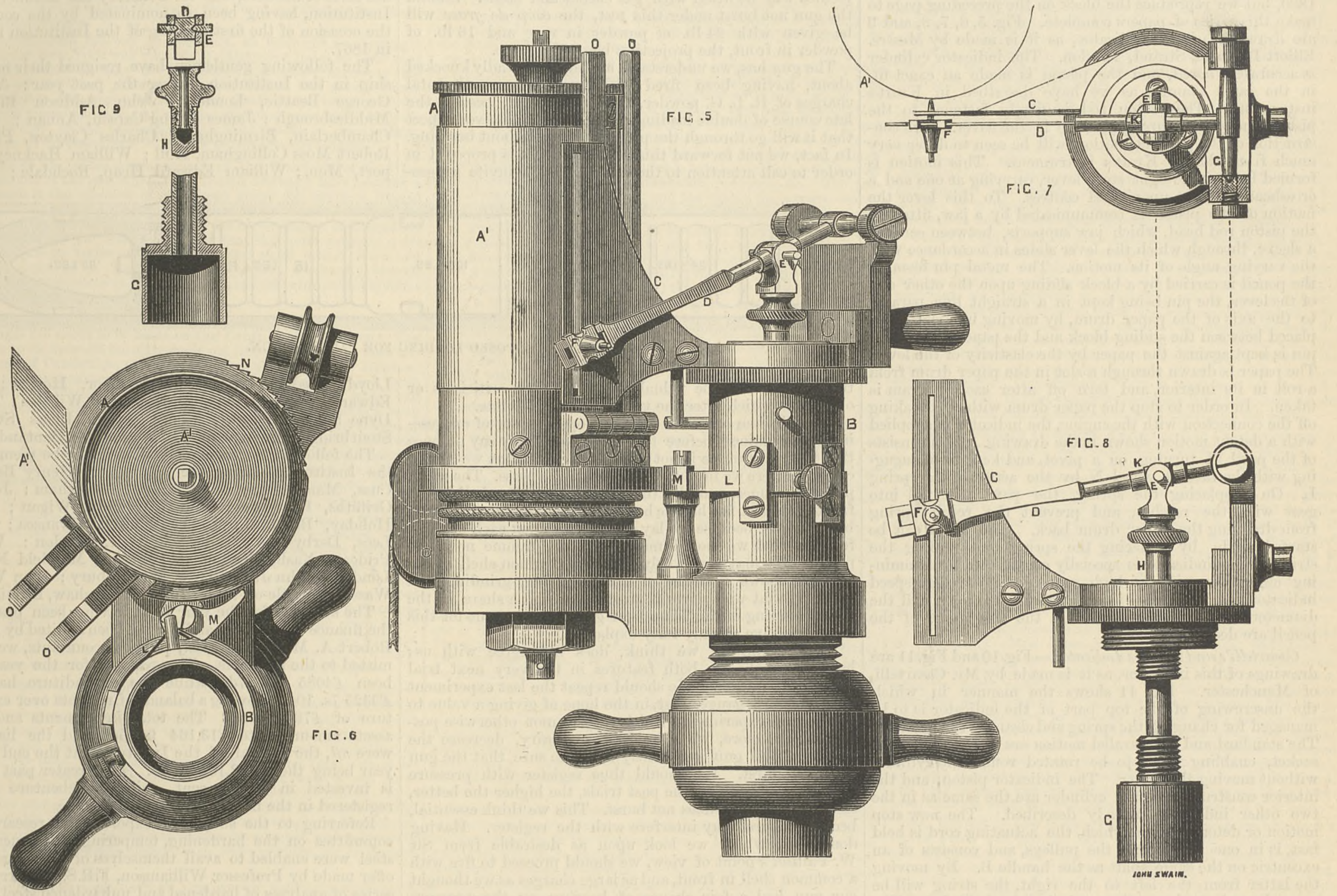
THE INDICATOR.

No. II.

Indicators for High Pressures.—If diagrams for very high pressures are required—for instance, with engines worked explosively—the strongest spring graduated to fifteen atmospheres is too weak. In order to make experiments at a pressure of forty atmospheres with the usual springs, Messrs. Kraft and Sohn supply the tapered piece *d*, Fig. 2—see vol. xl., page 415—with a bore having a diameter of 12·66 mm., = 0·5in., in which a corresponding piston travels. At pressures of about 100 atmospheres, the indicator is supplied with a separate cylinder, of which the diameter is 8·17 mm., = 0·32in.



DARKE'S INDICATOR

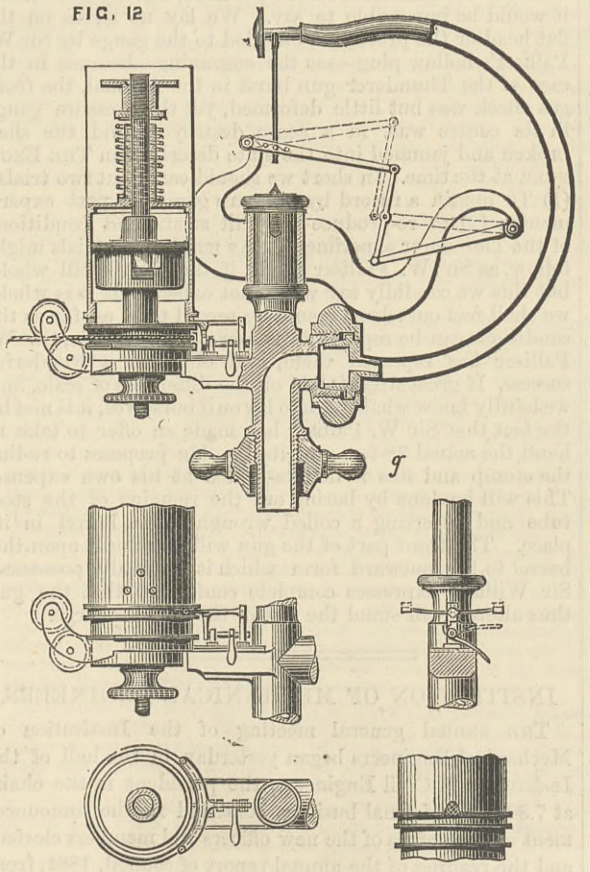
The indicators of these three sizes are sold with springs of various limits of load, as given in the following table :—

Indicator piston.	Diameter.	Area of the piston in proportion to that of No. I.	Limits of load in atmospheres for the four springs of each instrument.
No. I.	20 mm. = 0·79in.	1	− 1 to + 2 − 1 to + 5 − 1 to + 8 − 1 to + 15
No. II.	12·66 mm. = 0·5in.	$\frac{1}{2 \cdot 5}$	0 to + 5 0 to + 11·5 0 to + 20 0 to + 37·5
No. III.	8·17 mm. = 0·32in.	$\frac{1}{6}$	0 to + 12 0 to + 30 0 to + 48 0 to + 90

Fixing and Management of the Indicator.—Notwithstanding that every steam or hydraulic cylinder ought to have a proper entrance for screwing in the indicator, it is very seldom that this is found, even in new engines. The indicator is therefore always provided with a steel tap corresponding to the pitch of the piece *i*.

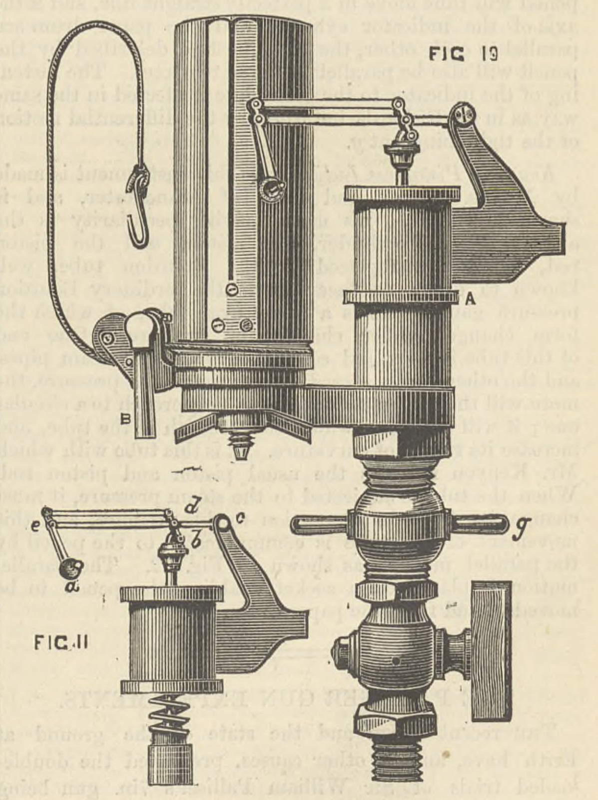
The proper place to put the piece *i* on the cylinder will be determined by its giving the most convenient arrangement of the indicator, and the most perfect communication between the cylinder and the indicator-piston. Hence it must not be at a place within the stroke of the piston. The indicator must accurately report the general pressure in the cylinder, and therefore must not be placed near the ports, where the steam is rushing out or in, or at any part where condensed water may be found. The system of coupling the top and bottom ends of the cylinder together by pipes leading to the indicator, in order to avoid the little difficulty of having to remove the indicator from top to bottom, and bottom to top again, is a very great evil, especially at high speeds, as the steam pressure will be seriously diminished by passing through these long and narrow tubes. To put another spring into an indicator-cylinder, the cover is to be unscrewed, and the parallel motion, the pencil, and the piston to be lifted off. The connection between the piston-rod and the pencil-lever is then to be loosened, the piston and the spring unscrewed, and the latter replaced by the new spring. Great attention must be given to insure catching the nut and not the coils, and to see that the new spring is completely screwed up. Before replacing the piston in the cylinder, it ought to be oiled. Having screwed a fine-pointed hard lead-pencil into the loop of the lever *p*, and fixed the paper, the regulation of the paper-drum is the only point left. Suppose that the spring of the paper drum is in its unstrained position, it has to be bent in order to give the drum a correct and quick return after having been turned by the string. This operation is performed by lifting off the barrel, loosening the nut *x*, and turning the cover *w* until the pull of the string has reached the desired tension. In this position the nut is firmly screwed against the cover, by which means the latter is secured to the spindle. Before the barrel is replaced on the pulley, its interior, as well as the exterior of the cap, must be oiled, in order to facilitate the lifting up of the barrel during the motion. After the termination of the experiment, the spring must be restored to the unbent state.

Taking of the Diagram.—We will now suppose the indicator-paper—3¾in. by 7in.—to be placed on the cylinder, and the important matter of transferring and reducing the



KENYON'S INDICATOR.

motion of the steam piston to be completed. We have then to describe briefly how, when the indicator has reached the normal temperature, a diagram may be taken. The plug of the cock is so turned that the indicator is in communication with the open air; the spring, having atmospheric pressure on the top and bottom, is then neither compressed nor extended. This position of the piston is fixed by the pencil's drawing a straight line, called the atmospheric line, which forms the base for all the calculations made by the diagram. The cock is then turned to connect the open air with the steam cylinder, in order to let the steam blow out through the tubes. Afterwards the connection between the steam cylinder and the indicator piston is effected by turning the plug into the position shown in Fig. 2. The diagram is then immediately taken by simply pressing the pencil slightly against the paper. If the diagram is only taken to ascertain what power the engine is exerting, it is sufficient to take a double stroke and to repeat this several times in order to obtain a good mean value. If it is important to know the effect of changes which take place in the engine during the motion, the diagrams are best taken on the same paper, in order to make a comparison. It will be easy for an experienced experimenter to change the paper without stopping the



CASARTELLI'S AND POTTER'S INDICATOR.

motion of the indicator, even at high speeds. But it is much more convenient to make use of the detent motion with which most indicators are supplied, and by which the motion of the paper drum is completely stopped without breaking the connection between the indicator and the engine. Such detent motions will be described later. It is well worth while to take a great number of diagrams in order to have ample material for subsequent study. The diagram must contain on its face the most important facts, which are necessary for its calculation. These are (1) the gross and effective boiler pressures; (2) the point of cut-off; (3) the number of revolutions; (4) the vacuum; (5) the dimensions and position of the examined engine; (6) the scale of the indicator spring; (7) the areas of the steam and exhaust ports, and of the inlet and outlet passages; (8) the cubical contents of the clearance spaces. We will now go on to describe some other types of improved indicators, each having special merits of its own.

Richards Indicator, with Darke's Parallel Motion.—This indicator was illustrated in our impression for March 5th, 1880, but we reproduce the block on the preceding page to make this series of papers complete. Fig. 5, 6, 7, 8, and 9 are drawings of this indicator, as it is made by Messrs. Elliott Brothers, Strand, London. The indicator cylinder is accurately bored, and the piston is made an exact fit, in the same manner as we have described in Kraft's instrument. The piston rod is firmly fastened to the piston, and passes through a hole in the cover. The construction of the parallel motion will be seen to differ very much from that of Kraft's instrument. This motion is formed by a single light steel lever, carrying at one end a crosshead, moving upon steel centres. To this lever the motion of the piston is communicated by a jaw, fitted on the piston rod head, which jaw supports, between centres, a sleeve, through which the lever slides in accordance with the varying angle of its motion. The metal pin forming the pencil is carried by a block sliding upon the other end of the lever, the pin being kept in a straight line, parallel to the axis of the paper drum, by moving in a slot guide placed between the sliding block and the paper drum. The pin is kept against the paper by the elasticity of the lever. The paper is drawn through a slot in the paper drum from a roll in its interior, and torn off after each diagram is taken. In order to stop the paper drum without breaking off the connection with the engine, the indicator is supplied with a detent motion shown in the drawing. This consists of the pawl M turning on a pivot, and kept from engaging with the ratchet wheel N by the action of the spring L. On displacing the spring, the pawl will fall into gear with the ratchet, and prevent the recoil spring from dragging the paper drum back. The drum can be started again by replacing the spring and pulling the string. This indicator is specially constructed for examining engines running at high speed. In the high-speed indicator the piston is $\frac{1}{4}$ square inch in area only, and the diameter of the paper drum and the movement of the pencil are decreased.

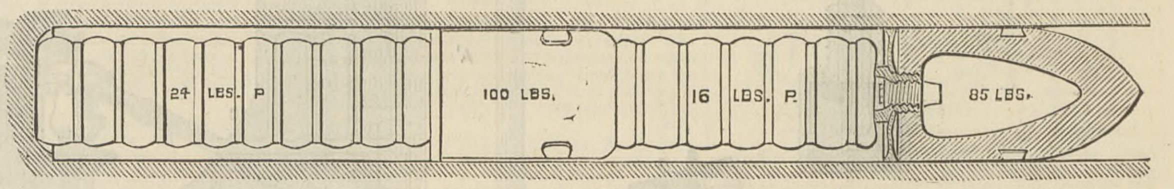
Casartelli's and Potter's Indicator.—Fig. 10 and Fig. 11 are drawings of this indicator, as it is made by Mr. Casartelli, of Manchester. Fig. 11 shows the manner in which the unscrewing of the top part of the indicator is to be managed for changing the spring and cleaning the cylinder. The standard and the parallel motion are in one piece on a socket, enabling them to be rotated round the cylinder without moving the latter. The indicator piston, and the interior construction of the cylinder are the same as in the two other indicators already described. The new stop motion or detent B, by which the actuating cord is held fast, is in one piece with the pulleys, and consists of an excentric on the same shaft as the handle B. By moving the latter from the left to the right, the string will be pressed against the pulley and thus be held fast. The parallel motion is shown in Fig. 11. If the points *a*, *b*, and *c* are set in the same straight line, the point *a*—the pencil—will move in a straight line parallel to the piston rod. For the lines *e a* and *d b* are always parallel to each other, therefore $\frac{c\,d}{c\,e} = \frac{c\,b}{c\,a}$; hence if the point *b* is describing a straight line, the point *a* must do the same. The pencil will thus move in a perfectly straight line, and if the axis of the indicator cylinder and the paper drum are parallel to each other, the straight line described by the pencil will also be parallel to these two axes. The fastening of the indicator to the cock-piece is effected in the same way as in the Richards indicator, by the differential motion of the tightening nut *g*.

Kenyon's Pistonless Indicator.—This instrument is made by Messrs. Storey and Sons, of Manchester, and is shown in Fig. 12. Its most striking peculiarity is the absence of the cylinder, the piston, and the piston rod, which are replaced by the Bourdon tube, well known to every engineer from the ordinary Bourdon pressure gauge. It is a coiled oval tube, of which the form changes under changes of pressure. One end of this tube is open and connected with the steam pipes, and the other end is closed. The higher the pressure, the more will the oval section of the tube approach to a circular one; it will therefore widen the breadth of the tube, and increase its radius of curvature. It is this tube with which Mr. Kenyon replaces the usual piston and piston rod. When the tube is subjected to the steam pressure, it must change its form in proportion to this pressure, and this movement of the tube is communicated to the pencil by the parallel motion, as shown in Fig. 12. The parallel motion is placed on a socket enabling the pencil to be moved to and from the paper drum.

THE PALLISER GUN EXPERIMENTS.

THE recent storm and the state of the ground at Erith have, among other causes, prevented the double-loaded trials of Sir William Palliser's 7in. gun being proceeded with. We have now received the following information with regard to them:—It is intended to resume them as soon as the weather will permit. The projectiles will consist of a flat-headed shot in the rear and a conical shell in front, as shown in the engraving herewith. It has been considered by some that the shell is likely to break up, and thus add to the strain upon the gun. In order, therefore, to meet with every possible requirement, a shell should be the front projectile in future double-loading experiments. The gas check is attached to the shell by means of a large hollow central plug; into this plug is screwed the pressure gauge, which is thus protected by the hollow ring of the plug. The rear projectile is made flat-headed in order that when it eventually impinges on the front projectile in the earth butt it shall not injure the pressure gauge. It is hoped that the pressure exerted by the front charge on the base of the shell will be ascertained. The first charge with which the gun will be fired will be a 22 lb. charge in the rear and a 14 lb. charge in the front, both of pebble powder; the rear shot will weigh 100 lb., and the front shell 85 lb.; both projectiles will be fitted with gas checks and studs. Should the gun not burst under this test, the *coup de grace* will be given with 24 lb. of powder in rear and 16 lb. of powder in front, the projectiles being the same.

The gun has, we understand, already been sadly knocked about, having been fired with excessive experimental charges of R. L. G. powder, and 180 lb. shot, besides the late course of double loading. We do not ourselves expect that it will go through the proposed tests without bursting. In fact, we put forward this notice of what is proposed in order to call attention to the subject, and to invite suggestions which may be valuable, rather than criticisms or objections which after the trial will come too late.



PROPOSED LOADING FOR PALLISER GUN.

We will then ourselves take this opportunity of expressing our opinions before the event, and may say at once that the programme is not exactly the one that we should carry out were we in Sir William Palliser's place. The use of pressure gauges, and also the employment of a shell as the front projectile, is what we have urged strongly throughout; but it is just because we lay such stress upon each of these features that we should modify the programme now proposed. We may say briefly, that the common shell in the Arsenal shows evidence of such wedging, grinding, and violence, that we believe it must have had a share in the actual rending of the Thunderer gun. Our reasons for this belief we have already fully explained.

Sir W. Palliser, we think, does not agree with us; hence he embodies both features in the very next trial without hesitation. We should repeat the last experiment with pressure gauges first, in the hope of giving a value to all the past experiments which they cannot otherwise possess. Nay, more, we should, if necessary, decrease the strain on the gun sufficiently to make sure that the gun does *not* burst. We should thus register with pressure gauges *some* stage of the past trials, the higher the better, so long as the gun does not burst. This we think essential, because a burst may interfere with the register. Having done this, which we look upon as desirable from Sir W. Palliser's point of view, we should proceed to fire with a common shell in front, and as large charges as we thought our gun had a fair chance of bearing, or the pressure gauges of registering. We should expect the gun to burst, and the shell to be found wedged and jammed in somewhat the same way as took place in the Thunderer gun.

Very possibly the front pressure gauge would be broken and jammed up in such a way as to show only that it had exceeded its maximum record pressure, but by how much it would be impossible to say. We lay no stress on the flat head or the protection afforded to the gauge by Sir W. Palliser's hollow plug—see the engraving—because in the case of the Thunderer gun burst in the Arsenal, the front gas check was but little deformed, yet the pressure gauge in its centre was, in a sense, destroyed, and the shell broken and jammed into the state described in THE ENGINEER at the time. In short we should carry out two trials: (1) To obtain a record by pressure gauge of past experiments; (2) to re-produce the full strain and conditions of the Thunderer experiment. As many more trials might follow, as Sir W. Palliser likes, if the gun is still whole, but this we candidly say we do not expect. If it is whole, we shall feel ourselves bound to record that as far as the conditions can be representative on a smaller scale, Sir W. Palliser has repeated them, and obtained a wonderful success. If great stress is laid on the difference of scale, and we hardly know what stress to lay on it ourselves, it is met by the fact that Sir W. Palliser has made an offer to take in hand the actual 38-ton gun itself. He proposes to re-line the stump and fire it double-loaded at his own expense. This will be done by boring out the remains of the steel tube and inserting a coiled wrought iron barrel in its place. The front part of the gun will be rebuilt upon this barrel to the outward form which it originally possessed. Sir William expresses complete confidence that the gun thus altered will stand the test of the double charge.

INSTITUTION OF MECHANICAL ENGINEERS.

THE annual general meeting of the Institution of Mechanical Engineers began yesterday, in the hall of the Institution of Civil Engineers, the president in the chair, at 7.30. The formal business consisted in the announcement of the names of the new officers and members elected, and the reading of the annual report of council, 1881, from which we learn that this is the 34th anniversary meeting, and that at the end of the year 1880 the total number of members of all classes on the roll of the Institution was 1210, as compared with 1178 at the corresponding period of the previous year. The increase arises as follows:—There were elected within the year 80 members of all classes; there were lost by deceases 8 members of all classes, and by resignation or removal from the register 40 members of all classes. This effective increase of 32 is highly satisfactory, considering the position in which engineers in general have been placed during the past year, being fully equal to the average annual increase in the Institution. The following deceases of members of the Institution have occurred during the past year:—Sir Thomas Bouch, Edinburgh; William Clark, London; Thomas Elwell, sen., Paris; Thomas Hawthorn, Gateshead; William Ebenezer Marshall, Leeds; General Arthur Morin, Paris; Lewis Olrick, London.

Of these General Morin, director of the Conservatoire des Arts et Metiers, was an honorary life member of the Institution, having been so nominated by the council on the occasion of the first meeting of the Institution in Paris in 1867.

The following gentlemen have resigned their membership in the Institution during the past year:—William George Beattie, London; John Addison Birkbeck, Middlesbrough; James Irving Carson, Annan; Walter Chamberlain, Birmingham; Charles Clayton, Preston; Robert Moss Collingham, Hull; William Hackney, Newport, Mon.; William Edward Heap, Rochdale; Wilson Lloyd, Wednesbury; William Moor, Hetton; John Edward Pearson (Graduate), Newton-le-Willows; Thomas Dyne Steel, Newport, Mon.; James Evers Swindell, Stourbridge; Enrique de Vial (Associate), Santander.

The following gentlemen have ceased to be members of the Institution during the past year:—Henry Berriman Cuss, Manchester; John Gillett, Melksham; John R. Griffiths, Pontypool; Robert Grundy, Wigan; Joseph Holiday, Bradford; Henry Kinsey, Swansea; James Lees, Derby; Alexander McNeile, London; William Prideaux Nash, Birmingham; William Manfield Newton, London; John James Trow, Wednesbury; John William Wass, Newcastle-on-Tyne; John Withinshaw, Birmingham.

The accounts for the year 1880, having been passed by the finance committee, and having been audited by Messrs. Robert A. McLean and Co., public accountants, were submitted to the members. The receipts for the year have been £4085 11s. 7d., while the expenditure has been £3325 7s. 10d., showing a balance of receipts over expenditure of £760 3s. 9d. The total investments and other assets amounted to £13,164 9s. 5d., and the liabilities were *nil*, the capital of the Institution at the end of the year being then £13,164 9s. 5d. The greater part of this is invested in 4 per cent. railway debenture stocks, registered in the name of the Institution.

Referring to the subject of experimental research, the committee on the hardening, tempering, and annealing of steel were enabled to avail themselves of a very generous offer made by Professor Williamson, F.R.S., to carry out a series of analyses of hardened and unhardened steel, at the laboratory, University College, London. Much time has been expended upon the experiments, owing to the great difficulty of finding any system of analysis which would give conclusive data on the particular points on which the committee wished for information; but the committee expect now to have the final results in their hands at an early date. Upon rivetted joints a long and valuable series of experiments has generously been carried out at University College, by Professor Kennedy, with his excellent testing machine; the steel being supplied by the Landore Steel Company, and the specimens prepared by the Wallsend Slipway Company, and in both cases free of expense to the Institution. The council feel that the thanks of the Institution are due to all these gentlemen for their kind assistance, in thus enabling the committee to conduct an investigation which they believe will be found of great practical value. The results would have already been in the hands of the members, but that it was considered desirable to check them by some final experiments on a larger scale, but embodying in fact the results of the investigations already made. These experiments are now in progress, the Barrow Hematite Steel Company having offered the use of their large testing machine for the purpose; and it is hoped that the results of the inquiry will shortly be in a condition to be laid before the Institution.

The library of the Institution has been considerably augmented during the past year, by the books purchased with the bequest of £100, received in February from the executors of the late Mr. Robert Napier, past president.

The attendances at the meetings have been very satisfactory. There were at the annual general meeting 110 members and 63 visitors; at the spring meeting 73 members and 73 visitors; at the summer meeting 164 members and 67 visitors; and at the autumn meeting 67 members and 66 visitors.

The routine business having been transacted, the reading of papers began. We are compelled to hold over our notice of these until next week. The programme includes the following papers:—"On the Various Modes of transmitting Power to a Distance," by M. Arthur Achard, of Geneva; "On Harvesting Machinery," by Mr. Ernest Samuelson, of Banbury; "On Machines for Producing Cold Air," by Mr. T. B. Lightfoot, of Dartford; "On Machinery for Dressing Silicious Stone," by Mr. J. Dickinson Brunton, of London; "On the Farquhar Filtering Apparatus," by Mr. Henry Chapman, of London; "On Rivetting, with Special Reference to Shipwork," by M. le Baron Clauzel, of Toulon.

The business of the meeting will be resumed to-day, at 3 p.m.

RAILWAY MATTERS.

THE South-Eastern Railway Company proposes to make a branch line to the Crystal Palace.

THE Arlberg Tunnel is being pushed rapidly forward. The length bored on the Tyrol side is upwards of two hundred metres.

THE report of the London and Brighton Railway is unsatisfactory, working expenses showing a considerable increase for the half year.

THE roof of the London, Chatham, and Dover Company's station at Ludgate-hill is now worse than ever, which is saying a great deal.

The Italian Government have decided that the St. Gothard Railway shall be united with the Italian system by the line passing to the left of the Lago Maggiore, this being the shortest and most convenient route.

ON the Erie Railway on Saturday, at midnight, a passenger train for New York was running at thirty-five miles an hour near Elmira, when an axle of the locomotive broke, throwing the train off the line. The coaches were turned over several times. The postal car caught fire, and four postal clerks inside, with the express messenger in the express car adjoining, were burnt to death in full view of the passengers, who were unable to rescue them. Eleven of the passengers were more or less severely injured.

ONE of the Indian correspondents of the *Times* states that the opponents of the metre gauge for Indian railways have secured a triumph in the selection of the broad gauge for the new Bhopal line. It is believed that this in a great measure is due to the objections to the narrow gauge urged by the clever Begum of Bhopal. It is now almost universally admitted that the metre gauge is quite inadequate for traffic on all except some small branch lines, and there seems to be little doubt that it will eventually become necessary to reconstruct the Rajpootana and other important systems of railway on the standard gauge.

THE *East Anglian Daily Times* announces that important changes are about to be made on the Great Eastern system. The main route between the metropolis and Norwich will be *viâ* Ipswich, instead of Cambridge, effecting a saving of ten miles in distance, and about a quarter of an hour in time. A new branch from Forncett to Wymondham will be opened on March 1st, which will bring central and north Norfolk into quick communication with London, and will open up the important market of East Dereham to traders of the adjoining county. A service of express trains will be run from London to Norwich, stopping at Ipswich and Forncett, where the train will divide, a portion going on to Norwich, and the remainder to Wymondham, Dereham, Fakenham, and Wells.

A VERY curious accident has taken place on the Midland Railway, near Oakham, blocking both lines for some time. The accident, it has been ascertained, was caused by the extended jib of a heavy crane, which was being conveyed on the front portion of the train, breaking loose and projecting outwards, causing it to come into contact with a signal-box at Egleton, which box it completely destroyed. The signalman had a miraculous escape from instant death. He was knocked down and had his arm injured. The force of the collision threw the wagon and the crane on to the down line, and piled all the wagons in a heap. It is fortunate that the jib did not extend towards the other line, or a terrible collision might have occurred with the first passenger express.

A MEMORIAL is at present in course of signature to the Premier and to Lord Salisbury, as chairman of the Great Eastern Railway, urging the adoption of uniform rates on railways, without respect to distance, for quantities of milk and sea water of 20 gallons and under, and also for pigs, sheep, cattle, and horses, according to class, per head. It is also suggested that similar rules should be adopted for rates for sewage trucks and water tanks of not more than five tons for corporations and local boards of health. It is further suggested that letters go by every train, and that weekly or monthly season tickets to cover the three kingdoms for farmers and merchants might with advantage be adopted, and a five-mile uniform weekly season ticket taken out anywhere for clerks and workmen.

THE Chicago City Railway Company is making arrangements to put down an experimental section of the rope railway now used in San Francisco, and illustrated in our pages, for motive power, to see how it will stand the test of a Chicago winter. The inventor of the rope system is in Chicago to superintend the proposed construction. He sees no difficulties about the two points as to which question has been raised (1) whether the rope would work round a curve, and (2) whether the trench in which the rope is laid would not fill up with snow and ice and prevent the running of cars. With the rope one man and an engine can do the work of three hundred horses. The ropes have been in use in San Francisco four or five years, and their utility and economy have, it is said, been demonstrated.

EITHER a lot of rolling stock is just now upon its last legs or considerable increase in traffic is expected. Several heavy orders have recently been given out. The Caledonian Railway Company has ordered 1000 wagons from Mr. S. J. Claye, of Barrow, and another 500 wagons are being tendered for on account of the same company. The Lancashire and Yorkshire Railway has ordered 580 pairs of wheels and axles from the Leeds Wheel and Axle Company, and has invited tenders for 1500 more pairs. The Glasgow and South-Western Railway has ordered 300 pairs of wheels and axles from Messrs. Craven Brothers, Darnall, Sheffield, and Messrs. Baker and Burnett, Conisborough. The Scotch railway companies must expect heavy traffic, for the North British Company is also having 1100 wagons constructed in the Sheffield district.

OWING to the severe weather prevailing for a fortnight past, the works upon the Berlin Electric Line have been much retarded, and cannot be resumed until a thaw sets in. A period of four weeks must then pass before progress sufficient can be made with the line to enable it to be opened for traffic. It is obvious that if insulated conducting rails are a no less necessary part of the system than the Siemens dynamo-electric machine, a heavy fall of snow will be a more serious impediment to the new line than to railways on the ordinary principle. The carriages on the Electric Railway will convey twenty passengers each. There will be seats for twelve, and standing room for the remaining eight. The dynamo-electric machine will be placed between the axle-trees and the floor of each carriage. The rate of travelling will be greater than that usual on tramways, and is expected to reach about twenty miles an hour. Powerful brakes, combined with an arrangement acting on the electrical apparatus, will enable the official in charge to bring the carriage to an almost instantaneous standstill.

A RAILROAD enterprise, still in the preliminary stage, contemplates the construction of a narrow gauge road through the north-western part of Colorado, with a possible extension to the Pacific coast. The precise route has not been determined; but its general course will be north-westward from Denver to the rich coalfields south-west of Erie, twenty or thirty miles from Denver, and through Estes Park, a summer resort; thence through Middle Park, and following the course of the Grande River, passing the Eagle River and other mining camps, to Iron City, Utah. The immediate object is to reach the coalfields, mining camps, timber lands, and quarries surrounding this route. The ground of the route as far as the Utah boundary-line is said to have been already examined, and the survey will be begun at once. The name of the company will be either the Colorado, Utah, and California Railroad Company, or the Denver, Middle Park, and California Railroad Company. Articles of incorporation have been filed with the Secretary of State of Colorada. Among the incorporators are governors Tabor and Routh, of Colorado, D. H. Moffat, jun., president of the First National Bank of Denver, and Mr. Walcott, manager of the Argo Smelting Works, near Denver. The capital is fixed at 30,000,000 dols.

NOTES AND MEMORANDA.

THE total traffic of the Suez Canal during 1880 amounted to 2026 ships of 4,349,548 tons, producing a revenue of 39,750,000f., thus enormously surpassing the traffic of any year since the opening of the canal ten years ago.

AT the Royal Observatory, Greenwich, the duration of registered bright sunshine in the week ending the 15th inst. was 3·8 hours—against 7·6 hours at Glynde-place, Lewes—the sun being above the horizon during 57·2 hours; the recorded duration of sunshine was, therefore, equal to 7 per cent. of its possible duration.

IN the course of dredging operations in the bed of the Limmat, at Zurich, some very interesting objects have been brought to light, among others ancient coins—including fifty gold pieces of Brabant, swords, and the skeleton of a stag of a species now extinct in Switzerland. The piers of a Roman bridge which once spanned the river have also been laid bare. All the finds are being placed in the Zurich Historical Museum.

THE following recipe for keeping lamp chimneys from cracking is taken from the *Diamond*, a Leipzig journal devoted to the glass interest. Place your tumblers, chimneys or vessels, which you desire to keep from cracking in a pot filled with cold water, add a little cooking salt, allow the mixture to boil well over a fire, and then cool slowly. Glass treated in this way is said not to crack even if exposed to very sudden changes of temperature. Chimneys are said to become very durable by this process, which may also be extended to crockery, stoneware, porcelain, &c. The process is simply one of annealing, and the slower the process, especially the cooling portion of it, the more effective will be the work.

A NEW microphone, made by M. Boudet in Paris, and described in *La Nature*, has the general shape of a telephone on a support. It comprises a mouthpiece, in which is an ebonite plate 1 mm. thick, with a short bar of copper penetrating from its middle a short way into a glass tube in which are six little balls of retort carbon in a row; a second mass of copper following the last, and resting on a small spiral spring in a case. The pressure can be varied by means of a screw. The instrument is worked with six Gaiffe elements—peroxide of manganese and chloride of zinc—mounted in tension, and a Bell telephone. It is said to transmit the voice very distinctly without altering its *timbre* and without disturbing sounds being produced.

ACCORDING to the Registrar-General's returns of births and deaths in London, and in nineteen other large English towns for the week ending Saturday, January 15th, the annual rate of mortality in twenty of the largest English towns averaged 23·6 per 1000 of their aggregate population, which is estimated at more than seven and a half millions of persons in the middle of this year. The rates of mortality in the several towns, ranged in order from the lowest, were as follow:—Brighton, 13·4; Newcastle-on-Tyne, 16·2; Portsmouth, 16·4; Hull, 19·8; Bradford, 20·8; Leicester, 21·7; Wolverhampton, 21·7; Sheffield, 22·2; Birmingham, 22·3; London, 22·6; Leeds, 22·7; Plymouth, 23·4; Norwich, 24·1; Bristol, 25·2; Nottingham, 25·2; Sunderland, 26·3; Liverpool, 29·3; Salford, 30·4; Manchester, 32·4; Oldham, 33·2.

MR. E. H. PLUMACHER, commercial agent of the United States, at Maracaibo, says there is in Venezuela a sand-bank full of holes, out of which gush streams of petroleum, mixed with boiling water. The sand-bank is about 7 kilos. from the confluence of the rivers Tara and Sardinarte. It is 10 metres high and 30 metres long. On its surface can be seen several round holes, out of which rises the petroleum and water with a noise like that made by steam vessels when blowing off steam, and above there ascends a column of vapour. There is a dense forest around this sand-bank, and the place has been called "El Inferno." About 240 gallons of water and petroleum are spurted forth per hour. The oil is of a very good quality. There are also many inferior wells in the country. The oil is gathered by the inhabitants in cloths, from which it is pressed out.

CONSIDERABLE differences of temperature are often recorded at nearly contiguous places, and it is probable that much of this is due to inaccuracy in the thermometers. M. J. Salleron says that even with well made thermometers, the indications of which are erroneous to 8 deg. or 10 deg., or more, especially at the higher temperatures and when in constant use at these, the glass undergoes sufficient change to cause inaccuracy. Such changes occur at printing-ink works, where oils are heated for several days to 270 deg.; in glycerine works, and with rectifiers of benzol. Glass is not merely modified when heated to 300 deg.; it undergoes true deformations at far lower temperatures. Thus the hydrometers used in sugar works, which are often exposed for a considerable time to temperatures of 95 deg., are affected. After an immersion of some days they are completely modified; their weight decreases, and they become erroneous to the extent of 7 deg. or 8 deg. B.

IN writing to a contemporary on the effect of the great easterly gale, of the 18th inst., in abnormally raising the afternoon tide, Mr. J. B. Redman, M.I.C.E., says that high-water was 4ft. 10in. above Trinity standard at London Bridge, at Westminster, 5ft.—in each case 3in. higher than the remarkable and then hitherto exceptional tide of the 15th of November, 1875, which marked relatively 4ft. 6in. and 4ft. 9in. above Trinity. The tide on the 18th was also 5ft. above the computed elevation by the tables of the Hydrographic Department of the Admiralty, so remarkable for their accuracy, but which do not, of course, allow for or predicate the excess resultant on gales. Hitherto 3ft. to 3ft. 6in. has been the excess in rise over the Admiralty estimate of those abnormal tides resultant on great gales of winds. The tide was, therefore, 3in higher than any recorded tide, and the super-elevation above computation under authority was 18in. in excess of any previously recorded spring tide.

IN a paper on car painting, read before the Master Car Builders' Association, Mr. W. C. White said of priming that though seldom looked upon as of chief importance, it is upon its excellence that the quality of the subsequent work depends. The purpose of priming is to fill the pores of the wood with a solid cohesive or elastic substance, which shall readily assimilate with and take to itself any subsequent coatings this work may require, and he is wise who adapts his means to the desired end. It is too often put into the hands of careless and inexperienced workmen, and some painters think anything in the shape of paint will answer for a primer. On the contrary, it bears the same relation to the subsequent coats which the foundation of a building does to the superstructure. A defect in the first endangers the whole. With reference to material, it should be of the best. Good white lead and raw oil, with enough litharge or other dryer to avoid any fattiness of the oil, are the essential components. The patent primers, or those made by some vaunted secret formula, cannot be recommended. On the other hand, it is a mistake to suppose that a primer can be carelessly made or mixed. The materials should be of the best, and the ingredients thoroughly incorporated.

ACCORDING to the *Comptes Rendus*, E. Moride has prepared a new elementary substance, which he calls nutricine. He combines raw flesh with other nitrogenous food, which absorbs the juices of the flesh, and perhaps forms with them some organic combinations which are, as yet, undetermined. He dries the whole in the air or in a stove moderately heated, then pulverises and sifts it. The powder is of a fine gray or yellowish colour and of an agreeable taste. It may be solidified by gum water, albumen, or grease, so as to form tablets, cylinders, and cubes of various weight, which can be divided, as needed, for making soups, sauces, or biscuits. The nutricine contains all the elements of the flesh in their natural condition; even the blood preserves all its properties of solubility, colouration and coagulation under the influence of heat. It is more nitrogenous and more nourishing, for equal weights, than meat itself, because all the worthless portions of the meat are rejected, and the fluids are replaced by farinaceous substances, which contain some additional amount of nitrogen. The same system, when applied to the blood or meat of horses and the refuse of abattoirs, gives a useful food for dogs, hogs, chickens, and ducks.

MISCELLANEA.

A PATENT has been granted in America to Professor Bell for the photophone.

CONSIDERABLE exertions are now being made to induce the Government to advance £72,000 for the improvement of Newry Harbour.

WE are requested to state that Mr. Wurr having retired from the firm of Wurr and Lewis, the business will be carried on in future under the title of Lewis and Lewis, Cambridge Works, Cambridge Heath-road, E.

IN the German Post and Telegraph Department large sums have been spent since 1872, chiefly in telegraphs, under which head we should more particularly notice the laying of an underground cable from Berlin to the Rhenish provinces and Alsace-Lorraine, and pneumatic tubes in Berlin. Under these heads we find an expenditure in round numbers—4,000,000 marks in 1874, 7,500,000 in 1875, 11,000,000 in 1876, 14,000,000 in 1877, 13,000,000 in 1878-79. The estimates for 1880-81 are moderate, the extraordinaries only 2,500,000 marks.

Les Mondes states that plans have been prepared for a large crystal palace, to be built in the park of St. Cloud, for permanent exhibitions of industry, art, horticulture, scientific spectacles with experiments upon a large scale, together with pictures and representations of the vegetable and animal kingdom in different geological ages. There will also be views and models of ancient and modern monuments, and curiosities from all parts of the world. It is proposed to combine the attractions of Sydenham Palace, the South Kensington Museum, and Kew Gardens.

