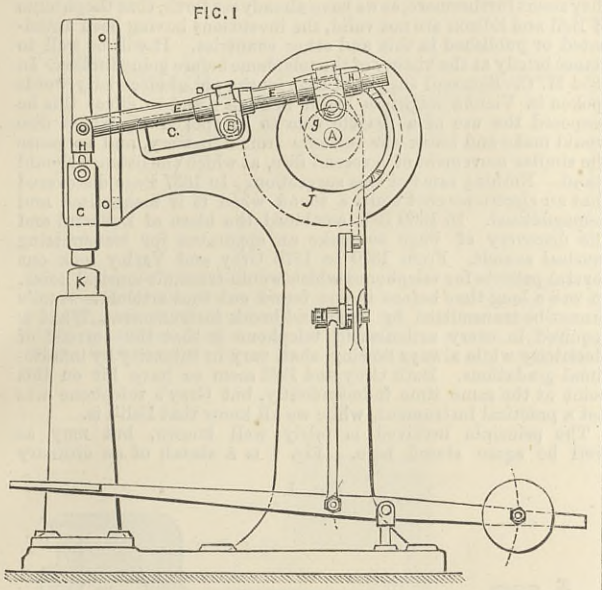
INSTITUTION OF MECHANICAL ENGINEERS.

THE third paper read at the recent meeting of the Institution of Mechanical Engineers, which we have already in part reported in our columns, was by Mr. Daniel Longworth on

POWER HAMMERS WITH A MOVABLE FULCRUM.

This paper described the uses of various forms of the movable fulcrum power hammer designed by the author. The small planishing hammer, Figs. 1 to 3, is used for copper, tin, electro, and iron plate, for scythes, and for other thin work, for which it is sufficient to adjust the force of the blow once for all by hand, according to the thickness and quality of the material, before commencing to hammer it. The hammer weighs 15 lb., and has a stroke

FIG. 1



variable from 2½in. to 9½in., and makes 250 blows per minute. The driving shaft A is fitted with fast and loose belt pulleys, and the belt fork being connected to the pedal P; when the pedal is released its weight moves the belt to the loose pulley. The fly-wheel on the shaft A is weighted on one side, so that it causes the hammer to stop at the top of its stroke after working, to enable the material to be placed on the anvil before starting the hammer. The movable fulcrum B consists of a stud, free to slide in a slot C in the framing, and held in position by a nut and toothed washer. On the fulcrum is mounted the socket D, through which passes freely a round bar or rocking lever E, attached at one end to the main piston F of the hammer G, and having at the other extremity a long slide H mounted upon it. This slide is carried upon the crank pin I, fastened to the disc J attached to the driving shaft A.

FIG. 2

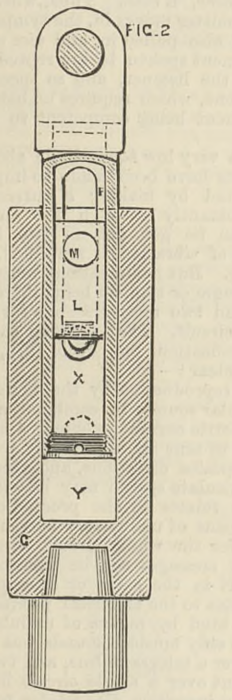
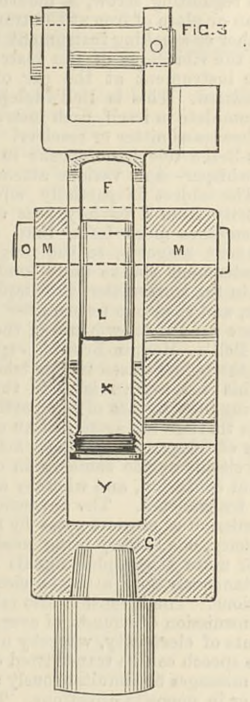


FIG. 3



The crank pin, in revolving, reciprocates the rocking lever E and main piston F, and, through the medium of the pneumatic connection, the hammer G. The slide H, in revolving with the crank pin, also moves backwards and forwards along the rocking lever, approaching the fulcrum B during the down stroke of the hammer, and receding from it during the up stroke. By this means the velocity of the hammer is considerably accelerated in its downward stroke, causing a sharp blow to be given; whilst it is gently raised during its upward stroke. To alter the force of the blow, the hammer G is made to rise and fall through a greater or less distance, as may be required, from the fixed anvil block K, after the manner of a smith giving heavy or light blows on his anvil. By placing the slot C parallel with the direction of the rocking lever E when the latter is in its lowest position, with the hammer resting on the anvil, and with the crank at the top of its stroke, this lowest position of the rocking lever and hammer is made constant, no matter what position the fulcrum B may have in the slot C. To obtain a short stroke and a light blow, the fulcrum is moved in the slot towards the hammer G; and to produce a long stroke and heavy blow the fulcrum is moved in the opposite direction. Fig. 3 gives the details of the pneumatic connection between the main piston and the hammer, in which packing and packing glands are dispensed with. The hammer G is of cast steel, bored out to fit the main piston F, the latter being also bored out to receive an internal piston L. A pin M, passing freely through slots in the main piston F, connects rigidly the internal piston L with the hammer G. When the main piston is raised by the rocking lever, the air in the space X, between the main and internal pistons, is compressed, and forms an elastic medium for lifting the hammer; when the main piston is moved down, the air in space Y is compressed in its turn, and the hammer forced down to give the blow. Two holes drilled in the side of the hammer renew the air automatically in the spaces X and Y, at each blow of the hammer. Figs. 4 to 6 represent the medium size forging hammer, for making forgings in dies, swaging and tilting bars, and plating edge tools, &c. The hammer weighs 1 cwt., has a stroke variable from 4in. to 14½in., and gives 200 blows per minute; the compressed air space between the main piston and the hammer is sufficiently long to admit forgings up to 3in. thick under the hammer.

The movable fulcrum B, Figs. 4 and 5, consists of two adjustable steel pins, attached to the fulcrum lever Q, and turned conical where they fit in the socket D. The fulcrum lever is pivotted on a pin R fixed in the framing of the machine, and is connected at its lower extremity to the nut S, in gear with the regulating screw T. The to-and-fro movement of the fulcrum lever Q, by which heavy or

FIG. 4

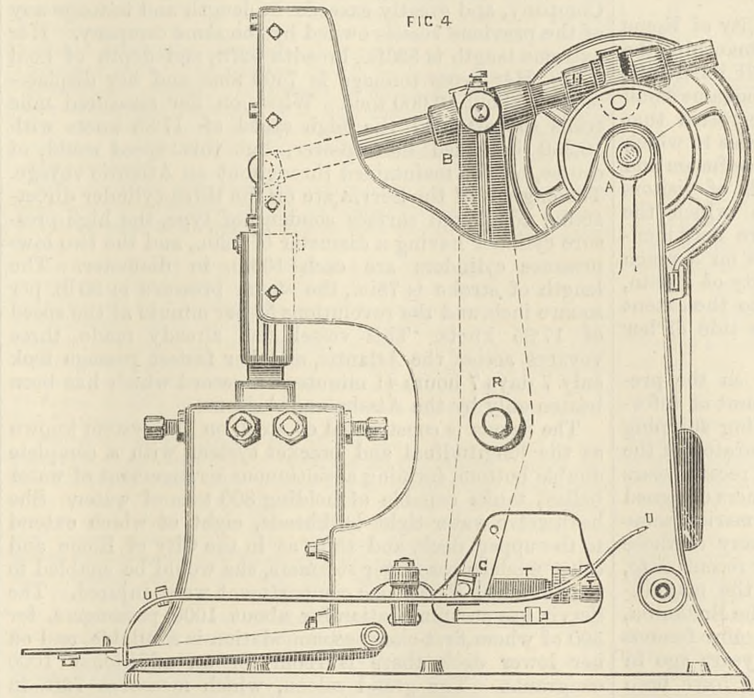
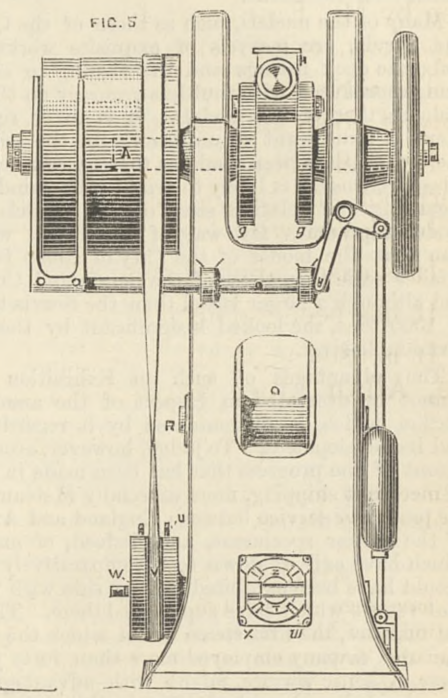


FIG. 5



light blows are given by the hammer, is placed under the control of the foot of the workman, in the following manner:—U is a double-ended forked lever, pivotted in the centre and having one end embracing the starting pedal P, and the other end the small belt which connects the fast pulley on the driving shaft A with the loose pulley V, or the reversing pulleys W and X. These are respectively connected with the bevel wheels W_1 and X_1, gearing into and placed at opposite sides of the bevel wheel Z, on the regulating screw in connection with the fulcrum lever. When the workman places his foot on the pedal P to start the hammer, he finds his foot within the fork of the lever U; and by slightly turning his foot round on his heel he can readily move the forked lever to the right or left, so shifting the small belt on to either of the reversing pulleys W or X, and causing the regulating screw T to revolve in either direction. The fulcrum lever is thus caused to move forwards or backwards, to give light or heavy blows. By moving the forked lever into mid position, the small belt is shifted into its usual place on the loose pulley V, and the fulcrum remains at rest. To fix the lightest and heaviest blow required for each kind of work, adjustable stops are provided, and are mounted on a rod Y connected to an arm of the forked lever. When the nut of the regulating screw comes in contact with either of the stops, the forked lever is forced into mid position, in spite of the pressure of the foot of the workman, and thus further movement of the fulcrum lever, in the direction which it was taking, is prevented. The movable fulcrum can also be adjusted by hand to any required blow, when the hammer is stopped by means of a handle in connection with the regulating screw.

Mr. David Joy asked whether Mr. Longworth had found any similar difficulty with the bar E E, Fig. 1, which transmitted the power from the excentric to the hammer bar, that is, whether or not the jar of the shock caused it to suffer. He did not think there could be the least trouble with the piston or any other parts of the machinery. The question with him was whether the elasticity of the air in the two cylinders X and Y so took away the shock from the rest of the machinery as to protect the bar E E from damage.

Mr. J. J. Smyth said he had two steam hammers, one ½ cwt. and one 1½ cwt. The 1½ cwt. hammer, used for making axles, had been at work, he believed, some nine or ten years; the cylinder had not required re-boring, and the only expense they had been put to was for new piston rings. Provided a power hammer of that class could work with equal economy as to repairs, it would be decidedly more economical of steam than a steam hammer.

Mr. Paget asked a question as to the statement, "the heavy blows are given at a slower rate than the light ones, owing to the greater resistance which they offer to the driving belt." He presumed what was really implied by this was that the driving belt slipped with the heavy blows, and that meant a heavy wear of belt and great loss of power.

Mr. Longworth, in reply to the discussion, said, with reference to Mr. Joy's remarks about the strain upon the bar, there had never been any trouble with regard to that point. In the first hammers he had made it was thought necessary, simply from custom, to put in piston rings, but afterwards they were entirely dispensed with, and there were no rings in the hammers now made. With reference to the belt, there was of course some slipping, as Mr. Paget had suggested, and if that were continued very long it would have a wearing effect upon the belt, but it was only occasional, for it was only when the hammer was wanted to go slow, for one or two heavy blows, at the commencement of a forging, that any slip took place. The hammers had not been used for forging small bolts and nuts; they had been used principally for forging in dies. Messrs. Avery, of Birmingham, were using them for that purpose very successfully.

MERCHANT STEAM VESSELS AT THE SHIPWRIGHTS' EXHIBITION.

No. I.

