ELECTRICITY AND TORPEDO WARFARE.

The public have lately learnt by perusal of the daily papers, many cogent arguments for and against the much talked of Channel tunnel, and thus have been made fully cognisant of the advantages incident to our insular position. But few, perhaps, are aware that these natural advantages have, by the aid of science, been greatly enhanced during the past few years. A visit to the interesting exhibits of the War Department at the recent Electrical Exhibition at the Crystal Palace gave one an idea of the important part played in modern times by torpedoes in the defence of our naval and mercantile harbours. Fortunately for visitors, the authorities, taking a hint from the exhibition at Paris, placed their exhibits under the charge of a most obliging and intelligent sapper, whose chief duty lay in answering the questions of curious visitors.

The whole of the important duties connected with the defence of our harbours, with the exception of course of the forts and guns, have been entirely entrusted to the Royal Engineers, and several companies have been detached for this service. These men during the summer months are thoroughly trained in their duties, and put through a practical course of laying cables and testing mines, and also the manipulation of the various electrical instruments comprised in the equipment.

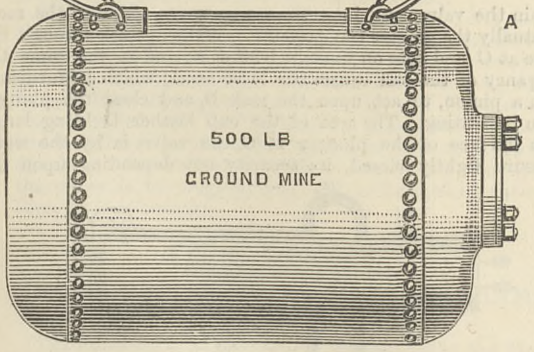
A harbour to be thoroughly protected requires not only to be defended by obstructions and mines, but these latter must also be protected by artillery fire. Mines alone can be more or less easily destroyed or picked up, unless the enemy in so doing are hampered by an effective fire from permanent coast defences. On the other hand, forts alone will not prevent a vigorous commander from forcing a passage, the channel of which has not been obstructed by submarine mines. In proof of this, we may mention Admiral Farragut's passage of Fort Jackson on the Mississippi into the batteries of Vicksberg. Thus, although submarine mines can never take the place of artillery, their use in connection with it very greatly increases the value of the defences.

Torpedoes, like all other offshoots of that mighty agent electricity, have of late developed very rapidly. It is only within the last few years that they have become a distinct feature of warfare. As long ago, however, as the Crimean War chemical torpedoes were employed by the Russians to guard their harbours; but the American War of Independence greatly developed the science — an interesting and instructive account of which is given by Von Schiella in his treatise on "Coast Defences."

Torpedoes may be classed under the following heads:—
(1) Those fired at will from the shore when a vessel is seen to be in their vicinity, generally known as observation mines; (2) those fired from the shore on the contact of the vessel with the mine, termed electro-contact mines; (3) those having no cables or connection with the shore, the firing arrangements being self-contained.

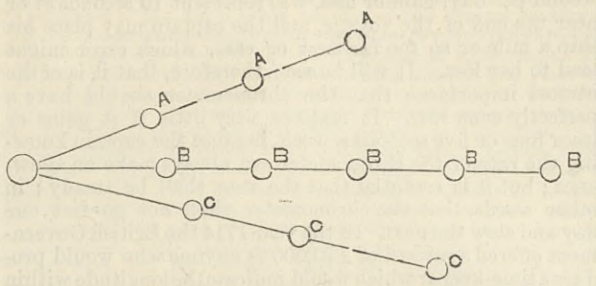
Observation Mines.—The great advantage of observation mines consists in their comparative simplicity and the ease with which they adapt themselves to either blocking the passage of the enemy's fleet or allowing friendly vessels to pass. Being placed at a considerable depth they are not easily damaged or detached, and are, moreover, not affected by strong tidal currents. They can be put down on the first outbreak of hostilities, and will remain in perfect order for a lengthened period. From the large charge used they can be placed at comparatively great intervals, and by the aid of a recently invented apparatus can be fired with such accuracy as to explode within a few feet of a vessel going at full speed. The largest mine exhibited is one that holds 500 lb. of gun-cotton, the explosion of which would cause serious damage to any vessel within a radius of 50ft. The general design will be seen by the following sketch, Fig. 1:—The case is made of thick boiler plates rivetted at the joints, and fitted with rings

FIG. 1

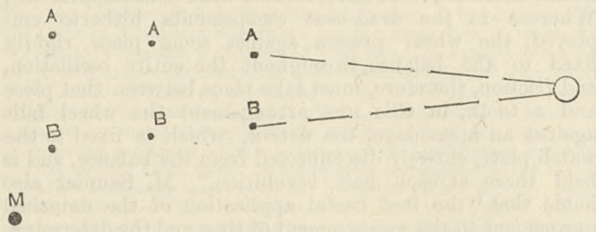


for attaching the chains. Also an opening with water-tight joints serves the double purpose of loading the mines and fixing the firing apparatus, to be hereafter described. Buoyant mines, made to hold the same quantity of gun-cotton, though somewhat similarly constructed, are larger in dimensions, in order that they may have sufficient displacement to give a considerable buoyancy. These mines are moored at varying depths below the surface, depending on the size of the mines employed and the nature of the channel to be defended. The mines being filled with wet gun-cotton, it is necessary to have a certain quantity of dry gun-cotton—generally termed primers—to set up the full force of detonation. The firing is effected by electric detonators, which are exploded by a voltaic battery from the shore. The primers and detonators are enclosed in an iron cylinder which fills the opening of the mine, and is secured by a water-tight joint. A polarised relay is also enclosed in the same cylinder to be used for testing the mines, to ascertain that the circuits are in good condition without the risk of exploding them.

Means of Firing Observation Mines.—Observation mines can be fired—(*a*) by one observer; (*b*) by two observers. (*a*) When observation mines are fired by one observer they are laid in rows, each row consisting of any number of mines, according to the width of the channel to be defended. Thus, A A A, B B B, C C C, are lines of mines converging on the observing station at O. The



whole of the mines in each row are connected with it, and would be exploded on the ship crossing the line of sight. (*b*) When mines are exploded by the joint efforts of two observers, they are also generally laid on a system, so that the line connecting them converges on to one of the observing stations. Thus, A A A, B B B, are mines in



line with the observer O; but in this case he does not fire the mines himself, but signals to the observer at M when the ship is in line with any of the mines. M then presses the key in connection with the mines, and should the telescope on his firing arc indicate that the vessel is over one of them, contact with the firing battery is established and the mine exploded. Circuit closers are generally attached to each mine, so that they can be fired at night, and when smoke or fog render observation impossible. A system of firing mines by separate intersections can also be arranged, in which case a single mine takes the place of the converging row already described. The instruments employed for observation firing, termed "observing arcs" are of two kinds, though identical in general construction—the one for the outer observing station, and the other for the inner firing station—see Figs. 2 and 3. The

OBSERVING ARCS

FOR OUTER STATION

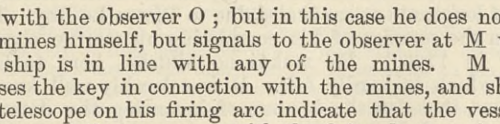
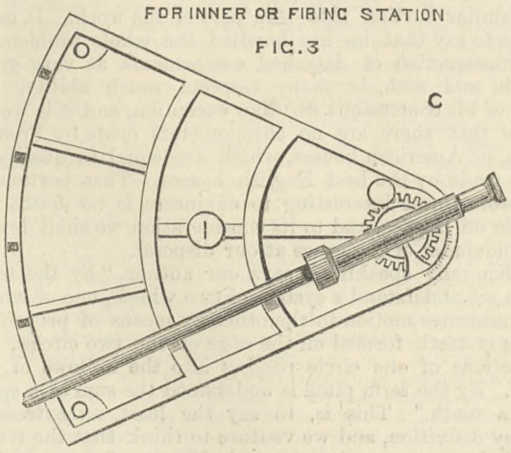


FIG 2

FOR INNER OR FIRING STATION

FIG. 3



arc consists of a light open triangular framework, supported on three feet provided with levelling screws. At the apex is a vertical spindle capable of being raised or lowered and traversed to the right or left by means of a rack and pinion. Attached to the spindle is an arm with vernier working over a graduated arc, and also a longer arm which sweeps over the outside arc. To the upper extremity of the spindle are fixed two Y's, in which rest a telescope. Sights having platinum contact pins are provided, which can be secured in the outer arc, so as to be in line with the mines, and which are also attached to the cable leading from the mines. A brass spring insulated from the long arm comes in contact with the sight when the telescope is directed at the mine, and on being connected with the firing battery explodes it.

Electro-contact Mines.—The great advantage of this kind of torpedo is that, being fired in actual, or at least very

100.LB. ELECTRO CONTACT MINE

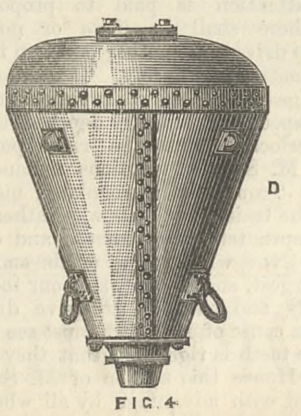


FIG. 4

close contact with the vessel, a comparatively small charge of gun-cotton is sufficient to destroy or render her unfit for service. They also more effectually defend a channel at night or during a fog, when the observation mines above described would be quite useless. They have, however, certain disadvantages, such as being more exposed to injury by countermines, and are difficult to place out of sight in positions where there is a great rise and fall of tide. The mines exhibited, Fig. 4, hold about 100 lb. of gun-cotton, and should be placed at about 13ft. under water, the exact depth, however, being dependent on the rise and fall of tide. The apparatus connected with submarine mines is termed the circuit closer. This is either placed

APPARATUS FOR CIRCUIT CLOSING

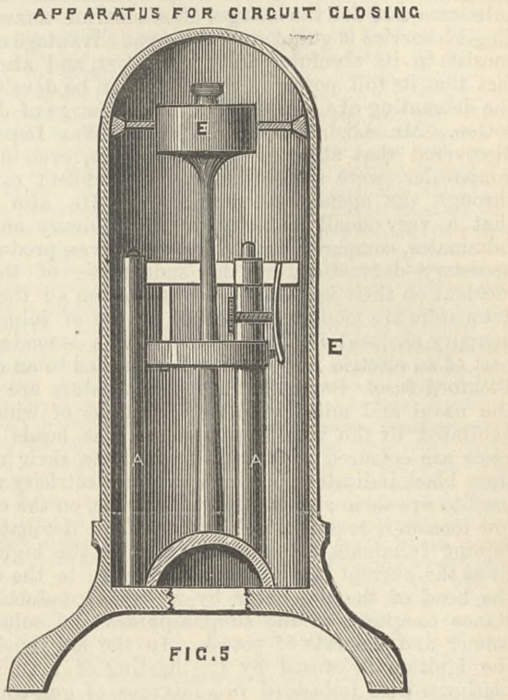


FIG. 5

inside a wooden jacket and connected by cable with the larger descriptions of mines, or is fitted inside the 100 lb. electro-contact mine. The apparatus itself is in either case almost identical, and is protected by a gun-metal dome arranged with a washer for excluding the water. Three columns (A), Fig. 5, between which is placed a polarised relay support an ebonite disc. Springing from the base is a steel pin, carrying at its top extremity an iron cylinder (E) surrounded with india-rubber. A ring attached to the dome limits the play of the cylinder, and prevents a permanent deflection of the spindle. Attached to the ebonite frame are three springs with platinum contact points, the sensitiveness of which can be regulated by screws. Half way up the spindle is fixed an insulated brass-plate having platinum points which come in contact with the platinum projections on the springs. In the later forms of the apparatus a helical spring takes the place of the vertical spindle. When the mine is struck the vertical spindle is thrown violently to one side, and one or other of the platinum points comes in contact with the springs and closes the circuit. A signal is then given in the test-room, when the operator can fire the mine, and by pressing down the firing key the action can be made automatic. Thus friendly vessels can be allowed at any time to pass, as their contact with the mines merely sends a signal to shore. The accompanying sketch, Fig. 6, shows the method of fixing a circuit-closer to a ground mine.

GROUND MINE WITH CIRCUIT CLOSER

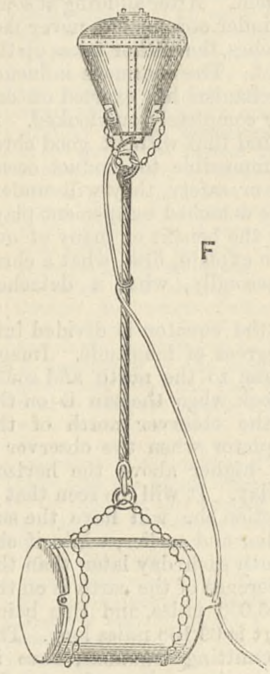


FIG. 6.

Shutter Apparatus.—The instrument on which the signals from the circuit-closer or electro-contact mine is recorded is called the shutter apparatus. It consists of a mahogany box nearly 4ft. long and 5in. broad, in which are enclosed seven electro-magnets; a projecting base-

SHUTTER APPARATUS

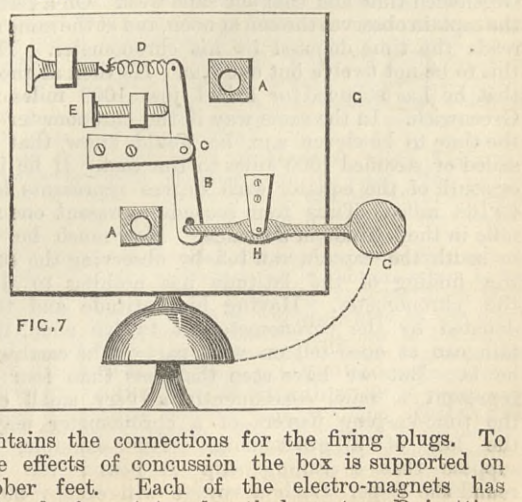


FIG. 7

board contains the connections for the firing plugs. To avoid the effects of concussion the box is supported on india-rubber feet. Each of the electro-magnets has adjustable pole pieces A A and vertical armatures B pivotting on their centres, and kept in a normal position by means of spiral springs D, the strength of which is adjusted by mill-heated screws E; the shutter arms pivotting at H, Fig. 7, are held in position by platinum pins on the armature, so that when the arm is attracted by a current passing through the electro-magnet, the weight of the metal disc causes the arm to fall and strike a bell. Thus the operator's attention is attracted, and at the same time the arm, passing between contact springs, makes connection with the firing bar.

Detonators and Charges for Submarine Mines.—The only substance used for the charges of submarine mines in the English service is gun-cotton, the great advantage of which consists in its absolute safety when wet, and also in the fact that its full power in that state can be developed by the detonating of a comparatively small charge of dry gun-cotton. Mr. Abel, the chemist for the War Department, discovered that all explosive substances, even including gunpowder, were susceptible of more violent explosions through the agency of detonation. He also noticed that a very small quantity of the mercury and silver fulminates, compared with other explosives, produced the necessary detonation, by the suddenness of the blow incident on their ignition. For this reason all the service detonators are made with a small charge of fulminate of mercury enclosed in a metal tube, which is made to form part of an electric fuse, or may be attached to an ordinary Bickford fuse. Several kinds of detonators are used in the naval and military services, sections of which were exhibited by the War Department. The heads of these fuses are coloured differently to indicate their nature—thus, black indicates that high tension electricity must be used to fire them; while for white heads, on the contrary, low tension is required. The tubes of all detonators containing fulminate are painted red. In the high-tension fuses the current is carried from one wire to the other in the head of the detonator by a badly conducting substance composed of the subphosphides and sulphides of copper and chlorate of potash. In the low tension fuses the ignition is caused by the heating of a thin iridio-platinum wire imbedded in a mixture of gun-cotton and powder. Various forms of these detonators are made for different purposes, and distinguished from one another by numerals.

LITERATURE.

A Treatise on Modern Horology in Theory and Practice. Translated from the French of Claudius Saunier by JULIEN TRIPPLIN and EDWARD RIGG, M.A. London: J. Tripplin. 1882.

[CONCLUDING NOTICE.]

IN our first notice of this important work we briefly explained the system of arrangement of his subject adopted by the author, and we carried our criticisms down to the chapter on the duplex escapement. After alluding at some length to the Breguet ruby cylinder escapement, never met with now save in very old watches, the author takes up the subject of detached escapement. The enormous influence which this little piece of mechanism has exerted on our trade and commerce is usually completely overlooked. If our readers will but bear in mind that without good chronometers it would be almost impossible to conduct ocean navigation with any certainty or safety, they will understand the value of the part the detached escapement plays in this world's economy. For the benefit of many of our readers, it may be well here to explain, first, what a chronometer does for us; and secondly, what a detached escapement is.

It is generally known that the equator is divided into 360 deg. These are called degrees of longitude. Imaginary lines are drawn from these to the north and south poles. It is always twelve o'clock when the sun is on the meridian, or due south of the observer north of the equator; due north of the equator when the observer is south. Also the sun is then higher above the horizon than at any other time of the day. It will be seen that if a ship sails in an easterly direction she will have the sun due south of her each day earlier and earlier, while if she sails west it would be due south each day later than the day before. Now the circumference of the earth is on the equator, in round numbers, 25,000 miles, and this being divided into 360 parts each part is 69·168 miles long. The earth revolves on its axis, omitting fractions, once in twenty-four hours. Hence any point on its surface at the equator moves, as regards the sun, at the rate of 1000* miles an hour. Thus if the sun is due south of a ship at twelve, noon, Greenwich time, it will be due south of another ship 1000 miles to the west just one hour later, or at one p.m., and so on. There are 3600 seconds in an hour, and dividing this by 1000 we find that each mile measured on the equator represents 3·6 seconds—15 deg. represent one hour. Now let us suppose that a ship leaves England with her chronometer set by Greenwich time and that she sails west. On a certain day the captain observes the sun at noon, and at the same moment reads the time denoted by his chronometer. He finds this to be not twelve but one p.m. He then at once knows that he has steamed or sailed just 1000 miles west of Greenwich. In the same way if the chronometer showed the time to be eleven a.m. he would know that he had sailed or steamed 1000 miles to the east. If he is north or south of the equator each degree represents less than 69·168 miles. Thus four seconds represent one nautical mile in the latitude of Jamaica. How much he is north or south the captain can tell by observing the sun; but the finding of the latitude has nothing to do with the chronometer. Having his latitude and the time denoted by the chronometer at twelve noon, the captain can at once tell on what part of the earth's surface he is. But we have seen that less than four seconds represent a mile, consequently a very small error in the time-keeping powers of a chronometer may cause the loss of a great ship. For example, let us suppose that a sailing ship is bound for Bombay round the Cape. Such a voyage will occupy 90 to 100 days. In the latter case an error of but one-tenth of a second per day, gain or loss, will represent 10 seconds at or near the end of the voyage, and the captain may place his ship a mile or so too far west or east, which error might lead to her loss. It will be seen, therefore, that it is of the utmost importance that the chronometer should have a perfectly even *rate*. It matters very little if it gains or loses four or five seconds a week, because the captain knowing the rate of the chronometer can always make an allowance; but it is essential that the rate shall be steady; in other words, that the chronometer shall not go fast one day and slow the next. In the year 1714 the British Government offered a reward of £20,000 to anyone who would produce a time-keeper which would indicate the longitude within thirty miles. Harrison, an English watch-maker, born in 1693, died 1776, invented the detached escapement, and with it he won the prize, and the principle then introduced is that on which all chronometers have since been made. Our author, however, gives the credit of inventing a detached escapement to Pierre Le Roy, about 1748, which is thus described: "A novel form of dead-beat escapement: Whereas in the dead-beat escapements hitherto employed, the wheel presses against some piece rigidly fixed to the balance throughout the entire oscillation, and friction, therefore, must take place between that piece and a tooth, in this new arrangement the wheel falls against an appendage, the detent, which is fixed to the watch plate, entirely disconnected from the balance, and is held there at each half revolution." M. Saunier also holds that "the first useful application of the detached escapement to the measurement of time and the determination of longitude at sea is also due to Pierre Le Roy. This was on the occasion of his completing his marine chronometer in 1766." He makes no allusion here to Harrison, which is hardly fair. It is tolerably well known, however, that for the honour of inventing the detached escapement there have been many claimants, and we shall not reopen an old question. M. Saunier holds that the theory of the detached escapement has never yet been published, and he goes on to give one at great length. He summarises this theory in twelve propositions. We have not the original work by us, but it appears that Mr. Rigg and Mr. Tripplin have translated these propositions literally. The result is that they read badly, and are, indeed, in certain respects hardly intelligible. For example, the second proposition reads:—"If the lifting angle and the motive force remain constant, the force of the impulse that maintains the movement of the moderator—and regulator—will increase with any diminution in the length of the escapement arms." This is simply unintelligible nonsense. So far as we can see, it does not apply to the chronometer escapement at all, but to the detached lever. The word "moderator" means balance. "Regulator" is superfluous, and "length of escapement arms" refers to the space included between the pallets. We are by no means certain, however, that this is what M. Saunier really means.

It would serve no good purpose if we were to follow M. Saunier further into this part of his work. It must suffice to say that he has handled the whole problem of the construction of detached escapements at very great length, and with, in many respects, much ability. To some of his conclusions we take exception, and it is worth notice that there are no chronometers made by French, Swiss, or American houses, which are equal in quality to those made by the best English houses. That portion of the work most interesting to engineers is no doubt the section on Depths, and to its consideration we shall devote the remainder of the space at our disposal.

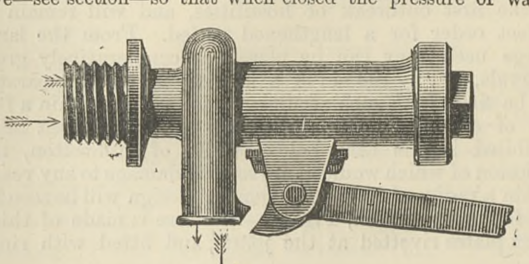
"Generally speaking," says our author, "by the term depth we understand a system of two wheels, one of which communicates motion to the other by means of projecting pieces or teeth formed on the edge of the two circles, the projections of one circle passing into the hollows of the other. By the term pitch is understood the sum of a space and a tooth." This is, to say the least, an extremely clumsy definition, and we venture to think that the translators have not quite grasped M. Saunier's meaning. "Depth" is not an equivalent for gearing, and M. Saunier himself uses the word elsewhere in quite a different sense; that is to say, the depth to which two wheels interlock with each other. It ought to be much better known to engineers than it is, what are right and wrong forms for teeth. Knowledge on this subject has greatly extended during the last half century; but, although many persons know how a wheel ought to be shaped as regards its teeth, not nearly sufficient importance is attached to putting the centres of the wheels at precisely the proper distance apart. If this be not done, the object to be attained by shaping the teeth on scientific principles cannot be attained. In large gearing, such as the engineer has to deal with, it in one sense, matters but little whether the pitch lines on two wheels gearing with each other are properly situated, and whether they just touch one another or not, because there is always force enough available to make the wheels turn round. For the same reason little attention is paid to proportioning the teeth so that there shall be little or no drop when one cog ceases to drive and another takes up the work; but in watches the matter is different. If they are to perform accurately, the geared wheels and pinions must not only be properly shaped but properly depthed, that is to say, they must interlock to just the right point, and no further. Thus M. Saunier mentions instances in which duplex watches "could not be regulated merely because one depth in the train of wheels was rather too shallow, and yet this depth felt quite smooth and did not occasion stoppage." Now what is true of the smallest gearing is true of the largest, and if we want our toothed wheels to work silently and without excessive drop, which is almost the whole cause of noise, we must see not only that the shape of the teeth is right, but that they are properly put to work. Hence this section of M. Saunier's book may be consulted with advantage by all who have much to do with gearing. It will be found as the reader goes on that the word depth is used in a very wide or even loose sense, and it is to be regretted that the translators did not correct this. The word is not only employed by them to indicate a pair of toothed wheels, but a wheel and pinion, two teeth, the interlocking of teeth, and lastly the depth to which the teeth are geared. We cannot, of course, follow our author minutely through his chapters, but we can call attention to one or two points of considerable interest and not generally known. The author refers in one place to Camus' axiom that a driving wheel ought always to be a little larger than its apparently correct diameter in order that it may work smoothly; and in another place he says, "Since the measurements taken in practice only give the total diameters, it follows that, if three pinions are intended for the same wheel, but one has thin leaves, another thick leaves, and the third barley-shaped leaves, they may, nevertheless, have the same total diameters, but their primitive diameters will differ, so that the rounding will descend lower in one case than in another; the thick leaf will be struck farther from or nearer to the centre than the thin leaf, &c. It will inevitably result that, if one of the pinions gives a good depth, the two other pinions will be very bad, notwithstanding that all three would be in accordance with the so-called rule." The reader who has much to do with small gearing, such as that of lathes and drills, will not be slow to apply this lesson. "When the point of a tooth impels the leaf of a pinion, the point will slide rapidly along the face of the leaf, so that the succeeding tooth falls with a sudden jump—the drop—on to the face of the corresponding leaf." Now, this is just what takes place in all gearing to a greater or less extent, and, as we have said, it is the cause of noise, rapid wear, and the quick destruction of the gearing. This question is fully dealt with by our author, but we cannot follow him through all that he says. Indeed, want of space prevents us from saying anything concerning the latter sections of the book.

Before concluding we cannot avoid calling attention to the extreme inequality which is apparent in the work of translation. In places we find elegant, forcible English; while, on the other hand, whole chapters have been done into English so bald and poor as to be almost unintelligible. The difference is that which would exist between the work of a Frenchman translating French into English and an Englishman doing the same thing. With all its defects, such as they are, the book remains unrivalled as a treatise on modern horology—from a French point of view. It would be a mistake to assume that France or Switzerland makes the best watches and clocks in the world; and M. Saunier in more than one place reluctantly admits that English watchmakers do better work than that of his own countrymen. Perhaps some English authority may yet take M. Saunier's work in hand and compare French and Swiss practice with that of England. There is room for such a volume. M. Saunier's book supplies a want which has existed for years, but we rise from its perusal with the feeling that just a little more information is required than it supplies, and the information can only be supplied by an Englishman.

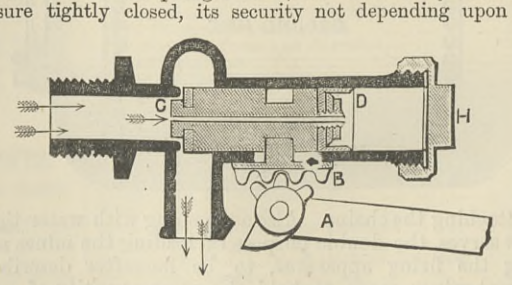
* The true rate is 1038·35 miles, but we adopt 1000 for simplicity.

STIDDER'S BALL VALVE.

THE ball valve illustrated herewith is very simple and at the same time perfectly efficient. A small hole is made through the valve—see section—so that when closed the pressure of water



within the valve acts in such a way as to close it the more effectually the greater the pressure. Water passes through the valve at C and acts on the cup leather D, and at the same the buoyancy of the ball causes the lever at A, which is furnished with a pinion, to act upon the rack B, and close the plunger upon its seating. The area of the cup leather D being larger than the face of the plunger at C, the valve is by the water pressure tightly closed, its security not depending upon the



buoyancy and leverage of the ball alone, but being supplemented and its action controlled by the action of the ball. A clear way is given for the water, and the valve cannot apparently get out of order. It is make by Messrs. J. G. Stidder and Co., of Southwark Bridge-road and Great Guildford-street, Boro', London, S.E.

WISWALL'S TILTING WEIR.

WE publish on page 160 drawings of a movable weir which is now being constructed in the bed of the river Irwell at Throstlenest, Manchester. The river Irwell below Manchester is conserved for the purposes of navigation by the Company of Proprietors of the Mersey and Irwell Navigation, and the weir at Throstlenest, which is being reconstructed, is the highest of a series of nine which serve to impound the rivers Irwell and Mersey in as many navigable reaches, connected, as is usual, by locks for the passage of barges from one level to another. Having regard to the discussion of the Société des Ingénieurs Civils, lately commented upon in this journal, and to the opinions on the subject expressed in the debates of the Institution of Civil Engineers, there appears to be a concensus of opinion that the desiderata with regard to inland rivers are:—(1) That in times when a river is swollen by floods it should have as free a flow as possible with an equal velocity in all parts of its descent, and therefore with an unobstructed bed. (2) That the waters should be impounded for the purposes of agriculture, manufacture, and navigation at such times as the river has only its normal flow. (3) That the mechanical means employed to effect these ends should be in perfect control, so that the transition from the one state to the other can be made gradually or quickly as varying circumstances require. All these capabilities are claimed for the structure now under notice. The weir is designed to effectually impound the water for navigation; to admit of being either slowly or quickly opened out as required; to give a full and free passage to the river water when floods or other circumstances make it desirable. The weir consists, as will be seen from the drawing, of a series of rectangular sluice gates turning on a common axis X. When closed the gates are inclined at an angle of 35 deg. from the perpendicular, when open they are suspended in a horizontal plane. Each gate is independent of all the remainder. The idea of a series of gates turning on their centres is not new, but the difficulty of bringing their edges into water-tight contact has hitherto prevented its application. It is obvious that round three of its edges each gate must make water-tight joints. This has been effected in the case before us by the lower edge being made to rest upon a prepared bed, the side edges below the axis resting against projecting flanges or ribs of the upright piers or frames which support the gates and the side edges above the line of axis falling into place side by side, as shown in the drawing. The gates retain their inclined position until the water of the river rises to 2ft. 9in. above its ordinary level, when they automatically tilt and release the impounded water. Such action, though valuable as a safeguard in times of sudden flood, is not always desirable, as the sudden discharge of a great body of water might cause serious erosion of the river banks. Draw-chains have therefore been provided whereby any or all of the gates can be opened at will, and the impounded water gradually released. The weir, consisting of the closed gates and the framework which supports them, presents a surface to the stream of 1400 square feet—140ft by 10ft. When the gates are opened, this is reduced to 293 square feet, or to one-fifth of the obstruction. The river bed being quite level and unobstructed by any sill or chamber, there is no tendency to catch silt or other matter in suspension. The absence of any head-gear gives a free surface to the passing stream, and floating matter is therefore uninterrupted in its passage. Subjoined is a more detailed description of the various parts of the weir :—

River Bed.—The river bed—plan A A A—is laid with a sheathing of stone and timber, and is perfectly level. The breadth across the river is 140ft., and the length down stream 33ft.

Piers.—At intervals of 10ft., centre to centre, across the bed of the river are erected cast iron piers B B with flanges for securing the piers to the river bed and for supporting the tie beam K and the key pedestals F in which the axle shafts are set. There are also flanges G G, against which the edges of the gates rest. The piers are of 1½in. metal.

Tie Beam.—A tie beam, 18in. by 14in., K, runs from shore to shore and binds the piers together. It is bolted to its seatings on each pier.

Axle.—The turned shafting, on which the gates hang and turn, is in lengths of 10ft., which reach from pier to pier, terminating in dumb pedestals F keyed to their respective seatings on the piers.

Gates.—The tilting sluice gates are framed of English oak and planked with pine. They are 12ft. long, 10ft. wide above the axle, 9ft. wide below the axle. Swivel plates are let into the side beams to form journals to turn on the axle.

Draw Chains.—A separate draw chain is attached to the centre of the foot of each gate; it is passed round a grooved pulley secured to the tie beam, thence over small guiding pulleys in a straight line to a wall box M, where it deflects upwards round a grooved pulley to a multiple crab, by which the gate is raised. Except for a few feet at the ends of the chains—for the pulley traverse—iron rods may be substituted for chains. The chains, and also the gates, when closed are protected by the tie beam from the impingement of the stream or of anything brought down by it in suspension.

Multiple Crabs.—There are two multiple crabs, one on either side of the river, and each connected with seven of the gates. The crab consists of seven sets of three-motion gearing with barrel, *i.e.*, one set for each gate chain. The first motion shaft, to which the handles are attached, has seven sliding pinions to enable any one or more of the seven sets of wheels to be geared to it; the remaining wheels run loose on the shaft. Ratchets are provided to fasten each gate open as it is raised.

The cast iron piers are from the works of the Pearson and Knowles Coal and Iron Company, Limited, Warrington; the multiple crabs and various pulleys from Messrs. Ormerod, Grierson, and Co., Manchester. The weir has been designed by Mr. Francis Wiswall, engineer to the Bridgwater Navigation Company, Limited, and the Company of Proprietors of the Mersey and Irwell Navigation, and it is being erected under his personal direction. One half of the weir is completed and in operation; the other is in progress, and will be finished in the course of three or four months.

THE BRITISH ASSOCIATION AT SOUTHAMPTON.

THE following is an abstract of the address to the Mechanical Science Section of the British Association, delivered by Mr. JOHN FOWLER, M. Inst. C.E., president of Section G.

