reaching to the bottom. Water is placed in the saucepan, but does not reach up to the tray, so that the fish is cooked by steam.

2365. APPARATUS FOR PACKING SUBSTANCES INTO PARCELS, *W. A. G. Schönheyder.—Dated 11th June, 1880.* 8d.

A is the base plate on which are mounted the two standards B B, which carry the principal parts of the working gear. C is the driving pulley, and D the cam shaft on which most of the cams are fixed. E E are two connecting rods—one on each side of the machine—actuated by cams, and giving motion through the

2365

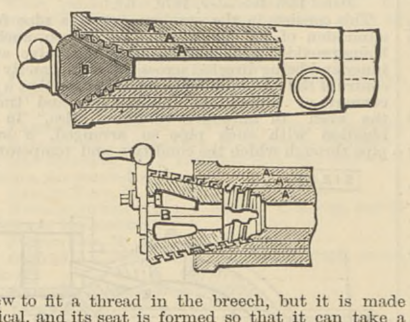


smaller rods F F to the rocking levers G, to which the variously shaped finger-pieces are fixed. H H are levers worked by cams I at the lower ends, and fulcrumed at the top, and giving motion to the four plungers G^2 on which the rocking levers G are hinged as well as to two intermediate plungers G^1, each with a fixed finger or creasing tool. J is a guard-piece for preventing the material which is to be packed from spreading sideways; one is furnished on each side of the machine. L is the presser which forces the paper and material into the dies of the intermittently revolving wheel.

2371. BREECH-LOADING ORDNANCE, &c., *J. Needham.—Dated 11th June, 1880.* 6d.

The body of the gun is built up of a series of tubes A closely fitting each other, but instead of shrinking them one over the other or forcing them into position by hydraulic pressure they are formed slightly conical, and to enable them to be forced well home their breech ends are formed with screw threads which by turning one tube on the other force the tubes fully home. The conical breech piece B is formed with a

2371

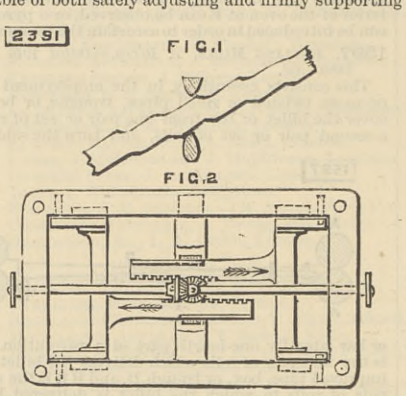


screw to fit a thread in the breech, but it is made conical, and its seat is formed so that it can take a firm hold of all the tubes A, excepting, if desired, the outer one. This arrangement of gun is suitable for muzzle-loaders, but for breech-loaders the breech piece B is divided longitudinally in two parts which close on to each other as the piece B is screwed home, and open out when it is withdrawn for the purpose of loading. The screw on B is formed with projections, and the thread in tubes A with a corresponding undercut as shown in the second Fig.

2391. MECHANICAL MEANS OF VARYING THE HEIGHT OF SEATS, TABLES, &c., *W. Dawes.—Dated 12th June, 1880.* 6d.

This consists in the application and use of a series of waved line or sloping notches, hollows, or surfaces, so constructed and arranged that projecting pins, studs, or other surfaces fitting or sliding into them, shall be capable of both safely adjusting and firmly supporting

2391

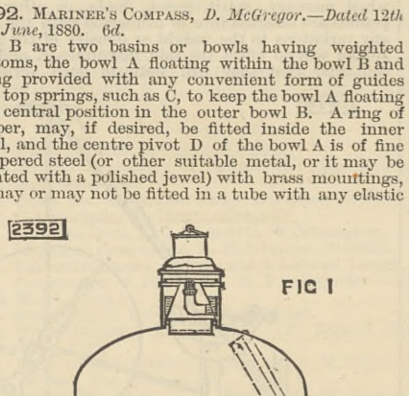


at any desired height the top or adjustable portion of tables, seats, or other articles. Fig. 1 is a portion of the waved line notches and hollows (with the supporting and the upper pins), as a rib or projection. Fig. 2 is a plan of a table or large oblong seat with the waved line lifters at the corners.

2392. MARINER'S COMPASS, *D. McGregor.—Dated 12th June, 1880.* 6d.

A B are two basins or bowls having weighted bottoms, the bowl A floating within the bowl B and being provided with any convenient form of guides and top springs, such as C, to keep the bowl A floating in a central position in the outer bowl B. A ring of copper, may, if desired, be fitted inside the inner bowl, and the centre pivot D of the bowl A is of fine tempered steel (or other suitable metal, or it may be pointed with a polished jewel) with brass mountings, or may or may not be fitted in a tube with any elastic

2392



material to compensate for vertical vibration on shipboard. The bowls A B can be arranged with glass bottoms in manner similar to ordinary transparent compasses, so as to let light through from beneath to illuminate the card E. The directive power of the card is supplied by the magnets H, which are composed of one or more flat thin steel bars of equal or varying lengths, similar to the steel used for chronometer springs but of harder temper. These magnets or needles H H are fitted to the underside of the card E by means of the springs J. The second Fig. is a sectional elevation on a larger scale of a compass card and magnets.

2403. COLOURING AND FLAVOURING BEER, &c., *J. R. Plunkett.—Dated 14th June, 1880.* 6d.

This consists in the employment of roasted maize, malted or unmalted, as a colouring and flavouring agent.

2406. MAKING PAPER BAGS, &c., *R. Woods.—Dated 14th June, 1880.—(Not proceeded with.)* 2d.

This relates to apparatus for automatically making bags, wrappers, and envelopes from a continuous web of paper fed into the machine.

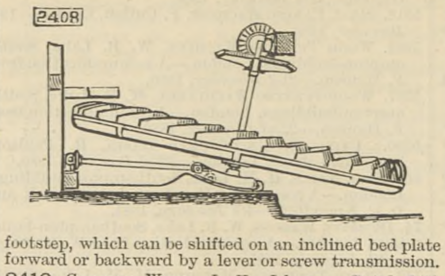
2407. THREAD HOLDER FOR SEWING MACHINES, *H. G. Grant.—Dated 14th June, 1880.—(A communication from G. Toussin.)—(Not proceeded with.)* 2d.

The appliance is in the form of a "Tyrolese box." On and around the circumference of the box and midway of its length, a groove is formed to receive the eye of a wire clip. The clip is formed with two arms, one being formed with an eye, in which the other arm of the clip is held when the appliance is attached to any convenient part of the sewing machine.

2408. WATER WHEELS, *F. H. F. Engel.—Dated 14th June, 1880.—(A communication from G. H. Müller.)* 6d.

The original part of this water wheel consists in the inclined bearings for the axle, thus forming a water wheel which is neither a horizontal nor a vertical one. The inclination of axle and wheel will be made adjustable by placing the step-bearing of the axle in a sledge

2408



footstep, which can be shifted on an inclined bed plate forward or backward by a lever or screw transmission.

2410. COMBING WOOL, *J. H. Johnson.—Dated 14th June, 1880.—(A communication from A. Skene and L. Devallée.)—(Not proceeded with.)* 2d.