NOT the least attractive of the many objects of interest on view at the Shipwrights' Exhibition, Fishmongers' Hall, is the large collection of models of passenger and cargo-carrying steamers belonging to the mercantile marine of this country. Among the principal of these are several of the recently-constructed large passenger vessels, such as the City of Rome and the City of Berlin, of the Inman Line of steamers, trading between Liverpool and New York; the Britannic and Germanic, of the White Star Line, trading between the same ports; the Alaska, of the Guion Line; the Servia belonging to the Cunard Company, also engaged in the Transatlantic trade; the Ravenna, Clyde, and India, of the Peninsular and Oriental Company, built for the East India and Australian mail trades; the Moor, Trojan, and Athenian, of the Union Steamship Company, trading between Southampton and the Cape; and the Garth Castle and Drummond Castle, lately added to Messrs. Donald Currie and Co.'s Cape Line of steamers. Of the remainder, several are types of cargo-carrying vessels employed in the North Atlantic and East Indian trades. Others, such as the Monarch Line of steamers, trading between London and New York, have been designed to carry passengers, cargo, and cattle.

Among the shipbuilders who have sent models of vessels built by them are Messrs. Denny and Brothers, of Dumbarton, who exhibit models of three vessels enumerated above built for the Peninsular and Oriental Company. Also models of the Bhundara, built for the British India Steam Navigation Company; the Rotomahana and Mahinapua, built for the Union Steamship Company of New Zealand; and the Tridente built for service in South America. It is of interest to note that the whole of these vessels are constructed of mild steel, which material Messrs. Denny have used to a greater extent, we believe, than any other shipbuilders in the country.

Messrs. J. and G. Thomson, of Clyde Bank, exhibit a model of the Servia recently built by them for the Cunard Company; and of the Moor, built for the Union Steamship Company's service between England and South Africa. Other vessels built by Messrs. Thomson are exhibited by the owners.

Messrs. R. Napier and Son, of Glasgow, exhibit a half model of the Parisian, built of steel in 1880 for the Allan line of Transatlantic steamers. A model also of the Aberdeen, a highly successful vessel whose engines we illustrated in our issue of the 28th ult., is entered by the owners, Messrs. George Thompson and Co., for competition in Section B, Class 3, for steamers engaged in the Eastern trade.

Messrs. Archibald, McMillan, and Sons, of Dumbarton, exhibit five models of steamers. Of these one represents the Clan Buchanan and Clan Drummond recently built for Messrs. Cayser, Irvine, and Co.'s Clan line of steamers; another represents the Amsterdam and Edam, built for the Netherlands American Steam Navigation Company, and employed in the American trade; a third model represents the Stamboul, built for a Marseilles company; another represents the Lydian Monarch and two sister vessels, built for the Royal Exchange Shipping Company; and a fifth represents the Diolibah, built for a Marseilles firm. In addition to the above, Messrs. McMillan have entered for competition in Section B, Class 1, the model of a twin screw steam vessel for the transatlantic mail and passenger service. The dimensions of this vessel are—length, 600ft.; breadth, 70ft.; and moulded depth, 37ft. 9in. The gross tonnage is estimated at not less than 10,000 tons. Her indicated horse-power is 20,000, which it is calculated will give an ocean speed of 20 knots per hour.

Messrs. John Elder and Co., of Fairfield, Glasgow, exhibit models of the Alaska, built for Messrs. Guion and Co.; of the Imperial yacht Livadia, built for the late Emperor of Russia; and of the Stirling Castle, recently built for Messrs. Thomas Skinner and Co., for the China tea trade. The latter vessel, it may be remarked, has, so far, been highly successful, having on her trial trip attained a speed of 18½ knots with 8500 indicated horse-power. Another fast vessel, the Austral, completed recently by this firm for the Orient Steam Navigation Company, trading between London and Australia, is entered for competition in Section B, Class 2.

The Barrow Shipbuilding Company contributes the model of the City of Rome, already mentioned; a model of the paddle steamer Adelaide, built for the Great Eastern Railway for service between Harwich and Rotterdam; and a model of the screw yacht Aries, built for Sir James Ramsden.

Messrs. Short Brothers, of Sunderland, enter for competition in Section B, Class 3, a model of a large cargo-carrying steam vessel, for trade between Europe and the East, *viâ* the Suez Canal; and in Class 4 of the same section, models of three other vessels, two of which are for the Black Sea trade, and the other—a self-trimming collier—for the Baltic.

Many of the models, such as those of the City of Rome and Servia, are marvels of exquisite workmanship, the elaborate deck fittings and the rigging in all its details being reproduced with faultless accuracy on the same small scale as that of the models. It is to be regretted that there is some want of uniformity in the scales to which the models have been made, as thereby some confusion and misapprehension is likely to arise in the minds of visitors regarding the relative sizes of the vessels which the models represent. By way of illustration we may mention that the model of the City of Rome is on a much smaller scale than those of the Servia and City of Berlin, and although a larger vessel than the Servia to the extent of 1000 tons, she looked insignificant by the side of her formidable rival.

The advantages of such an Exhibition as the present cannot be overrated in respect of the amount of information which is disseminated by it regarding shipping and its development. To judge, however, accurately of the extent of the progress that has been made in recent years in merchant shipping, more especially in steamers designed for passenger service between England and America, some of the earlier specimens, and, indeed, of many of those which have existed down to a comparatively recent date, should have been exhibited side by side with the magnificent vessels which have superseded them. The Britannia, for instance, the first steam vessel which the now famous Cunard Company employed more than forty years ago in their Atlantic service, might with advantage have been placed side by side with the Servia, the Cunard Company's latest addition to their fleet. The Britannia was a wood-paddle steamer of 1155 tons, and carried 90 passengers and 225 tons of cargo. She attained an average speed of 8½ knots per hour, and made the passage to America in fifteen days.

Her latest successor—the Servia—has a gross tonnage of 7400 tons, and she carries 3000 tons of cargo and 2000 tons of coal, in addition to 1000 passengers. She has attained a speed of 17·85 knots on the measured mile, and crossed the Atlantic recently in seven days seven hours and forty-one minutes, thus making the voyage in half the time taken by the Britannia. The Great Western, too, another wood paddle vessel, built by Patterson, of Bristol, in 1837, for the Great Western Company, and which earned a great name by making the voyage to America in fifteen days—an unprecedentedly short time—might with appropriate fitness have been represented in the list of models exhibited, together with some of the sailing passenger vessels, which not unfrequently took nearly six months in which to make a voyage which is now often completed in little more than a week.

The first of the models to which we would draw the attention of our readers is that of the City of Rome—exhibit No. 296. This vessel, the model of which is shown by the builders—the Barrow Shipbuilding Company—was launched last year, and is, next to the ill-fated Great Eastern, the largest vessel afloat. Her length over all exceeds 600ft. Her breadth is 52ft. 3in., and her depth of hold is 37ft. The gross tonnage is 8415 tons, and the displacement is 13,450 tons. Her engines, which are also manufactured by the Barrow Shipbuilding Company, are compound-inverted, direct-acting, surface condensing, with six cylinders, the diameter of each of the three high-pressure cylinders being 43in. and of the low-pressure cylinders 86in. The length of the stroke is 72in., and the steam pressure 90 lb. per square inch. She has eight boilers; cylindrical return-tubular, fired from both ends. The propeller is four-bladed, and has a diameter of 24ft. Her engines are capable of developing 10,000 indicated horse-power, with an estimated speed of 18 knots. The vessel has already made two passages across the Atlantic, and has lately arrived at New York after a voyage of about eight days. The excellent workmanship in the model of this vessel we have previously alluded to. Her appearance, which is enhanced by the elegant clipper bow, is, we think, all that can be desired, her graceful outline reminding one of a pleasure yacht. The City of Rome is constructed of iron with the ordinary system of transverse floors and framing, but her plating, instead of being arranged with raised and sunken strakes in the way now usual in shipbuilding, is worked flush upon the frames with doubling strakes along all the longitudinal seams—a plan which is of great strength, and which has been adopted by the Barrow Company in building previous vessels for the North Atlantic trade. She is divided into eleven water-tight compartments, so that should any one compartment be pierced through collision, grounding, or otherwise the vessel would still be able to keep afloat; and in the event of her machinery becoming disabled she has sufficient sail power to enable her to proceed on her voyage under canvas alone. The vessel has four decks, three of which are of iron. Being of such great length, especial care was necessary in preparing her design to insure sufficient longitudinal strength to resist the enormous strains to which she will be subject when crossing large Atlantic waves, and she has been built to receive the highest class at Lloyd's. She has a water ballast tank capable of holding nearly 380 tons of water for trimming purposes. The City of Rome has spacious passenger accommodation. Her state rooms are capable of receiving 290 saloon passengers. In addition she has sleeping quarters on the main deck alone for 500 emigrants, and 1000 more could be carried on the lower deck. The saloon is 72ft. in length; it extends from side of the vessel, and can accommodate about 250 people at dinner. The state cabins of the saloon passengers are somewhat larger than usual, and of great height, there being a distance of about 9ft. between decks. Above the upper deck is a promenade deck carried out to the sides amidships, and enclosing officers' cabins, saloon, galley, &c. The ends of the vessel are protected from head and following seas by a forecastle and a turtle back poop.

The Servia, exhibit No. 293, the model of which is not entered for competition, was built last year by Messrs. J. and G. Thomson, of Clydebank, for the Cunard Company, and greatly exceeds in length and tonnage any of the previous vessels owned by the same company. Her extreme length is 530ft., breadth 52ft., and depth of hold 37ft. Her gross tonnage is 7400 tons, and her displacement is about 13,000 tons. When on her measured mile trials she attained the high speed of 17·85 knots with 10,350 indicated horse-power, but this speed could, of course, not be maintained throughout an Atlantic voyage. The engines of the Servia are of the three-cylinder direct-acting compound surface condensing type, the high-pressure cylinder having a diameter of 72in., and the two low-pressure cylinders are each 100in. in diameter. The length of stroke is 78in., the steam pressure is 90 lb. per square inch, and the revolutions 53 per minute at the speed of 17·85 knots. This vessel has already made three voyages across the Atlantic, and her fastest passage took only 7 days 7 hours 41 minutes—a record which has been beaten only by the Alaska and Arizona.

The Servia is constructed of steel, on the system known as the longitudinal and bracket system, with a complete double bottom, forming a continuous arrangement of water ballast tanks capable of holding 800 tons of water. She has twelve water-tight bulkheads, eight of which extend to the upper deck, and thus, as in the City of Rome and other modern passenger steamers, she would be enabled to remain afloat if any one compartment were injured. The Servia has accommodation for about 1000 passengers, for 500 of whom first-class accommodation is available, and on her lower deck there is room for an additional 1000 emigrants. The grand saloon, which measures 72ft. in length and 50ft. in breadth, is capable of accommodating 350 people at dinner; and the vessel generally is most luxuriously furnished. The appearance of the Servia afloat is very unlike that of the City of Rome, on account principally of her stem being nearly upright, and without any of the projection or overhang which forms so attractive a feature in the appearance of the latter vessel.

The sister vessels, Britannic and Germanic, two of the most successful of modern passenger vessels trading between England and America, are represented by models No. 19, Section B, Class 1, exhibited for competition by the owners, Messrs. Ismay, Imrie, and Co., of the White Star Line. The Britannic was built by the eminent firm of shipbuilders, Messrs. Harland and Wolff, of Belfast, in 1874, and the Germanic by the same firm a year later. Their principal dimensions are: Length between perpendiculars, 455ft.; length over all, 468ft.; breadth extreme, 45ft. 3in.; and depth of hold, 34ft. The gross register tonnage is 5000 tons, and the displacement on a draught of water of 23ft. 7in. is 8500 tons. They are constructed of iron, on what is known as the transverse or ordinary system of framing, and are divided into numerous water-tight compartments by transverse bulkheads. Their engines are compound, vertical, direct-acting, with four cylinders, the two high-pressure having a diameter of 48in., and the low-pressure a diameter of 83in. The length of the stroke is 60in., and the working pressure in the boilers is 65 lb. per square inch. Each vessel has eight boilers, each boiler being fired from both ends. The propeller has a diameter of 23ft. 6in., with a pitch of 31ft. 6in., and makes fifty-two revolutions with 4900-indicated horse power. When the Britannic was built, the propeller was fitted in such a manner as to enable it to be lowered when at sea. The supposed advantages of this plan, which was suggested by Mr. Harland, the senior partner of the firm of Messrs. Harland and Wolff, were that the propeller would work in comparatively undisturbed water, and would be therefore more efficient, and that the racing of the engines, which takes place when the vessel is pitching heavily, would be avoided, as the propeller would be kept well below the surface of the water. It was found, however, that there were many disadvantages connected with this plan, and the Britannic has now been fitted with a propeller in the ordinary way. For some years these two vessels have been among the fastest of the passenger vessels trading between Liverpool and New York. It is on record that the Britannic made the passage from New York—Sandy Hook—to Queenstown, a distance of 2882 knots, in 7 days 12 hours 41 minutes, with an average speed of 15·95 knots per hour; and the Germanic, in April, 1877, made a passage from Queenstown to New York in 7 days 11 hours 37 minutes, covering a distance of 2830 knots, with an average ocean speed of 15·75 knots per hour. Each of these vessels has accommodation for 1300 passengers. Like other passenger steamers of large size, they have extensive deck houses covered by a promenade deck extending to the sides for a part of the length amidships, and a turtle back forecastle and hood have been fitted for protection against head and following seas.