CLARKE'S apparatus for getting rid of snow has been at work in Fore-street. It consists of a series of metal plates placed in an inclined position one above another, directly beneath the man-hole, so that the snow deposited therein falls upon them; beneath each plate are atmospheric gas burners by which they are heated as well as the spaces between them, the burners are supplied with gas from an adjacent main. An air shaft communicating with the outer atmosphere is provided for ventilation. Flues are also fixed to carry the heat from the spaces between the heated plates to the manhole shaft, so as to operate upon the surface of the snow placed therein. One labourer only is required to work the apparatus, viz., to rake the street scrapings from the plates as the snow is melted, the resulting water runs direct into the sewer.

THE Government Telegraphs Department in Calcutta appear to be following the lead of the Postmaster-General in this country. In November last they obtained a sample supply of some thirty of the loud-speaking telephones of the Gower-Bell Company for experimental trials, and we understand that the results have given so much satisfaction that the company has now received by telegraph a substantial order for a large number of its instruments. If this may be taken in conjunction with the recently announced refusal of the Government of India to sanction the setting up of telephonic exchanges on the part of private speculators, it would seem to indicate a resolve on the part of the executive to itself supply the Indian public with what will soon be found to be an indispensable aid to the business and pleasure of life in India.

A SINGULAR explosion occurred in a dwelling house at Salford on Wednesday. Mrs. Jones, living in Hodge-lane, had placed a bottle full of water, and holding about a gallon, in the heated oven, to warm the water to place it at the feet of her sick husband, when the bottle suddenly exploded, breaking into fragments the oven door and the bottle. The flying fragments struck Mrs. Jones and her three children, so severely injuring them that the latter are all detained at the hospital, one of them being in a critical condition. It is very probable that we have here a case of delayed ebullition due to the water being heated in a clean glass vessel, although it is possible that the bottle may have been tightly corked, and that pressure thereby accumulated in it. It is not likely, however, that the explosion would have been so violent in that case.

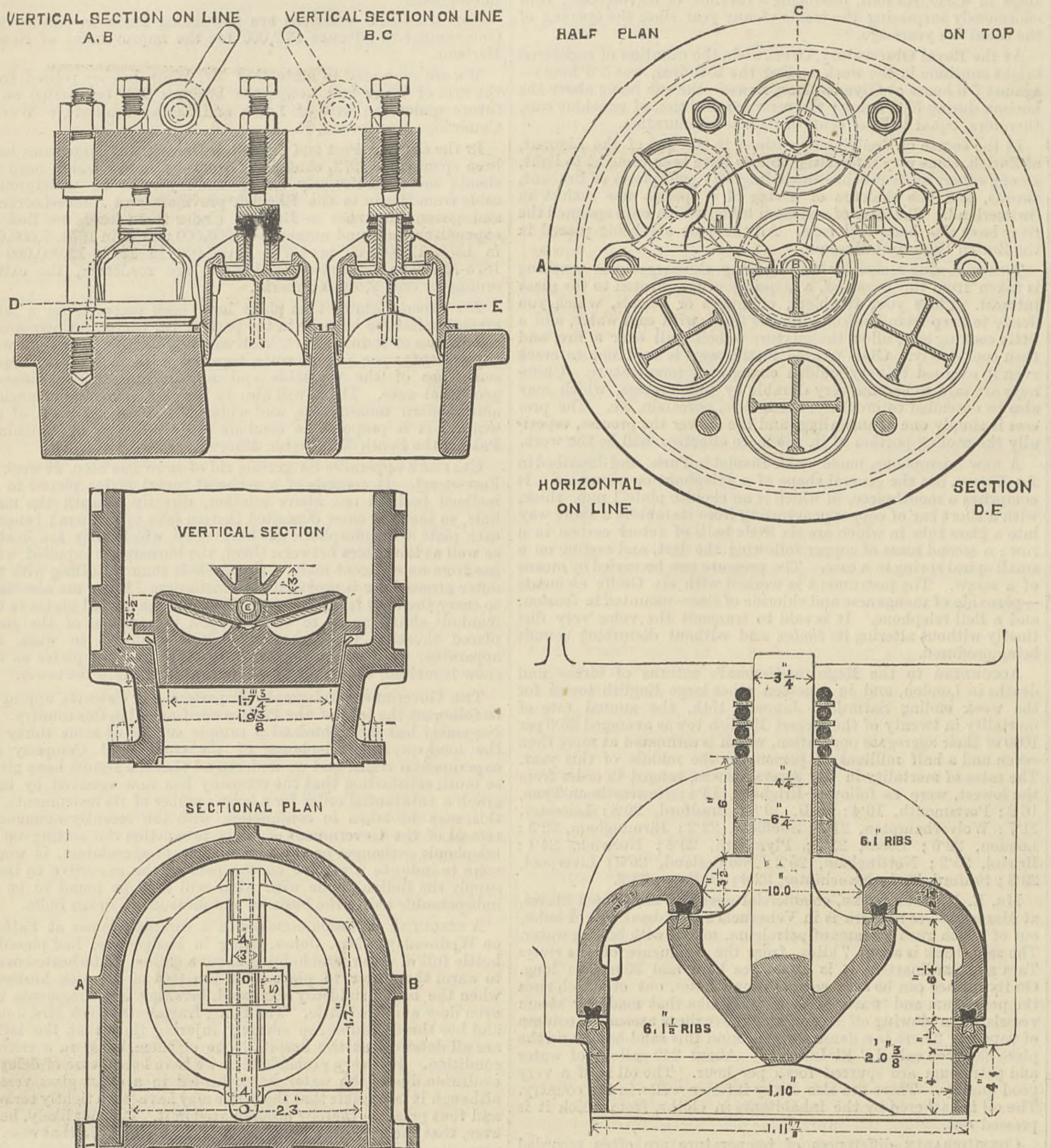
MR. EDISON is now seeking for bamboo filament for his electric lights, which will last, he says, for six months. Between seven and eight miles of line are about completed at Menlo Park, and between seven and eight hundred electric lights have been tried. It is estimated that to furnish New York city with 500,000 lights it would cost £750,000, or an average cost per light of £1 9s. 4d. per year, while gas costs from £1 9s. 4d. to £2 5s. 6d. each per annum. Mr. Edison has also designed a new combined engine and dynamo machine. The engine is to make 600 revolutions per minute, and indicate 100-horse power. The armature weighing one and a-half ton is mounted directly on the crank shaft. We may as well point out that no steam engine has yet been made which will run continuously and quite steadily for long periods of time at 600 revolutions per minute.

THE new steel works of the North Chicago Rolling Mill Company, at South Chicago, are fast nearing completion, and will doubtless be finished by the coming February. The blast furnaces, four in number, are heated by fourteen Whitwell's patent stoves. The latter are nearly ready, and are said to be the largest in America. Into each furnace will be driven twenty thousand cubic feet of air per minute. The blast chimney is 195ft. high by 12¼ft. in diameter. Besides these buildings there are four casting-houses, each 124ft. by 59ft., and another building, 368ft. by 98ft. for stock. The boiler-house, 250ft. by 28ft., will contain seventy-two boilers, each 35ft. by 4ft. These buildings, together with the engine-house gas stack, are nearly all completed. The foundations alone of the blast-house are finished. The company intends to make the machinery of this department the largest in the country. The building will have a boiler and engine-house of its own. The rail mill lacks only the roof of being finished, and when completed it will, according to an American exchange, be one of the largest in the world.

"THE second trial," says the *Melbourne Argus*, December 7th, "of the two London-made fire-engines by Shand, Mason, and Co., and by Merryweather and Sons, took place yesterday, in the presence of the jurors and a large number of spectators. On this occasion the competitors were placed well apart, so that neither should have their fires put out by showers of spray. Fires were lighted at the same moment. The temperature of the Shand-Mason engine stood at 75 deg., and in Merryweather's boiler at 74 deg. It was provided that they were to begin work as soon as the pressure in the boilers reached 100 lb. on the square inch. Shand, Mason's engine was ready in eight minutes ten seconds; Merryweather's in eight minutes fifty-eight seconds. Water was projected into the air by single jets, then by two, three, four, five, and six jets. In each case the Shand-Mason engine did the best work. The highest altitude reached by the single jet was about 130ft. Water was thrown from four hydrants simultaneously to the height of 106ft. and upwards. The test all through was in favour of Shand, Mason, and Co., but both engines did good work."

A LARGE hydraulic pumping engine for draining the Chollar Norcross and Savage shafts—the largest of the kind, it is represented, ever built—has just been completed in San Francisco. The engine occupies a space 65ft. by 20ft. and weighs between 200 and 300 tons, which the underground machinery will increase to about 1000 tons in all. According to the *American Manufacturer*, the engine accumulates water at 1000 lb. pressure to the square inch, in a reservoir at the surface 60ft. high, from which it will be conducted by a pipe 2400ft. to the bottom of the shaft, there to operate a pump which will raise the drainage water 800ft. to the Sutro Tunnel, into which it will be discharged. The water which does the work returns to the surface by another pipe. The system can be extended to 3000ft. in depth or take water from mines half a mile away, simply by extending the pipes. The new system is intended to dispense with the heavy and cumbersome pump rods heretofore used. It appears to us that this very system is the invention of Mr. Henry Davey, of Leeds, who has, if we are not mistaken, patented it. Nothing is said, however, on this point by our contemporary. Why?

THE "STAVELEY" PUMP VALVE.



THE two engravings at the top of this page illustrate a pump valve invented by Mr. Charles Markham, of Staveley, which has been severely tested at the Hartington Colliery of the Staveley Coal and Iron Company. It will be seen that it consists of a block or seating, in which are fitted seven small valves. The seating is treated as one valve, and fixed in its place in the usual way. It can be drawn by the slings shown in the cut. The valves are of the Cornish or double-beat type, with a sufficient excess of area in the ring valve to provide for a quick lift. This system possesses many advantages. We illustrate for the sake of comparison, the ordinary double-beat as used in South Durham collieries, and the old type of butterfly valve used at Staveley, and now being supplanted by the "Staveley" valve. The following statement will make the matter quite clear to our readers, we think, without further explanation :—

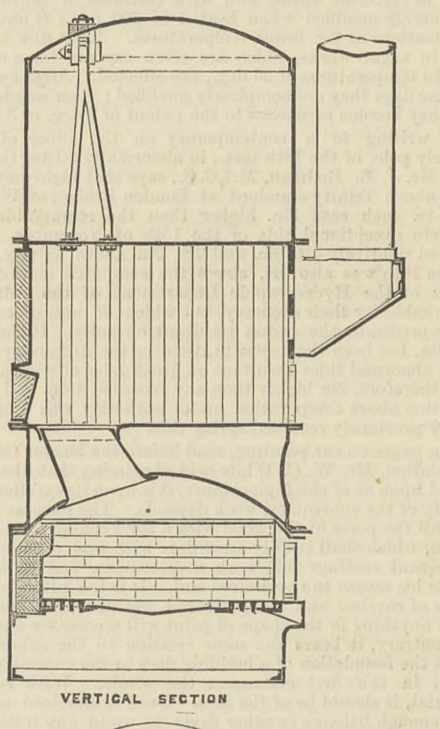
Comparative efficiency of pump clacks.

		The Staveley valve.	Single Cornish or double-beat valve.	Old Butterfly valve.
Diameter of pump rams	1ft. 8in.			
Stroke of ditto	10ft. 0in.			
Diameter of rising main	1ft. 6in.			
Area of ditto	254·47 sq. in.			
Height of column	720·0ft.			
Pressure in lb. per sq. in. due to column	312·48			
Area of valve under pressure of column		16·9	367·6	415·4
Area of openings in clacks for delivery		222·6	113·08	156·
Area of beating surface		55·65	56·5	118·2
Pressure per square inch on ditto in lb.		664·24	2033·	1098·1
Weight of clacks in lb.		7·	466·	218·
Lifting area of ditto		9·	299·4	219·3
Pressure per sq. in. required to lift ditto		·777	1·55	·994
Percentages.				
Area of delivery, rising main being taken at 100		87·47	44·4	61·3
Area of delivery, Staveley valves being taken at 100		100·	50·8	70·
Pressure per sq. in. on beating surface, ditto 100		100·	306·	165·
Pressure ditto required to lift valves, 100		100·	199·5	127·9
Average time of clacks working without changing		65weeks	—	3 weeks

LIVERPOOL ENGINEERING SOCIETY.—The hundred and fourth meeting of this Society was held on Wednesday evening, at the Royal Institution, Mr. A. Holt, president, in the chair. A paper was read by Mr. C. F. Findlay, M.A., C.E., of the Dockyard, Liverpool, "On the Design of Movable Bridges." After enumerating the different types of bridges made use of in different localities, and describing the advantages and defects of each type, the author proceeded to discuss the comparative merits of swing bridges constructed in one leaf and in two, advocating the single leaf system on the score of economy up to a limiting span, dependent on the proportion of the moving load to the dead load. He then investigated the ratio which the tail end of the bridge should bear to the total length to make the cost the smallest, and described methods of determining the strains on the continuous girders of a single leaf bridge, which were illustrated by diagrams. The paper was further illustrated by sketches of a bascule bridge, a drawbridge, and a single leaf and a double leaf swing bridge. A discussion followed the reading of the paper, and the further discussion was adjourned to the next meeting on February 2nd.

JONES'S VERTICAL BOILER.

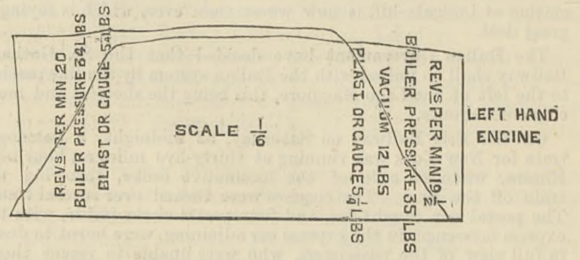
THE accompanying illustration explains itself. It shows in section and plan a vertical boiler, patented by Mr. Jones, of Liverpool,



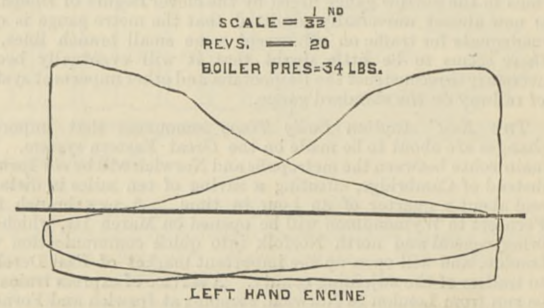
and manufactured by Messrs. C. Wilden, King and Co., Parliament-street, Westminster. It resembles in some respects Cochran's vertical boiler, but instead of having horizontal fire flues it has vertical water tubes. At each side of the central chamber are pipes, as shown, which return the water from the top to the bottom. This should be a very efficient boiler. The tubes are of brass, and the fire-box of Lowmoor.

BLOWING ENGINES AT THE STAVELEY IRONWORKS.

WE give herewith a set of diagrams from one of the engines and blowing tubs which we illustrated on the 14th inst. The diagrams or both engines are nearly identical, and on working the calcula-



tions out it will be found that the effective work is nearly 92 per cent. of the total work done. It will not fail to be noticed that the air pressure diagrams do not begin with a curve, the pressure rising in an inclined line. It is not easy to account for this. We



have failed to find any satisfactory explanation of the fact, which is equally apparent in both blowing cylinders. The rise of temperature, we may add, is very small, the large surface of metal exposed and the small pressure acting together to keep it low.

THE ARIZONA.—For this ship it is claimed that she is the fastest ocean steamer in the world. The Arizona is 465ft. long, 46ft. beam, and 37ft. 6in. depth of hold, and about 6000 tons burden, and propelled by engines of about 7000 indicated horse-power. Her cargo space measures 167,000 cubic feet, and she carries over 2600 tons of dead weight cargo, exclusive of 1200 tons of coal for fuel. She is steered by steam, her anchors lifted by steam, and in fact steam does the work of the ship. She has four iron (hollow) masts, which serve as ventilators to the holds, carries ten large life-boats, and is in every respect a first-class steamer. The following tabular statement of some of her voyages will give an idea of her speed :—

	d.	h.	m.
Roche's Point 12.35 p.m., June, 1 1879; Sandy Hook, 7.45 p.m., June 8	7	11	32
S. H. 6 p.m., June 17, 1879; R. P. 7.20 a.m. June 25	7	8	58
S. H. 10 a.m., July 22, 1879; R. P. 10.30 p.m., July 29	7	8	8
R. P. 9.27 a.m., August 10, 1879; S. H. 9.30 p.m., August 17	7	16	25
S. H. 2.55 p.m., August 26, 1879; R. P. 5.15 p.m.. September 3	7	21	58
R. P. 10.12 a.m, Sept. 14, 1879; S. H. 10.20 p.m., Sept. 21	7	16	30
S. H. 7.25 a.m., February 10, 1880; R. P. 9 a.m., February 18	7	21	13
S. H. 3.55 p.m., April 20, 1880; R. P. 6.58 p.m., April 28	7	22	41
R. P. 12.45 p.m., May 9, 1880; S. H. 7.10 p.m., May 16	7	10	47
S. H. 8.45 a.m., May 25, 1880; R. P. 9.23 a.m., June 2	7	20	16
S. H. 1.27 p.m., June 29, 1880; R. P. 9.30 a.m., July 7	7	15	41
R. P. 9.34 a.m., July 18, 1880; S. H. 9.10 p.m., July 25	7	15	58
S. H. 5.30 p.m., August 3, 1880; R. P. 2.15 p.m., August, 11	7	16	23
R. P. 9 a.m., August 22, 1880; S. H. 11.30 p.m., August 29	7	18	52
S. H. 9.30 a.m., Sept. 7, 1880; R. P. 1.16 p.m., Sept. 15	7	23	24
R. P. 9.20 a.m., Sept. 26, 1880; S. H. 6.10 p.m., October 3	7	13	12
R. P. 12.44 p.m., October 31, 1880; S. H. 7.20 p.m., Nov. 7	7	10	58
S. H. 6.50 a.m., Nov. 16, 1880; R. P. 11.48 p.m. Nov. 23	7	12	36
Queenstown 9 a.m., Dec. 5, 1880; S. H. 3.15 p.m., Dec. 13	7	22	37

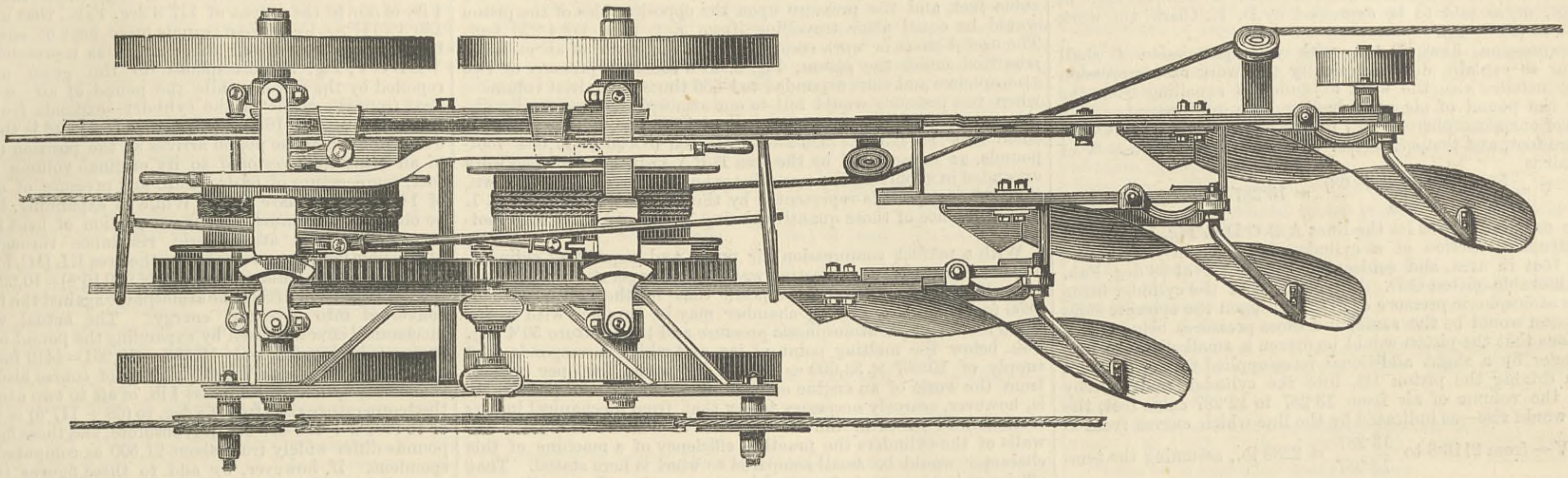
The last trip but one in the preceding table, the Arizona left her dock at New York at 4.30 a.m., November 16, and passed Queenstown 11.48 p.m., November 23, but was unable, owing to a heavy gale, to land her passengers, and continued on her voyage, docking at Liverpool at 4 p.m. on the 24th of November, making the run from dock to dock in eight days and seven hours, without deduction for stoppages. Abbreviations :—R. P., Roche's Point ; S. H., Sandy Hook.

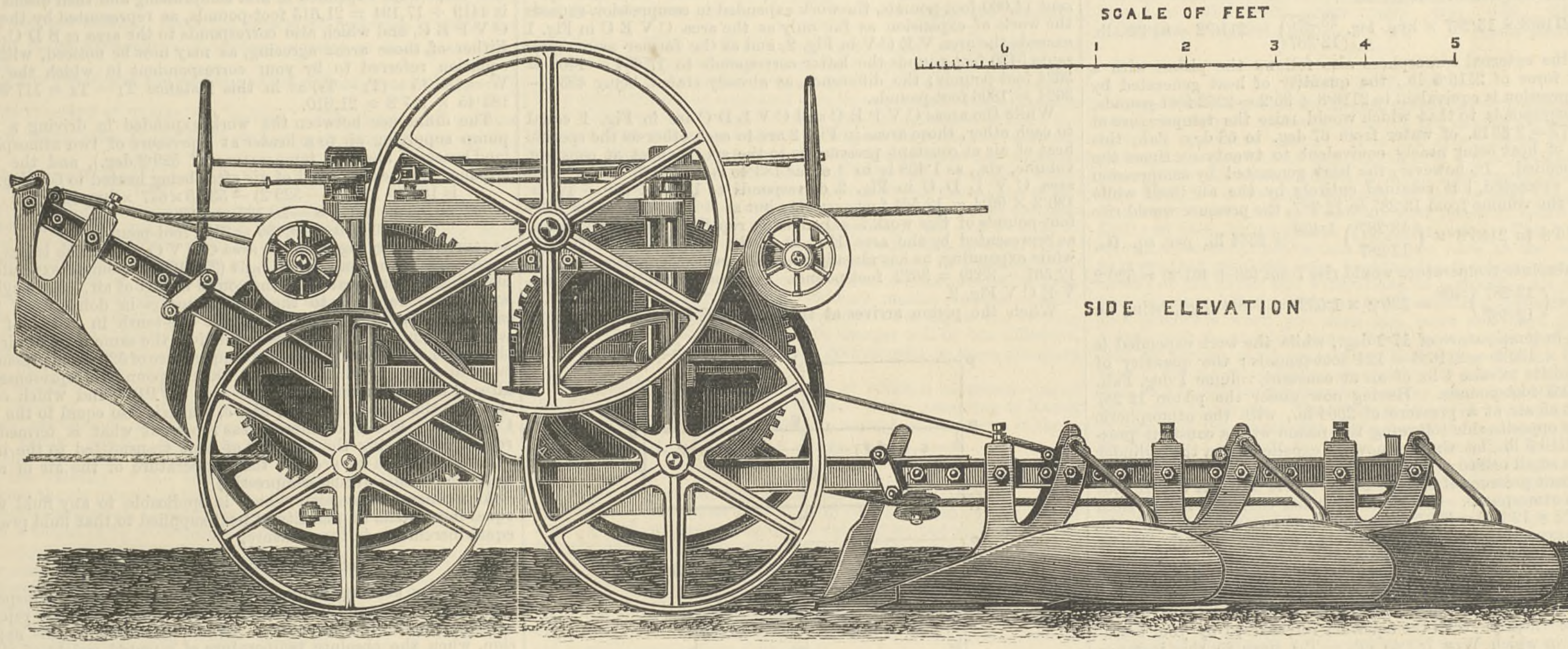
KITCHEN BOILER EXPLOSIONS.—The Manchester Steam Users' Association have issued the following circular on kitchens and circulating boiler explosions :—"Kitchen boiler explosions are due to an accumulation of pressure in the boiler in consequence of the outlets being stopped up while the fire is burning. These explosions occur during the frost through the choking up of the pipes with ice. Sometimes stop taps are placed in the circulating pipes, and should these taps be shut, or should the circulating pipes become choked with sediment or stopped up from any other cause, the pressure would then be bottled up and an explosion might result at any time, whether summer or winter. To prevent this every boiler should be fitted with a small reliable safety valve, whether the boiler be of copper or of cast iron, and whether it be fitted with a copper cylinder or not. A safety valve of dead weight construction is recommended as the most simple. In the event of the outlets becoming choked, it would relieve any undue pressure and prevent an accumulation, while at the same time it would emit a slight hissing noise, which would tell those in the kitchen that something was wrong. In the meantime, until a safety valve can be fixed, open the hot water tap in the bath room, and any other hot water taps connected with the boiler. If the water cannot be drawn freely from these taps, do not light the fire, and if the fire be already lighted, put it out at once. If the water flows freely the fire may then be lighted, but this must be done with caution, and the taps just described frequently opened to see that the flow continues and that the water gradually heats. If the flow does not continue, or if the water does not heat, the supply of water to the boiler must be running short or something must be wrong with the circulation and the fire must be drawn. Also the cold water cistern as well as the ball tap should be examined, and the cold water taps in the bath room, and elsewhere, opened to see that the water supply is free, otherwise the boiler may run dry. When the fire is once lighted and the circulation proved to be free, the fire should be kept burning by night as well as by day as long as the frost lasts, otherwise the frost may get the mastery during the night, choke the pipes with ice, stop the circulation, bottle up the pressure, and thus lead to the bursting of the boiler. But the only true safeguard is a reliable safety valve, and the sooner that is fixed to the boiler the better. The Manchester Steam Users' Association has nothing whatever to do with the manufacture or sale of the dead weight safety valve recommended ; but it may be of convenience to the public to state that one made in accordance with the association's drawings may be obtained for 10s. 6d. at Messrs. Isaac Storey and Son's, Cathedral-yard, Manchester."

STEAM PLOUGHING TACKLE.

MR. T. R. H. FISKEN, ENGINEER, LEEDS.

PLAN

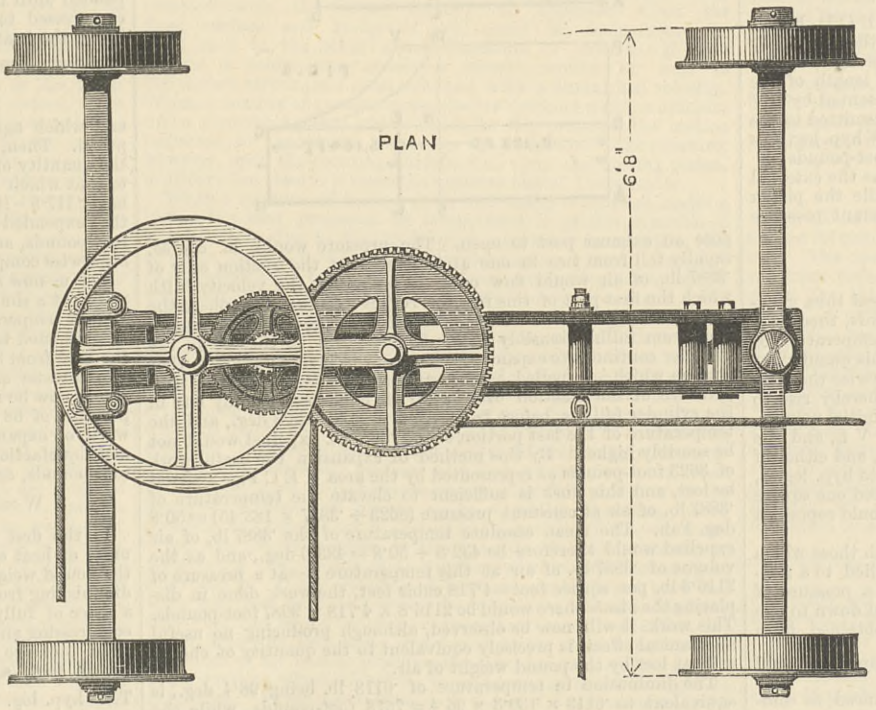




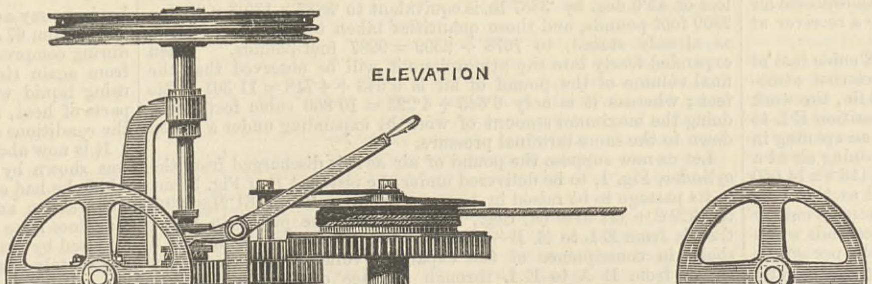
SIDE ELEVATION

THE accompanying engravings illustrate the steam plough tackle tried with much success by Mr. Fisken at the Carlisle Show of the Royal Agricultural Society, and noticed at some length in our columns at the time. It will be seen that the plough is moved by two steel ropes, one end of each of which is inclined, while the other is fixed to one of two drums mounted on the plough or implement. The drums are driven alternately by the well-known Fisken fly-rope, and as the drums revolve they haul the plough backwards and forwards, and the hauling ropes are not rubbed along the ground. The balance plough is mounted in such a manner that it can be moved up and down, each end alternately being in the ground. The frame carrying the winding drums is as it were the plough middle, and the whole forming a combined windlass and cultivator. The anchors are mounted upon road or travelling wheels, the shafts of which can be drawn when at work to the field-side of the anchor, and thus prevent the latter being turned over when the strain of the cultivating implement comes upon it. One end of the coiled steel wire being made fast to the anchor is shown at the end of the field remote from the windlass cultivator, motion is given to the grooved pulley by an endless rope from the engine or other motor, and the plough being let down, the drum of the extended rope is clutched into its spur wheel and winds up the rope, drawing the cultivator towards the far anchor; the other drum lays out or uncoils its rope behind the cultivator in readiness to draw it back. On reaching the end of the field the drum which has been winding up is unclutched, the end of the plough which was in work being raised and the other end brought into action, then the other drum is clutched and motion of the cultivator is reversed.

PLAN



ELEVATION



TYPE DRAWINGS OF SEWERS.

AT page 68 we give another of the Local Government type drawings, of which we have already published several, the last appearing in THE ENGINEER for July 9th 1880. The present drawing is a modification of No. 1, with one or two additions. The modification consists in making the outgoing sewers from each manhole lower than the incoming sewers to the extent of its full diameter—that is, the crown of the outgoing sewer is level with the invert of the entering sewers. This arrangement, of course, can only be made where there is sufficient fall to enable one to be somewhat lavish of it. The object claimed to be effected by this arrangement is that the branch sewers cannot be backwatered until the main sewer is running full up. Hence there is less risk of deposit occurring. Figs 1, 2, and 3, show various arrangements of manholes and sluices. Fig. 4 is intended to show a means of connecting sewers at different levels, where the gradients are considerable. This has hitherto been done by allowing a sewer to enter a manhole at the necessary height, while the outgoing sewer is perhaps some feet lower. The result of this arrangement is that the sewage is churned up, and produces most pernicious smells. By constructing an inverted syphon as shown, all risk of annoyance from this cause is done away. The syphon can be of small size to take the dry weather flow, the storm water being allowed to pass as shown. This arrangement is equally effective on very steep gradients for checking the too rapid flow of sewage and consequent bursting of pipes, and for preventing the upward flow of sewage gases. Figs. 5, 6, and 7, show various forms of manhole with and without sluices.

THE WESTINGHOUSE AIR BRAKE COMPANY.—Although the works of the Westinghouse Air Brake Company now cover the block of ground bounded by Liberty, Twenty-forth and Twenty-fifth streets, and Spring-alley, to which a large addition was recently made by purchases of property on Twenty-fifth street to provide for a steady increase of the regular passenger-car brake trade, the commencement of the freight-brake business has rendered the present great establishment totally inadequate to the enormous demands of the business. As a consequence the company bought yesterday, through Mr. William Roseburg, cashier of the Bank of Pittsburg, completed the purchase—from Messrs. Birmingham, Watson and Co.—of the large property in Allegheny City, two blocks from the Suspension Bridge, known as the Anchor Cotton Works, with the buildings thereon erected, the Corliss engine, shafting, and all the appurtenances. The property on which the main works are situated is 240ft. by 130ft. on Robinson and Lacock-streets, and that piece on which the iron foundry and stable are situated fronts 120ft. on Lacock-street by 114ft. on Balkam-street. The old brick cotton warehouse will be converted into an iron foundry; new offices will be erected on Robinson-street, and the present office buildings will be torn down and converted into immense blacksmith and boiler shops. Some alterations will also be made in the main building to furnish increased light. The main machine shop building will consist of nine floors about 50ft. by 130ft. each; all provided with steam heating, water, gas, and perforated iron pipe fire-extinguishing devices. The engine is a model in its way, having a cylinder 24in. by 48in., with 20ft. band wheels. The establishment will admit of the employment of about 1000 workmen, and, when completed, it is believed, will be one of the most complete manufacturing establishments in the United States. It is probable that the present works of the Westinghouse Air Brake Company, on Liberty-street, will in future be occupied by a new company, about to be organised, and to be known as the Westinghouse Machine Company, and to be devoted to the manufacture of patented specialities.—*Pittsburg Telegraph.*

LETTERS TO THE EDITOR.

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

ON THE COMPRESSION OF AIR, WITH HYPOTHETICAL CONSIDERATIONS REGARDING THE NATURE OF HEAT.

SIR,—In a letter to THE ENGINEER of November 5th, p. 345, it is said that the work expended in compressing 1 lb. of air is in foot-pounds 183·45 times the augmentation of temperature in Fah. deg., or, as said to be expressed by D. K. Clark, the work $W = 183{\cdot}45\,(T_1 - T_2)$.

This expression, however, as with your permission I shall endeavour to explain, does not signify the work of compression only, but includes also the work expended in expelling from the cylinder the pound of air after having been compressed. At a pressure of one atmosphere of 14·7 lb. per square inch, or 2116·8 lb. per square foot, and temperature of 68 deg. Fah., the volume V of 1 lb. of air is

$$V = \frac{53{\cdot}15 \times (461{\cdot}2 + 68)}{2116{\cdot}8} = 13{\cdot}287 \text{ cubic feet.}$$

In the annexed figures let the lines A B C D in Fig. 1 represent the longitudinal section of a cylinder 13·287ft. in length and 1 square foot in area, and containing 1 lb. of air at 68 deg. Fah. under a movable piston C D. The end C D of the cylinder being open, the atmospheric pressure of 2116·8 lb. upon the opposite sides of the piston would be the same, and those pressures being equal, it is obvious that the piston would be driven a small distance into the cylinder by a slight additional force applied to the external side. In driving the piston 1ft. into the cylinder, and thereby reducing the volume of air from 13·287 to 12·287 cubic feet, the pressure would rise—as indicated by the line which curves from C towards V—from 2116·8 to $\frac{13{\cdot}287}{12{\cdot}287} = 2289$ lb., assuming the temperature to be prevented from rising by the injection of water or otherwise.

The work expended in driving the piston 1ft. into the cylinder at constant temperature would be

$$W = \left(2116{\cdot}8 \times 13{\cdot}287 \times \text{hyp. log.}\ \frac{13{\cdot}287}{12{\cdot}287}\right) - 2116{\cdot}8 = 85{\cdot}2\text{ft.-lb.}$$

But as the external atmosphere also follows the piston with a constant force of 2116·8 lb., the quantity of heat generated by this compression is equivalent to 2116·8 + 85·2 = 2202 foot-pounds, which corresponds to that which would raise the temperature of 2202 ÷ 772 = 2·85 lb. of water from 67 deg. to 68 deg. Fah, this quantity of heat being nearly equivalent to twenty-six times the work expended. If, however, the heat generated by compression was not extracted, but retained entirely by the air itself while reducing the volume from 13·287 to 12·287, the pressure would rise from 2116·8 to $2116{\cdot}8 \times \left(\frac{13{\cdot}287}{12{\cdot}287}\right)^{1{\cdot}408} = 2364$ lb. per sq. ft., and the absolute temperature would rise from (68 + 461·2) = 529·2 to $529{\cdot}2 \times \left(\frac{13{\cdot}287}{12{\cdot}287}\right)^{{\cdot}408} = 529{\cdot}2 \times 1{\cdot}0325 = 546{\cdot}4$ deg., being an elevation in temperature of 17·2 deg., while the work expended is only 17·2 × 130·3 — 2116·8 = 124 foot-pounds; the quantity of work requisite to raise 1 lb. of air at constant volume 1 deg. Fah. being 130·3 foot-pounds. Having now under the piston 12·287 cubic feet of air at a pressure of 2364 lb., with the atmospheric air on the opposite side following the piston with a constant pressure of 2116·8 lb., let the air now be expelled from the cylinder through a small orifice or delivered into a reservoir containing air at a constant pressure of 2364 — 2116·8 = 247·2 lb. per square foot above the atmosphere. The work expended could not be less than W = 247·2 × 12·287 = 3037 foot-pounds, and in adding to this the quantity expended in compression—124 foot-pounds—the whole work expended in first compressing and then expelling from the cylinder the pound of air at a uniform pressure of 247·2 lb. per square foot above the atmospheric pressure is W = 124 + 3037 = 3161 foot-pounds, and it will now be observed that those figures correspond—nearly—with the equation referred to by your correspondent, in which $W = 183{\cdot}45\ (T_1 - T_2)$ since in this instance $T_1 - T_2$ is 17·2 deg., and therefore W = 183·45 × 17·2 = 3155 foot-pounds.

Let us now suppose the pound of air in cylinder A B C D, Fig. 1, to be compressed at constant temperature into half the volume by forcing the piston C D into the position E L. The pressure of one atmosphere of 2116·8 lb. being represented by the length of the line D C or L E, would rise to two atmospheres represented by L V or A P, and the quantity of heat generated and transmitted to the cooling medium during this compression would be P V hyp. log. 2 =

$$2116{\cdot}8 \times 13{\cdot}287 \times {\cdot}693 = 28{,}127 \times {\cdot}693 = 19{,}490 \text{ foot-pounds}$$

represented by the area—in Fig. 1—D C V L D, but as the external atmosphere follows the piston through 6·643ft.—while the piston is moving from the position C D to E L—with a constant pressure of 2116·8 lb., the work expended is only

$$19{,}490 - 6{\cdot}643 \times 2116{\cdot}8 =$$
$$19{,}490 - 14{,}060 = 5430 \text{ foot-pounds}$$

represented in Fig. 1 by the area C V E C. The heat thus generated by the expenditure of 5430 foot-pounds of work is, therefore, equivalent to that which is required to raise the temperature of 19,490 ÷ 772 = 25·2 lb. of water 1 deg. Fah., and this quantity of heat must be abstracted during compression, or otherwise the temperature would be augmented, and the pressure thereby rise to more than double by compressing the air to half the initial volume. The area—Fig. 1—A B C D is equal to the area A P V L, and the area C V L D C is also equal to the area C B P V C, and either of those first two areas are to either of the last as 1 is to hyp. log. 2, which is ·693. Or say, if the area A P V L represented one square foot of surface, the area C V L D C or C B P V C would represent ·693 square feet.

The lines B P V C B, Fig. 1, correspond nearly with those which would be traced by the pencil of an indicator if applied to a non-condensing engine working with steam admitted at a pressure of two atmospheres, cut off at half stroke and expanded down to one atmosphere. Under those conditions the work obtained from $\left(\frac{13{\cdot}287}{2}\right) = 6{\cdot}643$ cubic feet of steam of two atmospheres would also be nearly the same (19,490 foot-pounds) as is required to compress at constant temperature 13·287 cubic feet of atmospheric air into half the volume, and then deliver the same into a receiver at the constant higher pressure of two atmospheres.

Having now under the piston E L—Fig. 1—6·643 cubic feet of air at a pressure of 2 × 2116·8 = 4233·6 lb., and the external atmosphere following the piston with a pressure of 2116·8 lb., the work expended in driving forward the piston from the position E L to B A, and thereby expelling the pound of air through an opening in the end of the cylinder, conducting to a receiver containing air at a uniform pressure of two atmospheres, would be 6·643 × 2116·8 = 14,060 foot-pounds, as represented by the area E V P B, and as this area is equal to the area D C E L, which represents the potential energy or work done by gravity upon the external air which descends while following the piston with a pressure or weight of 2116·8 lb. per square foot during compression, the 25·2 units of heat then generated and discharged is therefore equivalent to the work expended in first compressing and then discharging the air from the cylinder at the higher pressure.