Gentlemen,—Of all the important sections of the British Association the one over which I have now the honour of presiding is, you will all, I think, admit, at once the most practical and the most characteristic of the age. In future times the present age will be remembered chiefly for the vast strides which have been made in the advancement of mechanical science. Other days have produced as great mathematicians, chemists, physicists, warriors, and poets, but no other age has made such demands upon the professors of mechanical science, or has given birth to so many men of eminence in that department of knowledge. Though a member of the profession myself, I may venture before my present audience to claim that the civil engineer is essentially a product and a type of the latest development of the present century. Telford has admirably defined the profession of a civil engineer as "being the art of directing the great sources of power in nature for the use and convenience of man, as the means of production and of traffic in states both for external and internal trade, as applied in the construction of roads, bridges, aqueducts, canals, river navigation and docks, for internal intercourse and exchange, and in the construction of ports, harbours, moles, breakwaters, and lighthouses, and in the art of navigation by artificial power for the purposes of commerce, and in the construction and adaptation of machinery, and in the drainage of cities and towns." This definition, written more than half a century ago, is wide enough to include all branches of engineering of the present day, although amongst those specifically mentioned the departments presided over by the railway engineer, the locomotive superintendent, and the electrician will be looked for in vain. As Telford was beyond all question the most widely experienced and far-seeing engineer of his time, this little omission well illustrates and justifies my statement that the typical civil engineer of the day is a late product of the present century; for even Telford never foresaw the vast changes which railways, steam, and electricity would evolve in the course of a few years. There have undoubtedly been published during the last fifty years many works of mark and merit, but the work which above all others would, I think, have astonished and perplexed our ancestors, is the little one known to all the civilised world as "Bradshaw." This indispensable handbook of the nineteenth century testifies that the face of the country is dotted over literally with thousands of rail way stations; that between many of these stations trains run at two-minute intervals, whilst the distance between others is traversed at a mean speed of nearly 60 miles an hour. The public are often justly indignant at the want of punctuality on some railways, but they should blame the management and not the engineers, for the daily conduct of the heavy traffic between England and Scotland shows, that notwithstanding the constantly varying condition of wind and weather in this climate, a run of 400 miles can, on a properly laid out railway, and with suitably designed rolling stock, be accomplished with certainty to the minute, if the management is not at fault. On the Great Northern Railway, for instance, of which I am consulting engineer, the 400 miles between London and Edinburgh is traversed in nine hours, or deducting the half-hour allowed at York for dining, at the mean rate of no less than 47 miles per hour including stoppages. A few months ago the Duke of Edinburgh was taken on the same line of railway from Leeds to London, a distance of 186¾ miles, in exactly three hours, or at a mean rate, including a stop at Grantham, of over 62 miles an hour. I know of no railway in the world where this performance has been eclipsed, and it will be, perhaps, both instructive and amusing to contrast with it the performance of the engines at the opening ceremony of the Liverpool and Manchester Railway, on September 15th, 1830. A newspaper correspondent of the time, after describing many eventful incidents of his journey, proceeds as follows:—"The twenty-four vehicles left behind were now formed into one continuous line, with the three remaining engines at their head, and at twenty minutes past five o'clock we set out on our return to Liverpool. The engines not having the power, however, to drag along the double load that had devolved upon them at a faster rate than from five to ten miles an hour—once or twice only, and that but for a few minutes, did it reach the rate of twelve miles—it was past eight o'clock before we reached Parkside. Proceeding onwards, we were met on the Kenyon Embankment by two of the missing engines, which were immediately attached to the three which had drawn us from Manchester. We went still slower than before, stopping continually to take in water—query to take breath—and creeping along at a snail's pace till we reached Sutton inclined plane, to get up which the greater part of the company were under the necessity of alighting and making use of their own legs. On reaching the top of the plane we once more took our seats, and at ten o'clock we found ourselves again at the company's station in Crown-street, having accomplished the distance of thirty-three miles in four hours and forty minutes." The incident of the passengers descending from a train headed by five engines to walk up an insignificant incline is, I think, worthy of being recalled to the remembrance of the travelling public who are accustomed to see without astonishment a single engine rushing along with a train of a dozen heavy carriages at as high a speed as if it were running alone. We must do our immediate forefathers, however, the justice to remember that even they effected some considerable improvements in the speed of locomotion. For example, in 1763 the only public conveyance for passengers between London and Edinburgh was a single coach, which completed its journey in fourteen days, or at the average rate of 1¼ mile per hour. Strange as it may appear, there are at the present time many large fertile districts in Hungary where, owing to the absence both of road and water communications, a higher rate of speed cannot be attained in a journey of several days' duration. An essential condition of the attainment of high speed on the railway is that the stopping places be few and far between. The Great Northern express previously referred to makes its first halt at Grantham, a distance of 105 miles from London, and consequently but little power and time are lost in accelerating and retarding the speed of the train. In the instance of the Metropolitan Railway, on the other hand, the stations average but half a mile apart, and although the engines are as powerful as those on the Great Northern Railway, whilst the trains are far lighter, the average speed attainable is only some twelve miles an hour. No sooner has a train acquired a reasonable speed than the brakes have to be sharply applied to pull it up again. As a result of experiment and calculation, I have found that 60 per cent. of the whole power exerted by the engines is absorbed by the brakes. In other words, with a consumption of 30 lb. of coal per train mile, no less than 18 lb. are expended in grinding away the brake blocks, and only the remaining 12 lb. in doing the useful work of overcoming frictional and atmospheric resistances. Comparatively high speed and economy of working might be attained on a railway with stations at half-mile intervals if it were possible to arrange the gradients so that each station should be on the summit of a hill. An ideal railway would have gradients of about 1 in 20 falling each way from the stations, with a piece of horizontal connecting them. With such gradients gravity alone would give an accelerating velocity to the departing train at the rate of one mile per hour for every second; that is to say, in half a minute the train would have acquired a velocity of thirty miles an hour, whilst the speed of the approaching train would be correspondingly retarded without the grinding away of brake blocks. Could such an undulating railway be carried out, the consumption of fuel would probably not exceed one-half of that on a dead level railway, whilst the mean speed would be one-half greater. Although the required conditions are seldom attainable in practice, the broad principles should be kept in view by every engineer when laying out a railway with numerous stopping places. Nearly thirty years ago, when projecting the present system of underground railways in the metropolis, I foresaw the inconveniences which would necessarily result from the use of an ordinary locomotive, emitting gases in an imperfectly ventilated tunnel, and proposed to guard against them by using a special form of locomotive. When before the Parliamentary Committee in 1854, I stated that I should dispense with firing altogether, and obtain the supply of steam necessary for the performance of the single trip between Paddington and the City from a plain cylindrical egg-ended boiler, which was to be charged at each end of the line with water and steam at a high pressure. In an experimental boiler constructed for me, the loss of pressure from radiation proved to be only 30 lb. per square inch in five hours, so that practically all the power stored up would be available for useful work. I also found by experiment that an ordinary locomotive with the fire "dropped" would run the whole length of my railway with a train of the required weight. Owing to a variety of circumstances, however, this hot water locomotive was not introduced on the Metropolitan Railway, though it has since been successfully used on tramways at New Orleans, Paris, and elsewhere. I am sorry to have to admit that the progress of mechanical science, so far as it affects locomotives for underground railways, has been absolutely *nil* during the past thirty years. The locomotive at present employed is an ordinary locomotive, worked in the ordinary way, except that in the tunnel the steam is condensed, and combustion is aided by the natural draught of the chimney alone, instead of being urged by a forced blast as on open portions of the line. Whether a hot water, a compressed air, or a compressed gas locomotive could be contrived to meet the exigencies of metropolitan traffic is a question which, I think, might be usefully discussed at the present or some future meeting of the Association. A reference to the underground railway naturally suggests the wider question of tunnels in general. The construction of tunnels was not one of the novelties presenting itself to railway engineers, for many miles of tunnel had been driven by canal engineers before a single mile of passenger railway had been built in this or any other country. To foreign engineers belongs the honour of having boldly conceived and ably accomplished tunnel works of a magnitude which would have appalled a canal engineer. I need only refer to the Mont Cenis Tunnel, over 7½ miles in length, commenced in 1857 and finished in 1870; the St. Gothard Tunnel, 9¼ miles in length, commenced in 1872 and finished in 1882; and the Hoosac Tunnel, 4¾ miles in length, commenced in 1854 and finished in 1875. In all cases rock of the hardest character had to be pierced, and it is needless to remark that without the aid of the machinist in devising and manufacturing compressed air machinery and rock-boring plant the railway engineer could not have accomplished his task. Intermediate shafts are not attainable in tunnels driven through great mountain ranges, so all the work has to be done at two faces. In the case of the Mont Cenis Tunnel the mean rate of progress was 257ft. and the maximum 400ft. per month. In the St. Gothard Tunnel the mean rate was 429ft. and the maximum 810ft. In the Hoosac Tunnel the average rate was 150ft. per month. Tunnels under broad navigable rivers and estuaries have been a subject of discussion by engineers for at least a century, but the only one at present completed is the unfortunate and costly Thames Tunnel. Two important works of the class are, however, now well in hand, namely, the Severn Tunnel at Portskewet, and the Mersey Tunnel at Liverpool. Undoubtedly the numerous accidents which occurred during the construction of the Thames Tunnel, together with its enormous cost of about £1500 per lineal yard, and the eighteen years occupied in its construction, destroyed the chance of any other projected subaqueous tunnel for many subsequent years. One lesson enforced by the Thames Tunnel was the necessity of leaving a reasonable thickness of ground between the water and the tunnel. In the Severn Tunnel the minimum thickness is 40ft., and in the Mersey Tunnel 22ft. The width of river at the point of crossing of the former tunnel is two and a-quarter miles, and the maximum depth of the rails below high-water 163ft. In the case of the Mersey Tunnel the width is nearly three-quarters of a mile and the depth 144ft. The Thames Tunnel, as almost every one knows, was carried on by means of a special contrivance termed by Brunel a "shield." No special appliances have been adopted in the case either of the Severn or the Mersey tunnel. Both are driven in the ordinary way, but of course enormous pumping power is required and has been provided. In many cases of tunnels under estuaries, special appliances could be used which would obviate all risk and make the successful completion of the work a mathematical certainty. A tunnel under the Humber, about one and a-half mile in length, projected by myself in 1873, the Bill for which was subsequently passed by the Commons and thrown out by the Lords, was a case in point. The bed of the Humber is of very fine silt, and I proposed to build the tunnel in lengths of 160ft., under the protection of rectangular iron caissons 160ft. long, by 42ft. wide, sunk by the pneumatic process. As the pressure of the air in the caissons would always be slightly in excess of that due to the head of water in the river, no interruption from influx of water could ever occur, and the operation of building the tunnel in lengths inside this huge diving-bell would be as certain and free from risk as the every-day work of sinking a bridge pier by the pneumatic process. A tunnel over a mile in length now in progress under the Hudson River at New York is being driven through a silty stratum by the aid of compressed air, and with a certain amount of success, as only some twenty men have been drowned up to the present time. The principle upon which the compressed air is used is, however, a false one, since it is merely forced into the tunnel with a view to uphold the ground by its pressure, like so much timbering, and not to keep out the water on the principle of a diving-bell. It is clear, therefore, that the completion of the Hudson River Tunnel, if the present system be persevered in, is purely a matter of conjecture, and all we can do is to hope for the best. That the series of mishaps with the Thames Tunnel, and the consequent postponement of all other projects for subaqueous tunnels, were due to errors in design and want of foresight on the part of the engineer, is patent to every one now, and was foreseen by at least one acute contemporary of Brunel himself. Only a few months ago, when turning over the leaves of an old periodical, I became aware of the fact that a scheme, identical in all its main features with my Humber Tunnel project, had been suggested for adoption in the case of the Thames Tunnel, in lieu of the plan proposed by Brunel. Writing in December 1823, or fifty-nine years ago, the author of the project, a working smith of the name of Johnson, says: "I propose to construct the Thames Tunnel without coffer-dams by making it in parts, 28ft. in length, each part having the ends temporarily stopped up and being constructed on the same principle as the diving-bell. The men dig from the inside round the edge as if sinking a well, and throw the earth towards a dredger, the buckets of which work some feet below the bottom of the excavation. Each length will be suspended between two vessels and be conveyed to the place where it is to be let down." A description of the mode of connecting the several lengths is given, and I may add that the tunnel blocks had a sloping face to tend to bring the faces of the joints together, a plan since adopted with the huge concrete blocks at Kurrachee and other harbours. There is not a flaw in the design from beginning to end, as modern experience in the sinking of numerous bridge piers on precisely the same plan has amply demonstrated. It is beyond all doubt that if the design of this working smith had been adopted in lieu of that tendered by Brunel the Thames Tunnel would have been completed in a couple of years, instead of eighteen years, and at a cost of about £300 per yard instead of £1500. If another tunnel be constructed under the Thames, which is far from improbable, as the requirements of below-bridge traffic necessitate some such means of communication, I venture to predict it will be built in accordance with the plan suggested fifty-nine years ago by the working smith, and not on that of Brunel's Thames Tunnel, or of any other tunnel yet carried out. After referring to a proposal made in 1805 for a tunnel under the Forth, Mr. Fowler went on: —As you will receive a paper on the Forth Bridge from my partner, Mr. Baker, I will not trouble you with details of the proposed structure at the present moment. I may state, however, that after a careful consideration of the difficult problem, in concert with my able colleagues, Mr. T. E. Harrison, the chief engineer of the North-Eastern Railway, and Mr. W. H. Barlow, chief engineer of the Midland Railway, we unanimously advised the directors of the Forth Bridge Company to abandon the project for a suspension bridge, and to construct a steel girder bridge of the unprecedented span of 1700ft. The total length of the structure is one and a-half miles, and it includes two spans, as aforesaid, of 1700ft., and two of 675ft. over the navigable channels on each side of Inchgarvie. The execution of the work has been entrusted to me, and my intention is that the Forth Bridge shall be not only the biggest, but the strongest and stiffest bridge yet constructed. To realise, however, the important part which rivers play in facilitating inland communication, it is necessary to glance at the other side of the Atlantic. In Canada, for instance, we have the great inland port of Montreal, where Transatlantic steamers anchor some 500 miles from the coast. The very term "stream of traffic" suggests a river, and the St. Lawrence well illustrates it. Into some small forest tributary of the Ottawa the lumber-men slide a log of timber, and many months after will that log, with thousands of others, forming together a huge raft, with huts upon it for the accommodation of the care-takers, be found pursuing its slow but ever continuing progress down the St. Lawrence to Quebec, where it will be shipped to this country. Having filled the office of consulting engineer to the Egyptian Government for seven years, I have had occasion to give particular attention to the Nile, and I may state that in an average year that river conveys no less than 100,000 million tons of water, and 65 million tons of silica, alumina, lime, and other fertilising solids down to the Mediterranean. The Nile begins to rise about the middle of June, at which time the discharge averages about 350 tons of water per second, and attains in September a height of from 19ft. to 28ft., and a discharge of from 7000 to 10,000 tons per second. Napoleon the Great said that every drop of Nile water should be thrown on the land, and he was right so far as Low Nile discharge is concerned. The cultivated lands in the provinces of Lower Egypt have an area of three million acres, and to irrigate this effectually at least 30 millions of tons of water per day would be required, an amount somewhat exceeding the whole of the Low Nile discharge. At present the irrigation canals are totally inadequate to convey this quantity, and imperfect irrigation and consequent loss of crops is the result. In many instances a couple of men labour for a hundred days in watering by shadoof a single acre of ground, all which amount of labour might be dispensed with if the barrage of the Nile were completed, and a few other works carried out, the whole of which would be paid for handsomely by a water rate of two shillings an acre. You will gather, therefore, that I do not think the resources of Egypt have yet been fully developed, magnificent as they even now are, having reference to the size of the country. It is hardly possible to refer to Egypt without saying a few words about the Suez Canal. Far-seeing people, including the late Khedive, have long been of the opinion that another ship canal will be required in Egypt. In 1876 I submitted to his Highness, in accordance with my instructions, detailed plans and estimates for such a canal from Alexandria through Cairo to Suez. The total length of the canal was 240 miles, and with the same width as the existing Suez Canal, the estimated quantity of excavation was 160 million cubic yards. An interesting and significant incident in the history of the Suez Canal occurred in May, 1878, when a fleet consisting of ten steamers and sixteen sailing vessels passed through with 8412 native troops bound from India to Cyprus. During the same year no less than 58,274 soldiers traversed the Canal. Since 1878 events have marched rapidly, for no one then foresaw that the next important movement of British troops canal-ways would be of a nature hostile in appearance, if not in fact, to the inhabitants of Egypt. The inauguration of steam navigation to India was much delayed by the vacillation of the authorities respecting the Suez and the Euphrates Valley routes. Happily, however, the Arabs stole the first bag of mails that went by the Euphrates, and so in 1834 a Committee of the House of Commons finally resolved that "steam navigation between Bombay and Suez having in five successive seasons been brought to the test of experiment, and the practicability of that line being established, it be recommended to his Majesty's Government to extend the line of Malta packets to Egypt to complete the communication between England and India." Nothing appears to have been done during the next two years, but in 1837 a new paddle-wheel steamer, the Atlanta, of 650 tons, steamed out to Calcutta round the Cape in ninety-one days and was put on the Red Sea station. She left Bombay with the mails on October 2nd, 1837, and arrived at Suez on October 16th. The mails were carried across the desert by camels, and down the Nile to Alexandria in four days, where they remained until H.M.S. Volcano took them on board on November 7th. At Malta on November 16th they were transferred to H.M.S. Firefly, and finally were landed in this country on December 4th, having been in all sixty-three days in coming from Bombay to England. At the present time about eighteen days are occupied in carrying the mails from Bombay *viâ* Brindisi to London. A few months later ninety-four passengers were plucky enough to embark at London, on April 4th, 1838, in the Sirius, of 700 tons and 320-horse power, for New York, where they arrived on the 23rd, having performed the voyage in seventeen days from London, and fifteen days from Queenstown. The Great Western sailed from Bristol on April 7th, and arrived at New York a few hours after the Sirius, and thus was the great problem of steam navigation to America successfully solved, by vessels of small size, and capable of maintaining a speed of but eight to nine miles an hour. I need hardly remind you that since the year 1838 the ships conducting the enormous traffic between Europe and America have been of ever increasing size and speed. Thus the Britannic, built in 1874, has an extreme length of 468ft., a beam of 45ft. 3in., a displacement of 8500 tons, and a speed of 16 knots per hour; whilst the Servia, built in 1881, has an extreme length of 530ft., a beam of 52ft., a displacement of 13,000 tons, and a speed of 18 knots, and the City of Rome, built in the same year, has a length of 600ft., a beam of 52ft. 3in., and a displacement of 13,500 tons. Another Atlantic liner, the Alaska, having a length of 500ft., a beam of 50ft., and a displacement of 12,000 tons, attained a speed of $18\frac{1}{2}$ knots on the measured mile, and has done the distance between Queenstown and New York in seven days four hours and thirty-two minutes, and the return voyage in six days and twenty-two hours, a mean ocean speed of, say, 17 knots per hour, or more than double that of the first steam vessels trading to America. The present generation has grown so accustomed to the embodied results of the progress of mechanical science, that it has long ceased to wonder at big ships, or at any other novelty. To realise what has been attained it is necessary to place ourselves as far as possible in the position of our immediate ancestors, and to look at things through their spectacles. With this view, and to give you some scale of comparison to measure the size of the present Atlantic liners by, I will quote a short passage from a newspaper of September 19th, 1829, where reference is made to a vessel then under construction, of about the size of one of the much abused "cockle-shells" performing the Channel service between Dover and Calais. "The Dutch have been engaged for the last five years in constructing and equipping a steamboat of extraordinary magnitude, in order to facilitate the communication between Holland and Batavia. It has four masts; is about 250ft. long; and has been appropriately called the Monster. In consequence of her great length, she hung when going off the slips, and it was some days before she was fairly launched; a circumstance which gave the wits of Paris occasion to remark that their Dutch neighbours were so determined to excel all other nations in the magnitude of their steam-boats, that they had built one so long that it was several days running off the stocks. One of the most remarkable features of this enormous vessel is her extreme narrowness as compared with her length; her greatest breadth of beam being only about 32ft. The great size of this vessel will bring to the recollection of our readers the Columbus, which was built in the river St. Lawrence in 1824, and made the passage to England in safety, but was afterwards broken up on account of her unmanageable bulk. We shall not be surprised to hear that a similar fate awaits the Monster, and for a similar reason." The Channel boat Albert Victor, now on the Folkestone station, is of the same length as the Monster—namely, 250ft.—whilst the beam of the former is but 29ft., instead of what the critic of 1829 termed the "extreme narrowness" of 32ft. The successive attempts at mitigating the discomforts of the Channel passage by the swinging saloon and twin steamers of Sir Henry Bessemer and Captain Dicey have gradually prepared the way for what I believe will be the next and important step of establishing Channel communication by means of large floating stations or ferry steamers, capable of traversing the narrow sea between England and France in little more than an hour. Ten years ago I applied to Parliament for powers to carry out this project, and obtained the unanimous sanction of a Committee of the House of Commons. The Bill was, however, thrown out in the House of Lords by the casting vote of the chairman.

What was practicable at that time has now become comparatively easy, owing to the introduction of steel into shipbuilding, and the improvements which have been effected in marine engines and mechanical appliances generally. In few departments of the engineer's work has such progress been made as in that of steam navigation. When in 1820 steamships were first used for conveying merchandise as well as passengers, the tonnage of the whole of the steam traders of this country, it is stated, amounted to but 505 tons. At the present time the corresponding figure is $2\frac{1}{2}$ million tons.

Mr. Fowler concluded with a graceful allusion to Dr. Siemens, and a hope that the meeting would be satisfactory.

LAST year 4715 women and girls were employed at the mines of Great Britain—all, however, above ground.

THE FORTH BRIDGE.

By Mr. B. BAKER, M. Inst. C.E.*

AT the request of Dr. Siemens the following short paper on the proposed Forth Bridge has been prepared. Before referring in detail to the history of the undertaking, and to the character of the design, the author would like to convey, if possible, some notion of the magnitude of the proposed bridge across the Firth of Forth. In preparing the detailed designs he has often experienced no little difficulty is realising the scale upon which he was working. For example, the bed-plates for an ordinary railway girder bridge, say a couple of hundred feet span, would be about half the size of an ordinary dining table, and it is difficult at first to picture to oneself a bed-plate about double the size of an ordinary dining-room; but that is the size of the bed-plates for the Forth Bridge girders. In the report of the Anthropometric Committee it was stated that the average stature of a new-born infant is 19·34in., whilst the average height of the Guardsmen sent out to Egypt has been officially given at 5ft. $10\frac{1}{2}$in. These figures have a ratio of 1 to 3·65, and, singularly enough, as the largest railway bridge in this country, the Britannia Bridge has a span of 465ft., and the Forth Bridge a span of 1700ft., the ratio there also is 1 to 3·65. Hence, to enable anyone to appreciate the size of the Forth Bridge, we have merely to suggest the following rule-of-three sum:—As a Grenadier Guardsman is to a new-born infant, so is the Forth Bridge to the largest railway bridge yet built in this country. Bridges a few feet larger in span than the Britannia have been built elsewhere, but they are baby bridges after all. The Act for constructing a bridge at Queensferry was obtained in 1873. At this point the Firth of Forth is divided by the island of Inchgarvie into two unequal channels, but the depth of water in each is such that a smaller span than 1700ft. could not be economically adopted for either channel. North of Inchgarvie the maximum depth of water is 218ft., and south of the same 197ft. In the former channel the bottom is of hard trap rock, and in the latter partly of rock and partly of extremely stiff boulder clay. It is not the treacherous character of the bed of the Forth, therefore, but the depth of water which precludes the construction of intermediate piers. Pneumatic apparatus is inapplicable to such depths as 200ft., and no responsible engineer would care to found the piers of an important structure upon a bottom which he had no means of examining by diving apparatus or otherwise.

An Act was obtained this year for constructing a continuous girder bridge across the Forth at Queensferry, having two spans of 1700ft., two of 675ft., fourteen of 168ft. and six of 50ft., and giving a clear headway for navigation purposes of 150ft. above high water spring tides. For this work Mr. Fowler and the author are acting as engineers.

In an ordinary suspension bridge, with stiffening girder vertically to provide for the rolling load, and horizontally to meet wind stresses, the mass of metal will be somewhat greater towards the centre of the bridge than at the piers, and consequently for a given mass the moment will be much less in the continuous girder than in the suspension bridge. Thus the Forth Bridge superstructure weighs but 2 tons per foot run at the centre of the 1700ft. span, and $13\frac{1}{2}$ tons per foot run at the piers; whilst in a suspension bridge the weight of superstructure per lineal foot would be somewhat greater at the centre than at the piers. This consideration, coupled with the facts that suspension links are more costly than girder work, that a suspension bridge requires a very costly anchorage, and that the contingencies and risks during erection in a stormy estuary are very great, explains why, in such a case as the Forth Bridge, well-designed continuous girders form a cheaper, as well as a far stiffer, structure than a suspension bridge with stiffening girder. By all authorities a beam is considered to be continuous if it is either rigidly or partially fixed as well as supported at each end in such a manner that a pair of equal and opposite couples act on the vertical planes at its points of support. In the case of the Forth Bridge, such continuity is attained by connecting together the ends of the two 1700ft. spans at Inchgarvie, and by projecting the other ends a distance of 675ft. beyond the main piers, and weighing them to the required extent. The question of the most advantageous position for the points of contrary flexure was a subject of elaborate investigation, as it was known to have a vital influence on the economy of the design. Having reference to all the conditions of the problem, it proved to be most advantageous to fix the points at a distance of 675ft. from the piers, so that in effect the 1700ft. girder may be considered as made up of two cantilevers each 675ft. in length, and a central girder 350ft. in span. Similarly, on investigation, the most generally advantageous depth proved to be about 50ft. at the centre, and 350ft. at the piers; and, this being settled, the next thing to be determined was the most advantageous width for the superstructure, and investigation showed the economical width of superstructure to be about 32ft. at the centre and 132ft. at the piers.

It was open to consideration whether the wind stresses should be resisted by bracing together both the top and bottom members of the girder, or the bottom members alone. The author, however, never had any doubt that, as the stresses must sooner or later be brought down to the masonry piers, they had better be brought down at once by the shortest route along the bottom members only. The top members are, therefore, spaced at the distance of from 33ft. to 27ft. apart, centre to centre, and are unconnected by wind bracing. Each of the main vertical and diagonal struts consists of a pair of tubes spread out at the base like a bridge pier, and the wind stresses on the bracing between the tubes are much reduced thereby. In like manner are the wind stresses on the bracing of the bottom member reduced by the spreading out of the legs of the cantilevers, and the general stresses on the web members by the tapering depth from the piers towards the ends of the cantilevers.

Having thus blocked out the general outline of the girder so that the shearing stresses from the diagonal action of the wind and load should be largely taken up direct by the main members, the next point was to determine the number of bays and the angle of the web bracing. Whatever the angle of the bracing, it was quite clear that, in a girder of 1700ft. span, exceptionally long struts would have to be provided, and it was a matter of much importance, therefore, that the struts and compression members generally should be of the most economical and efficient form. The advantages offered by a circular form of cross section were self-evident. A flexible sheet of drawing paper, simply rolled upon itself, became transformed into a stiff column, as everyone accustomed to handle plans and drawings well knew. Similarly, a thin sheet of iron or steel, bent into a tubular form, without further stiffening, offered as high a resistance per square inch to compression as the most heavily braced rectangular strut. The author recently tested a piece of ordinary stove pipe, 4in. in diameter and 2ft. long, made of sheet iron only about a fortieth of an inch in thickness, and found it stood, without buckling, a compressive stress of 15·9 tons per square inch, whereas one of the Britannia Bridge rectangular cells, 18in. square and 8ft. long, made of plates and angles $\frac{1}{2}$in. thick, crippled under a stress of 13·6 tons, or, say, 15 per cent. less stress than that sustained by the piece of stove pipe. If flat plates as much as $\frac{1}{2}$in. in thickness behaved so badly in a rectangular cell only 18in. square, it is hardly necessary to speculate as to what would be the case in tubes 12ft. square, which would be the size required for the Forth girders. With rectangular struts formed of four corner pieces and lattice sides, the required strength of the lattice work has been found by experiment to be considerably greater than theory would indicate, and the form, therefore, is a very disadvantageous one as compared with a circular cross section where every particle of metal performs useful work. In a long-span bridge it is essential to reduce the secondary bracing to a minimum, because the weight of metal itself constitutes the chief load. For that and for many other reasons, including the comparatively small resistance offered by a curved surface to the wind, the author, after carrying out not a few experiments himself, and passing in review the numerous experiments made by others during the past thirty years, was satisfied that a circular form of cross section was the proper one in the case of the Forth Bridge. All the main compressive members, therefore, will be tubes varying in diameter from 5ft. to 12ft., and only the wind bracing, subject to alternate compressive and tensile stresses, will consist of rectangular latticed members.

Between the two main girders, as described above, the double line of railway will be carried on an internal viaduct supported by trestles and cross girders. The permanent way will consist of heavy bridge rails on longitudinal sleepers bedded in four steel troughs, the outer pair of which serve also as the top members of the girders of the internal viaduct and the inner pair being simply rail bearers. The width of trough is such that, in the event of derailment, the wheels will drop into the troughs, and run along the timber sleepers clear of obstruction. A buckle plate floor and parapet or wind screen will be provided of ample strength to ensure the safety of the trains. No guard rails will be introduced, as the engineers and the Board of Trade are in accord in considering them a source of danger during high winds.

It is hardly necessary to state that the whole of the superstructure will be of steel. For the tension members the steel used is to have an ultimate tensile strength of not less than 30 tons nor more than 33 tons per square inch, with an elongation of 20 per cent. in a length of 8in. For the compression members the strength is to be from 34 to 37 tons, and the elongation 17 per cent. In making the tubes and other members, all plates and bars which can be bent cold are to be so treated, and, where heating is essential, no work is to be done upon the material after it has fallen to a blue heat. The steady pressure of hydraulic presses is to be substituted for hammering wherever practicable, and annealing will be required if the steel has been distressed in any way. No punching or shearing will be allowed, and all plates will be planed at the edges and butts, and all holes drilled through the whole thickness of plates and angles after being put together. Previous to the preparation of the designs and estimates, many consultations were held with the Board of Trade officers with reference to the maximum wind pressure to be provided against, and the admissible stress upon the metal. Existing rules limit the stress to $6\frac{1}{2}$ tons per square inch, and it was desired to get this limit extended to $7\frac{1}{2}$ tons. This was assented to by the Board, as the $6\frac{1}{2}$ tons working stress was based upon the assumption of the steel having a minimum ultimate tensile strength of 26 tons per square inch, whereas the Forth Bridge steel was to have a strength of at least 30 tons. As regards wind pressure, the present Board of Trade provision of 56 lb. per square foot has been adhered to, and that pressure has been assumed to take effect upon a surface equivalent to double the plane surface of the bridge, a deduction of 50 per cent. being made in the instance of the cylindrical surfaces. Under the combined action of the wind pressure, estimated as above, and a rolling load of two tons per foot run, or 3400 tons on each span, the maximum stress would in no case exceed $7\frac{1}{2}$ tons per square inch, whilst upon the members of the wind bracing, subject to alternate compressive and tensile stresses, it would not be greater than 5 tons per square inch. In ordinary working—that is to say, with heavy coal trains and light winds—the maximum stresses would be about 6 tons in tension and 5 tons in compression, which were about the same as the Saltash Bridge of 460ft. span would be subject to under the same circumstances, and that bridge is of iron. Even assuming that such a hurricane as 56 lb. per square foot could ever take effect over so large a surface as that offered by the 1700ft. girders, it was quite clear that no train could be on the bridge at the time, for a pressure of 30 lb. to 40 lb. would certainly stop the progress of any train. Without the rolling load the maximum stresses during the hurricane would, however, be only about $4\frac{3}{4}$ tons in tension and 6 tons in compression. Indeed, if the Forth Bridge were made of iron instead of steel, it would be a relatively stronger structure than either the Britannia or Saltash Bridge, so that the 50 per cent. extra strength due to the adoption of the steel may be regarded as an addition to the factor of safety, and not as a necessity of the unprecedented length of span.

Continental and American engineers at the present time almost universally take note of the vast difference in the destructive effect of a live load and a dead load; but the Board of Trade entirely ignore this fact, and adopt the same limiting stress in a main girder, where the greater portion of the load may be dead, as in a cross girder, where it is practically all live, and where vibration is set up by every passing wheel. It is generally admitted—and the practice and experience of mechanical engineers confirm the conclusion—that metal of any class may be subject to a working stress twice as great under a dead as under a purely live load. Some engineers make a compromise, and take the ratio at one and a-half times. If this be done, and a factor of safety of three be adopted in the instance of a purely dead load, the admissible working stresses for iron having an ultimate strength of 20 tons per square inch would be $6\frac{2}{3}$ tons for a dead load, $5\frac{1}{3}$ tons for a half dead and half live, 5 tons for quarter dead and three-quarters live—which is about the proportion obtaining in railway girders of 100ft. span—$4\frac{1}{3}$ tons for all live load, and $2\frac{1}{3}$ tons for members subject to alternate tension and compression of equal intensity. With steel having a strength of 30 tons, the corresponding stresses would be 50 per cent. greater—that is to say, they would range from $6\frac{2}{3}$ tons for an all live load to 10 tons for an all dead load. If the stresses be limited as above, the results of experiment and of actual practice show that a structure may be subject to an indefinite number of repetitions of the stress without injury. But, in the case of hurricanes, the repetitions will necessarily be few and far between, and higher stresses are therefore admissible in the members of wind bracing than in the piston rod of a steam engine, though both are subject to alternate tensile and compressive stresses. When it is remembered that the dead weight between the piers of the 1700ft. span is upwards of 10,000 tons, whilst the live load due to a couple of heavy coal trains would be less than one-tenth of that amount, the relative lowness of the $7\frac{1}{2}$ tons per square inch maximum stress in the Forth Bridge girders, under the combined action of an impossible load and an improbable hurricane, will be conceded by all. So far as the author is aware—although it has been established beyond all dispute that repeated application of a tensile stress amounting to two-thirds of the ultimate strength of the material would in time cause fracture—it has never been proved that the same conclusion applies to metal in compression. In fact, some of the author's experiments lead him to think that a contrary result might obtain. For example, one of the consequences of heavy varying stresses and vibrations is that the quality of the metal deteriorates, both iron and steel becoming more crystalline and less ductile. These conditions are rather favourable than otherwise to the resistance of a compression member. Thus the author tested some columns, 30 diameters in length, of high-class ductile steel, and of inferior crystalline steel, both having, however, the same tensile strength. The inferior steel bore 40 per cent. more load than the high-class steel, and it appears not improbable that, if the quality of the latter had been deteriorated by vibration and heavy stresses, the ultimate resistance would have been increased as regards compressive stresses almost as much as it would be diminished in respect of tensile stresses. Similarly, in columns of the same proportion, the commonest class of pig iron would beat the finest brands of wrought iron.

Long struts were avoided at any expense by some engineers, but, the author thought, without good reason. The tubular struts in the Forth Bridge, if made of iron, would resist as high a compressive stress per square inch as the top flange of any existing girder, and the same remark would apply to steel. An interesting series of experiments was recently made in America with full-sized wrought iron hollow columns, from 8in. to 12in. in diameter, and up to 28ft. in length. The influence of the length of the column on its resistance was singularly small. For instance, the 8in. column, when 15 diameters in length, failed with a stress of 16·2 tons per square inch; and when as much as 42 diameters in

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* Abstract of paper read before the British Association, Section G.

length, with 15·6 tons. Now the model of the Britannia Bridge, 75ft. in span, failed with 14·8 tons per square inch compression; Brunel's 66ft. girder, having a 3ft. wide cellular top member, failed with 12·6 tons; and some girders tested by the author with 15 tons per square inch as an average on the top flange. Taking the mean results of a large number of experiments, the influence of length between the practical limits of 15 to 25 diameters would be just appreciable; but, if only a few experiments were compared, the deduction might be drawn that lengthening a column, or rounding its ends, increased rather than reduced its strength. Thus one steel tube, 20 diameters in length, tested by the author, bore 22 tons per square inch, whilst a similar tube of half the length bore only 19·2 tons. Again, a round-ended column, 20 diameters in length, bore 19·3 tons per square inch, whilst a flat-ended one failed with 18 tons. No doubt greater regularity would obtain with full-sized than with model tubes, but still the practical fact remained that, within the limits occurring in the Forth Bridge, the compressive resistance of the tubular struts would be as high as that of the top flange of any plate or box girder that could be built, and that whatever stress was admissible in the girder would be admissible in the struts. This was a reassuring result to arrive at, because the practical experience had been chiefly with girders and not with tubular struts.

The author's experiments conclusively prove that steel is far superior to iron as a material for struts. The peculiarities of steel are tolerably well understood now, and amongst other precautions it is especially desirable to so design the joints in tension that no tearing action shall be set up along a line of rivet holes. As regards cost of manufacture, the difference is comparatively small between a circular and a rectangular member. The main tubes will be made up circumferentially of ten bent plates, lap-jointed and double rivetted through the flanges of ten rolled beams, which will run longitudinally through the whole length of the tube. Stiffening rings will also be introduced at suitable intervals. The junctions of the tubular struts with the tubular bottom members offered some little difficulty at first in designing, but, this being surmounted, the manufacture of the junction lengths becomes, as it were, a piece of shipbuilder's work. Before dismissing the question of steel in compression, the author would wish to mention the results of some experiments made by him on steel which had been previously subjected to end pressure in a tube, so that flexure could not occur. The rods were 1in. diameter by 30in. long. With the mildest steel the resistance to flexure was 14·5 tons per square inch in the uncompressed rods, and 22 tons, or say 50 per cent. more, in the rods which had previously been subjected to an end pressure of 36 tons per square inch. With somewhat harder steel the corresponding figures were 16 tons in the uncompressed, and from 26 to 29 tons in the previously compressed bars—a gain of from 60 to 80 per cent. The bars, when tested in tension, showed no loss in strength or elongation from the previous compression. As 30-ton steel, after the end pressure had been applied, bore as much load without flexure as 54-ton steel which had not been so treated, it is clear that the adoption of mild steel in railway bridges would be much accelerated if some simple practical method could be devised for bringing about the molecular change effected in the above instances by an end pressure.

Changes of temperature as well as gales of wind will affect the stresses upon the steel, but to a comparatively insignificant extent. Only experience could decide whether it would be safe to carry an ornamental ashlar-faced building on a girder 150ft. in length without running the risk of inducing cracks in the masonry; but the author, having tried it, can say that the effects of temperature in such a case may be safely ignored. Similarly he had used, without inconvenience, girders 630ft. in length in the floor of a building, and purlins of equal length in the roof of a station. Each case must, however, be dealt with on its own merits. Arched station roofs, such as the St. Pancras roof of 240ft. span and 700ft. length, seem to require no provision for expansion in either direction. Again, the Victoria Bridge at Pimlico has longitudinal girders 913ft. in length, and cross girders 100ft. in length, with no provision for expansion in either direction. On the other hand, in the Southwark Bridge, grooves had to be cut in the masonry to admit of the free expansion of the cast iron spandrils, which had been fractured by expansion in several instances, though the arch was only 240ft. in span, and the spandrils were not continuous across the piers. 12 deg. increase of temperature is the equivalent as regards elongation of 1 ton per square inch stress. Since by no practical means could stresses from expansion and contraction be wholly eliminated from the Forth Bridge, it became a matter for careful consideration what provision for expansion would be requisite or expedient, and what could be dispensed with. There could be no doubt, of course, that longitudinal expansion in the 1700ft. span should be provided for by placing one end of the 350ft. girder on rollers where it was supported by the cantilever. The direct stresses would thus be eliminated, but there remained those due to the unequal heating of the different members, as in every other bridge. These stresses were not included in the estimated maximum tension and compression per square inch given in a previous part of this paper, but were assumed, as usual, to be covered by the factor of safety. A more difficult question arose with reference to the portions of the girders between the piers. Thus the Inchgarvie pier consists of four cylindrical masses of masonry, spaced 270ft. apart longitudinally and 120ft. apart transversely, centre to centre. The point to be decided was whether the great girders should be bolted to each mass of masonry, or be fixed at one end only of the above 270ft., and be placed on rollers at the other end. This would be done, as a matter of course, with an ordinary 270ft. span girder bridge, but the conditions here were very different. In the first place, the pressure was enormous, and a bed-plate 35ft. by 18ft. was not a convenient one to provide with rollers. The most important point, however, was that sudden and unequally distributed gusts of wind caused stresses which rendered it extremely desirable to dispense with rollers if possible. On considering the question in detail it proved to be quite possible to do so. The range of temperature in this climate is not really great on well protected surfaces, as the practical uniformity of temperature a few inches below the ground testifies. Taking the average of twenty years' observations at Greenwich, the mean shade temperature of the different months ranged from 38·94 deg. in January to 62·54 deg. in July. As the average for the whole twenty years was 49·69 deg., the range was thus merely 11 deg. below and 13 deg. above the mean temperature. Since 12 deg. corresponds to a ton per square inch stress, ironwork bedded at a mean temperature in a mass of masonry might well be subject to no greater stress from variation of temperature than plus and minus 1 ton per square inch, which is far less than would obtain in a so-styled free to expand structure exposed to the rays of the sun. In January the temperature fell to 12·7 deg., whilst in July it rose to 97·1 deg., a range of no less than 84·4 deg. in the shade. The lowest mean daily temperature was 19·4 deg. in January, and the highest 78·6 deg. in July—a range of 59·2 deg. The maximum daily range was 37 deg., and monthly range 53 deg., both in July. In the sun the temperature rose as high as 150 deg., and the extreme range for the year would be no less than 137 deg. The average yearly range being less than 24 deg., a clear explanation is thus afforded of the fact so well proved by experience, that provision for expansion is essential in point rods, signal wires, and similarly exposed and light pieces of ironwork, whilst it may safely be ignored in the case of girders enclosed in buildings or bedded in jack-arches. Having reference to the considerations thus briefly set forth, and to the behaviour of existing structures of all classes in this climate, it proved, on investigation, to be quite unnecessary, as far as temperature was concerned, to provide rollers at Inchgarvie pier. The steel tubes between the four cylindrical masses of masonry will be covered, like marine boilers, with 2in. of "fossil meal," or some other suitable non-conducting material, and an exterior iron envelope. Inside the tubes will be lined with about 2ft. in thickness of cement concrete, to serve as an equaliser of temperature, and these precautions being taken, the results of calculation show that the stresses from changes of temperature will be of no moment either to the superstructure or to the masonry. There still remained the question whether, for other reasons than temperature, rollers might not be necessary at Inchgarvie. Since the 270ft. long tubes would be erected upon scaffolding, there would be no stress upon the metal at first, but as the erection of the cantilevers by overhanging proceeded, there would be the gradually increasing thrust from the bottom member, and it appeared difficult to say whether this thrust would come upon the tubes or upon the piers as abutments unless rollers were introduced. A compressive stress of 5 tons per square inch would shorten the tube 1½in., and as the stout masonry piers would tilt very little, this movement could not occur, and the tubes would not take up their share of the work unless some sliding were provided for. After a careful consideration of all the conditions of the problem, including changes of temperature, the author came to the conclusion that a certain amount of initial stress on the tubes between the masonry piers was desirable; and although it might at first appear to be difficult to do this with a tube 12ft. in diameter by 2in. in thickness, the difficulty vanished, as usual, upon being grappled with. He proposed simply to make the upper and lower bed plates, which were intended to slide on each other during the erection of the bridge, with serrated surfaces sloping at an angle of 1 in 6. As the co-efficient of the well greased and planed steel surfaces would not exceed one-twentieth of the load, the shortening of the tube under the compressive stress due to the erection of the cantilevers would proceed freely, whilst the desired initial stress would be put on partly by the weight of the structure and the tightening of the holding-down bolts taking effect on the 1 in 6 incline, and partly by the test load of the bridge. A movement of 1½in. would be provided for temporarily, and the two bed plates would finally be gripped together, and made fast to the piers by forty holding-down bolts of 3in. diameter. When complete, the stresses on the metal would never exceed the limit of 7½ tons under the joint influence of live load, wind, and temperature, and the pressure upon the masonry piers and foundations would be well within the working limits. It is unnecessary to refer in detail to the mode of erection, as it is obvious that the work will be commenced at each pier, and be proceeded with by adding successive portions to the ends of the cantilevers until the same are complete. The central girders will also probably be erected on the overhanging system, temporary connections being formed between the ends of the cantilevers and the central girders. The closing lengths or key pieces at the centre of each 1700ft. span will be put in on a cloudy day, when there is little variation in temperature, and the details will be so arranged that the key piece can be completed and the temporary connections cut away in a few hours, so as to avoid any temporary inconvenience from expansion and contraction. No special difficulty will arise with respect to the foundations, though the works will be, of course, on an unusually large scale. The island of Inchgarvie is of trap rock, and the central pier at that spot will consist of four cylindrical masses of concrete and rubble work faced with granite, and having a diameter of 45ft. at the top and 70ft. at the bottom. The height above high water will be 18ft., and the depth below the same will vary from 24ft. to 70ft. After the sloping face of the rock foundation has been cut into steps, wrought iron caissons will be floated out, lowered into place, and filled with concrete lowered through the water in hopper-bottomed skips. Queensferry Pier will be founded on boulder clay. Open-topped cylindrical caissons, 70ft. diameter, with an external and internal skin 7ft. 6in. apart, will be floated out and lowered into place. The space between the skins will be filled with concrete, to give strength and weight to overcome frictional resistance in sinking. Grab excavators will be carried on a turntable top to the caissons to remove the earth from the interior, and pneumatic apparatus will be supplied to enable men to clear boulders from the cutting edge of the caissons. From a depth of 6ft. below low water upwards the masonry will be built in the dry, inside a movable caisson connected by an india-rubber joint with the permanent caisson below it. The piers will be carried down at least 10ft. into the boulder clay, which will give depths ranging from 68ft. to 88ft. below high water, and 18ft. less at low water in the respective cylinders. In round numbers, the weight of one of the cylindrical piers at Queensferry may be taken at 16,000 tons, and the combined vertical pressure on the top of the pier from the dead weight of superstructure, rolling load, and wind pressure at 8000 tons; so the load on the clay would average about 6 tons per square foot over the area of the foundation. This is an insignificant amount on such hard clay as that at the Forth, and the margin is ample, therefore, to allow of the unequal distribution of the pressure due to the action of partial blasts of wind and of a certain amount of expansion in the tubes connecting the piers. The total length of the great continuous girder is 5330ft., or, say, a mile, and of the viaduct approaches 2754ft., or rather over half a mile.

About 42,000 tons of steel will be used in the superstructure of the main spans, and 3000 tons of wrought iron in that of the viaduct approach. The total quantity of masonry in the piers and foundations will be about 125,000 cubic yards, and the estimated cost of the entire work, upon the basis of the prices at which the original suspension bridge was contracted for, is about £1,500,000. Owing to the varying price of steel, and to the magnitude and novelty of the undertaking, this estimate must be taken as approximate only, as a contract has not yet been concluded for the works.

LETTERS TO THE EDITOR.

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

ROAD LOCOMOTIVE LEGISLATION.

Sir,—I have just read with much interest your article on "Road Locomotive Legislation." The result arrived at is so startling that it is well worthy of further consideration. According to the figures you adduce, the net saving to the country by the use of 4000 traction engines is £18,904 10s. per diem, or allowing 300 working days in the twelve months, £5,671,650 per annum. If this enormous dividend is earned upon a capital of £2,000,000, it must be a very short-sighted policy that would impose any restrictions on the use of road locomotives.

In order to arrive at this result, you assume that each traction engine does on an average the work of twenty horses. If worked to their full capacity this would perhaps be correct, but they frequently go about with loads that could be taken by four or five horses. Speaking of my own experience in this county, in one part of which traction engines are extensively used for drawing coal, I do not think that on the average one engine does the work of five horses. If this be generally so, the enormous saving before mentioned dwindles down to a comparatively trifling amount.

Let us now take another view of the matter, basing the cost of carriage on the figures adopted by you. An engine starts with a truck containing, say, ten tons of coal, to deliver it at a place ten or eleven miles distant, which with stoppages for water, repairs, &c., and the return journey will occupy the whole day. The working expenses will be :—

	£	s.	d.
Interest, maintenance of value and repairs, 20 per cent. on £500, 300 working days per annum is equivalent to per diem		6	8
Wages of two men..		8	0
Half a ton of coal		5	0
Oil		2	0
Total	1	1	8
Cost of drawing same by horse power :—			
Six horses at 5s.	1	10	0
Wages of four men at 3s...		12	0
Total	2	2	0

showing a saving by steam haulage of £1 0s. 4d. If this coal is sold at 1s. per ton less than when drawn by horse power, the public benefit to the extent of 10s., and the remainder, 10s. 4d. is netted by the engine owner.

Now comes the question whether the public do benefit to the above extent. In this district the roads used by the engines having become disturnpiked are repaired by the parishes, half the cost of which, under certain conditions, is refunded by the county. If the owner of the traction engine resides in another county, it is clear that he does not contribute one single penny towards the damage done to the roads. To deliver this coal the engine and truck pass over twenty-two miles of road. Knowing what it costs to maintain these roads, the damage done each journey greatly exceeds the benefit derived by the public, and in certain states of the weather exceeds also the profit made by the engine owner. The latter, therefore, and the people who buy the coal, derive their benefit at the expense of the ratepayers. You may say, But the roads would be damaged if the coal were drawn by horse-power; and you produce figures to show that the pressure on the roads per inch of tire is less with traction engines and trucks than with carts and wagons. But in a case of this sort a little practice is worth a great deal of theory. It is well known that these roads were in a good condition before the use of traction engines, and maintained at a comparatively low rate, whereas after a twelvemonth's use by engines they are in a deplorable condition, and cut to pieces, although a much larger sum has been expended upon them.

I quite agree with you that every appliance which tends to reduce the cost of transit must be of great benefit, and should be encouraged; but the comparison you draw between railways and traction engines is scarcely a fair one. The owners of the latter do not maintain the roads they use, and it is as though the tenants of the land through which railways pass were compelled to maintain the permanent way. If traction engines, after making good all the damage that they cause, can be worked at a profit, I for one should be glad to see them more extensively used; but if—although a source of profit to the owner—they are worked at a loss, as in one part of this country I believe they are, it must be false economy to encourage their use.

With reference to the outcry which has been raised against them on account of a few accidents—which are much to be deplored—that have resulted from their use, the fault is not entirely on the side of the traction engines. There are many places in the country to pass which is attended with much more danger than meeting an engine on the road—such as level crossings, under an iron bridge, or alongside an embankment over which a railway train is rushing at sixty miles an hour. If the power which the driver of a vehicle has to stop a traction engine while passing it, and a little care are exercised, the danger is reduced to a minimum. Drivers of traction engines are hedged round with restrictions imposed upon them by Act of Parliament. They are so carefully looked after and punished for the slightest infringement of the Act, that it is no wonder they do not return the "soft answer" you recommend to the strong language which is frequently addressed to them.

In making these remarks I am only alluding to the experience gained in this county. It is possible that elsewhere the conditions may be more favourable to the use of traction engines; but it only shows that our legislators must be careful to look at all sides of the question, in order that any measure framed for the public benefit does not press unfairly on a particular class.

J. Somes Story, M. Inst. C.E.,
County Surveyor for Derbyshire.

Market-place, Derby, August 28th.

SEWAGE AND AIR.

Sir,—In reply to "A. F.," I am not able from personal observation to give the information he desires as to the condition of latrines resorted to by large numbers when the urine is automatically separated from the fœces, but I have lately seen copies of some testimonials from the authorities of the town of Batley, in Yorkshire, where the system is rather extensively carried out, though without the use of earth or ashes, or anything else to cover the fœcal matter, and these all bear high testimony to the value of the results obtained. The Sanitary Inspector writes that they have put in about 100 of the dividable closets, principally in factories where the urine is required for fulling purposes, and that all who have adopted them speak highly of their advantages. Three millowners who had tried the appliances with part only of their closets, had since had them all fitted up with the system, "and they are giving great satisfaction." "We have about twenty put into cottage property. The urine is conveyed direct into the drains and the solids are collected once a month. One pail will serve for six weeks if used by twenty persons daily." "By its use decomposition and fermentation is prevented, and the smell reduced to a minimum." The Mayor of the same town says—Dec., 1880: "During the last six months we have had 100 placed in various parts of the borough, and they are all giving satisfaction. Millowners and manufacturers are finding out that their adoption is not only a sanitary but a pecuniary benefit; while our Sanitary Inspector finds his labours eased and his men less worked wherever they have been put in." Since the date of these letters I believe many more closets have been altered to the new system with good results, and in this method it must be remembered the fœces and urine are simply separated and the latter run off to the drains or used for fulling purposes, the solid matters being left entirely uncovered. I am not advocating this method, however, but simply showing what may be done even on a large scale, with a proper system of ventilation, by merely separating the solids from the fluids; and as I maintain, in spite of "A. F.'s" suggestion, so preventing the latter acting as ferments to the former.

In reply to the last paragraph of "A. F.'s" letter, the supply of the deodorising material—ashes—as proposed by Dr. Lloyd, is ready to hand in every house and has to be removed in some way. The quantity required is not large, and the usual domestic fires will in most cases provide an abundant supply, but when this is not the case a very small amount of quicklime will make up for any deficiency.

G. Septimus Hughes.

Manchester, August 29th.