In our next impression we shall speak of other models, which our space compels us to leave at present.

LEGAL INTELLIGENCE.

HIGH COURT OF JUSTICE.—CHANCERY DIVISION.

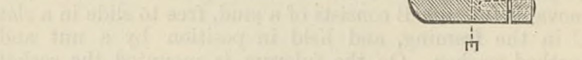
(*Before Mr.* JUSTICE FRY.)

UNITED TELEPHONE COMPANY *v.* HARRISON.

IN our last impression we gave a summary of the case of the United Telephone Company *v.* Harrison, Cox-Walker, and Co. We propose here to try and make the precise point at issue intelligible to our readers, the question raised being one of much importance to all makers and users of telephones. Put into the shortest possible form, the case is that the United Telephone Company is the owner of two patents—one by Bell and the other by Edison—and the defendants are owners of a patent by Mr. Hunnings for a transmitter, which is said to infringe both Bell's patent and Edison's. It is alleged to infringe Bell's patent because Mr. Hunnings uses a diaphragm, and to infringe Edison's because Mr. Hunnings uses carbon as used by Edison. The defendants assert that they do not use either a diaphragm or carbon as used by Bell and Edison; and they assert furthermore, as we have already set forth, that the patents of Bell and Edison are not valid, the inventions having been anticipated or published in this and other countries. It will be well to glance briefly at the history of the telephone before going further. In 1854 M. C. Bourseul suggested that by the aid of electricity words spoken in Vienna might be heard in Paris; and to effect this he proposed the use of a flexible disc to be spoken to, which disc would make and break the currents from a battery, and so cause the similar movement of a second disc, at which the listener should stand. Nothing came of this suggestion. In 1837 Page discovered that an electro-magnet emits a sound when it is magnetised and demagnetised. In 1860 Reis combined the ideas of Bourseul and the discovery of Page to make an apparatus for transmitting musical sounds. From 1870 to 1876 Gray and Varley took out several patents for telephones which would transmit musical notes. It was a long time before it was found out that articulate sounds cannot be transmitted by make-and-break instruments. What is required in every articulating telephone is that the current of electricity while always flowing, shall vary in intensity by infinitesimal gradations. Both Gray and Bell seem to have hit on this point at the same time independently, but Gray's telephone was not a practical instrument, while we all know that Bell's is.

The principle involved is fairly well known, but may as well be again stated here. Fig. 1 is a sketch of an ordinary

FIG. 1.



Bell telephone. A magnet C has a coil of wire B put round one end. In front of the magnet is a thin disc of iron P. When the iron is spoken to it vibrates freely to and from the magnet, but it affects the magnet by induction, altering the shape of the magnetic field, and so causing magnetic currents to cross the coils of insulated wire. The result is that currents are induced in the coil. These re-act on the magnet at the other end of the circuit through the wires F F^1. D is a regulating screw, A mouth-piece, E case. Thus, when the tympan or plate of iron at the transmitter moves in, the tympan in the other or speaking instrument is also pulled in, and *vice versâ*. Thus, the vibrations of the instrument spoken to are reproduced by the instrument at the ear of the listener, and so speech is transmitted. This is Bell's telephone, which requires no battery. It is complete in itself, each instrument being competent to work as either transmitter or receiver.

But Bell's telephone speaks in a very low tone—little above a loud whisper—and various attempts have been made to improve it. The object is partially effected by making a current of electricity from a battery pass constantly through the circuit. This supplies more force than can be got out of two little permanent magnets, so the range of vibration is amplified, and the instrument speaks more loudly. But modifications were also made in the transmitter, the diaphragm or tympan being increased in size, and then one transmitter and two receivers—one for each ear—are needed at each end of the circuit. The following extract from Bell's—Morgan-Brown's—specification, No. 4765, 1876, will make the points raised in this trial clear:—

"This invention relates to the reproduction by the necessary receiving instruments of any particular sounds or combinations of sounds through the agency of an electric current, whereby a multiplicity of telegraphic messages may be sent simultaneously over a single circuit in the same or in opposite directions, and received without confusion, and whereby articulate speech may be electrically transmitted. The invention relates to the production or transmission of musical notes by means of undulatory currents of electricity, one battery being used for the whole circuit, whereby two or more telegraphic signals or messages can be transmitted simultaneously over a single circuit in the same or in opposite directions. The invention also relates to the electrical production or transmission of sounds of every kind by means of undulatory currents of electricity, whereby not only musical sounds but articulate speech can be transmitted over a telegraph line, and two or more messages be simultaneously sent over a single circuit in the same or in opposite directions. The invention also relates to the electrical production or transmission of sounds of every kind without a battery by means of undulatory currents of electricity, whereby not only musical notes but articulate speech can be transmitted over a telegraph line, and two or more messages be sent simultaneously over a single circuit in the same or in opposite directions. The invention also relates to the automatic reception of signals or messages by introducing at the receiving end of the line a local circuit containing a vibratory circuit breaker, whereby telephonic signals or messages may be automatically recorded. The invention also relates to the application of electric telephony to autographic telegraphy, whereby characters or marks of any description may be copied in *fac-simile* at the receiving end of the line. In the first three plans described in this specification a separate instrument is employed for every pitch, and the electric vibrations for different pitches are combined upon the wire, each armature being capable of transmitting or receiving but a single note, and thus as many separate instruments are required as there are messages or musical notes to transmit. In the fourth part of the invention a single instrument is employed, the armature of which can be set in vibration by a musical instrument or by the tones of the human voice, or by any sound whatever. The telephones are illustrated in Figs. 2 and 3. One of the ways in which the armature may be set in vibration has been stated to be by wind. Another mode is shown in Fig. 2, whereby motion can be imparted to the armature by the human voice, or by means of a musical instrument, or by sounds of any kind. The armature A is fastened loosely by one extremity to the uncovered leg *h* of the electro-magnet E, Fig. 3, and its other extremity is attached to the centre of a stretched membrane *n*. A cone C^2 is used to converge sound vibrations upon the membrane. When a musical note is made in the neighbourhood of the membrane *n* it is set in vibration, the armature A is forced to partake of the motion, and thus electrical undulations are created upon the circuit G, B, E, W, E^1, G^1. The armature A^1 is thus thrown into synchronous vibration with the armature A, emitting a musical note of similar pitch to that which originated the vibration of armature A. If two or more musical notes be simultaneously sounded in the neighbourhood of the cone C^2, the resultant motion of the air is copied by the membrane n to which the armature A is attached, and this armature A, acting inductively upon the current traversing the coils of the electro-magnet E, occasions an increase and diminution in its intensity, and the armature A^1 is thrown into vibration by the varying attraction of the electro-magnet E^1 to which it is attached, and thus imparts to the air at n^1 a *fac-simile* copy of the motion of the air that acted upon the membrane n. Hence two or more musical notes or telegraphic messages can be sent simultaneously along a single circuit from one station to another by means of one instrument at each station. Instead of the cone membrane and armature shown in Fig. 2 a plate of thin steel may be used; the vibrations of the plate in front of the magnet occasioned by the motion of the air during the production of sound changes the intensity of the current, and occasions a similar motion in a similar steel plate in front of another electro-magnet at another station in the circuit. Such a plate is shown in Fig. 3, it being attached to a frame. This invention is not limited, however, to the use of a steel plate, but includes within its scope any material capable of inductive action upon a current of electricity. In the telephone shown in Fig. 4 the magnet may be of the horseshoe form as shown at 24, and the coils of insulated wire 25 may surround soft iron cores or pole pieces 26, screwed or otherwise fastened to the ends of the magnet 24. The cores or pole pieces are placed near the face of the metallic plate A^3, it being attached to a cup-shaped block 28, having a central orifice 29 for the reception of a speaking or hearing tube to convey sounds to or from the plate A^3. The magnet is attached to a stud 30 adapted to be moved in suitable grooves in the base 31 by means of a screw 32 having its end connected with the stand, the body of the screw being fitted to turn in a screw threaded stud. The movements of the screw are just the distance between the pole of the magnet and the plate A^3, and permit the poles to be placed almost in contact with the plate. The coils may be placed about the ends of the magnet 24, and the soft iron pole pieces be omitted. The coils will preferably be very thin, and be placed at the extremity or extremities of the magnet. One, two, or more magnetic poles with coils may be placed near a plate to intensify the effect. The soft iron core and coil may be attached to the plate instead of the magnet, or the core may be placed upon the plate, and the coil on the magnet, or *vice versâ*. The magnet may be made to vibrate instead of the plate."

FIG. 2.

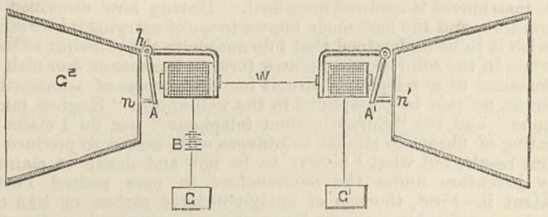


FIG. 3.

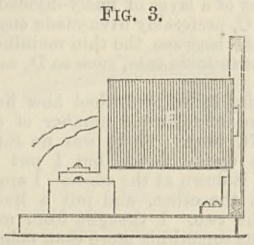


FIG. 4.

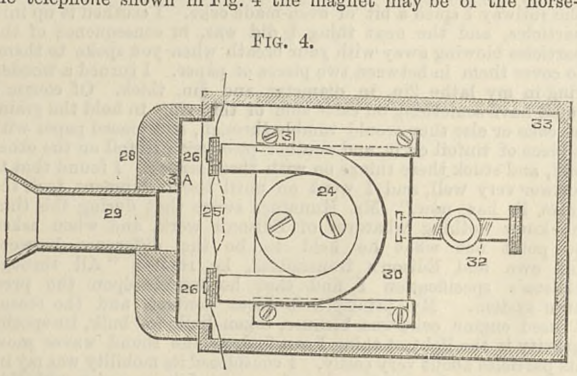
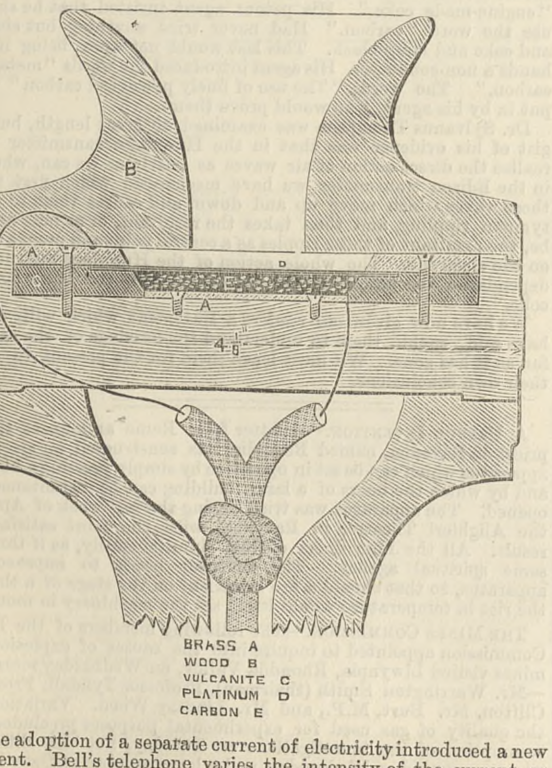


FIG. 5.



BRASS A
WOOD B
VULCANITE C
PLATINUM D
CARBON E

The adoption of a separate current of electricity introduced a new element. Bell's telephone varies the intensity of the current, as we have said, by altering the shape of the magnetic field by the aid of an iron tympan vibrating in that field. But Edison discovering that the conducting power of carbon varies with the pressure put on it, constructed a telephone in which a lozenge of carbon is pressed on gently by a tympan. There is no magnet. The current flowing in the circuit between the two telephones passes through the carbon lozenge, and its rate of passage is modified by the greater or less pressure on the carbon, caused by the vibration of the diaphragm, or tympan. At the receiving end is an instrument which has a magnet, whose strength varies with the intensity of the current, and so causes a tympan to vibrate or speak.