The brush is caused to descend vertically on to the needles of the comb, whereby the work is more efficiently and advantageously performed.

2411. COMBING WOOL, &c., *J. H. Johnson.—Dated 14th June, 1880.—(A communication from A. Skene and L. Devallée.)—(Not proceeded with.)* 2d.

The rods with friction balls for pressing the holder are dispensed with, as well as the two pieces of cast iron which connect the rods to the said holder, and in lieu thereof, rollers, cylinders, or segments are employed, acting upon the flat upper side of the holder.

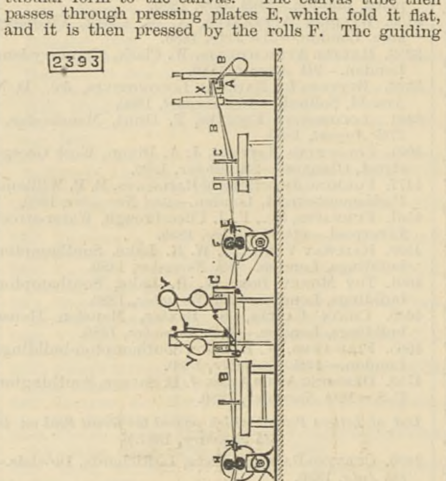
2412. SEPARATING ANIMAL FROM VEGETABLE MATTER, &c., *W. R. Lake.—Dated 14th June, 1880.—(A communication from A. Faidherbe-Dankier.)—(Not proceeded with.)* 2d.

This consists in a process based entirely upon chemical or scientific action, either by reaction or by maceration in the open air, and it effects a series of operations heretofore performed separately and by hand by a combination of mechanical apparatus whose operation is certain and continuous.

2393. BELTS OR BANDS FOR DRIVING MACHINERY, *M. Gandy.—Dated 12th June, 1880.* 6d.

B is a roll of canvas, which passes through pressing rollers A, and then through adjustable guide pieces X, from whence it is led through one of a nest of concentric rings C, according to its width, and through an oval former D, the rings and former imparting a tubular form to the canvas. The canvas tube then passes through pressing plates E, which fold it flat, and it is then pressed by the rolls F. The guiding

2393

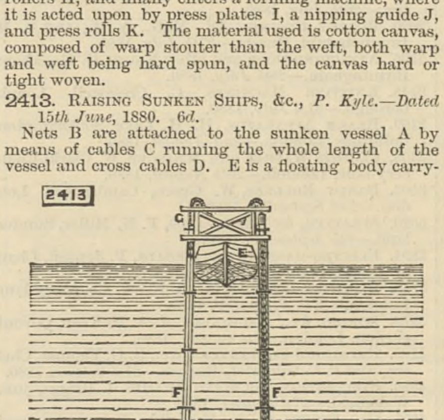


appliance G opens the canvas and makes it in the form of a trough, into which any number of canvas cloths are laid, so as to form the complete belt, such cloths being supplied from rollers Y. The whole then passes over a table and through pressing plates and rollers H, and finally enters a forming machine, where it is acted upon by press plates I, a nipping guide J, and press rolls K. The material used is cotton canvas, composed of warp stouter than the weft, both warp and weft being hard spun, and the canvas hard or tight woven.

2413. RAISING SUNKEN SHIPS, &c., *P. Kyle.—Dated 15th June, 1880.* 6d.

Nets B are attached to the sunken vessel A by means of cables C running the whole length of the vessel and cross cables D. E is a floating body carry-

2413

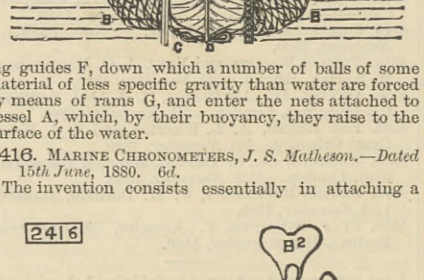


ing guides F, down which a number of balls of some material of less specific gravity than water are forced by means of rams G, and enter the nets attached to vessel A, which, by their buoyancy, they raise to the surface of the water.

2416. MARINE CHRONOMETERS, *J. S. Matheson.—Dated 15th June, 1880.* 6d.

The invention consists essentially in attaching a

2416

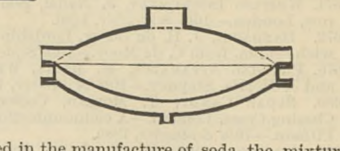


small toothed wheel A to the ordinary winding square, or fusee arbor A^1 underneath and outside the chronometer case 2 with which a toothed pinion B, fitted in the corner of the box 1, in which the whole is enclosed, may be put into gear when desired. The pinion B is preferably fitted on a vertical spindle B^1 the upper end of which is made in the form of a key B^2. This arrangement admits of winding the chronometer without the necessity of turning it over.

2417. APPARATUS EMPLOYED IN EFFECTING CHEMICAL DECOMPOSITION, *R. S. and F. S. Newall.—Dated 15th June, 1880.* 6d.

The pans employed are made of phosphor bronze, and are so formed that they may be heated by steam or hot air instead of by a furnace, for which purpose it is made double, and steam or hot air admitted between the two walls. Supposing it is salt that is to be de-

2417



composed in the manufacture of soda, the mixture of salt and acid is placed on the upper surface of the pan, and stirred by mechanical means until the decomposition is carried to the required degree, when the sulphate is expelled from the pan into the roaster, where the decomposition is completed. The pan is covered as usual to collect the gas which is conveyed to the condenser. The form of the pan is shown in the drawing.

2420. TILES AND TILE ROOFING, *F. Baclène.—Dated 15th June, 1880.—(Not proceeded with.)* 2d.

The roof tiles are formed with a rib or flange along the top and down one side of the face of the tile, the opposite side being provided with an enlargement or hooked flange, which is intended to fit over the rib or flange on the side of an adjacent tile.

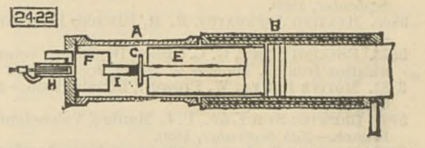
2421. LOOMS, *G. Kirk.—Dated 15th June, 1880.—(Not proceeded with.)* 2d.

A sliding bar is operated by a cam on the star or pegging wheel, which is so set and regulated as to push the sliding bar underneath steps formed in the end of the bell crank levers, which holds them up until the cam has moved out of the way, when a spiral or other spring withdraws the sliding bar from under the steps in the bell crank levers. At the end of the sliding bar are loose catches, which are held by spiral or other springs, and can be pushed out of the way on the rising of the bell crank levers.