While the 6·643 cubic feet of air is entering the receiver, let the same air, or a similar quantity from the receiver, be admited under the pistons A B, Fig. 2; so that while the piston in Fig. 1 moves slowly from L E to A B, the piston in Fig. 2 shall, under a similar resistance, simultaneously move from A B to L E. The work transmitted to the piston in Fig. 2, excluding friction, would, it is obvious, be nearly equal to that expended in driving the piston in Fig. 1

Let the pound of air (6·643 cubic feet at a pressure of two atmospheres and absolute temperature of (68 + 461·2) = 529·2 deg.) now be supposed to expand, without receiving heat from the sides of the cylinder, down to a pressure of one atmosphere as indicated by the curve V C in Fig. 2. The temperature would then fall from 529·2 deg. to $529{\cdot}2 \times (\frac{1}{2})^{{\cdot}29} = 529{\cdot}2 \times {\cdot}8179 = 432{\cdot}8$, which is 28·4 deg. below the zero of Fah. thermometer, or which corresponds to a fall—from 68 deg.—of 96·4 deg. In consequence of this fall in temperature the volume of air, while falling to half the pressure, would only increase from 6·643 to $6{\cdot}643 \times 3^{{\cdot}71} = 6{\cdot}643 \times 1{\cdot}636 = 10{\cdot}867$ cubic feet, and the pressure upon the opposite sides of the piston would be equal after travelling (from E L to C D) 4·223 feet. The useful effect or work recovered from the pound of air on being admitted under the piston, Fig. 2, at a constant pressure of two atmospheres and then expanded to 1·636 times the initial volume—when the pressure would fall to one atmosphere—and finally discharged at an absolute temperature of 432·8 and volume of 10·867 cubic feet is 183·45 × (529·2 — 432·8) = 183·45 × 96·4 = 17,684 foot-pounds, as represented by the area B P V C B, Fig. 2. The work expended in supplying the same air to the receiver, as already shown, is 19,490 foot-pounds represented by the area C V P B C in Fig. 1. The difference of those quantities being 19,490 — 17,684 = 1806 foot-pounds.

With a perfect compression air pump and expanding cylinder, and sufficient supply of injection water at a temperature rather less than 68 deg., it therefore appears that by the expenditure of 1806 foot-pounds a cooling chamber may be supplied with 10·867 cubic feet of air of atmospheric pressure and temperature 50·4 deg. Fah. below the melting point of ice, and which corresponds to a supply of 10·867 × 33,000 ÷ 1806 = 198 cubic feet per minute from the work of an engine or water-wheel of 1-horse power. It is, however, scarcely necessary to say that from mechanical imperfections and losses in the transmission of heat to and from the walls of the cylinders the practical efficiency of a machine of this character would be small compared to what is here stated. That efficiency is also much impaired by the presence of a small quantity of the vapour of water which partly liquefies during expansion, and thereby yielding heat to the air while expanding. Since the areas P B V E in Figs. 1 and 2 are equal to each other and represent 14,060 foot-pounds, the work expended in compression exceeds the work of expansion as far only as the area C V E C in Fig. 1 exceeds the area V E C V in Fig. 2, and as the former area represents 5430 foot-pounds the latter corresponds to 17,684 — 1406 = 3624 foot-pounds; the difference, as already stated, being 4530 — 3624 = 1806 foot-pounds.

While the areas C V P B C and C V L D C are in Fig. 1 equal to each other, those areas in Fig. 2 are to each other as the specific heat of air at constant pressure is to the specific heat at constant volume, viz., as 1·408 is to 1 or as 183·45 is to 130·3. Hence the area C V L D C in Fig. 2 corresponds to $130{\cdot}3 \times (T_1 - T_2) = 130{\cdot}3 \times 96{\cdot}4 = 12{,}561$ foot-pounds; but as 4·223 × 2116·8 = 8939 foot-pounds of this work is expended in repelling the atmosphere, as represented by the area E C D L, the useful effect of the air while expanding, as has already been otherwise computed, is only 12,561 — 8939 = 3622 foot-pounds as represented by the area V E C V Fig. 2.

When the piston arrives at the position E L Fig. 2, let us suppose an exhaust port to open. The pressure would, of course, rapidly fall from two to one atmosphere, but the fraction only of ·3887 lb. of air would flow out. In arresting the velocity with which the first part of this fraction rushes into the atmosphere the heat thereby generated would be sufficient to prevent the temperature from falling sensibly below 68 deg.; but as the air in the cylinder continues to expand and lose heat in giving motion to that portion which is expelled against atmospheric resistance, the temperature of the fraction ·6113 lb.—6·643 cubic feet—finally left in the cylinder falls as before from 529·2 deg. to 432·8 deg., and the temperature of the last portion of the ·3887 lb. expelled would not be sensibly higher. By this method of expansion the useful work of 3623 foot-pounds as represented by the area V E C Fig. 2 would be lost, and this work is sufficient to elevate the temperature of ·3887 lb. of air at constant pressure (3623 ÷ ·3887 × 183·45) = 50·8 deg. Fah. The mean absolute temperature of the ·3887 lb. of air expelled would therefore be 432·8 + 50·8 = 483·6 deg., and as the volume of ·3887 lb. of air at this temperature is—at a pressure of 2116·8 lb. per square foot—4·718 cubic feet, the work done in displacing the atmosphere would be 2116·8 × 4·718 = 9987 foot-pounds. This work, it will now be observed, although producing no useful mechanical effect, is precisely equivalent to the quantity of energy or heat lost by the pound weight of air.

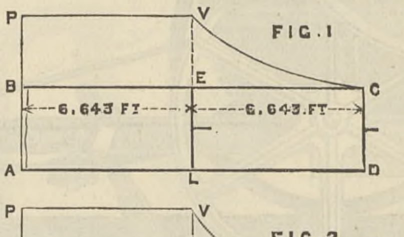


FIG. 1

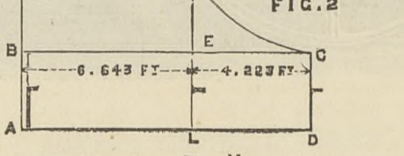


FIG. 2

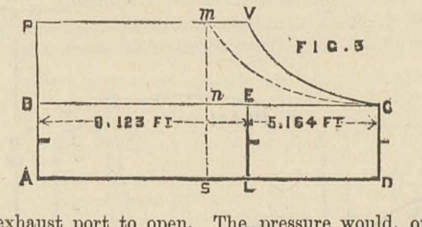


FIG. 3

The diminution in temperature of ·6113 lb. being 96·4 deg., is equivalent to ·6113 × 130·3 × 96·4 = 7678 foot-pounds, while the loss of 45·6 deg. by ·3887 lb. is equivalent to ·3887 × 130·3 × 45·6 = 2309 foot-pounds, and those quantities taken together correspond, as already stated, to 7678 + 2309 = 9987 foot-pounds. When expanded freely into the atmosphere it will be observed that the final volume of the pound of air is 6·643 + 4·718 = 11·361 cubic feet; whereas it is only 6·643 + 4·223 = 10·866 cubic feet, when doing the maximum amount of work by expanding under a piston down to the same terminal pressure.

Let us now suppose the pound of air as it is discharged from the cylinder, Fig. 1, to be delivered under the piston A B of Fig. 3, but in its passage to be raised in temperature from (68 + 461·2) = 529·2 to (529·2 + 117·8) = 647 deg., so that while the piston in Fig. 1 travels from E L to A B—through 6·643ft.—the piston in Fig. 3 shall, in consequence of the expanded volume, simultaneously travel from B A to E L through a space of 8·123ft. Further admission of air from the heater now being suppressed, let the piston E L move onwards under a gradually diminishing pressure through a further distance of 5·164ft., when having arrived at C D the internal and external temperature and pressure upon the piston will be alike, and this cylinder—Fig. 3—will now contain 13·287 cubic feet of air at 68 deg. Fah., and pressure of one atmosphere as at first taken in by cylinder Fig. 1; the 117·8 deg. of heat supplied by a heater to the pound of air while passing from the compressing to the expanding cylinder having entirely disappeared.

Let us now see what we have got in equivalence for this lost heat. In the first place, when not heated, it will be observed the pound of air only drives the piston at the full pressure of two atmospheres—4233·6 lb. per square foot—through a distance of 6·643ft., whereas when heated, the distance travelled under full pressure is 1·48ft. in excess of this, which corresponds to 1·48 × 4233 = 53·15 × 117·8 = 6260 foot-pounds as represented by the area *m* S L V *m*, and as this quantity never appears as heat, but represents the gross resistance repelled by the air while being heated and expanding under constant pressure, it is termed the latent heat. Hence, after having augmented the temperature of 1 lb. of air to the extent of 117·8 deg. Fah., that air only contains 130·3 × 117·8 = 15,350 foot pounds more heat or energy than it did before being heated, and this energy—as represented by the area V L D C V, Fig. 3—corresponds to the gross mean resistance repelled by the piston, while the pound of air—without receiving heat from the walls of the cylinder—expands from a volume of 8·123 to (8·132 + 5·164) = 13·287 cubic feet, and is therefore entirely exhausted when the piston arrives at the position C D, the pound of air being now restored to its original volume of 13·287 cubic feet, temperature of 68 deg. Fah. and pressure of one atmosphere of 14·7 lb. per square inch. While so expanding, however, it will be observed that much the largest portion of heat lost is expended in repelling the atmospheric resistance through a space of 5·164 cubic feet, as represented by the area E L D C, Fig. 3, and by the expulsion of this volume of air (5·164 × 2116·8) = 10,931 foot pounds of heat energy is, in lifting the atmosphere against the force of gravity, converted into potential energy. The actual work or useful mechanical effect realised by expanding the pound of air to half the pressure is therefore only 15,350 — 10,931 = 4419 foot-pounds as represented by the area V E C V. This of course also corresponds to the work required to compress 1 lb. of air to two atmospheres when the temperature rises from 68 deg. to (68 + 117·8) = 185·8 deg. Fah., or to (461·2 + 185·8) = 647 deg. absolute, and those figures 4419 foot-pounds differ widely from about 21,500 as computed by your correspondent. If, however, we add to these figures (4419) the work expended in delivering the heated pound of air into a receiver at a uniform pressure of two atmospheres, which is 8·123 × 2116·8 = 17,194 foot-pounds, as represented in Fig. 3 by the area V P B E, the whole work expended in first compressing and then discharging is 4419 + 17,194 = 21,613 foot-pounds, as represented by the area C V P B C, and which also corresponds to the area *m* S D C V *m*. Either of those areas agreeing, as may now be noticed, with the equation referred to by your correspondent in which the work $W = 183{\cdot}45 \times (T_1 - T_2)$ as in this instance $T_1 - T_2 = 117{\cdot}8$ and 183·45 × 117·8 = 21,610.

The difference between the work expended in driving a force pump supplying air to a heater at a pressure of two atmospheres (and constant absolute temperature of 529·2 deg.), and the work obtained from each pound of air after being heated to 647 deg.

$$\text{is } 183{\cdot}45 \times (647 - 529{\cdot}2) - 53{\cdot}15 \times 647 \times \text{hyp log. } 2 =$$
$$= 183{\cdot}45 \times 117{\cdot}8 - 28{,}127 \times {\cdot}693 =$$
$$21{,}610 - 19{,}496 = 2114 \text{ foot-pounds}$$

as represented in Fig. 3 by the area C *m* V C, and which is less than one-tenths of the quantity of heat (21,610 foot-pounds) expended in elevating the temperature of the pound weight of air. Although the whole heat supplied to the air disappears in doing work upon piston Fig. 3, this work is only about one-tenth in excess of that which is required to compress and deliver the same mass of air into the heater at a constant absolute temperature of 529·2 and pressure of two atmospheres, which work (19,496 foot-pounds) is represensed (as already stated) in Fig. 1 by the area CVPBC, and which correspond to the area C *m* P B C, Fig. 3, which is also equal to the area C *m* S D C. Either of those areas represent what is termed the *rejected* heat, being the quantity of heat transmitted to the injection water, so as to prevent the temperature of the air or other fluid from rising during compression.

As a general expression which is applicable to any fluid when equal increments in quantity of heat supplied to that fluid produce equal increments in temperature,

$$\text{Rejected heat} = CT_2 \times \text{hyp. log. } \frac{T_1}{T_2}$$

T_1 = superior absolute temperature, and T_2 the inferior, C = specific heat of the fluid, and if written in foot-pounds, the heat rejected is also expressed in foot pounds. Then, according to this expression, when the absolute temperature of a pound weight of air is, under any constant pressure, raised from 529·2 to 647 –, then expanded until the temperature falls from 647 to 529·2, and finally compressed to the original volume at a constant temperature of 529·2, the heat generated and rejected during that compression is

$$183{\cdot}45 \times 529{\cdot}2 \times \text{hyp. log. } \frac{647}{529{\cdot}2} = 183{\cdot}45 \times 529{\cdot}2 \times {\cdot}201 = 183{\cdot}45 \times 106{\cdot}4 = 19{,}519 \text{ foot-pounds.}$$

and which agrees nearly with the quantity (19,496) otherwise computed. Then, since the pound of air was elevated 117·8 deg., and the quantity of heat rejected during the compression is equivalent to that which would heat the same air 106·3 deg., the difference being 117·8 – 106·3 = 11½. The work while expanding would exceed that expended in compression to the extent of 183·45 × 11½ = 2110 foot-pounds, and this corresponds nearly with 2114 foot-pounds as otherwise computed.

Let us now suppose a pound of water to be confined under a piston at a similar temperature of 185·8 deg. Fah. The pressure at that temperature being fully 8 lb. per square inch, let the piston be permitted to yield to the vapour pressure by gradually reducing the load from 8 lb. to $\frac{3}{10}$ lb. per square inch, when the temperature of the water and vapour would fall from 185·8 to 68 deg. Let the piston now be returned reliquefying the vapour at a constant temperature of 68 deg. and pressure of $\frac{3}{10}$ lb. per square inch. The work of expansion would then exceed the work of compression and liquefaction of the vapour to the extent of 772 × 11½ = 8858 foot-pounds, corresponding to the equation

$$W = 772 \times \left\{ (T_1 - T_2) - T_2 \times \text{hyp. log. } \frac{T_1}{T_2} \right\}$$

In the first place the quantity $(T_1 - T) = (185{\cdot}8 - 68) = 117{\cdot}8$ units of heat entirely disappears in evaporating about one-tenth of the pound weight of water and repelling the piston under a load diminishing from 8 lb. to nearly $\frac{3}{10}$ lb. per square inch, and through a space of fully 93 cubic feet; but on the return of the piston, compressing and condensing this 93 cubic feet of vapour at a constant pressure of fully $\frac{3}{10}$ lb. per square inch (or 47·87 lb. per square foot) and temperature of 68 deg. Fah., the quantity $T_2 \times \text{hyp. log. } \frac{T_1}{T_2} = 529{\cdot}2 \times \text{hyp. log. } \frac{647}{529{\cdot}2} = 106{\cdot}3$ units of heat—or say as much as would raise the temperature of 106·3 lb. of water from 67 deg. to 68 deg.—reappears, and must be abstracted during compression so as to prevent the temperature and pressure from again rising while liquefying the vapour. Hence, whether using liquid water or air, it appears that while expending 117·8 parts of heat, not more than 11½ of those parts can possibly, under the conditions specified, be utilised as a motive agent.

It is now about thirty-eight years since, when in New Orleans, I was shown by Dr. Gorrie a small machine with two cylinders, which he had constructed for the purpose of freezing water by the compression and expansion of air under pressure. Many cooling machines have since been made; but although the process may be reversed by first expanding and then compressing, and air thereby moderately heated supplied to a vinery or other building by a small expenditure of power, I am not aware of this having ever been put in practice.

Suppose, for example, one pound of air of atmospheric pressure to be maintained by the injection of water at a constant absolute temperature of (38·8 + 461·2) = 500 deg. while expanding in a cylinder under a piston to a double volume and pressure of half an atmosphere; then discharged into a receiver, in which receiver the pressure is prevented from rising above half an atmosphere by a pump drawing away the same air, in which pump it is recompressed, and finally discharged into the building to be heated at atmospheric pressure and temperature of $500 \times 2^{{\cdot}29} = 611{\cdot}3$ or 150·1 deg. Fah. The work expended in compressing one pound of air when taken n at 500 deg. (38·8 Fah.), and discharging the same (15·35 cubic feet) at atmospheric pressure and temperature of 611·3, is 183·45 × (611·3 – 500) = 20,420 foot-pounds. But the work obtained from the same air when taken in at one atmosphere, then expanded to a double volume, and finally discharged into the receiver at a pressure of half an atmosphere and constant temperature 500 deg. absolute would be

53·15 × 500 × ·693 = 18,340 foot-pounds.

By this process, 18,340 foot-pounds = 23·7 units of heat is first extracted from the injection water, the temperature of which water must be rather higher than 38·8 deg. Fah., and this heat, along with (20,420 – 18,340) = 2080 foot-pounds expended in driving the machine, is delivered into the building to be heated.

Then, since one pound of air (12·55 cubic feet) is taken in to the first cylinder at 38·8 deg. Fah., and discharged from the second at 150·1 deg. Fah., and volume of 15·35 cubic feet by the expenditure of 2080 foot-pounds of work, a steam engine or water wheel of one horse power would, under the specified conditions and exclusive of losses, yield a constant supply of 15·3 × 33,000 ÷ 2080 = 242 cubic feet of air per minute at the above temperature of 150·1 deg. Fah., this quantity of heat being nearly equivalent to ten times the work expended.

The pressure of air, or other gases and vapours, is supposed to result from the impact of the molecules against the sides of the vessel in which they are contained. The velocity of the gaseous molecules requisite to produce the observed pressure as propounded by Kronig, Herapath, Thomson, Joule, Clausius, and others, corresponds to that which a body would acquire by gravity in falling from one and a-half times the height of a homogeneous atmosphere of the same gas, the weight of which, on any unit of base, corresponds to the pressure. As long as a gas strictly follows the law of Boyle—having at any constant temperature precisely a double pressure at half the volume—the height of a homogeneous atmosphere of that gas is proportional to the absolute temperature, and is unaffected by pressure. With air, the height referred to is 53·15 T ft., and the mean velocity of air molecules at any absolute temperature T will be $v = \sqrt{2\,g \times 1\frac{1}{2} \times 53{\cdot}15\ \mathrm{T}} = 71{\cdot}65 \sqrt{\mathrm{T}}$ feet per second. Since the density of hydrogen is ·0692, the height of an atmosphere of uniform density of that gas will be $\frac{53{\cdot}15}{{\cdot}0692}\mathrm{T} = 768\ \mathrm{T}$, and the velocity of the molecules $v = \sqrt{(2g \times 1\frac{1}{2} \times 768\ \mathrm{T})} = 272 \sqrt{\mathrm{T}}$ feet per second. The density of gaseous steam being nine times that of hydrogen, the velocity of the molecules will be $\left(\frac{272}{\sqrt{9}}\right) = \frac{272}{3}\sqrt{\mathrm{T}} = 90{\cdot}7\sqrt{\mathrm{T}}$; and since the density of oxygen is nearly sixteen times that of hydrogen, the molecules of that gas will, when at the same temperature, only move with one-fourth the speed of the hydrogen molecule.

The temperature or intensity of heat manifested by a gas is not sensibly affected by the quantity of matter or number of molecules enclosed within any given space, but is nearly proportional to the square of the velocity into the weight or mass of the individual molecules. The oxygen molecules being sixteen times heavier than those of hydrogen, produce the same temperature when moving with one-fourth of the velocity. In illustration, let us suppose 1 oz. weight of hydrogen to be enclosed within a vessel of the size and shape of 1 cubic foot, at a temperature of 38·8 deg. Fah., which corresponds to 500 deg. absolute. The pressure which this ounce weight of molecules would exert upon each of the six sides of the cube is 768 × 500 = 384,000 oz., and the velocity of the molecules—moving in all directions and striking the six internal sides of the cube—requisite to produce that pressure corresponds to that which a body would acquire in falling from a height of $1\frac{1}{2} \times 384{,}000$ft., which is $= 272\sqrt{500} = 6082$ft. per second. If an ounce weight of oxygen of the same temperature was similarly confined within a cubic foot of space, the pressure would only be 48 × 500 = 24,000 oz. per square foot, and the molecular velocity requisite to produce that pressure corresponds to that acquired by a body in falling from a height of $1\frac{1}{2} \times 24{,}000$ = 36,000ft., and which is $68\sqrt{500} = 1520\frac{1}{2}$ft. per second.

Let us now imagine the absolute temperature of the ounce of oxygen within the cube foot to be elevated from 500 deg. to 8000 deg. We should then have the ounce weight of oxygen molecules moving with the same velocity, exerting the same pressure, and containing, although sixteen times higher in temperature, only the same quantity of heat or intrinsic energy as the ounce weight of hydrogen. The hydrogen molecules being sixteen times more numerous will make sixteen impacts against the internal sides of the cubic foot vessel for each blow delivered by the oxygen molecules, and thereby produce the same pressure, but the oxygen molecules being sixteen times heavier, will, when moving with the same velocity, strike with sixteen times the force, and thereby produce sixteen times the absolute temperature, provided the molecules are of equal hardness or firmness of texture.

The vibrations excited in a bell by a blow with a wooden mall or hammer of lead would not be quite the same as those generated by a hammer of steel of equal weight and striking with the same velocity; and temperature or intensity of heat may likewise be similarly modified to some extent by the character or structure of the impinging molecules. It is, moreover, obvious that the action of the bell hammer would be greatly enfeebled if divided into sixteen parts, although all of those parts continued to strike with the same velocity, and this division might be repeated until the sound became inaudible, although those smaller parts possessed in the aggregate the same intrinsic energy, and also exerted the same mean pressure upon the internal surface of the bell as the original mass. When gaseous molecules of any given weight are confined within a cubic foot and move in all directions with a uniform velocity, the pressure is nearly proportional to the number of molecules present, whereas the cube foot may contain a million or billions of molecules without any sensible change in temperature, provided there is no change in velocity, but provided also that the molecules do not unite and form larger masses, or break up into smaller masses, since by such union or breaking up the temperature would be proportionally elevated or depressed irrespective of the heat generated by chemical union or lost by disruption. According to this hypothesis the absolute temperature of the interstellar medium would be doubled without changing either its velocity, energy, elasticity, or pressure, were it only possible for each couple of atoms of that medium to unite, and form one unit of double mass.

Returning now to the ounce weight of hydrogen confined in the space of one cubic foot, and exerting a pressure of 384,000 oz. = 24,000 lb. per square foot, which requires a molecular velocity of 6082ft. per second, it is obvious that if the molecules had no heat in themselves, but moved all directions in rectilineal paths with a motion of translation only, the total energy in foot-pounds of the cubic foot of hydrogen would correspond to one and a-half times the pressure in pounds per square foot, *i.e.*, in this instance $1\frac{1}{2} \times 24{,}000 = 36{,}000$ foot-pounds. On the same conditions the quantity of heat in foot-pounds requisite to double the pressure of a cubic foot of any gas would simply correspond to one and a-half times the initial pressure in pounds per square foot; but to increase the volume from one to two cubic feet at any constant pressure would require two and a-half times the pressure in pounds per square foot. In doubling the pressure at constant volume, the velocity of the molecules must be increased from v to $\sqrt{2} \times v$; but in doubling the volume at constant pressure, the velocity of the molecules must not only be similarly increased, but a load equivalent to the pressure must at the same time be lifted 1ft.

The specific heat of a gas at constant pressure, divided by the specific heat at constant volume, is usually denoted by the letter y or k, and on the above conditions we should have

$$k = \frac{2\frac{1}{2}}{1\frac{1}{2}} = \frac{5}{3} = 1\tfrac{2}{3} = 1{\cdot}666.$$

In a short letter, which appeared about two years since in the *Philosophical Magazine*, this (1·666) is said to have been the value found for k with the vapour of mercury, and in a work on "The Atomic Theory," by Ad. Wurtz, published this year, I find the following paragraph. "Kundt and Warburg have shown that internal work is not performed in the case of mercury vapour, and that the relation between the specific heats of mercury vapour under constant pressure and under constant volume (1·67) is the same as that indicated by theory. It is obvious that in this case there is no internal work, because the molecule is only composed of a single atom." This, if reliable, is certainly a most remarkable circumstance, as it indicates the existence of molecules which are neutral or impenetrable to heat, having a progressive motion only; but without either rotary motion or vibratory motions of the smaller atoms of which a molecule is supposed to be constituted. The molecules of mercury vapour being one hundred times heavier than those of hydrogen will produce the same temperature when striking with one-tenth of the velocity.

For hydrogen gas $k = 1{\cdot}412$ and $\frac{1{\cdot}412}{{\cdot}412} = 3{\cdot}425.$

For nitrogen $k = 1{\cdot}41$ and $\frac{1{\cdot}41}{{\cdot}41} = 3{\cdot}44.$

For oxygen $k = 1{\cdot}4$ and $\frac{1{\cdot}4}{{\cdot}4} = 3{\cdot}5.$

For air $k = 1{\cdot}408$ and $\frac{1{\cdot}408}{{\cdot}408} = 3{\cdot}451.$

For gaseous steam $k = 1{\cdot}304$ and $\frac{1{\cdot}304}{{\cdot}304} = 4{\cdot}29$·

Vapour of sulphuret of carbon $k = 1{\cdot}198$ and $\frac{1{\cdot}198}{{\cdot}198} = 6{\cdot}05.$

The quantity of heat in foot-pounds required to double the pressure of one cubic foot of air at constant volume, is $\frac{1}{{\cdot}408} = 2{\cdot}451$ times the initial pressure in pounds per square foot, and to double the volume at constant pressure is $\frac{1{\cdot}408}{{\cdot}408} = 3{\cdot}451$ times the pressure, and 3·451 × 53·15 = 183·45 foot-pounds, which is the quantity of heat or work required to augment the temperature of 1 lb. weight of air one Fah. degree when under any constant pressure. This quantity may be separated into three portions; taking first the latent heat = 1 × 53·15 foot-pounds, which is not manifested in the form of heat, but is equivalent to the gross load lifted or resistance repelled when expanding to a greater volume under any constant pressure P; secondly, $1\frac{1}{2} \times 53{\cdot}15 = 79{\cdot}725$ foot pounds, which must be expended in accelerating the velocity of translation of the molecules to an extent sufficient to maintain the same constant pressure within the larger space; and thirdly, ·951 × 53·15 = 50·55 foot-pounds, the action of which portion is uncertain, and has therefore provoked much speculation; but is assumed by Clausius to be expended in heating and expanding the solid molecules, or, in other words, in giving a rotary or vibratory motion to the smaller atoms of which a molecule is constituted. The higher the velocity of translation of the molecules, the sharper will be the collisions, and the sharper the collisions, the greater will be those vibratory motions.

This fraction of heat—the action of which is uncertain—varies more or less with every gas or vapour. While, according to Kundt and Warburg, it is nothing with the vapour of mercury; it corresponds to $\left(\frac{3{\cdot}451 - 2{\cdot}5}{3{\cdot}451}\right) = \frac{951}{3{\cdot}451} = {\cdot}275$ of the whole heat expended in heating air under any constant pressure. With hydrogen and nitrogen it is slightly less, and with oxygen rather more, as will be observed from the value of k; but with the vapour of sulphuret of carbon when heated under constant pressure it constitutes $\frac{6{\cdot}048 - 2{\cdot}5}{6{\cdot}048} = \frac{3{\cdot}548}{6{\cdot}048} = {\cdot}586$ of the whole heat expended. Notwithstanding the high specific heat of this vapour, the ratio of expansion—as I determined experimentally many years since—is not sensibly greater than that of air.

Gaseous molecules, on striking a fixed surface, can only rebound with the mean velocity of approach when the fixed surface and molecules are equal in temperature or yield each to the other equal quantities of motion. If that surface is colder, the molecules impart motion or heat to the surface struck, and must rebound with a diminished velocity. When a number of gaseous molecules are confined within a cylinder under a movable piston which yields to the pressure, the motion imparted to the piston is lost by the molecules. The pressure, however, upon the receding surface, *i.e.*, upon the moving piston, is always less than it is upon the opposite end of the cylinder.

When a mixture of heated water and steam is confined under a piston the heat generated by compression is greatly in excess of that which is due to the gross action exerted in compressing the mixture, the steam and water molecules having a strong tendency to unite and hold together with a force similar to that by which iron filings are held to a magnet. Every known experiment, however, including the observed velocity of sound in air, verifies the belief that air molecules—except at low temperature and excessive pressures—have no sensible attraction towards each other. If air molecules had any attraction for each other it is obvious that the molecules would lose motion in expanding without doing any external work, or in doing work the heat lost would always be in excess of that which is due to the external action, as it always is in evaporating a liquid. But the experiments of Joule, referred to by your correspondent, in which air confined at a high pressure within a vessel A was permitted to flow into a vacuous vessel B proved that the quantity of heat lost by the air in A while expanding under pressure, and doing work in driving out a portion of its own molecules, was precisely equal to the quantity of heat generated in accelerating the velocity of the molecules which were driven into the vessel B. If the quantity of heat gained by B had been less than that lost by A this would have been considered as evidence that work had been expended in separating the air molecules; but as no heat was lost Joule was forced to the conclusion that the molecules of air had no sensible attraction for each other, and this is the question which in making those experiments Joule sought to determine. Experiments similar to those of Joule were made by Regnault about 1853, and it is said by Laplace also about a generation earlier, with the same results.

The equivalence of heat and work was first deduced approximately from the observed velocity of sound in air by Mayer, and his theory was found to yield results strictly agreeing with Joule's subsequent experiments with water, and Regnault's experiments with regard to the specific heat of air compared to water. Before Regnault's experiments were published, Sir William Thomson had computed—from the velocity of sound and Dr. Joule's experiments—the specific heat of air to be ·2374, which was afterwards found by Regnault to be from ·2376 to ·2379.

In illustration of the behaviour of air when permitted to rush from the atmosphere into a vacuous space, let us suppose a vessel of the capacity of 1·408 cubic feet to be exhausted, and as nearly as possible entirely vacuous. On opening an orifice, the vessel would be rapidly filled with air of atmospheric pressure, but at an absolute temperature 1·408 times that of the external atmosphere, 1 cubic foot only of which air would pass through the orifice, provided no heat was absorbed by the walls of the vessel.

Supposing the atmospheric pressure to be 2116 lb. per square foot, the total energy of 1 cubic foot of this air is, at any temperature, 2·451 × 2116 = 5186 foot-pounds; but in forcing 1 cubic foot of the same air through the orifice into the vacuous space, 2116 foot-pounds of work is expended by gravity in accelerating the molecular velocity, and this potential energy, *i.e.*, the descent of 2116 lb. through 1ft., is converted into heat, or kinetic energy. The total energy of the cubic foot of air, which, after passing through the orifice, measures 1·408 cubic feet, is therefore 5186 + 2116 = 7302 foot-pounds, and the pressure being unaltered, the energy is 5186 foot-pounds per cubic foot, as at first, since 1·408 × 5186 = 7302.

The initial absolute temperature of the air being 500 deg., the temperature after entering the vessel would be 1·408 × 500 = 704 deg., and the velocity of the molecules would increase from $71{\cdot}65\sqrt{500} = 1604$ to $71{\cdot}65\sqrt{704} = 1901$ft. per second.

I shall now conclude by giving a few figures, exhibiting at a glance the rate at which air rises or falls in temperature when compressed or expanded under pressure:—

When the whole heat generated by compression is retained by the air itself while being reduced
from 1 to $\frac{1}{2}$ $\frac{1}{3}$ $\frac{1}{4}$ $\frac{1}{5}$ $\frac{1}{6}$ $\frac{1}{7}$ $\frac{1}{8}$ $\frac{1}{16}$
of the initial volume, the pressure rises
from 1 to 2·653 4·697 7·04 9·641 12·46 15·485 18·687 49·59,
and the absolute temperature which is proportional to the products of these figures rises
from 1 to 1·327, 1·565, 1·76 1·92, 2·077, 2·31 2·335 3·1.

When air is expanded under pressure, without receiving heat from any external source,
from 1 to 2 3 4 5 6 7 8 16
times the initial volume, the pressure falls
from 1 to ·377 ·213 ·142 ·104 ·08024 ·0646 ·0535 ·02016,
and the absolute temperature falls
from 1 to ·754 ·639 ·568 ·520 ·4814 ·452 ·428 ·322.

When atmospheric air is compressed from the volume
1 to ·6113 ·4585 ·3737 ·319 ·2803 ·251 ·2285 ·1397,
the pressure rises
from 1 to 2 3 4 5 6 7 8 16
atmospheres, and the absolute temperature rises
from 1 to 1·223 1·375 1·495 1·595 1·682 1·757 1·828 2·235.

When air is expanded under pressure
from 1 to 1·636 2·181 2·676 3·135 3·568 3·98 4·377 7·161
times the initial volume, the pressure falls
from 1 to $\frac{1}{2}$ $\frac{1}{3}$ $\frac{1}{4}$ $\frac{1}{5}$ $\frac{1}{6}$ $\frac{1}{7}$ $\frac{1}{8}$ $\frac{1}{16}$,
and the initial absolute temperature falls
from 1 to ·818 ·727 ·669 ·627 ·595 ·568 ·547 ·447.

Glasgow, Dec. 10th, 1880. JAMES BROWNLEE.

THE PATENT LAWS.

SIR,—There is a part of the English patent law with which, unfortunately, too few are interested in as the law stands, but which ought to be an important matter. It is the arrangement by which a prolongation of a patent may be obtained. Having lately passed through the mill in this respect, will you allow me to express what I have felt to be the chief iniquity of the present arrangement? You have first of all to make up your mind to spend between £500 and £600 for the chance of a prolongation. This is bearable, though a somewhat heavy tax, when you have at the same time to prove that you have been working for fourteen years for the benefit of the public and without any to yourself. All this, however, is comparatively a fair game of speculation. Where I find the shoe pinches is when you come into court and have spent your money with the stoicism proper to the occasion, or perhaps being able to appear as if you rather liked being skinned, you have then to appear—metaphorically—with your hat in your hand; in fact, as a beggar for any crumbs that the court may choose to dole out to you in charity. The slightest hint that you are asking anything which the country is morally bound to grant you is resented as if you had attacked the Queen in person. This is my experience, though I succeeded in my application. More illogical nonsense I never heard talked by boys at school than was deliberately put forth as wisdom by the judges. If the case was reported in full I would undertake to prove this. I got substantially all I asked for, but why should I get this as a beggar and not as a just claim?

As regards the conduct of the case by the Attorney-General and his assistant, Mr. A. L. Smith, on the part of the Crown, I wish to record my appreciation of their urbanity and fairness; in fact, the word kindness more nearly expresses what seemed to me to be their attitude towards me. I believe they felt—whether consciously or unconsciously—that it was unfair that I should appear there as a beggar in place of as a claimant, and assisted me all they could against the Court, which more than once pleased itself by conveying to my counsel that we were only beggars, and depended entirely on their favour.

Hyde Park-street, Glasgow. ROBERT D. NAPIER.

["Nonsense, logical or illogical," is so rarely heard from the English bench, that we are fain to think that our correspondent failed to understand the judges whom he criticises, possibly because he could regard the case from only one point of view.—ED. E.]

THE EXPLOSION OF HEATED WATER.

SIR,—I have read carefully your article on the above subject, and on its principles have wrought out a calculation for an ordinary case. The result is rather startling, but as I think it is correct you may perhaps think it worth insertion in your columns, as it places the thing in a concrete form. The case I have supposed is that of an ordinary Cornish or Lancashire boiler 7ft. diameter by 30ft. long, having two flues 33in. diameter; steam room in boiler = about one-third diameter from crown = roughly 323 cubic feet. Deducting this and the space occupied by the flues—about 355 cubic feet—from the whole capacity of the boiler—1154·4 cubic feet—we find the volume of water in the boiler 475·6 cubic feet = 29,629·8 lb. Let the working pressure of boiler be 50 lb. = 65 lb., absolute, temperature corresponding to this is 147·7 deg. C. If, now, by collapse of a flue or in some other way, the pressure be suddenly reduced to 14·7 lb., then the temperature will fall to 100 deg. C., and 47·7 deg. of heat will be set at liberty for the formation of steam. Taking latent heat of steam at 100 deg. C. as = 537 deg., then $\frac{47{\cdot}7}{53{\cdot}7}$, or roughly one-eleventh of the water in the boiler will be converted into steam of 14·7 lb. pressure, and this is about 2693·6 lb.

The volume of steam produced from this quantity of water at the atmospheric pressure will be 70,841·68 cubic feet, but as this must all be contained within the steam room of the boiler + $\frac{1}{11}$ of the space formerly occupied by the water, that is 366·2 cubic feet, the pressure in atmospheres will be $\frac{70{,}841{\cdot}68}{366{\cdot}2} = 193$, or about 2840 lb. per square inch, a pressure which few boilers constructed for a working pressure of 50 lb. are calculated to withstand, and which is quite equal to producing the effects which follow these explosions. Of course the above calculation can only hold in the case of instantaneous explosion. If we suppose that even a small amount of time is occupied by the various processes—first the collapse of the flue, then the diminution of pressure, the increased evaporation, and the enormous consequent increase of pressure—then the accuracy of the calculation is destroyed; but as these are practically simultaneous it will pretty well indicate the destructive energy of one of these explosions. PM.

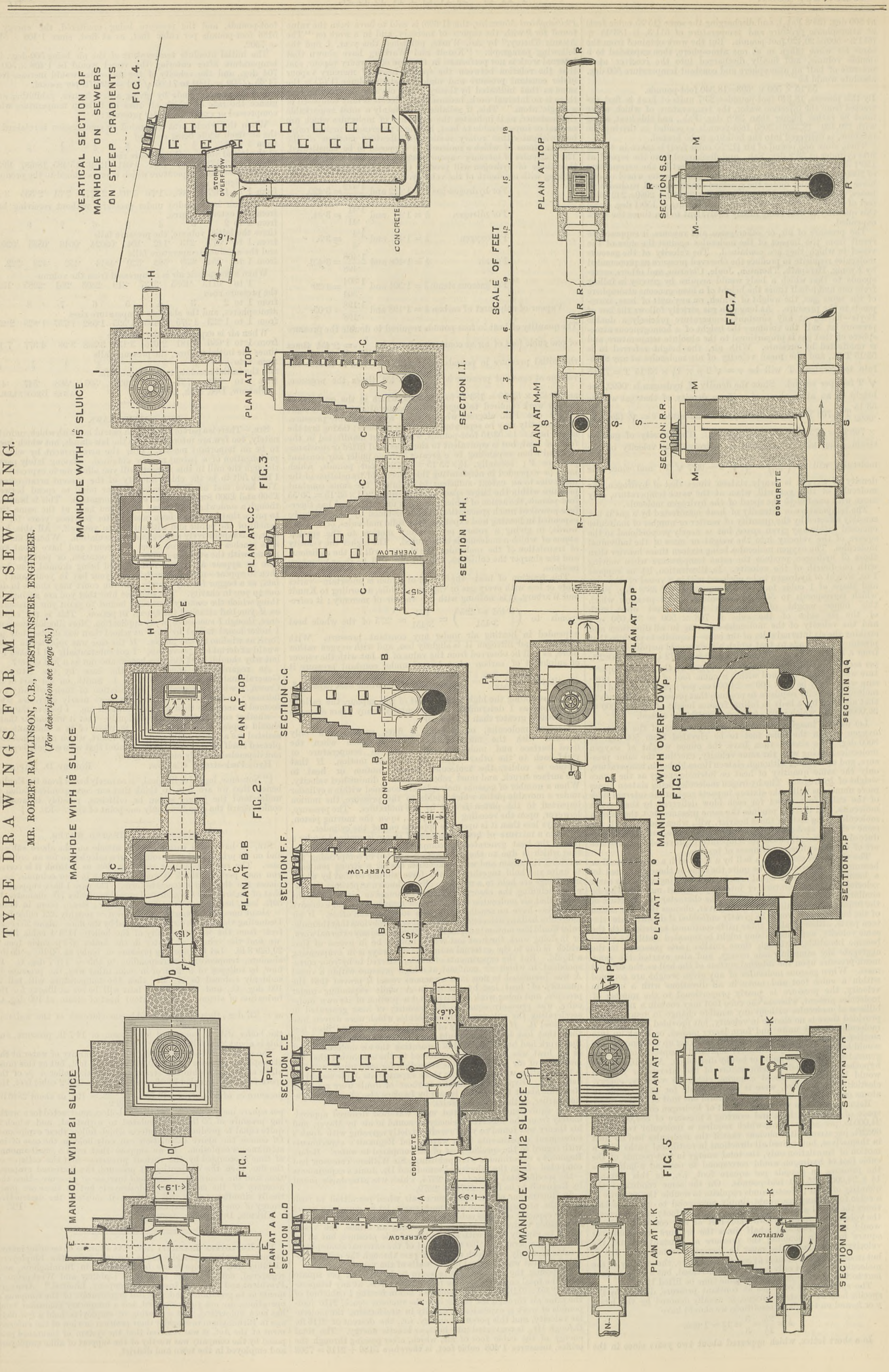
Kirkton, Dumbarton, January 26th.

THE EMPLOYERS' LIABILITY ACT.—As a means of securing manufacturers against possible losses arising from the Employers' Liability Act, a company has been formed in Birmingham, and registered, entitled "The Employers' Liability and Workpeople's Provident and Accident Insurance Company, Limited." Arrangements as to premiums, and the full organisation of the company's operations, are not yet completed, but a temporary guarantee fund has been subscribed. At a meeting of employers held a few days ago in Birmingham to consider their position in view of the enforcement of the Act, it was resolved that the system of insurance proposed by the company was worthy of the support of alike employers and employed in the town and district.

TYPE DRAWINGS FOR MAIN SEWERING.

MR. ROBERT RAWLINSON, C.B., WESTMINSTER, ENGINEER.