In Fig. 5 we illustrate Hunnings' instrument, which the plaintiffs assert is an infringement. This instrument was patented by Mr. Hunnings, who is a clergyman, on the 16th of September, 1878, about fourteen months after the date of Edison's patent. Mr. Hunnings states that his apparatus consists of one or two vibrating diaphragms, composed wholly or in part of suitable metal, such as, preferably, platinum, silver, ferrotype iron, tinned iron, &c., placed in close proximity to each other, and connected respectively with the opposite poles of a galvanic battery. The receiving telephone being in circuit, the intervening space is filled with carbon or other suitable conducting substance—preferably in the form of powder—and about $\frac{1}{16}$in. in depth. The whole is secured in a box of suitable non-conducting material with a mouthpiece. The great feature claimed by Mr. Hunnings is the use of carbon in a state of fine loose powder, not in any way compressed or consolidated. Mr. Hunnings does not claim the principle of using carbon in the solid or consolidated form to increase or diminish the resistance of a telephonic current for the purpose of transmitting sounds, as this is well exemplified in the well-known Hughes microphone and the Edison carbon telephone; but he does claim the use of finely powdered carbon in the loose or free state as a means of varying the resistance of a telephonic circuit by the vibrations of a thin metallic diaphragm enclosing it, controlled by the sound waves impinging on it. The receiver used is known as the Cox-Walker electrophone receiver. It consists of an electro-magnet, having the poles in close proximity to a thin circular plate of ferrotype iron. This receiver must necessarily be used with a transmitter producing undulations in a continuous current and not an alternating current.

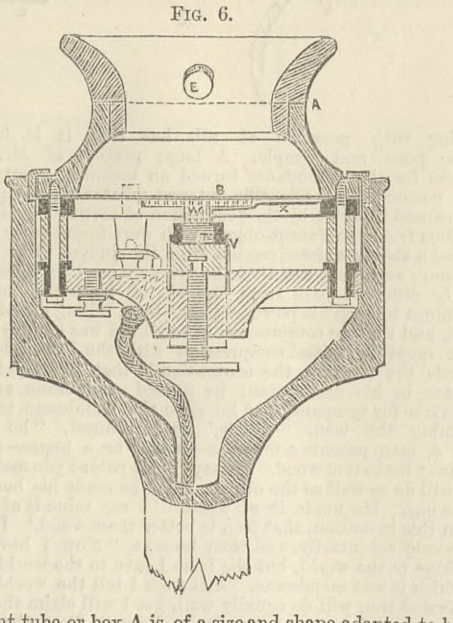
Thus it will be seen that the point made by the defendants is that they use powdered carbon, by preference engine coke crushed but not ground fine, whereas Edison uses carbon in a consolidated form.

We have already given the claims of the Bell patent, and before considering those made by Edison, it will be well to point out that they are said to cover the use of a diaphragm in a telephone, the eleventh claim running, "The combination with an electro magnet of a plate of iron or steel, or other material capable of inductive action, which can be thrown into vibration by the movement of surrounding air, or by the attraction of a magnet." It is of course alleged by the plaintiffs that such a plate is found in the Cox-Walker receiver.

We come now to Edison's patent. When it was acquired by the plaintiffs, they found that it contained certain claims, concerning the validity of which they were doubtful. Accordingly disclaimers were filed, and as the specification now stands nothing is claimed save a mica diaphragm, the electric tension regulator, and the well-known phonograph. The so-called tension regulator is the carbon button or lozenge before referred to. The following extract from Edison's patent, No. 2909, 1877, will make matters clear:—

"This invention relates to that class of electrical instruments in which sound becomes one of the elements in the transmission of the communication, and the same sound is produced at the receiving station, so that oral communications can be sent by electricity and clearly distinguished at the receiving station. In my present invention I make use of the vibrations given to a diaphragm or tympan, by speaking into a resonant case, to produce a rise and fall of electrical tension upon the line with such accuracy that the electric pulsations or waves will represent the atmospheric sound waves produced by articulation, and the electro-magnet at the receiving station will respond to the electric waves in such a manner as to reproduce the articulation by acting upon a resonant plate. The instrument in a complete form is represented in Fig. 6, being a section of the transmitting instrument.

FIG. 6.



The resonant tube or box A is of a size and shape adapted to being spoken into, the same having an opening at one end or side and a diaphragm or diaphragms B, against which the sound waves from the human voice act, and these and the motion that the diaphragm receives is the means of producing a rise and fall of electric tension on the line by the devices hereafter set forth, so that the battery connected to the line will transmit a greater or less current to the distant electro-magnet, and increase or lessen the magnetism of the cores, and in so doing act upon a resonant plate and develope sound corresponding to the articulation at the transmitting station. For convenience the speaking instrument, Fig. 6, is provided with a handle and flexible conductors to the battery and line respectively, so that it may be handled and brought to the mouth. Many materials have been employed by me, such as metals, horn, vellum, celluloid, ivory, &c., but almost all of these produce a prolonged or secondary vibration from their own resonant character, hence the articulation is defective, and the sound vibrations blend. After extensive experiments I find that mica is almost entirely free from any resonant action, and hence it will respond with the greatest accuracy to the sound vibrations, and being of a laminated character can be employed of any desired thickness, and when secured at its edges responds with the greatest accuracy to the sound vibrations, and does not require to be strained; furthermore, the changes of temperature and atmospheric condition have little or no effect upon the mica diaphragm or tympan. I find that it is not practical to open and close the line circuits in instruments for transmitting the human voice; the circuit to the line must be always closed, and the transmission be produced by a rise and fall of electric tension, resulting from more or less resistance in the line. This resistance may be produced in several ways. I have shown several which will hereafter be named, but I find the most delicate to be small bunches or tufts, or discs of semi-conducting elastic fibre, such as particles of silk, and an intermediate conducting or semi-conducting material. This device I call an electric tension regulator; it is more or less compressed, according to the vibrations of the diaphragm or tympan, and the electric current rises in tension as it is compressed or lessens as the fibre expands. This fibre is placed in a small roll between a delicate diaphragm spring, and a variable presser, adjustable by screw or otherwise in the electric circuit at this point, or it may be within a cavity in said presser V, as in Fig. 6, there being a delicate cork centre piece W to the diaphragm B, with a piece of platina foil X in contact with the fibre. In all instances the telegraphic circuit at the diaphragm is made by a thin strip of platina or similar material extending to the centre from the line or battery connection. The fibre is rendered semi-conductive by being rubbed with plumbago, soft metal, or similar material, or by a deposit of metal upon its surface, or by fine particles of conducting or semi-conducting material mixed with it, the conducting power varying with the density of the tuft or bunch of fibre. I sometimes arrange the battery in connection with the transmitting instrument as shown in Fig. 7. h is the resonant chamber, at the end of which is the diaphragm 10, and at each side of this diaphragm there are springs c^2 c^3, having points made of compressed plumbago mixed preferably with gum rubber, but any substance not liable to rapid decomposition, or the elastic or fibrous tension regulator aforesaid may be used. These points face each other on opposite sides of the diaphragm, and make contact with platina foil discs secured to the diaphragm. The spring c^2 passes through a hole or small slot in the side of the chamber h. d^2 d^3 are the main batteries. The battery d^2 has zinc to the line or spring c^2, and the battery d^3 has copper to the line or spring c^3. When the springs c^2 and c^3 are adjusted to make contact with the diaphragm equally, no current passes to the line; but when the diaphragm is vibrated its movement to one side, say c^2, causes a greater pressure upon the plumbago on that spring, and a lessening of the pressure on the plumbago on c^3; hence the balance of the batteries c^2 and c^3 will be destroyed, c^2, having the advantage, will send a negative current to line; upon the return of the diaphragm the battery currents will again neutralise each other. The vibration of the diaphragm to the other side causes the pressure to be reversed, and the battery d^3 will send a positive current to the line. As the tension regulator of fibre or of plumbago decreases and increases its resistance enormously under slight changes of pressure, it follows that the strength of the electric waves will be in proportion as the speaker's voice is strong or weak. For repeating from one circuit into another I use with the receiving diaphragm the elastic tension regulator Fig. 6 in addition to the electro-magnet, and connect the relay or second circuit through the same, so that waves received from the distant station cause the magnet to vibrate the diaphragm, and this acting upon the tension regulator transmits the waves into the second circuit, and they are received at the other end by an electro-magnet and diaphragm. By placing the fibrous tension regulator within a small band of india-rubber the same is rendered more elastic, and the fibre is allowed to expand by the heat of the current without altering the electric tension. In cases where a strip of hard rubber or a cord of silk or other material coated with plumbago or metallic foil is introduced between the diaphragm and a rigid support, the expansion and contraction due to the passage of the electric currents will produce a movement upon the diaphragm corresponding to the diaphragm producing the electric pulsations. In some instances the diaphragm should be free to vibrate without being checked by contact with any stationary substance. I provide for this by placing upon the diaphragm or tympan 10, Fig. 8, a small cylinder t^7 of hard rubber or non-conducting material, within which is the fibrous tension regulator t resting upon a piece of platina foil connected to one pole of the battery, and within this cylinder t^7 is a disc t^{10} of iron or other metal, loose, but pressed towards the tension regulator by a spring t^8 and screw cap t^9, and the other electric conductor is connected with said spring. The inertia of the metal disc causes more or less compression of the tension regulator as the diaphragm is vibrated, and hence the electric pulsations are sent over the line in harmony with the vibrations. Nearly the same effect is produced by connecting the disc t^{10} to a yielding spring that extends across from one edge of the diaphragm to the other, as seen in Fig. 9. This construction of tension-regulating device is especially available with large diaphragms. In some cases I use a soft rubber diaphragm immediately in contact with the transmitting or receiving diaphragm, so as to check or dampen any prolonged or false vibration, and render the sound more clear and free from prolonged tones. In preparing the tension regulator I find in some cases that it is preferable to use lampblack mixed with pure plumbago, amorphous phosphorus, and a very small amount of non-conducting material, such as rubber dissolved in a solvent that will entirely evaporate."

FIG. 7.

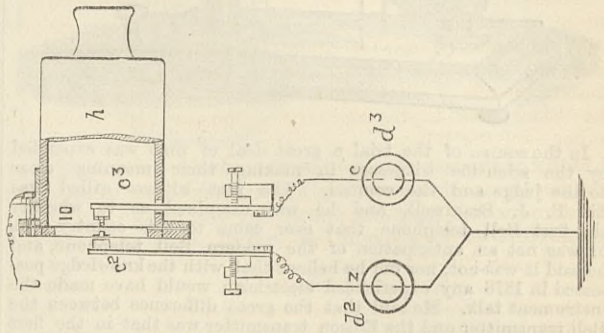


FIG. 9.

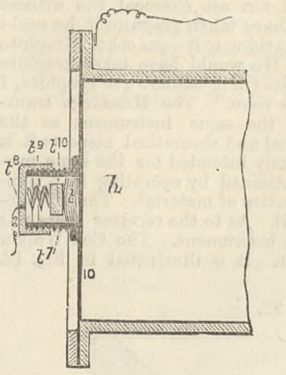
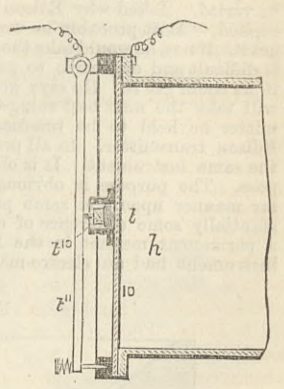
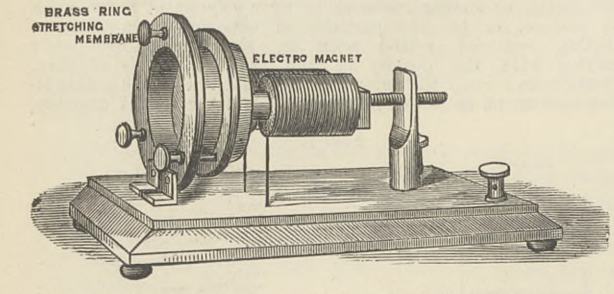


FIG. 8.