2422. GAS ENGINES, *W. Foulis.—Dated 15th June, 1880.* 6d.

The cylinders are formed so that while the part in which the heat of the combustion of the mixture of gas and air is developed is maintained as hot as practicable, the part in which the piston works is kept much cooler. For this purpose the cylinder is made in two parts; A in which the combustion takes place, and B in which the piston works. The piston carries a projecting tubular piece E, of the same diameter as

2422

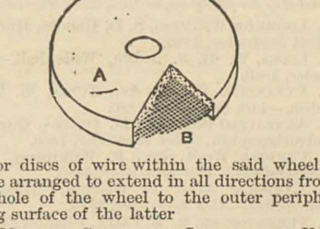


the cylinder, and nearly as long as either part of it, and is lined with asbestos. The part A containing the compressed charge has a combustion chamber F, and from the centre of the piston projects a second piston G to work in chamber F. H is the igniter. So as to delay the ignition of the charge until all the gas and air has been forced into the combustion chamber F a sleeve I is fitted to piston G, and encloses the igniter during this period of delay. The part B is cooled by a water casing. An arrangement is decribed for mixing the air and gas in the proper proportions.

2424. EMERY WHEELS, *W. R. Lake.—Dated 15th June, 1880.—(Partly a communication from C. Heaton.)* 6d.

In the drawing, A represents the wheel formed of emery powder or similar substance, and B represents

2424



a disc or discs of wire within the said wheel. The discs are arranged to extend in all directions from the centre hole of the wheel to the outer periphery or grinding surface of the latter

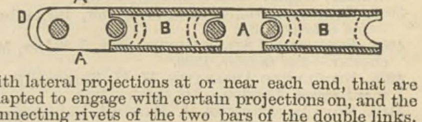
2425. MOVABLE STAGES FOR LOADING AND UNLOADING GOODS, *C. D. Abel.—Dated 15th June, 1880.—(A communication from A. Sue and M. H. H. Compte Delamare.—(Not proceeded with.)* 2d.

The platform, which may be framed of metal and covered by planking, paving, or otherwise, and which may have on it rails or a turntable, is fitted to sink into a hollow in the ground or floor, so that when it is lowered its surface is level with that of the ground, and under this hollow are arranged the means of raising and lowering it.

2426. CHAINS, *S. Pitt.—Dated 15th June, 1880.)—(A communication from J. M. Dodge.)* 6d.

The drawing shows a longitudinal central section of a chain. A A represent double bar links, and B B single bar links. The single links are in this case shown as being of cast malleable iron, and are made

2426

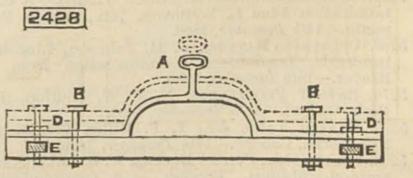


with lateral projections at or near each end, that are adapted to engage with certain projections on, and the connecting rivets of the two bars of the double links, while the latter are composed of two bars or castings A A, each of which has an inwardly projecting rim or flange-like device D at each end.

2428. APPARATUS FOR PREVENTING ACCIDENTS TO VEHICLES, *H. J. Allison.—Dated 16th June, 1880.—(A communication from L. Lievin.)* 6d.

The splinter bar is recessed to receive the ends of the shafts or the roller bolts E through which pins D pass from the upper side of the splinter bar. These pins are secured to a metallic piece fitted with a handle A, extending up in front of the driver near the splash

2428



board. By raising this metallic piece the pins are withdrawn from the ends of the shafts which are thus released, and will be pulled out of the recesses in the splinter bar, by the forward motion of the horse or horses, leaving the vehicle behind. The metallic piece is guided in its movement and secured to the splinter bar by means of two guide bolts B attached to the splinter bar, which allows the necessary play to enable the pins to be withdrawn.

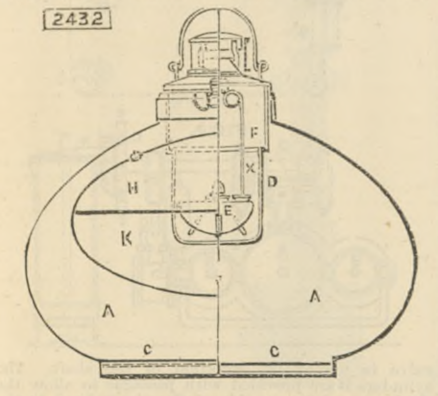
2430. Sewing and Plaiting or Quilting Machine, *W. R. Lake.—Dated 16th June, 1880.—(A communication from H. Buckofzer.)—(Not proceeded with.)* 4d.

The apparatus for laying the different folds consists chiefly of two knives of steel plate which lie one over the other, each one being separately movable on pivots and arranged to work in guides in the frame.

2432. Ships' Binnacles and Lamps, &c., *J. M. Sim.—Dated 10th June, 1880.* 6d.

The binnacle dome A has a hole in the top for the lamp, and a raised flange, over which the lamp head fits. C is the compass card, and D the lamp globe with holes to admit air under the rounded bottom of the lamp E. The air is deflected downwards, so that in-

2432



stead of blowing out the flame it collects under the lamp and rises through the annular space between the lamp cistern and the globe in an even stream, which promotes combustion and cools the globe. A handle or rod X serves to lift out the lamp. The globe D hangs from the tube F attached to the lower part of the top. H is the night shade, and K the opening through which the card is viewed.

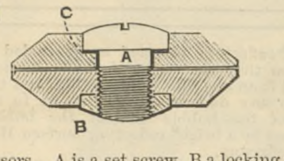
2433. Moving and Locking Railway Points and Signals, *R. Hill and D. Marlor.—Dated 16th June, 1880.—(Not proceeded with.)* 2d.

The points are connected with a sliding bar or part which is actuated by a screw, formed upon or attached to or connected with a hand lever.

2434. Securing the Blades of Scissors, Shears, &c., *W. and W. T. W. Simpson and J. Wilkinson.—Dated 16th June, 1880.* 6d.

The drawing shows a cross section of the joint of a

2434

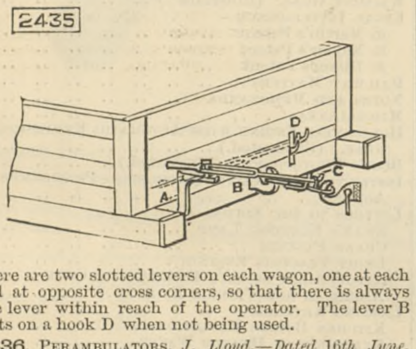


pair of scissors. A is a set screw, B a locking plate or lock nut, and C is a washer of ordinary construction.

2435. Coupling and Uncoupling Railway and Tramway Wagons, &c., *T. G. Massicks.—Dated 16th June, 1880.* 4d.

A bracket A is attached to the end of a wagon and supports a slotted pivotted lever B with a projection and a hook at one end. On the coupling is a stirrup C having a hook so that it can be raised by the lever B and placed on the coupling hook of the next wagon.

2435



There are two slotted levers on each wagon, one at each and at opposite cross corners, so that there is always one lever within reach of the operator. The lever B rests on a hook D when not being used.

2436. Perambulators, *J. Lloyd.—Dated 16th June, 1880.—(Not proceeded with.)* 2d.

The body proper is constructed somewhat as hitherto; to this body the handle is permanently secured, the seat, back, and sides, with heelboard, which are independent of the body, are caused to rotate by means of a pin or pivot passing through, or in some cases affixed upon the base or bottom of the vehicle, secured by a cotter pin or other suitable means.