Sir,—Observing in your valuable paper observations on the utilisation of sewage—a subject I think you wisely encourage—I beg to call your attention to the fact, that long before the "Moule Earth Closet" came into use, I had erected a machine in my printing office for the purpose of securing the valuable manure. I do not pretend to any engineering knowledge, but I was anxious to utilise what nature intended to give back to mother earth, requisite for the growth of vegetation. I, for the sake of carrying the deposit to the land, separated the liquid from the solid. The former I secured in a cask, and the latter, by means of sifted burnt clay, converted into a substance as hard as rock, and without any odour. I had it placed in a sack outside my printing office, in the most prominent part of the city of London, and in the height of summer there was no effluvia arising from such exposure. Now, Mr. Editor, I think you must agree with me that it would be desirable to prevent the pollution of rivers. Earth to earth. In fact, if I had the power, I would make it a criminal offence to pollute the streams, but at the same time provide the means of preventing the pollution.

I think there is another way of disposing of the sewage, viz., running it down in pipes by the side of the different railway banks, to places far from habitation; and however barren the land might be, it would become very productive. My own experience has proved the great value of the manure as a fertiliser, but it requires experience and proper management to save expense and to produce profitable results.

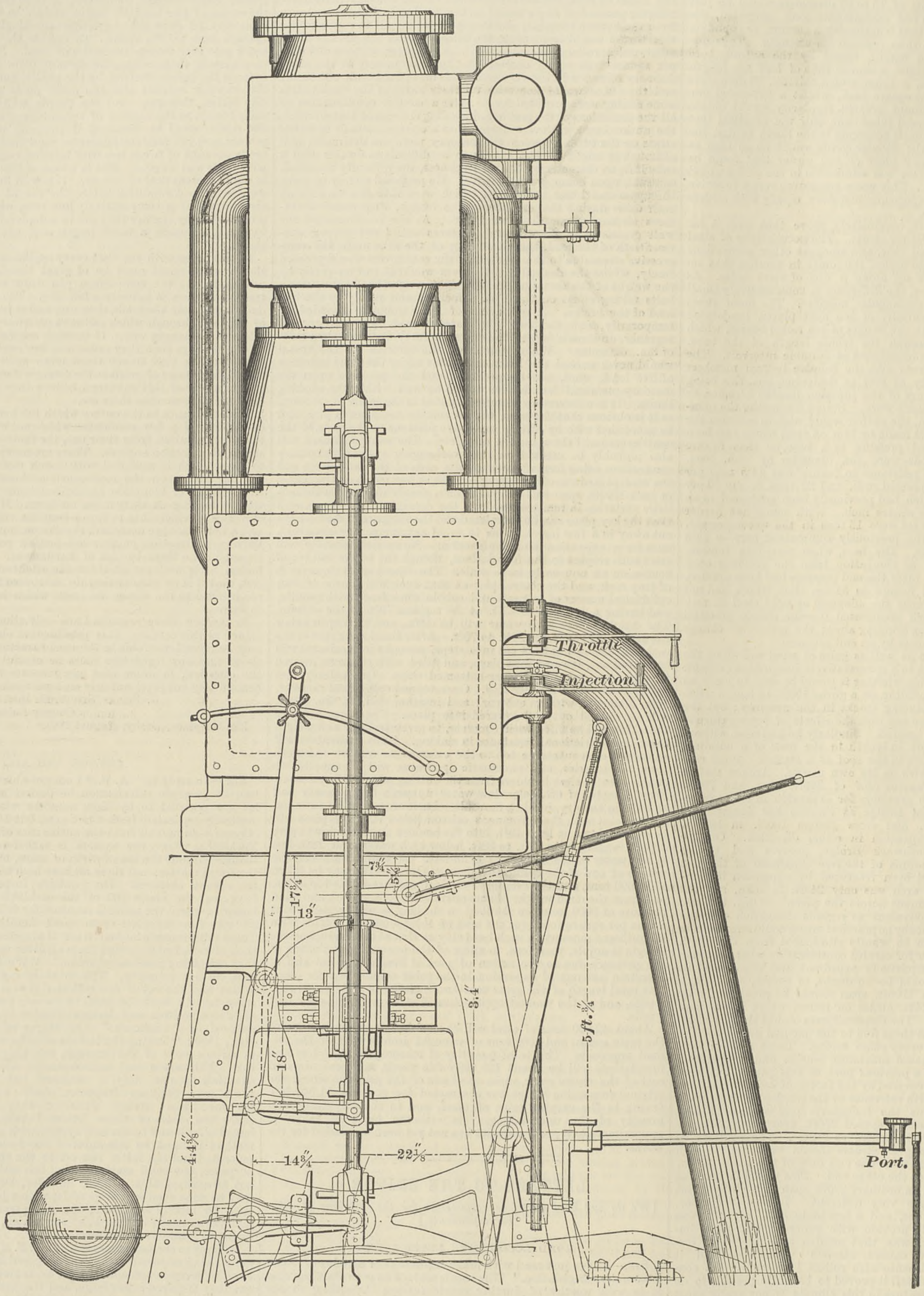
Thos. Smith.

Penge, Surrey, August 30th.

[*For continuation of letters see page* 157.]

COMPOUND ENGINES OF THE S.S. BOSCOBEL

MR. S. F. HODGE, DETROIT, U.S., ENGINEER.



OUR contemporary, the *Mechanical Engineer*, New York, gives in a recent impression an interesting account of the alteration of a single-cylinder marine engine into a compound engine. The particulars are as follows:—"The steamer Boscobel, the property of the Peshtigo Company, employed in towing lumber barges between Peshtigo and Chicago, is of the following dimensions:—Length on water-line, 150ft.; length over all, 161ft.; beam moulded, 27ft. 6in.; depth moulded, 6ft. 12in.; mean light draught, 10ft.; light displacement, 600 tons. Capacity for 200 tons of coal. She formerly had a 32in. by 32in. high-pressure engine supplied with steam by two return tubular boilers, 7ft. 6in. diameter, 17ft. long, each boiler containing four main flues 14in. diameter, and ninety 3½in. return tubes, and two boilers weighing 32 tons. Having to pass through the Sturgeon Bay Canal, it was found that with her full complement of coal she drew too much water, and it was decided, after the close of navigation last year, to change the engine to a combined engine with a high-pressure cylinder 22in. by 32in. and a low-pressure cylinder 40in. by 32in. The economy of this engine has enabled the owners to dispense with about one-half of the fuel, thus diminishing the draught of water. The vessel tows two barges carrying 1,000,000ft. of lumber at nine miles an hour. Steam 100 lb. and 90 revolutions per minute. The screw is 10ft. diameter, 11ft. 6in. pitch. The bed-plate and frame were made for the original engine. The frame has considerable batter in a fore-and-aft direction; so great was it that we found it necessary to use a rocking shaft for the valve gear, in order to avoid off-setting the excentric rods. It is not usual in the States to adopt this method, as the frames are generally nearly or quite vertical in a fore-and-aft direction. The condenser is of the ordinary jet variety; the foot valve is in lower end of the air pump barrel. The air pump is 24in. diameter by 11in. stroke. The high and low-pressure slide valves are keyed to one stem; the lower valve has ⅛in. less lap than the high-pressure steam valve, thus giving the low-pressure piston ⅛in. more steam lead than the upper. The high-pressure valve has a cut-off valve on its back worked by an excentric on the after end of the engine, operating a rocking shaft on the forward end, on which an arm is forged to operate the cut-off valve by means of a radius rod in the usual way. The cylinders and pipes are lagged, first with asbestos paper, then with hair felt, and lastly with black walnut staves.

"The design for rebuilding this engine was made by Harry W. Granger, late constructing engineer of the Dry Dock Engine Works, assisted by Mr. Stowell. Mr. Frank E. Kirby advised as to proportions of valves and ports, and also directed the changes to be made in new location of engine, boilers, &c. &c., to secure the best results in draught of water. The result has proved the correctness of his calculations, the mean draught coming within 1in. of his figures.

"The greater part of the new work, consisting of cylinders, valves and gear, condenser, air pump, &c. &c., were built by Mr. Samuel F. Hodge, of Detroit, and shipped to Chicago, where they were erected by local mechanics, superintended by a machinist from Mr. Hodge's shop."

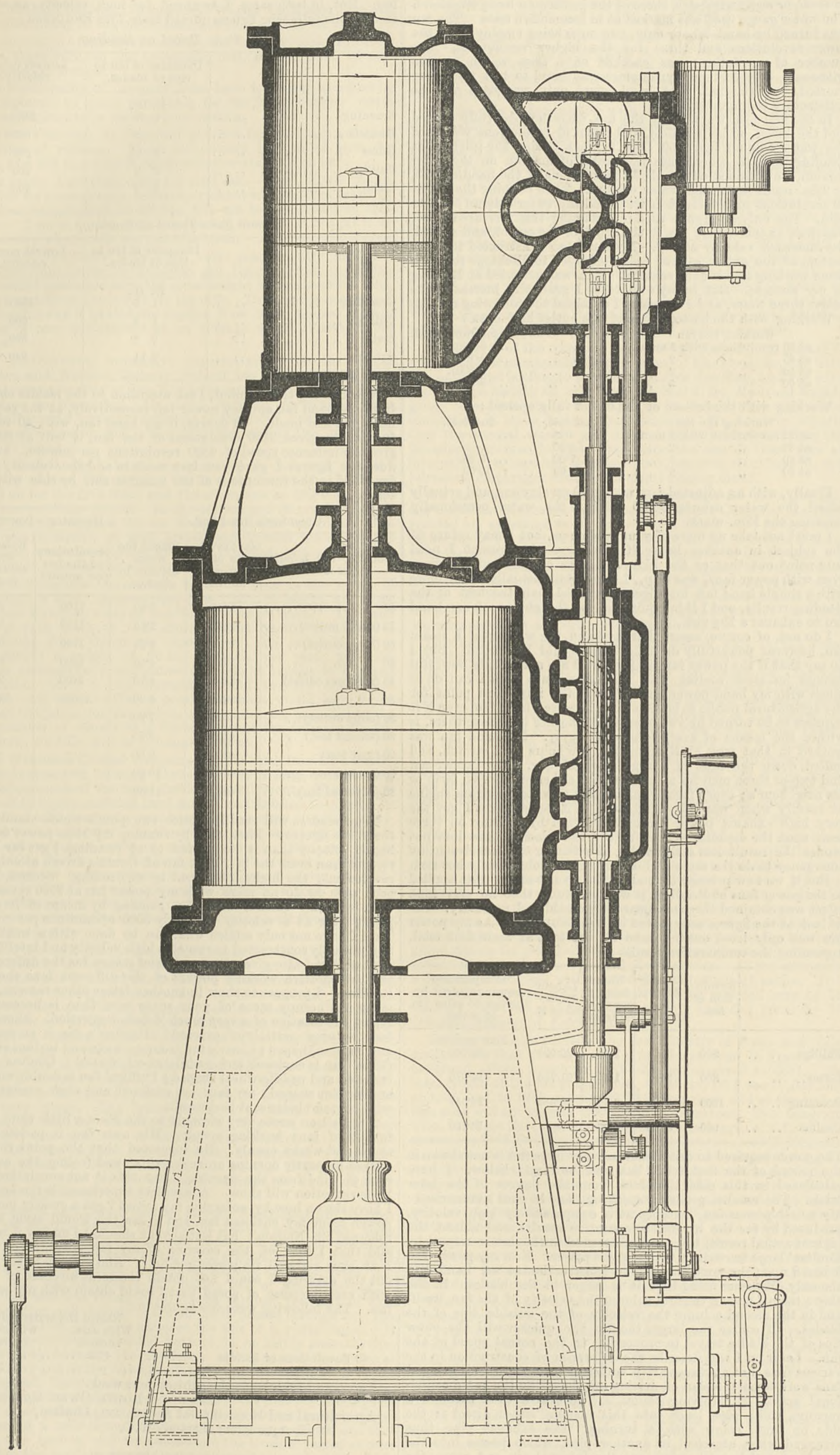
Our engravings show the arrangement very clearly. The entire alteration consisted in the substitution of the two new cylinders and the frames, as are shown, said crank shaft, &c., remaining as before. The original engine had no condenser.

THE BASIC PROCESS IN THE UNITED STATES.—According to the U.S. *Engineering and Mining Journal* the Bessemer Steel Company and Mr. Jacob Reese are at loggerheads about the ownership or control of the patents covering the alleged invention of the basic process. Mr. Reese, it appears, sold to the Bessemer Steel Company, Limited, not alone his letters patent already obtained, but also future inventions, for the sum of 5000 dols. and a royalty of 5c. per ton, a maximum limit of 10,000 dols. a year being placed on the latter. Later, he assigned the claim for an annunity to Mr. Andrew Carnegie for an annunity of 5000 dols. Subsequently Mr. Reese made an agreement with the Harrison Wire Company, of St. Louis, Mo., licensing them to use various patents taken out by him for making steel, which he had previously tendered, under the agreement, to the Bessemer Steel Company, and which had been accepted by them. When Mr. Reese demanded a second instalment of his annuity, he was informed that it would not be paid until he assigned all his letters patent affecting the contract with the Harrison Wire Company to the Bessemer Steel Company. Mr. Reese then announced his intention to rescind existing agreements, and the Bessemer people have asked a court in Pittsburg to grant an injunction against him and the Harrison Wire Company.

PENZANCE SCIENTIFIC AND INDUSTRIAL EXHIBITION. — This exhibition will be held in the Public Buildings, Penzance, under the patronage of the Science and Art Department, South Kensington, and the Royal Geological Society of Cornwall. The exhibition is projected for the purpose of bringing together a display of apparatus and products illustrative of the modes of working and results attained in the various departments of science and industry. Examples, models, diagrams, or descriptions of obsolete or disused machines or processes possessing historic interest, will be eligible for exhibition; but the committee more particularly desire a collection of the most approved modern appliances in use at the present time. It is proposed to open the exhibition on Monday, the 25th September, and to keep it open during one week. Short lectures descriptive of some of the exhibits will be given at intervals. At night the halls will be illuminated by electric light, and vocal and instrumental music will be provided. The profits, if any, will be devoted to the advancement of Penzance science classes. The committee hope that all persons possessing objects suitable for exhibition will assist by lending the same. Exhibits may be for sale if the owners desire it, the secretaries being authorised to receive things for that purpose. All communications should be addressed to Messrs. Barnett and Taylor, secretaries of the Executive Committee, Public Buildings, Penzance.

COMPOUND ENGINES OF THE S.S. BOSCOBEL.

MR. S. F. HODGE, DETROIT, U.S., ENGINEER.



LETTERS TO THE EDITOR.

[*Continued from page* 155.]

THE FORESHORE AT HASTINGS.

SIR,—Your article on the Hastings foreshore suggests to me that some further information on the subject may be of interest. About five or six years since there was a great poverty of shingle along the western front of the towns of Hastings and St. Leonards. With the hope of improving the shore and protecting the sea wall, new groynes were erected at this place, which, shortly after beginning to fill, deprived those groynes to the east of their regular supply of beach, the shore here becoming bare as the remaining shingle travelled away further eastwards, and damage resulting at about the middle of the frontage in consequence. Later these empty spaces becoming filled and the poverty more felt towards the old town, further damage ensued opposite the fish market, which danger still threatens that locality.

Mr. Bray, in a paper read before a local institution, and containing much valuable information on the foreshore question, says, in reference to this: "It is worthy of remark that the groyne space whose turn it is to be next supplied with the ever travelling and accumulating shingle from the westward, is always the worst off for beach, and a serious and almost total denudation here exists." When it is stated that there are to the west of the fish market about thirty groynes, belonging to Hastings and St. Leonards alone, intervening between that place and the principal source of beach supply, and but two, though large ones, about half a mile to the east of that point, it will be evident that any fears entertained are not ill founded. The natural protection is, however, slowly advancing to the rescue. The stretch of shore now threatened not having before been injuriously affected by artificial works, has not received much attention; this, I think, accounts for an apparent injustice to the fishing population.

The two groynes stated as lying to the extreme east are quite recent erections; originally Sir John Coode advised the construction at this place of two concrete groynes with a revetment wall between, but his advice, unless I am much mistaken, was sought rather to ensure the safety of the large tidal sewage tank here situated, than from any serious apprehensions concerning the foreshore. The easternmost groyne planned by him was four years ago carried out at a cost of £10,000. It is 460ft. long and 25ft. high—above foundations—at the break-back. It is built of concrete, faced with a hard local blue stone, and rests on the rock. Not liking the expense, the town authorities have endeavoured to supplement this construction by another of timber instead of masonry—the groyne unfairly spoken of by the fishermen in their memorial as "a paltry wooden" construction. I may mention that there appears to be an impression amongst many people in the town that there is some peculiar virtue in a concrete groyne, apart from its dimensions, profile, or durability. I need not in this journal combat the fallacy. This groyne is probably the largest in timber on the coast, and was designed by Mr. Andrews, borough surveyor. Its length is 300ft., having the top level for 88ft. and then sloping seawards at an inclination of 1 in 9. The greatest height is 24ft. above the rock upon which it is built, consisting of a very hard white sandstone. A number of piles, 10in. by 10in., varying in length from 28ft. to 11ft., and spaced 4ft. from centre to centre, each having oak cleats spiked on at their ends, are let into the rock to depths of from 4ft. to 6ft., the holes being filled in with fine concrete. Running parallel with the tops of the piles, and starting from the shore end, are three walings on the east side 10in. by 10in., fastened to each pile by 1¼in. bolts; the upper waling runs the whole length of the groyne, but the other two are shorter, stopping off as they slope to the ground; upon the lower of these rest the ends of twelve raking land-ties, which are upon the west side, 20ft. long each. Upon the middle waling rest seventeen land-ties from 24ft. to 30ft. in length, and upon the upper one twenty-one ties varying from 30ft. to 40ft. long; these are solid oak trees, their large ends resting upon the walings and secured by a piece of timber 10in. by 7in. by 10ft. long on the east side, let into the tie, and parallel to the waling, being secured by 1¼in. bolts to the piles, and having a large 1¼in. bolt passing vertically through it, the oak tree and the waling bolting the whole up solid. The smaller ends of these ties are anchored by two short piles on either side of it, which are let into the rock, bolted up, and the holes filled up with concrete. At the top the groyne has a waling on its west side 10in. by 6in., bolted to the piles with 1¼in. bolts. The whole height is planked on the west side with 2½in. oak. A section taken across the groyne at a land-tie would show a right angled triangle, of which the base would be the rock surface, the perpendicular side the upright piles, and the hypotenuse the land-ties. The work, which has been about two months finished, will, I believe, be thoroughly reliable, as both materials and work are good. The cost was £2360, the contractor being Mr. F. Winser of Hastings, whose son, Mr. Ben. Winser, undertook the actual erection, dealing with the difficulty incidental to this kind of work with considerable skill.

I think it will be conceded from the above account that this groyne, so long as it is kept in good repair, is likely to prove itself trustworthy; as to its usefulness, I am informed that already a considerable quantity of shingle has collected. The relative advantages of concrete and timber for this particular situation appear to be pretty evenly balanced, though in concrete the cost would be about three times as great, yet the term of life would probably be considerably more than three times as long; so that a comparative estimate, taking interest into account, for the length of life of a masonry construction would leave the timber groyne with but a small advantage on the score of economy. The most easterly groyne, however, being in a slightly more exposed position, left but little choice in the matter as to material, especially as it is to be considered a permanent work for the protection of a costly sewage tank.

I have already remarked that the shingle is advancing towards the fishing station, but in view of the fact that there are now about two and a-quarter miles of shore defences to the westward, and that others are about to be erected beyond the town boundary in the same direction, it is imperative that the beach when it arrives at this place should be arrested. The new timber groyne will render valuable assistance, but it will not probably be sufficient. Groyning must be continued to meet that nearer the middle of the town. Large groynes are by no means economical, as, whilst the length of coast they will protect increases only with their own length, the cost increases in a much greater ratio, both on account of the break-back being carried farther out, which adds to the average height, and because of the greater cost of erection as the work is carried seawards. Nevertheless, I would suggest that not three or four small groynes be built, but one, or at the most two large ones, between that just finished and the fish market. The reason for limiting the number is obvious, as many groynes cutting up the strand would be fatal to the fishery.

Your article expresses strong disapproval of the custom which obtains of carting away the beach in a wholesale manner. When it is remembered that the sole office of a groyne is to collect shingle, that without this it would be practically useless, it must be evident that the beach so collected has cost as much as the groyne itself; this being so, it is difficult to condemn too strongly a practice which without return deprives the town of so much valuable property. From a rough estimate, I find that the shingle arrested by the large concrete groyne has cost about 5s. per cube yard to acquire. It was 2200 cart loads of this, or about as many yards, which were mentioned in your article as having been taken away in six weeks. W. H. THORPE.

London, August 23rd.

PATENT OFFICE DRAWINGS.

SIR,—Being impressed with the idea, from constant and diligent perusal of your esteemed paper, that no one is more ready to set lance in rest and do battle in the interest of our profession than yourself, where a justifiable grievance can be pointed out, I take the liberty, with your kind permission, to trouble you with these few lines.

I had occasion lately to take out a patent for a machine in several countries. A day or two ago I received an English Patent-office copy—blue-book—of it. What was my surprise, I might say disgust, at turning to the plates or drawings it contained. Firstly, I did not recognise my own drawings as reflected in these plates, but that was, of course, only momentary. I never saw more coarsely executed plates in my life. They may be termed crude, nay barbarous attempts, such as I picture to myself Albrecht Durer's first etchings on wood or Gutenberg's first essays in printing might have been. But that even is not the worst feature of the matter. The letters, and especially the figures, are so indistinct and blotchy that they are misleading, and sometimes even prevent the proper understanding of a complicated, intricate new machine or apparatus. If this could not be mended and these said drawings or plates were the best attainable with our present knowledge and skill in the photographic art, of course I should never have dreamt of taking up your valuable space with these remarks; but that is by no manner of means the fact, as a proof of which I send you by the same post, for comparison, the English plates above alluded to, the plates from the German Patent-office book, and some plates which I got made for myself, to save copying, from a private firm, which are beautiful, all copies of the same machine, which, no doubt, you will kindly show to any one interested in this matter.

I believe now you will agree with me in saying that ours are a disgrace to us as that nation which is generally supposed to be in advance of all others as regards mechanical manipulation. The plans enclosed show this not to be the case, and that our Patent-office Commissioners should be ashamed of letting such abominable productions leave their hands. But it becomes doubly unjust towards us patentees when it is borne in mind that we pay in England £25 and in Germany, for instance, 48s. only for the stamp dues, knowing at the same time that our Commissioners have a fund of more than a million of pounds as capital—which, by the way, has come out of our pockets—which Germany has not, and out of which the outside mind at least would suppose it were possible to provide and apply the best known apparatus for the work, and such as would cause us no more to blush at the backward state the Patent-office plant must be in to turn out such wretched productions as they really now do.

In conclusion, I trust you will take up your independent, powerful pen in our general interest and in furtherance of a good object and improvement—one very much needed at our Patent-office—on the first fitting occasion, and not spare the rod where so well deserved. F. Y.

Rheinland, August 26th.

[We agree with our correspondent that the drawings now published by the Patent-office are disgracefully bad. Allusion has more than once been made to this fact by judges trying patent cases. Unfortunately, it is not easy to see how improvement can be effected. The Patent-office authorities appear to be entirely indifferent in the matter, and no efforts seem to be made to induce the lithographers to turn out better engravings; possibly, however, the price paid by the Government is too low to secure good work. The illustrations are, as a rule, nearly useless, save in the case of very simple machines, and thus the very object had in view in publishing them is defeated.—ED. E.]

SPEED OF CUTTING TOOLS.

SIR,—In THE ENGINEER of August 11th there is an article on the visit to Leeds of the Institution of Mechanical Engineers, in which are a few remarks about the speeds of cutters, drills, &c.; amongst others I notice the following :—"In Leeds, as elsewhere, there is, as far as the eye can tell in walking through the works, considerable difference in the speeds at which cutters working on similar materials are employed, and there is no doubt that attention to this subject, so as to secure the highest practicable speeds, might be advantageously bestowed."

The workmen have so many speeds from which to choose, and so many rates of advance or cuts per inch, that unless they give the matter some attention, or are closely watched by the foreman, they do not always use the best speed for the work they have in hand. If one asks a turner how many revolutions a certain piece of work should make per minute, and how many cuts per inch the tool should advance in order to remove a certain depth of cut in the least possible time, and of course produce good work, he will probably be unable to tell you.

Publications are, as you say, "meagre," and there is, too, considerable difference in the information they give. Molesworth gives two-thirds of a page to the subject, making the speed for wrought iron to cast iron as 27 to 17, and brass nearly twice as fast as cast iron. T. Greenwood, in his "Turners' and Fitters' Handbook," says, "Wrought iron is about a quarter quicker than cast iron, and brass the same as cast iron or a quarter slower." Molesworth makes planers 15ft. and shapers 12ft. per minute. Do not shapers generally go faster than planers? For drilling, tapping, and boring he gives 80ft. to 120ft. per minute; feet is, I suppose, a misprint for inches; but are taps run as fast as drills? Another book says, "Large planing machines on armour plates run as high as 24ft. per minute and cut 1in. deep and ½in. pitch." If this is so many ordinary planers are doing much less than they might do. Some say the speed of cut is not much affected by the depth; others that if you have a deep cut you must employ a slow speed.

Are there many shops where a cutting speed of 30ft. per minute is maintained on wrought iron? Are not advances of the cutting tool of six, four, and three to the inch very exceptional? Are the following speeds of tooling surfaces ever realised in practice :—Steel, 12 to 16 square feet per hour; cast iron, 15 to 25 square feet per hour; wrought iron, 20 to 30 square feet per hour?

Now, it seems to me that if some of our turners, foremen, or managers would give particulars of work they have actually done, such as cutting speed, number of cuts to the inch, depth of cut, sort of tool used, nature of lubricant, where used, class of work, heavy or light, material and name of piece operated on, their observations could not fail to be of interest to many of your subscribers. MACHINIST.

TRIALS OF HAY-DRYING FANS AT READING.

SIR,—In the continued trials at Reading, it is said, all the hand fans are to be left out. This decision will naturally create in the public mind a doubt as to the adequacy of hand-power fans to do the work.

Now I think every one will feel that it would be a misfortune of almost national dimensions if such a conclusion should be necessary. The great mass of tenant farmers have holdings of moderate size only. They are not generally possessors of steam power, or at all events they seldom possess it in a form available for harvest-saving purposes. It is therefore worth while to very carefully discuss the question before arriving at a decision adverse to hand fans, and adverse to all hope of the Neilson system being available for the benefit of the many. If you will grant me the favour of the necessary space to deal with the details I propose to show cause in favour of a more hopeful conclusion. I take, first, the table of results obtained by the judges at Reading. These results were published in THE ENGINEER of July 28th, and as your representative was privileged to afford some assistance in the work of testing, we may, I think, assume the accuracy of the figures.

What do they show? Leaving out all other details, let us look at the capability of the hand fans to raise water in a column, and the power required to be exerted to do this. I take, first, all the fans working at forty revolutions of their handles.

	Raised the water column.	Power required in foot-pounds.	Proportionate power required to raise 1in. of water.
Bamlett's fan	0·10	2,650	26,500
Phillips' ,, ...	0·47	4,592	9,770
Lister's ,, ...	0·50	5,740	11,480
Gibbs' ,, ...	0·55	2,741	4,983
Greening's ,, ...	1·30	10,332	7,947

The last column I have worked out myself, but any of your readers can check the figures by calculation for themselves.

We find, then, that under these tests Bamlett's fan certainly worked with small power, but only raised the water $\frac{1}{10}$in., and if the effect is compared with the power required, the result is very small indeed. Phillips' hand fan raised the water nearly ½in. Lister's just ½in. Gibbs's fan a little over ½in.; and my own fan $1\frac{3}{10}$in. Taking the work done, my fan stands first and Gibbs' second. Taking the economy of power, Gibbs' fan stands first and mine second, as will be seen.

But an unfortunate thing happened at the Reading tests. The two fans which thus stood first and second were not tried further. Mr. Gibbs, I suppose, was not present, and I was called to London to attend the monthly Council meetings of the Agricultural and Horticultural Association.

Your repretentative states as regards Mr. Gibbs' fan :—"The fan was removed; the man in attendance concluding that nothing more was to be done, went away, and taking the pulley from the fan with him, removed the possibility of the further observations which were subsequently decided on." And as regards my own fan, he states :—"The test of this fan was only made at forty revolutions per minute because some part was out of balance." But the other makers being on the ground, and being naturally dissatisfied with the results, succeeded in getting their fans tested at a higher velocity than forty revolutions of the handles. The incidents are thus described by you :—"Phillips' fan: This fan was, like Gibbs', at first tried at forty revolutions of the hand wheel, that being supposed to be a fair speed for a man to turn, but Mr. Phillips' representative insisted that sixty revolutions was nearer the mark, and hence it was tried at that speed also." Lister's fan: "Besides the figures there given, it was found, when the fan was turned by one of the judges at the speed which he considered that at which a man could continue, the water column by a water guage, not that used in the tests recorded, in the table was 0·75, and when turned at full speed, it was 1·00in. by the same guage." Let us see the results of higher velocities upon the fans fortunate enough to be re-tested :—

	Revolutions.	Raised the water column.	Power required in foot-pounds.
Phillips'	40	0·47	4,592
,, ...	60	0·95	6,681
,, ...	66	1·20	—
Listers'	40	0·50	5,740
,, ...	80	1·45	21,716
Bamlett's	40	0·10	2,650
,, ...	60	0·70	5,550
,, ...	120	2·90	18,864

It will thus be seen that Philips was able to increase his effect threefold, Lister threefold, and Bamletts twenty-nine times, by increasing their speed, although of course 120 revolutions would in practise be too high for hand turning upon any fan. And now I have to report results more remarkable. Naturally dissatisfied with the shutting out of my machine from tests applied to others, I have this week repeated and extended the tests in the presence of seven or eight witnesses, three of the gentleman being engineers. The water gauge used was marked as in locomotive tests. The fan was turned by hand labour only, two men being employed for the lower revolutions and three for the higher revolutions. The number of revolutions was checked on a stop watch by two witnesses. We had no dynamometer at hand to test the power exerted, but the fact that hand-power only was used will be satisfactory to inquirers.

In the first test we worked the fan with the inlet fully opened and the outlet at its smallest, and with 40 revolutions we raised the water column just 1·50, (1½in.) Then closing the inlet as at Reading, so as to concentrate the power of the fan on the water column, we obtained with only 32 revolutions of the handles 2·75, or 2¾in. result upon the water column. Then running the fan at 80 revolutions with three men we raised the water column 5·50, or 5½in. The only difference used in obtaining this increased effect was first, an increase of 1in. in the depth of the outlet, and second, the increased velocity named. My fan is so constructed that the bottom of the outlet can be easily enlarged to discharge more air when working at a higher velocity. This was not tried at Reading in my absence. But in my own tests I gradually increased the outlet three times, and eventually I obtained the following results.

Working with the bottom slide of the outlet half open :—

Working the fan	Water column raised.
at 30 revolutions with 2 men	3·00in.
at 45 ,, 2 ,, ...	4·10in.
at 56 ,, 2 ,, ...	5·00in.
at 90 ,, 3 ,, ...	8·50in.

Working with the bottom of the outlet fully opened :—

Working the fan	1st test.	2nd test.
at 32 revolutions with 2 men	4·25 ..	—
at 36 ,, 2 ,, ...	4·50 ..	—
at 80 ,, 3 ,, ...	7·00	9·25
at 90 ,, 3 ,, ...	9·00	10·00

Finally, with an adjusted fan, we ran 80 revolutions, and actually raised the water column 11·50 (11½in.) the water occasionally touching the 12in. mark.

I must not take up more of your space now, but I may return to the subject in another letter if necessary. At present I need only point out that as the highest figures obtained at Reading, even with power fans, was 5½in., I have thus actually done more with a simple hand fan intelligently worked than the best of the Reading results, and I think quite settled the ability of my hand fan to exhaust a hay rick.

I do not, of course, assert that my hand fan will equal a steam fan, however powerfully driven. That would be absurd. But I do say that if the power fans so far tested are admittedly powerful enough for stack cooling, then I have evidence that I can do as much with my hand-power fan. That is the important point for the agricultural public to have settled, because a hand fan, even if it requires to be turned by two men with another to relieve them, is within the means of every farmer to apply. My hand fan was worked in that way at Reading for two hours at a stretch, and pulled down the heat of a large stack 25 deg. Any farmer can find two or three men for an hour or two either on his own farm or his neighbour's; every farmer cannot find a portable steam engine as readily when wanted. And even if it be said that I got the very high exhaust power recently reported by putting on three men upon the handles to turn at a great velocity, that does not render the result less satisfactory, as a farmer can contrive in an emergency to do the same with a very big and obstinately hot rick.

But if we now proceed to analyse the results of the tests applied to the power fans at Reading, it will be found that no very high effect was obtained there or apparently considered necessary. Let us look at the figures as reported in THE ENGINEER. As my power fan was only tried once, I take all the fans at their first trial, appending the comparative results :—

	Revolution of fan.	Velocity of tips of fan blades V	Water column supported in in.	Labour required in ft.	Comparative power required by the fan to raise 1in. of water.
					Foot-pounds.
Phillips	800	3143	1·20	20·090	16·740
Lister..	800	5447	1·45	21·716	14·976
Greening	1500	5980	2·45	30·654	12·511
Coultas	900	8254	4·90	—	16·760

The power required to drive Coultas' very large fan is not shown in the record of the first trial, but will be found below. I have calculated in this case, therefore, from the figures of the later trials. The results, generally speaking, may be thus summarised: My small power fan, running at a comparatively high velocity, produced by far the highest comparative results, and almost the highest actual result, being only distanced in the latter respect by Coultas' large fan driven with a great power. Now my power fan is based upon the same principle of construction as my hand fan, the only difference being that it is larger in the blades. In the above table I give in the first column the velocity of the fan itself, and in the second column the velocity of the outside tips of the blades. Of course the larger the fan the quicker will the outer tips of the blades travel in proportion to the actual speed of the fan. Later on I will describe the difference of construction in the various fans, but at present it is sufficient to say that all exhaust fans work upon the plan of driving off the air by the rapid centrifugal action of revolving blades. The centre thus becomes a vacuum, and a pipe leads into this vacuum either direct at the side or from below with a turning. The exhaust pipe thus arranged when attached to another pipe, which passes into the centre of a rick, will pump out the internal air and cause the external air to rush from the open outer atmosphere in all directions through the rick towards its centre. That in brief is the explanation of stack cooling by a fan.

Now what happened at Reading, with the tests of the power fans was very much what happened with the tests of the hand fans; mine, which showed the best comparative work, was tested once. Phillips had three tests; Lister had two tests, besides the hand speed; Coultas had six tests. The three re-tested fans showed the following results with increased velocities :—

	Revolutions of fan.	Water column supported	Labour required in foot-pounds.	Comparative power required to raise 1in. of water column.
				Foot-pounds.
Phillips ..	800	1·20	20·090	16·740
do. ..	1520	2·90	53·757	18·539
do. ..	1600	—	—	—
Lister.. ..	800	1·45	21·716	14·976
do. ..	1000	—	—	—
Coultas ..	900	4·90	—	—
do. ..	990	5·40	—	—
do. ..	1008	5·50	92·184	16·760

The other tests of Coultas' fan, being made to try the effect of drawing air from one, two, or three inlets, we need not trouble with them now. It is sufficient to point out that Phillips, without doubling his speed, increased his effect nearly two and a half times; but at a great expenditure of power. Indeed, THE ENGINEER comments upon this, remarking :—"From the illustration it will be seen that the air enters on both sides of the fan, but still it does not seem to be so economical in power as some of the others." My own conviction remains that with a properly constructed fan the secret of success is high velocity rather than size of blades. And I believe this will be borne out by a comparison of the Reading figures, already quoted, with what I am going to add. Mine was the smallest hand fan shown at Reading and the smallest power fan. But, in both cases, I arranged for high velocity, as will be seen by the following figures quoted from THE ENGINEER :—

Hand Fans Tested at Reading.

	Diameter of fan to tips of blades.	Lowest normal velocity.
	ft. in.	
Greening	1 0	2160
Bamlett	1 2	680
Gibbs	1 8½	520
Phillips	2 0	400
Lister	2 2	400

Power Fans Tested at Reading.

	Diameter of fan to tips of blades.	Lowest normal velocity.
	ft. in.	
Greening	1 3	1500
Phillips	1 3	800
Lister	2 2	800
Coultas	2 11	840

Now bearing this in mind, I ask attention to the results obtained from my hand fan and my power fan respectively, at the re-tests I have just had made. Of course, if my hand fan, with 40 turns of the handle, gives 2160 revolutions of the fan, it will at 80 turns give the immense speed of 4320 revolutions per minute. I reproduce the figures I gave you last week to add the velocity of the fan itself to the revolutions of the handles side by side with each other.

Greening's Hand Fan.			Greening's Power Fan.	
Working the handles at per minute.	Gave revolutions of the fan per minute.	Raised the water column in inches.	Revolutions of the fan per minute.	Raised the water column in inches.
30	1620	3·00	1100	2·75
32 (small outlet).. ..	1721	2·75	1150	3·50
32 (large outlet)	1721	4·25	1700	5·50
36 do.	1944	4·50	1800	7·00
45 (medium outlet) ..	2430	4·10	2400	9·00
56 do. ..	3024	5·00	2550	10·25
80 (large outlet)	4320	7·00	—	—
80 (second test)	4320	9·25	—	—
90 (first test)	4860	9·00	—	—
90 (second test	4860	10·00	—	—
80 (adjusted fan).. ..	4320	11·50	—	—

Your readers will readily notice two points which stand out of the above figures :—First, that by running my 15in. power fan at a higher velocity than it was tested to at Reading, I get far higher results than even the 2ft. 11in. fan of Coultas driven at only 1008 revolutions, the highest he went to at Reading. Second, I have been able to do no more with my power fan at 2500 revolutions than with my smaller hand fan running by means of its multiplying gear at a velocity of nearly 5000 revolutions per minute. Thus I have not only settled what can be done with a small hand fan, properly constructed to run at a high velocity and intelligently worked, but I also give a first and chief reason for the difference in the comparative working powers of the different fans shown at Reading. I propose to show in another letter other reasons, but I must not occupy more of your space now than is necessary to report the solution of a very much debated question. Should the fans be open entirely or covered? Bamlett's fan is an open one and turbine shaped; Lister's fan is an open one and turbine shaped; Gibbs' fan is enclosed and paddle-wheel shaped; Coultas' fan is enclosed and turbine shaped; Phillips' fan is doubly enclosed and turbine shaped; my fans are enclosed and work excentrically with curved blades sent backwards.

Mr. Neilson wrote very strongly to the *Field* a little time ago in favour of fans working openly. His own fan is paddle-wheel shape and works openly. He suggested that the point could be settled by partly opening an enclosed fan and feeling the outward rush of wind from the opening. But this is not conclusive, as a little reflection will show. A complete experiment is the best test. I have shown how by enlarging my outlet I get a greatly increased power from my enclosed fan, and so far this would seem to corroborate Mr. Neilson; but lest anyone should be misled, I want to add that I took off the covering of my fan entirely and found I at once reduced its power one-half. And strange to say, without the covering I could not obtain the great increase of power with each increase of speed that I could obtain with my enclosed fan. The following were the figures :—

	Raised the water column. With case. Inches.	Without case. Inches.
36 Revolutions of handle	4·50	3·00
50 ,, ,, ...	—	3·25

I propose to return to the subject next week.

EDWD. OWEN GREENING.

Agricultural and Horticultural Association, Limited, 3, Agar-street, Strand, W.C.

COLD-AIR MACHINERY.

SIR,—I am much obliged to Mr. Kilvington for pointing out the mistakes in Figs. 1 and 2. It is quite true that the areas below the atmospheric line should have been shaded as forming part of the work done during compression and expansion.

With regard to the areas E D F G and E F G in Article II., Fig. 3, which I presume are those to which reference is made, I think they quite correctly represent the work to be applied by the motive power, the rectangle E H being accounted for by the constant pressure of the atmosphere. T. B. LIGHTFOOT.

116, Fenchurch-street, E.C., August 26th.

ENAMELLED GAS PIPES.

SIR,—I have seen while in Bahia, about the year 1868, samples of service pipes enamelled for the purpose of defeating the extensive corrosion that takes place underground. Consequently it is a question if enamelling pipes is a novelty, as would appear from several remarks in your valuable journal. I am inclined to think that those I saw in Bahia were of foreign production. Doubtless the Bahia Gas Company, Limited, will be able to verify the statement of J. GILLAND.

August 26th.

THE ACCIDENT TO THE SERAPIS.

SIR,—The accident which happened to the Imperial troopship Serapis in Portsmouth Dockyard on the 15th inst. makes another addition to the already long list of disasters arising from the same cause, viz., the accidental opening of seacocks.

We would point out that were Mr. Halpin's syphon arrangement, which you fully illustrated some time since, universally fitted to all steamships, such catastrophes would be absolutely impossible.

London, August 26th. LEWIS OLRICK AND CO.

RAILWAY MATTERS.

A COMMITTEE has been formed to promote a railway line between Killin and Loch Tay.

THE Roumanian Government are expected shortly to order rails, &c., for the Bahna and Verciorova line.

THE Midland Railway Carriage and Wagon Company, Limited, is at present busy in the manufacture of rolling stock for Egypt.

ACCORDING to a statement issued by the French Minister of Public Works, there were, on 31st December, 1881, 107,112 miles of railway opened in Europe.

THE Municipality of Rangoon have been led, after a report by their engineer, to grant permission for the Merryweather steam tram car engines to be used in their streets.

A NEW Victorian Railway Bill provides for the construction of 840 miles of railway. There are already 1293 miles open for traffic, and 408 in course of construction or about to be let.

THE heavy Australian order for steel rails—some 33,000 tons—to which we have already referred, is stated to have been taken by a Melbourne merchant at £6 11s. 6d. per ton delivered at Melbourne. This is a poor price considering the cost of freight from any country where rails are manufactured.

A LOCOMOTIVE fitted with Joy's valve gear recently hauled a passenger train on the Philadelphia and Reading road, consisting of 18 loaded passenger cars, the gross weight being about 400 tons, and the maximum grade 60ft. to the mile. The speed is not stated. On the same day it hauled the regular New York express train—number of cars not stated—at an average speed of sixty miles an hour.

MR. MCDONNELL, locomotive superintendent of the Great Southern and Western Railway, Ireland, has been appointed locomotive superintendent of the North-Eastern Railway. His duties commence in November. Mr. John Aspinall, for several years Mr. McDonnell's principal assistant at Inchicore, succeeds to Mr. McDonnell's appointment. The right men will in this case be in the right places.

THE electric light has been permanently adopted for the Waverley station, Edinburgh. On Saturday night the light was turned on for the first time, and the effect was as brilliant as the dingy surroundings permit. In the station and its precincts there are 29 lamps, supplied by an 80-light dynamo machine. The traffic will be carried on with greater safety with the aid of the new light, while the expense will, it is expected, compare favourably with the annual gas account hitherto incurred.

THE Indianapolis *Journal* says that "as soon as the new mill at Chicago is fairly in operation, rails 120ft. in length are to be made and tested on some of the North-Western lines." The chief wear of rails being at the joints, caused by the pounding of the wheels, great things are expected of this rail. Its advocates favour a weight of 70 lb. or 80 lb. per yard, and predict an extraordinary endurance with slight repairs to ties and fish-plates. Such a rail, however, would be very difficult to handle; and inasmuch as a great allowance would have to be made at the joints for expansion, each joint being pounded by the same number of wheels as if the rail was of the ordinary length, the result, we fear, will be a disappointment.