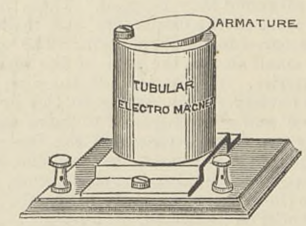
We have already described the grounds on which the defendants dispute the claim of the plaintiffs. The point on which they insist most strongly is that the Bell telephone having been publicly exhibited and described in this country before the patent for it was secured, a valid patent could not subsequently be obtained. It will be understood also that a good deal turns on whether Mr. Reis' telephone anticipated Bell's. But Reis could only transmit musical notes, not articulate sounds. Thus a man might transmit the musical notes of a song, but not the words, by singing into the transmitter. Is there or is there not a substantial difference between this and the transmission of articulate sounds? As the case is still *sub judice* we, of course, express no opinion on this point. There can be no doubt that Sir William Thomson brought with him from America the first speaking telephone that Bell had made, which is illustrated by Figs. 10 and 11, and in his address to the Mathematical Section of the British Association, in 1876, he showed and described the Bell telephone, but he could not make it speak. Reliance is placed by the defendants on the fact that Mr. Conrad Cooke subsequently borrowed the instruments and illustrated and described them in *Engineering*; but Mr. Cooke could not make them speak, and understood them so little that he described them inaccurately. We believe we have now given the essential features of this most important case, but it must not be forgotten that the pleadings and evidence of witnesses fill already several large printed volumes, so that it is quite impossible for us to do more than indicate the nature of the arguments on both sides.

FIG. 10.



In the course of the trial a great deal of time was expended by the scientific witnesses in making their meaning clear to the judge and the counsel. The first witness called was Sir F. J. Bramwell, and he was examined as to whether the first Bell telephone that ever came to this country was or was not an anticipation of the modern Bell telephone, and he said it was not, nor did he believe that with the knowledge possessed in 1876 any experienced electrician would have made the instrument talk. He said that the great difference between the Bell transmitter and the Edison transmitter was that in the first the voice of the speaker had always to generate the electricity, but in the latter the speaker merely modifies it. He was disposed to

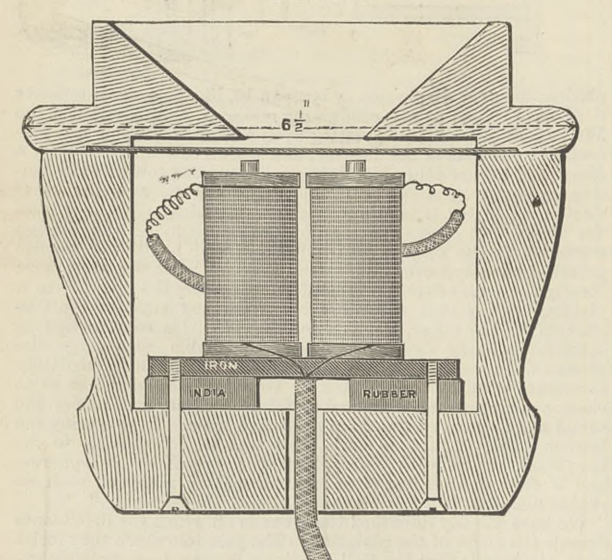
FIG. 11.



regard crushed coke as equivalent in all respects to lamp-black as used by Edison. He had heard an Edison instrument with loose lamp-black speak beautifully. Except for the convenience of putting it in nothing was gained by making the lamp-black into a lozenge. Had seen a good many instruments opened, and always found the lozenge reduced to powder.

Sir William Thomson was examined generally as to what he had seen and heard of the Bell telephone in the United States in 1879. He held that powdered lamp-black would work just as well as a lozenge. The resistance of carbon is about 600 times that of platinum, 4500 times that of copper. Solid carbon as used in electric light pencils may have a resistance 5400 times that of silver. With increase of pressure resistance is diminished. The automatic action of plumbago and other forms of carbon, as in the Edison instrument, depend on the molecular condition of the particles and the position in which they are put in circuit. Asked if the particles of carbon in the condition of plumbago were arranged in powder in a case, and particles of carbon in the shape of gas coke were arranged in precisely the same mechanical condition, the action would be quite of the same kind in both cases, and of the same degree. The diamond is the only known form of carbon which is a non-conductor. Edison's specification did not include the use of diamond. In 1877 Edison's specification would have guided a workman to use small particles of semi-conducting material, and to place them in such a way without any pressure of proximity or surface of contact. That is, the extent of the surface of contact would be varied by the pressure, and therefore the resistance in a closed circuit would be varied. Asked why Edison did not use charcoal, the witness replied, "Most probably he would have taken graphite if he could get it. If not, he would take the next thing to it—gas coke. Graphite is difficult and expensive to get. He would have taken graphite if he could get it. He says graphite; if I cannot get graphite, I will take the next best thing—gas coke." The Hunnings transmitter he held to be practically the same instrument as the Edison transmitter. In all practical and theoretical respects it is the same instrument. It is obviously intended for the same purpose. The purpose is obviously attained by operating in a similar manner upon the same properties of material. There is substantially some difference of detail. As to the receiver there was a permanent magnet in the Bell instrument. The Cox-Walker instrument had an electro-magnet. It is illustrated in Fig. 12.

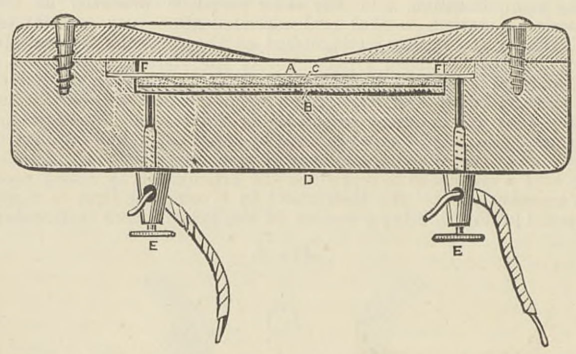
FIG. 12.



But Bell in his specification describes electro-magnets as being interchangeable with steel magnets. The Cox-Walker instrument was not adapted to work merely by local circuit; there must be a current through the line wire. Bell's instrument could work with an alternating current. Mr. Hemming, in cross-examining Sir William, first elicited from him the well-known facts about the influence of a magnet on a current, and Faraday's discoveries, and then proceeded to point out, if we may use the words, that Edison in his patent said nothing about the use of the instrument patented as a voice transmitter. The object of this interrogation will be readily understood by those versed in the intricacies of patent law. The remainder of the cross-examination was devoted to the original Bell instrument, Figs. 10 and 11. The edge of the diaphragm, Fig. 11, was loose—save at one point; in fact, it was a kind of reed; but in the new or modern Bell telephone the disc is fixed all round the edge, and this, Sir William pointed out, was a most important point, perhaps the most important point of all. It may be well to explain here that the object of the defendants is to prove that the original Bell instrument anticipated Bell's patent, while the plaintiffs contend that it never spoke in this country and could not be made to speak; that its presence here was consequently not publication or prior user, and of course if it had a free reed and the patented instrument has a fixed disc, which is an essential and valuable improvement, then the original instrument could not be an anticipation. Allusion was made to a statement by du Moncel that powdered wood charcoal had but the thousandth part of the conducting power of solid carbon. A good deal turned on the use of a diaphragm in Hunnings' instrument, the contention of the defendants being that it is not essential to the working of the instrument, and an instrument was produced in court—a microphone in fact—consisting of two contiguous brass plates on a board, united electrically by a little heap of powdered carbon. Sir William was asked if this would speak, and said very likely, when Mr. Hemming proceeded to say that in that case the tympan was absent. Sir William replied that it was not, the board on which the instrument stood being the tympan. He believed that the Edison transmitter depended wholly for its action on resistance of interfaces of contact between metal and small particles of carbon and between small particles of carbon mutually. The remainder of the witnesses examined on behalf of the plantiffs practically repeated what each had said.

For the defence it is urged that Mr. Hunnings—trying experiments in telephony one day—took a box, put a sheet of paper on top of it, and some cinders on the paper. Then he buried two wires in the heap of cinders, sent a current through, talked to the cinders, and, to his delight, found the arrangement work very well. This was in November, 1877, and at the time he knew nothing of Edison's patent. A rather amusing discussion took place between Mr. Pearson, in his opening speech for the defence, and Mr. Justice Fry. Mr. Pearson stated that it never occurred to Mr. Hunnings to use a diaphragm at all; but Mr. Justice Fry called his attention to the sheet of paper. But, said Mr. Pearson, "That was to put them on." It seems natural enough that he should put cinders on a sheet of paper. Then Mr. Pearson proceeded, "Having tried the cinders, after some experiments which followed upon it, he took some object which came closest to cinders—that is to say, he took hard engine-turned gas coke." This seems to have taken Mr. Justice Fry's breath away, and he uttered an exclamation. Then Mr. Pearson explained that he meant coke made in an oven. "Oh," said the judge, "in a coke oven." "Your lordship," said Mr. Pearson, "must excuse me if I sometimes go wrong. The terminology is so strange to me, that if I had been asked to address your lordship in Sanscrit instead of this, I do not know whether I should not have preferred Sanscrit." "Well," said his lordship, "I suppose it would be my duty to endeavour to understand the Sanscrit." Counsel then proceeded to explain that Mr. Hunnings simply put his cinders into a case to make them portable, and that in point of fact the instrument did not work in compliance with Edison's principle of conductivity

FIG. 13.



varying with pressure at all, but that it is just a micro phone pure and simple. A large portion of Mr. Pearson's address for the defendants turned on technical points in patent law, possessing no scientific interest whatever. Some confusion was caused in court by the production of certified copies of specifications from the Patent-office which were found to be wrong, and evoked a strong animadversion from the judge. The gist of Mr. Pearson's argument was that the tympan used by Edison played a totally different part from the bit of platinum foil used by Hunnings to keep his powdered coke from falling out of the instrument, and that no compression of any kind was employed, whereas there must be initial compression with the Edison lozenge. As regards the receiver, the contention is that Bell's patent is bad, because in his first patent he named membrane and iron as materials for tympans, and he gave the membrane to the world, retaining the iron. "This," said counsel, "he could not do. A man patents a machine—it may be a house—and he said you may make it of wood. He says in his patent you make it of iron, one will do as well as the other. After he made his house someone made one. He made it of wood. 'I say mine is of iron, and I claim this invention, that iron is better than wood.' He gave it to the world voluntarily, and then he says, "Now I have given my machine to the world, but the form I gave to the world was a form in which it was membrane. Although I tell the world that membrane and iron will do equally well, yet I will claim the use of iron as a new and separate invention, distinct from that I gave the world." Counsel then went on to assert that the screw which held down the tympan in the original instrument when Sir William Thomson had it, was put in only to prevent the diaphragm from being lost on its way to this country, and its presence really prevented the instrument from acting; but without it there was the diaphragm fixed all round, by the attraction of the tubular electro-magnet, as in the modern Bell instrument. He went on to say that even though the original Bell receiver had been injured, it would still speak with a good transmitter, such as Hunnings', and he added, "Now, if that be so, I think I am entitled to say that Mr. Bell's receiver was anticipated, because long before he took out his patent you had an exact description, practically, of his receiver that he has now patented. You had a description from which a workman could make it, and the moment the proper transmitter was found, the transmitter being something independent of the receiver, you had that which any person trying experiments with a transmitter would apply to that transmitter, and applying it to a transmitter, if that transmitter was a good one, that receiver would work and work most effectively." As far as the Cox-Walker receiver was concerned, that was nothing more than the receiver shown in Glasgow. Mr. Hunnings' specification runs as follows:—

"In transmitting sound by the ordinary telephone the power of the voice is much reduced at the receiving end. Now, my invention is designed to take the place of the transmitting telephone, and consists in a compact apparatus that can be freely handed about without liability to be injured. It consists of a front vibrating diaphragm composed wholly or in part of suitable metal, such as, preferably, platinum, silver, ferrotype iron, tinned iron, &c. In close proximity to the aforesaid vibrating diaphragm is fixed a disc of brass or other suitable metal, the intervening space being filled with carbon in the form of powder to the depth of about $\frac{1}{16}$ of an inch. The aforesaid vibrating diaphragm and the fixed disc of brass are connected respectively with the opposite poles of a voltaic battery. The whole may be secured in a box of suitable non-conducting material, with a mouthpiece if desired. Referring to the drawing, Fig. 13, A is the vibrating diaphragm, which I make very thin, preferably of platinum foil, though thin ferrotype iron, silver, or other material may be used, being fixed as shown, or in other suitable manner, so as to vibrate freely. It is kept in place by ring F. B is the fixed disc or diaphragm of brass or other suitable metal, the intervening space being filled with the loose finely-divided conducting material C. I find the most advantageous result to proceed from the use of oven-made engine coke crushed very finely, not ground, so as to pulverise, not to shear or tear, the particles, as I find the best result proceed from this. I may, however, use metallised carbon powder, prepared with mercury or other suitable metal if desired. E E are the binding screws placed in connection with the plates A and B. The above is placed in circuit with a voltaic battery and receiving telephone of suitable construction, such as Bell's, and the words or other sounds made close or otherwise to the instrument will be found to be distinctly and loudly reproduced at the receiving instrument. The diaphragms and case D may be altered in form, and made oval or square, or other suitable shape if desired, but the best results are produced if the instrument is made as described. Having now described my invention, and the best mode known to me of carrying it into effect, I wish it to be understood that I do not claim the principle of using carbon in the solid or consolidated form to increase or diminish the resistance of a telephonic circuit for the purpose of transmitting sounds, as this is exemplified in the well-known "Hughes microphone" and the "Edison carbon telephone," nor do I claim the coating of fibrous or similar substances with carbon to produce the same result, but what I believe to be new and desire to claim as my invention under the hereinbefore in part recited Letters Patent is—First, the use of finely-powdered carbon or like conductor—preferably oven-made engine coke prepared as described—in a loose and free state—not compressed or consolidated in any way, or combined with foreign materials—as a means of varying the resistance of a telephonic circuit by the vibrations of a thin metallic or metal-covered diaphragm enclosing it, controlled by the sound waves impinging upon it. Second, a telephone transmitter consisting of a layer of finely-divided carbon or similar conducting material C, preferably oven-made engine coke placed in a loose and free state between the thin metallic or metal-covered diaphragms A B, in a suitable case, such as D, as and for the purposes described."