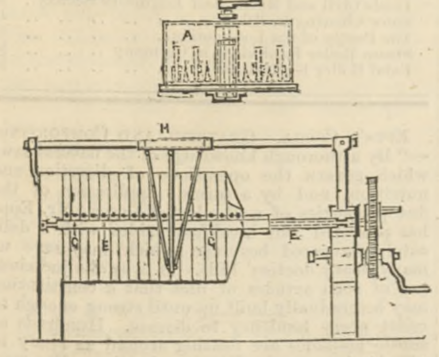
2438. Preservation of Alimentary Substances, *T. F. Wilkins.—Dated 16th June, 1880.—(Not proceeded with.)* 2d.

This consists essentially in first treating the article to be preserved with an antiseptic, and then coating it with a paraffin melting only at a very high temperature, and devoid of taste and smell.

2439. Manufacture of Pottery, *A. F. Wenger.—Dated 16th June, 1880.* 6d.

This relates, First, to an improved plunger or vessel wherein raw clay is made to slip. The plunger A is made round instead of hexagonal, but instead of giving the usual rotary motion to the plunging arms, a reciprocating or to-and-fro motion is given to them by means of a revolving crank. The second Fig. shows

2439

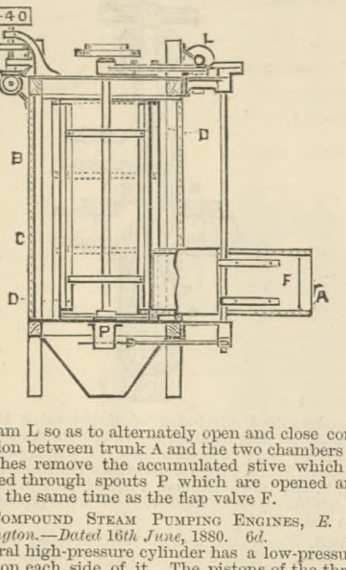


an improved filter press used for extracting the water from the slip and making plastic clay. The chambers are carried on two side rods or bars E, and in order to facilitate the moving of the chambers anti-friction rollers G G are interposed between the chambers and rods or bars, and to prevent the chambers from rocking side levers or rods H are employed.

2440. Collecting Stive and Separating Dust, &c., in Working Mill Machinery, *J. F. Stewart.—Dated 16th June, 1880.—(A communication from G. T. Smith.)* 8d.

The stive trunk A communicates by two branches with the two closed wire gauze chambers B surrounded by a casing C. Brushes D mounted on shafts revolve in contact with the inner surfaces of the cylinders; F is a flap valve worked automatically

2440

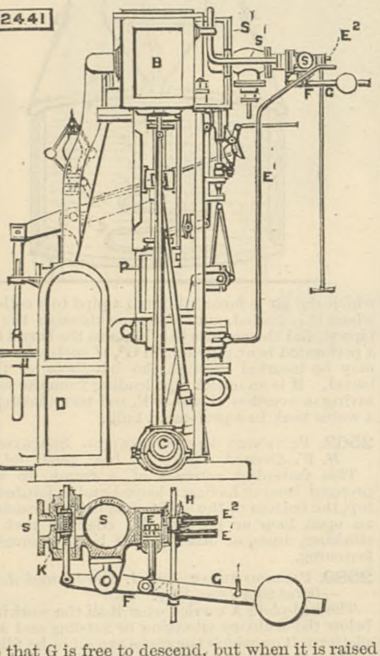


from a cam L so as to alternately open and close communication between trunk A and the two chambers B. The brushes remove the accumulated stive which is discharged through spouts P which are opened and closed at the same time as the flap valve F.

2441. Compound Steam Pumping Engines, *E. B. Ellington.—Dated 16th June, 1880.* 6d.

A central high-pressure cylinder has a low-pressure cylinder on each side of it. The pistons of the three cylinders are directly connected to the plungers of the three pumps P and are linked by connecting rods in the usual way to the cranks of a three-throw crank shaft C. The condenser D with air pump is situated at the back. S is the main steam pipe which besides leading directly to the slide cases of the high-pressure cylinder, communicates by branch pipes S^1 with the slide cases of the low-pressure cylinders B, the communication being governed by the apparatus shown in the second figure, in which E is a water cylinder fitted with a plunger, the stem of which butts against a lever F. To this lever is jointed another loaded lever G, the joint having a butt, indicated by the dotted

2441

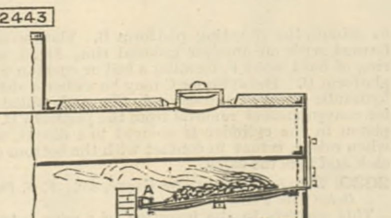


line, so that G is free to descend, but when it is raised it causes F to rise. The lever G is connected by a chain passing over a pulley to a counterweight suspended over the accumulator, so that when the accumulator rises beyond a certain point, raising this counterweight, the lever G descends, and when the accumulator descends the counterweight also descending causes the lever G to rise. To the lever F is linked a slide K which governs a port opening to the branch pipes S^1 leading to the low pressure cylinders. At the side of the water cylinder E is a piston slide H, which governs communication between the cylinder E and either of two pipes E^1 E^2, the one E^1 being a pressure pipe communicating with the discharge pumps P, and the other E^2 being a discharge pipe for relief of pressure.

2443. Consuming Smoke and Economising Fuel, *J. Turpenny.—Dated 16th June, 1880.* 4d.

A perforated block or grating A is placed between the ends of the fire-bars and the bridge, the perfora-

2443



tion being preferably conical and smallest at the top. Air is admitted through A and causes the ignition of the gases.

2446. Preparing and Decolouring Jute, China Grass, &c., *J. J. Sachs.—Dated 16th June, 1880.* 4d.

The fibres are treated with acids and alkalies, with or without the addition of other suitable chemical substances.

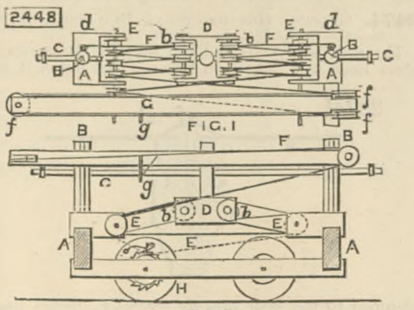
2447. India-rubber Bands or Cords, *C. Kesseler.—Dated 16th June, 1880.—(A communication from the Continental India-rubber and Gutta-percha Company.)—(Not proceeded with.)* 2d.

This consists in manufacturing india-rubber bands or ropes by means of a machine, such bands or ropes having an insertion of rope or twine of hemp, cotton, leather, flax, jute, or other suitable material, or even metal.

2448. Transmitting and Accelerating Motion, *A. M. Clark.—Dated 16th June, 1880. (A communication from J. Schofield.)* 6d.