THE Wisconsin Central Company has put upon its road a car for the convenience of hunting parties. It is a long, twelve-wheel easy-riding coach of the finest finish and equipment. The interior is set off in highly-polished hard woods, and finished in plush. It is supplied with berths for members of a fair-sized hunting party, and for cook and porter. In the cooking apartment are a French range and complete outfit of cooking utensils. The gun racks, ammunition drawer, and dog kennels are well arranged, and space is set apart for baggage room, ice closets, game cooler, &c. The look-out is fitted up with plate-glass mirrors, carpet, &c. This is the first car of the kind ever owned by a Wisconsin company, but the Pennsylvania Railroad Company built two similar cars some time ago.

THERE are now fifteen locomotive works in the United States, with a capacity of from eight to fifty engines per month. In 1881 they turned out in round numbers 3700 locomotives. Add to this 300 built by railway companies, and we have at least 3000 new engines constructed during the year, besides those rebuilt. At the commencement of last year there were, speaking roughly, 18,000 locomotives running on the 94,000 miles of railway in the Union, or an average of about one engine to every five miles. If, as is probable, the new railway construction this year reaches 10,000 miles, this average would call for 2000 new engines. The life of a locomotive is estimated by manufacturers to average from fifteen to twenty years. The latter figure is probably more nearly correct, as the improved condition of American railways has prolonged the existence of engines considerably. At this rate about 1000 new engines per year would be required to keep good the reduction by decay. Adding this to the 2000 presumably required this year for the increased mileage, we find that about 3000 new engines will be demanded.

A UNIQUE accident occurred on the South-Eastern Railway early on the morning of the 14th of June, a goods guard being killed while riding in a brake-van of the 10 p.m. up Folkestone goods train. A sheet-pole, belonging to a truck in the 8 p.m. down goods train from London to Ashford, became detached from that truck, and was forced into the leading end of the brake-van, in which the man was riding, and thence through the roof of that van, striking and killing the man as it passed through it. The pole, about 16ft. long, was slung at the side of a goods wagon. It appears, according to Colonel Yolland, to be highly probable that the fastening between the sheet-pole and the truck first broke at the trailing end as the down goods train was running, and that this trailing end, hanging from the truck, made marks in the ballast before Staplehurst station was reached; but that the leading end of the sheet-pole was not broken from the truck until nearly three-quarters of a mile beyond Staplehurst had been reached, and that when this leading end separated from the truck it passed at once across to the up line, forced its way through the end of the goods guard's brake-van, and killed the guard.

A CURIOUS accident happened on the London and North-Western Railway on the 29th of July at Clifton Brook Junction, near Rugby. A goods train ran off the rails at a pair of trap points, just as the up Holyhead mail had arrived close to the same place. The driver of the mail, then running at eighteen or twenty miles an hour, when passing the goods train—both trains running in the same direction—feared an accident, and succeeded in pulling up his train just in time. Major Marindin, in his report to the Board of Trade, says:—"This accident to the goods train would probably have had far more serious consequences than the damage of some rolling stock, and the slight injuries to the driver and fireman of the train, if it had not been for the promptitude of the driver of the up auxiliary mail train, which was running alongside the up goods train on the up main line. This man, seeing when he passed the van of the goods train that it was running too fast to stop short of the junction signals, and that therefore it must run off at the safety-points protecting the line upon which he was running, at once took steps to stop his own train, although the signal was off for him, and succeeded in doing so only a second or two before the goods engine ran off at the safety-points, and two of the goods wagons were thrown across the line upon which he was standing, only five or ten yards in front of his engine." Major Marindin goes on to say that the driver ought to have used his chain brake. Perhaps he did not put much faith in it. He states in his evidence that he applied his steam brake, which acted on the four coupled wheels of his engine and all the tender wheels, reversed his engine, sanded the rails, and did all in fact that a man could do impressed with the feeling that he must stop his train at once; and yet he did not resort to the chain brake. This is curious, to say the least.

NOTES AND MEMORANDA.

A CLOCK was exhibited some time ago at Paris which fired a shot every hour. Somebody says that its great practical utility was "to kill time."

THERE are now in France 52,520 steam engines of a total force of 3,341,000-horse power, whereas in 1850, the collective horse-power was only 22,025, and in 1854, only 35,263.

THE *Scientific American* states that there was completed, July 22nd, at Marine City, Michigan, a well which passed through 115ft. of solid crystal salt. Salt was encountered first at a depth of 1633ft., and from that point to the depth of 1748ft. the material removed was pure salt.

FOR the sake of comparison with the performance of the Mary Beatrice, described in our last impression, we may say that the new Isle of Man steamer, Mona's Isle, built by Messrs. Caird, of Renfrew, is a vessel 330ft. long, 38ft. beam, and 15ft. deep, gross tonnage 1420. On a trial of seven consecutive hours she maintained a speed of 18¼ knots.

THE Hartford *Evening Post* says that Messrs. Jewell are now making two large belts for one of the largest rubber factories in the United States. One belt is 48in. wide and 120ft. long; the other is 44in. wide and 150ft. long, both double thickness. These are the largest belts that can be made from a single hide, as no hide can be solid and thick more than 4ft. in width. It is but a few years since belts of these proportions could be made, or pulleys on which to run them, and in no country save the United States is it done now. We are more prudent in England, using ropes instead of belts, to which when properly used they are in all respects superior.

AN observer of the recent aurora at Mont Clair, N.J., August 4, writes that on connecting the two poles of his telephone, one with the water pipe leading to a cistern near his dwelling, and one with the gas pipe leading all over town, he heard the electrical crackle going on, substantially the same as is heard when the same connection is made during thunderstorms. He, however, reports that the auroral crackle was more delicate in its sound than the thunderstorm crackle, and that beside the crackle there were at intervals of perhaps half a second each, separate short taps on the telephone diaphragm that gave a slight ringing sound.

WE learn from the *North China Herald* that Sir Robert Hart, the Inspector-General of the Chinese Maritime Customs, has fully granted his assistance to the project of a China coast meteorological service. Formerly a certain Minister of the Customs Officers voluntarily made observations and sent them to M. Dechevrens, the head of the Siccawei Observatory at Shanghai; but these were frequently interrupted by the observers being transferred to other ports. Sir Robert has now directed that the observations at all the ports and lighthouses be sent to Shanghai regularly. A storm warning service is also being organised in Japan.

THE Edison electric light has been put to work in the Press Department of the Telegraph Office, St. Martin's-le-Grand. The Edison Electric Light Company has its centre on Holborn Viaduct. The extension to the top room of the General Post Office, which was accomplished last week, is the greatest yet made from one centre, the distance from the dynamo-room of the company's office to the Press Room of the General Post Office being 1950ft. The Press Room to which the Edison electric light has thus been supplied is a very busy part of the telegraph department, 1200 persons being employed there, and it occupies the whole upper floor of the western building in St. Martin's-le-Grand. Fifty-nine incandescent lamps of the well-known pear-shaped pattern, with the carbon of the shape of an elongated horse-shoe, are used.

WE learn from *Nature* that the next congress of electricians will meet in Paris on October 11th. The members will have to deliberate, as follows:—(1) On the determination of the length of the mercury column equivalent to the practical ohm; (2) on the construction of lightning conductors, and influence of telegraphic or telephonic wires on thunderstorms; (3) on the means of establishing a general system of observations for atmospheric electricity; (4) on the opportunity of using the telegraph system for establishing constant communication between a certain number of meteorological observatories. At the same time a diplomatic congress will meet on the protection of cables. It is surmised, moreover, that the former will be presided over by M. Cochery, Minister of Postal Telegraphy, and the latter by M. Duclerc, Minister of Foreign Affairs.

RECENT statistics published by the Ministry of Posts and Telegraphs show that there are at the present moment in France 5481 telegraph offices, which in 1883 will be increased to 6681. The total length of the telegraph lines, which in 1877 was 57,090 kilometres, had in 1881 reached 73,944 kilometres, and at the end of this year will not be less than 87,020 kilometres. The telegraph wires on these lines represented in 1881 a total length of 211,873 kilometres; in 1883 it will amount to 263,000 kilometres, or 163,060 miles. In addition to these above-ground lines, France is now following the example set her by Germany, and is laying subterranean lines of telegraphic communication. Already 1132 kilometres of the underground lines have been laid, and it is calculated that by the end of this year 2190 more kilometres will be completed. These 3322 kilometres of subterranean telegraph cable will have cost about twenty-eight million francs. In 1883 it is proposed to lay 1355 kilometres of new underground telegraph cable. The total length of the subterranean lines it is now proposed to lay is 7296 kilometres, the cost of which is estimated at fifty-four million francs.

THE determination of the astringent matters contained in wine is considered a most delicate operation. These matters are various; the principal is a tannic compound called *œnotannin*, and there are several colouring matters closely related to it. The ordinary methods of determination are rather uncertain, especially where there is little astringent matter. M. Girard has lately devised a method which depends on the tendency of the matters in question to combine with animal tissues. He takes some fine white violin strings, the last process of polishing with oil having been omitted. Four or five of these are put together. A certain quantity is soaked in water for four or five hours—one grain having previously been detached to ascertain the water in it—then these swollen portions are put in a known quantity of the wine to be analysed. This is quickly altered in consequence. In twenty-four hours generally, or forty-eight at most, all colour has disappeared. The tanned and dyed portions of cord are then dried, first in a flat dish, then in a closed vessel at higher temperature. A comparison then made of the original cord—free from water—with the same cord tanned, coloured, and dried, affords a correct estimate of the *œnotannin* and colouring matters of the wine.

THE *Travers Herald* describes the finding of an ancient work in the digging a canal between Lakes Eustis and Dora, to open up the more southern lakes of the great lake region of Florida. The first excavations revealed the existence of a clearly defined wall lying in a line tending toward the south-west, from where it was first struck. The wall was composed of a dark brown sandstone, very much crumbled in places, but more distinct, more clearly defined, and the stone more solid as the digging increased in depth. The wall was evidently the eastern side of an ancient home or fortification, as the slope of the outer wall was to the west. About 8ft. from the slope of the eastern wall a mound of sand was struck, embedded in the earth formation above and around it. This sand mound was dug into only a few inches, as the depth of the water demanded but a slight increased depth of the channel at that point; but enough was discovered to warrant the belief that here on the north-western shore of Lake Dora is submerged a city or town or fortification older by centuries than anything yet discovered in this portion of Florida. Small, curiously shaped blocks of sandstone, some of them showing traces of fire, pieces of pottery, and utensils made of a mottled flint were thrown out by the men while working waist deep in water. One spear head of mottled flint, 5½in. long by 1¼in. wide, nicely finished, was taken from the top of the sand mound and about 4ft. below the water level of the lake.

MISCELLANEA.

MORE than 1000 deaths are recorded as having resulted last year from accidents in mines in Great Britain.

THE widening of the grand canal from Rotterdam to the sea, estimated to cost 43,800 florins—nearly £3700—is to be carried out forthwith.

AN exhibition of electric light appliances, with especial regard to the artistic side of the question, is announced to be held at Munich from 16th September to 8th October.

THE Highland Society of Scotland, after a trial of sheaf-binders which took place on the 30th, awarded the first prize to Messrs. Hornsby, the second to Wood, and the third to Howard.

A VALUABLE discovery has, it is said, just been made in Lehigh county, which is so rich in iron, slate, zinc and other mineral deposits. Emery has been found in quantity and of excellent quality.

THE committee of the Worcester Agricultural Society have accepted the invitation of the Corporation of the county town to hold their exhibition next year in that city, subject to the usual conditions.

MESSRS. ISAAC AND WILLIAM BEARDMORE, of the Parkhead Forge, Glasgow, have added to their extensive works a new bar and angle mill, which was started a few days ago, in presence of a large and influential company of gentlemen connected with the leading industries of the West of Scotland. The mills, which were built by Messrs. Miller and Co., of Coatbridge, are three rolls high, with cogging and finishing mills placed alongside. The mills are capable of turning out 120 tons of finished material during every shift of twelve hours, and their addition to the works necessitates the employment of between 200 and 300 extra workmen. The mills will be used largely, if not exclusively, in the manufacture of mild steel.

OWING to the interest taken by Signor Baccarini, Italian Minister of Public Works, and one of the most distinguished hydraulic engineers in Italy, the following works of vital importance for Venice have, *The Architect* says, been approved, and will doubtless be carried out with all possible expedition—namely, the removal of the river Brenta from the lagoons; the deepening to 9 metres of the principal navigation canal from Malamocco to the Arsenal and to Venice; the excavation of the canals at the maritime station; the construction of dykes at the Lido to impede the passage of the sands; and the raising and fortification of the banks of the principal rivers flowing into the lagoons, to prevent as far as possible the neighbouring country from being inundated.

THE members of the company trading under the name or firm of Thomson, Sterne, and Co., Limited, Crown Ironworks, Glasgow, have just resolved to increase their capital considerably, and change their designation to "L. Sterne and Co., Limited." They have acquired new works at Hollinwood, Manchester, where it is intended to manufacture the larger sizes of Clerk's gas engines and Strong's feed-water heaters. The old works at Glasgow will continue the spring-making business, together with the emery wheel and machine department and the smaller sizes of Clerk's patent gas engine. This last-named is manufactured solely by this company, and as we stated a few weeks ago, was awarded a gold medal at the Electrical Exhibition in the Crystal Palace this year.

WITH reference to the new Staffordshire Steel and Ingot Iron Company, Limited, of which an advertisement appeared in our columns of the 2nd inst., specimens of the steel made during the recent trials are now on exhibition at the offices of the company at 17, Temple-row, Birmingham. These specimens comprise tin and black plate stampings from 4in. in diameter by 2in. deep; tin-plates of charcoal quality, horseshoes, and screws; ⅜ boiler plates bent close, hot and cold and flanged, without any flaw; butt welded tubes flanged and bent close without flaw; rivets and Galloway tubes. The peculiarity of this exhibition is that none of the articles were made under the control of the new company or those interested in the process, but were turned out in the works of leading firms in the district who purchased and experimented on the metal for their own satisfaction.

AN exhibition was opened in the Casino, Ghent, on 28th August, under the auspices of the Chambre Syndicale des Arts Industriels de Gand. Both designs and executed works have been sent in to compete for prizes in twenty competitions, and the five classes into which the other exhibits are divided are well filled. The two greatest novelties are a process by M. J. Vandermersch, of Brussels, for depositing a millimetre in thickness of chemically pure nickel by the galvanic battery, and some sun blinds, devised by M. Bulens, of the same city, which are pulled up and down by an endless cord without rack or weight, and stay where they are placed, owing to a spring on the end of the roller acting as a brake. Some capital smith's work is shown by M. L. Wuyts, of Antwerp, in some figures ornamented with oak leaves and acorns.

ACCORDING to an article in the Japan *Weekly Mail*, and a report by M. P. Sarda—who signs himself "Engineer of Arts and Manufactures," charged with a special scientific mission from the French Government—the water supply of Yokohama is the cause of a great deal of sickness, as, although it is obtained from the river Tamagawa, which is never dry, it is conducted through twelve miles of open canal to a reservoir at Kashimada, and thence through about seven miles of wooden pipes. The wood pipes were laid in 1870-71, and so ought not to be the cause of pollution, unless they are leaking in the vicinity of broken drains, which may be the case, for they have been taken up and relaid in some places, and iron pipes substituted in others. M. Sarda attributed the ill-health to insufficiency in the supply, as well as to pollution of the water in various ways and to bad sewerage.

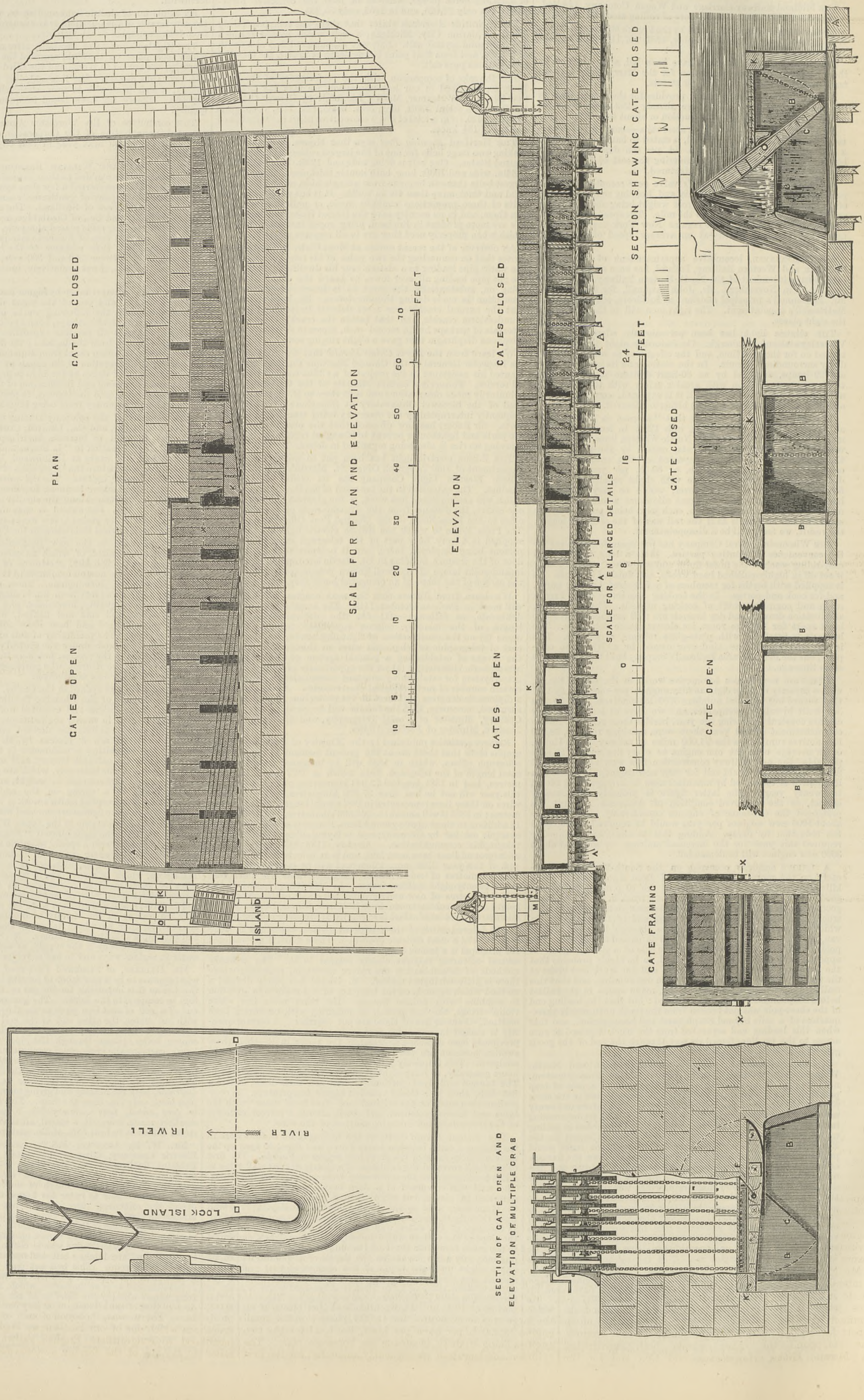
MR. HELLIER, of Stockwell Park-road, London, has invented what appears to be a new mode of heating conservatories. In using this heater it is impossible for the gas or the products of combustion to escape into the house. The generator is connected to one end of a coil of cast iron pipes as in the ordinary way of heating with hot water, the other end of the coil is carried through the end or roof of the house; the steam, which is generated in an open copper boiler, passes through the pipes and escapes outside the house, carrying the products of combustion along with it. The air to support combustion is not taken from the house, but is brought in from the outside through a pipe in the floor under the generator. The pipes are kept as near the floor as possible, which is very desirable, both for heating and giving room in the house, the under pipe being only 7in. from the floor. The amount of gas required is very small, four ordinary No. 1 gas jets, which are the smallest made, being, it is stated, all that is required to generate steam sufficient to heat 50ft. of 3in. cast iron pipes.

MR. W. H. AKESTER, F.S.T., electrician to the Universal Electric Company, Glasgow, has fitted up in his residence at Balvaird, Rutherglen, near Glasgow, a system of electric alarms, for although he had complained repeatedly to the police authorities of the ancient burgh of several burglarious attempts that had been made to enter his house, they seemed helpless to detect the offenders. Mr. Akester has had fitted up in his kitchen an electric bell which communicates with the garden gate, so as to ring whenever the gate is slightly opened. This warns the inmates of the house of any person opening the gate, and they are naturally on the alert to see who is coming. At night the current is switched off the kitchen bell, and operates on a bell fixed in Mr. Akester's bed-room. This bell not only communicates with the garden gate, but with the doors and all the windows of the house. It has attached to it an indicator, which, immediately the bell is rung, shows whether the thief is at the garden gate, at the hall door or that of the kitchen, or at any one of the windows of the house, and the exact position of each of these, that is, how far open, when the bell rings. Late on Wednesday night last week the apparatus was put to the test, but the two burglars, it is reported, were off before they could be caught in the bedroom they had entered.

SELF-ACTING WEIR ON THE IRWELL AT THROSTLE NEST.

MR. FRANCIS WISWALL, C.E., MANCHESTER, ENGINEER.

(*For description see page 152.*)



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J. T.—*See the article "Single v. Compound Engines" below.*

W. J. T.—*Address the Secretary, Royal Naval College, Greenwich.*

W. H. W.—*We do not think you have any remedy against the Water Company. Consult a solicitor.*

A. E. P. (Wednesbury).—*Much depends on the nature of the contract between A and B. Under ordinary circumstances B would be entitled to a new casting, but not to the value of any labour expended on the defective casting. We cannot refer you to a case bearing directly on your question.*

TREATING SHALE.

(*To the Editor of The Engineer.*)

SIR,—Can any correspondent give the names of makers of plant for the extraction and treatment of petroleum shale for the production of kerosine oil, grease, &c.? NEMO.

VISITS IN THE PROVINCES.

(*To the Editor of The Engineer.*)

SIR,—In your notice of August 11th of the Leeds Forge Company's works, you say "large quantities of steel plates are used hitherto from Landore." I shall be glad if you will correct this, as the whole of the steel I have used in my patent corrugated flues has been made to my instructions of a special mild quality by Messrs. John Spencer and Sons, of Newcastle-on-Tyne. SAMSON FOX.

Leeds, August 24th.

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THE ENGINEER.

SEPTEMBER 1, 1882.

SINGLE *v.* COMPOUND ENGINES.

As we stated in our last impression, a visit was paid by many members of the Institution of Mechanical Engineers to the spinning mills of Messrs. Illingworth, in Bradford, expressly to see the great Corliss engine which drives their machinery. This engine, which, it will be remembered, has a stroke of 10ft. and a piston 40in. in diameter, was constructed and erected by Messrs. Hick, Hargreaves, and Co., in 1879. Before that date the motive power was supplied by a somewhat similar engine of smaller dimensions, constructed by the same firm in 1871. This engine has a single cylinder 38½in. diameter and 5ft. stroke; it is still frequently used, sometimes at the same time as the larger engine, sometimes alone. Both these engines have recently been tested for economy by Mr. Neil McDougall, chief engineer to the Boiler Insurance and Steam Power Company. The results obtained are highly instructive, and support in every particular the truth which we have persistently enforced in the pages of this journal for many years, namely, that compounding does not necessarily save fuel, and that non-compound engines may be and are made which are in all respects as economical in the use of steam as the best compound engines made. The experiments in question are especially noteworthy, because the performance of engines developing as much power has never before been investigated in the same way or with such precautions to ensure accuracy.

Mr. McDougall has prepared a preliminary report which is intended for private circulation only, and for this reason we do not reproduce it. We are, however, at liberty to give some of the principal results obtained, and to comment on these results. In Mr. McDougall's annual report for 1880 he published particulars of two engines, one compound the other simple, both constructed by Messrs. Hicks, Hargreaves, and Co., and for the sake of comparison he has reproduced in the report now before us particulars of these engines and of the results obtained from them. We have thus four distinct engines to deal with. The first, which we shall call A, being compound, with four cylinders arranged in pairs tandem fashion. The small cylinders are 20in., the large cylinders 31in. in diameter, stroke 6ft., piston speed 560·4ft. per minute; total indicated power 635-horses. The second engine, B, has a single inverted cylinder 32in. diameter, 4ft. stroke, piston speed 662·4ft., per minute, total indicated horse-power, 540. Engine C is the larger of the two at Messrs. Illingworth's mills, the cylinder being, as we have said, 40in. diameter and 10ft. stroke; the piston speed, 823ft. per minute; indicated horse-power, 917. Engine D is the smaller of the two at Messrs. Illingworth's, and has a cylinder 38½in. by 5ft.; speed of piston, 421ft. per minute; indicated horse-power, 425. Concerning engine A it will suffice to say that it required 19·07 lb. of steam per indicated horse-power per hour, the ratio of expansion, taking account of clearance, being 6·56 to 1. Engine B used 20·7 lb., the ratio of expansion being 4·27 to 1. Unfortunately, engines C and D had to be worked together from the same boilers, but they required on three different days, 18·02 lb., 18·21 lb., and 18·82 lb. of steam per indicated horse-power per hour, the ratio of expansion varying between 6·8 to 1 and 5·09 to 1. Taking a practical view of the matter, it will be seen that there is little or nothing to choose, as regards economy of fuel, between the four engines, the maximum difference in coal consumption being very small. Assuming, for example, that boilers were used which would evaporate 10 lb. of water per pound of coal, then engine A would burn 1·907 lb. per horse per hour; engine B, 2·07 lb.; and engines C and D, 1·802 lb. A comparison of engines A and B, however, shows that in the first cost, space occupied, cost of repairs, lubrication, and general maintenance, engine B has enormous advantages over engine A.

It may, of course, be said that engine A is an unfavourable specimen of the compound engine. We do not think, however, that such an argument can be legitimately urged against an engine which, after six years' hard work, needed but 19 lb. of steam per horse per hour. It is true that under exceptional circumstances somewhat better results have been obtained. But even if we admit that compound engines have been made to work with 17 lb. of steam per indicated horse-power per hour, the difference between that figure and 18 lb. is too small to in any way compensate for the extra first cost of a compound engine, including, of course, that of foundations, engine-house, &c. Leaving, however, this, the purely commercial aspect of the question, we may go on to deal with it from a technical point of view. The advocates of the compound system, as we have very recently had occasion to point out in dealing with a report by Mr. Longridge, have long been compelled to pin their faith in the compound system on one dogma, namely, that the low-pressure cylinder cuts the high-pressure cylinder off from the frigorific influence of the condenser, and so saves steam. If this protection really was operative to anything like the extent supposed, or if it was not neutralised by counteracting evil influences, the difference between the compound and the simple engine in economy of fuel would be enormous. Indeed, we have heard it urged that the difference in the weight of steam required to develope an indicated horse-power in a simple and a compound engine of the best construction must be at least 5 lb. per hour. We have persistently maintained that although there is beyond question a certain small saving effected as regards the high-pressure cylinder in the way stated, that the saving is much more than counterbalanced by the extra total surface with which the steam has more or less to come into contact in the compound as compared with the single engine; and a further loss is represented by the gap in the diagrams. To the first point we shall return in a moment; as regards the last, it is worth while here to correct a very prevalent error, viz., that the gap between two diagrams taken from a pair of compound cylinders only represents a loss of pressure, and not a loss of fuel, because, although the pressure falls between the two cylinders, yet this is due to augmentation in volume; and as, within certain limits, as much work may be got out of 2 cubic feet of steam at 50 lb. pressure as out of 1 cubic foot at 100 lb., the loss represented by the gap is more apparent than real. No doubt the reasoning thus used is sound, but unfortunately it does not apply to the particular case with which we have to do. The loss of pressure between the small and large cylinders is apparent enough, and has nothing whatever to do with the gap between the two diagrams, which represents dead loss, for reasons which we shall not now stop to explain. It must suffice to say that the gap is due partly to condensation, partly to clearance; and in some cases it represents a very heavy loss indeed. Returning now to the question of the prevention of cylinder condensation by compounding, we cannot too strongly insist that this is admitted on all sides to be the only reason why compounding should save steam. We are not dealing now, be it understood, with regular turning, simplification of valve gear, and such like, but solely with what takes place inside the cylinders and valve chests. Now, nothing can be more easy than to bring this question to the test of actual practice. If compounding really does prevent condensation, then the indicator will account for more steam in the compound engine than in the single engine working under the same conditions of temperature and expansion. Turning now to Mr. McDougall's report, we find that compound engine A used, as we have said, 19·07 lb. of steam per horse per hour. Of this the indicator accounts for 15·1 lb. only. Thus the loss by cylinder condensation was 3·97 lb. per horse per hour, or 20 per cent. The single engine B used 20·7 lb., of which the indicator accounted for 18·8 lb. The cylinder condensation was therefore only 1·9 lb., or 9 per cent. If we turn to engines C and D, we find that the indicator on the large engine accounted for 15·093 lb., and on the small engine 15·299 lb. per horse per hour, the total for the two engines being 18·02 lb. of steam per horse per hour. The cylinder condensation consequently amounted for the first engine to 2·927 lb., and for the second to 2·721 lb. per horse per hour, or very nearly for the two to 16 per cent. In the face of such figures as these, what becomes of the contention that compounding prevents cylinder condensation? Regarded from another point of view, we find all our arguments confirmed. Assuming that all four engines were perfect, no waste taking place, the weight of steam required for such engines working within the stated limits of temperature, and with complete expansion, would be for A 8 lb., for B 8 lb., for C 8·994 lb., and for D 8·581 lb. per horse per hour. The actual efficiency of A compared with a perfect engine was ·423 to 1; of B, ·39; C and E, ·489 in one experiment, ·483 in another, and ·502 in a third. Such figures as these ought to be conclusive. We do not assert that equally good results cannot be got from compound engines; on the contrary, our argument is that there need be no difference whatever between the efficiency of the two types—that, in practice, it is a matter of indifference as regards economy of fuel whether we employ compound or simple engines.

So little faith have the advocates of the compound engine in their own arguments, that we find them invariably contending that steam jackets must be fitted to compound engines. It is, indeed, urged by some persons that a great point in favour of the compound engine is that its cylinder surface is so great as compared with the single engine that the advantages of jacketting can be most fully realised with it; these very persons forgetting the while, that so long as jackets are kept warm by live steam from the boiler they represent a dead loss. We do not know what weight of water was discharged from the jackets in the case of engines C and D, but we do know that in the case of other engines it seldom amounts, when the jacket is efficient, to less than 3 lb. per indicated horse-power per hour. But it remains to be proved, strange as the statement may sound, that in the case of an unjacketted engine working within the proper limits of expansion, and with *dry steam*, the loss by cylinder condensation would be much greater. This is a point of very great interest, and we venture to suggest that Mr. McDougall, Mr. Longridge, Mr. Fletcher, or any other competent engineer who can get the opportunity and spare the time, shall carry out an experiment with an engine working under given conditions, first with steam admitted to the jacket and then without, the weight of steam accounted for by the indicator and discharged from the jacket to be very carefully ascertained. We are perfectly aware that investigations in this direction have been made, but they are not conclusive as to the results; and it is not too much to say that the whole jacket question remains as unsettled as ever. If our readers will turn to THE ENGINEER for March 3rd, 1882, they will find on pages 163-4 a report by Mr. Michael Longridge, in which he shows that while without jackets it is possible to get an indicated horse-power with 16·81 lb. of steam per hour, with the jackets in use the consumption was increased. On the other hand, Mr. Cowper finds a direct advantage from using jackets. It is beginning to dawn upon engineers, moreover, that to merely surround a cylinder with steam is not in itself alone conducive to economy. If it were, then the system adopted by Messrs. Hornsby and other engineers of putting the cylinder of a portable engine into the steam space of a boiler ought to be attended with the best possible results. We have, however, no data whatever to prove that this is really the case.

THE IMPROVEMENT OF PERMANENT WAY.

THE spirit of finality is usually supposed to have disappeared from the earth with the late Earl Russell. We believe, however, that there is at least one place where it will be found to linger, nay, even to flourish, and that place is the office of an English permanent way engineer. We are quite willing to admit that such an office may be admirably ordered, and that much useful work may be done therein, but we do assert that anything new is looked upon with suspicion and dislike, and existing designs are considered beyond the reach of improvement. For proof of this statement we need only challenge our friends to mention any single change of the slightest importance in permanent way which has been introduced and carried out by English permanent way engineers during the last ten years. But this is by no means all. Some time back our contemporary, the *Railway Engineer*, opened a special column for the reception of new plans and ideas on the subject of permanent way, but the movement failed to meet the slightest support. Again, the great question which has been agitated and partially settled on the Continent during the past few years—we need hardly say that we refer to the substitution of iron for wooden sleepers—has been steadily ignored by the bulk of English authorities, and is ignored by them still, so far as they can manage to keep their ears closed. Two exceptions may indeed be mentioned—first, Mr. Webb has lately essayed a simple form of iron cross sleepers on the London and North-Western Railway; but amongst English railway engineers Mr. Webb may be looked on as the exception that proves the rule. Secondly, the North-Eastern Railway did, some three years back, yield so far to solicitation as to permit the trial of a short length of Mr. Chas. Wood's iron sleeper system. We are by no means prepared to say that this system is the best that can be adopted; but, at any rate, the experience of its behaviour under the heavy traffic has been satisfactory, while its author's advocacy of it has been most persistent. Nevertheless, he has been unable to point to any extension of it, even on the North-Eastern itself, much less to its adoption by any other company. His last attempt to ventilate the subject, in a paper read before the Institution of Civil Engineers, furnished a most striking proof of the truth we are illustrating, since it would be difficult to find a single contribution by an English engineer, either in the discussion or correspondence, which the extremest stretch of courtesy could describe as possessing any novelty or value. There was, however, one very remarkable speech, in which one of our best-known engineers had the hardihood to congratulate English railways on having failed to try any of the foreign systems described in the paper, because many or most of them had been unsuccessful, and intimated that where some one system had been thoroughly established, and its merits put beyond all doubt by years of successful working, he and his brethren might then be inclined to see if they could recommend their companies to adopt it. We are inclined to consider this as the most "grandmotherly" utterance we ever heard, even within the walls of the Institution, where such utterances are not uncommon. It is simply an absolute renunciation of all claim to aid in the development or improvement of one's profession. With such men at the head of affairs, stagnation is no longer an incident but a principle. It is fortunate that the English engineers of former days were of a different temper, or we should still be transporting our goods across the land by stage wagons, and across the sea by sailing ships; our houses would be lighted by oil, our guns would be of cast iron, and our telegraphic communications would be made by the semaphore.

Happily the grandmothers—we should have said the fathers—of the profession do not live for ever; and there is reason for hoping that those who are to succeed them are men of broader views and higher energies. Meanwhile, whether English engineers are to stand aside altogether from the march of progress or not, that march will certainly go on. To keep to our present subject, neither in France, in Germany, or in America, is there any thought of finality in connection with permanent way. In Germany, as our readers at least will be aware, the superiority of iron sleepers as against wood is no longer a matter of debate; it is over the different forms of iron sleeper that the contest is now raging. Herr Haarmann, well known as the inventor of a very promising system alike for a longitudinal and cross-sleepered road, has lately found it worth while to make an elaborate series of experiments on the resistance to flexure in his own and several other types of iron sleepers. In presenting the results to the Railway Union he expressed satisfaction at the signs of apparent breaking up in the English apathy on the subject; but we fear that his self-gratulation on this point must be regarded as premature. In France, moreover, while unfavourable experience with the earlier forms of iron sleeper have seriously checked their progress, it is evidently the general opinion that their adoption is merely a question. This came out clearly in the course of a recent discussion on the new system of permanent way proposed by M. Charles Bergeron. This permanent way, which has been described, but not discussed in England, comprises the use of iron sleepers, but at the same time involves a much wider departure from existing practice, both in construction and laying, than most of the iron sleeper systems proposed in Germany. The leading idea is to produce a perfectly even, steady, and stable road, comparable to that offered by the longitudinal girders of a viaduct, when the rails are laid directly upon them. M. Bergeron points out that a train shoots over such a viaduct with a smooth and even motion resembling that of skating. Already the road is altogether destitute of that wooden elasticity which some engineers still affect to consider necessary for good travelling. The mode in which the inventor proposes to obtain this object is as follows:—He digs in the soil, or in the ballast of an existing line, a trench, 18in. wide and 18in. deep, along the course of each rail. The trenches he fills with fine sand, carefully wetted and punned. The sleepers are plates of cast iron, having a rib cast along the top to form a half-chair, and two deep flanges with sharp edges depending from each side of the bottom. These sleepers will be laid in place, a properly-shaped chock of wood laid on them, and they will then be hammered until they sink in the sand so far that their under-side comes fair on the surface, and rests there as a solid support. Each sleeper is then united to its opposite fellow by a tie-bar; the rails are laid in place and secured by bolts to the half chair, the joints being made on the sleeper, and the whole is complete. In another arrangement, two jaws, as of an ordinary double chair, are cast on the sleeper; the rails are secured in these by the ordinary oak keys, and suspended joints are used, with extra deep fish-plates. On curves the arrangement would be the same, but the sleepers would be put closer together. Finally, the whole would be well covered with soil and sown with grass, so that eventually nothing will be seen but a stretch of turf with the rails lying on its surface.

M. Bergeron is well known as an engineer who has had large experience in the maintenance of railways, and exceptional opportunities of becoming acquainted both with English and Continental practice. His proposal, however, in its bold deviation from established modes, is sufficient to take away the breath of an ordinary English railway engineer; nor do we mean, in the least, to put it forward as a satisfactory solution of the problem. Criticisms are easy enough to find, were this the place to give them; several were, in fact, brought forward in the course of the discussion in Paris, and others may readily be added. Nevertheless, more than one eminent engineer took, on the whole, a favourable view of the idea, and even recommended that it should be tried in practice, and all showed in discussing it a healthy disregard of finality, and readiness to open the mind to new ideas, from whatever quarter, which is very refreshing as a contrast to the usual state of things on this side the Channel. The President, in summing up the debate, said the general sense of the speakers seemed to be that some improvement in existing permanent way was necessary, in view of the continually increasing speed and frequency of the trains on all main lines. With regard to the latter question, a point was brought out which we do not remember to have seen noticed before. It was observed that the life of iron rails and wooden sleepers was very much the same; and, therefore, when a road had once been thus laid, it remained intact until the time came when both parts had to be taken up together. The use of steel for rails, more than doubling their life, destroyed this condition of things; and a road will now have to be taken up at more frequent intervals, sometimes to renew the rails, sometimes the sleepers. But this relaying, with the augmented traffic of the present day, is a very serious matter, and the substitution of iron for wooden sleepers, by once more giving to all parts of the road about the same durability, will effect an important improvement in this respect.

The verdict of the French engineers may be said to have been that this proposal was a step in the right direction, however doubtful it might be whether it was the wisest step that could be taken with its main principle—namely, to construct a road which shall be practically continuous, that is, on which the elasticity shall be everywhere uniform. We believe that those who have most carefully studied the subject will be most inclined to agree. When people talk, as they do so loudly, of the necessity of elasticity, it is uniform elasticity that they are really asking for. Thus, no debate on this subject ever takes place, without some allusion being made to the stone sleepers of the very early railway days, and their failure. It is forgotten, however, that between those sleepers the road was quite as elastic as it is now; probably much more so, when we consider the very light rails which did duty at that date. The fault was that there was a light, springy rail passing at every few feet over an immovable stone block, and it was the change from the highly elastic to the non-elastic portions that caused the unpleasant shocks and the excessive wear. On a line laid directly on live rock carefully levelled and smoothed trains would probably run easily enough; just as they run easily on rails laid directly upon the top flanges of a bridge girder, which equalises the elasticity throughout. For similar reasons a line laid with cross sleepers, and therefore with alternate lengths of unsupported rail, requires a more elastic sleeper than a longitudinally-sleepered road, where the support is uniform throughout. It is scarcely necessary to say, however, that elasticity can be obtained quite as easily, and much more satisfactorily, with iron than with wood. Again, the proposal to turf the road over, extraordinary as it appears, was actually carried out some years ago by Mr. Benedict on one of the Bengal railways. He then used bowl sleepers, of the type which Mr. Livesey has made so familiar; and after filling them with sand he buried them in the ordinary earth of the Indian plains, without any attempt at a "formation" of any kind, and had this grassed over as far as was practicable. The plan, we believe, answered perfectly, the sleepers remaining immovably fixed in the soil, which was not liable to be washed away by floods in the way common in hot countries. It is, in fact, in such countries, where sand is plentiful and wood scarce, that M. Bergeron's system should, if anywhere, receive a trial; to England, unless in a few districts, it is obviously inapplicable. Nevertheless, we feel sure that our French brethren will not regret the attention which they have bestowed upon it, in so far as it will have enabled them to bring their practice into closer accordance with the needs and exigencies of the age.

A BERTHON BOAT IN A GALE.

IT has been believed by many that the remarkable collapsible boats invented by Rev. E. L. Berthon, and now coming into general use, though good for some purposes, could never stand the test of a gale of wind or compete with other boats in sailing powers. To prove the fallacy of this opinion, Captain Frederick Harvey, R.N., and Captain Whalley Nicholson ventured to take an ocean trip in a 28ft. boat of this kind, built at Romsey for the Union Company. With four seamen they embarked in the s.s. Esquibo, by the permission of the Royal Mail Company, on Friday, the 11th inst. On Monday the 14th, the boat and its crew were put overboard about 400 miles west of the Scilly Isles. There was a very strong wind and high sea. Owing to the thick weather and constant rain the boat's crew got no observations, and when they ascertained their whereabouts by hailing a ship, they found themselves about sixty miles west of Cape Finisterre; they then bore away more to the north, and reached the Scilly Isles on Saturday at 3 a.m. Here they stayed till Sunday, the 20th, at 4 p.m., when in more than half a gale of wind they started again for Southampton, and made the wonderful run of 240 miles to the Needles in thirty-five hours. We believe this is quite unprecedented for a ship's boat. Sometimes they logged more than ten knots an hour. That an open canvas boat should live in such a stormy sea as would have swamped any other is remarkable enough; but that she should have been able to carry sail through it all, and at such tremendous speed, is quite astonishing. The courage and skill of Captain Harvey and his able coadjutor, Captain Nicholson, an officer in the army, were admirably displayed in starting again from Truro after encountering such a gale of wind as they had in skirting the Bay of Biscay from south to north. One member of the crew—who were all volunteers—was the boatswain of the unfortunate Teuton, wrecked at the Cape last year. This man expressed his wish to join the party in order to prove that it was no fault of the Berthon boat on board the Teuton that it did not save the passengers. His testimony on this point concurs with that of all the other survivors, that the said boat was never lowered nor opened at all, but like others of the boats went down with the ship. The total distance run on this occasion could not have been much less than 800 miles, and when it is considered that the whole time she bore the brunt of the gale which raged here in the beginning of last week, we have abundant proof that Berthon boats are not exceeded in seaworthiness and speed by any others in the world. The boat is now afloat in the inner dock at Southampton, and has not suffered in the smallest degree. She has been visited by a great many members of the British Association. The dimensions of the boat are as follows:—Length, 28ft. 4in.; breadth, 8ft. 6in.; depth, 3ft. 9in. When shut against the bulwarks of a ship her width is 22in. with all her gear stowed in her, such as masts, sails, oars, water breakers, and anchors. The time required to open, set up, and lower such a boat is less than one minute. It was done before 160 members of the British Association on Saturday last in forty-five seconds. It is an interesting question whether the great elasticity of these boats has not something to do with their unusual speed.