Mr. Hunnings, being called, described how he made the experiments. He tried an innumerable number of experiments. "I had a box about 2ft. long. There was no lid to it. I did not think of turning it upside down, but I put a piece of paper all over it and glued it down at the edges. I applied an electrode at one end and at the other, and put a line of cinders from my grate between the two. I thought from my experience that what was wanted was something more than point of contact, so as to avoid absolute make and break. I spoke to my line of cinders, and was very glad to hear the reply sent me, "Yes, I hear." From that moment I made sure that I had hit on the right theory, if I could only find a good conductor, and walking along the railway I spied a bit of oven-made coke. I crushed it up into particles, and the next thing I did was, in consequence of the particles blowing away with your breath when you spoke to them, to cover them in between two pieces of paper. I turned a wooden ring in my lathe 2in. in diameter and $\frac{3}{8}$in. thick. Of course I must have something on each side of this ring to hold the grains of coke or else they would tumble through, so I placed paper with a piece of tinfoil on it, and another piece with tinfoil on the other end, and stuck these things on with three screws. I found that to answer very well, and I went on until the instrument took the form it has now." Mr. Hunnings swore that during this time he knew nothing whatever of Edison's work, and when asked to point out what he held to be the difference between his own and Edison's transmitter, he replied "All through Edison's specification I find that he works upon the pres sure system. My principle is loose contact, and the reason I used engine coke was because, taken bulk for bulk, its specific gravity is the lightest thing I can find, as the sound waves move its particles about very easily. I considered its mobility was my invention and my patent, and not connected in any way with Edison's patent. Had I thought for one moment that I was infringing Edison's patent, the patent should not have been proceeded with. Asked whether he had tried other materials, he replied that he had tried the sifted brass turnings from his lathe and had got excellent results from them. Antimony he had tried but found too heavy. He must have a fairly good conductor. Hardness and roughness of texture were more important than anything else. If the coke grains were packed tightly the instrument would not work. The grains must be so loose as to shake about. On the 19th of August, 1878, he had two instruments finished and offered them to the Post-office authorities, the coke between two platinum discs. His provisional specification is dated 16th September, 1878. In this specification are the words "two vibrating diaphragms," but he did not explain what definite meaning he attached to them. The specification contains the word carbon. That was the patent agent's doing, not his; he meant engine coke. He knew before he filed his final specification of Edison's specification. His attention was called to the fact that he might be considered an infringer of Edison because he used the word carbon, but in his sense of the view engine-made coke is not carbon. He thought he had invented the battery telephone. Whether he had or not was for his lordship to decide. His invention began and ended with the loose grains of coke. He should not have used the word "carbon" in his specification, but "engine-made coke." His patent agent insisted that he should use the word "carbon." Had never tried anything but cinders and coke and lamp-black. This last would not work, being in his hands a non-conductor. His agent introduced the words "metalised carbon." The words "The use of finely powdered carbon" were put in by his agent, who would prove them.

Dr. Sylvanus Thompson was examined at great length, but the gist of his evidence was that in the Hunnings transmitter "we realise the direct action of air waves as nearly as we can, whereas in the Edison transmitter we have mechanism which first takes those waves which move up and down, and causes them to set a tympan rippling, and then takes the resultant, or as near as can be, the resultant of those ripples as a central point and pumps them on the electrode. The whole action of the Hunnings instrument depends on the action of the air enclosed in the box with the coke."

We have now given our readers a statement which will, as we have said, enable them to understand the bearings of the case so far as it has gone. We must leave them for the present to draw their own conclusions.

A USEFUL INVENTION.—A letter from Rome announces that a priest of Ravenna, named Ravaglia, has constructed an electrical apparatus which can be set in operation by simply pressing a button, and by which the doors of a large building can be instantaneously opened. The apparatus was tried during the last week of April at the Alighieri Theatre, in Ravenna, with the most satisfactory result. All the nine doors opened simultaneously, as if through some spiritual agency. The inventor hopes to improve his apparatus, so that should a fire break out on the stage of a theatre the rise in temperature would itself set the machinery in motion.

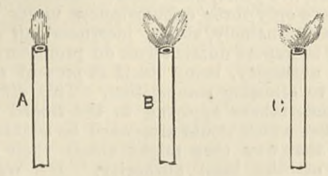
THE MINES COMMISSION.—The following members of the Royal Commission appointed to inquire into the causes of explosions in mines visited Llwypia, Rhondda Valley, on Wednesday morning:—Mr. Warrington Smith (chairman), Professor Tyndall, Professor Clifton, Mr. Burt, M.P., and Mr. Lindsay Wood. Variations in the quality of gas used for experimental purposes precluded the resumption of the investigations on Tuesday, but this difficulty was surmounted on Wednesday, and a large number of Davy lamps were tested in a variety of explosive mixtures of definite composition and of velocities varying from 600ft. to 900ft. a minute.

MECHANICAL VIBRATIONS AND MAGNETISM.

No. II.

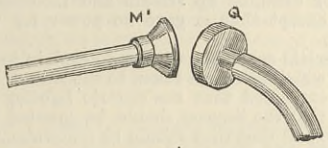
WE have in our previous article described the experiments by means of which Mr. Stroh corroborated and extended the results obtained by Professor Bjerkness. It was seen that, so far as the phenomena of attraction and repulsion are concerned, these experiments show that there exists a great similarity between the mechanical vibrations

FIG. 12.



of a more or less elastic medium, and magnetism. The magnetic action, however, takes place through a comparatively larger space, and is governed by fairly well ascertained laws. The experiments to be now described carry on the work suggested by Professor Bjerkness, and allow

FIG. 13.



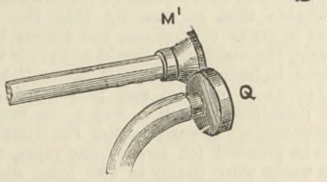
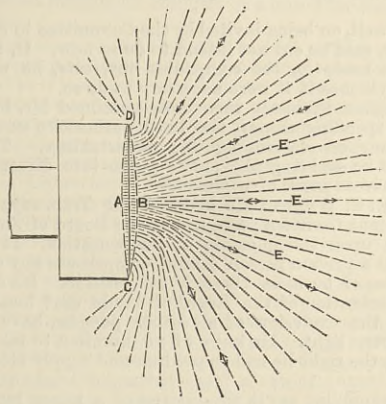


FIG. 13A.

of a conclusion to be drawn as to the reasons for such action. In his lecture Mr. Stroh disclaimed originality of ideas in the preceding experiments, and gave the credit of initiator into this domain of physical research to Professor Bjerkness, whilst mentioning the experiments made by

FIG. 14.



Professor Guthrie. As we have said, the aim of Mr. Stroh was to find out why currents of air took certain directions; and in order to ascertain the direction and amplitude of the vibrations, he devised the experiment illustrated in Fig. 12. A little gas jet, 12A, if placed in

FIG. 15.

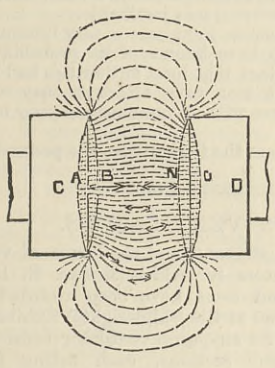
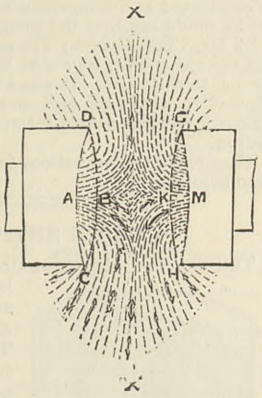
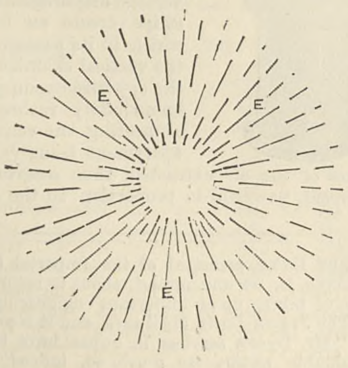


FIG. 16.



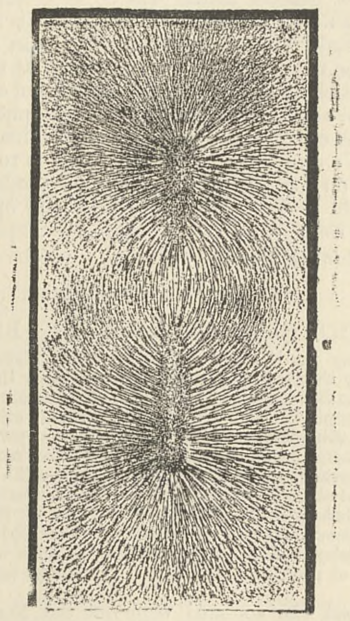
front of the vibrating membrane, which may of course vary in position as in Fig. 13A, will take a somewhat similar form to those shown by 12B and 12C, and by placing the gas jet in various positions in the vibrating field a pretty correct idea of the form of field can be obtained. Mr.

FIG. 17.



Stroh's investigation of these fields shows that the field of a single membrane has the form shown in Fig. 14, while the fields of two membranes in like and unlike phase respectively are shown in Figs. 15 and 16. The dotted lines in these figures show the direction, and the arrows the amplitude of the vibrations. In Fig. 15, A B, N O, show the maximum positions of the diaphragms, C D the tubes; while A B, K M in Fig. 16 show similar positions. Fig. 17 represents, theoretically, the vibrations of an imaginary

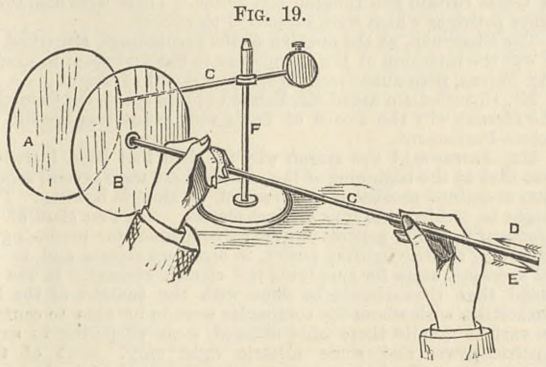
FIG. 18.



disc of air looking in the direction of the axis, E being the circle of greatest amplitude.

It may be thought interesting to compare at once these lines of force in the vibrating field with the lines of force in a magnetic field. Fig. 18 shows the lines of force

FIG. 19.



in a magnetic field, as obtained by placing a glass plate over a magnet and sprinkling iron filings over the plate, then gently tapping till the filings have arranged themselves, when by one or two methods they can be permanently fixed. If a disc of cardboard A, suspended as in

FIG. 20.

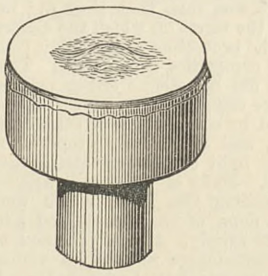


FIG. 21.

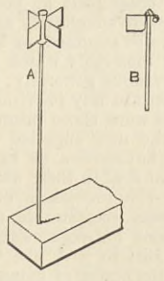


Fig. 19, have forcibly projected towards it another disc B fastened, as shown, to a rod C, the reasonable expectation is that the suspended disc will be repelled and fly away, but when tried it is found that no such action takes place. It recedes for an instant, but as instantly returns, and seems

FIG. 22.