The drawings show the application to produce intermittent or reciprocating motion. The frame A supports standards B with holes in which the rod C moves, such rod carrying a sliding carriage D fitted with sheaves *b* revolving on pins. Groups of sheaves E are fixed on opposite parts of the frame A. F is a rope or chain whose ends are made fast to the standards B at *d*, while the rope itself passes over the sheaves *b* and E. The bight of the rope is passed over the sheaves *f* and along bar G, which may represent

2448



the keel of a steam boat, while *g* may be the floats that feather when moving in one direction, and oppose their full surface when moving in the other. When the carriage D is moved a short distance by the rod C which is attached to an engine the floats move through a much greater space, and as the rod C is reciprocated, a reciprocating motion is imparted to the floats or propellers *g*. If the bight of the rope be passed round pulley H, motion will be imparted thereto on the forward movement of D through the ratchet and pawl arrangement, while it will remain stationary on the return stroke of D.

2449. Umbrellas and Sunshades, *A. M. Clark.—Dated 16th June, 1880.—(A communication from F. M. C. Farradesche.)* 6d.

This consists, First, in the combination with the joint uniting the ribs and stretchers of springs applied and acting in such manner as to press the ribs and stretchers against the stick when the umbrella is closed. Secondly, in an internally grooved runner notch in combination with an inner split tube for retaining the joint pins of the stretchers, and uniting the same to the runner.

2450. Lamps for Sewing Machines, *R. Bourne.—Dated 17th June, 1880.—(Not proceeded with.)* 2d.

This consists in enclosing the light within a metal covering containing upon one side of it a circular opening, in which may be placed a lens; within this case or covering upon the opposite side of the light is placed a reflector of metal or glass, pivotted so that it can be adjusted to any angle to throw the concentrated light which passes through the opening containing the lens upon any object within focus.

2451. Receptacles for Powders, Matches, &c., *R. Bourne.—Dated 17th June, 1880.—(Not proceeded with.)* 2d.

This consists in forming a box or case, made of wood, metal, or other suitable material, in which is placed a false bottom inclining upwards, towards one end or side of the box, thus forming the box at that end or side shallower than elsewhere, so that the contents can move up into position under the slide.

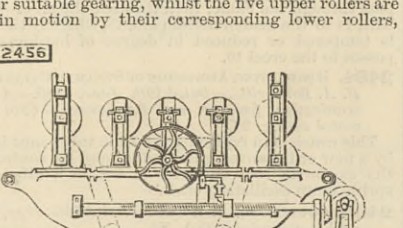
2452. Metallic Fenders, *R. Roberts.—Dated 17th June, 1880.—(Not proceeded with.)* 2d.

The front and sides of the fenders are constructed of a series of detached panels or portions, which are afterwards connected together.

2456. Washing Woollen Fabrics, *J. Wetter.—Dated 17th June, 1880.—(A communication from N. J. Hannemann.)* 6d.

The machine consists of a metal trough lined with wood for the reception of water or lye, and of several (preferably) pairs of rollers placed above the trough and forming a series of pairs, the lower rollers of each pair being driven direct by means of a belt or belts or other suitable gearing, whilst the five upper rollers are set in motion by their corresponding lower rollers,

2456

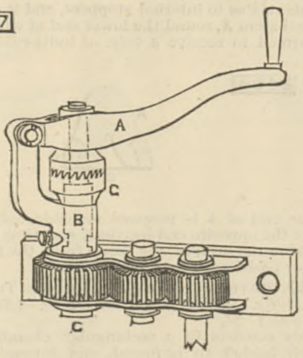


upon which they rest with their full weight. For the further guiding of the fabric, guide rollers (preferably two) are placed in the above said trough through which the fabric passes. Between two consecutive pairs of rollers is placed a waterpipe provided with perforations or an equivalent appliance for conveying water to the fabric when required.

2457. Levers for Actuating the Brakes of Tramcars, &c., *E. W. Lemm.—Dated 17th June, 1880.* 6d.

A handle A is pivotted to the projecting arm of a socket piece B through which passes a spindle C having at top an enlarged piece with teeth to gear with

2457



corresponding teeth on a piece pivotted to lever A. By lowering A the teeth engage, when A is revolved and imparts motion to the spindle C, on which is a toothed wheel, which by intermediate gearing actuates the brake.

2460. Low Water Alarms for Steam Generators, *S. and H. N. Bickerton and D. Orme.—Dated 17th June, 1880.—(Not proceeded with.)* 2d.

This relates to a low water indicator, in which a float working in an enclosed chamber is employed for opening a communication with a whistle.

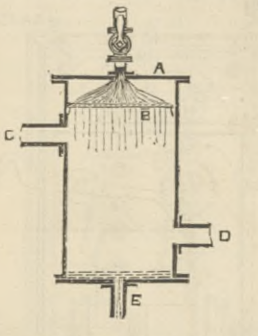
2463. Davits for Carrying and Stowing Ships' Boats, *J. W. D. McDonald.—Dated 18th June, 1880.—(Not proceeded with.)* 2d.

The davits are made of two pieces of suitable material, and duly bolted together for part of their length, and for the lower part they are spread out, so as to form, as it were, two feet, which are hinged to lugs or brackets stepped on the rail or other convenient part of the ship. On the top of a stanchion, placed midway between the feet of each davit, are pulleys, over which passes the topping lift for the davits, which is secured to the davits at the top of the spread-out legs thereof, and is worked in any convenient way.

2458. Purifying and Softening Water, *G. Best.—Dated 17th June, 1880.* 6d.

The drawing shows a vertical condenser closed at top, where there is an inlet cold water pipe A, at a suitable distance below which is an inlet steam pipe C, and between these two is a sieve or strainer B. Near

2458

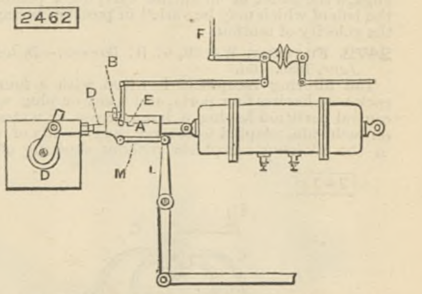


the bottom is an outlet steam pipe D, and an outlet hot water pipe E. The water falls through the sieve in a shower, and coming in contact with the steam the harder matters incrust around the interior of the condenser, while the softer matters run out with the water into a tank, where they fall to the bottom, leaving the water soft and free from hardening matters.

2462. Expansion Gear of Steam Engines, *A. Dobson.—Dated 18th June, 1880.* 6d.

A loose sleeve A is employed, which slides along a bar, spindle, or rod D, and is actuated by a lever L and link M attached to the excentric rod. The bar, spindle, or rod D is attached to the valve spindle, and is provided with a slot or groove E, into which, as the oose sleeve A slides along a loose piece or key B carried by the loose sleeve A, drops by its own gravity, or assisted

2462



by a spring, and the bars, spindle, or rod and valve spindle are thereby actuated and moved along with the loose sleeve, and the steam valve is opened and steam admitted to the cylinder. In order to close the valve and shut off the steam, a lever or levers is or are employed, attached at one end to the loose sleeve, and at the other end to the governor rod F, and acting upon a snug or pin on the loose piece or key, by which the loose piece or key is thrown out of the slot or groove.