(*For description see page 65.*)



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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.*

T. C. (Hartshill.)—*No.*

W. CONYERS (Dunedin)—*Subscription received with thanks.*

REGULAR READER.—*The patent has not yet expired. We never pronounce an opinion concerning possible infringements.*

C. AND T. (Preston.)—*Apply to any makers of hot-water heating apparatus, and have hot-water pipes laid round the sides of the bath.*

G. P. R.—*The clock you show is only novel in detail. The fact that it is driven by water has nothing to do with its time-keeping qualities.*

R. M. D.—*You allude no doubt to the compressed air engine of Col. Beaumont, tried at Woolwich. A letter addressed to him at the Arsenal will reach him.*

J. C.—*There is no special work on the manufacture of gas holders. You will find a great deal of useful information in Richard's Treatise on the Manufacture of Gas.*

R. S. T.—*We are unable to help you further than to say that it is probable you may by advertising meet with some gentleman who will aid you to dispose of the patent.*

C. M.—*We regret to say that wide as is our range of information, there are some things which we do not know, and one of these things is the address of Mr. Foster, maker of umbrella sticks.*

T. S. (Birmingham.)—*We cannot give you the name of a maker of small Corliss engines, for so far as we are aware none are made. Possibly some one of our advertisers would make one to order for you. See our advertisement pages.*

RAIL (Leeds).—*We cannot say what is the greatest weight of rails ever turned out of one mill in a week. Mr. Windsor Richards says that he has made with reversing rolls* 2200 *tons of rails per week, but it is stated that with three high rolls at the Edgar Thomson steel works, over* 3000 *tons have been made.*

FAHRENHEIT.—*There is nothing puzzling in the fact that a thermometer on the roof of a lofty building falls lower than one in or near the ground. The indications of thermometers are affected by apparently insignificant causes, and a thermometer placed on the grass may register as much as* 10 *deg. more or less than one hung on a stick 2ft. away from the first. On the roof heat is radiated more freely into space than it is on or near the ground.*

ARMOUR PLATE.—*No experiments have ever been made to test the influence of temperature on armour plates. A considerable number of experiments have however been made by Mr. Sandberg, on the effects of impact on rails at low temperatures, and these prove very conclusively that rails are more brittle in frost than they are in warm weather. We have no doubt whatever that armour plates, whether of iron or steel, are more brittle at low temperatures than they are in summer. Whether they are more easily punched, assuming that they do not break, is quite another question, on which we can express no opinion.*

A. C. L.—*Fahrenheit mixed snow and salt, and obtained what he believed to be the greatest possible cold. He put his thermometer into the mixture, and marked the point to which the spirit fell. This he called zero, or the point of no heat. Then he put the thermometer into a vessel containing melting ice, and he divided the distance between zero and the place to which the spirit now rose into* 32 *parts or degrees. The freezing point of water is therefore* 32 *deg. above zero. In the Centigrade thermometer the boiling point is* 100 *deg.; in Reaumur's* 80 *deg. The Centigrade freezing point is zero, and so is Reaumur's freezing point.*

J. H.—*As a rule a worm cannot be driven by a wheel, and will hold a weight in any place. But you can easily settle the point for yourself by projecting the worm of the screw on the drawing board and ascertaining the angle of inclination of the thread with the axis. Then ascertain the load on the thread, and the coefficient of friction between the tooth and the thread. To this coefficient must be added some constant for the resistance offered by the screw to revolving, which resistance is due to its collar friction, which, owing to the endway thrust, will be very considerable, and the friction of the gearing which will be put in motion. If the pressure of the load trying to descend be sufficient to overcome these resistances, then the screw will not hold, and must be made of less pitch; but as a rule such screws, as we have said, hold perfectly and waste over* 40 *per cent. of the power applied in friction.*

HARRIS'S BELT FASTENER.

(*To the Editor of The Engineer.*)

SIR,—Can any reader favour me with the address of the maker of Harris's patent belt fastener? W. J. M.

Burton-on-Trent, January 22nd.

TAPIOCA MACHINERY.

(*To the Editor of The Engineer.*)

SIR,—I have an inquiry for above, and if any of your readers can give me the names and addresses of makers I shall be much obliged. R.

Ipswich, January 21st.

REMOVING BOILER INCRUSTATIONS.

(*To the Editor of The Engineer.*)

SIR,—Can any reader tell me if curriers' shavings of leather put into a wooden box perforated with half-inch holes is good for the above?

Scotland, January 27th. ENGINE-DRIVER.

MEXICAN FIBRE-PRODUCING MACHINERY.

(*To the Editor of The Engineer.*)

SIR,—Can any of your correspondents inform me of the names of manufacturers of machinery suitable for converting the Maguy or Centuary plant into Mexican fibre? MEXICAN FIBRE.

Lincoln, 21st January.

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

MEETINGS NEXT WEEK.

THE INSTITUTION OF CIVIL ENGINEERS.—Tuesday, Feb. 1st, at 8 p.m.: Discussion upon "Deep Winning of Coal in South Wales," and the following paper will be read:—"Portsmouth Dockyard Extension Works," by Charles Colson, Assoc. M. Inst. C.E.

CHEMICAL SOCIETY.—Thursday, Feb. 3rd, at 8 p.m.: "On the Estimation of Organic Carbon in Air," by Drs. Dupré and Hake. "On the Action of the Copper-Zinc Couple upon Nitrates," by M. W. Williams.

SOCIETY OF ARTS.—Tuesday, Feb. 1st, at 8 p.m.: Foreign and Colonial Section, "The Industrial Products of South Africa," by the Right Hon. Sir Henry Bartle Frere, Bart., G.C.B., G.C.S.I., D.C.L., LL.D. Wednesday, Feb. 2nd, at 8 p.m.: Ordinary meeting,. "Trade Prospects," by Stephen Bourne.

BIRTH.

On the 22nd inst., at 176, High Park-street, Liverpool, the wife of G. FREDK. RANSOME of a son.

DEATHS.

On the 22nd ult., at Rawul Pindee, Punjab, HENRY HARE SCOTT, formerly ex-Engineer Public Works Department, Punjab.

On the 19th inst., suddenly, at Exmouth, WILLIAM ALEXANDER BRUNTON, M. Inst. C.E., of Hillwood, Sutton, Surrey, only son of John Brunton, M. Inst. C.E., of 13A, Great George-street, Westminster.

On the 22nd inst., at the Wood, Fixby, in his 75th year, GEORGE CROWTHER, Civil Engineer, Huddersfield. Friends will please accept this intimation.

On the 23rd inst., suddenly, on board the s.s. Ardandhu, on the passage from Bilbao, Spain, to Clyde, ROBERT SCOTT, C.E., late manager of the Orconera Iron Ore Company, Bilbao.

THE ENGINEER.

JANUARY 28, 1881.

PARLIAMENT AND THE RIVERS.

THE Government measure "for the Conservancy of Rivers, the Prevention of Floods, and other matters," has been brought forward in the House of Lords, and its second reading is promised for Monday next. The announcement made in the Queen's Speech with reference to this subject is therefore fulfilled; and the appeal made by the powerful deputation to Mr. Dodson last November has not been in vain. The Bill itself was issued on Tuesday last, and it is to be hoped that it will enjoy a better fate than its predecessors. The Earl of Redesdale, who is nothing if not critical, appears to have his eye on the Bill for the purpose of interposing some elaborate motion of his own, and has already given signs of a scheme that it should be referred to a Select Committee. The Lord President of the Council, who has charge of the Bill, replied to Lord Redesdale on Monday, signifying that there was at present no intention to refer the Bill to a committee, seeing that a Select Committee of their lordships' House considered the subject only a few years ago. To this it may be added, as stated by the Speaker of the House of Commons when addressing Mr. Dodson, that twice within the last two years Parliament has attempted to deal with the question, and Bills have been introduced, framed mainly upon the lines of the report of the Select Committee of the House of Lords. The failure of these Bills to pass was mainly due to the pressure of other business, and no hostile motion was carried against either of them. If, according to the usual phrase, any subject was ever ripe for legislation, it is this; and the loss of time which has unfortunately taken place only makes the necessity for the interposition of Parliament more urgent. In the present instance the earnestness of the country is shown by the Bill which Mr. Magniac has brought forward in the House of Commons, and which contemplates the same object as the Bill introduced by the Government in the Lords.

The Government Bill, as also Mr. Magniac's, is of a permissive character. The Select Committee of the House of Lords which investigated this subject in 1877, while desirous that means should be taken to ensure the appointment of a Conservancy Board for each watershed area, considered that it should in the first instance result, if possible, from the application of persons having an interest in the district. Following the application there is to be an inquiry by the Local Government Board, and if it appear desirable to create a Conservancy district, certain proceedings will ensue, resulting in the preparation of a Provisional Order, which will await the sanction of Parliament. If the Order be confirmed by an Act, the Conservancy Board will then be formed, with power to execute all such works as may be necessary for the prevention of floods in their district, and for carrying into effect all or any of the other purposes of the Act. In the scheme for the constitution of the district, the Local Government Board will, wherever it is "just and practicable," make a distinction between lowlands, midlands, and uplands, and will prescribe in what proportion these are to contribute to the expenses of the Conservancy Board. The highest rate in the pound payable by the uplands is not to exceed one-sixth part of the highest general rate payable by the lowlands. It is also to be observed that an urban sanitary authority may be constituted a Conservancy Board, and may defray their expenses under the Act out of the general district rate.

It is important to forecast how far this measure will be in accordance with what we may term engineering principles. Existing sanitary legislation has failed to deal successfully with river floods, because it has had respect to limited and artificial boundaries. The Select Committee of 1877 thoroughly endorsed the opinion expressed by almost all the witnesses who came before them, that in order to secure uniformity and completeness of action in dealing with each river, "each catchment area should, as a general rule, be placed under a single body of conservators, who should be responsible for maintaining the river from its source to its outfall in an efficient state." It was in no violation of this principle that the committee suggested the possible advantage of placing the tributary streams under the care of district committees, subject to the general control of the conservators, who were themselves to consist of "residents and owners of property within the whole area of the watershed." It was admitted that in some instances a tributary stream might be of such magnitude and importance as to require a separate Conservancy Board for itself. But in that case it was conceived that the intervention of a superior power might be occasionally necessary in order to decide differences arising between the co-ordinate bodies. The idea of subdivision pervades Mr. Magniac's Bill, provision being made in that measure for three grades of Conservancy Boards—namely, sub-district, district, and general. The Government Bill scarcely strikes us as having been founded on a clear apprehension of the catchment theory. The provision that an urban sanitary authority may be constituted a Conservancy Board cuts at the very root of the watershed principle. The chopping up of a river into sections is the great defect of the present system—if system it can be called. We have very little hope of seeing the river floods conquered, or the rivers protected against the effects of drought, unless they are dealt with as part and parcel of a great system of national drainage. The main drainage works of the metropolis would never have been carried out, had the design and execution been left to the disjointed wisdom of forty London vestries. A river is the drainage of a basin, and the basin must be dealt with in its integrity. Towns can be properly represented on a Conservancy Board comprehending the entire catchment area, and no Conservancy Board will be able to deal successfully with a river unless it has the entire possession of the area to which the river belongs.

In common with previous measures, each of the Bills before Parliament excludes the Thames from its provisions, as also the Lee, so far as the existing Conservancy Acts are concerned. It cannot be said that the Thames is in a happy state at the present time. It overflows its banks, and half drowns some hundreds of families within the metropolitan area, and seems determined to rise higher and higher as time goes on. Sir Joseph Bazalgette declares that there never was so high a tide as that of last Tuesday week. Yet there was no land water to aggravate it. Not only does the main stream run over, but the streams that run into it are likewise rebellious. It does not appear that the Thames Conservators take any thought for the Ravensbourne and the Quaggy, or the mysterious streams which submerge Brixton. The Thames basin possesses a variety of authorities. The Lee, for instance, has its own Board of Conservators, and very properly so; but they owe no allegiance to the Conservators of the Thames. The Metropolitan Board have to deal with the Thames floods which occur in their own area, while the Ravensbourne and the Quaggy are in the hands of the Greenwich District Board, the Lewisham District Board, and sundry rural parishes. The Chinese are said to have a game in which they place a couple of crickets in the middle of a large china basin, and then tickle their tails, each with a feather to make them fight. There are several crickets in the Thames basin, and they are by no means in harmony with each other. The Thames Conservators have quarrelled with the Metropolitan Board, the Metropolitan Board are subject to a Chancery injunction obtained against them by the Greenwich District Board with regard to the storm overflow in Deptford Creek, and Greenwich and Lewisham are by no means in agreement with respect to the Lewisham floods. For all this, which concerns the peace, comfort, and good reputation of a great city, the Rivers Conservancy Bill of the Lord President provides no remedy; neither does it distinctly promise to bring peace and good government into any of the large river basins of the provinces. It is simply an instalment of what is wanted—a "tentative" measure, as we are told, which is the way in which we always do things in this country. If passed, it will have to be amended, and for the present we can only be thankful that there is to be a beginning, without which there can never be an end.

RAILWAYS AS STATE PROPERTY.

A FAVOURITE argument with those who clamour for the transference of English railways from private hands, is that great reduction in the cost of management will result from central control. That a few of the separate boards of management of small tributary railways could be dispensed with by merging these little railways in the larger systems is perhaps true, but the fallacy of the idea that either great economy or increased facilities are likely to ensue from Government possession of the railways, has now been sufficiently shown by the results of the working of the German or Prussian State lines. After considerable experience as a great railway trading concern, the German Government finds that the railways suffer from the want of district or local management; and as a result of this a Bill is now before the Chamber of Deputies, which has for its object the provision, as an addition to the State management, of such a local and personal element as will meet the wants of passengers and manufacturers, so that these wants may not be lost sight of as they apparently are now under the State management, which cannot descend from the weighty strategic and bureaucratic considerations, and the more salient of the general questions of management, to the matters of local and trade interest upon which the economical profitable management of railways largely depends. To a very great extent the profit which can be made upon railways depends upon the attention which is paid to the wants of those who use the railways, just as the business of any trader flags or increases in proportion to the accommodation which his customers find themselves receiving at his hands. Hence it has been found in Prussia that it is necessary that the railways shall be so managed that the wants of the Prussian people shall be studied and their demands supplied. To this end, and in addition to the Royal decree, which has already created an Economical Council for Prussia, a Bill has been laid before the Chamber of Deputies providing for the appointment of district railway councillors and of a national railway council for the management of the State lines. This council will consist of a president and vice-presidents, to be nominated for three years by the King; of commissioners from the Ministries of Public Works, Trade and Commerce, Finance, and Agriculture; of three members from either House of Parliament; and of one, two, or three representatives of the various provinces, according to their importance in respect of the railways. The council is to begin its labours on the 1st of January, 1882. It is thus easy to see that the State having become possessed of the railways, finds that they cannot be managed like a post-office department, which puts out half its work to be done. It is found that railways want a good deal of management, and that central dictation is not the sort of thing that effects this. It is found that the special management which the railways had under private enterprise cannot be dispensed with, but having dispensed with the boards of directors it is now found necessary practically to re-create them. In other words, in order that the railways may do as much work and be as useful as they were formerly, the very means which were formerly employed to manage them must be again resorted to.

It is much to be questioned whether the proposed railway councils can ever be as effectual in the management of what may be looked upon as a purely trading concern as the boards of directors directly interested in the welfare of the railways. The stimulus which causes individual railway companies to make those improvements and grant those facilities which entice custom will be wanting. It may, of course, be said that our railway companies show considerable reluctance to adopt costly improvements as eagerly as a semi-informed public would wish; but at the same time there is no evidence that any Government Department ever regards the inventor of any improvement with great affection. Government officials need at least as much proof of the necessity and value of any proposed reform as the directors of railways, and it is not at all certain that if our railways were in the hands of the Government, extensive improvements, either for the comfort or convenience of railway travellers, would be made, without the same pressure of public opinion which has now, in some matters, to be brought to bear on private companies to effect these. With the fact before us that centralisation of railway management has so far failed in Germany as to make it necessary, on the grounds of economy, to establish an equivalent of the boards of directors of the railways when privately owned, the argument for State purchase under this head is practically demolished. It is not on these grounds alone, however, that these new district railway councils are found to be necessary. It is notorious that on the lines under State management, accidents during the past year or more have been so much more frequent than under the former management as to cause general concern. Salaries have been greatly reduced, and the wages of some of the men, such as pointsmen, have been brought down to a sum not much in excess of that given to our poorly-paid letter-carriers. Travelling in Germany was formerly very safe, if very slow; but the reduction, on grounds of economy, of the number of officials, such as line inspectors, has taken away even this reason for praise. Such secrecy is, moreover, observed respecting accidents that a long time elapses before the public is made aware of the true number of killed or injured, and all such matters are hushed up as soon as possible. This is facilitated by the difficulty with which the press obtains correct information on accidents, so that very little is said of such things in the newspapers except when they happen in England. Those who support the purchase of railways in England by the State will have to show very strong proof of the possibility of State management being better in this country than in Germany, or their arguments on other grounds will have little weight.

THE VALUE OF PATENTS.

CERTAIN of our readers appear to be determined that a good deal shall be heard about cheap patents, and the questions raised by these gentlemen in our own correspondence columns, and elsewhere, no doubt possess interest for many people—engineers, manufacturers, workmen, and amateurs. While we are willing to give all the space we can spare to the letters of our correspondents, we may be excused if we express our own opinions on the subject, even if these opinions should not quite meet the views of others; and we even dare to hope that an impartial consideration of the questions raised may serve to call back some minds to the path of logical reasoning from which they have wandered. The thing advocated just now by those who write about patents at all is a reduction in the Government fees. This reduction would give what are known as "cheap patents," and we propose to inquire here whether it is or is not advisable that the scale of fees for patents should be reduced. It can hardly be overlooked that the advocates of reduced fees do not base their advocacy on any claim which the inventor may have to consideration from the Government. They take far higher ground, and assert that Patent-office fees should be reduced for the good of the nation. This simplifies our task, and we willingly follow Mr. Standfield and others to the pinnacle whence they survey the world and discourse on patents. But we cannot wholly dispense with the inventor and his interests. He, too, deserves some consideration; indeed, the influence of reduced fees must act on the inventor first and directly before it can in any conceivable way affect the public generally.

The advocates of cheap patents contend that a mere reduction of the fees would multiply patents at least fourfold, and that as each patent would represent a valuable invention, we should have twenty thousand valuable inventions every year instead of five thousand. Hence, as a direct consequence the prosperity of the country would be marvellously increased. We have not seen as yet one word of logical argument in favour of this proposition. We have no doubt, of course, that a reduction in the fees would induce many men to take out patents who do not take them out now; but so far as we can see no one would of necessity be any the better, save the patent agents. The old-established firms would make fortunes in a very short time, and quite four times as many men would then make a good living as now contrive to earn their bread by playing the part of patent agents. We may, however, put this fact on one side. It remains to be proved that the inventor would reap any advantage; and there is good reason to conclude that he could gain no benefit whatever. If our readers will turn to our illustrated list of patents, and examine them carefully, they cannot fail to arrive at the conclusion that many of the inventions patented are really good for nothing. Of the remainder, how many do they suppose are taken up and made use of? Not a week passes without numerous patents being taken out for improvements in spinning and weaving machinery. If our readers will turn to Mr. Spencer's paper on cotton spinning machinery, read before the Institution of Mechanical Engineers in Manchester, and reproduced in THE ENGINEER for November 19th, they will find a history of the progress made in such machinery during the last ten years; and they will also see that in the greatest cotton spinning district in the world not, at most, more than half-a-dozen patents have been actually adopted out of, we are under the mark if we say, 500 patents which have been taken out during the last ten years for improvements in this class of mechanism. The remainder are pure waste; and to reduce fees would only enormously increase this list of wasted patents. Let us turn again to the steam engine. Hundreds of patents are taken out every year in this country for improvements in the steam engine. How many of them come to anything? Take the locomotive engine as it stands, and the patents secured within the last twenty years for improvements in locomotive engines and actually in use, may be counted on the fingers. The most noteworthy are Allan's straight link, Adams's radial axle-boxes, W. Adams's traversing bogie, Ramsbottom's safety valves, some form of the injector, and probably the method of securing the tires on the wheels. Not ten out of a multitude. Again, those who contend that patents are the great stimulus to improvement will do well to consider what patents have *not* done for the marine engine. In 1856 the steamship Persia, with engines indicating 3600-horse power, burned 3·7 lb. of coal per horse per hour, and carried 250 tons of goods; in 1880, the Arizona, indicating 6000-horse power, burns 1·75 lb. of coal per horse per hour, and carries 3400 tons of cargo at 16·25 knots. This means 4 cwt. of coal for every ton of cargo carried, while the Persia burned over 6 tons per ton of cargo. How much of this improvement is due to patents? How many patented inventions are to be found in the engines of the Arizona? Practically none. Dozens of patents are, however, taken out, and have been taken out, for improvements in marine engines, and in scarcely one instance have they repaid their owners. Almost, if not altogether, the only complete patent marine engine at work is that of Mr. Allan, manager of the North-Eastern Engineering Works, Sunderland. Patents have done next to nothing to bring about the enormous improvement that has been wrought in transatlantic navigation, for of all the various inventions patented and tried at sea, not half-a-dozen have borne the test of experience, or are now in use. The more carefully the day-to-day progress of events is studied, the more clear will it become that of the host of patents obtained, the great bulk die out without ever paying for their own existence. They all as a rule represent dead loss, and this even when the things are good in themselves. We published last week two items of legal intelligence, which ought to be read by every intending patentee. One gives the history of Martin's fire-door, an invention which possesses the charm of being at once simple, cheap to make, and efficient. The other is the history of the Napier friction clutch—also an invention simple, elegant, and efficient. Few inventions have had more chances in their favour, and for nearly fourteen years their inventors have struggled and fought, and spent money, and brain labour, and time. They have undergone humiliations, criticisms, contempt. They have battled and toiled, and lost money steadily. Is the game worth the candle? Is Mr. Martin the better of his fire-doors? Has Mr. Napier's clutch added to his happiness? Their story is the story of thousands, and in the face of such facts to talk of the patent fee of £75 for seven years as a check on the prosperity of the nation appears to be simple nonsense. The truth is—and the sooner the truth is known the better—that the cost of getting any invention adopted and put into use must be expected to reach hundreds of pounds under the most favourable conditions, and may amount to thousands of pounds. The notion that cheapening patents would do any good to the nation is totally opposed to known facts, which all go to prove that the patent fees are but as a drop in the ocean compared with the subsequent outlay required to make the invention remunerative either to the State or the individual.

Of course men like Mr. Standfield or Mr. Grierson will not regard the matter from this point of view. They consider it in an entirely different aspect, and it is only fair that we should say something about this also. They point to Watt and Stephenson and Bessemer, and say, "Behold, these men revolutionised the world, and only because they had patents. Let us have more patents, and we shall have more Watts and Stephensons and Bessemers." They hereby confuse the means and the end, cause and effect. A cheap patent would in no way have helped Watt, or Stephenson, or Bessemer, and the last man in the world to be cited as a favourable example of what patents can do, is Sir Henry Bessemer. He has taken out patents, not by the half-dozen, but by the score, and we are not aware that any one of them ever brought him in one sixpence of profit, save his steel patents. His celebrated bronze powders are made by machinery, the construction of which is a secret, and the machinery described in the patents which he secured for making these powders proved on trial quite useless. The truth is that Watts and Stephensons and Bessemers will always be rare, and no reduction in the patent fees will multiply them. The fixed idea with Mr. Standfield, and those who hold his opinions, that once a patent is secured the inventor must make money out of it, is the cause of much mischief. The patent is regarded as an end, whereas it is only a means. It resembles in all respects the letters of marque which used to be granted to private ships, entitling them to all the prizes they could take at sea from an enemy; or the donation of a kingdom to an adventurer who had as the next step to raise funds and an army and go and conquer the kingdom—if he could.

We have no intention whatever of asserting that it is not desirable that we should have patents. On the contrary, we regard them as the just reward of men who devote time, talent, and money to effecting improvements in the arts and sciences. But we completely fail to see that anything would be gained by multiplying them. There are now patented every year in this country at the most moderate computation 3000 useless inventions—useless in the sense that they are never carried into practice. Those who take out these patents have presumably some money and some chance of pushing their inventions. Is it to be supposed that the men who find £25 a burthen which they cannot bear, will be better educated and more competent to invent well, than the men who can pay the existing scale of fees? or is it probable that the new army of inventors will be in a better position than the existing regiment of inventors to push inventions or get them adopted? These are the questions to which the advocates of cheap patents must address themselves, and must answer satisfactorily before they can convince any sound political economist that cheap patents are desirable. Inventors have, however, just cause of complaint, in the fact that more of the money which they pay is not devoted to its legitimate use. The nation wants a good patent museum and a convenient library. Both should be under one roof, and the building containing them ought to be in a central place. The museum should not be confined to patented inventions. It ought to be an exhibition of all that is noteworthy in mechanical art and physical science. What it should be, and what it ought to contain, we may, perhaps, explain at length another time. Meanwhile, if Mr. Standfield and Mr. Grierson really wish to help the inventor, let them do their best to place the means of acquiring information before him. If, however, the friends of cheap patents seek nothing but the multiplication of patents pure and simple they will, perhaps, not like this suggestion, as nothing would tend more powerfully to reduce the number of patents then the spread of information. The history of inventors is a ghastly record. At one time the door on the right and left hand of the entrance to the Great Seal Patent-office bore the inscriptions "Registrar in Bankruptcy" and "Commissioners in Lunacy." There was a grave humour in the concatenation, which would not have lost anything of its appropriateness had the cost of patents been largely reduced years ago.

THE SCHOOL OF MINES.

THERE is some reason to think that matters in certain respects are not going quite smoothly at the School of Mines, South Kensington, the science teacher students being apparently dissatisfied with the authorities, while the authorities have some reason to complain of the teachers. As the facts are not as well known as they ought to be, we state them here. A very good education in geology, chemistry, and theoretical mining is given at the school, and the fees paid are adequately high. Every year, however, a certain number of candidates for the posts of science teachers present themselves at the school. There is no very strict limit as to age. The candidate fills up a form, and on a stated day he and his fellows undergo an examination which is, or ought to be, easily passed; it is in fact a species of matriculation examination. Of those who pass some twenty are then selected and placed on the books of the school. They not only are taught all that the School of Mines can teach, but they have besides an allowance made them in money for lodging and railway fares. In return for this they pledge their word that on leaving the school properly qualified they will become science teachers. The science teacher lives where he pleases, and he holds classes for artisans, and gives lectures, the minimum fee for each course being 5s. The artisans whom he has taught go up from time to time to the School of Mines, and are then examined. For each one who passes in the first class the teacher gets £2 2s.; for each one who passes in the second class he receives £1 1s. Now it appears that the science teachers in embryo at the school have been dissatisfied with their teaching. They assert that Professor Frankland does not attend as he ought to the laboratory, and find fault with his lectures. The great body of the students, however, hold different views, and are quite satisfied, as, indeed, seem to be not a few of the science teacher students themselves. How the dispute which exists will end remains to be seen. It is now stated that very often the gentlemen who have promised to become science teachers find that they cannot make a living at the business, and that they throw it up and take very good appointments both in this country and abroad as analytical chemists and mining engineers. They thus get an expensive education in return for nothing. The whole scheme, indeed, appears to be thoroughly Utopian. There is no possible check on the men after they have left the school; and it is hardly to be expected that a man who can earn at most £80 or £100 a year as a science teacher, will refuse an appointment at home or abroad worth three times as much, simply because he has promised, not an individual but a department, that he will do nothing of the kind. Such conduct is wicked no doubt, but the department supplies the temptation. We understand that the whole question will very soon be brought before Parliament, and the sooner the better. If South Kensington has any statistics to prove that the system has worked well and paid for itself by results, they ought to be got out and put into shape. The department will have to make out a very good case indeed to justify the existence of the system.

THE EXTENSION OF LETTERS PATENT.

THE letter on this subject, which we print in another page, deserves a word or two of comment. We do not understand our correspondent to say that a patentee is entitled to extension as of right. As the law stands, that contention would be impossible, because the Act of William IV., which authorises the exercise of the prerogative to the extent of seven years' extensions, expressly states that the matter may be referred to a committee of the Privy Council, and that the king "is authorised and empowered, if he shall think fit, to grant, &c." It is not the cost to which the writer objects; what he really chafes under is the position of a suppliant which the petitioning patentee has to adopt. But surely this is somewhat illogical. He suggests a moral duty on the part of the "country" to grant the extension. This obligation can only arise in consideration of some sacrifice on the part of the patentee, and the whole drift of the inquiry at Whitehall is to ascertain the fact and amount of this sacrifice. Prove that fact, and the extent of it within the rules of practice which are necessarily formulated for the exercise of a judicial discretion, and you are assured of an extension. To give this proof a patentee must condescend to particulars. He must show that he is a meritorious but an unremunerated person. Surely it could not be otherwise under any systems of law which did not provide for indiscriminate renewals. We do not say that a system might not be suggested of granting extensions without inquiry upon payment say of a very considerable fee. That is a large question to which serious if not fatal objection may obviously be urged. But so long as inadequate remuneration is a ground for extension, that inadequacy, and the consideration whether or not it has been due to the fault of the patentee himself, must be submitted to the decision of some person or persons before whom the applicant cannot but be in a position of dependence, which however, is in no sense dishonourable. We think that Mr. Napier is too hard upon his judges. The Judicial Committee have a reputation for patience and courtesy remarkable even among English judges, who are proverbially gentlemen in every sense. The report of another case in which the petitioner was not so fortunate as our correspondent, shows how willing they are to help a deserving patentee, if they can do so consistently with rules of practice. Everybody will agree with Mr. Napier as to the courtesy of the counsel of the Crown, but we wonder whether he would have been so lavish of his praise if they had adopted in his case the position which they took up in the other—that of a most strenuous opposition to the patentee, notwithstanding that he had another opponent—a competitor in trade—before the Court.

BOROUGH SURVEYORSHIPS.

THE class of candidates for borough surveyorships who are brought to the front by the offer of £200 a-year was very amusingly illustrated at Barnsley this week. For the vacant office there were no fewer than 175 candidates, several of them undeniably good men who ought to command at least double the money. One applicant was from Sheffield, and his letter was a curiosity in its way. Of course great minds are superior to such mean considerations as grammar and orthography, but the Sheffield applicant was unique in his disregard of the conventionalities of composition. In offering himself as a candidate for borough "surveyour" of Barnsley, he based his claims on the fact of his "having had great experience as builder in cheap and jerry line," and therefore "knew all tricks of jerry builders." On that account he would be able "to see that good property was put up in Barnsley." The rest of the letter would be spoiled by condensation:—"Jerry building in Sheffield now does not pay, so having made a bit would leave it 2 accept post of borough surveyour of your important and rapidly increasing towns which I visited several times, and the air of which agrees me also with my wife and five children, youngest of which is 4 years old. I would give my whole time to the job, and would accept £200 until you discovered my great capabilities, when I am sure you would give me a full salary. I used to be clerk of works for building firm until I went into jerry building line—cottages—and should have done very well, but Sheffield is over-built with jerry property. I will look after your important town well and catch them, knowing their tricks. I can wait on you any day this next week, if appointment be made. I will give you references to people here. Your humble servant, ———." There is something very attractive in the logic which runs through this application. "Set a thief to catch a thief," was once considered the acme of police wisdom. This applicant evidently thinks that the perfection of Corporation wisdom is to set a jerry builder to catch a jerry builder. "Jerry," it may be needful to explain outside South Yorkshire, is a term for houses which are simply thrown together—half bricks, and these bad half bricks, in the walls; street scrapings for mortar; and green wood in the windows, floors, and doors. Everything, in short, that is cheap and nasty. Drains, of course, are a luxury that are never dreamed of. King Death and the jerry builder strike up a partnership which keeps doctors busy, and thin off the population with unfailing regularity.

THE ELECTRIC LIGHT IN ITS NAVAL AND MILITARY APPLICATIONS.

AT the Royal United Service Institution on Wednesday last, Mr. R. E. Crompton delivered a lecture on the progress of the electric light, in which several novel statements were made. It seems that Glasgow has recently experienced a continued succession of thick fogs, and as many of Mr. Crompton's lamps are in use in the city, a series of experiments were carried out to obtain data relating to the fog-penetrating power of the electric light rays. It will be understood at once that the property of fog-penetration is of considerable value in naval and military operations. Under cover of fog bodies of troops can be moved with impunity, torpedo launches can advance almost to a vessel's side, but given a light whose rays can penetrate the fog, and such movements are rendered impossible. The use of the holophote to send a beam of parallel rays in any direction was condemned by Mr. Crompton, because the greater portion of the rays so used are incapable of fog penetration. His experiments led him to conclude that the rays possessing this characteristic were almost wholly confined to those rays proceeding from the crater in the positive carbon, a few proceeding from the tip of the cone of the negative carbon, and practically none from any other portion of the arc or incandescent material. The holophote uses but few of the former rays and reflects the latter. Inasmuch as the size of the crater bears a certain proportion to the carbon current, the capacity for fog penetration by a given current, can be approximately calculated. Instead of using the holophote, it was suggested that the lights should be raised as high as possible, so as to get the full effect of the crater illumination, and that the look-out man should be placed below and not above the light. An 80 Weber current, the lecturer inferred, would give command of a circle 200 yards in diameter even in a thick fog. These suggestions indicate the necessity of further and exhaustive experiment. The smoke from the battery is not altogether similar to a fog, though there exists a brotherly likeness, and the question must be answered, Do the same rays penetrate through smoke as through fog, or are some other rays to be preferred?

LITERATURE.

How to Manage a Steam Engine. By M. POWIS BALE, M.I.M.E. London: Wyman and Sons. 1880.

Rules for Engine Drivers. Mounted Sheet on Roller. London: Wyman and Sons. 1881.

THERE is room for comprehensive, accurate, and concise works on the subject which Mr. Powis Bale has taken up. Our readers may form their own opinions of the value of his contribution from the following quotations:—"Should a certain bulk of steam be confined in a boiler, the smaller the space it is confined in the greater the strength of the boiler necessary to confine it." We have not yet seen the yard in which a 30-horse boiler could be made in accordance with the following:—"The heating surface allowed in the boiler should not be less than 17ft. 6in. square per nominal horse-power." The following may be referred to when reading the instructions given further on:—"The cylinder area should be ample—much diversity of practice unfortunately exists as to what is considered the correct amount of area per nominal horse power; we are, however, of opinion it should not be less than from nine to ten square inches."

The meaning to be attached to the following may be clear to some readers:—"When the engine is employed for driving a thrashing machine, it should, if possible, be so fixed that the dust from the corn may be blown in a contrary direction." But we do not know whether they will be able to reconcile what is said above and in Nos. 1 and 7 of the following, or whether it will be necessary to forego economy if these and the 8th cannot be observed. "A horizontal engine to be really economical should combine in its construction the following points:—(1) A stroke of twice the diameter of the cylinder; (2) an efficient condenser; (3) an automatic expansion slide controlled by a sensitive governor; (4) a steam jacketed and lagged cylinder; (5) short steamways; (6) all bearing surfaces well fitted and lubricated, and an efficient method of packing; (7) large cylinder area; (8) a fly-wheel of large diameter."

The phrase "more or less" is sometimes very handy, to wit, "Copper is the best material for boiler construction, but its excessive cost, more or less, precludes it's use." The meaning of the following is not quite clear, "The heat evolved from the combustion of different kinds of coal differ considerably, the carbon varying from 75 deg. to 95 deg." It may be hoped that few of our readers have conversed with the authority referred to by Mr. Bale in the annexed: "As a prevention to corrosion we have heard strongly recommended a small portion of coal-tar, to be poured in the boiler before getting up steam, this adhering in a thin coat over the interior surface in a degree protects the plates." Boiler insurance companies should study the following on explosions arising from collapse. "These are supposed to be caused by the combined action of a vacuum, often caused by the sudden admission of water on hot plates, and considerable internal pressure acting on the internal flues of the boiler, which, being in some cases insufficiently stayed, and also weakened by overheating, are forced inwards, death in many cases resulting from the hot water thus let loose."

In the mounted sheet for engine drivers we find the following:—"Check also the safety valve against the pressure gauge by altering the former to blow off at whatever pressure is at that time shown on the pressure gauge." Usually, it is not thought advisable to permit engine drivers to tamper with a safety valve, and it is not generally considered that the pressure gauge is the more likely of the two to remain accurate. The book and sheet above noticed remind one of the young author, whom our amusing contemporary *Punch* said "did not read books; he wrote them."

LEGAL INTELLIGENCE.

JUDICIAL COMMITTEE OF THE PRIVY COUNCIL.

(*Present*: Sir BARNES PEACOCK, Sir MONTAGUE SMITH, *and* Sir ROBERT COLLIER.)—January 19, 21, 22, and 25.

Re ADAIR'S PATENT.

THIS was the hearing of the application of Mr. William Adair, of Liverpool, for prolongation of letters patent granted to him, and dated the 5th April, 1867, No. 1027, for "Improvements in Pumps." It was alleged by the petition, and supported by evidence, that for some time previous to the grant of the patent, Mr. Adair had sought to design a pump for use at sea as a ship's main pump, which should be free from the chief drawback of the pumps then in use—difficulty of access to the valves for purposes of clearing from obstruction. Prior to his patent the practice was not to use double-action pumps at sea as main pumps, because of their more complicated character; and because, in the event of the valves becoming choked, there was much more difficulty in clearing them. The first completed pump made by the petitioner was suited for a ship of about 1500 tons burden, and was exhibited in 1867 at the Duke's Dock and Princes' Dock, in Liverpool, for a period of six months. This pump, which was constructed upon the plan described in the specification of the letters patent, was double-acting, had a loose cover to the working barrel covered by the water in an open water head, and valves all accessible, and except as to one pair, also covered by the water of the water head. The advantages offered by it were evident, but it was not easy for some time to induce shipowners to take out existing pumps and replace them with the new, and, moreover, single-action pumps cost less. However, in course of time, sales improved, and with the improvement came infringement. The petitioner was obliged to defend himself, and in one action—that against Messrs. Wallace and Captain Young, reported in THE ENGINEER at the time—the costs alone amounted to nearly £3000, all of which was lost to the patentee by the failure of the defendants—the Messrs. Wallace—immediately after their defeat in the Court of Appeal. Mr. Adair had also taken out patents in France, Belgium, Canada, and the United States. The dates of all the foreign patents were subsequent to the English patent. The three former had expired or lapsed and that for the United States had been re-issued and was still in force. No profit had, it was alleged in examination, been made in respect of any of them. The petition was opposed by Mr. Wm. Mills, of Greenock.

Mr. Kay, Q.C., and Mr. Chadwyck Healey, were counsel for the petitioner; Mr. Aston, Q.C., and Mr. Lawson, for Mr. Mills; and the Attorney-General and Mr. A. L. Smith for the Crown.

The opposition was very severe, as well on the part of the Crown as of Mr. Mills. Objection was in the first place taken to the fact that the petition did not upon its face disclose the fact of the foreign patents, further that the patentee had been sufficiently remunerated, that he had been litigious and had threatened people, including the objector, with actions for infringement, and that his accounts were hypothetical, not to be relied upon, and in any case not presented in a form which the Court could approve. The petitioner had come to their lordships to make out a case for indulgence, and he had not done all he could to inform the Court as to the facts. The accounts showed that 1706 pairs of pumps had been sold, and that the balance of profits learned after making allowance for costs of litigation, and other payments, amounted to about £2000 only. It was explained that the petitioner had not been in the habit of keeping careful cost and other accounts, and that he had not kept accounts of his pump business separate from those of his general business. Moreover he had been unfortunate in losing books and vouchers, and had therefore been obliged to make his accounts from estimates of quantities of material used in making the given number of pumps—which number appeared from his pump register which was in existence and had been carefully kept—supported by such invoices and books as he had. Certain items, such as rent, salaries, and cartage had been apportioned between his pump and general business. Witnesses, the petitioner, his bookkeeper, and Messrs. J. T. King and W. Fraser, of Liverpool, were called in support of the fairness of the charges and of the merit of the invention, and on the other side witnesses, among them Mr. Hastie, of Greenock, and Mr. Alex. Fraser, of Liverpool, were called to discredit these accounts on all grounds. Objection was also strongly urged by the Crown to the application on the ground, not only that the foreign patents had not been stated in the petition, but that because they had been allowed to lapse, it would be contrary to public policy, if not to the provisions of the 25th section of the Patent Law Amendment Act, to prolong the patent and so put English manufactures to a disadvantage. *Newton's Case* (15 Moo. P. C.), *Winans' Case* (L R 4 P. C. 93), *Normand's Case* (L R 3 P. C. 193), were referred to as authorities in support of this proposition. To this it was answered, on behalf of the petitioner, that there was no absolute rule that foreign patents should be mentioned in the petition, though the practice was often convenient, that in fact if there were such a rule it would put applicants to the additional expense of procuring the assistance of counsel in settling their petitions, which had not been done in this case. Further, that there had been no surprise because the objections filed by the opposition themselves disclosed these patents. It was further answered that the existence and lapse of the foreign patents was no ground for a refusal. The case was not within the Act, because the patents had all been taken out after the date of the English patent, and *Betts's Case* (1 Moo. P.C. N.S.) and *Johnson's Case* (L R 4 P.C. 75) were cited as clear authorities upon this point in the petitioner's favour. Moreover, on the point of public policy all the instances alleged of a refusal on this ground were cases of foreign inventions patented here by foreigners, which also was not this case.