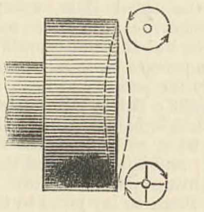
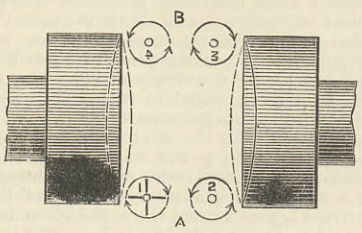
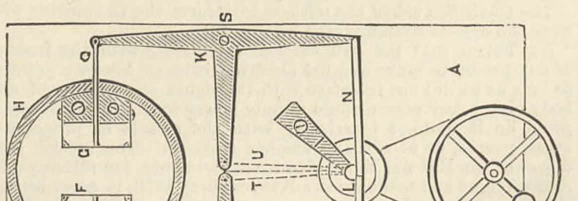


FIG. 23.



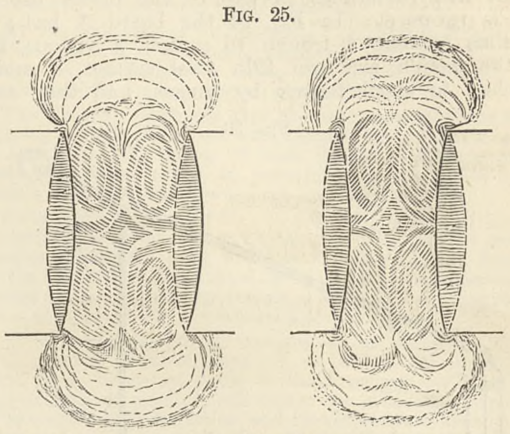
to be attracted towards the projected disc. The reason of this Mr. Stroh explained was that the air ejected from between the discs causes compression outside, and a consequent impulse from behind which brings the discs together.

FIG. 24.



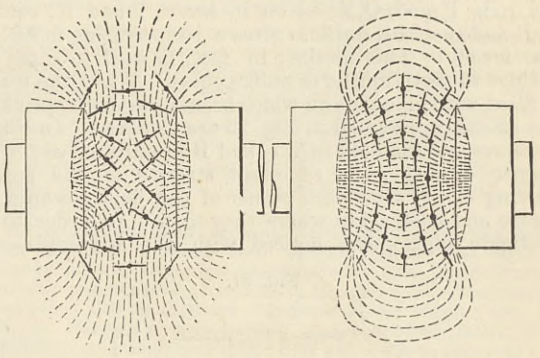
Similarly a disc at the end of a light-balanced beam, as in Fig. 8, turning on a centre, can be made to revolve by a rapid to-and-fro motion of another disc in the direction of the operator, when motion in the contrary direction would usually have been predicted. It was mentioned that if the membrane of the drum is wetted and then vibrated, the water collects in the centre. This experiment was not shown by the lecturer, but it is not difficult to depict the action, which would be as in Fig. 20.

FIG. 25.



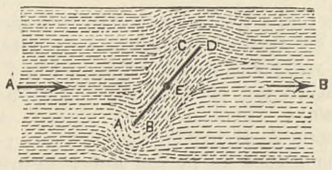
The action of the currents of air was investigated by means of little windmills, Fig. 21, with the result as shown in Figs. 22 and 23—the former showing the action with a single diaphragm in use, the latter with two diaphragms

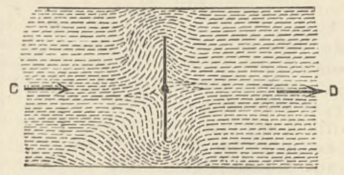
FIG. 26.



vibrating in like phase. In the positions 1, 2, 3, 4, Fig. 23, the windmill turns in the direction of the arrows. The action of the windmills not being suited for experiment before a large audience, other experiments with glycerine

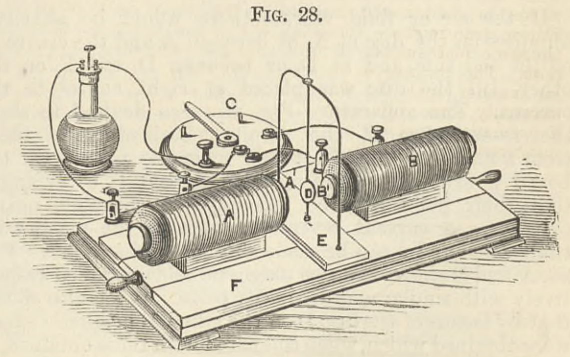
FIG. 27.





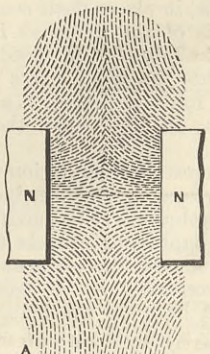
were shown; but we believe experimentalists will find windmills the best when following up these experiments in the laboratory. As we have said, Mr. Stroh contrived for the purpose of the lecture, imitation membranes and

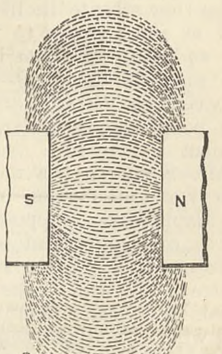
FIG. 28.



mills working in a medium of glycerine on glass, so that the action could be magnified and projected on a screen. A tiny crank and pulley caused two opposing elastic strips to oscillate, and between these, pivotted on four points,

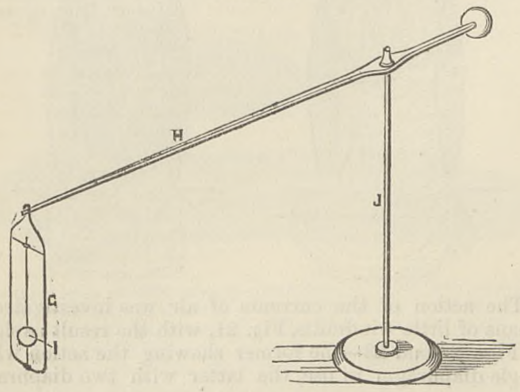
FIG. 29.





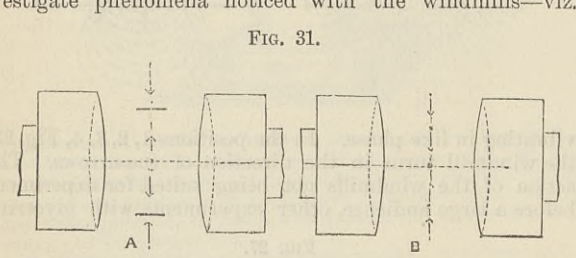
were four star-like wheels. The oscillating movement imparted to the glycerine a certain motion, the direction of which could be seen by the movement of the wheels. By altering the gear of the crank the character of the oscillations was varied, and, in the case of two membranes in unlike phase, the currents, though strong, are uncertain in direction. Since all the vibrating particles seem to have a tendency to move towards and along the central line, the outward current takes probably the weakest part of the field, for it is found that generally in one and sometimes in two of the places the current is reversed. In Fig. 24 the board A has a rim H, thus forming a trough to contain a viscous fluid. In the trough are two thin steel springs, F and G, attached to small frames by hinges, and they represent vibrating membranes.

FIG. 30.



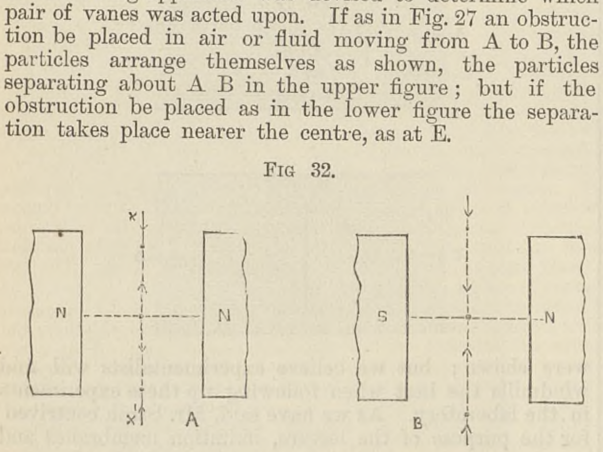
To F and G are attached the rods P and Q, acted on by levers I and K, centred at R and S. The crank L gives a reciprocating motion to the levers. This motion, in fact, is used to cause the springs to move in like or unlike phase. When the trough is filled with glycerine on which bronze powder is sprinkled, the effects represented in Fig. 25 are obtained. In Fig. 25 A represents the field in like, and B in unlike phase. The deeper shaded parts represent streams of the powder moving slowly from each corner of the field towards the centre and back again where they meet. In order to investigate phenomena noticed with the windmills—viz.,

FIG. 31.



that the vanes had a tendency to stop in a certain position, the following apparatus was devised to determine which pair of vanes was acted upon. If as in Fig. 27 an obstruction be placed in air or fluid moving from A to B, the particles arrange themselves as shown, the particles separating about A B in the upper figure; but if the obstruction be placed as in the lower figure the separation takes place nearer the centre, as at E.

FIG 32.



If the air or fluid vibrate there would be alternate impulses on the disc at A, or between A and the centre E on the one side, and at D, or between D and E, on the other, till the disc was placed at right angles to the current. The apparatus—Fig. 28—was devised to show the resemblance of the results obtained with those from a small iron disc between magnetic poles. On the board F are two electro-magnets A and B, so arranged that their poles can be separated or brought nearer together. A current reverser C acts on the magnet B; the poles *a* and *b* can be made similar or dissimilar. Fig. 29, A and B shows the two magnetic fields obtained respectively with similar and dissimilar poles. It was also shown that by means of the disc D on the stand E magnetic effects were obtained which, when compared with those obtained by means of the vibrating drum—Fig. 11—were just of the opposite character. The force acting on the disc is not at all points alike. Fig. 30 shows an iron disc I suspended by frame G to beam H, long enough to pass one of the electro-magnets —Fig. 28—or one of the drums—Fig. 11—and resting by a cup on a needle point J. If the disc is used with apparatus—Fig. 11—with G passing freely between the drums when they vibrate in like phase, it places itself centrally, and at right angles to the axis of the drum as in Fig. 31, and parallel when in unlike phase. If used with the magnets—Fig. 28—so that the disc plays freely between the poles, it arranges itself as in Fig. 32B when the poles are dissimilar, and as in 32A when they are similar.

Mr. Stroh gave a most interesting description of his theory as to the action of the vibrating particles between the diaphragms. Suppose the diaphragms to be moving outwards, each movement of the diaphragm propels the air in front of it, and the momentum will be greatest in the centre of the field. The air necessarily has to pass outwards in the same manner from between the diaphragm, and where the diaphragms recur, a partial vacuum obtains. The air having the greatest previous momentum now offers the greatest resistance to the incoming particles, and that which had the least now offers the least resistance, so that the most marked action now takes place in the latter direction. It will easily be understood that the relative positions of the air particles are somewhat changed by these movements, and by superimposing action upon action the results indicated by the exploration of the vibrating field take place.

There is no doubt a large field opened by these experiments for investigation, and any information relating to the action of gaseous matter will be welcomed by all engineers. We notice that Mr. Crompton in his recent lecture at the Crystal Palace indicated that he was almost ready to adopt the theory which we mentioned at the beginning of these articles, that the universe consisted only of matter and motion, and that the various natural phenomena presented to us were results of different combinations of these things. We understand that Mr. Stroh is to give his lecture again on the 18th inst., when, no doubt, many who were unable to be present will take the opportunity of witnessing some of the most ingenious experiments that have lately been devised.

THE ELECTRIC LIGHTING BILL.

ON Tuesday for the first time the Select Hybrid Committee, appointed by the House of Commons to consider the measure promoted by the Government for the purpose of facilitating and regulating the supply of electricity for lighting and other purposes in the United Kingdom, as well as the several private Bills of a similar character promoted this session, sat and received evidence.

The Committee, which was presided over by the Hon. E. Stanhope, consisted of Mr. Chamberlain, Sir J. McGarel Hogg, Mr. Alderman McArthur, and Messrs. W. Fowler, H. Northcote, J. H. Puleston, Boord, Brooks, Henderson, Mitchell-Henry, Molloy, Slagg, Whiteley, and Storey-Maskelyne. There was a very large attendance of promoters and other gentlemen interested in the subject.