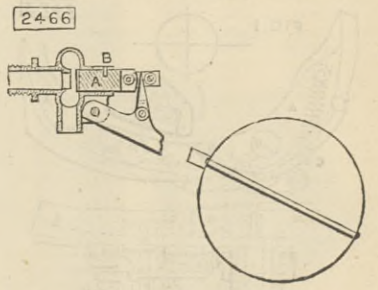
2464. Curing and Disinfecting Casks, Vats, &c., *F. Baxter.—Dated 18th June, 1880.* 4d.

Sugar or other saccharine matter, as free from moisture and extraneous substances as possible, is heated in a furnace until it approaches to or has just arrived at the carbonaceous point; this material is then mixed with water of the same weight. Into the same or a similar furnace is placed one-half of the above quantity of sugar or other saccharine material; this new charge is treated in the same manner as the other, except that the operation is not carried so far, and no water is added. Sulphate of zinc of commerce, or any other soluble salt possessing similar properties, is then dissolved in water in the proportion of $\frac{1}{30}$ to $\frac{1}{15}$ of sulphate of zinc to the water, which should be about eight times more than the quantity above mentioned. To the second named quantity of saccharine bisulphate of lime is added to the extent of about $\frac{1}{18}$ of the whole. The three solutions are now mixed together and are ready to be applied to the interior of the casks.

2466. Regulating the Flow of Liquids into Tanks, &c., *D. Young.—Dated 18th June, 1880.* 6d.

A wedge is connected to the short arm of a ball lever by means of an eye, so that when the ball falls the valve is opened by the wedge, and when the water

2466



rises and lifts the ball the wedge is withdrawn, and the valve is closed by the pressure of the liquid. The drawing shows the plunger A of the valve fitted with a friction roller, but it may have its end next the wedge simply rounded. The pin B prevents the plunger turning round.

2467. Producing Lighting Gas from Gasoline, &c., *C. Kesseler.—Dated 18th June, 1880.—(A communication from P. Richter and W. Triebel.)—(Not proceeded with.)* 2d.

A partial vacuum is produced within the mixing vessel, so that the evaporation of the gas liquid is always regulated accordingly. The vacuum is produced by two air pumps or fans, of which one delivers the required quantity of air into the apparatus, while the other draws off the more, the more hydro-carbon is evaporated.

2470. Fastenings for Belts, Straps, Cravats, &c., *J. A. E. Sabatier.—Dated 18th June, 1880.—(Not proceeded with.)* 2d.

The fastening is based upon the employment of the inclined plane or of the wedge, and is thus exempt from all springs or other means of pressure.

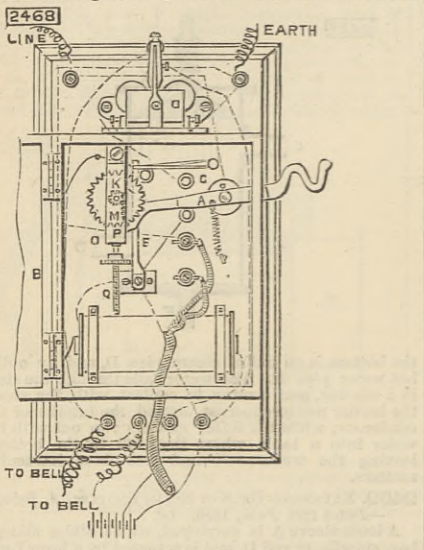
2471. Cans or Vessels, *W. B. Williamson.—Dated 18th June, 1880.—(Not proceeded with.)* 2d.

This consists of the construction and arrangement of parts for making a liquid and air tight joint between the cover and can, or box, case, and barrel, and also of appliances constructed for fastening the cover to and unfastening it from the said can or box, or case.

2468. Apparatus for Telephonic Signalling, *G. E. H. Johnson.—Dated 18th June, 1880.* 6d.

This invention relates to that portion of the apparatus used for automatically controlling the connections and effecting the signals. The principal improvement is in connection with a toothed wheel and engaging lever. In the front view shown A is a vibrating lever mounted on a centre in the case B terminating in a hook or support to carry the receiver C. A binding screw and relay D to bring into operation a bell is placed in circuit with line, when A is in a certain position. Another binding screw admits of C being placed in line under other conditions, the bell or signalling device being then cut off; F is another vibrating lever which, when parts are as shown, is in contact with a binding screw, placing transmitter in circuit.

2468

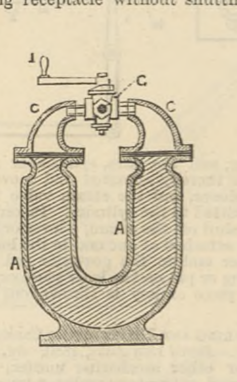


Ordinarily the motion of A is too rapid, and this invention is intended to obviate this difficulty, which is thus accomplished. A spur pinion fast on a spindle is carried as shown. A segmental rack engages this pinion, so that as the lever moves the pinion moves. On the spindle is an escape wheel, the teeth of which engage the pallet of an anchor carrying a pendulum, the bob of which may be varied in position to regulate the velocity of motion.

2472. FILTERING WATER, *G. W. Dawson.—Dated 18th June, 1880.* 6d.

The filtering receptacle is fitted with a four-way cock case having four ports, and a key or plug with a central partition having a large recess or water-way on each side, adapted to reverse the currents of water in the filtering receptacle without shutting off the

2472

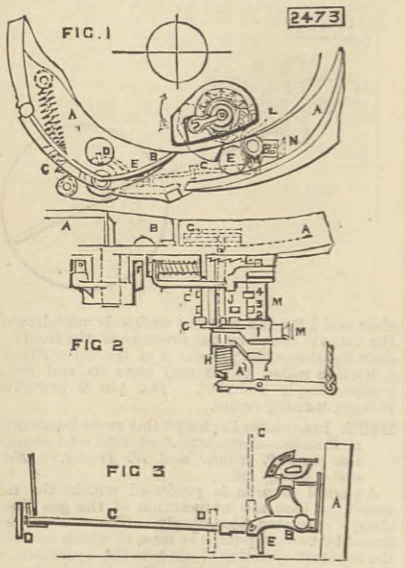


inlet or discharge openings. The receptacle A is filled with filtering material and is connected with pipes C, to which is secured the four-way cock G operated by a handle I so as to reverse the flow of the liquid through A when required to remove the sediment from the filtering material.