Their LORDSHIPS, after a lengthy deliberation, stated that they agreed with the judgment which had been delivered by the Court of Appeal to the effect that the invention was meritorious and useful, and that undoubtedly the petitioner came before them with a case which entitled him to their favourable consideration. Their lordships were not satisfied that he had been sufficiently remunerated, nevertheless, they were obliged to consider whether he had complied with the conditions which the Council had laid down as necessary to be observed by applicants for extension. In the first place it was a rule that foreign patents should be stated upon the petition in all cases, notwithstanding that the existence of these patents might not be a ground for refusal either as contrary to statute or public policy. Such information might be necessary to enable their lordships to consider whether the patentee had derived profit and to what extent from such foreign patents, and that was an important element for their consideration. It had been argued on behalf of the Crown and opponent that in this case the petitioner having taken out foreign patents and allowed them to lapse was fatal, but their lordships could not agree with this contention. There was no case of a refusal on these grounds where the patents were the patents of an English inventor taken out after the English patent. On that point *Betts' Case* and *Johnson's Case*, which had been cited for the petitioner, were conclusive authorities in his favour. Then as to the accounts, their lordships had carefully considered whether, consistently with their practice, they could adopt them. The practice as to statement of accounts was thus stated by Lord Chelmsford in *Betts' Case* (1 Moo. P.C. 61):—"There can be no difficulty in a patentee beginning from the first to keep a patent account distinct and separate from any other business in which he may happen to be engaged. He knows perfectly well that if his invention is of public utility, and he has not been adequately remunerated, he will have a claim for an extension of the original term of his patent. It is not, therefore, too much to expect that he should be prepared when the necessity arises to give the clearest evidence of everything which has been paid and received on account of the patent." Again, in *Saxby's Case* (7 Moo. P.C. (N.S.) 82) Lord Cairns stated the rule thus:—"It is the duty of every patentee who comes for the prolongation of his patent, to take upon himself the *onus* of satisfying this committee, in a manner which admits of no controversy, of what has been the amount of remuneration which, in every point of view, the invention has brought him, in order that their lordships may be able to come to a conclusion whether that remuneration may fairly be considered a sufficient reward for his invention or not. It is not for this committee to send back the accounts for further particulars, nor to dissect the accounts for the purpose of surmising what may be their real outcome if they were differently cast; it is for the applicant to bring his accounts before the committee in a shape that will leave no doubt as to what the remuneration has been that he has received." Their lordships repeated that they had considered with anxiety whether they could adopt the petitioner's accounts, and they had reluctantly come to the conclusion that they could not without infringing upon their practice and establishing a dangerous precedent. These accounts were based upon hypothetical weights, no properly verified statements of which had been put before the court. In fact there was a conflict of evidence as to these weights. The cost of advertising again—a large item—was not sufficiently explained, and their lordships were obliged to come to the conclusion that the accounts were not sufficient. Upon the above grounds then the petitioner failed to make out his case.

Mr. Aston applied for costs, but their lordships refused to give them.

Solicitors for the petitioner, Messrs. W. W. Wynne and Son; for Mr. Mills, Messrs. Field, Roscoe, and Co. For the Crown, The Treasury.

ACCORDING to a telegram from Cairo to a German paper, two pyramids of the sixth dynasty, the inner walls covered with several thousand inscriptions have been unearthed near Saggarah, to the north of the site of Memphis.

A GREAT CRUCIBLE STEEL CASTING.—During the past week Messrs. Jessop and Sons, Brightside Steelworks, Sheffield, cast the largest crucible steel casting that has yet been produced. It is a spur ring 28ft. in diameter, machine-moulded, and cast whole. To cast it 270 pots were used, each pot holding 80 lb. weight of molten steel. When the steel had been poured into the three large ladles, the plugs were removed, and it ran into the mould, the weight when cast being about 10 tons. In its finished state the weight will be about 8½ tons. It is, without doubt, by far the largest crucible cast steel casting of its kind that has ever been produced. Messrs. Jessop and Sons anticipate that this will be the beginning of an important trade with Lancashire millowners, as they discover how much more durable steel wheels are than the cast iron wheels at present in general use. The firm have previously cast wheels 13ft. and 14ft. in diameter, but to 28ft. was a greet leap. Now, however, they are prepared to undertake castings up to 34ft., having gone to very great expense in laying themselves out for this class of work. The operation of casting occupied eight and a-half minutes.

WEIGHT, SPECIFIC GRAVITY, RATES OF ABSORPTION, AND CAPABILITIES OF STANDING HEAT OF VARIOUS BUILDING STONES.

By HIRAM A. CUTTING, PH. D., State Geologist, Vermont.

HAVING during the past year instituted, and carried out, a series of experiments to ascertain, as nearly as possible, the capabilities of the various materials used in the construction of so-called fire-proof buildings to stand heat, I submit, in tabulated form, the result of such experiments, hoping they may be of use to the architects, quarrymen and insurance companies of our country, and also of some interest to those interested in science.

In connection with the capabilities of the various building stones to stand fire and water, I have taken their specific gravity, and weight per cubic foot, so that the identity of the various stones could at any time be compared, and if in the working of a quarry there was a change in gravity, or weight, that it could be easily detected, and thus all who chose could know whether the tests given would apply or not.

I have procured sample specimens of the most important building stones in the United States, and Canada, and, after dressing them into as regularly as possible, three by four inches, and two inches in thickness, I have taken their ratio of absorption, which ratio I have expressed in units of weight, according to the amount of water taken up. If 450 units of stone absorbed one unit of water, I have expressed it thus: 1 + 450, meaning that the stone weighed 450 units when immersed, and 451 when taken from the water.

To accelerate the process of absorption I have placed the specimens in water under the exausted receiver of an air pump. I find that in this way as much water is absorbed in a few minutes as in days of soaking. When specimens were removed from the water, I have, before weighing, dried their outsides with blotting paper. In relation to the specific gravity, I have not followed "Gilmore's rule" in full. He weighed the specimens in air, immersed them in water, and allowed them to remain until bubbling had ceased and then weighed them in water, after which he took them from the water, dried them outside with bibulous paper, and weighed them again in air. From this last weight he subtracted the weight in water, dividing the dry weight by the difference.

This gave a specific gravity subject to two sources of error. I have followed the more frequent custom of weighing the dry stone, using pieces of two or three pounds in weight, and then immersing them in water. After the usual saturation I have taken their weight in water, subtracting it from the dry weight in air, and then dividing the dry weight by the difference. This gives the specific gravity of the rock itself, as usually found, which is what we desire, and I believe as it would generally be in buildings constructed of the given material. The specimens were previously dried by long exposure to a temperature not exceeding 200 deg. Fah. To verify this I have taken specimens from the quarries direct, and after weighing, have brushed them over with paraffine dissolved in naphtha, weighing them again so as to ascertain the exact amount of paraffine, which made no visible change in the stone, other than to keep out water. I have then weighed in the usual way, and thus obtained the exact specific gravity of the stone as in the quarry, and I find my method used, as stated, to give the best results, and so have adopted it.

After this I have placed them in a charcoal furnace, the heat of which was shown by a standard pyrometer. In many instances I have placed them side by side with dry specimens, but I have been unable to note any marked difference in the action of heat, beyond this, that the dry specimens became sooner heated. I have, however, no doubt that the capacity of a stone to absorb water is against its durability, even in warm climates, and vastly more so in the changeable and wintry climate of New England. It is here often frozen before any considerable part of the moisture from autumn rains can be evaporated.

When the specimens were heated to 600 deg. Fah., I have immersed them in water, also immersing others, or the same, if uninjured, at 800 deg. and 900 deg., that is if they are not spoiled at less temperatures. I find that all of these samples of building stones have stood heat without damage up to 500 deg. At 600 deg. a few are injured; but the injury in many cases commences at or near that point. When cooled without immersion they appear to the eye to be injured less, but are ready to crumble, and I think they are many times nearly as much impaired, and always somewhat injured, when water produces any injury.

I would remark that my experiments with granites show that there is quite a range in their capabilities of standing heat, a range in fact much greater than I anticipated. With the sandstones the difference is also marked, as is their power of absorption. When exposed to the heat wet, they show a marked difference in the time required to heat them, the saturated ones seeming to resist the heat for a time; but when equally hot they crumble the same as those not previously saturated. Their relative worth can be seen by the table. The conglomerates stand heat badly; while the limestones and marble stand best of all (up to the point where they, by continued heat, are changed to quick lime) except soapstone, and a species of artificial stone made under the McMurtire and Chamberlain patent. The indications are, from this and other samples of artificial stone, that it may be possible to make an artificial stone cheaper and better for fire-proof buildings than our native quarries furnish; and we hope this possibility may receive attention. But comments are useless, as the facts set forth in the tables speak for themselves.

I give you results in tabulated form below.

No.	Kind.	Locality.	Specific Gravity.	Weight of one cubic foot.	Ratio of Absorption.	First appearance of injury.	Crumbles or cracks slightly.	Cracks badly or becomes friable.	Injured so as to be worthless for a building.	Melted or ruined.
	Granites.									
				lb.		Deg. Fah.	Deg. Fah.	Deg. Fah.	Deg. Fah.	Deg. Fah.
1	Light coloured	Hallowell, Me.	2·638	164·8	1 + 790	800	900	950	1000	1100
2	,, ,, ...	Fox Island, Me.	2·642	165·1	1 + 680	700	800	850	900	1000
3	Denning's Quarry	Mt. Desert, Me.	2·631	164·1	1 + 716	800	850	950	1000	1100
4	Light coloured	Rockford, Me.	2·600	162·5	1 + 482	600	800	850	900	950
5	Red	Red Beach, Calais, Me.	2·636	164·7	1 + 560	800	850	900	950	1000
6	Light coloured	Oak Hill, Me.	2·526	157·8	1 + 310	800	850	900	950	1000
7	Red	Stark, N. H.	2·631	164·1	1 + 534	600	700	800	850	950
8	Coloured medium	Concord, N. H.	2·636	164·7	1 + 778	800	900	950	1000	1200
9	Sanborn's Quarry	Plymouth, N. H.	2·649	165·5	1 + 685	800	900	950	1000	1200
10	Carter's Quarry..	Ryegate, Vt.	2·647	165·4	1 + 790	800	900	950	1000	1200
11	,, ,, ...	Woodbury, Vt.	2·654	165·8	1 + 784	800	900	950	1000	1200
12	Wetmore and Morse's Quarry	Barre, Vt.	2·651	165·6	1 + 720	800	900	950	1000	1200
13	Syenite	Quincy, Mass.	2·660	166·2	1 + 650	750	800	850	900	1000
14	Gray	Croton, Conn..	2·800	175·0	1 + 818	700	750	800	900	900
15	Common	Woodstock, Md.	2·648	165·5	1 + 394	700	750	800	900	900
16	,, ...	Port Deposit, Md. ..	2·700	168·7	1 + 816	800	900	950	1000	1100
17	Scranton County Quarry ..	Richmond, Va.	2·727	170·5	1 + 398	750	800	850	900	1000
18	Old Dominion Quarry	,, ,, ...	2·674	167·7	1 + 402	750	800	850	900	1000
19	Light coloured	St. Cloud, Minn.	2·690	168·2	1 + 280	700	700	800	850	900
20	,, ,, ...	Stanstead, P. Q.	2·833	177·0	1 + 420	800	900	1000	1000	1200
21	Coarse	North Halifax, N. S. ..	2·698	168·6	1 + 584	700	800	800	900	900
22	,, ...	Gauauogue, P. O., Can.	2·687	167·9	1 + 736	800	850	900	950	1000
	Sandstone.									
1	Freestone	Portland, Conn.	2·380	148·7	1 + 27	850	900	950	1000	1100
2	,, ...	North of England.. ..	2·168	135·5	1 + 27	850	900	950	950	1000
3	Seneca Stone	Montgomery Co., Md...	2·500	156·2	1 + 26	850	900	900	950	950
4	Sandstone	Salem, Md.	2·452	153·2	1 + 24	850	900	950	1000	1100
5	,, ...	Seneca, Md.	2·410	150·6	1 + 40	900	1000	1100	1200	1200
6	Montrose Stone..	Ulster Co., N. Y.	2·661	166·3	1 + 314	900	1000	1100	1200	1200
7	Freestone	Belleville, N. J.	2·350	146·8	1 + 27	900	950	1000	1100	1100
8	,, ...	Nova Scotia	2·424	151·5	1 + 240	900	950	1000	1100	1100
9	S. Carboniferous	Br. Phillipe, N. S... ..	2·353	147·0	1 + 19	900	950	950	1000	1000
10	Freestone	Dorchester, N. B... ..	2·363	147·7	1 + 26	800	850	900	1000	1000
11	Cincinnati Stone	Cincinnati, O.	2·188	136·1	1 + 23	900	950	1000	1100	1100
12	Potsdam Sandstone..	McBride's Corners, O...	2·333	145·8	1 + 28	800	850	900	1000	1100
13	Berlin Stone	Cleveland, O...	2·210	138·1	1 + 22	850	900	1000	1100	1100
14	Potsdam	McBride's Corners, O...	2·500	156·2	1 + 22	850	900	950	1000	1000
15	Euclid Stone	Near Cleveland, O. ..	2·290	143·1	1 + 35	850	900	950	1000	1000
16	Berea Stone	Berea, O...	2·254	140·8	1 + 20	850	900	950	1000	1000
17	Amherst Stone	Amherst, O.	2·200	137·5	1 + 18	850	900	changes colour.		1000
18	Brown Stone	Humbletown, Penn. ..	2·346	146·6	1 + 28	850	900	950	1000	1000
19	Potsdam Sandstone..	Beauharnois, P. Q. ..	2·512	157·0	1 + 38	850	900	950	1000	1000
20	Sandstone	Murray Bay, P. Q. ..	2·577	161·0	1 + 36	900	950	1000	1100	1100
21	,, ...	Cheat River, W. Va. ..	2·632	164·5	1 + 80	800	850	900	1000	1100
22	Freestone	Acqua Creek, Va.. ..	2·183	136·4	1 + 16	900	950	1000	1100	1200
23	Brown Stone	Manasses, Va.	2·348	146·7	1 + 17	850	900	1000	1100	1200
	Limestone.									
1	Limestone	Baltimore, Md.	2·917	181·8	1 + 340	900	1000	1100	1200	1200
2	,, ...	Bedford, Ind.	2·478	154·8	1 + 280	850	900	1000	1200	1200
3	Cincinnati Limestone	Hamilton County, O. ..	2·204	137·7	1 + 28	850	900	950	1200	1200
4	Potts Blue	Springfield, Penn. ..	2·666	166·6	1 + 280	850	850	900	1000	1200
5	Dolomite Limestone	Owen Sound, P. O. ..	2·571	160·6	1 + 480	850	900	1100	1200	1200
6	Trenton Limestone	Montreal, P. Q.	2·706	169·1	1 + 316	900	950	1000	1200	1200
7	Limestone	Isle La Motte, Vt... ..	2·696	168·5	1 + 320	950	1000	1100	1200	1200
	Conglomerates.									
1	Conglomerate	Roxbury, Mass	2·708	169·2	1 + 49	700	800	900	1000	1000
2	Potomac Stone	Point of Rocks, Md. ..	2·724	170·2	1 + 60	600	700	800	900	900
3	Conglomerate	Cape a La Aisle, P. Q.	2·645	165·3	1 + 80	600	700	800	900	900
	Marbles.									
1	Tuckahoe	Westchester Co., N. Y.	2·794	194·6	1 + 298	900	1000	1200	1200	1200
2	Ashley Falls	Ashley Falls, N. Y. ..	2·742	171·3	1 + 280	900	1000	1100	1200	1200
3	Snow Flake	Westchester Co., N. Y.	2·848	178·0	1 + 380	950	950	1000	1200	1200
4	Tennessee	Dougherty's Q'y, E. Tnn.	2·711	169·4	1 + 320	950	950	1000	1200	1200
5	Duke Marble	Near Harper's Ferry, Va.	2·812	175·7	1 + 340	1000	1000	1100	1200	1200
6	Black Marble	Isle La Motte, Vt. ..	2·682	176·6	1 + 320	1000	1000	1100	1200	1200
7	Sutherland Falls	Rutland, Vt..	2·666	166·6	1 + 342	1000	1000	1100	1200	1200
	Slates.									
1	Sabin's Quarry	Montpelier, Vt.	28·69	179·3	1 + 110	800	850	900	1000	1200
	Soapstones.									
1	Soapstone	Weathersfield, Vt. ..	2·668	166·7	1 + 3·8	1200	—	—	—	—
	Artificial Stone.									
1	Artificial Stone..	McMurtire & Chamberlain's patent ..	2·235	139·7	1 + 280	750	800	1100	1200	—

ON THE ACTION OF OILS ON METALS.*

By WILLIAM HENRY WATSON, F.C.S., &c.

AT the Plymouth meeting of this Association I brought forward the results of some experiments, showing the actions of various oils on copper, and the conclusions arrived at were briefly these :—

(1) That of the whole of the oils used, viz., linseed, olive, colza, almond, seal, sperm, castor, neatsfoot, sesame and paraffine, the samples of paraffine and castor oils had the least action, and that sperm and seal oils were next in order of inaction.

(2) That the appearance of the paraffine and the copper were not changed after 77 days' exposure.

(3) That different oils produce compounds with copper varying in colour, or in depth of colour, and consequently rendering comparative determinations of their action on that metal from mere observations of their appearances impossible.

I was disposed to conclude that these experiments would indicate the relative action of the oils on other metals, simply expecting that the extent of action would vary throughout, but that the variations would be proportionate between the different oils. Since the publication of these results, however, an interesting paper has appeared—*Pharm. Journ.*—"On the Action of Paraffine Oils on Metals," by Dr. S. Macadam. He comes to the same conclusion as myself with regard to their action on copper, but referring to iron, says, "it is slightly affected by paraffine oil, and on ten days' contact the oil becomes deeper in colour, and throws down a fine ferruginous sediment." Owing to this, I have lately made experiments on the action of the same oils as those previously used on copper, on iron, and the results which are the subject of this communication, are interesting to me as showing that there is no relation between the action of an oil on copper and the action of that oil on iron; that, in fact, in several instances those oils which act largely on iron, act slightly on copper, while those which act largely on copper act little on iron. Of course, the actual extent of action of the same oil, with the exception of paraffine, is greater on copper than on iron. In addition to the oils used in my experiments on copper, I also used a sample of refined lard oil, and a special lubricating oil prepared by the Dee Oil Company, near Chester. The following observations were made, after twenty-four days' exposure :—

(1) *Neatsfoot.*—Considerable brown irregular deposit on metal. The oil slightly more brown than when first exposed.

(2) *Colza.*—A slight brown substance suspended in the oil, which is now of a reddish-brown colour. A few irregular markings on the metal.

(3) *Sperm.*—A slight brown deposit, with irregular markings on the metal. Oil of a dark brown colour.

(4) *Lard.*—Reddish brown, with slight brown deposits on metal.

(5) *Olive.*—Clear and bleached by exposure to the light and air. The appearance of metal same as when first immersed.

(6) *Seal.*—A few irregular markings on metal. The oil free from deposit, but of a bright clear red colour.

(7) *Linseed.*—Bright deep yellow. No deposit or marks on metal.

(8) *Almond.*—Metal bright. Oil bleached and free from deposit.

(9) *Castor.*—Oil considerably more coloured—brown—than when first exposed. Metal bright.

(10) *Paraffine.*—Oil bright yellow and contains a little brown deposit. The upper surface of the metal on being removed is found to have a resinous deposit on it.

(11) *Special Lubricating.*—Metal bright. Appearance of oil not perceptibly changed.

The samples were then chemically examined, and the amounts of iron found in them were as follows :—

	Grain.
Neatsfoot oil (English)	0·0875
Colza	0·0800
Sperm	0·0460
Lard	0·0250
Olive	0·0062
Linseed	0·0050
Seal	0·0050
Castor	0·0048
Paraffine	0·0045
Almond	0·0040
Special lubricating oil	0·0018

For comparison, the following are the results obtained of the action of these oils on copper, as previously communicated, after exposure of ten days :—

	Copper Found. Grain.
Neatsfoot oil	0·1100
Colza	0.0170
Sperm	0·0030
Olive	0·2200
Linseed	0·3000
Seal	0·0485
Paraffine	0·0015
Almond	0·1030

Owing to the length of exposure being different in the two series, we cannot fix on the actual differences in the rate of action of any of the oils on the two metals. However, it is shown that almond oil, which acted largely on copper, acts very slightly on iron; in fact, with the exception of the paraffine and special lubricating oil —a mineral preparation—it acted less than any of the other oils on iron. The same is shown, as already mentioned, as to the action of various other oils; thus, while sperm oil acts slightly on copper, it acts considerably, compared with the others, on iron. Linseed, seal, castor, almond, and paraffine may be bracketed as having about the same, and very little action on iron, while linseed, olive, neatsfoot, almond, and seal have the greatest action on copper.

* Read before the Chemical Section of the British Association, Swansea meeting, 1880.

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, smelters complained that what had been an excellent supply of gas coke had been nearly cut off, and that they were driven to buy at higher prices the oven coal of the different districts. Owing to the larger demand they were only old customers whose orders for Lancashire, Derbyshire, and South Wales coke would be accepted by the agents at from 15s. to 15s. 6d. per ton, and then not in the lots which the buyers demand. For Durham coke the quotation was 18s. to 20s. Transactions in pig were scarcely more than nil upon either exchange, because of the inability of smelters to deliver; and there was insufficient reason to justify purchases upon speculative account. Quotations were mostly nominal, but they displayed little or no weakness upon those of my last report.

This week the prospects of a larger trade in the several descriptions of finished iron needed in bridge building are brighter, orders having been received by local engineers which will need for their fulfilment about 2000 tons of wrought iron of the class with which the Cleveland district is a severe competitor with South Staffordshire. And the quotations of the local firms would have been stronger to-day, but for a little weakness in this week's prices of angles and plates.

Most business was done in sheets of nearly all the gauges and qualities. Common sheets for export to India, the West Indian Colonies and portions of South America; medium sheets for corrugating; and best sheets for stamping and for tin-plate making were chiefly in demand. The trade with India is chiefly in ungalvanised sheets, and there are similar sheets in hand for delivery overland in Russia.

The galvanised sheet branch and some hardware departments are doing more this week because of the recent gales. One lot of 300 tons of sheets which went down at sea is being replaced; so, too, are certain cast and other goods which were sunk in Thames barges. Firmness characterised the quotations of the makers of galvanised roofing sheets to-day. Makers who had quoted up to about the middle of the month now withdrew the quotations, requiring more money. Some firms of this class who are customers of Messrs. E. P. and W. Baldwin are receiving supplies drawn some six or seven miles in powerful railway carriers' teams, while Messrs. Baldwin themselves only obtain supplies of fuel by carting it a mile.

The tone of the local tin-plate trade has improved upon the week, somewhat valuable orders having been booked since my last. Prices vary with the character of the specification.

Business is being done at the collieries on Cannock Chase to the extreme of the railway capabilities. The companies are doing their best, even to the extent of sending occasionally thirty-six special engines in one day to the London and North-Western station at Walsall, to bring away Cannock Chase coal. Some of this fuel is to meet the requirements of manufacturers whose supplies have been cut off by the strikes in certain portions of the Lancashire field. Forge coal on the Rugeley side of the district is 6s. to 6s. 6d., and on the Tipton side 7s. Furnace coal is from 8s. 6d. to 9s.—all to old customers. Household coal is offered at 12s. 6d. for best deep, 11s. for best deep kibbles, 12s. for shallow, and 11s. for shallow lumps, all delivered on trucks at local railway stations. These are the prices charged to old customers. New purchasers are glad to get the coal at considerably more money. These prices are mostly 2s. under those of a twelvemonth ago.

On Monday an important conference of ironworkers will be held at Wednesbury to consider the scheme of insurance which has been drawn up by the Ironmasters' Association, to take the place of the Employers' Liability Act in South Staffordshire, of which last week I sketched the leading features.

The founders in the employ of Messrs. T. and C. Clarke and Co., of the Shakespeare Foundry, Wolverhampton, who, I last week stated were upon strike against a proposal of the masters to make certain reductions in their wages for spoilt work, have now gone in, the principle for which the masters contended having been conceded.

At the half-yearly meeting of the Wolverhampton Railway Rolling Stock Company, on Tuesday, the balance-sheet showed a profit of £3811, as compared with £3678 in the previous half-year; and it was decided to pay a dividend at the rate of 3 per cent. per annum on the ordinary shares. It was stated that 185 wagons had been bought, and 232 sold during the half-year, leaving 4597 still in the possession of the company.

An important case to ironmasters and others was heard at Stafford Assizes on Tuesday last. The London and North-Western Railway Company, as representing the Shropshire Union Company, sought to recover £126 from Mr. Benjamin Wood, of Tipton. Defendant had been in the habit of consigning railway material from Tipton to London and other places, and in March, 1879, it was discovered by the company that he had been paying 15s. per ton for the carriage instead of 20s., the rate charged to other persons. Notice was served upon Mr. Wood that he would have to pay the higher rate, but he refused. The jury returned a verdict for the defendant.

There is a fair amount of business doing at those finished ironworks in North Staffordshire where fuel supplies are not stopped: but at many works great inconvenience is experienced by reason of the canals in the district being frozen up, and local makers have by no means a rolling stock sufficiently large to cope with the sudden demand. Pig iron is in improved request, and prices are firm. The coal trade is being benefitted by reason of the strike in the Lancashire coal-field.

NOTES FROM LANCASHIRE.

(From our own Correspondent.)

Manchester.—It is difficult to say what is just at present the actual condition of business in this district. For a fortnight manufacturing operations have been suffering more or less from the disorganisation of the coal supply caused by the colliers' strike, and before the market has been able to return to its normal condition a further complication has been added by the exceptional severity of the weather, which has stopped completely outdoor constructive and other work, and in some cases interfered with operations at the local ironworks.

So far as the iron trade is concerned business has been dull during the past week, and there was a very quiet market at Manchester on Tuesday. Although there is no actual giving way on the part of makers, who still entertain a confident feeling with regard to the future, and are not at all anxious sellers for long forward delivery, the tone of the market is, if anything, easier, with less disposition on the part of buyers to place out further orders at present. Lancashire makers of pig iron are kept going on old orders, but the new sales reported are only very limited in extent. Where business, however, is done, it is at late rates, and for delivery into the Manchester district local makers remain firm at 46s. 6d. for No. 4 forge, and 47s. 6d. for No. 3 foundry, less 2½. For Lincolnshire and Derbyshire brands delivered into this district about 1s. per ton above these figures are asked, but not much is being done, and makers being tolerably well sold are not at all pressing for orders.

In the finished iron trade moderate inquiries are reported in some quarters, and the increased cost of coal is causing manufacturers to talk about a corresponding advance in prices. The amount of actual business doing is, however, still too limited to enable any material upward movement in value to be carried out, and prices at present are practically unchanged, the average quotation for bars delivered into the Manchester district remaining at about £6 per ton.

The coal trade is returning somewhat to its ordinary condition, so far as the Manchester district is concerned. The principal local collieries are resuming their average output of coal, and the plentiful supplies which have also been sent in from outside districts are more than sufficient to meet the requirements of consumers. The disorganisation of transit arrangement by the ice block on the canals and the increased difficulty of cartage from the collieries in consequence of the weather has, however, interposed a serious difficulty in the way of deliveries, and as consumers have recently been working on from hand-to-mouth, any delay in obtaining supplies is at once felt. The greatest difficulty has been experienced in obtaining engine fuel, and to keep some of the mills going round coal has had to be obtained by cart from neighbouring collieries. The principal Manchester firms have made no further alteration in prices beyond the advance of 10d. put on a fortnight back, and although there is still a good deal of irregularity in the open market, the temporary high prices which were being charged by dealers and merchants are not now so readily obtained. In the West Lancashire districts the pits are still stopped, and local stocks are now generally exhausted. The shipping trade is suffering a good deal, and numbers of vessels have been lying at the docks in Liverpool unable to get their cargoes of coal.

With regard to the strike, the position of affairs remains much the same. The principal Manchester firms have kept their men at work, notwithstanding the threats of renewed disturbances which have emanated from the men on strike. Special precautions, however, have been necessary, strong bodies of armed police having been stationed in the neighbourhood of the pits, whilst the military have also been held in readiness to render assistance should it have been found necessary to protect the men at work from intimidation. In some of the smaller districts bordering on West Lancashire there have been serious riots, which at one colliery has been attended with loss of life. As I have already intimated, all the pits in the West Lancashire district are still stopped, and the amount of bitterness which has been introduced into the struggle stand n the way of any conciliatory proposals for a settlement of the dispute being put forward by either the masters or the men. The coalowners maintain most strongly that they are not in a position to advance wages, but if an amicable resumption of work could be agreed upon, there is little doubt they would be ready to make some offer to their men. It was reported in Manchester to-day that serious riots had taken place at Atherton collieries where men were resuming work. The pits were attacked by a large mob, much damage being done to surface plant, and a troop of cavalry had to be called out to disperse the rioters. The break up of the frost is facilitating the movement of stocks held in the district, and the men at Manchester collieries all continue working.

No definite action has yet been taken by the Lancashire colliery proprietors with the view of protecting themselves with regard to the provisions of the Employers' Liability Act; but this, of course, is a matter which is occupying general attention now that the miners have thrown over the mutual insurance arrangement. Incidentally the question was referred to at a meeting of the South Lancashire and Cheshire Coalowners' Association, held in Manchester on Tuesday, but the general feeling was that it was desirable to postpone any definite action until there is a more settled feeling in the trade.

Barrow-in-Furness.—The chief feature this week in connection with the iron trade of this district is the fact that the supply of coal is still limited from the Lancashire coal district, owing to the continuance of the strike. Supplies in the meantime have been obtained from elsewhere, but some inconvenience has been caused, and increased value has been the result all round, for both domestic and steam qualities of fuel have increased in price, owing to the limitation of supply. It is expected in a few days this difficulty will be got over satisfactorily, and that makers of iron and steel will not have the disadvantage of fighting against the effects of a small delivery of coal, when on the other hand they have plenty of work to do in connection with the production of iron and steel. There is a very steady demand for both iron and steel, and it is evident large deliveries will have to be made during the year to both home and foreign consumers. The output of the furnaces is very large, and all is going into consumption direct from the pig bed. Large engineering and shipbuilding orders have been booked. The Barrow Shipbuilding Company have secured a contract for the building of two Ducal Line Steamships for the Calcutta trade, 400ft. long each, and Messrs. Caird and Purdie, who commenced shipbuilding at Barrow a few months ago, have secured seven orders for steamers of from 1000 to 1500 tons burthen. The engines for these steamships are to be made at Barrow. In many respects there are reasons to believe that the year will be the most active season ever experienced as regards the various industries of this district. Mr. S. J. Claye, of Barrow, has secured the contract to build 1000 wagons for the Caledonian Railway Company.

THE SHEFFIELD DISTRICT.

(From our own Correspondent.)

THE agitation for a 10 per cent. advance in miners' wages in South Yorkshire and North Derbyshire does not show signs of bearing fruit. A meeting was held at Rotherham on Tuesday, when the council of the district passed a resolution requesting the colliers to at once give notice for an advance to the amount named. The Denaby dispute, which seems a "standing dish" in these parts, was under consideration. It was agreed that the Denaby men should ask to be allowed to resume work upon the terms on which they were formerly employed, and failing the adoption of this arrangement, that an offer be made to the masters to refer the points in dispute to arbitration, it being understood that if both proposals were declined the men would refuse to resume work.

At Chapeltown on Tuesday evening there was a lively meeting, the two leading union officials flatly contradicting each other, and a third attempted to talk while another was on his legs, the result being a considerable disturbance. One official interrupted another, loftily declaring that the Barnsley Association, which consisted of fifty lodges, would not condescend to ask advice from the officials of an association with one or two lodges. And the lesser official aimed at got sarcastic, the upshot being that a miner expressed the opinion that they had better "give all three the sack and manage their own affairs." And then the meeting appropriately broke up in confusion. There is not much hope of the 10 per cent. there.

Some firms are beginning to hear somewhat unpleasant news from Melbourne. I mentioned to you at the time that the silver and plated exhibit of Messrs. Walker and Hall had been wrecked in the Sorato, but that there was a prospect of the goods being recovered. It appears that the larger portion of them were utterly unfit, after they were fished up, to be placed in the exhibition. The firm have consequently been represented by a very small display, as compared with what they sent out, though the goods they have in the exhibition are spoken of in very high terms in all the accounts which have been written. Messrs. Wm. Jessop and Sons have also been unfortunate; with the exception of their circular saw plates, several blocks of steel, and similar goods, their "exhibit" is not exhibited, the greater part of their productions having gone down in the Sorato.

A very large tonnage of coal is still being sent into Lancashire, and all the collieries of the district are fully employed. House coal maintains its advance of 10d. to 1s. per ton, and slack is briskly called for at 6s., which is an advance of 2s. on previous quotations. If the present extraordinary weather continues, coal will soon be subjected to another rise. The coalowner is having his "innings" during this cold "snap."

Skate-makers continue very busy, both on home and foreign account. Cutlery and general hardware is in great request, the demand for the States being as great as ever. Steel is also in demand, and the firms who have a name for true crucible steel should do well this year if the trade is maintained.

THE NORTH OF ENGLAND.

(From our own Correspondent.)

THE severe and long-continued frost is altogether disorganising the Cleveland iron trade. Pig iron, under the circumstances, is becoming a drug. Neither manufacturers nor shippers can take it in their usual quantities, and therefore the only resource is to stock it. Consequently, we may expect to hear of an enormous increase of stocks by the end of the present month. Some guess the augmentation at 50,000 tons; others at considerably more. In little more than a week the exact returns will be published, and then it will be known for certain. The effect of the position and prospect upon the iron market held on Tuesday was very marked. Little business was done, and it is long since so flat a tone was apparent.

One of the great troubles of the week has been the short supply of water. This has resulted in the partial stoppage of several works, as water is an essential element in ironmaking. The whole district is now supplied by the Stockton and Middlesbrough Corporations' Water Board, who draw their supply from the river Tees, at a point about two miles above Darlington. During a severe frost the public have an uncontrollable habit of leaving all taps and water-closets running day and night, under the impression that in this way liability to freeze up will be avoided. The usual quantity consumed by the district supplied by the Board is fifty million gallons per week. Last week over seventy million gallons were supplied, and yet every one was short. In fact, it has been found quite impossible to keep up an adequate supply when such absurd waste is going on. On Monday a meeting of the Board was held to consider the situation. Unless something was done several of the works would have to be stopped, besides danger of explosions and so forth. It was eventually decided to cut off the water supply for household purposes every night from eight p.m. to six a.m. during the continuance of the frost. This was done on Monday night for the first time. During the afternoon the scarcity increased, no doubt owing to householders filling tubs, &c., in anticipation of approaching deprivation. After eight o'clock, however, relief was at once felt at all the works, and by nine o'clock there was abundance.

Mr. Waterhouse, the accountant to the Board of Arbitration, has just issued his returns for the last quarter of 1880. The average price realised for all descriptions of iron was somewhat lower than was obtained in the preceding quarter, and a reduction of wages, of 3d. per ton on puddling, and 2½ per cent. on all other wages, was declared. This reduction comes into force on Monday, the 31st inst. It is thought possible by some that the ironworkers may resist the award, as they every now and then have done when it operated against them. This, however, is scarcely likely to occur to any great extent, not for want of disposition to do so, but because they are not much in funds just now. The effects of much loss of time and heavy expenditure during the Christmas holidays has not been recovered yet. Besides, the severe weather is making work scarce, and family necessities in food, clothing, and fuel are increased. Therefore the award will probably be quietly acquiesced in.

The liquidators of the West Hartlepool Rolling Mill Company have just issued their report for the year 1880. When the price of iron rose so suddenly towards the end of 1879 they succeeded in leasing a portion of their works to a firm who set them going. The collapse which occurred last summer brought this attempt at resurrection to a sudden end, and they found themselves again in full possession of their "white elephant." They now intend to offer the same by auction at an early date, fixing the reserve price at such a figure that some one will surely buy. On the other hand, schemes are afloat for new works for making steel for shipbuilding purposes by the basic process, so that the future will probably see some fierce competition between the old and the new material. Whilst the superiority of steel over iron for rails seems fully demonstrated, on account of its greater wearing properties, no practical superiority has been yet shown in the case of ship plates and angles, because their wearing properties are not in question. If steel is to supersede iron in this case, it must be because it can be offered as cheap or cheaper. There seems to be little prospect of this, even by the basic process, for some time to come. Attempts to roll flat ingots into plates without the costly intermediate process of hammering has been repeatedly attempted, but has always failed. All steel plates now manufactured are hammered, and there is no present prospect of their being made otherwise. So long as that is the case, the cost is likely to remain considerably above that of iron ship plates, and even these can be much cheapened when necessary. Rather than be superseded, manufacturers will certainly force down their highly-paid rollers, shearers, re-heaters, and others, to such wages as are given for similar skill in other trades; and this alone will make a great difference in the cost of production. It will therefore be highly interesting to watch the progress of the iron and steel industries during the next few years. The present time is in many respects a time of transition. Our knowledge and experience in these matters is very imperfect. The tendency towards sanguine views is a very dangerous one. The greatest caution is really necessary, especially for the investing public, inasmuch as even experienced technical and commercial authorities can scarcely see their way clear. Those who are cautious will, as usual, not go far wrong. For those who greedily rush into any new and promising enterprise just now, there may probably be not a little repentance in store at a future time.

The third meeting of the session was held on Monday evening by the Cleveland Institution of Engineers; Mr. E. W. Richards, the president, occupied the chair, and there was an attendance of from two to three hundred persons. Mr. J. N. Shoolbred, of London, read an interesting paper "On Electricity as a Source of Light and Power." The paper was profusely illustrated by diagrams, showing the various systems in use. The Middlesbrough Corporation kindly lent a steam-engine, which was stationed in a street skirting one side of the building, and which, by means of a strap, passing through an aperture in a window, drove two dynamo-electric machines lent by Messrs. Bolckow, Vaughan, and Co. The current so generated was used in various ways to elucidate the paper. A large Siemens lamp of some 1200 candle power was lighted first; next a similar lamp of Crompton's type, and finally one of Swan's incandescent lamps. Arrangements had been made for twenty of these to be placed in circuit round the hall. Unfortunately, however, most of them were broken in transit, and, therefore, Mr. Swan's system could not properly be shown. An "Arab" printing press and a small circular saw were put into operation by electricity. Commemorative cards were printed off by the former and wood was sawn up by the latter, until each member had satisfied himself how completely power may be conveyed to great distances by means of two small wires. A discussion followed, in which several members took part. Mr. Harrison explained the system of lighting adopted at the Eston Steelworks, which require twelve Siemens lights costing 6d. per light per hour to maintain.

NOTES FROM SCOTLAND.

(From our own Correspondent.)

BUSINESS in the iron and allied trades has materially suffered from the very severe weather which has now prevailed for three weeks. The frost and snow have interfered with operations of different kinds, and the means of transit and communication of goods have not been nearly so satisfactory as usual. As regards the iron trade, it has been very dull, although there were not wanting indications this week that more activity may before long be experienced in the market. Shipments of pig iron were 2069 tons smaller than in the preceding week, but still considerably better than in the corresponding week of last year. There was a slight improvement in the bulk of the imports from Cleveland, which have been minimised during several weeks by the freezing of the Forth and Clyde Canal. Reports are current of some fresh business being done with the United States, but prices there are too low to admit of profitable sales being made on this side to any extent. There is but a moderate demand from continental nations, but the consumption at home is good. Stocks continue to increase at the rate of from 4000 to 5000 tons per week in the hands of Messrs. Connal and Co., and there must also be considerable additions at some of the ironworks on account of the large production. There are 122 furnaces in blast—nine of which are producing hematite iron—as against 108 at the same date last year.

Business was done in the warrant market on Friday forenoon at from 52s. 9d. to 52s. 7½d. cash and 52s. 11d. to 52s. 10½d. one month, the afternoon quotations being 52s. 8d. to 52s. 4½d. cash and 52s. 9d. to 52s. 7d. one month. The market was quiet on Monday morning, with transactions at from 52s. 4d. to 52s. 6d. cash, and from 52s. 6d. to 52s. 7d. one month; whilst in the afternoon business was done from 52s. 5d. to 52s. 4d. cash, and 52s. 9d. to 52s. 6d. one month. On Tuesday the tone of the market was somewhat steadier at 52s. 3d. and 52s. 4½d. cash, and 52s. 5d. to 52s. 6d. one month. The market was steadier on Wednesday, and business was done up to 52s. 7½d. cash and 52s. 9d. one month. To-day—Thursday—the market was strong, with business at 52s. 10d. prompt cash.

The tendency in makers' prices has been slightly downwards, there being a reduction in a number of brands of from 6d. to 1s. per ton as compared with those of the preceding week. The quotations are now as follows:—G.M.B. f.o.b. at Glasgow, per ton, No. 1, 53s.; No. 3, 51s.; Gartsherrie, No. 1, 61s. 6d., No. 3, 54s.; Coltness, No. 1, 63s., No. 3, 54s.; Langloan, 63s. and 53s. 6d.; Summerlee, do. do.; Calder, 62s. 6d. and 54s. 6d.; Carnbroe, 59s. and 54s.; Clyde, 53s. and 51s.; Monkland; do. do.; Quarter, do. do.; Govan at Broomielaw, 53s. and 51s., 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 coal trade as well as the iron trade has been much inconvenienced by the severe weather. But there really seems a prospect of an opportunity at last for our coalmasters to obtain a little more money for their product. Prices are being raised at some of the English ports, and the miners are now getting so clamorous for an advance of wages, that they cannot much longer be refused. But in one or two cases the miners are reported to have obtained an advance of wages this week without any dispute, and it is not unlikely that the example may be followed by other masters.