HEMATITE IRON IN CLEVELAND.

IN consequence of the peculiar manner in which the restriction in the production of pig iron in the Cleveland and Durham ironmaking district was brought about—that is, by the turning of many of the furnaces from the manufacture of Cleveland pig iron to that of the production of hematite and other iron from imported ores—there has been in the last year an enormous increase in the production of that class of iron. And at the present time there are one-half as many furnaces engaged in the district in the production of steel-making irons as there are in the production of iron from the native ores of Cleveland. It is true that in the case of Cleveland or native iron the production for a year has been much less than the sale, and the stocks have been drawn upon to the extent of the large deficiency; whilst though no account is kept of the stocks of hematite and other steel-making irons, it is supposed that in the year the stocks have increased. But the abnormal growth of the hematite iron trade in the Cleveland district remains, and this in the face of the stated success of the method for the utilisation of Cleveland iron in the production of steel. Unquestionably the growth has been contributed to by the extension of the area of the use of hematite ore, and by the fact that large quantities of its product have been sent out of the district, both as exports to the United States in the shape of pig or blooms, and in the former shape to the Sheffield and other consuming districts. It is true, also, that the Cleveland district is preparing to use more of its own iron in the steel manufacture; but allowing for this, the largeness of the production of hematite in a region which is the greatest of our depositories of iron ore in the kingdom is startling. Nor are there any signs of a reduced demand, for to the Tees and to the Tyne the imports of iron ore from Bilbao, Carthagena, and other districts, are, if possible, heavier than they have been in previous periods. The cheapness of the ore delivered here, in consequence of there being great competition in its supply in Spain, and the comparatively low freights that now prevail, are unquestionably contributing to its great use; and it is found cheaper in Cleveland to use the Spanish ore than that of the West Coast district. But the fact remains—and it is one that is worth noticing—that at the present time in the iron mining district of Cleveland there were produced last month 147,000 tons of iron from the local ores, whilst that of other kinds of iron is given as more than half that quantity—or, in round numbers, 79,000 tons. As the stocks of Cleveland iron are decreasing, it is probable that its manufacture will be increased; but there are indications that other furnaces on the seaboard will commence to produce hematite iron, and that thus the increase would be concurrent, and the large proportion of hematite iron might be maintained from time to time.

BASIC STEEL.

MORE will soon be known of the adaptability of the Thomas-Gilchrist process of steel making to the requirements of the several metallurgical centres of this country. Need it be said that in England only at Eston is the system as yet in commercial operation? There, however, the wealth and the enterprise of Messrs. Bolckow, Vaughan, and Co., have shown its adaptability to the utilisation of pig iron of the class most abundantly produced from English ores. Next in the order of starting will be the North-Eastern Works at Middlesbrough, which are designed for this process alone, and where it seems likely that by the end of the year a start will be made. Here as at Eston the pig smelted from Cleveland stone will be used. In South Staffordshire £30,000 is understood to be ready to be subscribed to a basic steel works, one moiety by the local men who were represented by the committee who there recently made experiments to test the adaptability of the common iron of that part of the kingdom to that process, and the other moiety by Mr. Gilchrist and his friends; and now the prospectus is out for the raising of a capital of altogether £70,000 to start and carry on such a concern, to be called "The Staffordshire Steel and Ingot Iron Company." The directors set forth that they feel assured that a very substantial profit can be made by the company on the capital required. In Scotland the utilisation of the pig smelted from the black-band of that part of the kingdom by the same steel-making process has been for some time under consideration, and has made such headway that until more is known, enterprise for the extended use in the northern kingdom of the acid process has been suspended. As the North-Eastern, and also the Staffordshire works, have the personal assistance of Mr. Gilchrist, it is conclusive that nothing that can be done will be left undone to attain technical as well as commercial success in the newer works. Already in Europe about 10,000 tons of the metal are being made per week; the works now in course of erection will be capable of turning out a further 10,000 tons weekly.

THE MANCHESTER SHIP CANAL.

ALTHOUGH the engineers employed in making the preliminary investigations in connection with the proposed ship canal to Manchester have not yet prepared a complete detailed report, the interim reports presented at the weekly meetings of the committee are, we understand, of a very satisfactory character as regards the practicability of constructing the canal. With regard to the alternative scheme suggested by a correspondent in one of the local journals, another correspondent, who has during numberless bicycle rides become pretty well acquainted with Lancashire, condemns the suggestion as altogether impracticable. The only course possessing a particle of feasibility for an alternative route would, the writer contends, be to keep to the level country south of a line between Manchester and Wigan, and then to bear away to the north north-west; but the high land west of Wigan would render even this course impracticable.

SOUTH KENSINGTON MUSEUM.—Visitors during the week ending Aug. 26th, 1882:—On Monday, Tuesday, and Saturday, free, from 10 a.m. to 10 p.m., Museum, 14,887; mercantile marine, building materials, and other collections, 8251. On Wednesday, Thursday, and Friday, admission 6d., from 10 a.m. till 6 p.m., Museum, 2296; mercantile marine, building materials, and other collections, 809. Total, 26,243. Average of corresponding week in former years, 19,774. Total from the opening of the museum, 21,274,309.

THE SANITARY INSTITUTE OF GREAT BRITAIN.—The autumn meeting of this Institute will take place at Newcastle-upon-Tyne from September 26th to the 30th. On Tuesday, September 26th, there will be at one p.m.—public luncheon; three p.m.—opening of the exhibition, by the Mayor of Newcastle-upon-Tyne; eight p.m.—first general meeting, opening addresses by Captain Douglas Galton, R.E., C.B., D.C.L., F.R.S., President of the Congress. On Wednesday, September 27th, Section I., "Sanitary Science and Preventive Medicine;" ten a.m.—address by Dennis Embleton, M.D., F.R.C.S., president of the section; eleven a.m. to one p.m.—papers and discussions on "Sanitary Science and Preventive Medicine;" two to five p.m.—papers and discussions on "Sanitary Science and Preventive Medicine;" eight p.m.—conversazione. On Thursday, September 28th, Section II., "Engineering and Architecture;" ten a.m.—address by Henry Law, M. Inst. C.E., president of the section; eleven a.m. to one p.m.—papers and discussions on "Engineering and Architecture;" two p.m. to five p.m.—papers and discussions on "Engineering and Architecture;" eight p.m.—lecture to the Congress, by Professor F. S. B. F. de Chaumont, M.D., F.R.S. On Friday, September 29th, Section III., "Chemistry, Meteorology and Geology;" ten a.m.—address by Arthur Mitchell, M.A., M.D., LL.D., F.R.S.; eleven a.m. to one p.m.—papers and discussions, "Chemical, Meteorological, and Geological; two to four p.m.—papers and discussions, "Chemical, Meteorological, and Geological;" five p.m.—closing general meeting of Congress; 7 p.m.—public dinner. Saturday, September 30th, excursions; lecture to the working classes, by B. W. Richardson, M.D., LL.D., F.R.S.

ON GOVERNING ENGINES BY REGULATING THE EXPANSION.*

By Mr. Wilson Hartnell, of Leeds.

The object of the present paper is to illustrate the advantage of automatic expansion gear: in other words, of controlling the expansion gear by means of the governor; and to describe two such methods which have been arranged by the writer, and which have been extensively used, chiefly for small steam engines. The chief advantages derived from automatic expansion gear are, first, the saving of fuel arising from the smaller consumption of steam, and secondly, the greater regularity of speed.

Saving of Fuel.—The extent of this saving depends upon the particular circumstances of the case. If the engine be for the most part fully loaded, expansion gear is of little benefit. If the steam pressure and the load be at all times nearly constant, expansion gear variable by hand may be equally advantageous. Non-automatic expansion gear must be adjusted to cut off late enough for the maximum load with the lowest pressure, otherwise the engine is liable to be stopped instead of regulated. Hence for engines subject to very variable loads, such as ordinary agricultural engines, expansion gear variable by hand is practically useless. It is well known that, when a non-expansive non-condensing engine is working with a light load, the fuel used is excessive in proportion to the horse-power expended, the work of the steam being spent principally in overcoming the atmospheric resistance. The saving in fuel, therefore, due to automatic expansion, will be greatest in non-condensing engines with very variable loads, for the most part lightly loaded. In portable engines with automatic expansion the saving of fuel and water has been frequently reported by the users to be as much as one-third, when compared with an ordinary engine under the same average conditions.

Estimate of the Steam Saved.—Since the economy effected by automatic expansion is a variable quantity, depending upon the range of variation in the load as well as upon the particular construction of the engine and boiler, it is better here to omit reference to the fuel. The measurement of the economy of steam and the manner in which it arises may be most readily shown by reasoning deductively from definite hypothetical conditions of load, and from assumed relations in regard to the point of cut-off; these relations agreeing with experiment on good average engines. Throughout this paper the writer has illustrated the various relations discussed by means of geometrical diagrams, without giving the demonstrations; first, as being the clearest and simplest means, and secondly, because many of the investigations thus illustrated would occupy more space than the whole of this paper.

Form of Indicator Diagrams.—Figs. 1 and 2 are hypothetical indicator diagrams, showing the cut-off at 20, 40, and 60 per cent. of the stroke, with single and double valves, in condensing and non-condensing engines. Fig. 3 shows the effects of throttling. These diagrams are drawn in accordance with actual indicator diagrams, the initial pressure being assumed at 60 lb. per square inch.

Economy of Steam with Various Periods of Cut-off.—The vertical ordinates to the curved lines in Fig. 4 show the water used per indicated horse-power per hour for a cut-off at all parts of the stroke, the lines being drawn in accordance with experimental data and with Figs. 1 and 2.

Economy of Speed Under a Variable Load.—Fig. 5 shows the relation between the quantity of steam expended and the mean pressure on the piston, using the throttle valve and the expansion valve respectively, in non-condensing engines corresponding with the diagrams in Figs. 2 and 3. The intersections of the vertical lines by the dark line represent the mean pressure on the piston, and by the curved lines the comparative steam used. Any vertical distance between the curved lines is the extra steam used with throttling as against expanding at the corresponding mean pressure. Fig. 5 may be constructed from real indicator diagrams, by drawing curves to represent the final cylinder pressures corresponding with the observed mean pressures, and making allowance for compression, condensation, &c.

Economy of Steam with any Given Variable Load.—This is shown by Fig. 6. The horizontal distance between the vertical lines represents intervals of time. The height to the darkened curve represents the mean pressure on the piston at the corresponding time. The dotted curves are plotted from Fig. 5 at heights corresponding with the mean pressures. Hence the space enclosed between the darkened curve and any two ordinates—such as the space shaded—represents the relative work done in that interval of time; and the spaces enclosed by the two dotted curves represents the relative quantities of steam used when regulating with the expansion valve and with the throttle valve. The space between the dotted curves represents the steam saved.

Prompt Governing.—The promptness with which automatic expansion gear controls the engine, as compared with a throttle valve, is owing to its freedom from two evils, which may be termed "retardation from storage" and "retardation from friction." The retardation from storage is the effect due to the steam that is stored between the throttle valve and the steam port. The retardation from friction is the effect due to the friction of the throttle valve or of the controlling gear. With a cut-off valve there is no storage, if it be a main slide valve or a valve on the back of the main valve. With a cut-off gear there is also little or no friction to be overcome by the governor; for the reciprocation itself tends to move the gear in opposite directions alternately, so that the governor has merely to hold it still, or else permit it to move itself.

Relation Between Position of Governor, Speed of Engine, and Pressure on Piston.—These three quantities have a definite relation, if the boiler pressure be uniform. For the mean pressure depends upon the position of the cut-off gear or throttle valve, which position depends upon the speed of the engine. This is illustrated in Figs. 7, 8, 11, and 12, by three series of lines, which may be called governor-position lines, speed lines, and load lines. Thus in Fig. 7 the speed line No. 3 is supposed to correspond with the position of the governor on the governor line 3, and also with the mean pressure or power, as shown by the dotted line 3. If the speed falls to line 4, or rises to line 2, the corresponding position of the governor and of the dotted power line will be the lines 4 or 2.

Perfect Governing.—Perfect governing with automatic expansion gear is illustrated by Fig. 7. The dark line on the lower part of the diagram indicates the load, that is, the mean pressure on the piston which would exactly balance the load, which may be called the independent variable. The dotted power line already described shows the actual mean pressure on the piston, or the power. It is obvious that the spaces enclosed between the zero line and the load line, and between the zero line and the power line, will on the average be equal to each other, as illustrated by the horizontal shaded spaces. When the load is in excess, the speed and position of the governor will fall; when the power is in excess the speed and position of the governor will rise. This diagram is merely illustrated, and not quantitative. The load is supposed to rise suddenly from 3 to 4, and simultaneously the speed of the engine, the position of the governor, and the mean pressure on the piston begin to vary, until the power rises to balance the load. The speed then remains uniform, but rather slower. This is shown by all the lines changing to position 4, and remaining there. The horizontal shaded space represents the power absorbed from the fly-wheel. Further on the load is supposed to fall to 2, and the speed to rise to 2. The vertical shaded line then represents the power absorbed by the fly-wheel.

Retardation from Storage.—This is illustrated by Fig. 8. The load is supposed to vary from 2 to 4. The speed falls from 2 to 4, and the position of the governor does the same; but owing to the storage the mean pressure does not simultaneously rise to line 4. The speed therefore continues to fall, say to line 5, and the governor, instead of remaining at position 4, falls to position 5, thus putting on too much steam. The speed will then begin to rise again until too much steam is shut off; and in consequence several oscillations of speed take place without any further change in the load.

Retardation from Friction.—Fig. 9 shows the outline of a pendulum governor with balls 5in. diameter, about the size usual on an 8-horse power engine. Fig. 10 shows the centripetal force due to the weight of the balls, at various radial distances indicated by the vertical ordinates to the curved line. The inclined divergent speed-lines show the centrifugal force—increasing with the radius—due to the various speeds marked. The intersections of these lines by the curve show the speeds that balance gravity. By measuring vertically above and below the centripetal curve the resistance of the throttle valve at various radii, the dotted friction curves may be drawn through these points. The intersections of the friction and speed lines shows the increased or decreased speed required to overcome friction, and to move the balls outwards or inwards from any position. The area enclosed between the centripetal curve, a friction curve, and any two vertical ordinates, shows the work done by the governor in overcoming external friction while passing from one to the other of the corresponding radial positions. The area enclosed between the centripetal curve and the base line shows the work required to open the balls, which may be described as the "governor power."

Governor Power.—It may be seen from Fig. 10 that, whatever be the difference between any two good centrifugal governors, giving the same variations of speed, the average ratardation from friction will depend on the ratio between the total governor power and the resistance. It follows that the two governors, although they may be totally dissimilar, will be about equally efficient with equal power; otherwise the one with most governor power will govern best. It may be demonstrated that, if the above ratio be a small fraction, this fraction added to the free variation of the governor will give the retarded variation. In the above example the sensitiveness of the governor, when free, is about 6 per cent. from the mean speed. If the friction of the throttle valve be 3 per cent. of the governor power, the retarded sensitiveness of the governor will be 3 per cent. greater or $7\frac{1}{2}$ per cent. from the mean; whilst the alternate variation of speed must be 3 per cent. before the governor will move at all. In order to be ample, the governor power should be say twenty times the friction to be overcome; it may be forty times with advantage. The description of any governor should state its free variation and its power. For example, the governor in Fig. 9, with 5in. balls at $8\frac{5}{8}$in. maximum radius, allows 6 per cent. variation from the mean speed, and its power is 5·6 foot-pounds. It may be observed from Figs. 10 and 28 that as the friction curve is raised the governor begins to be unstable, commencing at the least radius. This would cause continuous "hunting," the balls flying out and returning slowly. The more sensitive the governor, the more possible is such an occurrence.

Retardation from Friction.—The effect of this is to oblige the engine to change its speed sufficiently to overcome the friction every time the load is in the least changed, as shown in Fig. 11. The load changing from 2 to 3, the speed falls to 3 before the governor commences to move, and falls say to 4, before the governor has fallen to 3. The load again being taken off, the speed makes a large excursion in the opposite direction.

Retardation from Storage and Friction Combined.—The total variations of speed, arising from the combined retardation from storage and of friction, are much greater than either separately. They are illustrated in Fig. 9, where the load is supposed to increase from 3 to 4, and to remain constant. The governor, owing to the friction, does not begin to fall until the speed has fallen to 4; and when it does fall, the power line is not sufficiently changed till a little later. In consequence the speed continues to fall still more, and too much steam is admitted. The mean pressure thus continues to rise, and produces an opposite variation before the governor begins to go in the opposite direction. Thus one small variation of the load may produce a series of disturbances in the speed, although there be no further variation in the load. These effects may be noticed in an exaggerated form in a compound engine, where the governor works stiffly. By comparing Fig. 7 with Fig. 12, the immense advantage of governing the cut-off gear will be apparent. It is, however, but just to state that the same effect could be produced with the throttle valve, if friction were a very small fraction of the governor power, and if storage could be got rid of.

The writer will now describe two arrangements of automatic expansion gear which he has devised, and which have been extensively and successively used for some years. The governor shown in Figs. 13, 14, and 18 to 21, is fixed to the crank shaft, and was schemed especially for portable engines. Its design resulted from the following considerations:—(1) that very great governor power—several hundred foot-pounds—could be obtained by placing the governor in the fly-wheel; (2) that with so much power it would be easy to move the excentric, and by some form of wedge gear to hold it when moved. It was afterwards found that sufficient power could be obtained in a much smaller diameter than that of the fly-wheel; and separate governer drums were then adopted as more convenient.

Form Applied to a Separate Cut-off Valve.—Figs. 13 and 14 represent this governor as applied to the cut-off excentric of a fixed engine. It consists of a drum A, and weights B B, swivelling on the weight pins C C. The weights are connected by the coupling rod D, which is acted upon by the spring E. The excentric F is attached to the excentric carrier G, swivelling on the excentric pin H. The governor is coupled to the excentric carrier by means of a curved link I called a quadrant—although really less than a quarter of a circle—which is fixed to the quadrant arm and works through the quadrant pin on the excentric carrier G. The quadrant is placed oblique to the circular path it describes, thus acting as a wedge; so that by its intervention the governor can move the excentric, but the excentric cannot move the governor. It will be noticed that the excentric and the weight are guided in circular paths by pins, and not in straight lines by slides; thus reducing friction to a minimum, and so ensuring greater delicacy of action. The resistance of the valve may be considered as a force acting on the centre of the excentric, as shown in Fig. 15, and tending alternately to push it towards and pull it from the centre of the shaft during each semi-revolution. Thus the power required to move the excentric is obtained from the crank shaft, and not from the governor. The incline of the link, and other moving surfaces, are so proportioned that the frictional work produced by the resistance of the valve equals, as nearly as possible, the tendency to alter the throw of the excentric. Thus the governor has little or nothing to do in order to hold the excentric in place; and freely adjusts it at such times as the governor and the excentric are acting in the same direction. The cut-off valve used may have single ports; but to reduce the travel of the excentric, multiple ports have been generally used, as shown in Fig. 16, and especially in Fig. 17.

In designing this governor and its valves, the chief points to be arranged are the position and adjustment of the excentrics. The less the linear adjustment of the excentric the less the incline of the quadrant, and the more readily will the governor control the excentric. With condensing engines which do not require a late admission one port will suffice; but with large non-condensing engines which require steam to be admitted to $\frac{6}{10}$ the stroke triple ports may be necessary, and the cut-off excentric less than 25 deg. in advance of the main valve excentric. The main valve should have lap enough to open the port, say three-fourths its width at the end of the stroke, to get suitable compression and avoid back pressure. The valve ports should be as close as possible without risk of admitting steam at the back edge with an early cut off. The governor cannot be too powerful provided it be not too costly; 5 to 8 foot-pounds per nominal horse-power has been found sufficient.

Governor Applied to Ordinary Slide Valves.—With small engines, say with less than 10in. cylinders, it has been preferred for the sake of simplicity to use but one slide valve. The governor was at first placed in the fly-wheel. It is now generally placed in a separate drum, attached to an excentric which is coupled direct to the valve-rod. Fig. 18 shows the interior of the governor as used for an 8-horse power or 10-horse power portable engine, with the weights open and the excentric in mid gear; Fig. 19 shows the weights closed and the excentric in full gear; Fig. 20 is a plan. It is confined to 18in. diameter in order to clear the boiler. The parts have been arranged to use all the available space. The construction is essentially the same as in Fig. 13, but the quadrant can be set oblique in either direction, in order to reverse the engine. As before, A is the drum in three pieces, namely, the disc plate, which is keyed to the shaft and turned on both sides to carry all the working parts, and the casing in halves; B B are the weights, C C their pins, D the coupling rod, E E the two springs, F the excentric, G the excentric carrier, H its pin, I the quadrant, J the quadrant arm, K the quadrant pin. The path of the centre of the excentric is a curved line from full gear forward to full gear backward. When the weights are open the quadrant puts the excentric in mid gear—*i.e.*, opposite the crank pin of the engine. In this position the quadrant pivot N is nearly concentric with the quadrant pin. The other end of the quadrant is held by a screw O. Suppose the quadrant set obliquely, to run the engine forward. Then, to reverse the engine, set the piston near the end of its stroke, insert a strong screw-driver through the open part of the excentric, slacken the screw, push the excentric across, and tighten it again. This form of governor was first used at the Cardiff engine trials ten years ago, and was immediately adopted by Messrs. E. R. and F. Turner for their 8-horse power portable engines; from that time uninterruptedly until now the throttle-valve has been abolished in their 8-horse power engines. So far as the writer is aware, from that date it is the only automatic gear which has been thus used for portable engines, to the entire exclusion of the throttle-valve, or which is even so used at the present day. With this governor it is difficult to detect any variation of speed under the most rapid and frequent changes of load. The supply of steam seems to vary simultaneously with the change of load. After a few governors had been made on the Cardiff pattern, it was found that larger wearing surfaces and more accurate work were desirable. The form of the drum was altered to that shown in order to facilitate the application of machine work. The bearing surfaces were enlarged, and the adjustment fitted to the quadrant pin; retaining however almost the indentical centre lines. Some of these earlier governors were replaced, as were also the piston valves shown at Cardiff. So far as the writer is aware, with the above exceptions the governor has been uniformly satisfactory; and he anticipates that automatic expansion governors fixed on the crank shaft will in future be more used for small engines than any other kind of governor. Another form of this governor is shown in Fig. 20*a*. A is the drum, B B the weights, C C very large pins cast on the weights, D the coupling rod, E E the springs, F the excentric fixed on the coupling rod. Although the friction of the pins cannot hold the whole thrust of the excentric, yet with quick-running engines the governor works well with the ordinary slide valve. Being simple and inexpensive it is being applied to such engines, including the cheapest forms, without increasing their cost. It can be reversed by attaching the coupling rod to the opposite side of the axis of the weight. Thus by means of governors placed on the crank shaft and acting on the excentric, throttle-valves may be abolished, and the advantages of being governed by regulation of the cut-off may be obtained in all sizes of ordinary engines.

Automatic Expansion Regulator.—A governor and expansion gear not fixed on the crank shaft, and therefore called for distinction by the above name, is shown in Figs. 21 to 23. Here A is the body casting, B B the weights swivelling on the pins C C, D the slide pins, E the spring, F F two rollers which press on the slide. This was designed as a simple compact automatic expansion gear suitable for small engines. It is capable of any required degree of sensitiveness, and so powerful that it readily controls the expansion gear. The form of slide valve used may be the same as in Figs. 16 and 17. That shown in Fig. 17 has been chiefly used for large engines. The cut-off is varied by means of the link gear shown in Fig. 21, which has been arranged so that, with a mean load, the eccentric rod and valve rod are in line, and there is little or no slope on the block. The whole is hung on the governor stand. The maximum incline of the link should not exceed 1 in 6.

Governor Power obtained with Springs.—This is much greater than can be obtained by the action of gravity in the same space.

The size of a spiral spring may be calculated from the formula on page 304 of Rankine's "Useful Rules and Tables," but experience with Salter's springs has shown that the safe limit of stress is more than twice as great as there given, namely 60,000 to 70,000 per square inch with $\frac{3}{8}$in. to $\frac{1}{4}$in. wire and about 50,000 for $\frac{1}{2}$in. wire. Hence the work that can be done by springs of wire is four or five times as great as Rankine allows:—

For $\frac{3}{8}$in. wire and under maximum load in lbs.

$$= \frac{12{,}000 \times (\text{diam. of wire})^3}{\text{Mean radius of springs.}}$$

Weight in lbs. to deflect the spring 1in.—

$$= \frac{180{,}000 \times (\text{diam.})^4}{\text{Number of coils} \times (\text{rad.})^3}$$

The work in foot-pounds that can be stored up in a spiral spring would lift it above 50ft. Thus the weight of the springs in lbs. need not exceed $\frac{1}{50}$ the "governor power" in foot-pounds. The coefficient of rigidity was noticed to be 12,600,000 to 13,700,000 with $\frac{1}{4}$in. wire, 11,000,000 for $\frac{11}{32}$, and 10,600,000 to 10,900,000 for $\frac{3}{8}$in. wire, in a few rough experiments made with Salter's springs.

Fig. 9 shows an outline of a pendulum governor for an 8-horse power engine, and Fig. 24 shows that of the 8-horse power automatic expansion regulator to the same scale. The power of the former is 5·6 foot-pounds, and of the latter 37·2 foot-pounds. The dotted lines show the diameter of ball, which, being raised the same height as the spring, will give an equal power. Fig. 25 shows the same for a 50-horse power engine with double springs; its governor power is 270 foot-pounds. Comparing Figs. 9 and 24 in the 8-horse power engine, the spring governor is six times more powerful. The most advantageous travel for the balls may be shown to be half the maximum radius. The large governor is of unusual power. The expansion governor used at the Cardiff trials had about 90 foot-pounds governor power. The usual power for an 8-horse power engine is about 50-foot-pounds.

For the resistance due to friction will be inversely as the travel, as the capability of overcoming this varies with the radius. To give the least radius the maximum advantage—assuming that the maximum radius is fixed—the least radius × travel must have a maximum value—*i.e.*, they must be equal. It has sometimes been supposed that because the weights of a gravity governor are constant, and the resistance of the spring is least at the least radius, therefore the spring has a disadvantage. In either case the minimum centrifugal force is balanced and no more, the weight at that time rising slower. The two governors here described are numbers 6 and 12 of a series. After many unsuccess ful attempts to form a rational basis for this series, these sizes were drawn to embody all the latest experience, and logarithms taken of all their similar parts, from which were formed a series of equi-distant logarithms—*i.e.*, in arithmetical progression—and from their corresponding number the intermediate sizes were drawn.

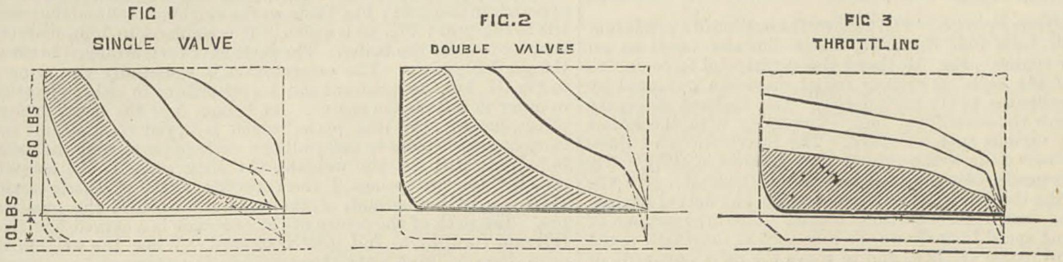
Sensitiveness.—In this design the sensitiveness, or the variation from the mean speed required to traverse the governor, can be varied as desired. About 4 per cent. from the mean speed has been found best for small engines, and 3 per cent. for large ones. The size of the fly-wheel must be such that the variation of speed in each semi-revolution is less than the variation of the governor.

It is essential to good governing to have a sufficient fly-wheel. The "rules of thumb" usually found in engineers' pocket books ignore the laws of dynamics and are of no assistance. The writer has used the following approximate formula derived from Prof.

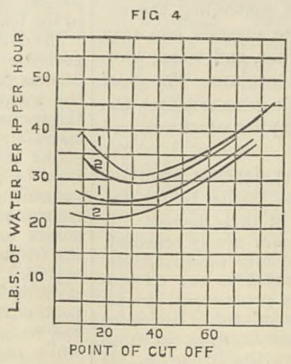
* Read before the Institution of Mechanical Engineers at Leeds, August 18th.

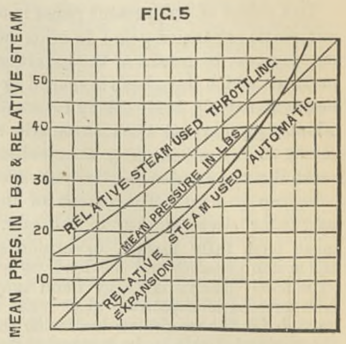
HARTNELL'S GOVERNORS.

(*For description see page* 163.)

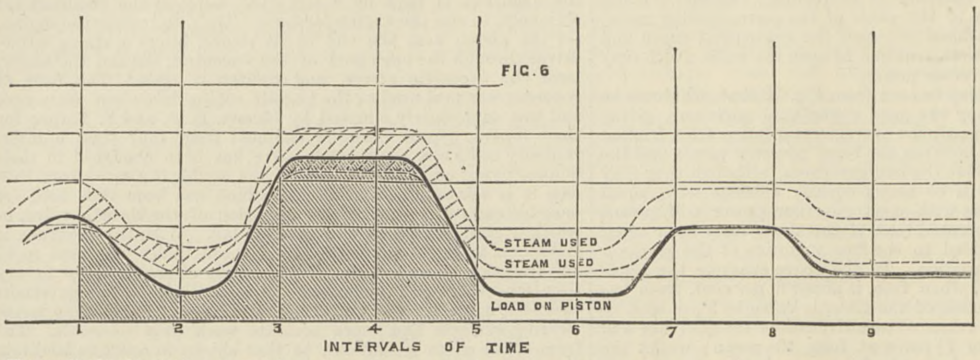


Figs. 1, 2, and 3 are the assumed indicator diagrams on which is based the economy of fuel illustrated in Figs. 4, 5, 6.

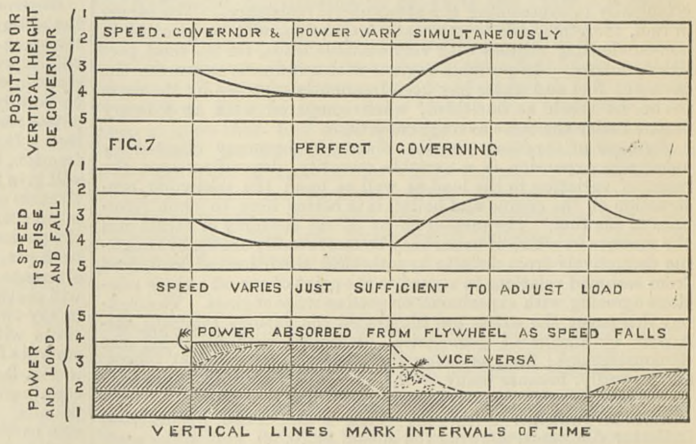


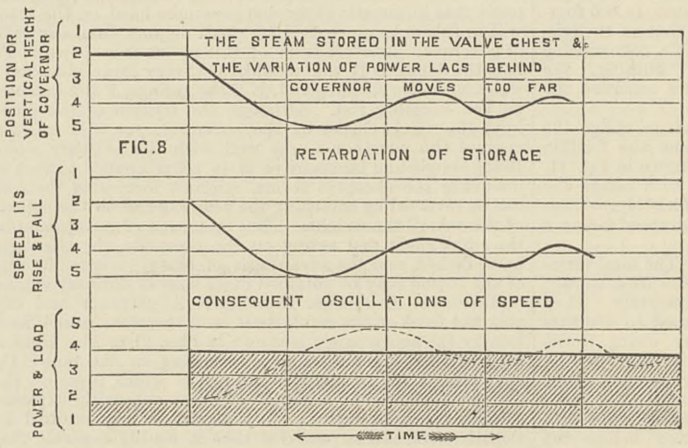


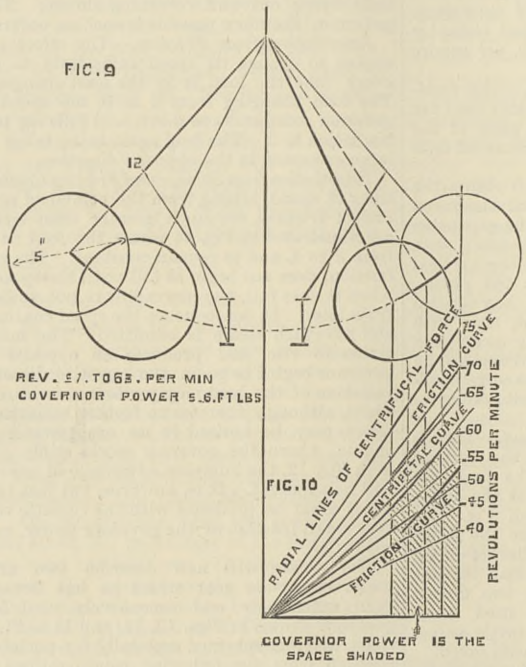
The vertical ordinate shows mean pressure on the piston, and the relative steam used by expanding and throttling, or what is the same ratio, the corrected cylinder pressures at the end of the stroke and mean pressure.

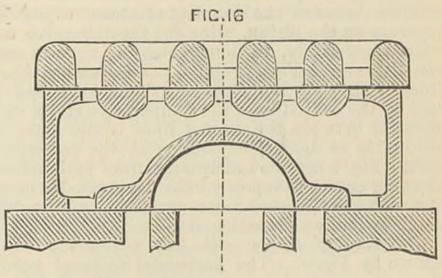


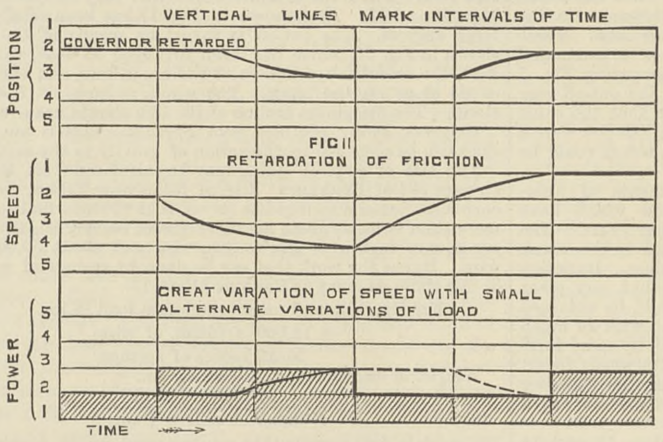
The vertical ordinate to a curved line shows the pounds of water per hour at that point of cut off with diagrams 1 or 2, as figured, for condensing and non-condensing. Any areas, such as those shaded, show the load and the relative steam used by expanding and throttling to drive a variable load in that interval of time, and hence show the steam saved; as lightly shaded.

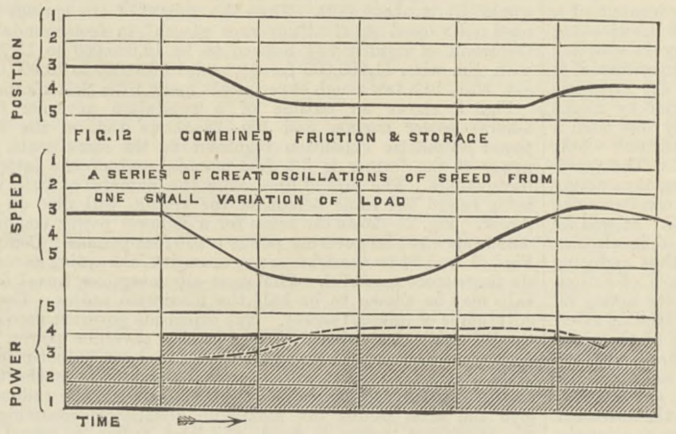


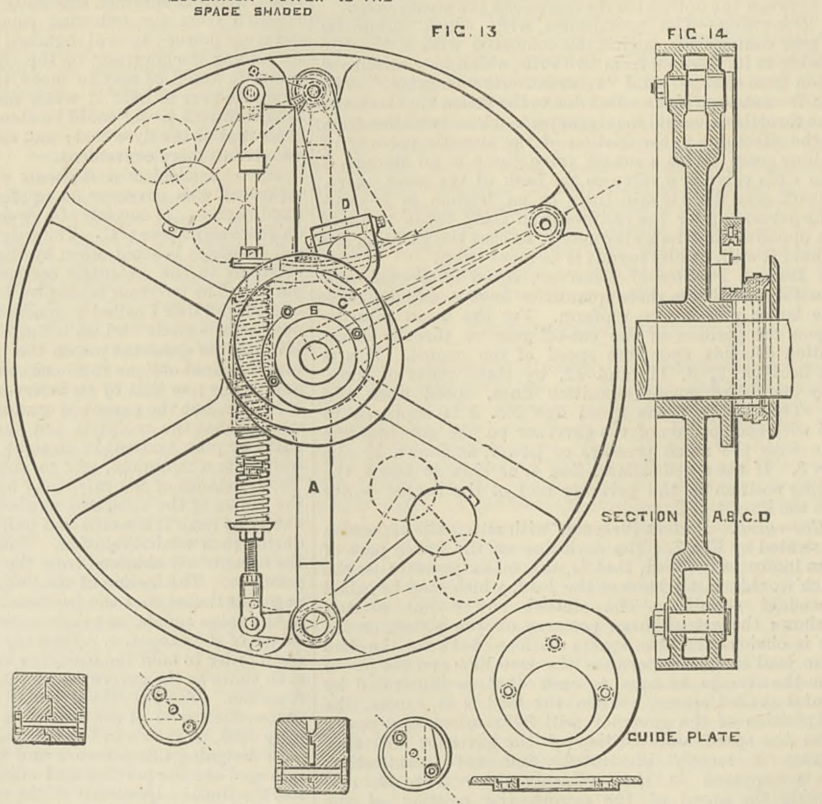


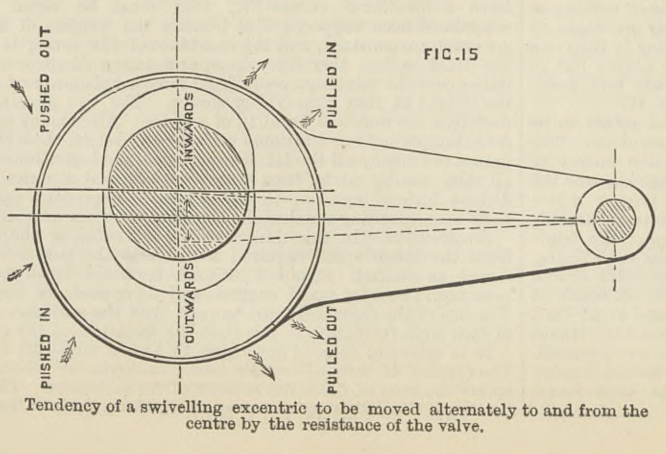




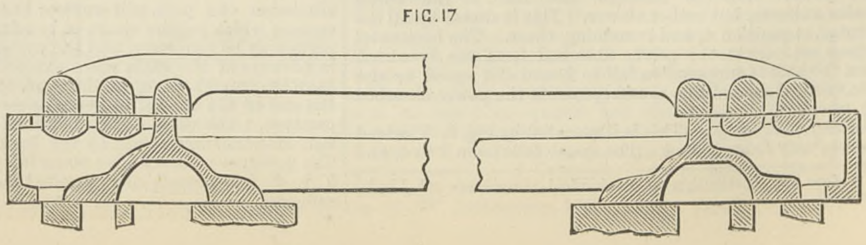








Tendency of a swivelling excentric to be moved alternately to and from the centre by the resistance of the valve.



HARTNELL'S GOVERNORS.