2473. REAPING MACHINES, *C. A. Duvall and T. Hoskison.—Dated 18th June, 1880.* 6d.

The first part consists of novel mechanism for controlling the switch, so that any desired number of the rakes may be made to act as gatherers or sweep the platform at the will of the driver, and such mechanism being operated by the rollers on the rake arms in their passage along the cam tracks. In Figs. 1 and 2 A is a part of the cam track; B is a movable part or switch; C is the spring for holding the switch in the position for causing the rakes to sweep the platform, shown in dotted lines; D is the tail-piece, by which the switch is moved into the position shown in full lines; E E are rollers on the rake arms; F is the spring catch, which holds the switch in the last-named position

2473



until locked; G is the tappet piece fixed to the spindle A^1, and projecting partly across the path of the rollers E, one of which is seen in Fig. 1 in contact with it; H is a spring which pulls the tappet piece G forward after a roller has passed; J is the cylinder having ratchet teeth on its end face; C^1 C^1 are projections on cylinder J, and which engage the cam L, which may be set upon the cam shaft M by the spring stop N opposite to any set of projections C^1. The figures 1, 2, 3, 4, and 6 indicate the number of rakes which are to sweep the platform, as 1 in 3, 1 in 6, &c. Fig. 3 shows an arrangement for facilitating the raising of the finger bar for transport. A is the driving wheel; B is the main frame of the machine; C is the finger bar; D the platform wheel; E is the leg or support hinged to the main frame. The finger bar is shown in dotted lines in the raised position C^1, and the platform wheel shifted to the axle on the main frame for its reception, D^1.

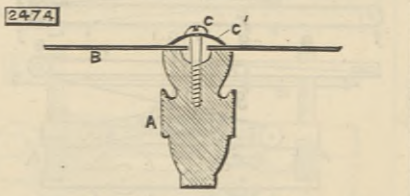
2476. MATCHES, *W. R. Lake.—Dated 18th June, 1880.—(A communication from La Société des Allumettes, Caussemille Jeune et Cie., et Roche et Cie.)—(Not proceeded with.)* 2d.

This invention is designed to provide matches in blocks of prismatic form, the separate matches being made by cutting a block of wood with a saw or saws in such a manner that each match remains attached at one end to a part of the block remaining uncut, there being a clear space between all the matches, so that any one of the same may be readily broken off for use.

2474. GLAZING HORTICULTURAL BUILDINGS, *W. G. Smith.—Dated 18th June, 1880.* 6d.

The sash bars A are notched so that the panes of glass may bed flat upon them. The panes B are

2474



clamped to the sash bars by screws C, dished rings being interposed between the screw heads and the glass, their edges coming against the margins of the panes of glass. The panes are further kept in place by metal hooks of special construction.

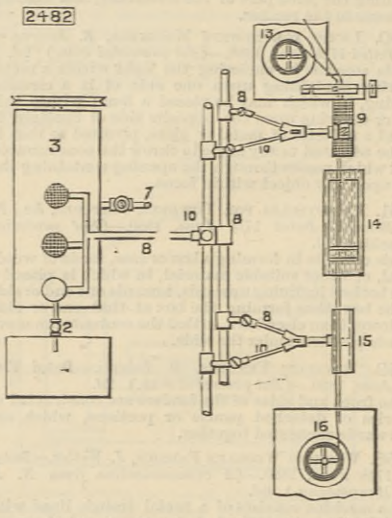
2478. HOIST PROTECTORS, *J. W. Midgley.—Dated 18th June, 1880.—(Not proceeded with.)* 2d.

In hoists having a number of stories, at the bottom and top rollers are fixed to which are attached belts of canvas, wood, or iron lattice, or other suitable material the width of the hoist. The cage of the hoist is between the two lengths of the canvas or other belts. The rollers are connected by ropes or chains, and are so arranged that in whatever position the cage stops, the entrances from the other rooms are blocked with the canvas or other belt.

2482. HEATING, HARDENING AND TEMPERING STEEL WIRE, *J. Sykes.—Dated 19th June, 1880.* 6d.

Petroleum spirit passes by pipe 2 through the shell of cylinder 3, within which is an axis with lags to receive a lamp wick. The axis is revolved by means of a pulley so as to present a changing surface of wick to the spirit to secure free evaporation. The pipes 7 supply air which, with the gas, passes through wire

2482



gauze sheets in the domes above the cylinder, and through pipe 8 to the receiver 9, to which more air is supplied by pipe 10. The gas and air is burned on the surface of wire gauze at 9. The wire from swifts 13 pass through the flame, then through the oil or water bath 14 to the heated metal plate 15, whereby the wire is tempered or reduced in degree of hardness and passes to the creel 16.

2484. REGULATING ADMISSION OF STEAM TO CYLINDERS, *H. A. Bonneville.—Dated 19th June, 1880.—A communication from G. von Brochowski.)—(Not proceeded with.)* 2d.

This consists in replacing the slide valve now in use by a new or improved slide valve, and in controlling the excentric rod—enclosed or not in a tube—by a spring or an oscillating click.

2485. COUPLINGS, *E. Wilson.—Dated 19th June, 1880.—(Not proceeded with.)* 2d.

The ends of the carriages are provided with hooks or catches somewhat of the form of a harpoon or harrow-head, an extension from which is made to run freely on a pin in an upward direction. The one hook or catch consists of a single bar, whilst the other consists of double bars with a space between them so as to allow of the single bar-hook or catch catching or coupling within the double one when two carriages are pushed against each other.

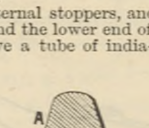
2487. DRAWING AND SPINNING MACHINES, *E. Sykes and W. Cliffe.—Dated 19th June, 1880.—(Not proceeded with.)* 2d.

This consists in combining the tube and drawing rollers in such manner that they shall revolve together, and so avoid what is known as "false" twist.

2488. STOPPERS FOR BOTTLES, *J. Lamont.—Dated 19th June, 1880.* 6d.

This relates to internal stoppers, and it consists of a conical stem A, round the lower end of which a groove is formed to receive a tube of india-rubber D. The

2488



larger end of A is recessed or made hollow so as to make the opposite end heaviest, and thus facilitate its entering the neck of the bottle from the inside in its proper position to close the mouth.

2489. DRYING, STOVING, &c., YARN OR THREAD, *T. P. Miller.—Dated 19th June, 1880.—(Not proceeded with.)* 2d.

This consists in a rectangular chamber, through which heated air is forced, and through which the material is passed by means of endless cloths.

2492. MOULDING PASTE AND MAKING PIES, *W. S. Clark, D. Edwards, and R. Davenport.—Dated 19th June, 1880.—(Not proceeded with.)* 2d.

This consists in attaching two dies to a plunger in such a manner that they may act simultaneously on the paste to be moulded, one to mould the pie, and the other to lid it.

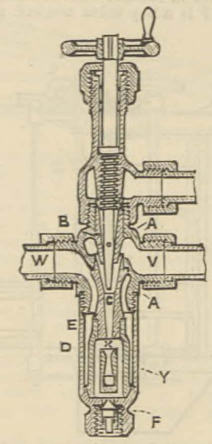
2493. BICYCLE LAMP, *J. Lucas.—Dated 19th June, 1880.* 6d.

To the upper portion of the body of the lamp two semi-cylindrical forms are arranged in a horizontal line and extending the width of the lamp, or nearly so. These are connected together by means of a hinge or joint at the top. One of the forms is securely connected to the body; the other is securely connected to the door, which is the front of the lamp, the door being locked by engaging in two lamina springs at the base of the body of the lamp.