Returns have been obtained respecting the Clyde and East Indian Shipping trade which show that the imports in 1880 were 89,656 tons as against 67,435 tons in 1879, and the exports 190,423, as compared with 146,139 tons.

Several new shipbuilding contracts have been booked by Messrs. Russell and Co., of Greenock and Port Glasgow. The shipwrights at two of the Clyde shipbuilding yards were on strike for an advance of wages, but they have now obtained a promise that they will get it on the 14th February, and so have returned to work.

WALES & ADJOINING COUNTIES.

(*From our own Correspondent.*)

It may be taken as certain that the price of steam coal will be advanced generally on the 1st of February. There has been a long period of stiffened prices, and now, demands being great and supplies short, further delay in advancing the price is not likely to occur. House coal has maintained its advance, and as much as 11s. 6d. f.o.b. has been obtained in exceptional cases at Cardiff for steam coal to save demurrage costs, but quotations henceforth are certain to take an upward character. The buyers, however, are well placed, and large contracts for long periods are in force at last quotations.

The verdict at the Penygraig inquest has been accidental death. Mr. Galloway's hypothesis as to the origin has been published in full, and is certainly a document of great ability. His idea, and very logically worked out, is that a party of men were blasting down roof near the point where Tubervilles heading enters the solid coal; that it ignited a quantity of fire-damp lying in a large cavity in the roof, near the spot, and not observed by the overman; that the explosion of this fire-damp produced a violent air-wave, which swept through the galleries of both the upper and lower pits, raising the coal dust and producing an inflammable mixture, and thus the explosion, in all its severity, was carried in the form of a sheet of flame to the very bounds of the workings. The condition of these Rhondda collieries is shown by Mr. Galloway's statistics respecting the amount of fire-damp given off per hour in the colliery of Penygraig. "After the explosion," he said, "I estimated the whole amount of fire-damp given off by the whole mine to be about 1100 cubic feet per minute. This amounts to 2·2 cubic feet per minute per ton of coal raised in the twenty-four hours. Taking the output of the lower pit at 200 tons and the upper 300 tons daily, we have then 440 cubic feet of fire-damp produced in the lower pit, and 660 cubic feet in the upper per minute." Mr. Galloway considers the percentage of gas on the return air-way is too small to be detected by any but skilled men with best lamps, and that the view held of the pit by such evidence would be that it was in all respects a safe one.

Circulars have been issued by Mr. W. T. Lewis showing that a large number of collieries have given in their adhesion to the Miners' Permanent Fund. Several of the collieries of the Aberdare and Plymouth Company are included; Powells Duffryn have five collieries, Ebbw Vale three, Nixon, Taylor, and Co., two. I note, too, in the list, that the colliers of all the large collieries recently opened, such as the Deep Navigation, have given in their names as members. All the objectors will very likely give way now, especially as an advance is probable at the next declaration of sales according to the sliding scale agreement.

Coke is firm, with a decidedly upward tendency. I should say that with an improving iron trade, and advancing prices in coal, there will be an upward bound in coke in a very short time. Coke generally feels the impetus first, and most frequently advances at a more rapid rate than either coal or iron.

The shipments of coal from Cardiff during the year 1880 were 4,897,440 tons; of iron, 164,923; coke, 25,806; and of patent fuel, 131,083. This, as regards coal, it must be understood was for foreign destinations.

I am glad to see that the iron trade is steadily looking up, and shall expect to see firmer or even advanced quotations next month. There are large holders of pig in the district, and none are anxious to get rid of stocks.

Iron rails are firm at £5 10s.; steel quotations, £6 7s. 6d. to £6 10s.; hematite pig, £3 7s. 6d. One noticeable feature of the present time is the tardiness of sellers in accepting offers, and anything but the exact figure is not accepted. Only 1050 tons of iron were cleared last week from Cardiff and Newport. Slackness characterises trade at Swansea principally on account of weather. A petition is to be presented for winding up Onllwyn and Dulais Colliery Company, Limited.

Difference of opinion is very great as to the opening of the new docks at Swansea this year. I believe from excellent authority that they will be opened, and under distinguished prestige.

Tin-plate is dull, ordinary coke tin at the utmost 15s. 9d. per box. An open verdict has been returned in the case of the Clansman, a Swansea vessel alleged to have been destroyed by explosion from coal.

The *London and China Telegraph* understands that in all probability the service of the Messageries Maritimes will be altered so as to run at alternate dates in conjunction with the Peninsular and Oriental Company's service to the Far East. This is consequent on the recent changes in the homeward service of the latter company.

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.

18th January, 1881.

220. Ice, &c., J. H. Johnson.—(*A. J. Rossi and L. F. Beckwith, New York, U.S.*)
221. Vinegar, H. H. Lake.—(*O. F. Boomer and H. R. Randall, Brooklyn, U.S.*)
222. Chlorine, W. Weldon, Burstow, and W. G. Strype, Murrough.
223. Glazing Rice, &c., H. J. Haddan.—(*A. Leytens, Antwerp.*)
224. Power Hammers, J. F. M. Pollock, Leeds, and T. Beeley, Manchester.
225. Electric Lamps, St. G. L. Fox, Rushmore.
226. Shoes or Plates, H. Bland, Luton.
227. Chests, &c., J. H. Johnson.—(*J. B. Geneste, Paris.*)
228. Cleansing Casks, &c., M. W. Proudlock, Newcastle-upon-Tyne, and R. Weatherburn, Burton-on-Trent.
229. Restoring Waste India-rubber, &c., H. H. Lake.—(*H. A. Clark, Boston, U.S.*)

19th January, 1881.

230. Foot Coverings, P. Martin & T. Sneyd, Sheffield.
231. Perambulators, &c., J. Watterworth, Hull.
232. Wheels, A. M. Clark.—(*A. B. y Fabregas, Manila.*)
233. Closing, &c., Bottles, R. Lanham, Whetstone.
234. Scribbling, &c., Machines, T. C. Fawcett, Leeds.

20th January, 1881.

235. Sampling Liquids, J. O'N. Mackle, Liverpool.
236. Blacking, &c., Borders of Paper, &c., A. C. Henderson.—(*A. Duret, France.*)
237. Packing Sugar, &c., A. and J. D. Scott, Greenock.
238. Saddle-girth, E. Noirit, Walsall.
239. Coffee, C. Pieper.—(*A. von Hofmann, Augsburg.*)
240. Picking Bands, J. Taylor, Newchurch.
241. Railways, T. G. Hardie and T. Kendall, Yorkshire.
242. Purifying Apparatus, J. H. Dane, San Francisco.
243. Discharge Apparatus, J. Shanks, Barrhead.
244. Heating Water, &c., J. McAllister, Barrhead.
245. Lighting Gas, C. Clarke & J. Leigh, Manchester.
246. Cask Stopper, L. A. Groth.—(*E. Markgraf, Paris.*)
247. Enamelling Iron, &c. F. Winterhoff and H. C. Webb, Worcester.
248. Heating Water, E. de Pass.—(*E. Körting, Hanover.*)
249. Regulators, E. de Pass.—(*E. Körting, Hanover.*)
250. Piecing Double Yarns, G. Balfe, Stockport.
251. Ventilators, G. Whitehead, Heywood.
252. Woven Bags, W. A. Carr, Manchester.
253. Electric Currents, C. G. Gumpel, London.
254. Furnaces, L. W. Sutcliffe, Birmingham.
255. Driving Potters' Wheels, T. Willett, Burslem.
256. Roller Bearings, W. R. Lake.—(*J. E. Maynadier, Boston, U.S.*)
257. Bracelet Fastenings, O. Vaughton, Birmingham.
258. Counting, &c., Machines, G. Heaton, Handsworth.
259. Tricycles, &c., G. Illston, Birmingham.
260. Seats of Tricycles, &c., J. Turner, Coventry, and J. A. Lamplugh and G. F. Brown, Birmingham.

21st January, 1881.

261. Chimney Tops, &c., W. Jones, West Derby.
262. Clasps, &c., T. and A. Osborn, Birmingham.
263. Knitting Machines, J. H. Smith, Nottingham
264. Measuring, &c., Apparatus, A. Apps, London.
265. Gas Jets, J. Darling and R. Murdoch, Glasgow.
266. Printing, &c., J. J. Sachs, Manchester.
267. Tubing, J. C. Mewburn.—(*La Société J. L. Martiny et Compagnie, Paris.*)
268. Velvets, &c., H. Lister, Ashbrow Mills.
269. Looms, H. Lister, Ashbrow Mills.
270. Heating Apparatus, C. D. Abel.—(*A. Morel, Epinal, France.*)
271. Automatic Syphon Tap, H. J. Allison.—(*MM. Clairac, Millot, and Berger, Algeria.*)
272. Raising Trees, &c., S. Newington, Ridgeway.
273. Knitting Machines, J. Wetter.—(*J. Byfield, Georgetown, Canada.*)
274. Watches, W. R. Lake.—(*T. Comstock, Indianapolis.*)
275. Semaphores, W. R. Lake.—(*F. R. Brown, Montreal.*)
276. Valves, J. H. Harrison, Chester.
277. Ore Separators, R. H. Brandon.—(*E. B. Hastings, J. F. Holbrook, and R. L. Goddard, Palmer, U.S.*)

22nd January, 1881.

278. Match Filling Machines, C. R. E. Bell, London.
279. Looms, J. Holding, Manchester.
280. Metallic Alloy, W. Koppel, Manchester.
281. Crushing Apparatus, P. Pfleiderer.—(*C. Meinicke, Zerbst, Germany.*)
282. Velocipedes, E. R. Settle, London.
283. Shaping Apparatus, T. Turton and R. Roberts, Liverpool.
284. Wind Engine, A. M. Clark.—(*M. E. de la Torre, Mexico.*)
285. Mixing Size, &c., H. Livesey, jun., Greenbank.
286. Telephones, F. H. Engel.—(*J. Heinrick, Germany.*)
287. Stoves, J. Waterhouse and B. Midgley, Yorkshire.
288. Controlling Engines, J. Richardson, Lincoln.
289. Cinnamic Acid, J. Dixon.—(*K. Koenig, Germany.*)
290. Smelting Zinc, J. Binnon & A. Grandfils, Belgium.
291. Looms, W. Adam, Kidderminster.
292. Brushes, J. Worrall and J. Lawrence, Ordsal, and J. Lea, Eccles.
293. Creaming Milk, &c., F. W. Unterilp.—(*T. Becker, Düsseldorf.*)
294. Transmitting Motion, A. M. Clark.—(*S. Dennis and A. Samper, Paris.*)
295. Refrigerating, J. Gwynne, Hammersmith.
296. Grass-box, C. D. Barrett.—(*Lloyd, Supplee, and Walton, Philadelphia, U.S.*)
297. Stair-rod Eyes, M. and M. M. Lenzberg, London.
298. Magnesia, C. Scheibler, Berlin.
299. Rotary Engines, J. Matthews, London.
300. Railway Points, &c., G. Edwards, Cheltenham.
301. Oil, J. H. Johnson.—(*F. F. Rohart, Paris.*)
302. Selvage, H. H. Lake.—(*L. Frobeen, Berlin.*)
303. Machine Guns, W. Tranter, Birmingham.
304. Carbon, &c., R. Werdermann, London.

24th January, 1881.

305. Gas Stoves, A. C. Anderson.—(*MM. André and Legrand, Lyon.*)
306. Elevators, J. Gauldie & T. Marshall, Kinning Park.
307. Preventing Water Freezing, J. Rule, Dublin.
308. Cords, J. Wetter—(*M. L. Rollier, France.*)
309. Cultivating Land, F. Brütschke, Berlin.
310. Wire Brushes, S. Abraham, Manchester.
311. Ornamenting Surfaces, H. E. Newton.—(*E. A. Batonnier, France.*)
312. Testing Apparatus, A. W. L. Reddie.—(*D. Monnier, Paris.*)
313. Opening, &c., Windows, H. Skerett, Sparkbrook.
314. Gymnastic Apparatus, G. Zander, Stockholm.
315. Roofing Tiles, R. C. Robinson, Preston.
316. Gymnastic Apparatus, G. Zander, Stockholm.
317. Brakes, J. A. Steward, Wolverhampton.
318. Toasting Fork, E. Brookes, Hawarden.

Grants and Dates of Provisional Protection for Six Months.

4946. Treating and Transmuting Wood, &c., W. Boggett, Chelsea, London.—*27th November*, 1880.
5138. Steam Engines, J. McCullum, Greenock.—*9th December*, 1880
5164. Drain Pipes, &c., E. Brooke, Huddersfield.—*10th December*, 1880.
5172. Lamps, &c., F. Siemens, Southampton-buildings, London.—*10th December*, 1880.
5216. Spinning Machines, A. Munzinger, Olten, Switzerland.—*13th December*, 1880.
5218. Metallic Alloys, G. Höper, Chancery-lane, London.—*13th December*, 1880.
5220. Fire-grates, J. R. Pickard, Leeds.—*13th December*, 1880.
5222. Looms, E. M. Heatley, Blackburn.—*13th December*, 1880.
5230. Shield, W. P. Thompson, High Holborn, London.—A communication from D. McFee, R. A. Kellond, and D. E. McFee, Quebec.—*14th December*, 1880.
5327. Colouring Matters, J. A. Dixon, West George-street, Glasgow.—A communication from C. Kœnig, Germany.—*20th December*, 1880.
5335. Dumb-bells, H. J. Haddan, Strand, London.—A communication from J. M. A. Despagnat, Melun, France.—*20th December*, 1880.
5350. Salt, J. H. Biggs, Liverpool.—*21st December*, 1880.
5374. Treating Mineral Phosphates, J. J. Knight, Widnes.—*22nd December*, 1880.
5377. Manual Lever Hammer, J. Cuthbert, Landport.—*22nd December*, 1880.
5392. Microscopes, J. M. Moss, Patricroft.—*22nd December*, 1880.
5392. Cartridge Belt Fabrics, &c., J. H. Johnson, Lincoln's-inn-fields, London.—A communication from A. Mills, Washington, U.S.—*23rd December*, 1880.
5395. Screws and Screw-drivers, J. F. Lackersteen, New-cross.—*23rd December*, 1880.
5397. Saw Frames, T. N. Robinson, Rochdale.—*23rd December*, 1880.
5399. Roving, &c., Frames, J. Farrar, Halifax.—*23rd December*, 1880.
5400. Travelling Trunks, J. J. B. Toussaint, Paris.—*23rd December*, 1880.
5401. Gas Governors, F. G. Hamer, Torquay.—*23rd December*, 1880.
5402. Syruping Beverages. J. McEwen and S. Spencer, Manchester.—*23rd December*, 1880.
5404. Locking, &c., Apparatus, M. C. Denne, Eastbourne, & T. J. Denne, Redhill.—*23rd December*, 1880.
5405. Cutter-holders for Tools, F. M. Newton, Eton College, Eton.—*23rd December*, 1880.
5406. Rotary Blower, &c., P. Goldschmidt, G. Hahlo, and A. Heussy, Manchester.—*23rd December*, 1880.
5407. Folding Bedsteads, &c., H. G. Grant, Manchester.—A communication from C. C. Held, Stuttgart, Germany.—*23rd December*, 1880.
5408. Kilns, E. E. Street, Clifton.—*23rd December*, 1880.
5409. Brooches, &c., H. G. Pendleton, Gower-street, Lozells, Birmingham.—*23rd December*, 1880.
5411. Door-knobs, &c., J. S. Edge, jun., Yardley, and J. Deeley, Birmingham.—*23rd December*, 1880.
5412. Rotary Machines, W. R. Lake, Southampton-buildings, London.—A communication from A. Kaiser, Munich.—*23rd December*, 1880.
5415. Weighing, &c., Machines, W. R. Lake, Southampton-buildings, London.—A communication from A. Kaiser, Munich.—*23rd December*, 1880.
5417. Fluid Motors, W. P. Thompson, High Holborn, London.—A communication from J. Merrylees, New York, U.S.—*24th December*, 1880.
5419. Tram-cars, &c., E. Latham, Birkenhead, and F. Bradley, Kidderminster.—*24th December*, 1880.
5420. Tramways, J. Leathwood, Liverpool.—*24th December*, 1880.
5421. Substitute for Gums, &c., C. Estcourt, Manchester, and F. C. Eastwood, Heaton Chapel.—*24th December*, 1880.
5423. Preventing Displacement of Linch Pins, W. Gardner, Southampton-buildings, London.—*24th December*, 1880.
5424. Pressing or Moulding Bricks, &c., H. Johnson and B. Suart, Keymer Junction.—*24th December*, 1880.
5425. Miners' Safety Lamps, W. Crossley, Glasgow.—*24th December*, 1880.
5426. Brake or Skid, W. M. V. Hill, Edinburgh.—*24th December*, 1880.
5427. Blowing, &c., Apparatus, E. P. Alexander, Southampton-buildings, London.—A communication from O. Presbrey, Port Henry.—*24th December*, 1880.
5428. Knitting Machinery, J. Imray, Southampton-buildings, London.—A communication from La Société Poron, France.—*24th December*, 1880.
5429. Derivatives of Benzole, J. A. Kendall, Dalston.—*24th December*, 1880.
5431. Motive-power Engines, &c., A. Andrews, jun., Kilmarnock.—*24th December*, 1880.
5433. Roundabouts, P. Everitt, Queen Victoria-street, London, and C. Burrell, jun., Thetford.—*24th December*, 1880.
5434. Safety Valves, W. R. Lake, Southampton-buildings, London.—A communication from G. W. Copeland, Boston, U.S.—*24th December*, 1880.
5435. Moving Cylinder Steam Hammers, A. C. Wylie, Cannon-street, London.—*24th December*, 1880.
5437. Turning, &c., Machinery, J. Evans, Wolverhampton.—*24th December*, 1880.
5438. Treating Liquid, W. R. Lake, Southampton-buildings, London.—A communication from F. Prévost, Amiens, France.—*24th October*, 1880.
5439. Door-knobs, &c., H. Payton, Birmingham, and W. S. Dackus, Balsall Heath.—*24th December*, 1880.
5440. Tricycles, J. H. Walsh, the Cedars, Putney.—*24th December*, 1880.
5444. Safety Apparatus, W. R. Lake, Southampton-buildings, London.—A communication from H. Ruelle, Paris.—*27th December*, 1880.
5452. Stays, &c., W. R. Lake, Southampton-buildings, London.—A communication from W. Bowers and H. B. Doremus, Newark, U.S., and A. Fellheimer, New York. U.S.—*28th December*, 1880.
5454. Skylights, A. Forbes, Govan.—*28th December*, 1880.
5456. Rotary Pumps, G. Waller, Holland-street, Southwark, London.—*28th December*, 1880.
5458. Heavy Ordnance, B. J. B. Mills, Southampton-buildings, London.—A communication from J. H. McLean, St. Louis, U.S., and M. Coloney, New Haven, U.S.—*28th December*, 1880.
5460. Pirns or Skewers, A. W. L. Reddie, Chancery-lane, London.—A communication from J. C. Zeller, Paris.—*28th December*, 1880.
5462. Spinning Machinery, A. M. Clark, Chancery-lane, London.—A communication from La Société anonyme des Corderies Parisiennes, Paris.—*28th December*, 1880.
5464. Furnaces, J. Jackson, Liverpool.—*29th December*, 1880.
5466. Freight, &c., Transfers, A. E. McDonald, New York, U.S.—*29th December*, 1880.
5468. Opening, &c., Dampers, Doors, &c., R. Waller, Leeds.—*29th December*, 1880.
5474. Seed Crushing Apparatus, C. Eskrett and W. H. Searle, Hull.—*29th December*, 1880.
5476. Treating, &c., Human Excreta, R. Hoodless, Ormskirk.—*29th December*, 1880.
5478. Ammonia, H. A. Dufrené, South-street, Finsbury, London.—A communication from La Société l'Azote, Rue Erard, Paris.—*29th December*, 1880.
5480. Pumps, A. M. Clark, Chancery-lane, London.—A communication from W. H. Triplett, New York, U.S.—*29th December*, 1880.
4582. Telephonic Apparatus, C. J. Wollaston, Great Winchester-street, London.—*30th December*, 1880.
5484. Pumping Apparatus, E. H. Greeven, Cheapside, London.—A communication from G. A. Greeven, Deutz, Germany.—*30th December*, 1880.
5488. Life-saving Apparatus, J. Wetter, Strand, London.—A communication from B. King, Paris.—*30th December*, 1880.
5490. Illuminated Clocks, C. H. Leycester, Gwynfé, Llangadock, South Wales.—*30th December*, 1880.
5492. Reciprocating Motion Apparatus, H. M. Brunel, Delahay-street, Westminster.—*30th December*, 1880.
5494. Holding Fabrics, &c., G. Allix, Fleet-street, London.—*30th December*, 1880.
5500. Preventing the Shifting of Cargoes, J. Goudie, East Hartlepool.—*31st December*, 1880.
5502. Valves, N. Foley, Jarrow-on-Tyne.—*31st December*, 1880.
5504. Sulphate of Ammonia, W. L. Wise, Whitehall-place, London.—A communication from H. Grouven, Leipzig, Saxony.—*31st December*, 1880.
5506. Ploughs, &c., H. J. Allison, Southampton-buildings, London.—A communication from H. Wagner, Toulouse, France.—*31st December*, 1880.
5508. Preparing Fibrous Substances, W. Fox and J. Hall, Leeds.—*31st December*, 1880.
5512. Drain Pipes, W. R. Lake, Southampton-buildings, London.—A communication from C. W. Durham, Chicago, U.S.—*31st December*, 1880.
5514. Torpedoes, C. A. McEvoy, Adam-street, Adelphi, London.—*31st December*, 1880.
5516. Designs or Figures, A. Guattari, Chancery-lane, London.—*31st December*, 1880.
2. Mechanism for Pianofortes, &c., E. Underwood, Birmingham.—*1st January*, 1881.
4. Shaping Hat Brims, T. Rowbotham, Hazel-grove, Chester.—*1st January*, 1881.
10. Photographic, &c., Printing, A. M. Clark, Chancery-lane, London.—A communication from L. dit Christian and A. Liébert, Paris.—*1st January*, 1881.
12. Motive Power Engine, G. O. Topham, Maida Vale, London.—*1st January*, 1881.
16. Screw Steam Ships, L. F. Irwin, Liverpool.—*3rd January*, 1881.
20. Dental Engine, P. Shaw, Manchester.—*3rd January*, 1881.
24. Holding or Securing Pictures, &c., H. H. Lake, Southampton-buildings, London.—A communication from Goldenstein and Co., Vienna.—*3rd January*, 1881.
26. Weighing Yarn, &c., J. H. Johnson, Lincoln's-inn-fields, London.—A communication from J. L. Mouchère, Paris.—*3rd January*, 1881.
28. Moulding Plastic Substances, C. G. Goddard, Brighton.—*4th January*, 1881.
30. Revolving Seats, &c., W. H. Blain, Liverpool.—*4th January*, 1881.
32. Straining Paper Pulp, D. Bentley, Church-road, St. Anne's-on-the-Sea.—*4th January*, 1881.
34. Wheels, J. Rigby, Southampton-buildings, London.—*4th January*, 1881.
40. Steam Boilers, G. Petrie, Rochdale.—*4th January*, 1881.
42. Drying Bricks, J. Craven, Wakefield, and H. Chamberlain, Barnsley.—*4th January*, 1881.
50. Giving Motion to Spinning Tops, T. Wrigley, Chancery-lane, London.—A communication from G. Fischer, Nürnberg—*4th January*, 1881.
4759. Supplying Furnaces with Fuel, J. Proctor, Burnley.—*18th November*, 1880.
4933. Electric Lamps, J. W. Swan, Newcastle-on-Tyne.—*27th November*, 1880.
5053. Foot-warmers, T. G. Greenstreet, Camberwell New-road, Surrey.—*4th December*, 1880.
5219. Gas Motor Engines, A. Fiddes, Bristol.—*13th December*, 1880.
5241. Brushes, J. Worrall and J. Lawrence, Ordsall, and J. Lea, Eccles.—*14th December*, 1880.
5245. Rectification of Alcohol, &c., S. Pitt, Sutton.—A communication from the Compagnie Iudustrille des Procedés Raoul Pictet, Paris.—*14th December*, 1880.
5319. Alphabet or Code System, A. M. Clark, Chancery-lane, London.—A communication from C. G. Burke, New York, U.S.—*18th December*, 1880.
5337. Eire Extincteurs, F. B. Brunell, Sheffield.—A communication from H. Gübler, Thurbenthal.—*20th December*, 1880.
5363. Guns, &c., H. E. Newton, Chancery-lane, London.—A communication from J. Ericsson, New York, U.S.—*21st December*, 1880.
5403. Breech-loading Mechanism, D. Fraser, Edinburgh.—*23rd December*, 1880.
5441. Valve Gears of Engines, J. A. Stott, Manchester.—*27th December*, 1880.
5443. Air Compressing Engines, F. Beaumont, Westminster, and D. Greig, Leeds.—*27th December*, 1880.
5445. Valves, &c., T. Meacock and A. W. C. Ward, Chester.—*28th December*, 1880.
5451. Mash Cooling Apparatus, W. Brierley, Halifax.—A communication from A. Nohring, Marsonvasar, Hungary.—*28th December*, 1880.
5453. Artificial Ear Drums, H. P. K. Peck, Cincinnati, U.S.—*28th December*, 1880.
5455. Ships, &c., F. H. Danchell and R. Blum, Paris.—*28th December*, 1880.
5457. Blow Pipe Revolving Furnace, B. J. B. Mills, Southampton-buildings, London.—A communication from G. Duryee, New York.—*28th December*, 1880.
5459. Machine Guns, B. J. B. Mills, Southampton-buildings, London.—A communication from J. H. McLean, St. Louis, and M. Coloney, New Haven, U.S—*28th December*, 1880.
5461. Printing Machinery, W. C. Kritch, Leeds.—*28th December*, 1880.
5463. Staining, &c., Wood, E. Brydges, St. Leonard's-terrace, Upton.—A communication from A. Thimm, Berlin.—*28th December*, 1880.
5467. Destroying Field Mice, &c., H. A. Bonneville, Cannon-street, London.—A communication from M. Gouteau, Leouville, France.—*29th December*, 1880.
5469. Moulding Apparatus, F. Wirth, Germany.—A communication from P. Gallas and H. Aufderheide, Kaiserslautern, Germany.—*29th December*, 1880.
5473. Window Sashes, J. Terry, R. Judson, and G. Smith, Keighley.—*29th December*, 1880.
5477. Saddle Bars, Sir T. Dancer and E. Chappell, Malmesbury.—*29th December*, 1880.
5479. Applying Motive Power, J. Graddon, Forest hill, Kent.—*29th December*, 1880.
5481. Sofa Bed, R. E. Parr, Trafalgar-road, Greenwich.—A communication from F. Laeremans, San Francisco, U.S.—*29th December*, 1880.
5483. Wheels, J. Trippett and T. Walton, Sheffield.—*30th December*, 1880.
5485. Waterproof, &c., J. Neville, London-lane, Hackney.—*30th December*, 1880.
5487. Winding Yarns, J. Grayson, Leeds.—*30th December*, 1880.
5489. Regulating Steam Engines, H. Davey, Leeds.—*30th December*, 1880.
5491. Web Printing Machines, J. Foster, Preston.—*30th December*, 1880.
5493. Flanging Boiler Plates, R. H. Tweddell, Delahay-street, Westminster, J. Platt and J. Fielding, Gloucester, and W. Boyd, Jesmond-road, Newcastle-on-Tyne.—*30th December*, 1880.
5495. Regulating Air, R. Burchell, Kettering.—*30th December*, 1880.
5497. Firing Apparatus, A. M. Maude, Royal-mews, Buckingham Palace.—*30th December*, 1880.
5499. Compounds for Joints, &c., I. R. Blumenburg, Chancery-lane, London.—*30th December*, 1880.
5501. Fasteners, H. Fletcher, Strand.—*31st December*, 1880.
5503. Stretchers, J. C. Smith, Birmingham.—*31st December*, 1880.
5505. Steam Traps, H. Lancaster, Pendleton.—*31st December*, 1880.
5507. Mould Candles, W. E. Nutt, Hanworth-road, Hounslow.—*31st December*, 1880.
5509. Chimney Pieces, &c., J. H. Corke, Somers-road, Southsea.—*31st December*, 1880.
5511. Velocipedes, J. Starley, Coventry.—*31st December*, 1880.
5513. Gas, P. J. Wates, Balham.—*31st December*, 1880.
5515. Crucibles, &c., A. Lansberg, Stoberg.—*31st December*, 1880.
5517. Treating Pork, A. M. Clark, Chancery-lane, London.—A communication from J. B. F. Chaumont, Paris.—*31st December*, 1880.
1. Ventilating, &c., Apparatus, G. D. Robertson, Palace-chambers, Westminster.—*1st January*, 1881.
3. Floor Springs, E. Bull, Halifax.—*1st January*, 1881.
5. Central Fire Cartridges, F. Wirth, Germany.—A communicaton from G. Bloem, Düsseldorf.—*1st January*, 1881.
7. Forming Floors, &c., R. L. Rylance, Blackburn.—*1st January*, 1881.
9. Railway Vehicles, H. H. Lake, Southampton-buildings, London.—A communication from J. W. Chisholm, Brooklyn, U.S.—*1st January*, 1881.
11. Compressing Air, F. Wirth, Germany.—A communication from F. Honigmann, Aix-la-Chapelle, Germany.—*1st January* 1881.

13. LITHOGRAPHIC MACHINES, G. Newsum, Leeds.—3rd January, 1881.
15. ELEVATORS, W. Dover, Liverpool.—3rd January, 1881.
21. EXTINGUISHING FIRE, O. Wolff, Schloss-strasse, Dresden.—A communication from A. Lehmann, Dresden.—3rd January, 1881.
23. COUPLING APPARATUS, H. H. Lake, Southampton-buildings, London.—A communication from G. F. Adams, Buffalo, U.S.—3rd January, 1881.
25. CUTTING SHEET METAL, J. H. Johnson, Lincoln's-inn-fields, London.—A communication from C. Donnay, Paris.—3rd January, 1881
27. LIME-LIGHT LAMPS, A. M. Khotinsky, St. Petersburg.—4th January, 1881.
29. RECEPTACLES OF VESSELS, F. C. Glaser, Berlin.—A communication from H. Schomburg, Alt-Moubit, Berlin.—4th January, 1881.
31. CLEANSING APPARATUS, P. van Gelder and T. Apsimon, Liverpool.—4th January, 1881.

Inventions Protected for Six Months on deposit of Complete Specifications.

202. FOG SIGNALS, H. A. Bonneville, Cannon-street, London.—A communication from F. Brown, New York, U.S.—15th January, 1881.
223. GLAZING RICE, &c., H. J. Haddan, Strand, London.—A communication from A. Laytens, Antwerp.—18th January, 1881.
229. RESTORING VULCANISED INDIA-RUBBER, &c., H. H Lake, Southampton-buildings, London.—A communication from H. A. Clark, Boston, U.S.—18th January, 1881.
274. WATCHES, W. R. Lake, Southampton-buildings, London.—A communication from T. C. Comstock, Indianapolis, U.S.—21st January, 1881.
275. ELECTRIC SEMAPHORES, W. R. Lake, Southampton-buildings, London.—A communication from F. R. F. Brown, Montreal.—21st January, 1881.

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

233. GAS METERS, H. Thomas, Oldham.—18th January, 1878.
235. FENCING, C. Whiteside, Liverpool.—18th January, 1878.
244. GAS, J. Livesey, Victoria-chambers, London, and J. Kidd, Wandsworth.—18th January, 1878.
252. DRYING and CLEANING GRAIN, &c., T. Balmer, Fochabers.—19th January, 1878.
573. RAISING OF PROPELLING WATER, &c., H. Simon, St. Peter's-square, Manchester.—12th February, 1878.
583. COMBING WOOL, &c., C. Whitehead, Holbeck — 12th February, 1878.
701. MARKING APPARATUS, J. Osmond, Breakspear-road, New-cross.—20th February, 1878.
332. BICYCLES, J. Beal, Greenwich.—25th January, 1878.
264. INFUSION, &c., APPARATUS, R. U. Etzensberger, St. Pancras, London.—21st January, 1878.
268. CARTS, WAGONS, &c., J. Dobbing, Darlington.—21st January, 1878.
304. NITRO-GLYCERINE, T. T. Jones, Basinghall-street, London.—23rd January, 1878.
286. ROTARY ENGINES and PUMPS, J. Cooke, Langley Old Hall.—22nd January, 1878.
288. PREPARING FIBROUS MATERIALS, J. H. Johnson, Lincoln's-inn-fields, London.—22nd January, 1878.
642. SAFETY LAMPS, J. Williamson, Hednesford.—15th February, 1878.
302. ANNEALING FURNACE, C. Pieper, Dresden.—23rd January, 1878.
312. SUBMARINE TELEGRAPH CABLES, H. Clifford, Old Broad-street, London.—23rd January, 1878.
346. FACING BRICK OR TILE, H. J. Lanchester, Brighton.—26th January, 1878.
376. FILTER PRESSES, F. L. H. Danchell, Oseney-crescent, Camden Town, London.—29th January, 1878.
1147. SHUTTLES, A. Anderson, Glasgow.—22nd March, 1878.

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

359. SOLITAIRES, &c., W. West and W. F. Spittle, Birmingham.—24th January, 1874.
323. DRYING, &c., APPARATUS, A. M. Clark, Chancery-lane, London.—24th January, 1874.
270. SIGNALLING ON RAILWAYS, W. T. Whiteman, Maitland Park-road, London.—22nd January, 1874.
289. TREATING BEER, &c., P. E. Lockwood, Leadenhall-street, London.—23rd January, 1874.
422. ALLOYS OF IRON, A Browne, Southampton-buildings, London.—2nd February, 1874.

Notices of Intention to Proceed with Applications.

Last day for filing opposition 11th February, 1881.

3755. SPLINTS, H. Hides, Mortimer-street, Cavendish-square, London.—16th September, 1880.
3759. LIGHTING APPARATUS, C. W. Kitto, Old Broad-street, London, and W. H. Thompson, Finsbury-circus, London.—16th September, 1880.
3760. WHEEL-BARROWS F. Wirth, Germany.—Com. from A. W. Pletsch.—16th September, 1880.
3770. COOLING, &c., MILK, E. Fitch, Fetter-lane, London.—17th September, 1880.
3772. IRON FRAMES, &c., G. Allix, Church-terrace, Cubitt's Town, London.—17th September, 1880.
3775. PRINTING PRESSES, W. Morgan-Brown, Southampton-buildings, London.—Com. from the Gilman Vertical Press Company.—17th September, 1880.
3787. OPENING, &c., COTTON, &c., R. Tatham, Rochdale, and J. Taft, Manchester.—18th September, 1880.
3788. COOLING, &c., AIR, A. M. Clark, Chancery-lane, London.—Com. from L. Allen.—18th September, 1880.
3793. NOZINGS, F. W. Hembry, Newgate-street, London.—18th September, 1880.
3797. STITCHED MACHINE BELTS, M. Gandy, Liverpool.—18th September, 1880.
3810. RECORDING APPARATUS, J. J. Seubich, Dresden.—20th September, 1880.
3824. LIFTS, J. M. Day, W. R. Green, and H. C. Walker, Falmouth-road, London.—21st September, 1880.
3855. COTTON CLOTHS, J. Winter and T. Ivers, Farnworth.—23rd September, 1880.
3858. CARTRIDGE CASES, S. Pitt, Sutton.—Com. from T. Nordenfelt.—23rd September, 1880.
3867. OLEINE, &c., B. Hofman, Millstream-road, Bermondsey, London.—24th September, 1880.
3885. TELEPHONIC APPARATUS, W. Morgan-Brown, Southampton-buildings, London.—A communication from A. G. Bell.—25th September, 1880.
3890. SEWING BOOKS, W. Morgan-Brown, Southampton-buildings, London.—A communication from E. S. Boynton.—25th September, 1880.
3921. LOCOMOTIVE ENGINES, W. Morgan-Brown, Southampton-buildings, London.—Com. from F. Stevens, J. H. and C. C. Pearson.—28th September, 1880.
3934. SETTING, &c., TYPES, W. Morgan-Brown, Southampton-buildings, London.—A communication from J. Thorne.—28th September, 1880.
4036. SEWING MACHINES, H. J. Haddan, Strand, London.—Com. from J. Keith.—5th October, 1880.
4037. VELOCIPEDES, L. Aviss, Gosford-street, Coventry.—5th October, 1880.
4038. MAKING CORD, &c., W. Morgan-Brown, Southampton-buildings, London.—Com. from C. Barnes, P. Webster, and P. Butler.—5th October, 1880.
4062. TREATING DIAMONDIFEROUS EARTH, J. Richardson, Lincoln.—6th October, 1880.
4063. UMBRELLA FURNITURE, B. B. Cox, North Audley-street, London.—6th October, 1880.
4193. FIRE-ESCAPES, H. J. Haddan, Strand, London.—Com. from F. W. Hofele.—15th October, 1880.
4364. CUTTING PAPER, &c., A. Reddie, Chancery-lane, London.—Com. from J. Meyer.—26th October, 1880.
4473. PRINTING MACHINERY, A. Sauvée, Parliament-street, London.—2nd November, 1880.
4771. COUPLING APPARATUS, W. P. Alexander, Draper's-gardens, London.—Com. from E. R. Thomas and G. Cowdery.—19th November, 1880.
4886. DYNAMO-ELECTRIC MACHINES, J. Hopkinson, Westminster-chambers, and A. Muirhead, Regency-street, Westminster.—24th November, 1880.
5266. WITHDRAWING, &c, AIR, W. and B. Verity, Stanhope-street, London.—15th December, 1880.
5421. SUBSTITUTE for GUMS, &c., C. Estcourt, Manchester, and F. C. Eastwood, Heaton Chapel, Lancashire.—24th December, 1880.
138. TREATING TEXTILE MATERIALS, H. J. Haddan, Strand, London.—A communication from S. Godchaux.—12th January, 1881.
202. FOG SIGNALS, H. A. Bonneville, Cannon-street, London.—Com. from F. Brown.—15th January, 1881.

Last day for filing opposition, 15th February, 1881

3808. DYNAMO MACHINES, F. G. Willatt, High Holborn, London.—20th September, 1880.
3809. DIVIDING, &c., APPARATUS, J. B. Rogers, Lombard-street, London.—20th September, 1880.
3813. EXTRACTING GOLD, &c., J. P. Dunker, Glasgow.—20th September, 1880.
3818. BRAKES, A. C. Boothby, Kirkcaldy.—21st September, 1880.
3819. CLOTH, J. Cook and J. Turner, Manchester.—21st September, 1880.
3827. IRON and STEEL, P. S. Justice, Southampton-buildings, London.—A communication from C. M. Dupuy, Philadelphia.—21st September, 1880.
3836. LEVER ESCAPEMENTS, J. Rattray, Dundee.—22nd September, 1880.
3869. GAS ENGINES, J. R. Purssell, Kingston-road, Merton.—24th September, 1880.
3891. SHAPING SUGAR, A. Scott, jun., J. D. Scott, and T. R. Ogilvie, Greenock.—25th September, 1880.
3900. RAILWAY FROG, G. F. Redfern, Finsbury, London.—Com. from F. Smith.—25th September, 1880.
3905. LOOMS, P. Banks, W. Slater, and J. Banks, Adlington.—27th September, 1880.
3908. SOAP, P. M. Justice, Southampton-buildings, London.—Com. from L. Bastel.—27th September, 1880.
3914. EXTRACTING PRUSSIATE OF POTASH, &c., W. Brierley, Halifax. — A communication from T. Richters.—27th September, 1880.
3944. LOOMS, A. F. Firth and J. Boothman, Bailiffe Bridge, Yorkshire.—29th September, 1880.
3956. PREVENTING PAIN, W. R. Lake, Southampton-buildings, London.—A communication from H. E. Dennett.—29th September, 1880.
4005. DYNAMO-ELECTRIC MACHINES, E. G. Brewer, Chancery-lane, London.—A communication from A. J. B. Cance.—2nd October, 1880.
4018. EXERCISING APPARATUS, J. M. Smith, Southampton-buildings, London.—4th October, 1880.
4136. SEPARATING ZINC, &c., G. Barker, Birmingham.—Com. from A. Harnickell.—12th October, 1880.
4181. COMBUSTION OF VOLATILE HYDRO-CARBONS, A. M. Clark, Chancery-lane, London.—Com. from L. A. de Coster and T. B. Oakley.—14th October, 1880.
4306. BOBBINS, I. Briggs, Wakefield.—22nd October, 1880.
4308. INCUBATORS, A. M. Clark, Chancery-lane, London.—Com. from O. Martin.—22nd October, 1880.
4314. STEREOTYPE PLATES, A. M. Clark, Chancery-lane, London.—Com. from A. Marinoni.—22nd October, 1880.
4444. GAS-LIGHTING APPARATUS, H. H. Lake, Southampton-buildings, London.—A communication from F. W. Pelton.—30th October, 1880.
4507. CARDING ENGINES, G. and E. Ashworth, Manchester.—4th November, 1880.
4733. COKING, &c., COAL, L. V. Semet and E. Solvay, Brussels.—17th November, 1880.
4740. GENERATORS, I. R. Blumenberg, Chancery-lane, London.—17th November, 1880.
4829. BICYCLES, &c., H. Hayward, Gloucester, J. Day, and J. H. Gosling, Southsea.—22nd November, 1880.
4973. BLENDING WORTS, D. McG. Watson and A. C. Botterill, Quay-street, Cardiff.—29th November, 1880.
5259. CUTTERS, &c., C. G. Elrick, Aberdeen.—15th December, 1880.
5261. PREPARING COTTON, &c., R. Southworth, Bolton.—15th December, 1880.
5339. SILK HATS, D. M. Easton, Arcola, U.S.—20th December, 1880.
5344. MOULDING MACHINES, H. Wren and J. Hopkinson, Manchester.—20th December, 1880.
5351. SURFACE CONDENSERS, I. R. Blumenberg, Chancery-lane, London.—21st December, 1880.
5369. COMBING MACHINERY, A. Smith, Bradford.—22nd December, 1880.
5375. LOOMS for WEAVING, E. Smethurst, Manchester.—22nd December, 1880.
5387. MICRO-TRANSMITTERS, W. Johnson, Sheffield.—22nd December, 1880.
5393. CARTRIDGE BELT FABRICS, J. H. Johnson, Lincoln's-inn-fields, London.—A communication from A. Mills.—23rd December, 1880.
5433. ROUNDABOUTS, P. Everitt, London, and C. Burrell, Thetford.—24th December, 1880.
5482. TELEPHONIC APPARATUS, C. J. Wollaston, Great Winchester-street, London.—30th December, 1880.
5489. REGULATING STEAM ENGINES, H. Davey, Leeds.—30th December, 1880.
5493. FLANGING BOILER PLATES, R. H. Tweddell, Westminster, J. Platt and J. Fielding, Gloucester, and W. Boyd, Newcastle-on-Tyne.—30th December, 1880.
5512. DRAIN PIPES, W. R. Lake, Southampton-buildings, London. — A communication from C. W. Durham.—31st December, 1880.
34. WHEELS, J. Rigby, Southampton - buildings, London.—4th January, 1881.
158. ARCHITECTURAL ORNAMENTS, L. A. Groth, Finsbury-pavement, London.—12th January, 1881.