(*For description see page 163.*)

FIG. 18

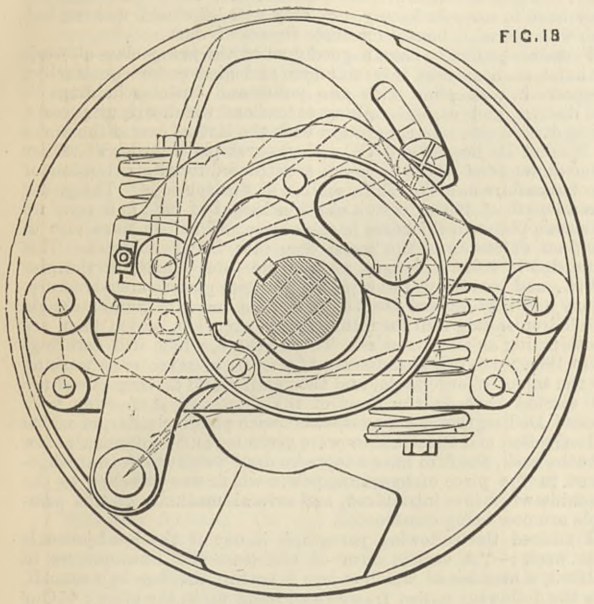


FIG 19

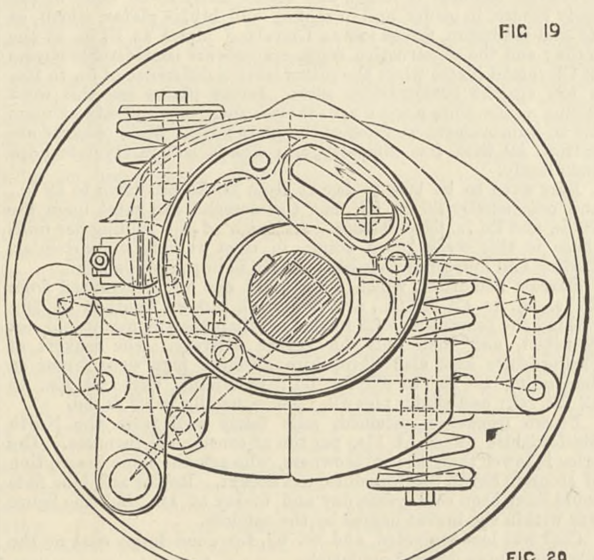


FIG 20

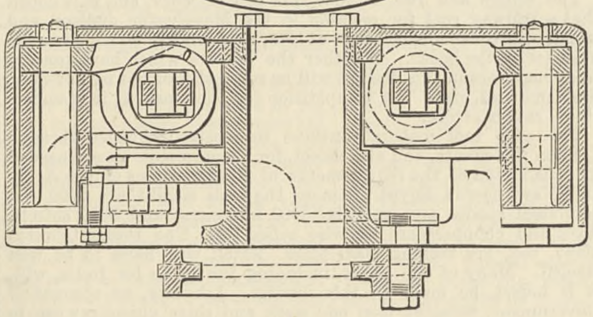


FIG. 25

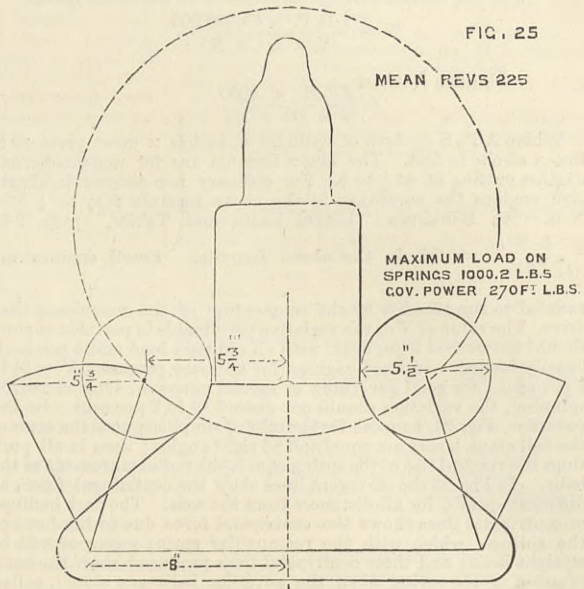


FIG. 21

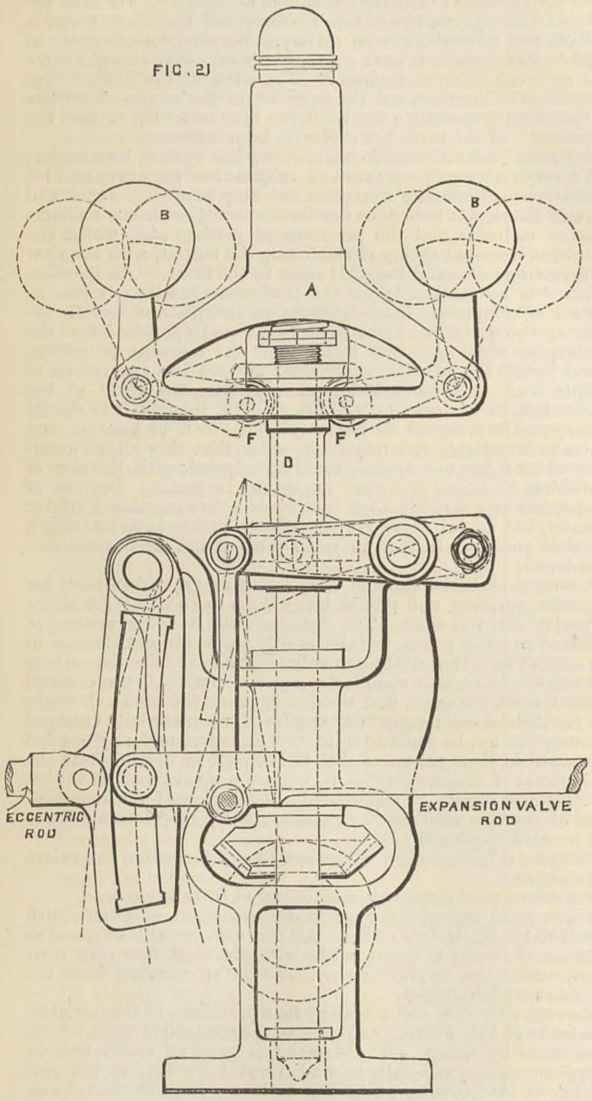
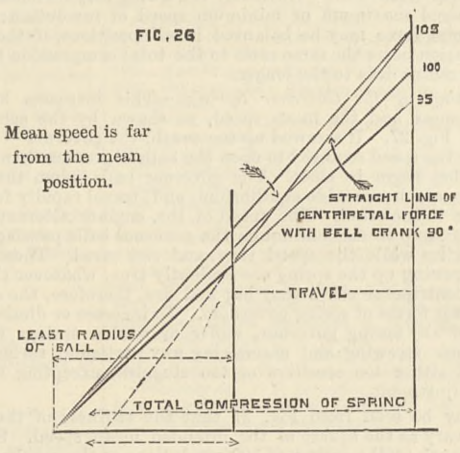


FIG. 26



Mean speed is far from the mean position.

Initial compression of spring.

FIG. 22

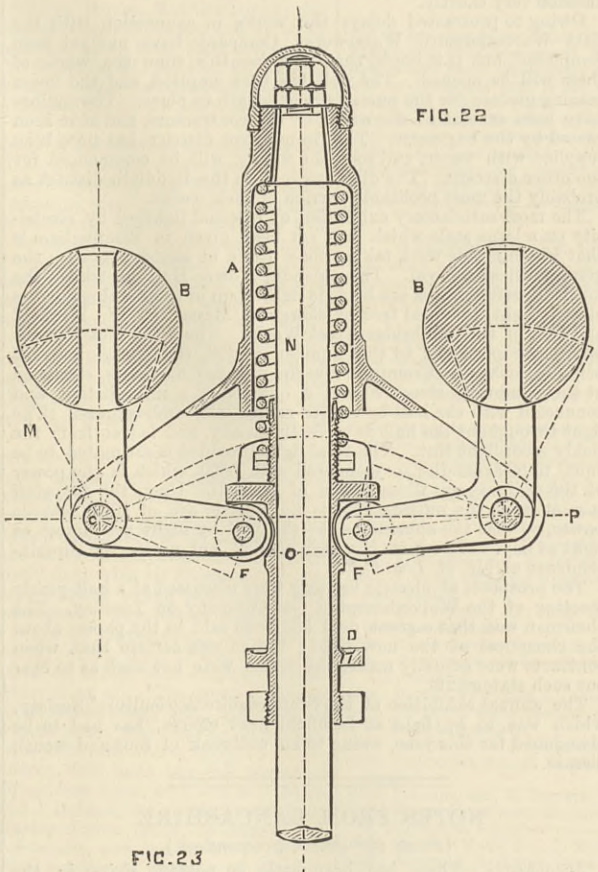


FIG. 27 Effect of screwing up springs on the speed and variation.

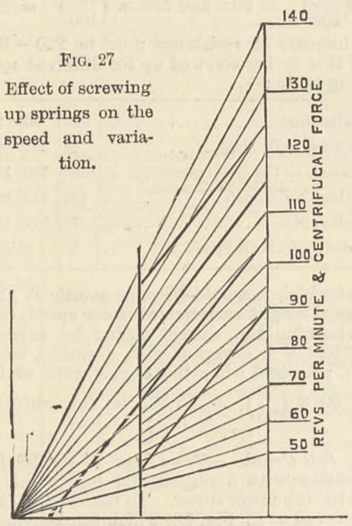


FIG 21A

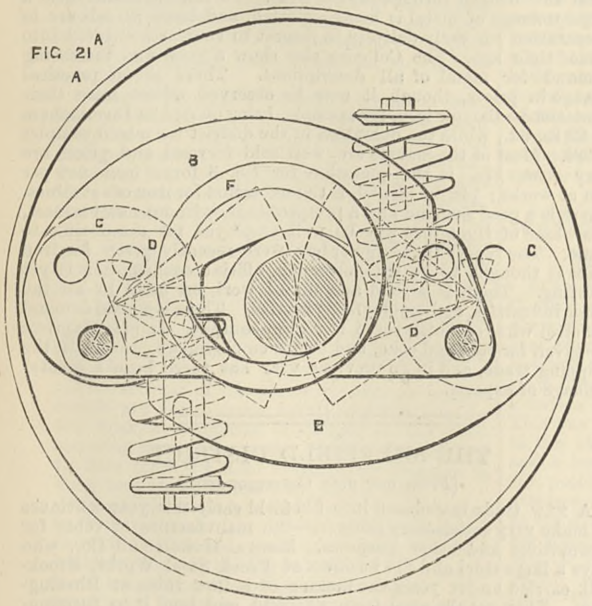


FIG. 23

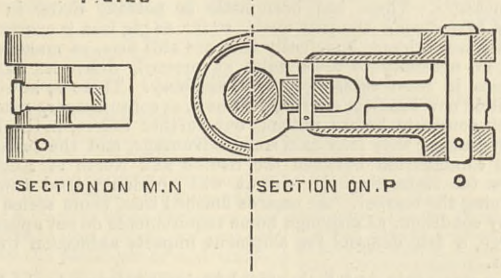


FIG. 28

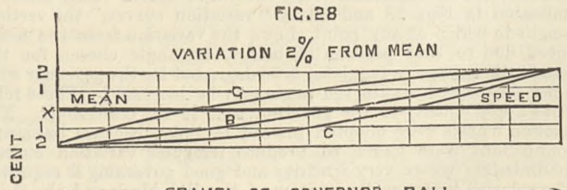


FIG. 29

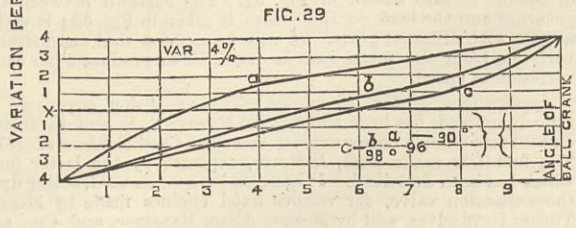
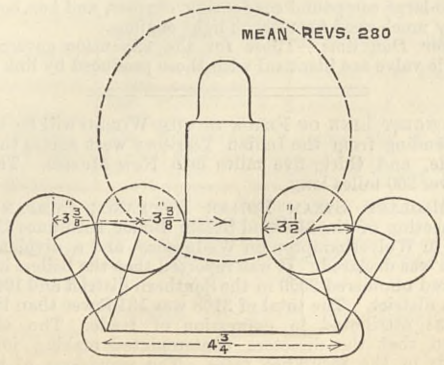


FIG. 24



Maximum load on spring, 234·4 lb.; governor power, 37·4 foot pounds.

FIG. 31.—Relation between height of governor and mean pressure on piston.

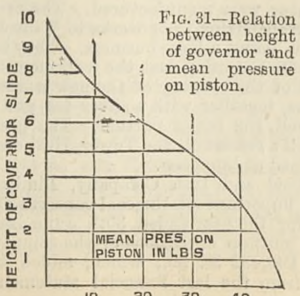
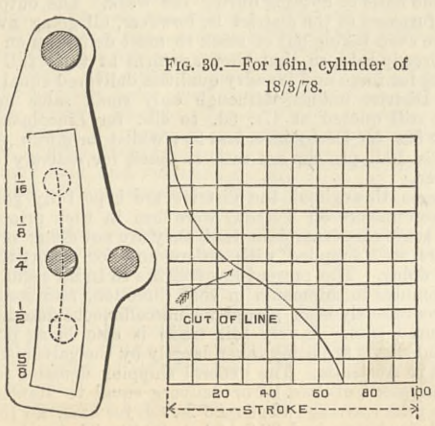


FIG. 30.—For 16in. cylinder of 18/3/78.



Position of the link block and the cut off.

Rankine's "Useful Rules and Tables," rule XI,, page 247. (q. v.)

Let D = Diameter of fly-wheel in feet, measured to centre of rim.
N = Number of revolutions per minute.
W = Weight of rim in cwts.
V = The variation of speed per cent. of the mean speed.

$$W = \frac{\text{1-H.P.} \times 65{,}800{,}000}{V \times D^2 \times N^3}$$

or

$$= \frac{AP_mS \times 4000}{V \times D^2 \times N_2}$$

Where $A\,P_m\,S$ = Area of cylinder in inches × mean pressure in lbs. × stroke in feet. The above formula are for non-condensing engines cutting off at $\frac{1}{3}$ to $\frac{1}{4}$. For ordinary non-automatic expansion engines the constants in the above formula may be $\frac{1}{5}$ less. N.B.—See Rankine's "Useful Rules and Tables," page 248, $\frac{\Delta E}{\int Pds}$ = ·19 in the above formula. Small engines are assisted to run steadily by the momentum of the machinery they drive. The value of V or the variation permissible in portable engines should not exceed 3 per cent. with an ordinary load and 4 per cent. heavily loaded. In fixed engines, for ordinary purposes, V = $2\frac{1}{2}$ to 3 per cent., for good governing or special purposes, such as cotton spinning, the variation should not exceed $1\frac{3}{4}$ to 2 per cent. In the governor, Fig. 24, suppose for the sake of simplicity that the arms of the bell crank levers are equal and at right angles; then in all positions the vertical rise of the spring equals the radial movement of the balls. In Fig. 26 the divergent lines show the centrifugal force, at different speeds, for all distances from the axis. The dark inclined or centripetal lines shows the centripetal force due to the force of the springs, which with the rectangular spring governor will be straight lines; and these centripetal lines produced show the compression of the spring when the governor balls are closed, called the "initial compression." A vertical ordinate of this centripetal line at 1in. compression would show the stiffness of the spring in pounds per lineal inch. Obviously the spring may be made to give any desired maximum or minimum speed of revolution; or the centripetal force may be balanced in all positions, if the initial compression bears the same ratio to the total compression that the shorter radius does to the longer.

Screwing up the Governor Springs.—This increases both the sensitiveness and the mean speed, as shown by the centripetal lines of Fig. 27. If screwed up too much, the governor "hunts," because the speed required to open the balls is greater than that at which they begin to close. The governor balls, when they begin to move, are in unstable equilibrium, and travel rapidly from one extreme to the other. The speed of the engines alternates from the maximum to the minimum, the governor balls pausing at the least radius while the speed rises, and *vice versâ*. These results from screwing up the spring are evidently true, whatever the form of the centripetal curve may be; and are, therefore, the same in all known forms of spring governors. To increase or diminish the speed of any spring governor, stiffer or weaker springs must be used, since screwing and unscrewing any particular spring would make it either too sensitive or too sluggish, excepting for very small adjustment.

It may be seen from Fig. 27 that the stiffness of the spring should vary as the square of the intended mean speed. Suppose the pressure on the spring at 100 revolutions at the maximum and minimum radii was 200 lb. and 100 lb. The springs to suit a variation 95 to 105 will be—

$$100\left(\frac{95}{100}\right)^2 = 90{\cdot}2 \text{ and } 200 \times \left(\frac{105}{100}\right)^2 = 220{\cdot}5.$$

That is, the increase of resistance must be 220 – 90 = 130. The speeds due to this spring screwed up for different speed are shown in the following table:—

Revolutions, balls shut	80	90	95	100	110	120
Pressure on springs, balls shut..	64	81	90	100	121	144
Increase of pressure as the ball opens	130	130	130	130	130	130
Pressure on spring, balls open	194	211	220	230	251	274
Revolutions, balls open	98	102	105	107	112	117
Variation, per cent. of mean speed..	10	6	5	3	1	—1

The speed at which it would become astatic is 114. Since any spring will give the right variation at some speed, it is often convenient to determine the correct spring by experiment with a wrong one. Thus, if a governor with a spring, whose stiffness is 50 lb. per inch, acts best when the engine runs at 95, 90 being its proper speed $50 \times \left(\frac{90}{95}\right)^2$ = 45 lb. is the stiffness of spring required.

Angle of the Bell Cranks.—From Figs. 26 and 28 it appears that the mean position with a rectangular bell crank by no means corresponds with the mean speed. To correct this, the centrifugal line must be curved as in Fig. 10, which can be done by increasing the angle of the bell crank. The effect of increasing the angle has been very carefully calculated for a progressive series of angles and for various variations from the mean speed. This effect is indicated in Figs. 28 and 29 by "variation curves," the vertical height to which at any point shows the variation from the mean speed due to that position of ball. The angle chosen for the automatic expansion regulator is 96 deg.; but for the governor with 5 per cent. speed limits the angle may be increased. These relations apply equally to the governor and to the crankshaft. The friction wheels were adopted instead of links, because links and connections were found to produce irregular variation curves, inadmissible where very sensitive and good governing is required. The relation between the position of the link-block and the point of cut-off is also shown in Fig. 31. The relation between the governor and the load on the piston is given in Fig. 32; it varies a little with different gears. It will be noticed that considerable variation from the mean load is required to produce 1 per cent. variation of speed.

Applications of the Governors.—The expansion governor, as already noticed, has been adopted by Messrs. E. R. and F. Turner on all their 8-horse power engines since the Cardiff Show of 1872. The first few made were, however, replaced by the latter form which has been described. It has also been much used, acting upon the expansion valve, for various fixed engines made by Messrs. Turner themselves, and by Messrs. Allen, Ransome, and Co., and others. The expansion regulator has been extensively used by Messrs. Marshall, Sons, and Co., on engines of all sizes, fixed and portable, and on all their large stationary engines. It has been applied to large compound condensing engines, and has been comparatively much used for electric light engines.

Indicator Diagrams.—Those for the expansion governor with single slide valve are identical with those produced by link motion.

THE LONGEST LINE OF FENCE IN THE WORLD will be the wire fence extending from the Indian Territory west across the Texas Panhandle, and thirty-five miles into New Mexico. The fence will be over 200 miles long.

THE MIDLAND STEAM BOILER INSURANCE COMPANY.—The annual meeting of the Midland Steam Boiler Insurance Company was held in Wolverhampton on Wednesday, and a dividend of 4s. per share was declared. It was reported that the boilers inspected and assured numbered 2059 in the Southern district and 1049 in the Northern district. The total of 3108 was 161 fewer than last year, which was attributed to depression of trade. The chairman announced that the directors contemplated making important alterations in the insurance rates. The provisions of the new Boiler Act would receive the greatest attention of the directors.

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

(*From our own Correspondent.*)

A BETTER business is doing, and seems likely to be done in the early future, in girder and in roofing and bridge plates, which, at £8 as a minimum, are as low as Cleveland plates at £7 5s. at the mills; and the constructive engineers here are considerable buyers of Cleveland plates when the prices leave a difference of 5s. to 10s. a ton against Staffordshire sorts. Boiler plates are this week selling no less than a week ago, though there is yet plenty of room for an improvement at most of the plate mills. More makers are getting £9 with less difficulty, and £10 is less rarely demanded than lately.

Bars were to be had to-day at from £8 2s. 6d. down to £6 5s., and occasionally £6 2s. 6d., but the demand ran most upon the £6 5s. and £6 7s. 6d. qualities. At some of the leading bar mills there is this week more doing, in rivet rounds in particular. Plating and horseshoe bars likewise are in improved demand.

Barrow hematites, which a fortnight ago were advanced from £3 7s. 6d. to £3 8s. 9d., are this week put up another 1s. 3d., making the present rate £3 10s. Less than that money would not be taken, and then only for future delivery. The makers of Staffordshire and also Shropshire all-mine pigs were firmer in demanding £3 5s. to £3 7s. 6d.; part-mine were £2 10s. to £2 12s. 6d.; and cinder pigs £2, up occasionally to £2 2s. 6d.

Brown ironstone, calcined, sells fairly well from the North Staffordshire mines at 11s. per ton at consumers' furnaces. The price is lower than the mineowners, who get the same description of stone in South Staffordshire, can accept. Robins and blue flats could have been sold yesterday and to-day at 14s., but the figure was within the lowest named by the vendors.

Coal was less neglected, and 6s. 6d. for good forge coal at the pits was a more general quotation.

The bridge and roof builders are full of work, and it is hoped that a railway roof for erection in the Manchester district, and which will consume 2800 tons of iron, may quickly be added to the business on the books. Whether the tenders which have gone in from engineers in this district will be successful or not is, however, problematical, since the competition for the work is, it is understood, rather severe.

The edge tool makers continue to receive inquiries through London merchants, and also direct, for Government stores needed in satisfaction of the requirements of those portions of the Army and Navy now in Egypt. Among the tools sought are 3000 best cast steel spades and shovels, 5000 hammers, and 3000 chisels. Axes and choppers are likewise called for. The Indian Government, too, are seeking 6000 picks, which will have to be well steeled. Many of the goods, including the picks for India, will, it is hoped, be made in this district. Likewise, on account of Government, wrought iron odd work and ships' chandlery are in brisk request.

The employers in the nut and bolt trade, at a conference with the operatives, have just promised to consider their demand for an advance of 15 per cent. "on the list of 1881," and to give them a decision very shortly.

Owing to protracted delays the works in connection with the East Worcestershire Waterworks Company have not yet been completed, but it is hoped that in a month's time the whole of them will be opened. The well has been emptied, and the lower bearing girders for the pumps are at length in place. The engines have been erected at the works of the contractors, and have been passed by the engineers. The Bromsgrove district has now been supplied with water, and soon the supply will be commenced for the other districts. The directors look to the Redditch district as probably the most profitable portion of their works.

The most satisfactory exhibition of internal lighting by electricity on a large scale which has yet been given in Birmingham is that which is this week taking place there in connection with the great musical festival. The splendid Town Hall, in which the musical performances are held, is lighted up in the evenings by the electric light, provided free of charge by Messrs. R. W. Winfield and Co., of the Cambridge-street Works. The Swan incandescent lamps are employed to the number of 496, the electric current being furnished by Crompton-Burgin dynamo machines, stationed at the Cambridge-street Works, a quarter of a mile distant, and connected with the hall by copper cables laid underground. The light throughout the hall is perfectly steady, and is free from the sickly moonlight tint. The total light provided is estimated to be equal to 8000 candles, as compared with 5600, which is the power of the ordinary gas illumination of the hall. Upon the flag-staff surmounting the outside roof is an electric arc of 10,000-candle power, so that the approaches to the hall by night are almost as light as day. The work has been carried out under the superintendence of Mr. H. Lea, C.E.

The prospects of electric lighting were discussed at a half-yearly meeting of the Wolverhampton Gas Company on Tuesday. The chairman said that a great deal had been said in the papers about the cheapness of the new light; but it was certain that, when contracts were actually made, the terms were not such as to bear out such statements.

The annual exhibition of the Staffordshire Agricultural Society, which was to be held at Lichfield next month, has had to be abandoned for this year, owing to an outbreak of foot-and-mouth disease.

NOTES FROM LANCASHIRE.

(*From our own Correspondent.*)

Manchester.—There has been little or nothing doing in the market here during the past week, so far as pig iron is concerned, to really test prices. Nominally they are still firm, as makers are under no necessity to press sales at present, deliveries against contracts in most cases keeping them busy. There is, however, very little new business offering just now, as consumers are running off their contracts before putting out further orders, in the hope that by waiting they may gain some advantage, and the break-up of the combination between the Scotch and North of England makers for restricting the output will no doubt tend towards weakening the market. As regards finished iron, trade seems in a healthy condition, as although home requirements do not appear to be large, a fair demand for shipment imparts animation to the market.

There was again but little actual business stirring in the Manchester Tuesday's market, and local makers of pig iron reported having done little or nothing during the week. The output from the blast furnaces in the district is, however, all going away, and makers are even taking out of stock to meet deliveries on account of iron already sold, so that they are firm at their full rates of 46s. less $2\frac{1}{2}$ for forge and foundry qualities delivered equal to Manchester. District brands, although only small sales are being made, are still quoted at 47s. 6d. to 49s. for Lincolnshire, and 48s. 6d. to 50s. for Derbyshire, less $2\frac{1}{2}$; whilst for g.m.b., Middlesbrough, 52s. 10d. per ton net cash is asked for delivery equal to Manchester.

The forges throughout the district are kept fully going, and finished iron makers on Tuesday were firm in their prices. Merchants in some cases complain that they are not doing much, but makers are well supplied with orders, and for export there is a good deal doing. The present low freights to India seem to have given a stimulus to shipments in that direction, and considerable orders have recently been placed for miscellaneous descriptions of manufactured iron. A very fair trade is also being done with Russia, and sheets are being taken largely by the galvanising trade for export to Australia. The general shipping demand for hoops has also increased of late. For delivery equal to Manchester or Liverpool prices average about £6 2s. 6d. for bars, £6 15s. 6d. to £6 17s. 6d. for hoops, and £8 7s. 6d. to £8 12s. 6d. for sheets.

The engineering trades of this district are generally kept well supplied with work, although in some departments new orders are reported to be coming not quite so freely as of late. This is the case amongst machinists, but the principal firms are still busy. Wheel and millwrights report orders fairly plentiful, but they have to compete keenly, not only with Sheffield makers, but also with German houses for some classes of work.

Founders generally have a good deal of the heavy class of work in hand, such as cast iron columns and girders for constructive purposes in connection with new public and business holdings in the district, and various railway extensions which are at present being carried out. In connection with the latter I saw at the works of Messrs. De Bergue and Co. a single web plate girder of rather large dimensions which is being constructed for the extension of the Lancashire and Yorkshire station at Staleybridge. The girder has a length of 130ft., with a uniform height of 9ft., and runs up to eleven plates in thickness in the centre. The firm have also in hand an extension of the Santos iron pier, South America. This extension is 420ft. in length, making the total length of the pier 900ft., and is built on screw piles with plate girder superstructure. I may add that Messrs. De Bergue and Co. have in hand an angle and T-iron rolling mill for rolling boiler rings hot, which they are constructing on a new model. The machine, which will roll rings from 18in. up to 6ft. 8in. diameter, consists of three rolls working on the top of a large table, and the gearing and driving power are all carried beneath the floor of the shop. In connection with Messrs. De Bergue's rivetting machine with yielding pillar, of which a description and illustrations were given in THE ENGINEER a few months back, the firm have adopted a dead-weight balance arrangement in the place of hydraulic power which was attached to the machine when first introduced, and several machines on this principle are now being constructed.

I noticed the following paragraph in one of the local journals this week:—"A certain firm of engineers and ironfounders in Salford, a member of which enjoys a seat in the borough council, has the following notice framed and hung up in the office:—'Our times for listening to solicitors of church subscriptions are from ten to two; book agents, two to four; commercial travellers, beggars, pedlars, and advertising men all day. We attend to business at night.' Facetious, is it not? And who would have thought there was so much humour in iron?" The office of the Salford firm referred to is, however, not the only one in the engineering trade of this district in which a similar notice is to be found, so that the "humour" of the thing has evidently been infectious.

A Miners' National Conference is sitting this week in Manchester, and a very elaborate programme of subjects has been prepared for consideration, including questions not only involving wages and working hours, but numerous details connected with the management of collieries and the processes of getting coal, whilst the somewhat worn-out theory of restricting the output, with the view of increasing prices and wages, is again to the front. One question which will be brought before the Conference is with reference to the use of compressed lime cartridges in the place of powder for bringing down the coal, and a resolution is to be proposed that the Conference urge upon the Home-office the necessity of finding means to test the principle of bringing into use this new system of getting coal. Mr. Burt, M.P., who occupies the chair at the Conference, in his opening address, said he thought they should urge upon Government to get employers, men of science, and others to investigate the matter, in order that they might determine whether the new system could be adopted, with the view of abolishing, he hoped for ever, explosions in mines. The use of compressed lime cartridges has been made a very prominent matter recently, but as yet there are no reliable proofs as to its being a practical success. In fact, in some cases it has been tried and abandoned.

A somewhat better demand is springing up for coal suitable for house-fire purposes, and pits in many cases are getting gradually in pretty near full work. The improvement, however, is not yet sufficient to affect prices, as there is still too much coal offering in the market for which sellers are only too ready to take the current low rates. As regards manufacturing classes of fuel, the demand remains much the same, and considering that the works throughout the district are mostly fully employed, no materially enlarged consumption can be looked for in this direction, and any upward movement in these classes of fuel will have to be derived from the withdrawal of the competition of house-fire qualities. At the pit mouth prices remain as last quoted; but in view of the unsettled state of the men with regard to wages, colliery proprietors will not sell forward at present rates.

Shipping is fairly active, with vessels more plentiful; but prices are no better.

For coke a good demand is maintained at fully late rates.

There is no material change in the condition of affairs with regard to the St. Helens strike. All the men are still out, and as determined as ever to continue the struggle until they gain their point, whilst the employers show no sign of receding from the position they have taken.

Barrow.—There is still a healthy tone prevailing in the hematite iron trade of this district, and sales to a considerable extent have been made by makers. The demand is good all round, but on American account especially so, and everything points to the probability of that country continuing to take a large amount of iron from this district throughout the year. To the Continent also a large tonnage of metal is being exported, and large parcels are in preparation for early delivery in respect to contracts entered into some time ago. The Colonies also show a good and increasing demand for metal of all descriptions. There is no practical change in prices, though it may be observed sellers raise their quotations—Barrow iron, for example, being quoted in Birmingham at £3 8s. 6d., while the quotation in the district for mixed samples is 58s. Most of the makers are well sold forward and prices are very firm, 57s. is the quotation for No. 3 forge iron net per ton at works; 14s. to 14s. 6d. is the quotation for iron ore at mines. There is a good demand and a prospect that, without new business, the whole of the mines will be well employed for some time to come. The report that large orders were recently given for iron ships is thought to be true, although official confirmation is yet wanting. There is a good amount of work on hand in all the other industries, and employment is brisk. There is a good demand for steel wire, of which there is a large output. Improved prices are given for coal and coke, and better employment prevails in the shipping trade, and in no previous year has there been a greater tonnage of exports.

THE SHEFFIELD DISTRICT.

(*From our own Correspondent.*)

A NEW trade introduced into Sheffield early this year continues to make very satisfactory progress—the manufacture of tubes for locomotives and other purposes. Messrs. Howell and Co., who have a large steel and file business at Brook Steel Works, Brookhill, carried on for years the making of hollow tubes at Birmingham. They get the steel from Sheffield, and send it to Birmingham, where the tubes were manufactured. The firm adopted the sensible course of transferring their works to Wincobank, Sheffield, where they are now doing a large business. They have resolved to add iron piping. On Saturday last the workmen, to the number of 250, on account of the opening of the new works, presented an illuminated address, together with a silver tea and coffee service, to Mr. J. B. Howell, the senior partner. The presentation took place at Mr. Howell's residence, the Tower, Hathersage, where the men were entertained at luncheon.

The Staveley Coal and Iron Company, Limited, one of the largest and most important of the coal concerns of England, has issued its report for the year ended 30th June last. The profits from the various business operations of the company for the past year amount to £49,492 3s. 2d., which, added to the balance brought forward from the last financial statement, amounts to

£78,202 5s. 8d. An interim dividend was paid in February last amounting to £26,066 13s. 4d., and it is now proposed to pay a further dividend of £2 per share on the A and C shares and 6s. 8d. per share on the B and D shares, carrying forward to the next account the sum of £26,068 19s. The directors add that excessive competition has continued during the year in the coal and iron trades of this locality. The Staveley Company is making extensive additions to its coal and ironstone properties. It has arranged to lease for sixty-three years the coal in the Sutton and Duckmanton estates adjoining Staveley parish, the property of Mr. W. Arkwright, containing a surface of upwards of 5000 acres. The company is making a railway to the proposed pits, and pushing forward the necessary preparations for sinking a pair of shifts into the top hard coal. The company has also, in connection with the Bestwood Company, secured a lease of an ironstone field belonging to the Duke of Rutland in the parish of Eastwell, and is already using stone from these mines in the Staveley furnaces. The company has further arranged for leasing an ironstone of a different description in the parish of Waltham, also belonging to the Duke of Rutland. When the whole of the mines the company own and are interested in are developed, the company hopes to be able to obtain from these sources the whole of their supply of ironstone for smelting purposes.

Wakefield new waterworks are being pushed vigorously forward. On the 18th October last there was cut the first sod of a reservoir at Ringstone, near Rishworth Moor, where about 3200 acres of gathering ground are available, capable of yielding near 4,000,000 gallons of water per day to Wakefield in the driest years, in addition to nearly two millions of gallons per day to be given as compensation to mill owners. Ringstone will provide storage accommodation for 200,000,000 gallons, and is being constructed by Messrs. Metcalfe and Sons, of Bradford, at a cost of £31,710. On the 31st inst. the sod of another reservoir was cut at Audley, which will provide storage accommodation for 300,000,000 of gallons, and will cost about £40,000. The contract has been let to Mr. Donkin, of Cullerwater, Newcastle-on-Tyne. The water pipes for the new works are being supplied by Messrs. Cochrane, Groves and Co., of Middlesbrough, at a cost of about £47,000, and the laying of the pipes is being executed by Mr. S. Jowett, of Brighouse, at a cost of about £10,000. Messrs. Guest and Chrimes, of Rotherham, are supplying the fittings.

NOTES FROM SCOTLAND.

(*From our own Correspondent.*)

THE iron market has been comparatively steady during the greater portion of the past week, with only a moderate speculative business doing. This has been due chiefly to the uncertainty prevailing up till Wednesday afternoon with reference to the fate of the proposal for renewing the agreement to restrict production. There can be no doubt that some of our ironmasters have felt for a considerable time that it would be an advantage to them individually to be at liberty to use as many furnaces as they might think proper. At the same time they could hardly disregard the necessity which existed for a combination to prevent stocks accumulating with the rapidity that they did before, and for some time after the production was reduced. There are still about 630,000 tons of pig iron in Messrs. Connal and Co.'s Glasgow stores; and even with the present reduced number of furnaces in blast, and the excellent demand for consumption and shipment, the stocks are decreasing but slowly. The past week's business in pig iron for home use and shipment has been very good.

Business was done in the warrant market on Friday forenoon at from 50s. 0½d. to 50s. 1d. cash, and 50s. 3½d. to 50s. 6d. one month, the afternoon quotations being 50s. 3½d. to 50s. 2d., and 50s. 3d. cash, and 50s. 5d. to 50s. 6d. one month. On Monday business was done in the morning at 50s. 2½d. to 50s. 5½d. cash, and 50s. 6d. to 50s. 8½d. one month. In the afternoon the market was firm with transactions at 50s. 5½d. to 50s. 6½d. and 50s. 6d. cash. Tuesday's business was at 50s. 10d. to 50s. 7½d. one month, and 50s. 6½d. to 50s. 5d. cash. Yesterday the market varied, with business done from 49s. 10d. cash, to 50s. 10d. one month. To-day market firm from 49s. 6d. to 49s. 11d. cash, to 49s. 8d. to 50s. 1d. one month.

Owing to the steady demand for makers' iron, the quotations do not show much alteration. They are as follows:—Gartsherrie, f.o.b. at Glasgow, per ton, No. 1, 61s. 6d.; No. 3, 53s. 6d.; Coltness, 64s. and 54s. 6d.; Langloan, 63s. and 56s.; Summerlee, 62s. and 53s. 3d.; Calder, 61s. 6d. and 53s.; Carnbroe, 55s. and 51s. 6d.; Clyde, 54s. 6d. and 51s. 6d.; Monkland, Quarter, and Govan, each 51s. 6d. and 50s.; Shotts, at Leith, 63s. 6d. and 56s.; Carron, at Grangemouth, 51s. 6d.—specially selected, 56s.—and 50s. 6d.; Kinneil, at Bo'ness, 51s. and 50s.; Glengarnock, at Ardrossan, 55s. and 51s. 6d.; Eglinton, 52s. and 50s. 6d.; Dalmellington, 52s. and 50s. 6d.

The arrivals of Cleveland pig iron at Grangemouth are again small, being only 3760 tons for the week, as compared with 8107 in the corresponding week of last year. For the present year to date there is a total comparative decrease in these imports of no less than 39,390 tons.

There appears to be a further improved feeling in the malleable iron trade, chiefly resulting from the continued great activity in the shipbuilding yards of the Clyde. Prices of malleable iron are without quotable alteration. The machinery trade is active, the exports being large and valuable, and the consignments of general iron manufactures from Glasgow are upon a satisfactory scale.

The coal trade has been moderately active in the past week, at firmer prices for all sorts.

THE NORTH OF ENGLAND.

(*From our own Correspondent.*)

THE attendance at the Cleveland iron market, held in Middlesbrough on Tuesday last, was large, and the general tone was firm and animated. The quantity of pig iron thrown into stock by the cessation of work during Stockton races seems already to have been absorbed, and the heavy shipments which have since taken place have strengthened the position of sellers very materially. The continued adoption of a restrictive policy by the combined Cleveland and Scotch ironmasters has not yet been definitely decided on. Nevertheless, it is generally regarded as certain that it will be, in the course of a few days; and both buyers and sellers are making their arrangements accordingly. Towards the end of last week, and early this week, a brisk business was done in pig iron. The price at which it changed hands was generally 44s. 6d. per ton, f.o.b., for No. 3. g.m.b., and 43s. 6d. for forge iron. There were cases, however, where lots were sold for 3d., and even 6d. per ton less. Consumers are anxious to buy for deferred delivery; but makers will seldom sell far ahead, believing that still better prices are in store for them. Warrants are in rather better request than they were, and 44s. can now be obtained for Connal's No. 3, f.o.b. warrants. The stock of iron in the Middlesbrough public stores is at present 116,981 tons, being a diminution of 370 tons during the week. Shipments have been extraordinarily brisk, owing to the fine weather. On Monday they reached the total of 7941 tons of pig iron, and 1489 tons of manufactured iron, making a grand total of 9430 tons. This is probably more than they have ever reached before in a single day. Reviewing their course through the month, it will be found they are 18,000 tons better than during the corresponding portion of July. In all probability they will reach 93,000 to 94,000 by the 31st. It is understood that the excess is largely due to a demand from America having again set in. The pig iron exported thither has not, however, gone direct from Middlesbrough, but by the usual liners from other ports.

The manufactured iron trade continues steady, but scarcely shares the animation noticed in pig iron. Indeed the manufacturers seem somewhat oppressed at present. Their prices have not advanced lately, and they have even had some difficulty in maintaining them. On the other hand, they are paying the first 2½ per cent. advance accorded by the Pease award, and in two or three weeks they will have to pay another 2½ per cent. To add to their discomfiture, they see pig iron going away in increased quantities to be worked up by others instead of by them, and its price enhanced to them accordingly. It is stated that they intend to claim 12½ per cent. reduction of wages to come into operation at the end of the Pease award.

The price of plates for shipbuilding purposes is still £6 15s. free in trucks, Middlesbrough, for large and favourable specifications, and up to £7 for small or less favourable lots. Bars and angles are from £6 5s. to £6 7s. 6d. per ton, all less 2½ per cent. discount. Steel rails continue a drug, and not more than £5 to £5 5s. can be obtained for them.

With regard to the somewhat ambiguous resolution passed at the recent conference of ironworkers at Leeds respecting the Board of Arbitration, the meaning has now been explained. The leaders of the men's Union say that they will not continue to act as representatives in negotiations with employers, on behalf of the ironworkers, unless they have a sufficient guarantee that the latter will in future abide by the decisions constitutionally arrived at. The guarantee they demand is a vote to be passed by a large majority of the workmen at every works affected, agreeing to abide by awards and decisions. Failing this, all representatives will resign and leave the Board of Arbitration to its fate.

Indeed, there seems now to be a general consensus of opinion both among employers and the more intelligent of the workmen that the Board should be allowed to die a natural death at the end of the Pease award, and should be succeeded by a joint committee of the two unions, which committee should deal with all disputes and discuss all matters relating to the relations of employers and employed. The unions should each recognise the other as representing, and able to command obedience from their constituents, and no non-unionists on either side should be consulted or considered at all. The great difficulty of the Board of Arbitration, viz., inability to enforce its own decisions, will thus be overcome. Decisions by the joint committee, or by its mutually chosen referee, will have the full power of both unions to enforce them, and will be certain to be respected. Indeed, the great present hope of the manufactured iron trade, as regards the management of labour, now lies in the direction of perfecting and intelligent working of the new system here indicated.

WALES & ADJOINING COUNTIES.

(*From our own Correspondent.*)

SUBSTANTIAL work was carried out by Mr. H. O. Fisher on the Taff Vale line on Saturday last. For some time the Taff Vale Railway Company has been placing a third line of rails, and the problem has been to remove a massive stone bridge on the main line and substitute iron girders, and yet not interfere either with the passenger or coal traffic. This was well accomplished. Resource was had to the electric light, powerful cranes, dynamite, and a large body of men, and by Sunday night the problem was solved. The task was one of extreme difficulty and danger, as it was necessary to use dynamite continuously and with all possible speed. Mr. H. O. Fisher was aided by Mr. Walker, electrician, who supplied light equal to 16,000 candles—Maxim Weston Electric Company—by Mr. Cooper, Messrs. C. Jenkins and John James, inspectors, and Mr. Page, treasurer. As a feat of no ordinary kind, and redounding to Mr. Fisher's capacity and perseverance, it well deserves a record.

With the exception of one or two rather conspicuous names, an agreement has been entered into by the anthracite coal owners of Swansea and their men, regulating wages according to the 9th clause of the Sliding Scale Agreement of the South Wales and Monmouthshire Association. This provides "additions or reductions of 2½ per cent. every period of four months as standards of 7s. 8d. and 8s."

Swansea coal trade has been very active during the past week, the total clearances of steam having been 30,912 tons. Patent fuel is also in good demand, 4150 tons having been exported during the week. This flourishing condition of the coal trade applies more or less to the whole of the South Wales coalfields, and notwithstanding the inclement weather which has either prevented vessels from coming, or others from being despatched, a total of 201,000 tons left the Welsh ports during the past week. The market, too, is firm, and though there has been a slight amount of disquietude amongst the house coal men at Llanvabon, on the whole the attitude of the men has been very good. The working of the insurance fund has much conduced to this. The house coal men have a grievance, they say, in not having had the advance which was due to them on the basis of the amended sliding scale arrangement. There is evidently an error somewhere, for the Association would not deviate from the arrangement. Probably this may be cleared up at the next meeting of delegates.

A large number of agents and workmen assembled at Tredegar, early on Saturday, to witness the formal trial of a steel rail mill, and this was satisfactorily accomplished amidst great applause. The full start of all the new works is now only the question of a short time.

Ynyswen Colliery, the property of the late Mr. Kelly, who was fatally injured when inspecting it some time ago, is in the market.

Important additions in the form of railway extensions and new docks are forthcoming at Newport, Mon. The new water scheme is being carried out there successfully.

It seems tolerably certain that Cardiff will get its new water supply from the Taff Vale, six miles to the north of Merthyr, but I fail to see the wisdom of taking it *viâ* Lisvane. The route should certainly be *viâ* Pontypraid, and water might be supplied by Cardiff to the dense population around. Merthyr has lost one of the golden opportunities which come to so few. It has ownership, so to state, of the highest land in Glamorgan, with its great watershed, and there are no engineering difficulties in the way of supplying Cardiff, Newport, and Swansea with water, second only to that of Glasgow.

I am glad to report favourably of the iron and steel trade. Several cargoes left this week, and there are hopes that some of the large floating orders may alight in Wales.

THE PATENT JOURNAL.

Condensed from the Journal of the Commissioners of Patents.

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

Applications for Letters Patent.

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

22nd August, 1882.

4011. FURNACES, J. and T. Robinson, Widnes.
4012. CONSTRUCTING RAILWAY CARRIAGE DOORS, J. Wallis, London.
4013. FASTENING for BUTTONS of GLOVES, W. B. Espeut, London.
4014. HYDROCARBON FURNACES, J. Mundell and W. J. Gordon, Philadelphia, U.S.
4015. APPLIANCES, &c., for RAILWAYS, C. Lea, Stafford.
4016. PISTON LUBRICATORS, H. J. Haddan.—(*J. Fleischer, Cologne, Germany.*)
4017. MANUFACTURE of HYDRATE of GLUCOSE, H. J. Haddan.—(*L. Verneisel, Germany.*)
4018. CLEANING, &c., TIN-PLATE, B. Williams, Cardiff.
4019. FIRE-ARMS, &c., F. Roberts & B. Moore, London.
4020. ROLLER-MILLS for GRINDING FLOUR, T. A. Adamson, Belfast.
4021. EXHAUSTING AIR from HAY STACKS, W. Haigh, Skipton-in-Craven.
4022. ROWLOCKS for BOATS, S. S. Hazeland, Cornwall.
4023. PREPARING BOOK COVERS, &c., R. Birdsall, Northampton.
4024. BOTTLE STOPPERS, I. Lippmann, Berlin.
4025. WORKING GEAR used in ELECTRIC LIGHTING, K. W. Hedges, London.
4026. SKATES, C. G. Beddoe, London.
4027. DREDGING, &c., E. P. Alexander.—(*M. Neuhaus, Berlin.*)
4028. FILTERS, &c., E. Perrett, London.
4029. WOOD MORTISING MACHINE, J. H. Johnson.—(*J. B. Alexandre, Paris.*)
4030. MAKING MATS, &c., J. Maddin, London.
4031. HEATING RAILWAY CARRIAGES, W. R. Lake.—(*M. J. Walsh, New York, U.S.*)
4032. MANUFACTURE of GLASS BOTTLES, &c., T. Pyke, South Shields.
4033. CARBURETTING ILLUMINATING GAS, C. Crozat, Eastcheap.
4034. GENERATION, &c., of ELECTRICITY, J. Williams, Riverton, U.S.