2499. INJECTORS, *S. Borland.—Dated 21st June, 1880.* 6d.

The part A has four branches, one of which receives the steam cone B, and there is a diaphragm in the middle of A which is bored to receive the combining cone C, the other end of which is turned to fit a part D in which the receiving cone and overflow orifice and passages are formed, and the lower end of this part is formed to fit a cone in a cap E screwed on to one of the branches of A. X is the overflow orifice, such overflow passing through passages Y, and then passing through a hole in the end of cap E, which may be

2499

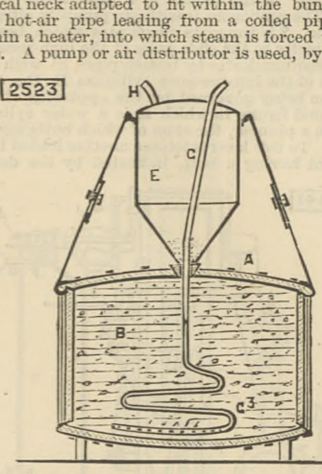


closed against admission of air by valve F pressed against its seat by a spring round its spindle. The receiving cone branches into two passages at a right angle to it, and enters a space between C and D and the cap E, and passes through a branch of A to the pipe W which conveys it to the boiler. V is the pipe supplying the water.

2523. PURIFYING AND AGEING LIQUOR, *W. R. Lake.—Dated 22nd June, 1880.—(A communication from A. L. Wood.)* 6d.

A indicates a barrel containing liquor B; E is a saving or overflow chamber having an open-mouthed conical neck adapted to fit within the bunghole. G is a hot-air pipe leading from a coiled pipe located within a heater, into which steam is forced through a pipe. A pump or air distributor is used, by means of

2523



which the air is forced through a pipe to a coiled pipe, where it is heated, and passes on through the hot-air pipe G, and thence into the liquor in the barrel through a perforated bent pipe or coil G^3, of such a form that it may be inserted through the bunghole of the said barrel. H is an outlet pipe leading from the top of the saving or overflow chamber E, and terminating within a water tank in a perforated bulb.

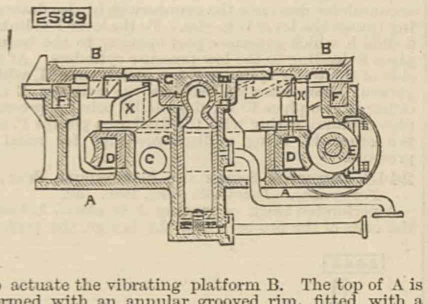
2563. FASTENING FOR SUSPENDING STOCKINGS, &c., *H. W. Everard.—Dated 3rd June, 1880.* 6d.

This fastening consists of a frame, to which a pronged tongue having a looped end is jointed at the top, the bottom of the said frame being furnished with an open loop or pocket, the edge or part of the stocking, dress, or other article being secured to the fastening.

2589. PACKING SUGAR, &c., *A. Stewart and A. Hunter.—Dated 25th June, 1880.* 6d.

The bed-plate A carries over it all the working parts below the ordinary vibrating or raising and lowering platform B on which the casks are set to be filled. In centre of A is a cylinder C, fitted with a plunger actuated to tilt the cask when filled. A large vertical eye or annular flange formed on A carries a worm-wheel D, driven by worm E, and fitted with inclines X

2589



to actuate the vibrating platform B. The top of A is formed with an annular grooved rim, fitted with a ring of hard wood F, forming a bed or cushion for the platform B. The cylinder C may be either a steam or hydraulic cylinder, and serves to tilt up the filled casks for convenience of removal from the platform B. The piston in the cylinder is secured to a disc G, which, when raised, comes in contact with the bottom of the cask and tilts the same.

2630. PROVISION BOXES OR CASES, &c., *F. S. Colas.—Dated 28th June, 1880.* 6d.

This consists in the insertion of a wire between a box or case and the flange of its cover, which wire is fitted at its end with a button or pin, and used to tear open the flange of the cover of the box.

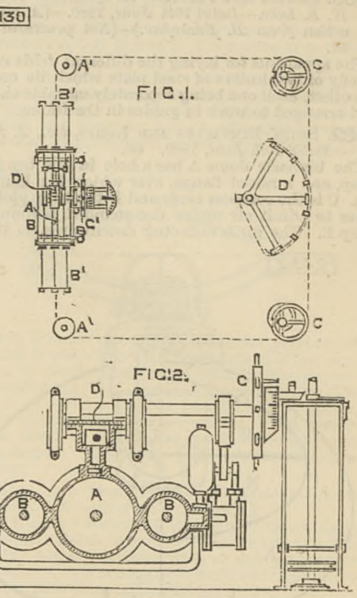
2637. CORSETS OR STAYS, *W. R. Lake.—Dated 28th June, 1880.—(A communication from M. K. Bortree.)* 6d.

This consists of a corset or stay in which the breast portions are cut away, and the sides of such cutaway parts are provided with guides or fastenings, adapted to receive and hold in position, vertically, adjustable breast pieces, which are not otherwise permanently secured to the said corset.

4130. STEERING APPARATUS FOR VESSELS, *A. M. Clark.—Dated 11th October, 1880.—(A communication from J. F. Guild and A. E. Knight.)—(Complete.)* 6d.

Fig 1 is a plan view of the steering apparatus, and Fig 2 is a vertical cross section of the steam and liquid cylinders. A is the steam cylinder and B B the liquid cylinders placed at opposite sides of the cylinder A. These cylinders have separate pistons, the rods of which extend through the heads at both ends and are connected by crossheads B^1. The steering chains or ropes are connected to the crossheads by shackles to eyes, and pass around fixed sheaves A^1, and along the deck to the excentric C, from which chains or ropes pass around a quadrant D^1 that is fixed on the rudder post, the ends of the chains or ropes being connected to the fore arm of the rudder-head or shaft, which may be extended to any desired height as required; D is the steam chest containing slide valve and provided with inlet ports to the cylinder A, and exhaust port. Above the steam chest in suitable bearings is a cross-shaft carrying the steering wheel G^1, and also carrying excentric from which rods extend to a crosshead on the valve rod, so that the

4130



valve is moved by operation of the shaft. The cylinders B are provided with passages to allow the fluid to pass from one side of the piston head to the other. These cylinders will be preferably filled with oil.

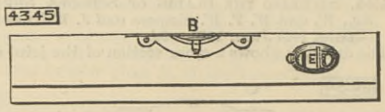
4320. SKATE ATTACHMENTS, *H. J. Haddan.—Dated 23rd October, 1880.—(A communication from C. Brewster.)—(Complete.)* 4d.

This consists partly in the combination of a plate having inclined slots, a slide having slots, and clamps having studs, with an operating device.

4345. SPIRIT LEVELS, *W. W. Vaughan and A. Clark.—Dated 25th October, 1880.—(Complete.)* 4d.

The level is provided with a longitudinal central tube B and a transverse tube C for a plumb, both of ordinary construction, and opening equally to both

4345



sides of reflectors pivotted or journaled above the tubes, so that the angle of the reflection may be changed from one side to the other, and thrown outward to any desired degree. So as to render the image of the bubble distinct the bubble tube is enveloped by a bright reflecting surface H. E is one of the reflectors.

CONTENTS.

THE ENGINEER, January 21st, 1881.