Patents Sealed.

(List of Letters Patent which passed the Great Seal on the 19th January, 1881.)

3411. KNITTING MACHINES, W. Morgan-Brown, Southampton-buildings, London.—25th August, 1879.
2999. BROOMS, &c., R. D. Gallager, King William-street, London.—21st July, 1880.
3014. INCUBATORS, R. Challinor and W. H. Mawdsley, Bolton.—22nd July, 1880.
3018. DYEING YARN, T. C. Firth and W. Sunderland, Stainland.—22nd July, 1880.
3020. PREPARING MAIZE, &c., J. G. Wilson, Market-street, Manchester—22nd July, 1880.
3025. ELECTRIC LIGHTING, P. Jensen, Chancery-lane, London.—22nd July, 1880.
3040. CONDENSERS, E. West, Liverpool.—24th July, 1880.
3043. PLATING IRON, &c., F. C. Glaser, Berlin.—24th July, 1880.
3044. CARDING ENGINES, R. Tatham, Rochdale.—24th July, 1880.
3049. CLARIFYING CERTAIN VEGETABLE INFUSIONS, S. C. Davidson, Belfast.—24th July, 1880.
3051. HOLDERS for INK, &c., G. W. von Nawrocki, Leipziger-strasse, Berlin.—24th July, 1880.
3052. ACTUATING SWITCHES, B. and S. Robinson, Beeston.—24th July, 1880.
3075. BOTTLE WASHERS, A. Clark, Frith-street, Soho, London.—26th July, 1880.
3092. ANTI-FOULING COMPOSITION, F. N. Baird and E. G. Baird, Glasgow.—27th July, 1880.
3114. MOTIVE POWER APPARATUS, A. C. Kirk, Glasgow.—29th July, 1880.
3121. ICE-MAKING MACHINERY, W. E. Gedge, Wellington-street, Strand, London.—29th July, 1880.
3136. CUTTING WOOD, A. C. Kirk, Glasgow, and D. Thomson, Johnstone, N.B.—30th July, 1880.
3161. SEWING MACHINES, E. Wiseman, Luton.—31st July, 1880.
3191. PROJECTILES, W. Palliser, Earl's-court-square, London.—4th August, 1880.
3220. TREATING WOOL, &c., C. Kesseler, Mohrenstrasse, Berlin.—6th August, 1880.
3257. CHILLED ARTICLES of STEEL, H. Springmann, Gneisenau-strasse, Berlin.—9th August, 1880.
3368. CARDING ENGINES, B. A. Dobson, Bolton.—19th August, 1880.
3491. FIRING APPARATUS, W. Palliser, Earl's-court-square, London.—28th August, 1880.
3634. TAKING-UP MOTIONS for LOOMS, W. Clayton, Macclesfield.—7th September, 1880.
3866. HOT AIR STOVES, T. Wardle and C. Lister, Middlesbrough-on-Tees.—24th September, 1880.
4056. WHITE LEAD, W. Thompson, Limehouse.—6th October, 1880.
4068. DYEING LEATHER BLACK, N. G. Sörensen, Stockholm.—7th October, 1880.
4145. WATCHES and CLOCKS, M. Cross, Bristol.—12th October, 1880.
4298. PROPELLING NAVIGABLE VESSELS, J. Gibbons, Liverpool.—21st October, 1880.
4351. LIFE-SAVING RAFTS, W. R. Lake, Southampton-buildings, London.—25th October, 1880.
4445. CONSUMING SMOKE, &c., J. B. Ball, Carisbrooke Lodge, Putney.—30th October, 1880.
4581. TELEGRAPH RECEIVING APPARATUS, J. W. Fuller, Old Broad-street, London.—8th November, 1880.
4647. SIFTING PORTLAND CEMENT, S. Mayell, Manor Works, Halling.—11th November, 1880.
4725. PIANOFORTES, A. Capra, J. B. Rissone, and S. Detoma, Clerkenwell, London.—16th November, 1880.

(List of Letters Patent which passed the Great Seal on the 25th January, 1881.)

3064. TELESCOPIC BALANCE, J. Gorham, Bordyke Lodge, Tonbridge.—26th July, 1880.
3077. PERFORATING CHEQUES, &c., S. Williams and A. P. Filleul, Newport.—26th July, 1880.
3078. ROCK-DRILLING MACHINERY, F. J. Adams, Lancaster-street, Surrey.—26th July, 1880.
3080. CULTIVATING LAND, W. Barford and T. Perkins, Peterborough.—26th July, 1880.
3087. ROAD SWEEPING MACHINES, G. M. Truss, Southampton.—27th July, 1880.
3088. MATCH-BOXES, W. J. Webster, Bethnal-green, London.—27th July, 1880.
3103. LEATHER SCRAP, H. Lissagary, Oakley-crescent, Chelsea.—28th July, 1881.
3107. HYDRAULIC MAIN, G. W. von Nawrocki, Berlin.—28th July, 1880.
3109. WRINGING MACHINES, &c., E. Clements, Great Russell-street, London.—28th July, 1880.
3110. ABATING SMOKE, H. Walker, Monkwood Collieries, Derby.—29th July, 1880.
3129. LEAD PIPE JOINTS, S. Bennett, Manchester.—29th July, 1880.
3134. CHECKING APPARATUS, H. Lyon, Goswell-road, London.—30th July, 1880.
3147. HAND-POWER MOTOR, S. P. Wilding, Rood-lane, Fenchurch-street, London.—30th July, 1880.
3149. DATE CALENDARS, D. Ross, Crutched-friars, London.—31st July, 1880.
3152. SCREENS, H. Shield, Grantham, and W. N. Crockett, Nottingham.—31st July, 1880.
3154. KNIFE CLEANER, J. Hunt, Bolton.—31st July, 1880.
3163. PROPELLING STEAMSHIPS, C. F. Osborne, Glasgow.—31st July, 1880.
3166. DRILLING MACHINE, W. Boyd, Newcastle-upon-Tyne.—2nd August, 1880.
3176. ENGINES, &c., W. H. Northcott, Hatcham Ironworks, Pomeroy-street, London.—3rd August, 1880.
3177. EXTINGUISHING FIRE, N. Jarvie and W. Miller, Glasgow.—3rd August, 1880.
3186. TIE and CORE METAL, T. Hyatt, Addison-gardens, London.—4th August, 1880
3233. MUSICAL INSTRUMENT, C. A. Drake, Bedford-square, London.—7th August, 1880.
3240. UPHOLSTERY NAILS, W. Pitt, Tarrington.—7th August, 1880.
3360. SEWING MACHINES, H. Greenwood, Albion Works, Leeds.—19th August, 1880.
3383. SAFEGUARDS, J. Wetter, Strand, London.—20th August, 1880.
3664. TREATING SEROUS MATTER, R. Werdermann, Princes-street, London.—9th September, 1880.
3690. BOOTS, &c., C. F. Gardner, Worship-street, London, and W. H. Dorman, Stafford.—10th September, 1880.
3724. PIANOFORTES, R. Howson, Middlesbrough-on-Tees.—13th September, 1880.
3856. STEAM BOILER, &c., J. Henderson, Fenchurch-avenue, London.—23rd September, 1880.
3864. ANNEALING IRON, &c., W. H. Nevill, Ferryside.—23rd September, 1880.
4133. GRINDING MILLS, J. Rae, New York, U.S.—12th October, 1880.
4160. STEAM ENGINES, W. R. Lake, Southampton-buildings, London.—13th October, 1880.
4247. IRON and STEEL, W. L. Wise, Whitehall-place, Westminster.—18th October, 1880.
4267. GALVANIC BATTERIES, R. C. Anderson, Woodstock-road, London.—20th October, 1880.
4309. STOPPERS for BOTTLES, J. Davies and P. Humphreys, Ruthin.—22nd October, 1880.
4403. MASHING MALT, &c., G. G. Cave, Dowlais.—28th October, 1880.
4504. FIRE-PLACES, &c., A. Jennings, Glasgow.—4th November, 1880.
4511. FURNACES, J. Mactear, Glasgow.—4th November, 1880.
4542. STEAM-HEATING APPARATUS, L. W. Leeds, Woburn-place, London.—5th November, 1880.
4677. TREATING DATE FRUIT, &c., T. F. Henley, Walbrook, London.—13th November, 1880.
4683. GAS-LAMPS, C. W. Siemens, Queen Anne's-gate, Westminster.—13th November, 1880.
4685. PAPER, A. Ford, Gloucester-crescent, Regent's Park, London.—13th November, 1880.
4691. SPINNING MACHINERY, R. E. Osborne, A. Mathewson, and J. Guild, Dundee.—13th November, 1880.
4701. BALLOONS, H. A. Bonneville, Cannon-street, London.—15th November, 1880.
4747. GOVERNING, &c., APPARATUS, C. W. Wardle, Hunslet, Leeds.—18th November, 1880.
4795. GAS-MAKING APPARATUS, C. F. Dieterich, Baltimore, U.S.—19th November, 1880.

List of Specifications published during the week ending January 22nd, 1881.

1613, 6d.; 2011, 2d.; 2076, 2d.; 2103, 2d.; 2285, 2d.; 2369, 6d.; 2370, 6d.; 2378, 6d.; 2388, 4d.; 2397, 4d.; 2437, 4d.; 2453, 6d.; 2454, 6d.; 2461, 6d.; 2469, 6d.; 2477, 10d.; 2498, 2s. 4d.; 2501, 6d.; 2502, 6d.; 2503, 2d.; 2505, 2d.; 2506, 8d.; 2507, 2d.; 2508, 2d.; 2509, 6d.; 2510, 2d.; 2511, 6d.; 2512, 6d.; 2513, 6d.; 2514, 2d.; 2515, 2d.; 2516, 2d.; 2517, 8d.; 2519, 4d.; 2520, 4d.; 2521, 2d.; 2524, 2d.; 2525, 2d.; 2526, 6d.; 2527, 6d.; 2528, 2d.; 2529, 6d.; 2532, 4d.; 2533, 2d.; 2535, 2d.; 2537, 2d.; 2538, 2d.; 2540, 2d.; 2541, 6d.; 2542, 6d.; 2543, 6d.; 2544, 2d.; 2546, 2d.; 2547, 2d.; 2549, 2d.; 2558, 4d.; 2559, 4d.; 2562, 2d.; 2565, 6d.; 2568, 2d.; 2570, 6d.; 2571, 2d.; 2572, 2d.; 2573, 2d.; 2574, 6d.; 2576, 6d.; 2577, 2d.; 2578, 6d.; 2582, 6d.; 2584, 2d.; 2585, 4d.; 2590, 6d.; 2592, 2d.; 2593, 2d.: 2594, 2d.; 2596, 2d.; 2600, 2d.; 2601, 2d.; 2602, 8d.; 2603, 2d.; 2605, 2d.; 2606, 2d.; 2607, 2d.; 2609, 6d.; 2610, 6d.; 2612, 6d.; 2613, 6d.; 2614, 2d.; 2615, 2d.; 2616, 2d.; 2618, 4d.; 2619, 6d.; 2640, 2d.; 2627, 6d.; 2628, 6d.; 2631, 4d.; 2638, 6d.; 2620, 6d.: 2645, 6d.; 2655, 6d.; 2676, 6d.; 2711, 6d.; 3377, 6d.; 3500, 6d.: 4300, 4d.; 4325, 4d.; 4352, 8d.; 4368, 6d.

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

ABSTRACTS OF SPECIFICATIONS.

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

1613. HEATING, COOLING, AND VENTILATING, *G. E. Pritchett.—Dated 20th April,* 1880. *6d.*

Water or other fluid is introduced between plates and tubes placed so near to each other as to divide the water into thin sheets, whereby the plates or tubes are rapidly heated or cooled.

2248. PREPARING, SIZING, DRYING AND WARPING WOOLLEN YARNS, &c., *W. Bywater.—Dated 2nd June,* 1880. *6d.*

The regulation of the length of yarn for the time to be operated upon is regulated by stopping the motion of the apparatus automatically, for which purpose the screw C carries forward a tappet D which acts upon lever E connected to a second lever which effects the shifting of the belt fork G. The screw C is geared to the cheese A. In order to prevent a slipping of the

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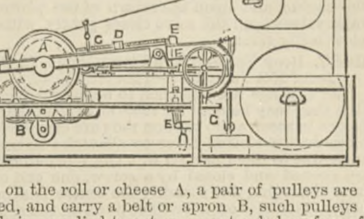

yarn on the roll or cheese A, a pair of pulleys are employed, and carry a belt or apron B, such pulleys and belt being applied to act on an extended surface of the roll or cheese of yarn.

2369. FURNACES FOR TREATING REFUSE, *B. D. Healy.—Dated 11th June,* 1880. *6d.*

The ordinary refuse is charged through the holes 1, falling upon the plates 2, below which are angular grate bars and horizontal grate bars. The inclined

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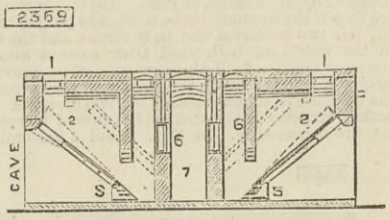

front of each furnace is supported on step bearers 5, in which step bars are fixed as required when clinkering. The products of combustion escape through outlets 6 to the chimney flue 7.

2370. PREVENTING THE TWISTING OF SHIPS' CABLES, &c., *J. A. Boxer.—Dated 11th June,* 1880. *6d.*

The drawing shows an end elevation of the apparatus for preventing the twisting of cables by the swinging of the ship, and for transferring the twists or turns when they occur from outboard to inboard to be further dealt with. A cylinder is pierced by two hawse holes B B, and fitted to a casing or tube, so that

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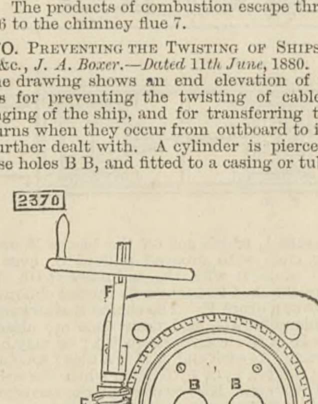

it can be rotated by the worm wheel D and the worm E on the vertical shaft F, which worm wheel and worm further form a stop or locking device to prevent the hawse pipe cylinder from turning under the action of the cable. A hole is pierced through the stem of the ship to receive the hawse pipe cylinder and its case, which are retained in their place endways by two covering plates.

2378. KNIFE AND PEELER, *H. Brands.—Dated 12th June,* 1880. *6d.*

A knife is pivotted at both ends to the shaft of a second knife in such a manner that the cutting edge of the pivotted knife coincides with the axes of the pivots, and is always parallel with the shaft of the second knife. The blade of the latter is of lancet or other suitable shape, while the other end of the shaft is fitted with a handle.

2388. GOVERNOR FOR STEAM ENGINES, *J. T. Abell.—Dated 12th June,* 1880. *4d.*

To the hollow spindle A of a governor two arms B are attached projecting at right angles thereto; on each of the two arms is loosely fitted a metal ball C, so that when in motion such ball can freely slide to and fro on the said arms, controlled by the spring D;

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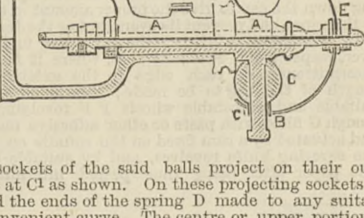

the sockets of the said balls project on their outer sides at C1 as shown. On these projecting sockets are fitted the ends of the spring D made to any suitable or convenient curve. The centre or upper portion of such curved spring is secured in any convenient manner to the upper part of the valve spindle at E.

2397. VALVES OF AIR COMPRESSING ENGINES, *S. Griffiths.—Dated 12th June,* 1880. *4d.*

The drawing represents in section an air outlet or delivery valve of an air compressing engine, in which A is the valve: B, the seating; C, the spindle of the valve which is lengthened in order to continue it through the stuffing-box D containing packing E; F

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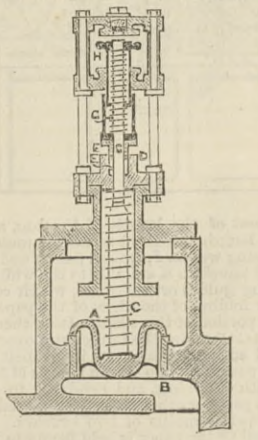

is the gland which is forced against this packing by screwing down the thumb screw H against the spiral spring G. The packing in its turn is forced against the valve spindle with a uniform pressure, which has the effect of restraining the movement of the valve within certain limits. This restraining action when applied as above described and delicately adjusted by regulating the position of the thumb screw H when the air compressing engine is at work, has the effect of immediately stopping the "chattering" of the valves against the seat, and instead of a succession of beats, which rapidly wear and in course of time break the valve, it is found that but one lift of the valve is made to allow the air to pass through it for each stroke of the engine, and upon the return of the piston as the inlet valves open the valve closes gently without any blow being given.

2437. ROOF TRUSSES AND VENTILATORS, *H. P. Holt.—Dated 16th June, 1880.—(Complete.)* 4d.

The castings are designed to be interchangeable, so that they may be used for roofs of several spans. The bosses to receive the tension rods are circular, and are formed with slotted holes to allow the tie-rod taking angle due to the strain on it. The ventilators in a roof are opened and closed by a screw, one end of which runs through a nut forming the centre boss of a cord pulley, mounted on a bracket fixed on the side of the light frame. The other end of the screw has a T head, which engages in a slide fixed on the light, which allows play for the light to swivel on its hinges.

2453. ELECTRIC APPARATUS FOR WORKING RAILWAY BRAKES, *J. C. Mewburn.—Dated 17th June, 1880.—(A communication from F. A. Achard.)* 6d.

This is an improvement on a former apparatus invented by M. Achard, of Paris. The leading features are that if the commutator be worked to put the brakes on, the two batteries, one in the front and the other in the rear van, both send their current into the electro-magnets of all the carriages, thus providing against a diminution of the tension of the current by the addition or combination of the two currents. The brakes are also automatic, and in case of a breakage act instantaneously. In Figs. 1 and 2 the ordinary

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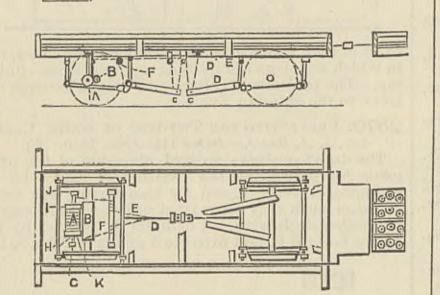

brake levers A, which act on the blocks B, are fitted at their ends with grooved pulleys C, over which passes a chain D with the end fixed at D^1. To this chain are attached two others E, carried obliquely and wound over a drum F. The chains E afterwards pass over guide pulleys G, and their ends are attached to the axis H of the electro-magnet A; or may be actuated direct. At each end of H is a disc I touching the axle and rotated by it by friction when the current is sent. The magnet is suspended to the carriage frame by rods J and steel spring copper-covered plates K.

2454. ROTARY HEEL TIP FOR BOOTS, &c., *H. Ball.—Dated 17th June, 1880.* 6d.

The tip is circular, and provided with flanges at the bottom of the internal edge, on which a piece of leather is dropped, such piece being fastened to the heel by brads, leaving the tip free to turn.

2461. ROTARY PUMPS, BLOWERS, &c., *J. W. Melling.—Dated 17th June, 1880.* 6d.

The drawing shows a cross section of a rotary pump or blower in which A is the casing; B B are the shafts; C C are the propellers, on which are formed or fixed

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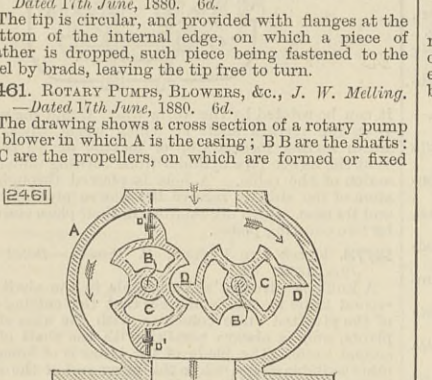

the projections or pistons D D; and D^1 D^1 are packing pieces extending the whole length of the propellers, which can readily be replaced when worn. The fluid or liquid enters at the aperture at the top of the casing and is drawn or forced in the direction indicated by the arrows.

2469. MANUFACTURE OF PAPER BAGS, *J. Nichols.—Dated 18th June, 1880.* 6d.

The roll of paper A is mounted at one end of the machine on a spindle working in suitable bearings, the friction of which may be increased as well by tightening down the cap to give the proper amount of tension to the paper, and prevent its overrunning the draw rolls B C. The paper as it leaves the roll passes under and over, respectively, two rolls D E, where it is passed intermittently on each edge to the extent of the length of the bag to be made; this is effected by suitable and adjustable wheels F F revolving in a trough G filled with paste or other adhesive medium, and actuated by a cam fixed on the spindle on which the severing knife revolves, and by suitable levers. The paper after being thus pasted intermittently

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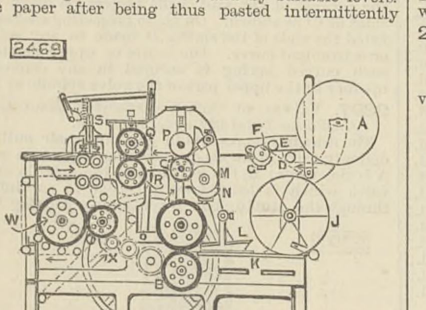

to the extent of the length of the bag, and a corresponding length impasted is drawn under a pair of large creasing wheels J, it then passes under a particular shaped template K suitable to the width of the bag and curling guides or folders L, which complete the turning or folding of the edges of the paper, and thus forms the portion of the seam. It is then drawn by the rolls B C C^2 under the former and over the latter, the folded edges or seams in its transit being continuously pasted by two elastic wheels M M adjustable to the width of the bag, and revolving in a trough N filled with paste or other adhesive material, this being evenly spread by means of two brushes. In passing over the roll C^2 the paper is held firmly in position by two draw rolls P which are adjustable on the spindle and are fixed to revolve between the two pasted seams, in which state it is drawn between the rolls Q and R. The length of the roll Q is such that it revolves between the two pasted seams, and its diameter is determined by the length of the bag to be made. A saw-shaped blade or knife is fixed on and projects beyond its periphery and extends at each end of the roll to the full width of the bag. X is an impression cylinder by means of which the bag is printed, and W is a distribution cylinder.

2477. BOOKBINDING, *W. L. Wise.—Dated 18th June, 1880.—(A communication from F. Martini and Co.)* 10d.

The machinery is so constructed that the sheets which are laid in are folded and grooves cut into their backs, bookbinders' thread is passed through, and the sheets are pressed through cylinders and laid out on a receiver. The thread passes on one side into the

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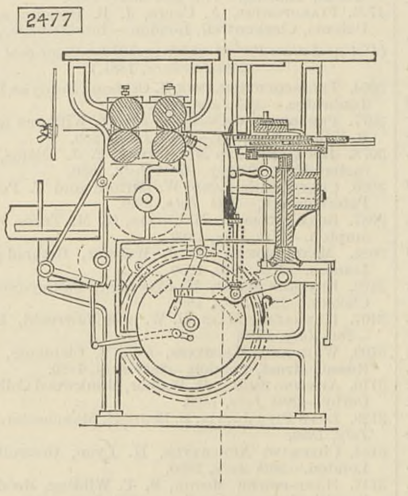

sheet, and having gone through a small box filled with binders' starch, sticks to the inner side of the fold, and is carried forward, drawn slightly out of the grooves forming there small ears; and brought out at the other end of the sheet. Both ends of the thread are mechanically cut so as to leave ends. Adjustable marks give an exact indication for laying on.

2497. MANUFACTURE OF VANILLIN, *W. R. Lake.—Dated 19th June, 1880.—(A communication from A. Meissner.)* 4d.

This consists in manufacturing vanillin from engenol by first forming acetengenol, then oxidizing the acetengenol, with permanganate of potash in a neutral solution, and finally further oxidising the product with bichromate of potash in a neutral solution.

2498. HULLS OF VESSELS, &c., *H. Hirsch.—Dated 19th June, 1880.* 2s. 4d.

This consists in applying to the shaping and construction of bodies to be acted upon by water curved lines of the same nature as those which the constituent molecules of water describe in their own motion. This shaping is effected by means of circles placed in juxtaposition one with the other.

2501. BRAIDING MACHINE, *W. E. Jefferson and E. Lee.—Dated 21st June, 1880.* 6d.

This relates to a means for at once stopping the machine in case of the breakage or running out of any one or other of the rubber threads. A A are the lower ends of the hollow axes of the revolving heads of the braiding machinery up through which the rubber

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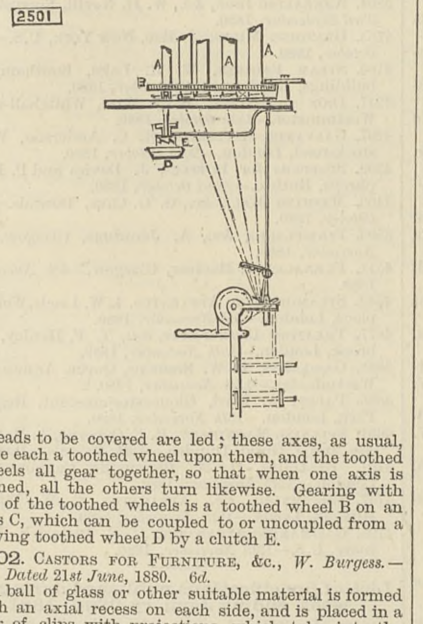

threads to be covered are led; these axes, as usual, have each a toothed wheel upon them, and the toothed wheels all gear together, so that when one axis is turned, all the others turn likewise. Gearing with one of the toothed wheels is a toothed wheel B on an axis C, which can be coupled to or uncoupled from a driving toothed wheel D by a clutch E.

2502. CASTORS FOR FURNITURE, &c., *W. Burgess.—Dated 21st June, 1880.* 6d.

A ball of glass or other suitable material is formed with an axial recess on each side, and is placed in a pair of clips with projections, which take into the recesses so as to form pivots, on which the ball revolves. These clips are connected to the vertical pivot on which the castor revolves.

2506. UNITING PAPER AND WOVEN FABRIC IN CONTINUOUS LENGTHS, *R. J. and A. Edwards.—Dated 21st June, 1880.* 8d.

B is the roll of paper which passes over a roller revolving in paste, and thence to a rail E and through

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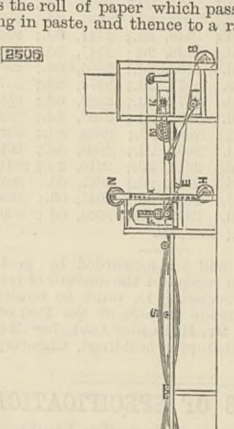

pressure rollers F, where it meets a sheet of cloth coming from roller H. A second length of paper is led from roller M, and passing over a paste roller K, is pasted to a length of cloth from roller N, the two lengths thus formed passing together through rollers F. The two lengths pass respectively over the top and bottom surfaces of the drying boxes S and are wound on the rollers U.

2507. SEWING BOOTS AND SHOES, *M. H. Pearson.—Dated 21st June, 1880.—(Not proceeded with.)* 2d.

In machines for sewing the outsoles to the welt or middle sole, a curved needle is mounted on a lever pivotted on the top of a needle post capable of a rotary reciprocating movement for the feed, such movement being conveyed to the needle through the lever. The shuttle is of circular form hollowed out to receive the cop of thread, and on its periphery is a point to take hold of the needle thread. A rotary reciprocating motion is imparted to it from a cam, and transmitted through a toothed sector and gearing. The thread lever operates above the needle lever to draw up the slack and complete the stitch. The presser foot is attached to a lever mounted in bearings concentric with the needle lever.

2508. BILLIARD BALLS, *H. G. Grant.—Dated 21st June, 1880.—(A communication from T. A. Gason.)—(Not proceeded with.)* 2d.

To ensure correctness of weight of these balls to each other, a hole is bored in each and extends to the centre, such hole being screw threaded to receive a plug. Before inserting the plug metal or other suitable material is placed in the hole.

2509. HIGH-PRESSURE HOT AIR ENGINES, *H. G. Grant.—Dated 21st June, 1880.—(A communication from Lecompte P. E. de Massia de Ranchin.)* 6d.

If air of 0 deg. be enclosed in a vessel and heat applied thereto, then as the temperature rises to 272 deg., there will be an internal pressure of upwards of 2 kilos. per square inch. On the other hand, when pressure is applied to a gas, its volume diminishes, as, for example, if the pressure be doubled, its volume is diminished one-half. If the enclosed air is at 0 deg. and the pressure five atmospheres, this pressure will increase to ten atmospheres, if the temperature be varied to 272 deg., for at this temperature the volume would be double that of before; now as the volume remains

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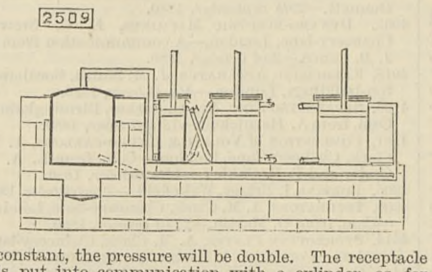

constant, the pressure will be double. The receptacle is put into communication with a cylinder, as, for example, the cylinder of an engine; the piston will be put in motion by a pressure of ten atmospheres; but as the air is carried away by this process, the boiler pressure diminishes until it arrives at atmospheric pressure, when the engine will stop. To prevent this the piston is arranged to drive a pump, which pumps the air back into the receptacle.

2510. BOTTLE STANDS, *G. Travis and T. Hill.—Dated 21st June, 1880.—(Void.)* 2d.

The bottles stand in recesses formed in the base of the stand, and are prevented from being lifted out by a bar extending over the tops of the stoppers and secured in this position by a lock and key.

2511. STANDS FOR SPIRIT BOTTLES, &c., *W. and J. W. Bartram.—Dated 21st June, 1880.* 6d.

The bottles stand in recesses in the base of the stand, and over their stoppers is fitted a slide provided with shields which can be brought over the stoppers and prevent the bottles being withdrawn. A lock is provided to secure the slide in this position.

2512. FOLDING PAPER, *J. Richmond and W. Whiting, Dated 21st June, 1880.* 6d.

The framing A below the table B supports a shaft driven by the driving pulley. This shaft carries two cams; one cam, through the medium of a compensating-rod, friction roller, and levers H, gives motion to the vibrating knife K and the vibrating roller L, which, with the roller L^1, forms the first pair of rollers, between which the doubled-up paper passes.

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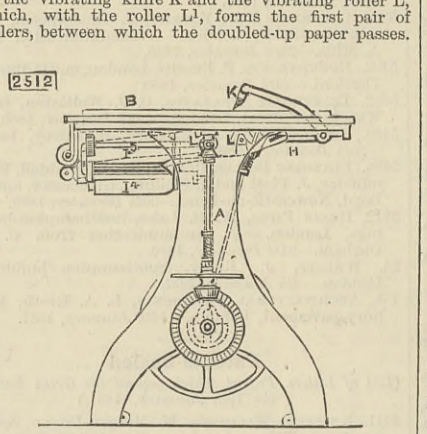

The roller L, during the descent of the knife K, is brought into contact with the roller L^1 revolving in fixed bearings, and is again withdrawn during the time the knife K is descending. The second cam transmits, through the medium of a compensating-rod, friction rollers and levers, motion to the vibrating roller I^4, which. with the roller I^5, forms the second pair of rollers, which are placed at right angles to the rollers L and L^1; the said roller I^5, supported in fixed bearings, has brought into contact with it whilst revolving the vibrating roller I^4.

2513. MINING MACHINES, *B. J. B. Mills.—Dated 21st June, 1880.—(A communication from G. D. Whitcomb and O. Butler.)* 6d.

The wheels A support the cylinder B over which is the steam chest C, enclosing a slide valve D operated by the cam E worked by a single excentric rotary engine F, the shaft of which has a hand wheel to start the excentric. On the upper face of the slide valve are two annular arcs, which guide a horizontally oscillating cup slotted upon its upper face to receive the cam E. The free motion of this cup allows it to adjust itself to the varying direction of the cam. The piston-rod stuffing box G projects from the cylinder

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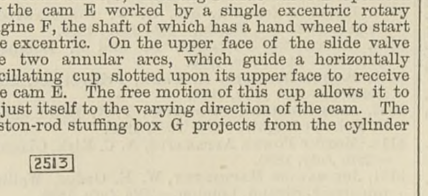

head, and is screw-threaded to receive the pick-holder sleeve, in which the pick-holder slides. On the upper side of the steam chest is a rectangular box J which serves as a guide for two pawls, that engage in the ratchets L on the wheels A, so as to prevent any retrograde motion. A pair of adjustable arms P slide in guides, so that they may be lengthened or shortened. The pick or channelling tool is chisel-shaped and has the bevel wheel wholly on one side, and a V-shaped notch on its edge, so that there is no tendency to wedge or glance side-wise.

2514. ARTIFICIAL LEATHER, *A. M. Clark.—Dated 21st June, 1880.—(A communication from L. B. le Gendre.)* 2d.

Scraps of Morocco leather are dipped in glue and laid upon sheepskin, and when a sufficient quantity is placed thereon a second sheepskin is placed over them. The two skins are then placed between flannel and between zinc plates, and subjected to hydraulic pressure, the flannel serving to absorb the glue expressed.

2517. SHEAF-BINDING APPARATUS, *C. D. Abel.—Dated 21st June, 1880.—(A communication from C. W. Levally.)* 8d.

The cord wound in the form of balls is contained in an upright cylindrical vessel, a number of balls being placed in the vessel one above the other, with the outer end of the cord of each ball attached to the inner end of the cord of the ball below it, so that as each ball is exhausted the next supplies cord. To prevent entanglement or kinks a stem jointed to the bottom of the box extends upwards through the balls, or a flexible stem is employed for this purpose. The cord passes through a hole in the top of the case and through adjustable clamps to give it the required tension, and thence along a spring arm and over a pulley at its end to the eye of what may be termed a needle, which is a bent lever mounted on a movable fulcrum, the needle and its fulcrum being made to oscillate by cams, so that the point of the needle

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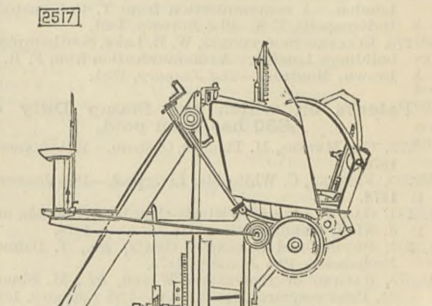

follows a certain curvilinear path in descending to the position where it is for a time held steadily in a notch of the framing and then ascends in a different path. The end of the cord after passing over a pulley in the eye of the needle extends to and is held in a movable clamp provided with a cutting knife, the clamp and knife being actuated by cams, so as to seize and release and cut the cord at periods timed to the other movements of the mechanism. Near the cord clamp is mounted the tying apparatus, which consists of a hook eye having peculiar movements effected by cams, so that at a certain time the eye opens to receive the cord, and then closing revolves and moves endways, so as to pass one convolution of cord through another, thus producing a knot.

2519. METAL ARTICLES WITH SURFACE ORNAMENTATION, *W. A. Barlow.—Dated 21st June, 1880.—(A communication from O. von Wiersbitzky.)* 4d.

This relates to the production of articles in metal having ornamentation of inlaid work by means of electrotyping. The pattern is traced on the metal and the pieces of material shaped to form the pattern are pasted on the metal which is then coated with a metallic deposit so as to embed the different pieces forming the pattern.

2520. MILLSTONES, &c., *F. C. Glaser.—Dated 22nd June, 1880.—(A communication from H. Schomburg.)—(Not proceeded with.)* 2d.

This relates to millstones in which the grinding surface consists of bars of hard material bedded in other material forming the body. So as to cause the grinding surface to wear equally the bars are made tapering so that the grinding surface increases towards the circumference. The part of the stone forming the grooves between the grinding bars is formed together with the central portion of the stone of one and the same mass of artificial stone.

2521. STOPPING BOTTLES, &c., *J. Broel.—Dated 22nd June, 1880.—(Not proceeded with.)* 2d.

The neck of the bottle is pinced in or slightly flattened at the lower part, and the stopper of glass is circular in horizontal section at the upper part while its lower part is extended so as to assume an oval shape. When the stopper is inserted the oval part passes through the corresponding portion of the opening, and by turning it partly round it will be locked within the neck by projection of the oval portion passing under the flattened portion of the neck. A modification is described.

2524. BUTTONS, *W. R. Lake.—Dated 22nd June, 1880.—(A communication from T. L. Snyder.)—(Not proceeded with.)* 2d.

The button-head is made of a single piece of hard material and at its rear side is a recess of dovetailed section and convexed base. A thin metal shell has a central orifice through which passes a shank of canvas secured to the shell by a metal disc, which clamps it between itself and the shell. The shell is now forced into the recess in the button, when the convex base spreads the edge of the shell into the inclined edge of the recess firmly locking it therein.

2525. FASTENERS FOR BOOTS, &c., *F. Hinde.—Dated 22nd June, 1880.—(Not proceeded with.)* 2d.

A shank button is fixed to one side of the material, and a wire of metal of S-shape with projecting shank or loop in the middle, which is threaded through the button proper, is fixed on the other side of the material. The S-shaped wire prevents the button being wrenched out.

2526. RAILWAY SIGNALS, *E. A. Sullivan.—Dated 22nd June, 1880.* 6d.

A is the ordinary rail and B a side rail placed preferably outside the track and having its leading end bent down, being held up by springs. A frame supports the gong D above which is a lamp F and disc G. The cord I passes over a pulley and is attached to the striking lever H, which when raised depresses the rail B. This cord is attached to the line wire connected with a hand lever in the signal box. The cord K is

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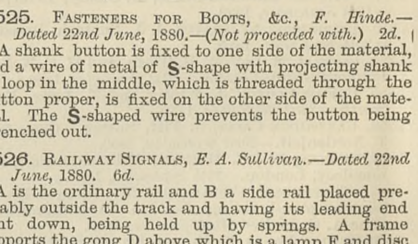
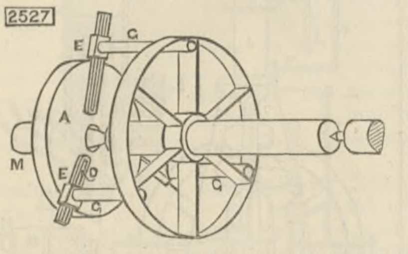


also connected to the line wire and passing over a pulley is connected to the disc G. A passing wheel depresses the side rail B, and thereby forces down lever H, the head of which strikes the gong D. When the rail B is depressed by means of the line wire no signal will be given. The disc G is only actuated by the line wire.

2527. Carriers, Dogs, or Drivers for Turning Lathes, *W. R. Lake.—Dated 22nd June, 1880.—(A communication from J. Hill.)* 6d.