23rd August, 1882.

4035. METAL CANS, J. A. Lloyd, London.
4036. WINDING WIRE upon ARMATURES of DYNAMO-ELECTRICAL MACHINES, W. B. Espeut, London.
4037. STOPPERS for BOTTLES, &c., H. J. Haddan.—(*G. Hardt, Cologne, Germany.*)
4038. COMBINATION ARMS, R. Howard, Southampton.
4039. IMPREGNATING MINERAL SUBSTANCES, W. R. Lake.—(*R. Michelet and L. Tescher, Berlin.*)
4040. MECHANICAL STOKERS, J. Proctor, Burnley.
4041. MACHINES for PREPARING COTTON, &c., W. Lord, Todmorden.
4042. MAKING STEEL for CORSETS, &c., J. S. W. Whitehead, Halifax.
4043. MACHINES used in MAKING MOULDS for NAILS, S. Williams, Aston, near Birmingham.
4044. TELEPHONE RECEIVING APPARATUS, R. and M. Theiler, London.
4045. WARNING APPARATUS, &c., H. Diggins and A. Glück, London.
4046. ELECTRIC ARC LAMPS, &c., J. Mackenzie, Halifax.
4047. LAMP and OIL FEEDER, W. Gillmore, Deptford.
4048. MAKING BLUE COLOURING MATTER, F. Wirth.—(*E. Oehler, Germany.*)
4049. COMMUTATORS for DYNAMO-ELECTRIC MACHINES, H. R. Lewis and W. C. Smythe, London.

24th August, 1882.

4050. STEEL WIRE used in PIANOFORTES, J. R. Gibson, J. S. Baptie, and A. Squire, London.
4051. APPARATUS, &c., for PRESERVING MEAT, &c., W. H. Northcott, London.
4052. PHÆTON GIG, H. Lloyd, Liverpool.
4053. SLEEPER CHAIRS for RAILWAYS, J. Blair, Glasgow.
4054. GAS FURNACES, C. D. Abel.—(*Stettiner Chamotte-Fabrik Actien-Gesellschaft vormals Didier, Germany.*)
4055. ENGINES, &c., T. Charlton & J. Wright, London.
4056. SPINNING, &c., WORSTED, &c., H. Illingworth, Bradford.
4057. MAKING AMMONIA, &c., E. P. Alexander.—(*H. Y. and E. B. Castner, New York, U.S.*)
4058. LACE BOOTS, &c., A. C. Andrews, Birmingham.
4059. GAS FIRES or STOVES, A. J. Boult.—(*P. Geofroy-Lomez, Tolouse, France.*)
4060. MACHINE for PAINTING, &c., W. H. R. Toye, U.S.
4061. LIDS for PROVISION CANS, &c., H. J. Haddan.—(*Schneider and Lemp, Leipzig, Saxony.*)
4062. SEWING MACHINES, H. J. Haddan.—(*J. A. Doering, Leipzic, Germany.*)
4063. RETAINING HEAT, &c., J. Cavargna, Manchester.
4064. REGENERATING FURNACES, C. Schön, Hamburg.
4065. ELECTRIC LAMPS, C. S. Snell, London.

25th August, 1882.

4066. FACILITATING STARTING of HORSE TRAMCARS, J. L. Walsh.—(*E. Gerig, Berlin.*)
4067. REVOLVING PAPER-CUTTING MACHINES, P. Jensen.—(*E. Dietz, Berlin.*)
4068. MOULDING TOBACCO, &c., into PACKETS, H. Clarke, London.
4069. APPARATUS for GETTING COAL, C. G. Robinson, Barnsley.
4070. LOOMS for WEAVING, J. Williams and H. Barnes, Burnley.
4071. APPARATUS for PRINTING, W. Haigh, Manchester.
4072. FILTERING APPARATUS, J. F. C. Farquhar and W. Oldham, London.
4073. ELECTRIC BELL, &c., P. M. Justice.—(*V. Vankerbergen, Brussels.*)
4074. HEATING BATHS, &c., D. Jones, Walton.
4075. MAKING CLOGS, G. Glover, Liverpool.
4076. ROTARY ENGINES, W. B. Espeut, London.
4077. GAS STOVES, J. F. & G. E. Wright, Birmingham.
4078. SPRING HINGES for SWING DOORS, E. Barnes, London.
4079. SECONDARY BATTERIES, L. H. Somzée, Brussels.
4080. ELECTRIC MEASURING, &c., APPARATUS, S. H. Emmens, London.

26th August, 1882.

4081. FRICTION COUPLINGS, &c., F. C. Glaser.—(*F. Braun and A. Stackfleth, Berlin.*)
4082. CANS for HOLDING OIL, &c., T. Marriage, Reigate.
4083. OPENING BOTTLES, D. Cole, Swindon.
4084. ARC ELECTRIC LAMPS, P. R. Allen, London.
4085. GUIDING, &c., FISHING NETS, &c., H. Davies, Aberdeen.
4086. RAILWAY CARRIAGES, &c., W. J. Bennett and C. H. Rosher, London.
4087. LIGHTING RAILWAY CARRIAGES by ELECTRICITY, H. E. Newton.—(*Société Universelle d'Electricité Tommassi, Paris.*)
4088. REGULATING, &c., FLOW of FLUIDS, J. C. Stevenson, Liverpool.
4089. HAMMERLESS GUNS, &c., W. Anson, Aston.
4090. APPLIANCES for HEATING, &c., W. Thornburn Boroughbridge.
4091. WIND MOTORS, H. Lübben, Hanover, Prussia.
4092. DRILLING BRACES, &c., J. Rettie, London.
4093. HARVESTING MACHINES, J. Howard and E. T. Bousfield, Bedford.
4094. STARCH, &c., W. Lake.—(*W. Jebb, Buffalo, U.S.*)
4095. UMBRELLA MOUNTINGS, A. C. Henderson.—(*C. Grataloup and J. B. Leymarie, Paris.*)
4096. GAS BURNERS, W. R. Lake.—(*E. Téterger, Paris.*)
4097. WHEELS, J. Fry, London.

28th August, 1882.

4098. BALLOONS, J. A. Fisher and C. Spencer, London.
4099. SAFETY-GUARD for CHAFF-CUTTING MACHINES, E. Rigby, Liverpool.
4100. HORSESHOE NAILS, W. J. Bingham, Sheffield.
4101. PLOUGHS, W. Swootman, Diss.
4102. CRANES, A. Grafton, London.
4103. KNITTING MACHINES, P. Bevernage-Standring, Gand, Belgium.
4104. PORTABLE FOLDING, &c., BOATS, L. Jelf, London.
4105. LOOMS for WEAVING, J. Dawson, Lawiston, U.S.
4106. PRINTING INK, C. F. Claus, London.
4107. WHITE PIGMENTS, C. F. Claus, London.
4108. PREPARING POROUS SILICEOUS MATERIALS, C. F. Claus, London.
4109. GAS LAMPS, F. H. Wenham, London.
4110. TELEPHONIC APPARATUS, G. L. Anders, London.
4111. DYNAMO-ELECTRIC MACHINES, H. H. Lake.—(*S. F. V. Choate, New York, U.S.*)

Inventions Protected for Six Months on Deposit of Complete Specifications.

3978. FURNACES for REDUCING, &c., ORES, J. Imray, Chancery-lane, London.—A communication from J. C. Newbury, J. L. Morley, and B. Cleveland, Melbourne, Victoria.—*19th August*, 1882.
3982. ELECTRIC SIGNALLING APPARATUS, R. H. Brandon, Paris, France.—A communication from H. W. Southworth, Springfield, Massachusetts, U.S.—*19th August*, 1882.
4010. CONSTRUCTION of CANNON, R. H. Brandon, Paris, France.—A communication from W. E. Woodridge, Washington, Columbia, U.S.—*21st August*, 1882.
4014. HYDROCARBON FURNACES, J. Mundell and W. J. Gordon, Philadelphia, U.S.—*22nd August*, 1882.
4039. IMPREGNATING MINERAL SUBSTANCES, &c., W. R. Lake, Southampton-buildings, Chancery-lane, London.—A communication from R. Michelet and L. Tescher, Berlin, Prussia.—*23rd August*, 1882.
4054. GAS FURNACES, C. D. Abel, Southampton-buildings, Chancery-lane, London.—A communication from the Stettiner Chamotte-Fabrik Actien-Gesellschaft vormals Didier, Stettin, Germany.—*24th August*, 1882..

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

3411. KNITTING MACHINES, W. Morgan-Brown, London.—*25th August*, 1879.
3425. LIGHTS for SIGNALLING, G. Pitt, Sutton.—*25th August*, 1879.
3478. PUDDLING FURNACES, C. A. Day, London.—*29th August*, 1879.
3521. GOVERNORS for PRIME MOVERS, A. Rigg, London.—*3rd September*, 1879.
3696. BOXES for TOBACCO, &c., C. Cheswright, London.—*15th September*, 1879.
3826. COUPLING for GAS, &c., PIPES, W. T. Sugg, London.—*23rd September*, 1879.
3599. FIRE WARNING APPARATUS, J. G. Tongue, London.—*6th September*, 1879.
3788. BRAKES, &c., J. A. F. Aspinall, Dublin.—*20th September*, 1879.
3408. LOCK-STITCH SEWING MACHINE, C. Pieper, Berlin.—*25th August*, 1879.
3440. WASHING WOVEN FABRICS, J. Smith, Thornliebank, N.B.—*26th August*, 1879.
3443. FURNACES for STEAM BOILERS, E. Bennis, Bolton.—*27th August*, 1879.
3488. LIQUORING LUMP SUGAR, C. D. Abel, London.—*30th August*, 1879
3490. PROTECTION of HARBOURS, J. Shields, Perth.—*30th August*, 1879.
3533. WIRE SEWING MACHINES, &c., T. White, Leeds.—*3rd September*, 1879.
3774. BURNING of SULPHUR, H. Glover, Silvertown.—*19th September*, 1879.
3785. WINDOW FRAMES, W. P. Thompson, London.—*20th September*, 1879.
3472. COMPOUNDS for INSULATING TELEGRAPH WIRES, A. Wilkinson, London.—*28th August*, 1879.

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

2981. FABRICS PRODUCED by LACE MACHINERY, J. Whiteley, Nottingham.—*25th August*, 1879.

Notices of Intention to Proceed with Applications.

Last day for filing opposition 15th September, 1882.

1872. Construction of Slide Valves, &c., E. Edwards, London.—Com. from E. Sonntag.—*19th April*, 1882.
1892. Steam-traps, J. Shaw, Huddersfield.—*20th April*, 1882.
1900. Hoops for Barrels, &c., T. Nash and G. H. Hunt, Sheffield.—*21st April*, 1882.
1916. Manufacturing Bricks, &c., T. A. Riggs, Aldeburgh.—*22nd April*, 1882.
1917. Tires for Rolling Stock, G. W. Knox, Sheffield. —*22nd April*, 1882.
1918. Manufacturing Water-gas, J. C. Mewburn, London.—Com. from G. S. Dwight.—*22nd April*, 1882.
1921. "Mordant" for Dyeing Blues, S. Musgrave, Leeds.—*22nd April*, 1882.
1924. Rope-traction Rail or Tram Roads, &c., W. P. Thompson, London.—A communication from W. Haddock and J. Frank.—*22nd April*, 1882.
1930. Exhibiting Placards on Tram-cars, &c., F. H. F. Engel, Hamburg.—A communication from G. Richter.—*22nd April*, 1882.
1935. Plumbers' Furnaces, W. S. Cooper, Liverpool. —*24th April*, 1882.
1940. Electric Batteries, W. R. Lake, London.—A communication from L. Maiche.—*24th April*, 1882.
1948. Converting Liquid into Spray, L. H. Armour, Gateshead.—*25th April*, 1882.
1959. Manufacturing Ornamental Surfaces for Building, &c., Purposes, J. Noad, East Ham, and H. Salomon, London.—*25th April*, 1882.
1967. Maximum, &c., Thermometer, H. Haddan, London.—Com. from H. Kappeller, jun.—*26th April*, 1882.
1969. Explosive Compound, C. W. Siemens, London. —A com. from C. Himly.—*26th April*, 1882.
1974. Barns, &c., with Raising and Falling Roofs, I. Henson Derby.—*26th April*, 1882.
1977. Valves, J. Baldwin, Keighley.—*26th April*, 1882.
1979. Urinals, J. Beresford, Birmingham.—*26th April*, 1882.
1981. Charging Hand printing Blocks with Colour, A. M. Clark, London.—A communication from J. Hutchison.—*26th April*, 1882.
1989. Making Barrels, H. J. Haddan, London.—A communication from W. Stewart.—*27th April*, 1882.
1993. Umbrellas, &c., J. T. and F. S. Liley, London. —*27th April*, 1882.
2011. Diminishing Liability to Corrosion of Screw-propeller Blades, D. Johnston, Govan.—*28th April*, 1882.
2030. Electrical Switches, &c., R. Brougham, London.—*28th April*, 1882.
2085. Screw-propellers, &c., A. J. Davison, Sunderland.—*3rd May*, 1882.
2122. Manufacture and Treatment of Textile Materials, G. Jaeger, Stuttgart.—*5th May*, 1882.
2123. Collapsible Boxes, H. J. Haddan, London.—A communication from B. Rückert.—*5th May*, 1882.
2175. Horseshoes, A. Vanderkerken and J. Mans, Brussels.—*9th May*, 1882.
2183. Machines for Dressing Silk, &c., A. M. Clark, London.—A communication from La Compagnie Générale de teinturerie et Apprêts "Système André Lyon."—*9th May*, 1882.
2960. Apparatus for Making Nails, J. W. Summers, Stalybridge.—*22nd June*, 1882.
3468. Fasteners for Boots, J. N. Aronson.—*21st July*, 1882.
3492. Signalising, H. J. Haddan, London.—A communication from A. & E. F. Webster.—*22nd July*, 1882.
3572. Clocks, W. R. Lake, London.—A communication from R. W. Willson.—*27th July*, 1882.
3635. Making Flour, &c., H. H. Lake, London.—A com. from R. R. Schmidt.—*31st July*, 1882.
3685. Dynamo-electric Machines, W. Lake, London. —Com. from H. Sample & F. Rabl.—*2nd August*, 1882.
3717. Axles for Rolling Stock, W. R. Lake, London. —A com. from D. Anderson.—*4th August*, 1882.
3795. Electric Lamps, &c., W. R. Lake, London.—A communication from J. Wallace.—*9th August*, 1882.
3872. Folding Chairs, W. R. Lake, London.—Com. from F. Johnson & J. Hayward.—*14th August*, 1882.
3904. Bleaching, C. Toppan, Salem, U.S.—*15th August*, 1882.
3905. Intensifying Colours of Fabrics, C. Toppan, Salem, U.S.—*15th August*, 1882.
3967. Watch-chains, A. M. Clark, London.—A communication from W. C. Edge.—*18th August*, 1882.
3982. Electric Signalling Apparatus, R. H. Brandon, Paris.—A communication from H. W. Southworth.—*19th August*, 1882.
4010. Constructing Cannon, R. H. Brandon, Paris.— A com. from W. E. Woodbridge.—*21st August*, 1882.

Last day for filing opposition, 19th September, 1882.

1458. Rendering Tissues, &c., Uninflammable, L. A. Groth, London.—A communication from H. R. P. Hosemann.—*27th March*, 1882.
1936. Constructing Wagons, J. McCulloch and W. Cook, Glasgow.—*24th April*, 1882.
1951. Machinery for Hooping Casks, A. J. Boult, London.—Com. from M. Beasley.—*25th April*, 1882.
1954. Machinery for Heating, &c., Metal Goods, H. F. Taylor, Neath.—*25th April*, 1882.
1962. Preventing Running Away of Horses, H. Lake, London.—Com. from R. La Grange.—*25th April*, 1882.
1962. Copying Presses, E. Behrens, East Greenwich. —*25th April*, 1882.
1972. Railway Carriage Roof Lamps, H. Defries, London.—*26th April*, 1882.
1973. Moulding Seggars, W. E. Gedge, London.—A communication from A. Pothier.—*26th April*, 1882.
1975. Ventilators, &c., T. E. Bladon, Birmingham.— *26th April*, 1882.
1991. Cutting Pipes, &c., C. D. Abel, London.—A communication from Th. J. Geerkens.—*27th April*, 1882.
1992. Internal Stoppers for Bottles, I. Burdin, Knottingley.—*27th April*, 1882.
1995. Heating, &c., Metals, H. H. Andrew, Sheffield. —*27th April*, 1882.
1998. Constructing Vessels for Liquids, J. Robinson, Bradford.—*27th April*, 1882.
2007. Machinery for Sorting Potatoes, C. D. Abel, London.—A com. from C. Gramke.—*28th April*, 1882.
2014. Treating Rice, &c., J. T. Armstrong, Newcastle-under-Lyme.—*28th April*, 1882.
2015. Opening, &c., Window-sashes, G. Hurdle and W. Davie, Southampton.—*28th April*, 1882.
2034. Apparatus for Raising Beer, &c., J. J. Harrop, Manchester.—*29th April*, 1882.
2044. Dynamo-electrical Machines, R. Brougham, London.—*29th April*, 1882.
2048. Vaginal Syringes, E. de Pass, London.—A communication from P. Lawrence.—*1st May*, 1882.
2055. Making Certain Parts of Boots, J. Keats, Bagnal.—*1st May*, 1882.
2073. Catheters, T. and W. J. Nicholls, London.—*2nd May*, 1882.
2080. Testing Strength of Materials, W. Porter, Lee.—*2nd May*, 1882.
2086. Manufacture Applicable as a Deodoriser, &c., O. Bowen and A. Miller, London.—*3rd May*, 1882.
2098. Making Paper Bags, H. J. H. Haddan, London. —A com. from M. N. Stanley.—*4th May*, 1882.
2106. Machinery for Coating Metal Plates with Tin, &c., H. F. Taylor, Neath, and G. Leyshon, Tividale. —*4th May*, 1882.
2111. Tubular Steam Boilers, A. F. Yarrow, Poplar. —*4th May*, 1882.
2295. Compensating Dynamo-electric Machines, B. H. Chameroy, Maisons-Lafitte (Seine et Oise), France.—*16th May*, 1882.
2536. Securing "Scales" to Tangs of Cutlery, H. H. and G. H. Taylor, Sheffield.—*27th May*, 1882.
2543. Drying Grain, &c., H. Scholfield, Nottingham. —*30th May*, 1882.
2829. Water Supply, &c., R. R. McKee, Kirkcaldy.— *15th June*, 1882.
3046. Extracting Gold and Silver from their Ores, R. Barker, Seacombe.—*28th June*, 1882.
3186. Recovery of Sulphur from Alkali Waste, W. Weldon, Burstow.—A communication from M. Schaffner and W. Helbig.—*6th July*, 1882.
3220. Metallic Wool, R. H. Woodley, Limehouse.— *7th July*, 1882.
3221. Secondary Batteries, R. H. Woodley, Limehouse, and H. F. Joel, Dalston.—*7th July*, 1882.
3244. Incandescent Electric Lamps, T. J. Handford, London.—Com. from C. Van Cleve.—*8th July*, 1882.
3271. Electrical Meters, T. J. Handford, London.— A communication from T. Edison.—*10th July*, 1882.
3282. Fastening for Lids, &c., J. Ingleby, Manchester. —A communication from the Berlin-Anhaltische Maschinenbau-Actien-Gesellschaft.—*11th July*, 1882.
3303. Secondary Voltaic Batteries, F. W. Durham, New Barnet, & P. Ward, Fulham.—*12th July*, 1882.
3318. Apparatus for Producing, &c., Electric Energy, I. L. Pulvermacher, London.—*12th July*, 1882.
3328. Lamps, C. W. Siemens, London.—*13th July*, 1882.
3344. Self-acting Window-blind Apparatus, W. S. Laycock, Sheffield.—*14th July*, 1882.
3355. Apparatus for Supplying Electricity, T. J. Handford, London.—A communication from T. A. Edison.—*14th July*, 1882.
3367. Machines for Printing Several Colours at the Same Time, E. de Pass, London.—A communication from J. Krayer.—*15th July*, 1882.
3416. Chimney-tops, T. J. Baker, Newark.—*18th July*, 1882.
3486. Ventilating Appliances, J. Leather, Liverpool. —*22nd July*, 1882.
3502. Fuel Economisers, J. G. Perkin and J. Scott, Wakefield.—*22nd July*, 1882.
3506. Carrying Coal, &c., E. O. Greening and H. J. Collins, London.—*24th July*, 1882.
3542. Machines for Washing Fabrics, B. Davies, Adlington, & J. Eckersley, Blackrod.—*26th July*, 1882.
3586. Toy Savings Banks, W. R. Lake, London.—A communication from J. H. Bowen.—*28th July*, 1882.
3587. Head Coverings, J. F. Watson, Anerley.—*28th July*, 1882.
3605. Driving Chains, W. Hartcliffe, Salford.—*29th July*, 1882.
3628. Looms, H. J. Haddan, London.—A communication from L. J. Knowles.—*31st July*, 1882.
3630. Motor, H. J. Haddan, London.—A communication from G. Rupalley.—*31st July*, 1882.
3634. Bobbin Frames, H. H. Lake, London.—A communication from R. S. Cookson.—*31st July*, 1882.
3639. Purifying Coal Gas, J. Walker, Leeds.—*1st August*, 1882.
3683. Locking Mechanism for Safes, &c., W. R. Lake, London.—Com. from F. Newbury.—*2nd August*, 1882.
3693. Evaporating, &c., Liquids, H. Gardner, London. —A communication from F. B. Nichols and C. Thompson.—*3rd August*, 1882.
3707. Compound Steam Engines, C. J. Galloway and J. H. Beckwith, Manchester.—*4th August*, 1882.
3962. Under-coverings of Rollers of Spinning Machinery, B. J. B. Mills, London.—A communication from L. Cunit and J. Culty.—*18th August*, 1882.
4039. Impregnating Mineral Substances with Bituminous Products, W. R. Lake, London.—A communication from R. Michelet and L. Tescher.— *23rd August*, 1882.

Patents Sealed.

(*List of Letters Patent which passed the Great Seal on the 25th August, 1882.*)

726. Blocking Fronts of Boots, S. Hudson, Belgrave.—*15th February*, 1882.
797. Distributing Artificial Manures, &c., F. Robinson, Bradley.—*18th February*, 1882.
942. Hair Clasps, F. L. R. Kopp, Hamburg.—*27th February*, 1882.
949. Folding, &c., Sheets of Paper, F. Wolff, Copenhagen.—*27th February*, 1882.
961. Machinery for Capsuling Bottles, F. W. Boldt and P. C. Vogel, Hamburg.—*28th February*, 1882.
966. Spring Hinges, &c., J. T. B. Bennett, Aston-juxta-Birmingham.—*28th February*, 1882.
1076. Smiths' Hearths, P. Everitt, London.—*6th March*, 1882.
1077. Fire-blowers, J. J. Lish, London.—*6th March*, 1882.
1166. Producing Surfaces for Printing, &c., J. J. Sachs, Sunbury.—*10th March*, 1882.
1170. Floating Anchors, W. M. Bullivant, London.— *10th March*, 1882.
1177. Telephones, J. D. Husbands, London.—*10th March*, 1882.
1237. Producing Light, &c., A. Reckenzaun, Leytonstone, and J. Redfield, London.—*14th March*, 1882.
1320. Breech-loading Small-arms, W. M. Scott, Birmingham.—*18th March*, 1882.
1350. Looms, A. Priestman and J. Ackroyd, Bradford. —*20th March*, 1882.
1388. Chimney-tops or Ventilators, G. Kent, Portsea. —*22nd March*, 1882.
1570. Electric Arc Lamps, W. Jeffery, North Woolwich.—*31st March*, 1882.
1745. Steam Boilers, R. H. Brandon, Paris.—*12th April*, 1882.
1878. Dynamo-electric Machines, J. H. Johnson, London.—*19th April*, 1882.
1946. Secondary Batteries, C. V. Boys, Oakham.— *25th April*, 1882.
2074. Transmitting Heat to Liquid, W. and J. Beesley, Barrow-in-Furness.—*2nd May*, 1882.
2290. Machinery for Winding Yarn, &c., B. M. Knox, Kilbirnie.—*16th May*, 1882.
2435. Sighting Ordnance, J. H. Johnson, London.— *23rd May*, 1882.
2511. Carriages, &c., S. Andrews, Cardiff.—*26th May*, 1882.
2783. Machinery for Cutting and Dressing Stone, H. J. Haddan, London.—*13th June*, 1882.
2818. Secondary, Batteries, J. S. Sellon, London.— *15th June*, 1882.
2848. Steam Pumping Engines, &c., T. H. Ward, Tipton.—*16th June*, 1882.
2898. Constructing Incandescent Electric Lamps, A. Swan, Gateshead.—*19th June*, 1882.
2907. Electric Telephony, J. G. Lorrain, London.— *20th June*, 1882.
2988. Harness, W. Powell, Merthyr Tydvil.—*23rd June*, 1882.
2990. Machinery for Generating, &c., Electricity, J. H. Johnson, London.—*23rd June*, 1882.
3002 Dynamo-electric Machines, P. Jensen, London. —*24th June*, 1882.

(*List of Letters Patent which passed the Great Seal on the 22nd August, 1882.*)

729. Folding Packing Cases, E. I. Billing, Cheltenham.—*15th February*, 1882.
906. Motor Apparatus, W. R. Lake, London.—*24th February*, 1882.
1004. Ships' Logs, F. Webster, London.—*2nd March*, 1882.
1005. Boiler Tubes, &c., W. H. Wood. Cookley.—*2nd March*, 1882.
1007. Damper-regulator, S. P. Wilding, London.— *2nd March*, 1882.
1014. Producing Caustic Barium, &c., from Sulphates, J. G. Tongue, London.—*2nd March*, 1882.
1022. Elevating Apparatus, W. Blythe, London.—*3rd March*, 1882.
1065. Blinds for Windows, J. Wetherilt, London.— *6th March*, 1882.
1078. Steam Generators, C. Kingsford, Upper Clapton.—*6th March*, 1882.
1087. Machines for Felting, &c., Hats, R. Wallwork, Manchsster.—*7th March*, 1882.
1090. Apparatus for Weaving, E. O. Taylor and T. Brierley, Marsden.—*7th March*, 1882.
1091. Looms for Weaving, D. Bailey, Lockwood.—*7th March*, 1882.
1117. Napped Hats, G. Atherton, Stockport.—*8th March*, 1882.
1152. Reaping, &c., Machines, J. S. Macgregor, Edinburgh, and G. Redfearn, Berwick-on-Tweed.—*9th March*, 1882.
1186. Making Heels of Boots and Shoes, W. E. Gedge, London.—*11th March*, 1882.
1206. Strainers for Paper Pulp, R. Laurie, Derby.— *13th March*, 1882.
1235. Rousing Beer, H. Long, Bristol, and H. Aplin, Redfield.—*14th March*, 1882.
1248. Rotating Drum for Tobacco-cutting Machines, T. Cope & W. Brewer, Liverpool.—*15th March*, 1882.
1289. Perambulators, W. H. S. Aubin, Bloxwich.— *17th March*, 1882.
1297. Manufacture of Printed Fabrics, J. Imray, London.—*17th March*, 1882.
1327. Transmitting Electric Currents of High Tension, L. J. Crossley, Halifax, J. F. Harrison, Bradford, & W. Emmott, Halifax.—*18th March*, 1882.
1331. Removable Tires, J. Haynes, Barnsley.—*18th March*, 1882.
1607. Door Locks, J. Mathisen, Christiania.—*3rd April*, 1882.
1970. Nut Locks, J. T. King, Liverpool.—*26th April*, 1882.
2116. Ventilators, A. W. Kershaw, Lancaster.—*5th May*, 1882.
2251. Rock-boring Machines, J. Urwin, Scotswood-on-Tyne.—*12th May*, 1882.
2363. Tobacco-pipes, J. Stanley, Manchester.—*19th May*, 1882.
2769. Dynamo-electric, &c., Machines, J. Imray, London.—*13th June*, 1882.
2838. Ring-spinning Machinery, G. Perkins, G. Wimpenny, & J. H. Evans, Manchester.—*16th June*, 1882.
2851. Furnaces for Burning Pyrites, J. Mason, Witney.—*16th June*, 1882.

List of Specifications published during the week ending August 26th, 1882.

5647, 8d.; 5688, 10d.; 16, 6d.; 50, 6d.; 73, 8d.; 212, 6d.; 227, 6d.; 239, 2d.; 240, 6d.; 250, 6d.; 284, 4d.; 287, 8d.; 297, 6d.; 303, 2d.; 305, 6d.; 308, 6d.; 313, 2d.; 320, 6d.; 324, 6d.; 327, 4d.; 328, 2d.; 330, 2d.; 331, 2d.; 334, 4d.; 336, 2d.; 337, 2d.; 338, 6d.; 340, 2d.; 341, 6d.; 342, 4d.; 343, 2d.; 344, 2d.; 346, 8d.; 347, 2d.; 348, 2d.; 350, 2d.; 353, 2d.; 354, 2d.; 355, 2d.; 356, 6d.; 358, 2d.; 359, 8d.; 360, 6d.; 362, 6d.; 364, 6d.; 365, 2d.; 366, 6d.; 367, 2d.; 368, 2d.; 369, 2d.; 371, 6d.; 372, 2d.; 373, 6d.; 374, 2d.; 375, 6d.; 376, 6d.; 378, 4d.; 379, 6d.; 381, 2d.; 383, 2d.; 385, 2d.; 386, 6d.; 387, 4d.; 388, 4d.; 389, 6d.; 390, 6d.; 391, 8d.; 395, 2d.; 396, 2d.; 398, 4d.; 399, 4d.; 400, 6d.; 401, 2d.; 402, 2d.; 403, 2d.; 404, 6d.; 405, 8d.; 407, 4d.; 409, 2d.; 410, 2d.; 413, 4d.; 416, 6d.; 417, 6d.; 419, 2d.; 420, 2d.; 421, 6d.; 422, 2d.; 423, 6d.; 426, 2d.; 427, 6d.; 430, 6d.; 434, 2d.; 435, 4d.; 438, 4d.; 439, 6d.; 441, 4d.; 444, 6d.; 447, 2d.; 449, 2d.; 450, 6d.; 452, 2d.; 453, 2d.; 455, 2d.; 466, 6d.; 470, 4d.; 473, 2d.; 485, 8d.; 543, 4d.; 553, 6d.; 617, 6d.; 665, 6d.; 909, 6d.; 975, 4d.; 1891, 6d.; 2168, 6d.; 2531, 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.*

5477. Improvements in Electric Lamps or Lighting Apparatus, *W. R. Lake, London.—14th December*, 1881.—(*A communication from C. F. de la Roche, Paris.*) 6d.

The inventor encloses his carbons in a chamber formed within a block of refractory material, preferably calcined magnesia chemically pure and compressed in moulds. The walls of the chamber are also provided with plates of mica to protect the arc from the external air, and to raise the temperature of the air about the arc.

5647. Steamships, &c., *W. P. Thompson, Liverpool. —24th December*, 1881.—(*A communication from G. A. Cochrane, Montreal.*) 8d.

This consists, First, in perforating all the decks below the main deck, and arranging the freight so as to allow air to circulate freely in a vertical direction from the ventilators on the ship deck to the bottom of the hold; Secondly, in forming a space at the very bottom a foot or two in depth, partially vacant and partially filled with any absorbent of gases of decomposition, such as charcoal, lime, or even soil; Thirdly, in forming the sides of the vessel and the bulkheads with one or more ventilated air jackets, with an inlet and exit ventilator for each; Fourthly, in causing cold dry air to circulate through the cargo to the bottom of hold and out through the exit ventilator; Fifthly, in applying the system to store-rooms and wagons for storing perishable organic matter.

5672. Ships Compasses, &c., *R. Evans, Newcastle-on-Tyne.—27th December*, 1881.—(*Not proceeded with.*) 4d.

This relates to means of ascertaining and correcting the local attraction in iron, steel, and other ships; and consists in a steering compass having, in addition to the usual lover's line, a movable lover's line, and a compass reflected, elevated, and projected from the port, starboard, or both together, and the stern or any other part of the ship, but so that the reflected, elevated, and projected compass is outside the influence of local attraction, and the difference—shown by the respective cards—between the reflected, elevated, and projected compass, free of local attraction and the steering compass under the influence of local attraction is plainly visible.

16. Shoes for Horses, Asses, &c., *J. Buckham and G. Jackson, Lanchester, Durham.—2nd January*, 1882. 6d.

This consists in forming projections at the toe and heels of horseshoes to receive roughing studs between them.

50. Locomotive Engines for Tramways and Railways, *T. Morgan, Westminster.—4th January*, 1882. —(*A communication from D. Mc I. Reid, India.*) 6d.

The engine is distinguished by the following features:—First, the fire-door and chimney flue are formed through the roof; Secondly, the application of direct heating surface vertical tubes admitting of indirect heating surface tubes being dispensed with; Thirdly, the engines being connected with one wheel only; Fourthly, the driving wheel having a tire sufficiently broad to take in the entire breadth of the rail on both sides of the flange.

73. Horseshoes, &c., *J. Vernon Newton Stewart, Scotland.—6th January*, 1882. 8d.

This consists, First, in forming the shoes with sockets to receive removable plates or gripping surfaces secured by bolts or pins, their wearing surfaces being flat if for use on ploughed fields, and ridge-like or knife-edged for use on frozen or slippery ground. To prevent the concussion of the hoof on hard roads injuriously affecting the hoof, an outer plate is secured to the shoe, an elastic substance being interposed between them. A Third improvement relates to securing shoes to horses' hoofs by steel straps or bands.

157. Improvements in Apparatus for Electric Lighting, *G. Hawkes, Westminster.—11th January*, 1882. 8d.

This invention refers to an arc lamp. The upper carbon holder is attached to the armature of an electro-magnet in the main circuit, which serves to establish the arc. The lower carbon is fed upwards by means of weights. To prevent its too rapid rise a gripping piece is provided attached to the armature of an electro-magnet in a shunt circuit. The tubular holder of the lower carbon is provided with a liquid, such as oil, to regulate the upward motion of the carbon. The inventor also provides the upper carbon with a coiled spring, which surrounds it. This presses on the armature of the electro-magnet, which strikes the arc, and thus counteracts the effect of the magnet to a certain extent, and allows the position of the carbon to be fixed, and also to be maintained. A contrivance for short-circuiting the lamps in case of accident, &c., is also described.

169. Improvements in Electro-motors and Dynamo-electric Machines, &c., *H. S. Raison, Bayswater.—12th January*, 1882. 8d.

The inventor constructs his motor of two parts, both of which revolve, the one in an opposite direction to the other. They are made in the form of two spherical balls, which contain the magnets. The inner ball is fixed on the shaft. The outer ball is in two parts, built up in segments and bolted together, having two pole pieces, and being wound with wire in the same manner as the inner ball. The outer ball is consequently free to rotate round the inner one, and the latter revolves inside the outer, but in an opposite direction. The power is taken from them by pulleys, one attached to the shaft of the inside magnet, and the other to the shaft of the outer coil.

178. Improvements in Apparatus for Signalling upon Railways by Means of Electricity, *C. E. Spagnoletti, Maida-hill, London.—12th January*, 1882. 6d.

This relates to improvements in railway signalling, which are particularly suitable for working junctions and large station yards. The inventor claims a special lever with electrical connections for controlling any or all levers required in the signal-box for any purpose. The system of working lines by locking by one action at either end both starting or other signal levers for up and down trains at each end of the single line section; also the mode of making and breaking contacts by divided armatures and by pins and springs on armatures. A pneumatic contact maker, blocking and locking instrument, rolling contact fitted to trains, and apparatus for resetting the contact pieces, &c.; also arrangement for warning the driver on approaching the signal, all of which are described and illustrated in the specification.

212. Corking Bottles, *K. F. C. Petersen, Hamburg.— 16th January*, 1882. 6d.

This relates to machines in which the cork is first compressed by a horizontal guided die, and consists, First, in arranging the main moving parts within a hollow column in which a sliding piece with two pistons is actuated by a lever. A rod attached to the sliding piece carries a wedge which acts through a second wedge, so as to raise the bottle holder to the required position. The sliding piece actuates dies and rollers which compress the cork, and its upper end carries the stamp which forces the cork into the bottle.

227. Range-finder, *G. W. Hart, Portsea.—17th January*, 1882. 6d.

A base plate is divided into degrees, minutes, and seconds, and can rotate on a vertical axis. On it are mounted two telescopes, one fixed and the other movable, and between them is fixed an index plate to show the relative amount of convergence or divergence of the telescopes. The movable telescope is actuated by a drum affixed to a tangent screw gearing with a wheel, on which the index plate is fixed. The drum is engraved with a succession of figures, which are tangent measurements for a given base. The divisions on the index plate show the degrees, whilst the distances are shown on the drum.

231. Improvements in Telephonic Conductors, *C. W. Siemens, Westminster.—17th January*, 1882.— (*A communication from F. Jacob, on board the s.s. Faraday.*) 6d.

The object of this invention is to render a number of pairs of telephone wires capable of supplying an increased number of instruments, so that one receiver can be worked for each wire instead of one for each pair of wires as at present. As an illustration, suppose that there are two adjacent circuits, A and B, as at present arranged, each circuit having its battery, sender, receiver, and pair of wires, or four wires in all. The inventor forms an additional circuit C with its battery, &c., using the pair of wires of the A circuit for the forward current and the pair of wires B for the backward current. He also forms a fourth circuit by using the four wires of the C circuit for the forward current, and earth for the backward current, so that four sets of instruments can be worked on the four wires.

232. An Improved Permanent Way for Electric and Telephonic Conductors, *H. R. Meyer, Liverpool.—17th January*, 1882. 6d.

The inventor constructs an insulated underground permanent way for wires, by means of blocks or slabs of glass, or glazed or unglazed earthenware rendered moisture-proof by dipping in hot asphalte or other suitable substance. The slabs are grooved for the reception of the wires, and laid one over another in layers, each slab being dovetailed into its predecessor and follower.

234. Improvements in and Relating to Dynamo-electric Machines, *W. R. Lake, London.—17th January*, 1882.—(*A communication from C. A. Hussey and A. S. Dodd, New York.*) 6d.

The improvements consist, First, in the combination in a dynamo of a field magnet and an armature severally having cores composed of arc-shaped portions wound with wire, intervening arc-shaped portions and radial portions connecting the two series of arc-shaped portions; the radial portions of both the field magnet and armature forming poles, polar extensions or consequent points, and extending towards each other. The field magnet core is preferably made of one integral piece of metal and the armature core of many thin pieces. Another improvement is a means whereby the machine may be made to produce continuous instead of alternate currents, which is accomplished by means of a suitable switch.

239. Compound to Serve as a Base or Ground for Oil Colours, &c., *F. Wirth, Frankfort-on-the-Maine. —17th January*, 1882.—(*A communication from O. Kall, Heidelberg.*) 2d.

One part of slaked lime is mixed with ten parts of blood containing fibrine, and left some time, when an equal volume of water is added. A thick precipitate is formed, over which the liquid portion is allowed to remain for fourteen days, being frequently stirred, after which the liquid is carefully removed, and one-twentieth part of permanganate of potash added, and as much water as will cause the mass to be of a consistency suitable for applying or laying on the same.

240. Manufacturing Cigarettes, *W. H. Beck, London.—17th January*, 1882.—(*A communication from E. F. Leblond, Paris.*) 6d.

This relates to several improvements in machines for making cigarettes, the most important consisting in the suppression of the moulds for forming the paper tubes, which are formed on a spindle or mandril, and removed by an india-rubber disc, roller, or brush.

245. Improvements in Apparatus for Regulating Electric Currents, *W. R. Lake, London.—17th January*, 1882.—(*A communication from A. de Khotinsky, Paris.*) 6d.

This invention consists in the combination with an exciting machine and a dynamo-electric generator of a regulator consisting of an auxiliary electromotor connected with the principal circuit, and actuating a lever fixed on the shaft of its armature, the said lever being provided with a spring or weight which counterbalances the action of the motor, and carrying at its opposite end a small conducting rod which closes a shunt circuit consisting of a vessel of some liquid, the resistance of which varies in proportion to the height of the liquid in the vessel. So long as the intensity of the current remains constant the lever will not change its position, but when the intensity increases the lever will descend, the rod touch the liquid, and a shunt circuit be established in the current of the armature of the exciting machine.

250. Testing Alcoholic Liquids, *H. J. Haddan, Kensington.—18th January*, 1882.—(*A communication from J. A. J. B. Devèze, Bordeaux.*) 6*d*.

The instrument consists of a retort and a refrigerator mounted on a movable stand, the former heated by a lamp so as to distil a certain quantity of the liquid, the distilled liquid being then delivered from the refrigerating coil to a sensitive balance and weighed.

278. Improvements in means for effecting Electro-hydro-therapeutic Treatment of Patients affected by Disease, *W. A. Barlow, London.—19th January*, 1882.—(*A communication from L. Encausse and Canésie, Paris.*) 6*d*.

This relates to a method for combining the treatment of disease by cutaneous absorption and by electricity, and to a special chamber and apparatus for carrying out the invention.

284. Vessels or Apparatus for Submarine Purposes, *T. Teodoresco, Galatz, Roumania.* — *19th January*, 1882. (*Void.*) 4*d*.

This relates to a vessel which it is required to maintain at a given depth or to cause it to move in a vertical direction, and consists in automatic apparatus to maintain the vessel in equilibrium at a given depth, being actuated and controlled by the variations in the pressure of the surrounding water acting on a body of compressed air in an air chamber.

287. Earthenware, *W. Boulton, Burslem.* — *20th January*, 1882. 8*d*.

This relates, First, to improvements in filter presses for preparing potters' clay from slip, and consists in forming the trays with a plain surface and interposing sacking or other suitable substance to form a conduit to carry off the water. A portion of the water is extracted from the slip before it enters the press, and steam introduced therein at high pressure so as to make it hot and cause it to filter more easily. The invention further relates to apparatus for making cups, bowls, &c., and consists in the means for bringing down the profile to shape the article to be formed, and to arranging the apparatus so that a plurality of profiles may be fixed on one "jolley" arm, whereby two or a larger number of articles or bats may be made by one downward movement of the arm.

289. Improvements in Secondary Batteries, &c., *J. Humphrys, Norwood.—20th January*, 1882. 4*d*.

The inventor makes his plates of an open lattice form. He connects the sides of the framework of each plate with bars either of diamond or oval section, these bars being arranged at an angle on the Venetian blind principle, thereby exposing a maximum area of spongy lead to the action of the liquid.