The dogs G are applied to a face-plate A provided with an internally screw-threaded hub, by means of which it is screwed upon the live spindle M of a lathe. When three dogs or drivers are to be used, a circle is laid off upon the face-plate, taking the centre of the spindle as its centre, making this circle for small face-plates as near to the hub of the face-plate as practicable. The circle is then divided into three equal parts, and at each point of division a hole is drilled through the face-plate to receive a spindle. When the face-plate is of sufficient thickness to furnish the requisite length of bearing for the spindle, the plate may



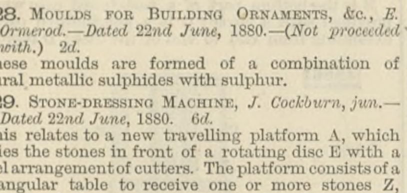
be formed with bosses or hubs, through which the spindle will pass, and thus have the required bearing surfaces. To each spindle is rigidly secured a radial arm D, arranged parallel with the face of the plate. Upon each one of these radial arms is fitted a slide E, from which projects to a considerable length a dog G, preferably arranged to extend out from one end of the slide, so that the slide may be detached from the arm D and reverse, in order that in again fitting it upon the radial arm the dog may be brought nearer to or farther away from the centre of the face-plate as required.

2528. Moulds for Building Ornaments, &c., *E. Ormerod.—Dated 22nd June, 1880.—(Not proceeded with.)* 2d.

These moulds are formed of a combination of natural metallic sulphides with sulphur.

2529. Stone-dressing Machine, *J. Cockburn, jun.—Dated 22nd June, 1880.* 6d.

This relates to a new travelling platform A, which carries the stones in front of a rotating disc E with a novel arrangement of cutters. The platform consists of a rectangular table to receive one or more stones Z, which are laid flat or on edge on a board secured to the table. At each end of the table is a standard, on which rests a longitudinal beam, extending from end o end, but having intermediate columns, so as to form



divisions, each of which can receive a stone. These columns can be removed when dressing a long stone. Each division is fitted with a steadying plate B, which are lowered on to the stones by means of screws. The table A is carried on wheels C, running on rails, and it is fed forward by a chain D, actuated by rack and pinion or screw gearing. The disc E is formed with four radial ribs at the back, to which the cutter holders are secured, and is revolved by suitable means. The cutters are arranged round the disc at different radial distances, so as to describe different circles.

2532. Billiard Balls, *F. Wirth.—Dated 22nd June, 1880.—(A communication from H. Ainmiller.)* 4d.

A composition, consisting of 80 parts bone gellatine—called Russian glue—10 parts Cologne glue, 5 parts heavy spar—carbonate of barytes—4 parts carbonate of lime, and 1 part boiled linseed oil, colouring matter being added if desired to produce coloured balls.

2533. Vegetable Fibre, *F. Wirth.—Dated 22nd June, 1880.—(A communication from S. Metzger.)* 2d.

Mexican or Tampico fibre is stained black, and placed in a bath of sulphuric acid, and then into a soda bath. While still wet, it is subjected to a strong rubbing, whereby it receives a deep black and perfect gloss and smoothness, which it never loses, and is rendered in appearance equal to bristles or horsehair.

2535. Utilisation of Furnace Slag, &c., *J. Wetter.—Dated 22nd June, 1880.—(A communication from G. Moysan)—(Not proceeded with.)* 2d.

The slag is collected in a ladle and taken to a mould and moulded by a press analogous to that used in the manufacture of terra-cotta. The piece is taken off the mould while red hot and treated in an annealing furnace.

2537. Decks of Ships, &c., *J. G. Hartley.—Dated 22nd June, 1880.—(Not proceeded with.)* 2d.

Waste cuttings of wood are secured together by cement or glue, in two or more layers, to form a wooden body about 3in. thick. This structure is laid down on the iron decks of ships in slabs, and secured thereto by cement or other adhesive substance. On this wooden body or structure planks are secured by nails to form the surface of the deck.

2538. "Emulsion" Processes of Photography, *R. Knott.—Dated 22nd June, 1880.—(Not proceeded with.)* 2d.

Two bottles with an intermediate stopper having a small perforation are employed. The solutions to be mixed are contained in the two bottles, and by shaking, the more fluid solution passes in small quantities from the bottle containing it to the other one, whereby the solutions are gradually mixed.

2540. Adjustable Double Ball Bearing for Bicycles, &c., *T. Humber, T. R. Marriott, and F. Cooper.—Dated 22nd June, 1880.—(Not proceeded with.)* 2d.

A double set of balls are applied to the wheel bearing, in order to reduce the friction to a minimum. The internal parts are protected from dust and are readily adjustable from without. The two sets of balls are parallel to each other and near together, and the pressure is equally distributed between and sustained of them.

2541. Damping Biscuits, &c., *E. Harvey.—Dated 22nd June, 1880.* 6d.

At the mouth of travelling ovens is a perforated steam pipe extending across the baking space, and arranged so as to blow steam at an angle upon the biscuits as they pass under the door of the oven. The condensed water runs along the bottom of the pipe and enters troughs at the ends. To moisten the atmosphere of the oven a second steam pipe is placed outside the baking space and below the baking rails.

2543. Driving Bands, Wire Rope, &c., *J. H. Johnson.—Dated 22nd June, 1880.—(A communication from J. A. J. Liebermann.)* 6d.

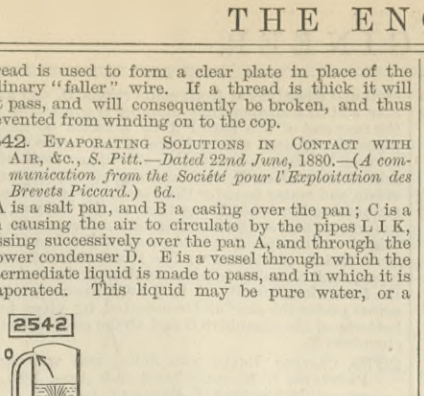
These driving bands are composed of a series of wires coiled in a helical form, and connected together by causing the coils of each helix to engage with the coils of the adjacent helices. To unite the two ends of the lengths so formed a helix, similar to those forming the band, is caused to interlock its coils with the coils of the helices at each extremity of the belt simultaneously.

2544. Mules for Spinning, *T. G. S. Garnett.—Dated 23rd June, 1880.—(Not proceeded with.)* 2d.

So as to prevent irregular yarn or thread being wound on the cop a plate with a narrow slit for each thread is used to form a clear plate in place of the ordinary "faller" wire. If a thread is thick it will not pass, and will consequently be broken, and thus prevented from winding on to the cop.

2542. Evaporating Solutions in Contact with Air, &c., *S. Pitt.—Dated 22nd June, 1880.—(A communication from the Société pour l'Exploitation des Brevets Piccard.)* 6d.

A is a salt pan, and B a casing over the pan; C is a fan causing the air to circulate by the pipes L I K, passing successively over the pan A, and through the shower condenser D. E is a vessel through which the intermediate liquid is made to pass, and in which it is evaporated. This liquid may be pure water, or a



saline solution or other liquids may be employed. F is a pump by which the intermediate liquid is made to circulate in the pipes N and M between the shower condenser D and the vessel E where the evaporation of the intermediate liquid takes place. G is a compresser or pump, withdrawing the vapour from the vessel E by the tube O, and forcing it by the pipe P into the space surrounding the tubes in the boiler H.

2546. Basis for Embroidery, *S. Redhouse.—Dated 23rd June, 1880.—(Not proceeded with.)* 2d.

Two or more pieces of lawn, muslin, crape, or other kindred material are placed one over the other, and the pattern worked by hand or machine through and upon the base thus formed. The stitching is unbroken and is carried along the bottom of the lower piece in such a manner as to unite by a chain stitch every separate portion of the entire outline of the pattern.

2547. Potato Diggers, *J. Kirkpatrick.—Dated 23rd June, 1880.—(Not proceeded with.)* 2d.

A screen is attached to the frame of the machine so that a jogging or tilting motion can be given to it. This screen is placed in a line with the prongs, the end nearest the tail of the machine being at a lower level than that nearest the front of the machine, the part at this lower level being near to or touching the ground.

2549. Knives for Wood Planing Machinery, *T. J. Clarke.—Dated 23rd June, 1880.—(Not proceeded with.)* 2d.

A piece of hardened steel of the required length and width is sharpened, and a piece of soft steel of the same length, but a little narrower, is bevelled on one edge and slightly hollow on one side. The knife is then clamped to the knife block with the soft steel plate on the back of the other, so that the bevel edge of the soft steel plate comes close to the back of the knife edge to prevent it from breaking. The holder is made with a T-groove, so that each bolt used to secure the knife may be put separately into its own groove.

2558. Combs, *F. H. F. Engel.—Dated 23rd June, 1880.—(A communication from T. Schnitzlein.)* 4d.

This relates to combs made of vulcanised india-rubber, horn, and celluloid, and consists in forming a concave groove extending towards the foot of the teeth and diminishing in width with the prolongation of the teeth. The base of the teeth are formed with a conically tapering broad base so as to render them strong and elastic.

2559. Cigars, *B. B. Mills.—Dated 23rd June, 1880.—(A communication from F. Germeshausen.)* 4d.

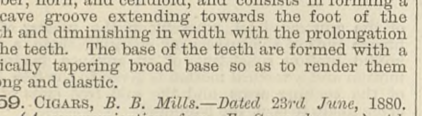
The point of the cigar consists of a small piece of parchment or paper rolled so as to form a tube which is partly filled with clean wadding and placed on the cigar, being fixed thereon by the wrapper. The wadding serves to absorb the nicotine and also arrest any dust in the smoke.

2562. Shears for Pruning, &c., *S. Ault.—Dated 23rd June, 1880.—(Not proceeded with.)* 2d.

This consists principally in so constructing the parts of the shears or pruners that one of the blades or cutters is stationary, and the other capable of sliding upon the stationary blade for effecting the shearing or pruning operation.

2565. Polishing, Cleaning, or Dressing Metals, &c., *T. Fenwick.—Dated 23rd June, 1880.* 6d.

The spindle A is fitted with a handle B, at one end retained by a nut, so as to be capable of removal, whilst the other end is fitted with a fixed handle C.



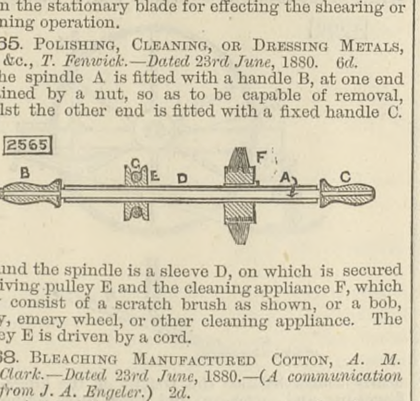
Around the spindle is a sleeve D, on which is secured a driving pulley E and the cleaning appliance F, which may consist of a scratch brush as shown, or a bob, dolly, emery wheel, or other cleaning appliance. The pulley E is driven by a cord.

2568. Bleaching Manufactured Cotton, *A. M. Clark.—Dated 23rd June, 1880.—(A communication from J. A. Engeler.)* 2d.

About 150 kilogrammes of cotton are placed in a closed vat communicating with an apparatus in which are mixed 1 part of unslaked lime and 1 part chloride of lime with 1 part of spirits of wine or acetic acid, and 4 parts water, the whole being treated with sulphuric acid, whereby about 2¼ cubic metres of vapours of chloroform are produced, which vapours under a pressure of 2 atmospheres, will thoroughly bleach in two hours the whole of the cotton in the vat.

2570. Adjustable Spindles for Locks, &c., *W. B. Shorland.—Dated 24th June, 1880.* 6d.

The handles A are secured on the ends of the two parts, B forming the spindle, each of which has at one end one or more screw tapped holes to allow for different thicknesses of doors, and an open slot in the other end through which a screw passes, such screw



being inserted at one side of the neck of the handle and passing through the tapped hole in one part of the spindle, and the slot in the other part, is screwed into the opposite side of the neck. The faces of the two parts of the spindle which are in contact are formed with teeth, which engage with each other so as to prevent sliding.

2571. Securing Coal-plates, &c., *W. G. Hunt.—Dated 24th June, 1880.—(Not proceeded with.)* 2d.

The plate which covers the hole to the coal cellar is secured by means of a rod, which hooks into an eye on the under side of the plate, its opposite end being screw threaded and passing through a cross bar, where it is fitted with a nut.

2572. Folding Bedsteads, &c., *J. Wetter.—Dated 24th June, 1880.—(A communication from C. G. Held.)—(Not proceeded with.)* 2d.

This relates to the general construction of bedsteads, chairs, or tables, so as to enable them to close up into a small space.

2573. Glasses for Gas or Oil Lamps, *E. Webb.—Dated 24th June, 1880.—(Not proceeded with.)* 2d.

The glass is made circular at its base in order that it may fit all existing gas fittings, and is gradually tapered and brought to a flat aperture at the top, by which means a flat current of air is made to act on the flat flames.

2574. Stand for Holding Bottled Effervescing Liquids, *W. E. Carter.—Dated 24th June, 1880.* 6d.

The stand is so formed that the bottles it contains when not in use may be turned upside down, whereby the gases in the liquid are kept at the bottom of the bottle, so that when the bottle is turned up to pour out the liquid the gases have to pass through the same and cannot immediately escape. The stand consists of an upright attached to a plate, and having at its centre a frame pivotted. The bottle is held on this frame by a spring bottom and at top a tapered cork or stopper.

2576. Skates, *E. R. Kimpton.—Dated 24th June, 1880.—(A communication from J. A. Whelpley.)* 6d.

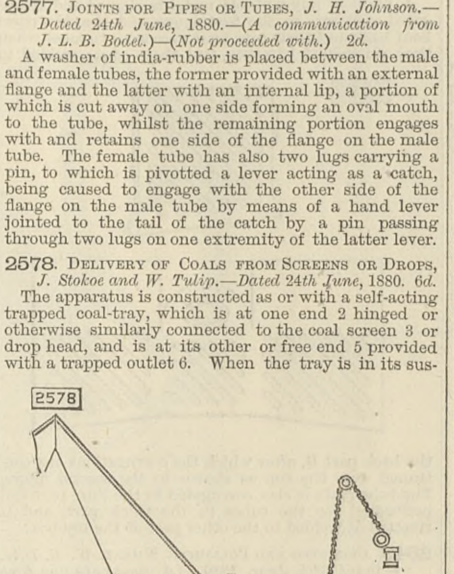
The sole plate is divided and pivotted between the toe cap and knee pieces. The heel plate has ears turned up to receive the back part of the heel, and has a small projection in front which is turned down in front and slotted to receive the after end of a forked link. A lever is formed with an excentric ear and is attached to the link by a button sliding freely in a slot of the link. A bridge supports the after end of the sole plate and is fastened to the runner by knees. The forked ends of the link have projections which enter diverging slots in the end of the divided sole plate. The forked link is formed with numerous holes to receive a pin in the adjusting plate.

2577. Joints for Pipes or Tubes, *J. H. Johnson.—Dated 24th June, 1880.—(A communication from J. L. B. Bodel.)—(Not proceeded with.)* 2d.

A washer of india-rubber is placed between the male and female tubes, the former provided with an external flange and the latter with an internal lip, a portion of which is cut away on one side forming an oval mouth to the tube, whilst the remaining portion engages with and retains one side of the flange on the male tube. The female tube has also two lugs carrying a pin, to which is pivotted a lever acting as a catch, being caused to engage with the other side of the flange on the male tube by means of a hand lever jointed to the tail of the catch by a pin passing through two lugs on one extremity of the latter lever.

2578. Delivery of Coals from Screens or Drops, *J. Stokoe and W. Tulip.—Dated 24th June, 1880.* 6d.

The apparatus is constructed as or with a self-acting trapped coal-tray, which is at one end 2 hinged or otherwise similarly connected to the coal screen 3 or drop head, and is at its other or free end 5 provided with a trapped outlet 6. When the tray is in its sus-



pended position the outlet is kept closed by the trap 10 by means of stepped rods 11, which are connected thereto at 12, and engage with stay rods or guide bars 13 depending from the tray, the trap 10 being hinged at 14 to parts 15 rising from the tray.

2582. Umbrellas and Parasols, *W. T. Parr.—Dated 24th June, 1880.* 6d.

To retain the umbrella opened or closed, two slots are formed one from each end in the runner tube with a partition between them. Upon the runner tube another tube is mounted, being retained by a rim on the runner tube, and capable of making a partial revolution. Bayonet-shaped slots are cut in the outer tube, the vertical portions corresponding with the slots in the runner tube. On the umbrella stick are two studs, and when the umbrella is opened, the upper pin enters the vertical slots in the tubes, and by partially revolving the outer one, the pin enters the bayonet slot in the outer tube, and thus retains the umbrella open. The other pin acts similarly to keep the umbrella in position when closed.

2584. Collapsible Core Barrels, *J. Mortimer.—Dated 25th June, 1880.—(Not proceeded with.)* 2d.

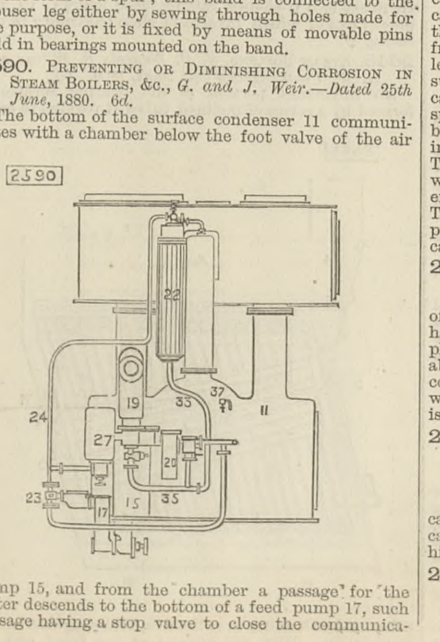
The shell is jointed to the tube by means of lugs and links, and is provided with internal flanges against which two circular end plates rest. The top plate is made with a circular groove in its underside and the corresponding flange is provided with a circular projecting V-shaped rim which fits into this groove.

2585. Preserving Trousers from Dirt and Wear, *A. Ligabue.—Dated 25th June, 1880.* 4d.

This consists of a thin metal or other band or ribbon in the form of a spur; this band is connected to the trouser leg either by sewing through holes made for the purpose, or it is fixed by means of movable pins held in bearings mounted on the band.

2590. Preventing or Diminishing Corrosion in Steam Boilers, &c., *G. and J. Weir.—Dated 25th June, 1880.* 6d.

The bottom of the surface condenser 11 communicates with a chamber below the foot valve of the air



pump 15, and from the chamber a passage for the water descends to the bottom of a feed pump 17, such passage having a stop valve to close the communication when desired. A hot well 19 is applied in connection with the delivery end of the air pump, and a second feed pump 20 is applied at the side of the air pump. The vessel 22 may be either a feed heater or an air separator. The pump 17 delivers to a three-way cock 23, from which a pipe 24 leads to the vessel 22, and another pipe to the boiler feed pipe. The hot well 19 communicates through a vessel 27, and pipe with pipe 24, and in vessel 27 is a float to prevent the passage of free air when the water gets below a certain level. The feed heater 22 has a pipe 33 leading to the inlet valve of the pump 20; and a pipe 35 also forms communication with that pump from the bottom of hot well 19, the pump delivering into the boiler feed pipe. From the top of vessel 22 a pipe leads air separated from the water into the condenser 11. The feed water may be taken directly from hot well 19 and passed by pump 20 into the boiler feed pipe, or it may be led through float vessel 27 and by pipe 24 to the feed heater or air separator 22, and thence to pump 20; or again it may be taken directly from the condenser without passing through the air pump 15 and be forced by pump 17 either through vessel 22 or directly to the boiler feed pipe. When an anti-corrosive gas is to be added to the feed water it may be led into condenser 11 by a pipe and stop-cock 37. An improved pumping apparatus is described consisting of two toothed wheels gearing together and placed in a box the sides of which do not touch the box; and in which there is the same liquid pressure all round the wheels, excepting at a small part of each wheel.

2592. Beating Carpets, &c., *W. J. Alldred.—Dated 25th June, 1880.—(Not proceeded with.)* 2d.

From the hinged end of each beater is attached a short rod or lath as a lever. At a short distance from the horizontal beater beam and parallel to it is placed a drum through the centre of which passes an iron rod, each end working in a bearing and continued long enough beyond the bearings to allow of crank handles or wheels, for the purpose of giving a rotary motion to the said drum.

2593. Gasaliers, &c., *R. Phelps.—Dated 25th June, 1880.—(Not proceeded with.)* 2d.

To the inner tube of an ordinary gas fitting and at a required distance from the bottom exterior is permanently arranged a seat; a loose cap is fed upon the tube until reaching the seat, and into this, also upon the tube, is placed the one end of a cylindrical washer of india-rubber of any desired length; a second cap is employed which covers the other end of the india-rubber washer. The same is held in position by means of a screwed nut upon the exterior surface of the said tube.

2594. Top Clearers for the Drawing Rollers of Preparing and Spinning Machines, &c., *R. Southworth.—Dated 25th June, 1880.—(Not proceeded with.)* 2d.

This consists partly in the use of a perforated belt of india-rubber or other material attached to the inner surface of the top clearer, which belt is driven by a spur wheel or projections on the driving shaft, which gear into the perforations in the belt; this belt works in recesses in the driver and driven shafts.

2596. Surface Printing Plate, *E. Evans and S. J. Hodson.—Dated 25th June, 1880.—(Not proceeded with.)* 2d.

A metallic plate is suitably prepared and a drawing is made upon it or transferred to it, and it is then subjected to the action of nitric, sulphuric, or other acid.

2600. Treads or Risers for Stairs, &c., *W. Bailie.—Dated 25th June, 1880.—(Not proceeded with.)* 2d.

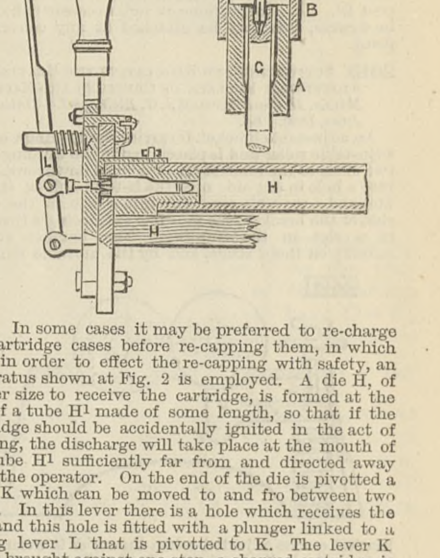
The tread is composed of a wrought iron or steel plate with the ends bent or turned upwards and inwards so as to form a kind of tray, or foundation and binder, for a series of pieces of wood placed close together and secured between such turned up ends.

2601. Parcel Carrier, Holder, or Handle, *G. C. Wallich.—Dated 25th June, 1880.—(Not proceeded with.)* 2d.

This carrier, holder, or handle is formed with a slot or opening through which the string is passed.

2602. Rendering Cases of Fired Cartridges Available for Repeated Use, *R. Morris.—Dated 20th June, 1880.* 8d.

The portion of the apparatus which is first employed has the function of restoring the cartridge case to its proper size and shape. For this purpose a die is employed shown in vertical section at Fig. 1 consisting of three parts—an external cylindrical shell A bored out internally to the size and shape of the cartridge case, a bottom cover B fitting the ends of A and an internal mandril C fitting the mouth of the cartridge



case. In some cases it may be preferred to re-charge the cartridge cases before re-capping them, in which case, in order to effect the re-capping with safety, an apparatus shown at Fig. 2 is employed. A die H, of proper size to receive the cartridge, is formed at the end of a tube H¹ made of some length, so that if the cartridge should be accidentally ignited in the act of capping, the discharge will take place at the mouth of the tube H¹ sufficiently far from and directed away from the operator. On the end of the die is pivotted a lever K which can be moved to and fro between two stops. In this lever there is a hole which receives the cap, and this hole is fitted with a plunger linked to a spring lever L that is pivotted to K. The lever K being brought against one stop, a charged cartridge is inserted in the die H and a cap inserted in the hole. The lever K is then moved up to the other stop, and when it is in this position the cap in the hole is exactly central with the base of the cartridge in H. The lever L is then pressed and its plunger advancing pushes the cap into the seat at the bottom of the cartridge.

2603. Circulating Boiling Liquids, *A. Mechesney.—Dated 26th June, 1880.—(Not proceeded with.)* 2d.

This consists of a flat plate constituting the bottom of the apparatus, which plate is provided with a rim having openings therein. From the upper side of the plate a tube projects upward to any desired distance above the level of the liquid or substance, or articles contained in the vessel. This tube is fitted at the top with an inverted conical discharge piece whose casing is perforated.

2605. Mechanically Incorporating India-rubber with Hydrocarbon Oils, *G. W. von Nawrocki.—Dated 26th June, 1880.—(A communication from L. Beckers.)—(Complete.)* 2d.

This consists in the process or method of mechanically incorporating india-rubber with heavy hydrocarbon oils, that is to say, hydrocarbon oils having a high boiling point.

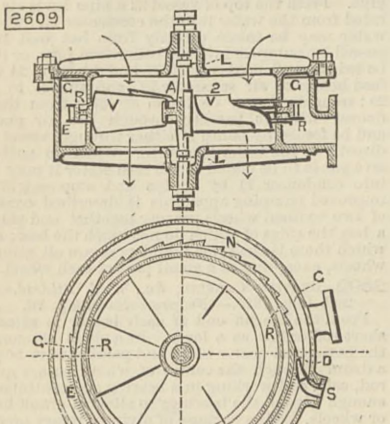
2606. Producing Images on Paper, *J. Wetter.—Dated 26th June, 1880.—(A communication from S. Bergel.)—(Not proceeded with.)* 2d.

This relates to a means of producing on paper the contours of objects by burning, in order to obtain images having the appearance of silhouettes.

2609. CENTRIFUGAL BLOWER OR FAN EXHAUSTER, *F. Zur Nedden.—Dated 26th June, 1880.* 6d.

A is the spindle working with its end gudgeons on centres L. On the spindle A is placed the fan proper which may be made in the form of a helical fan V, or in the form of a centrifugal fan V^2; R is an outside ring which unites the vanes or parts of the fan and works freely, but with a very slight lateral play through a circumferential slit in the outer case C. The ring R is provided with side flanges and with teeth or vanes N

2609

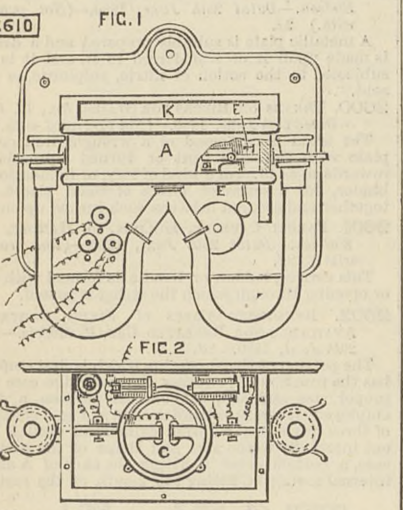


of any suitable form for a jet to act against or with brushes E, against which the jet of air, steam, water, or gas under pressure proceeding from the nozzle D on the pipe S acts so as to give off its motive power in the form of pressure velocity. The fan is then revolved quickly, and the air or gases drawn and forced in the direction of the arrows or in the opposite direction, according to the direction of rotation of the fan.

2610. IMPROVEMENTS IN TELEPHONES, *J. H. Johnson.—Dated 26th June, 1880.—(A communication from F. A. Gower.)* 6d.

Mr. Gower combines a microphone with a magnetic telephone. A microphone preferably having at least six contact points is attached to the upper part K of box A, a Gower chronometer telephone C being in the lower part of the box. The telephone is provided with

2610

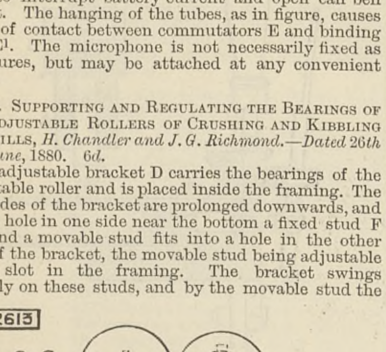


a double speaking tube as shown. Commutators are used to interrupt battery current and open call bell circuit. The hanging of the tubes, as in figure, causes break of contact between commutators E and binding post E^1. The microphone is not necessarily fixed as in figures, but may be attached at any convenient point.

2613. SUPPORTING AND REGULATING THE BEARINGS OF ADJUSTABLE ROLLERS OF CRUSHING AND KIBBLING MILLS, *H. Chandler and J. G. Richmond.—Dated 26th June, 1880.* 6d.

An adjustable bracket D carries the bearings of the adjustable roller and is placed inside the framing. The two sides of the bracket are prolonged downwards, and into a hole in one side near the bottom a fixed stud F fits, and a movable stud fits into a hole in the other side of the bracket, the movable stud being adjustable in a slot in the framing. The bracket swings radially on these studs, and by the movable stud the

2613

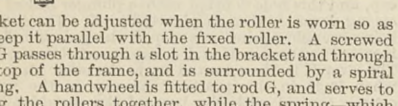


bracket can be adjusted when the roller is worn so as to keep it parallel with the fixed roller. A screwed rod G passes through a slot in the bracket and through the top of the frame, and is surrounded by a spiral spring. A handwheel is fitted to rod G, and serves to bring the rollers together, while the spring—which gives the requisite pressure for crushing or kibbling—comes into action when the material passes between the rollers.

2628. CLIPPING OR SHEARING HORSES, &c., *P. F. Mantelet.—Dated 28th June, 1880.* 6d.

The stationary or fixed comb is attached to the end of the fixed lever E by four screws. It is further pierced in the middle and towards the bottom (at this height or in line with the screws) with a circular hole.

2628

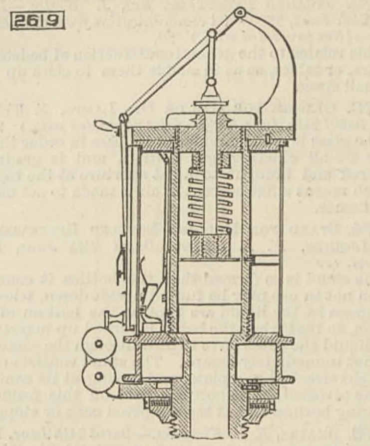


A mortice formed in the fixed lever serves together with this circular hole as seat for a pin of the working or movable lever D. This lever D has at its end, beyond the pin, a part which permits placing the working comb and giving it the necessary to-and-fro or reciprocating motion.

2619. INDICATORS FOR STEAM ENGINES, &c., *W. S. and W. O. Smith.—Dated 26th June, 1880.* 6d.

This consists in enclosing the cylinders within the paper drum, and arranging the pencil holder so that it may be traversed along a guide in a direction parallel to the axis of the cylinder and paper drum by

2619



means of a lever and links coupling it with the piston rod.

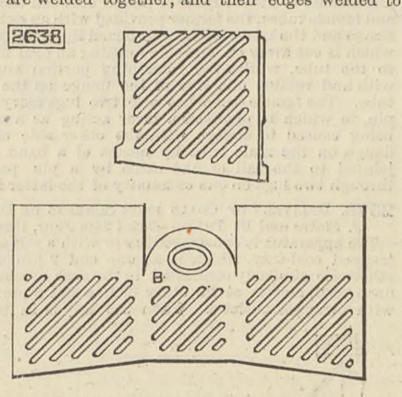
2627. COUPLING LINKS FOR RAILWAY CARRIAGES, &c., *J. H. Johnson.—Dated 28th June, 1880.—(A communication from A. Middleton.)* 6d.

This link is made without welding from a solid bar of steel, the eye being cut or punched out while the steel is hot, but not so hot as to impair the metal. The link is then rounded at each end. The grain is straight throughout and parallel with the sides of the link.

2638. STEAM BOILERS, *S. Fox and D. Greig.—Dated 28th June, 1880.* 6d.

A plate of any suitable metal is shaped and corrugated as shown in the first figure, and the side parts bent back and their tops bent over so as to meet when they are welded together, and their edges welded to

2638

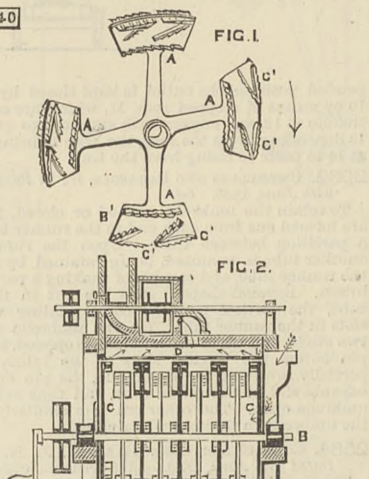


the back part B, after which the corrugations are continued over the top as shown in the second figure. The tube plate is also corrugated in the thin part and perforated for the tubes in the thick part, and is rivetted or welded to the other part of the fire-box.

2640. CLEANING AND POLISHING WHEAT, *W. R. Lake.—Dated 28th June, 1880.—(A communication from D. M. Richardson.)* 6d.

Fig. 1 shows a perspective view of one of the spiders, and Fig. 2 is a central vertical section of the apparatus in which a series of the spiders are mounted on the shaft B. Each arm of the spiders C terminates in a T-shaped blade, on each face of which there is a ratchet or serrated segment A extending nearly or

2640

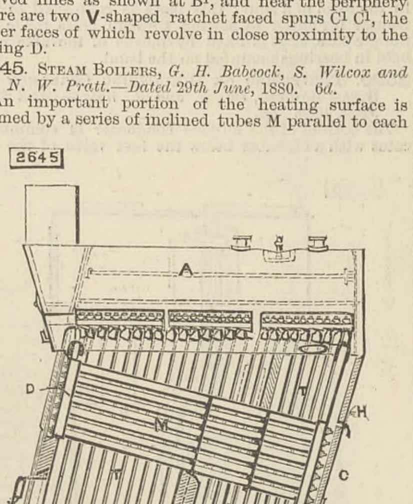


quite to the advancing edge of the head or blade of each arm of the spider, which blade is bevelled in curved lines as shown at B^1, and near the periphery there are two V-shaped ratchet faced spurs C^1 C^1, the outer faces of which revolve in close proximity to the casing D.

2645. STEAM BOILERS, *G. H. Babcock, S. Wilcox and N. W. Pratt.—Dated 29th June, 1880.* 6d.

An important portion of the heating surface is formed by a series of inclined tubes M parallel to each

2645

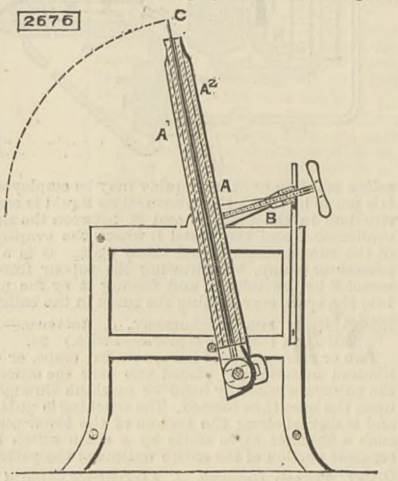


other and extending over the fire, being highest at the front ends. They are secured at the front end in sectional chambers or front connections D, and at the rear end in corresponding chamber G connected with the rear end of the barrel A by a series of inclined pipes H. In each side of barrel A is a series of holes covered by caps connected to the upper ends of the sets of side tubes T, and allow a strong current of steam and water to enter the barrel. P are chambers connecting the tubes T together at the bottom, so as to form several sections which communicate with each other. A chamber I extends across the front of the grate and is connected to the front chambers D by pipes, such chamber communicating at its ends with the front chambers P. K is a mud drum extending across under the rear and connected by pipes to the bottoms of the chambers G and at the ends to the side chambers P.

2676. CASTING LEADS AND SLUGS FOR THE USE OF PRINTERS, *J. Wetter.—Dated 30th June, 1880.—(A communication from J. Fleming.)* 6d.

The apparatus consists of a flask A made in two sections A^1 and A^2 which are coupled together at their lower ends by a slotted hinge joint. The base plates

2676

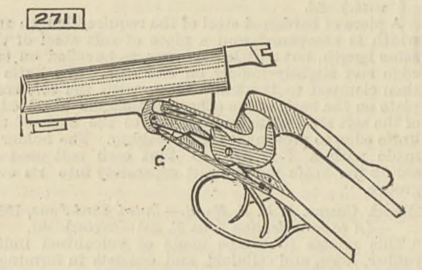


A^2 of the flask is provided with a clamping device B by which the plates are clamped together when the lead gate C is placed between for casting.

2711. BREECH-LOADING SMALL-ARMS, *J. F. Swinburn.—Dated 2nd July, 1880.* 6d.

This consists in the combination of the horizontal cocking arms G G, having inclines on their undersides, jointed excentrically to the knuckle of the joint of the fore-end, with fixed inclines or rollers on the body

2711

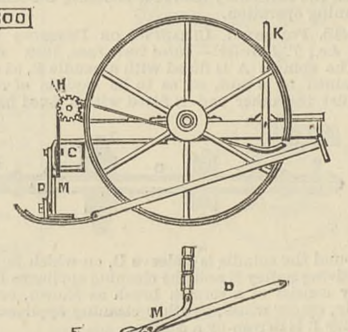


of the gun or pistol, whereby on the raising of the breech ends of the barrels for charging them, a compound motion consisting of an advance horizontal motion and a vertical motion is given to the free ends of the cocking arms, and the said free ends of the arms made to cock the hammers.

4300. MOWING AND GRAIN CUTTING MACHINES, *E. Smith.—Dated 21st October, 1880.—(Complete.)* 4d.

The frame consists of a single piece of L-shaped steel or iron, bent so as to form a rectangle. A casting C, bolted to the rear end, receives the bearings and attachments of the main operative parts. A spring sheave H is placed on the frame and over it passes a chain extending from the hinge D, that carries and controls the finger bar E, to the pivotted lever K, by which the hinge bar and finger bar are suspended, adjusted, and raised or lowered. The force of a coiled spring in the sheave is adjustable and is sufficient to

4300

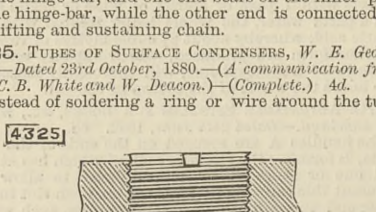


nearly counterbalance the weight of the hinge-bar, finger-bar, and cutter-bar, and other parts connected therewith, so that the finger-bar and cutter-bar run very lightly over the ground. A lever M is fulcrumed on the hinge-bar, and one end bears on the inner part of the hinge-bar, while the other end is connected to the lifting and sustaining chain.

4325. TUBES OF SURFACE CONDENSERS, *W. E. Gedge.—Dated 23rd October, 1880.—(A communication from C. B. White and W. Deacon.)—(Complete.)* 4d.

Instead of soldering a ring or wire around the tube

4325

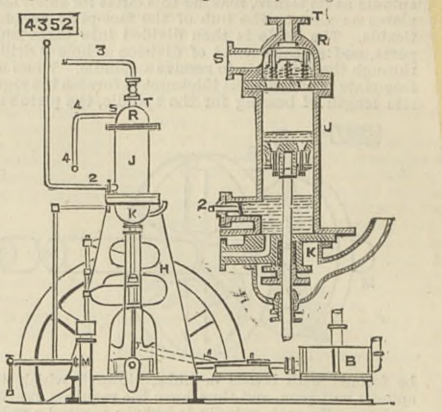


to form the enlargement a bead is formed in the tube itself so as to produce a swell or enlargement directly in its tube material entirely surrounding the tube, with which a screw threaded ring or thimble is combined, with its inner end bevelled on its inside, and a packing. This ring or enlargement then forms an integral part of the tube, which cannot be pulled off without destroying the tube.

4352. REFRIGERATING APPARATUS, *W. R. Lake.—Dated 25th October, 1880.—(A communication from J. C. De la Vergne and W. M. Mixer.)—(Complete.)* 8d.

On the bed-plates of engines B are secured uprights H on which the air or gas compression pumps J are supported, such pumps being formed with chambers K containing liquid to seal and lubricate the piston rods outside of the pump cylinders. The liquid is supplied to the interior of the pump cylinders by the pump M. 2 are the suction gas pipes; R is the upper chamber in the compression pump with two outlets S and T, the latter connected with the gas pressure pipes 3, and the former with the liquid discharge pipes 4. When steam is admitted to the engines a certain quantity of liquid is forced by pump M into the compression pumps, which have been previously charged with the

4352

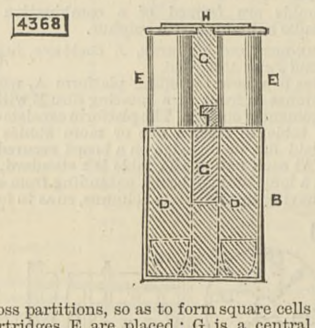


refrigerating agent, which is compressed and discharged into the pressure pipes 3, and passes into a separating foam tank and thence to a coil where it is cooled by a constant flow of water round the coil, and thus separated from the sealing and lubricating liquid.

4368. APPARATUS FOR HOLDING CARTRIDGES, &c., *H. H. Lake.—Dated 26th October, 1880.—(A communication from E. G. Parkhurst.)—(Complete.)* 6d.

B is the bottom part of a pasteboard case which is provided with a cover; C is a longitudinal partition extending from end to end of the case; D represents

4368



cross partitions, so as to form square cells in which the cartridges E are placed; G is a central longitudinal sliding partition lying above the partition C and between the upper parts of the cartridges. H is a plate of sheet metal tacked to the partition G or forming part of the same.

2655. WIRE FENCES, *J. List.—Dated 29th June, 1880.* 6d.

This relates to constructing or strengthening wire fences with anchors and wedges for diagonal and vertical connecting wires, and thus dispensing with winding pillars and straining appliances.

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