290. A New or Improved Application of Telephonic Conductors and Apparatus therefor, *H. J. Haddan, Kensington.—20th January*, 1882.—(*A communication from J. D. Morel, Roubaix. France.*)—(*Not proceeded with.*) 2*d*.

This relates to the combination of a telephonic conductor with a phonograph by utilising the telephonic conductor for producing an induced current in a wire passing round an electro-magnet, which attracts an armature whenever the main circuit is closed, thereby closing another circuit produced by a battery, and passing round a second electro-magnet which moves the pointer of the phonograph.

302. Improvements in Voltaic Batteries, *A. R. Bennett, Glasgow.—21st January*, 1882. 4*d*.

For the negative portion of the battery the inventor places an iron electrode packed tightly in iron turnings in a solution of potassium monoxide, or similar solution. For the positive portion, which should be separated from the negative portion by a porous cell, he uses the same solution with an electrode of zinc immersed in it.

303. Stereotype Plates, *T. Sowler and W. Ward, Manchester.—21st January*, 1882. –(*Void.*) 2*d*.

The object is to dispense with the necessity for dressing the edges of stereotype plates after casting, and it consists in avoiding the formation of the "burr" by cutting a rebate round the inner edges of the chase on three sides of the forme, so that this part, instead of being level with the type face, is only shoulder high, and the matrix made from it comes off with a raised edge round three sides. The inner edges of the gauges employed in the casting-box are also made with a similar rebate corresponding with the raised edge of the matrix, so that when placed in the casting-box and metal poured in, the plates formed will have a sunken edge instead of a "burr" on three sides, and the usual ingate on the fourth, which is removed by a sharp knife.

308. Application of Controlling Springs of Bogie Trucks, *H. Smellie, Kilmarnock.—21st January*, 1882. 6*d*.

This consists in making the controlling springs on both sides of the bogie pin resist the lateral movement of the bogie truck, so that to whichever side the bogie truck moves, both springs are compressed instead of the springs on one side being compressed, and those on the other side relieved from compression.

313. Copying Presses, *J. M. Plessner, Stuttgart.—21st January*, 1882.—(*Not proceeded with.*) 2*d*.

This relates to presses in which a roller under pressure is rolled over the copying book, and consists, First, in the use of a support plate placed below the leaves and manuscript, and serving to prevent the bending in of the leaves of the book; Secondly, in employing two rollers instead of one.

320. Recording Moves in Chess, *A. M. Clark, London.—21st January*, 1882.—(*A communication from L. Hours-Humbert, Paris.*) 6*d*.

This consists in fitting the men with pegs on the under side to enter holes in the different squares, and by establishing electric communication actuate registering apparatus provided with type wheels to print the number and letter of the squares from which the pieces are moved and those to which they are moved.

324. Kitchen Ranges, &c., *H. M. Ashley, Knottingley, Yorks.—23rd January*, 1882. 6*d*.

The object is to increase the durability of certain parts of ranges which are in contact with the fire, to improve the cooking qualities of such apparatus, to bring the action of the fire under control, and to regulate the admission of pure air to the underside of the fire, or to the interior of the apartment; and it consists, First, in forming the bottom and one or more sides of the oven of a waved form, to allow for contraction and expansion; Secondly, in arranging a sliding door between the fire and the chimney to below the outlet of the oven, so as to induce the draught to pass under the oven when required; and Thirdly, in the arrangement of a sliding blower under the fire-grate to regulate the admission of pure air to the fire or into the room.

327. Breech-loading Small-arms, *S., R., and W. Trulock, Dublin.—23rd January*, 1882. 4*d*.

This relates to drop-down guns and pistols, and consists in arranging and constructing parts of the lock mechanism, whereby the cocking of the locks is effected by raising the breech end of the barrels. A lever of the fore end has a solid circular knuckle and solid lifting nibs or pallets, which actuate a second lever when the barrels are depressed, and force back a spring, putting the lock in bent at full cock, it being released by the trigger acting on the sear.

328. Water Motors for Propulsion, *C. Smith, Bradford.—23rd January*, 1882.—(*Not proceeded with.*) 2*d*.

This consists of a water wheel enclosed in a case fitted with shields to prevent loss of water, which is emptied from the buckets near the bottom.

330. Regulating the Tension of Woven Wire Mattresses, *J. Foley, Dublin.—23rd January*, 1882.—(*Not proceeded with.*) 2*d*.

A flat steel spring is secured by one end at each angle of the bedstead, and their free ends curve upwards and point towards the extremities of the bedstead. These ends have sockets to carry the head and foot transverse rods, to which are fastened the ends of the woven wire mattress. Near the free end each spring has a slot through which a pin passes and enters the side rail, being secured by a nut underneath.

331. Attachment for Horseshoes to Prevent Slipping, *T. W. Ovenden, Kilburn.—23rd January*, 1882.—(*Not proceeded with.*) 2*d*.

This relates to a spring clip attachment formed with a sharp edge to be sprung into position on the shoe.

334. Vacuum Pumps, *C. D. Abel, London.—23rd January*, 1882.—(*A communication from J. Patrick, Frankfort-on-Main.*—(*Not proceeded with.*) 6*d*.

This relates to mercury or gravity pumps, and consists in improvements to enable a vessel when exhausted to be removed from the pump whilst retaining the vacuum obtained.

336. Bracket for Holding Rods, Bands, Sticks, &c., *T. S. Lyon, Strand.—23rd January*, 1882.—(*Not proceeded with.*) 2*d*.

This consists principally in pivotting the front portion of the bracket to the back part, so that the front can have a pendulous or swinging movement only imparted to it.

337. New Game of Skill, *G. F. Neville, London.—23rd January*, 1882.—(*Provisional protection not allowed.*) 2*d*.

This relates to a new game to be played with cups and balls on an ordinary tennis or other lawn.

338. Knives for Flaying or Skinning, *H. H. Lake, London.—23rd January*, 1882.—(*A communication from P. Brion, Paris.*) 6*d*.

This consists principally in the combination with a blade fixed firmly to the handle of one or two movable guards to regulate the projection of the cutting edge, and raise the skin as the work proceeds.

340. Cigarette Papers, *A. G. Goodes, London.—23rd January*, 1882. 2*d*.

The object is to render cigarette papers waterproof and prevent them adhering to the lips; and it consists in coating the part to be placed between the lips with a mixture of albumen and a suitable yellow colouring matter.

341. Hand Stamps for Endorsing, *G. K. Cooke, London.—23rd January*, 1882. 6*d*.

This relates to means for effecting the rotation or semi-turn of the die plate of hand stamps of the so-called rotary class, and consists in forming studs on the guide frame to act upon ears on the die plate.

342. Starting, Stopping, and Reversing Engines, *W. H. Allen and R. Wright, Lambeth, and W. L. Williams, Westminster.—23rd January*, 1882.—(*Not proceeded with.*) 4*d*.

This relates to machinery used for the purpose of starting, stopping, and reversing marine or other engines in which it is required that the reversing or other mechanism of considerable weight should be moved easily and readily, and at the same time with steadiness, and it consists in arranging mechanism so that the valve by which the motion is controlled remains open in the position to which it has been moved until the pistons, together with stopping, starting, or reversing gear, have moved nearly to the point of their travel corresponding to the position of the valve, which s then rapidly closed.

343. Brake Apparatus, *J. J. Tansley, Liverpool.—24th January*, 1882.—(*Not proceeded with.*) 2*d*.

This consists in actuating the brake block by means of an excentric or oval-shaped cam placed at the ends of the rods or in connection with the levers to which the brake blocks are attached, and which, when turned in either direction, forces the rods in a direction from the centre of the cam, and thereby presses the brake blocks against the wheels.

344. Bonding Roll Roofing Tiles, *S. H. Bevan, Neath, Glamorgan.—24th January*, 1882.—(*Not proceeded with.*) 2*d*.

This relates to tiles with fillets, rolls, and skirts, and consists in making the tile square and carrying the roll of cylindrical form nearly up to the point down to which the overlapping tile in the higher course extends, and then continuing the roll for the rest of the length with a recess in its surface wide enough to receive the fillet of the overlapping course.

347. Lawn Tennis Markers, *W. Thomson, Manchester.—24th January*, 1882.—(*Not proceeded with.*) 2*d*.

A wheel revolves in a box containing whiting and water or paint, and over it and the marking wheel runs an endless band.

348. Repeating Gun, *F. J. Cheesbrough, Liverpool.—14th January*, 1882.—(*Not proceeded with.*) 2*d*.

This relates to repeating guns, and consists in certain breech or hammer and lock mechanism, whereby the consecutive or repetition firing is effected, the cartridges being held in a casing which travels laterally across the breech. The percussion and explosion of the cartridges is arranged to take place in the breech of the barrel, the cartridges being in rotation pushed forward from the holder into the barrel after each explosion.

350. Supplying Furnaces with Fuel, *J. H. Johnson, London.—24th January*, 1882.—(*A communication from J. A. Strupler, Paris*)—(*Not proceeded with.*) 2*d*.

A frame or carriage runs on wheels in front of the furnace door, and is capable of being caused to occupy a position over the incandescent fuel, when the fuel is allowed to fall on to the grate by opening the bottom, which consists of a number of pivotted bars or plates.

353. Water-closets, &c., *P. J. Davies, Kensington.—24th January*, 1882.—(*Not proceeded with.*) 2*d*.

This consists in combining with the closet basin, pan, hopper, or trap of a closet or latrine, two or more syphons, water traps, seals or water tubes, which, owing to a confined body of air between them, will cause the water in the basin to stand at a higher level than the water level of the first syphon.

354. Acetic Acid, *H. J. Haddan, Kensington.—24th January*, 1882.—(*A communication from Frohlich and Co., Germany.*)—(*Not proceeded with.*) 2*d*.

The object is to produce concentrated acetic acid without losing the peculiar aroma which is generally destroyed by the distillation of vinegar or by the decomposition of acetates, and it consists in causing vinegar to freeze, and separating the concentrated vinegar from the ice by means of a press or by a centrifugal machine.

355. Bottoms, Gratings, or Bars of Fireplaces, &c., *W. J. Doubleday, Westminster Bridge-road.—24th January*, 1882.—(*Not proceeded with.*) 2*d*.

This consists in forming the bottom grating or bars in one or more pieces hinged to the stove, so that they may be made to fall down when required to clear the stove.

356. Arresting the Progress of Vessels, *A. W. L. Reddie, London.—24th January*, 1882.—(*A communication from J. McAdams, Boston, U.S.*) 6*d*.

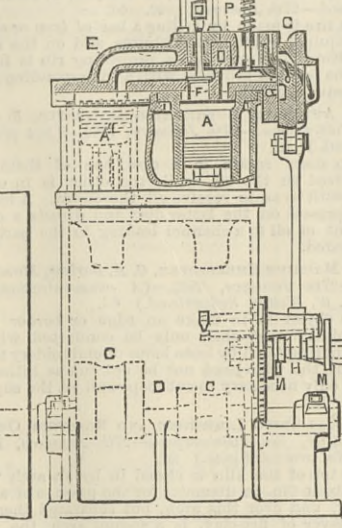
This relates to means to quickly stop vessels, so as to avoid collision and other disaster; and it consists in the application of wings, fins, or blades connected by upright hinges to the sides of the stern post, and adapted to fold close against the sides of the vessel when not required, and to be swung outwards so as to project laterally from the sides of the ship, and thus offer a great resistance to its passage through the water.

360. Supporting, Balancing, and Adjusting Window Sashes, *W. R. Lake, London.—24th January*, 1882.—(*A communication from P. W. Blythe, Boston, U.S.*) 6*d*.

The side edges of each sash are grooved to fit tubes secured to the side of the window frame, and each containing a spiral spring, by means of which the raising and lowering of the sashes are facilitated.

362. Gas Engines, *F. W. Turner, St. Albans.—24th January*, 1882. 6*d*.

The engine has two cylinders A and A^1, the pistons of which are connected to cranks C, formed nearly at right angles to each other on shaft D. At the upper end the cylinders communicate by passage E, in which is a valve F. The slide valve G is operated by a rod connected with crank H on shaft I, driven by gearing from shaft D. Shaft I also carries the cams M and N, the former actuating valve F through suitable rods, and the latter the exhaust valve. P is a valve to admit air. In the drawing the piston in cylinder A has performed nearly half of its down stroke, and the piston of cylinder A^1 is at the top of its stroke, the cylinder A above its piston contains gas and air admitted through valves G and P; the valve G is about to rise to admit more gas, and valve F is also



about to be opened by cam M. When the piston of cylinder A has reached the end of its stroke; the cylinder A will be filled and cylinder A^1 half filled, and the supply cut off. During the up stroke of piston in cylinder A the charge is compressed into A^1, and by the further movement of the engine into cylinder A, the piston in the latter again arriving at the position shown. Valve G then allows the charge to be ignited, and valve F being open the explosive force is exerted simultaneously on both pistons. The exhaust is then opened and the foul gases expelled by the up strokes of the pistons.

364. Tablets for Holding and Preserving Names, Addresses, &c., *W. Carter, Buckhurst Hill.—24th January*, 1882. 6*d*.

A metal frame is fitted with a plate of thin horn, mica, or other transparent waterproof substance in its front side, and the label bearing the address is placed within the frame, which is then secured by screws to the article to which it is to be attached.

365. Handles for Railway Carriage Doors, *J. A. Macmeikan, Lincoln's-inn.—24th January*, 1882.—(*Not proceeded with.*) 2*d*.

This consists in forming the handles so that they cannot be acted on accidentally to open the doors, and whereby they are rendered specially adaptable for operating the latches from the inside of carriages.

366. Power Looms for Weaving Figured Pile Fabrics, *S. C. Lister and J. Reixach, Manningham, Yorks.—24th January*, 1882. 6*d*.

This relates to machines for weaving two or more pieces of figured pile fabric connected together by the pile, which is afterwards severed, and it consists; First, in the combination of a jacquard machine for working the pile warps, with healds and tappets for working the ground warps, and for regulating the length of the pile; and Secondly, in the use of a movable shuttle rail in the going part, in combination with the pile gauge.

367. Sulphuric Acid, *W. Windus, Bristol.—24th January*, 1882.—(*Not proceeded with.*) 2*d*.

This consists in disengaging oxides of nitrogen from sulphuric acid containing these oxides by means of agitation, either before leaving the sulphuric acid chambers or after, and in utilising the oxides so produced.

368. Purification of Lead, *W. J. Carr, Newcastle-on-Tyne.—24th January*, 1882.—(*A communication from P. Négris and E. Rizo Ergastiria, Greece.*)—(*Not proceeded with.*) 2*d*.

This consists in the use of a jet of steam in the bath of lead, on such lead coming out of the reducing furnace, and as soon as the cake of scoria has been removed, as well as the matter and speiss, if there be any.

369. Spittoon for Smoking Carriages, *J. Clark, Bloomsbury.—25th January*, 1882.—(*Not proceeded with.*) 2*d*.

The vessel is of cast iron or other suitable material, and is placed level with the floor of the carriage, an opening fitted with an air-tight cover being provided for discharging the contents.

371. Printing Machines, *T. G. and J. Dawson, Otley.—25th January*, 1882. 6*d*.

This relates to machines in which the impression cylinder has an intermittent rotary motion, and consists of an improved automatic apparatus for stopping the cylinder at every alternate revolution of the machine, or for an indefinite period by hand, without stopping the other parts of the machine. A bell-crank lever is coupled to a vertical bar and pawl, so that when the pawl is liberated the end of same is in position to fit into an indentation formed in a weighted swivel plate jointed to a reciprocating bar, which, on moving in one direction, actuates the bell-crank lever and vertical bar, thereby stopping the impression cylinder, feeding board, printing apparatus, and grippers, until the pawl is placed back in its original position.

372. Canal Locks, &c., *J. Revell, Dukinfield, Chester.—25th January*, 1882.—(*Not proceeded with.*) 2*d*.

This consists in having in connection with canal locks one or more large inverted water and air cisterns constructed to hold a quantity of water and air, acting as a balance weight to the water in the lock.

373. Shuttles for Looms, *J. R. Richards, near Preston.—25th January*, 1882. 6*d*.

This relates to the tongue or peg of the shuttle, the object being to close the spring of the peg as soon as the latter is raised up out of the shuttle, so that the cop pirn, or bobbin of weft can be easily placed thereon or removed, and thus diminish the liability to injury to the interior thereof and consequent waste of the yarn. One modification consists in fixing a double excentric or cam in the slot at the heel end of the peg, and between it and the end of the spring passes a bent arm capable of oscillating on a pin fixed in the wood of the shuttle.

374. Tobacco Pipes, *H. E. Meyer, London.—25th January*, 1882.—(*A communication from Messrs. Jeanket-David, France.*)—(*Not proceeded with.*) 2*d*.

This relates to a cover or wind guard for pipes, and consists in securing the same over the bowl by spring clips or arms.

375. Manufacture of Cattle Food from Brewers' Grain, *C. D. Abel, London.—25th January*, 1882.—(*A communication from O. Zucker, Berlin.*) 6*d*.

This consists in pressing the grains by means of a double pair of pressing rollers furnished with an endless cloth, mixing the same in an upright cylinder with food-stuff lightly fermented in the previously expressed liquid, and working the mixture by an archimedian screw of diminishing pitch of thread; gathering the mixture by the screw into moulds formed in the circumference of a cylinder moved intermittently, such moulds having movable bottoms for the automatic ejection of the cakes from the moulds, after compression of same by mould stampers carried by a wheel or roller, the finished cakes falling on an endless cloth which conducts them to a drying place.

376. Piano Organs, *C. D. Abel, London.—25th January*, 1882.—(*A communication from Cäsare, Donadoni, Pohl, Berlin.*) 6*d*.

This relates to piano organs in which the pins of a barrel actuate the ordinary hammer mechanism of a piano, and it consists in means to enable such pianos to be played both by the barrel and by the hands on the keys in the ordinary manner.

378. Signalling Apparatus for Railways, *W. P. Thompson, Liverpool.* — *25th January*, 1882.—(*A communication from W. W. Gary, Boston, U.S.*)—(*Not proceeded with.*) 4*d*.

The object is to provide a simple, reliable, and inexpensive signal mechanism for use at crossings, curves, stations, and other places at which audible or audible and visible signals are required to be given, and it embraces the use of a magneto generator or dynamo-machine driven by passing trains so as to develope an electric current which is utilised to actuate the signals.

379. Flush Cisterns for Water-closets, &c., *W. Wright, Plymouth.—25th January*, 1882. 6*d*.

In a cistern a rectangular frame is set up edgewise and has a hole at its upper side to admit the supply pipe, and under this is a valve of a syphon which starts the water in the syphon and draws the water for flushing without the necessity of retaining hold of the handle after the first pull; the lever which opens the valve at the same time closes the supply valve.

381. Disinfectants, *E. G. Brewer, London.—25th January*, 1882.—(*A communication from E. E. Egasse, Paris.*)—(*Not proceeded with.*) 2*d*.

This refers to the manufacture of disinfectants from the chlorure of zinc, and consists in admitting compressed air with hydrochloric acid into a receiver containing zinc, where the chlorures are obtained, and which are applicable for disinfecting purposes generally.

383. Drawing Boards, *G. Low, Ipswich.—25th January*, 1882.—(*Not proceeded with.*) 2*d*.

This consists in securing paper to the board by causing its ends when wetted to overlap grooves made in the board, and then forcing narrow strips of hard wood into such grooves.

385. Utilising Waste and other Heat for Drying Bricks, Tiles, Pipes, &c., *G. Woolliscroft, Stoke-on-Trent.—25th January*, 1882.—(*Not proceeded with.*) 2*d*.

This relates particularly to utilising the waste heat given off when cooling an oven of fired bricks, and consists in drawing cold air through such oven by means of an exhaust fan, and forcing the air, which in its passage becomes heated, over and among the articles to be dried, which are arranged in drying rooms or chambers.

387. Purifying Coal Gas, *J. Walker, Leeds.—26th January*, 1882. 4*d*.

This relates to improvements on patent No. 5269, A.D. 1881, and consists, First, in effecting the purification of coal gas by the employment of ground coke or breeze impregnated with compounds of iron when in a state of division; and Secondly, in effecting the purification of coal gas by the employment of ground coke or breeze impregnated with compounds of iron, and used in conjunction with hydrate of lime.

390. Terrets for Facilitating the Driving of Horses, &c., *W. R. Lake, London.—26th January*, 1882.—(*A communication from E. W. Johnson, Boston, U.S.*) 6*d*.

This consists essentially in a rein-guiding terret provided below the rein aperture with a ball-receiving socket in combination with a ball on the guide rein, so located as to enter the socket when desired to check the horse, and to be readily disengaged when desired to uncheck the horse.

395. Production of Photographic Copies on the Surface of all Matters, *R. Schroer, Vienna.—26th January*, 1882.—(*Not proceeded with.*) 2*d*.

This consists in producing photographic images on any surface by applying a sensitive coating containing tanned glue to such surface, and then developing the image after exposure.

396 Treatment of Paper, &c., for Packing, *J. Greenwood, Bacup.—26th January*, 1882.—(*Not proceeded with.*) 2*d*.

This consists in applying a fine coating of paraffine wax to paper for packing confectionery or other articles, so as to protect them from damp and prevent the evaporation of the aroma or volatile essence.

388. Transferring Designs to Surfaces, *J. M. Moss, Patricroft.—26th January*, 1882. 4*d*.

This relates to an improved method of transferring designs, and consists in impressing the design upon a gelatine tissue by the action of light, afterwards raising the unchanged portions by moisture, inking the portions so raised, whilst the changed parts are left without ink, and finally pressing the tissue upon the surface to which the design is to be transferred.

400. Propeller for Steam Vessels, *C. Corneby, Poplar.—26th January*, 1882. 6*d*.

The object is to increase the speed of steam vessels without augmenting the engine power, and to reduce the vibration or tremulous motion thereof. This consists in constructing the propeller on the principle of a

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FIG. 1.

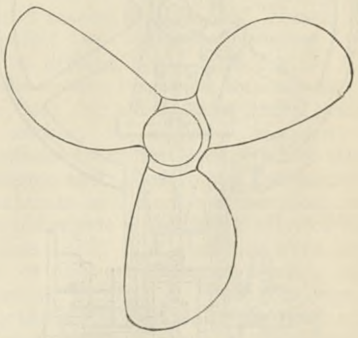

FIG. 2.

revolving cutter as used in cutting or boring holes, two or more blades being employed, the form of which is shown in the drawings.

401. MACHINERY FOR THE MANUFACTURE OF CASKS OR BARRELS, *S. Wright, Harriston, Canada.—26th January*, 1882.—*(Not proceeded with.)* 2d.

A pair of saws are capable of being placed at an angle to cut the staves to the proper shape, such staves being forced down on to a table curved to the form of the barrel, and capable of moving in guides between the saws.

402. SAWING WOOD, *T. N. Robinson, Rochdale.—26th January*, 1882.—*(Not proceeded with.)* 2d.

This relates to circular saw benches provided at each end with rollers, which feed the wood to the saws and return it to its original position after being operated upon, and it consists in means to enable the rollers to be rotated in either direction by the same power as that which drives the saw, such rollers revolving at a greater speed when returning the wood than when feeding it forward.

403. COMBINATION FRAME FOR EXHIBITING SAMPLES AND PRINTED MATTER, &c., *T. Whetstone, London.—26th January*, 1882.—*(Provisional protection not allowed.)* 2d.

A suitable frame is divided into compartments to receive the samples or objects to be exhibited.

404. MAKING GLASS BOTTLES, &c., *T. Wood, Portobello, N.B.—26th January*, 1882. 6d.

This relates to an improved marevr, on which the plastic mass is rolled into a suitable form for blowing a bottle, and consists in forming its upper surface with a flat rim or "cranny" part along the side furthest from the blower or workman, and the remaining part is concaved, the concavity extending from side to side, so that the workman can roll the plastic glass a sufficient distance from side to side, whilst the curvature of the surface enables him to make the glass take the desired shape.

407. VESSEL FOR SAVING LIFE AND PROPERTY AT SEA, *W. Fewster, Margate.—26th January*, 1882. 4d.

A vessel in the form of a duck sitting in her nest, with two heads and two necks, one at each end, the one at the fore end turned aft, and the one at the after end turned forewards, and both looking downwards, and forming air pipes for ventilation, is employed. Water tanks are provided, and above them is a platform for provisions, passengers' luggage, &c. Above the platform is a deck forming the flooring of saloon, steerage, and cabins.

409. HEATING FEED-WATER FOR STEAM BOILERS, *M. Ashworth, near Manchester.—27th January*, 1882.—*(Void.)* 2d.

This relates to a feed-water heater applicable to condensing engines only, and consists in introducing such heater either into the condenser itself or preferably into a chamber situated between the exhaust passage from the cylinder and the condenser, so that the feed-water is heated by the steam as soon as it leaves the exhaust passages of the cylinder.

413. PROTECTING ROOFS, WALLS, &c., *B. L. Thomson, London.—27th January*, 1882. 4d.

This consists in the application of enamelled or vitrified iron plates for covering and protecting roofs, walls, and other like surfaces.

416. BLAST FURNACES, *J. Cliff, Frodingham, and J. H. Dawes, Messingham, Lincoln.—27th January*, 1882. 6d.

This relates to means for facilitating the correct charging of blast furnaces, and consists in placing a plate, or a set of iron plates, opposite the opening where the furnace is charged, in such a position as to receive the charge from the barrows and distribute it equally around the furnace.

417. GAS ENGINES, *S. Withers, Torquay.—27th January*, 1882. 6d.

The cylinder A is long enough to leave a chamber below its piston when at the bottom of its stroke,

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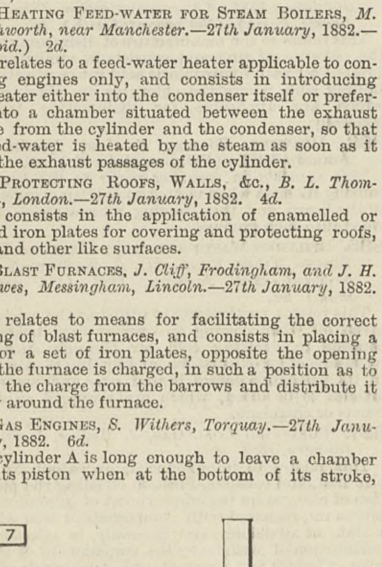

which serves to contain air to form a cushion. The slide valve X is worked from a cam on crank shaft, through rod Y and bell crank Z, spring W tending to keep the top end of rod Y in contact with the cam.

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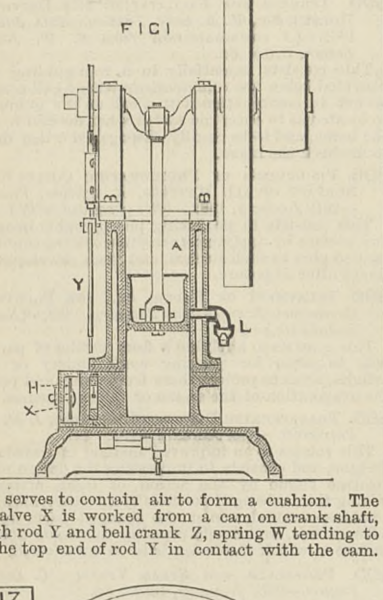

Behind the slide valve is a box H in which the gas is mixed with air, admitted through holes in the box, before entering chamber below the piston. The slide valve has ports to admit the charge to the cylinder, and also to the ignition jet. D is the exhaust port controlled by the piston, and L is a valve on the cylinder for relieving the vacuum during the upstroke when starting engine, and for the same purpose in the event of a non explosion.

419. PORCELAIN OR EARTHENWARE COFFEE-POTS, *W. R. Lake, London.—27th January*, 1882.—*(A communication from J. Herttan, Bohemia.)*—*(Not proceeded with.)* 2d.

The coffee-pot is made up of four separate parts, each of earthenware, the first forming a receptacle for the liquid coffee, and over which fits a vessel to hold the coffee, and the bottom of which forms a strainer, whilst the third rests on the top of and projects into the second vessel, and is provided with holes around the circumference of its bottom, so as to distribute the hot water on to the coffee in the vessel below. The third vessel is provided with a cover which will also fit the other two vessels.

420. MOTIVE POWER ENGINE, *H. J. Haddan, Kensington.*—27*th January*, 1882.—*(A communication from E. Schopfer, France.)*—*(Not proceeded with.)* 2d.

This relates to the use of two parallel beams, bearing a weight at one end, and connected at the other with a chain passing over a pulley, which, by the shifting of the weight, is caused to revolve continuously.

421. FELLOES AND TIRES OF WHEELS, *G. Perks, Stafford.—27th January*, 1882. 6d.

The tire is made by rolling a bar of iron or steel to the required width and thickness, and on the side to constitute the inner face a projecting rib is formed, and the felloe is provided with a corresponding groove to receive such rib.

422. AUTOMATIC LUBRICATING APPARATUS, *R. Simon, Nottingham.—27th January*, 1882.—*(Not proceeded with.)* 2d.

Two discs rotate in a case, one of them being immersed in the oil, while the other is in contact therewith so as to receive oil therefrom. A blade or strip presses on the latter disc and directs a certain amount of oil to a channel leading to the part to be lubricated.

423. MACHINE EMBROIDERY, *C. A. Barlow, Manchester.—27th January*, 1882.—*(A communication from C. W. Wetter, Switzerland.)* 6d.

The object is to make an edge or border to the embroidery that shall only be connected with the surrounding cloth by loose loops of embroidery thread, so that the edge need not be cut out as hitherto, it being only necessary to cut loops and let the edge slip out.

426. CALCINING LIMESTONE AND ROASTING ORES, *S. Collier, jun., Glamorgan.—27th January*, 1882.—*(Not proceeded with.)* 2d.

The top of the kiln is closed in by an arch with a hole about 2in. in diameter for the passage of air and piping, and over this arch, but separated therefrom by a layer of fire-clay, is a second arch, the top of which is levelled and forms the floor of the kiln, a hole of about 15in. in diameter being formed in the centre, and four others about 12in in diameter constitute draw-holes to remove the lime from below the arch. The kiln is heated by gas jets applied to the underside of the arch.

427. STEAM BOILERS AND FURNACES, &c., *P. Jensen, London.*—27*th January*, 1882.—*(A communication from W. Wilmsmann, Hagen, Germany.)* 6d.

The object is to consume the products of combustion, and it consists in forming a hanging arch or bridge F of fireproof material over the grate at or near the end

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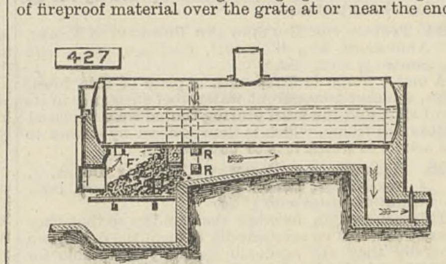

so as to compel the gases from the raw coals thrown on the top of fire to pass under the bridge, the stoking being such that the fuel is heaped up towards the back of the grate so that the gases pass through it. Behind the hanging bridge are arranged air flues R, which supply heated air from descending flues in the side walls of the boiler setting, and by thus mixing hot air with the gases immediately they emerge from under the hanging bridge F, a complete and smokeless combustion is effected by the still unconsumed gases.

430. ROVING MACHINERY, *W. R. Lake, London.—27th January*, 1882.—*(A communication from W. E. Whitehead and A. T. Atherton, Lowell, U.S.)* 6d.

This consists in subjecting the sliver, while in untwisted condition, to successive drawing operations until it is reduced and drawn out to the proper extent, and then twisting it into roving of proper fineness by the usual flyer and spindle; in other words the sliver is not twisted between the different drawing operations.

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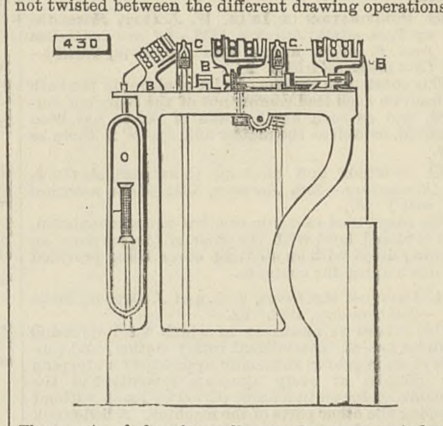


Three sets of drawing rolls are shown mounted on brackets B, and at the delivery end is the spindle and flyer O. Between the sets of rolls an intermediate rotary condenser C is placed, and serves to condense the sliver as it passes from one set to the other.

434. SHAPING WOOD, *E. E. Bahn, Germany.—28th January*, 1882.—*(Not proceeded with.)* 2d.

This relates to machines for shaping articles of wood of square, polygonal, or other angular section, and it consists in the application of several independent work-tables, each of which is adapted to hold at the same time several pieces to be shaped, such tables being connected with the driving mechanism, so as to be capable of being separately detached. Three cutter heads act successively on the article.

435. GUN WADS, *H. E. Newton, London.—28th January*, 1882.—*(A communication from Messrs. De Condé, Schmid, and Du Houx, Paris.)* 4d.

This consists in making gun wads from wood pulp or other fibrous pulp.

438. MANUFACTURE OF DECORATING PAPERS, *J. Imray, London.—28th January*, 1882.—*(A communication from A. Cottais, Paris.)* 4d.

The paper is covered with a layer of fixed white made up with solution of gum arabic, and on it an impression is made with fatty ink, the white absorbing excess of same. When dry the surface is coated with insoluble varnish, on to which thin unsized paper is glued, and the first sheet moistened and detached, leaving the design on the unsized paper, which is then applied to the surface to be decorated.

439. TRICYCLES, *A. Burdess, Coventry.—28th January*, 1882. 6d.

This consists, First, in an improved seat carried by levers supported on springs; and Secondly, in mounting the handles of the machine on spring levers, to prevent the rider experiencing any jarring sensation in the hands.

444. DYEING COTTON YARNS, &c., *F. A. Gatty, Accrington.—28th January*, 1882. 4d.

This consists in dyeing cotton yarns, or yarns of other vegetable fibrous material in the cop by first boiling the cops in dye-wood extracts, and subsequently treating them with suitable mordants.

447. SECTIONAL WARPING OR BEAMING MACHINES, *E. and W. A. Rothwell, Walkden.—28th January*, 1882.—*(Not proceeded with.)* 2d.

The ordinary sectional warping frame is fitted with a curved or segmental creel similar to that used with warping mills, and the ends are simply passed through a heck fixed at a distance from the frame, and then through an angular or expansion reed and over the measuring roller on to the section.

449. KITCHENERS OR COOKING RANGES AND COOKING GRATES, &c., *J. W. Brown, Leamington.—28th January*, 1882.—*(Not proceeded with.)* 2d.

This relates, First, to causing a current of fresh and warm air to circulate through the ovens and then be discharged at a high level into the vertical smoke flue; and, Secondly, to means for ventilating kitchens containing a kitchener or cooking range.

450. ROUGHING HORSESHOES, *H. Turner, Birmingham, H. Olver, Tamworth, and E. Price, jun., Birmingham.—28th January*, 1882. 6d.

The shoes at the points where the projections or roughing studs are to be secured are provided with rectangular holes, passing through them and serving to receive the shanks of the projections, the top ends of which have a hole drilled through them to receive a split cotter, which is passed into a groove or recess formed in the upper side of the shoe.

452. HOISTS, *W. Adair and G. B. Smith, Liverpool.—30th January*, 1882.—*(Not proceeded with.)* 2d.

The hoist consists of a worm wheel driven by a screw on the shaft carrying a winding barrel, and which is fitted with a spur wheel gearing with a pinion on a countershaft also carrying a winding barrel. The countershaft pinion can be moved in and out of gear. The winding barrel shafts are carried in a frame also carrying the rotating shaft and the screw or worm shaft. A brake and hand gear of suitable construction is provided. The hoist is actuated by appliances consisting essentially of a rotating shaft, a double-acting friction clutch, and bevel and worm gearing.

453. BRASS BOBBIN WINDING ENGINES, *W. Paulson, Nottingham.—30th January*, 1882.—*(Not proceeded with.)* 2d.

This relates to the general construction of winding engines.

455. MACHINERY FOR BEAMING YARN, *R. Hindle and G. Greenwood, Blackburn.—30th January*, 1882.—*(Not proceeded with.)* 2d.

This relates to an improved construction of the presser or roller for pressing upon and evening the surface of the yarn as it is wound on the beam; and consists in making such roller in two halves, so that it may be adjusted in width to suit the beam.

466. SEWING MACHINES, *J. F. McLaren, Glasgow.—31st January*, 1882. 6d.

This relates to the part of sewing machines by which the upper thread is pulled out into a loop of the required dimensions, and which in this invention also carries the under thread by which the sewing, in combination with the upper thread, is produced. It consists of a hollow rotating hook, which pulls down the upper thread and carries the bobbin of under thread, which is thus passed through the loop, thereby dispensing with the usual shuttle and spool.

470. DYEING AND PRINTING, *W. W. Richardson, Leeds, —31st January*, 1882. 4d.

This consists in the preparation of colours and stains from a decoction of logwood combined with the compound sodic or potassic metallic oxalates.

473. UTILISING ALKALI WASTE, *J. Brock, Widnes.—31st January*, 1882. 2d.

This consists, First, in roasting and grinding or pulverising to fine powder "alkali waste" for the purpose of using it as an agricultural manure; and Secondly, in mixing the roasted and ground alkali waste with wood charcoal, peat charcoal, nitrogenous substances and compounds, phosphates, natural or artificial, salts of potash or soda, or magnesia, or with any or all of these combined, so as to form manures suitable for agricultural purposes.

485. TAPS AND APPARATUS FOR FACILITATING THE TAPPING OF BEER BARRELS, &c., *W. Rose, Halesowen.—31st January*, 1882. 8d.

A plate carrying a screwed socket is secured to the barrel over the bung, and the stem of the tap is screwed to fit such socket, so that when the stem of the tap is placed in the socket and screwed home, the end of the stem forces the bung into the barrel.

665. MEDICAL INJECTING OR IRRIGATING APPARATUS, *H. A. Bonneville, Paris.—11th January*, 1882.—*(A communication from J. A. Joltrain, France.)* 6d.

This relates to a medical injecting apparatus composed entirely of soft and hard india-rubber, having neither valve, spring, tap, or mechanism of any kind.

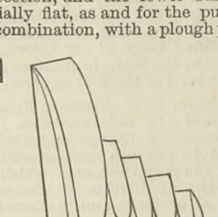
SELECTED AMERICAN PATENTS.

From the United States' Patent Office Official Gazette.

261,836. PLOUGH SHARE AND POINT, *William Dicer, Marengo, assignor of one-half to Pratt A. Spicer, Marshall, Mich.—Filed December 23rd*, 1881.

Claim.—(1) A ploughshare having a corrugated cutting edge, and its upper surface having a series of parallel concave grooves of variable curvature or width in their cross section, and the lower surface of said share substantially flat, as and for the purpose specified. (2) The combination, with a plough point having

261,836



its upper surface provided with a concave groove and its lower surface substantially flat, said groove being of variable curvature or width in its cross section, of a ploughshare having a series of similar parallel concave grooves, substantially in the manner as and for the purpose specified.

261,850. MAGNETO-ELECTRIC MACHINE, *Otto Heikel, Jersey City, N.J., assignor to the National Electric Light and Power Company, New York, N.Y.—Filed May 2nd*, 1879.

Claim.—(1) The commutator made of separate seg-

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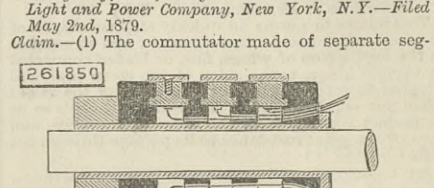
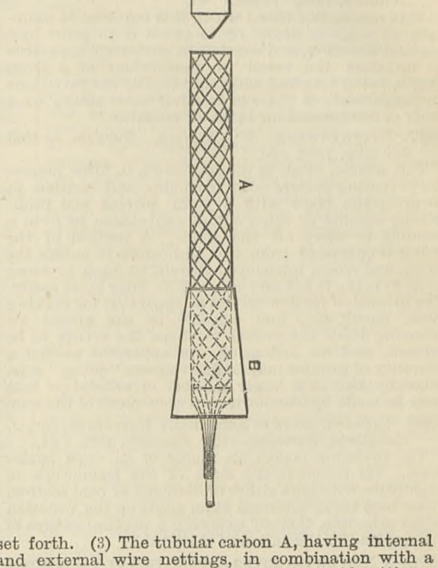


mental blocks, with flanges between separate grooved rings, loose upon a tube or shaft, and clamped by a nut at the end of the tube or shaft, there being a space between the plate and shaft for the circuit wires, substantially as set forth. (2) The combination, in a commutator, of the segmental blocks with flanges, the insulating rings grooved to support the blocks, a central tube or shaft smaller than commutator, and leaving a space beneath such blocks for the insulated wires, the nut to clamp the blocks and rings, and the removable faces to the commutator, substantially as set forth.

261,904. ELECTRIC LIGHT CARBON, *Edward J. Brooks, East Orange, N.J.—Filed May 27th*, 1882.

Claim.—(1) The combination, with the body of an electric light carbon, of metallic wires in the form of a netting connected with the conducting wire, substantially as herein specified, for the purpose set forth. (2) The combination, in a tubular carbon for electric lights, of internal and external tubular metallic nettings or coatings connected with the conducting wire, substantially as herein described, for the purpose

261,904



set forth. (3) The tubular carbon A, having internal and external wire nettings, in combination with a conducting wire, connected with each of said nettings, substantially as shown, for the purpose set forth. (4) In combination with a tubular carbon having an external wire netting connected with a conducting wire, an insulating holder B, having a hole in its bottom through which the netting wires extend, substantially as herein specified.

261,980. GOVERNOR FOR STEAM ENGINES, *Anders Back, Korsnäs, Great Kopparberg, Sweden.*—*Filed October 6th*, 1881.

Claim.—(1) A governor shaft provided with a lateral pin, in combination with a sleeve which is adapted to move up and down on said shaft, and provided with a spiral way that receives said pin, and a pair of governor balls attached to said sleeve, and operating substan

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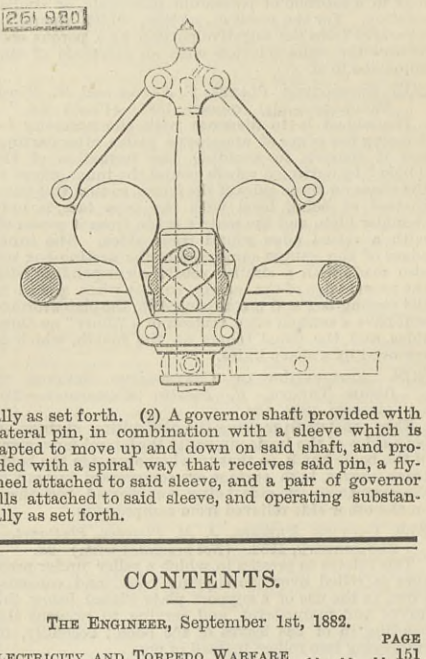

tially as set forth. (2) A governor shaft provided with a lateral pin, in combination with a sleeve which is adapted to move up and down on said shaft, and provided with a spiral way that receives said pin, and a flywheel attached to said sleeve, and a pair of governor balls attached to said sleeve, and operating substantially as set forth.

CONTENTS.

THE ENGINEER, September 1st, 1882.