The counsel who appeared were—for the Northern Electric Lighting Supply Company, Mr. Clifford; for the Electric Lighting Companies, Mr. Rodwell, Q.C., and Mr. Moulton; for the Lighting Association of Great Britain, Mr. Pember, Q.C.; for the Corporation of Liverpool, Mr. R. S. Wright; for the Dundee Lighting Bill, Mr. Michael, Q.C., and Mr. Robertson; for the Gaslight and Coke and other companies, Mr. Pope, Q.C., Mr. Vaughan Richards, Q.C., and Mr. Michael, Q.C.; and for the municipal corporations of Great Britain and Ireland, Mr. Jeune. There were also several other petitions which were supported by agents.

The Chairman, at the opening of the proceedings, remarked that it was the intention of the Committee in the first place to examine Mr. Farrar, permanent secretary to the Board of Trade.

Mr. Chamberlain asked Mr. Farrar to place before the Committee the reasons why the Board of Trade were promoting the Bill now before Parliament.

Mr. Farrar said the reason why the Bill had been introduced was that at the beginning of the session there were several schemes that contained provisions with respect to electric lighting. These might be divided into four distinct classes. The first class of bills proposed to confer general powers on companies for producing and supplying electric lighting power, to break up streets and to take all necessary steps for supplying the electric current. It was proposed that that should be done with the consent of the local authorities with whom the companies were to be able to contract. In various details these bills differed, some proposing to supply electric power and some electric light only. Most of them were not confined to any one town or district, but were to enable the companies who promoted them to supply electric light or power to any towns in the United Kingdom. There were six of this class of Bills, but one had fallen through. The Bills of the second class were to enable the existing gas companies to supply electric light and power, and of these there were eight at present before Parliament. The general provisions of these Bills proposed to enable companies to supply light or power, but in detail they differed very much. One of the main objections to these Bills at present was this, that they did not appear to provide adequately as to the terms on which the electric lighting was to be supplied, or for the protection of the public from the extended monopoly which the companies would have. They went into provisions generally, but did not define either price or quality, or contain any provision for compulsory supply. Bills of the third class were those promoted by corporations or other local authorities who now supplied gas, and these Bills proposed to enable these authorities to supply light or power, though they differed a great deal in their details. Many of them only applied to electricity the provisions of existing Gas Acts, which were in many respects inapplicable, and none of them contained adequate provisions for regulating the supply. It was proposed by the Dundee Bill to give the Commissioners not only a virtual monopoly in the power of using the streets, but absolutely forbade any person else to supply the electric light in their district. He believed of this class of Bills there were eight. He would remind the Committee that these Bills contained no provision as to the condition under which a supply might be made compulsory, and no provision for giving a preferential supply. In his opinion the Dundee Bill would create an absolute monopoly for the sale of electricity. Most of the Bills contained provisions enabling the promoters to supply electricity to private persons. Bills of the fourth class had been promoted by municipal corporations and local authorities, and they resembled the third class, except that the promoting corporations or authorities did not now supply gas. There were four of these Bills, but three of them did not provide for the supply of electricity to private persons. Some of the Bills proposed to supply electricity for power and heat, as well as for the purposes of light. In 1879 a Select Committee, after considering the whole subject of electric lighting, came to the conclusion that power might be given to a certain extent for making experiments with electric lighting; and they declared that gas companies had no monopoly for lighting public streets or private houses beyond the power given to them to lay pipes in the streets. Seven Acts had been passed since that time, giving local authorities power to supply electric light, and to raise money for that purpose. In all these Bills the powers were generally similar in terms and limited in point of time. The sums to be raised were also limited. The Acts he referred to were the Blackpool Improvement Act, the Liverpool Corporation Act of 1879, the Over Darwen Improvement Bill, the Oldham Improvement Act, the Irvine Borough Act, another Lancashire Bill, and the Hull Corporation Lighting Act.

The Chairman asked the witness to inform the Committee what were the objects contemplated by the Bill.

Mr. Farrar said the Bill avoided interfering with the freedom of any person to make and use electric power on his own premises so long as he did not interfere with the rights or property of anybody else. Any person could supply power to others so long as he could do it without interfering with the streets or property of other people, or of existing electric systems. The second great object of the Bill was to provide for experiments, for although the electric light had made great advances since 1879, it must be considered as being still in the experimental stage. Therefore, as it was thought extremely desirable to give the utmost possible facilities for making experiments, provision was made in the second clause to enable the Board of Trade to grant licences for a period not exceeding five years, the person to whom those licences might be granted being either local authorities, private persons, or companies. In the case of a licence granted to a private company or to a private person, the consent of the local authority would be necessary. These licences were to be granted for electricity, either for public purposes as defined in sub-section 3, or for private purposes. There was, however, a condition attached that where a light was supplied to private persons it should be supplied to every person within the district on the same terms, unless otherwise stipulated. In that way preferential supply was rendered impossible. There was also a provision to the effect that the local authority or the company supplying electric power should not be entitled to require the use of any particular form of lamp. The object of this provision was to enable the consumers to use any lamps they pleased, and so to be placed in the same position as the gas consumer. The licence which would be granted under the Bill would give power to break up streets as well as give local authorities power to borrow money. If a local authority refused its consent to a private company, or required a longer term than five years, such a case was met by Clause 3. Of course there were only three circumstances under which the case was likely to arise, namely, simple inertness; an endeavour by a local authority to impose unfair terms on promoters; and the case where a local authority, being itself at present suppliers of gas, might object to allowing competition. This difficulty could be met by the undertakers applying to the Board of Trade for a provisional order, which would afterward be confirmed by Parliament, and in that way they might obtain their powers without the consent of the local authority. He would point out that one of the chief objects of the Board of Trade was to prevent the creation of a monopoly as against the community. In some cases it was provided that after the expiration of seven years the local authorities might require a private company to sell for the actual value of their then existing plant, without any compensation for future profits. In the General Tramways Act of 1870 a similar provision was inserted, and that provision had in no way interfered with the investment of private capital in the tramways. The eighth clause was an important one, inasmuch as it gave powers for breaking up streets and incorporated the Land Clauses Act, except that it gave no power for the compulsory taking of land.

Mr. Chamberlain asked the witness to explain to the Committee the objections which had been taken to the Bill.

Mr. Farrar explained that the electric lighting companies had recommended that the licences should be granted for seven years instead of five, and that they should be renewable. He, however, thought it probable that on hearing that the object of these licences was not to grant concessions but simply to enable experiments to be made, the companies would not press their suggestion. They also desired to have the provision as to the use of lamps a little modified, so as to prevent any person using electric light within his own premises in such a way as to interfere with the supply to other persons. Regarding the Provisional Orders, they wished them to be granted for twenty-one years, and also that in any case where works were partly in two local districts, then the local authority purchasing the undertaking should be obliged to purchase the whole. In addition to this they suggested that all bye-laws should be approved by the Board of Trade, and that there should be a slight alteration in the Postmaster-General's clause. The local authorities had sent in various suggestions to the Board of Trade. One of their suggestions was that no application for a licence or Provisional Order should be made in respect of all or any part of any district of gas supply without three months' notice, during which the local board should be entitled to make a similar application. He saw no objection to that suggestion.

Mr. Rodwell, on being invited by the Committee to cross-examine Mr. Farrar, said he did not intend to do so now. If, however, any attack was made on the companies' interests, he would supply scientific evidence if it were necessary to do so.

Mr. Vaughan Richards then cross-examined Mr. Farrar: With regard to spending money, the local authorities would be free to spend money on electric lighting undertakings. The result of that might be to bring the public purse into direct competition with the private purse of companies.

By Mr. R. S. Wright: He believed the Tramways Act of 1870 to some extent formed a precedent to the Board of Trade in regard to this Bill upon the question of compensation. It was not intended that a private person should compensate any existing body for mere loss of business through competition. He did not think it was the intention of the Board of Trade that local authorities should, to the exclusion of all other persons, have the right to supply electric light. He knew of no intention to take away from any person the right he had to produce and supply electricity.

By Mr. Jeune: It was a fact that major local authorities, who were now supplying gas in the district of a minor local authority, were compelled to give the supply. A minor local authority under the Bill introduced this session would be able to obtain a licence for the supply of electricity, and there would be no control over the supply, except by the Board of Trade. He would give to minor authorities the absolute right to supply themselves with electricity, just as in the first instance they had had the absolute right to supply themselves with gas.

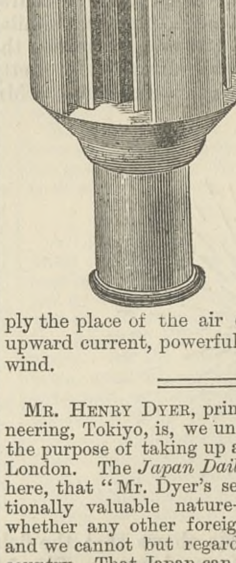
By Mr. Moulton: He would not say that electricity should not be considered as a competitor to gas companies in certain districts, but he would say that the competition was justifiable.

By Mr. Chamberlain: The electric light was a new illuminant, and the gas companies ought to have known of its probability of coming to the front. It was a fact that local authorities had been allowed to construct and work tramways, although they might seriously and injuriously interfere with an omnibus company in the district.

After one or two questions from the Committee, the proceedings were adjourned.

BOYLE'S SHIPS' VENTILATORS.

THE annexed engraving illustrates one of the forms of ventilators for which Messrs. R. Boyle and Sons have been awarded the £50 at the Shipwrights' Exhibition. The air-pump ventilator consists of four sections, each acting independently of the other. At the outer part are four vertical curved baffle plates or guards which prevent the wind blowing through the slits opposite. Within each of these outer parts are two narrow curved plates which prevent down draught, and in combination with central vertical diaphragms and other curved strips create an induced current, which in its passage draws air from the vertical chamber, expelling it at the opposite opening. The foul air immediately rushes up the shaft connecting the ventilator with the apartment being ventilated, to supply the place of the air extracted, thus securing a continuous upward current, powerful in proportion to the strength of the wind.



MR. HENRY DYER, principal of the Imperial College of Engineering, Tokiyo, is, we understand, about to return to England for the purpose of taking up an important engineering appointment in London. The *Japan Daily Mail* says, and it is pretty well known here, that "Mr. Dyer's services in Japan have been of an exceptionally valuable nature—so much so, indeed, that we doubt whether any other foreigner is likely to achieve similar results—and we cannot but regard his departure as a misfortune for this country. That Japan can offer no inducements sufficient to prevent this is, for her sake, very much to be regretted."

RAILWAY MATTERS.

IN concluding a report on the collision that occurred on the 29th March at Stoke Station, on the North Staffordshire Railway, Colonel Rich says, "If this train had been fitted with continuous brakes, the collision would probably not have occurred."

DURING a recent heavy thunderstorm the railway station at Tenbury was completely wrecked by a whirlwind. The roof was stripped and lifted out of position, the windows and doors were blown away, and two men in the signal-box were carried some twenty yards by the wind.

MR. CHAS. BERGERON has published a pamphlet explaining a system of longitudinal permanent way cast iron sleepers imbedded in sand, and employing lighter rails than usual, the rails being fastened to fishing flanges cast on the cast iron sleepers, which are about 2ft. in length, and of an inverted channel section.

THE Ashbury Railway Carriage Company, Manchester, has secured one-half of the order for 1200 wagons recently placed in the market by the Midland Railway Company; but this practically includes only about half the constructive work, as the wheels, axles, axle-boxes, and springs are supplied by the railway company.

OF the 400,000 tons of Bessemer ingots which were used for other purposes than rails in 1881, a large part took the form of blooms for export to the United States. The production of blooms in 1881 was about 100,000 tons in excess of that of any former year. About 50,000 tons of ingots were manufactured into tires, axles, and general forgings; and 15,000 tons were made into angles for shipbuilding purposes and so forth.

THE Highway Committee of the Sheffield Town Council recommend that steam locomotives shall not be suffered to pass over any part of any turnpike road or highway within the borough of Sheffield, between the hours of nine o'clock in the morning and five in the afternoon, and no locomotive is to be allowed to stand on the highway unless some person is in charge of it, nor under any circumstances to stand longer than twenty minutes, except where accident or "other sufficient reason" render longer stoppage necessary.

THE Midland Railway Company contemplates the construction of a new mineral line connecting Staveley with Bolsover. The line is four miles in length, and starts at the junction with the Staveley and Doe Lea Branch, passing through the parishes of Bolsover and Scarcliffe in the county of Derby, and terminating near Bolsover Castle. The undertaking, which is known as the Doe Lea Extension, will open out a considerable extent of undeveloped mineral resources on the eastern side of Chesterfield. Messrs. J. and G. Tomlinson, railway contractors, Ashbourne-road, Derby, have obtained the contract for the work.

A MEMORANDUM has been published by the Engineer-in-Chief of the Nagpore State Railway explaining the scheme for connecting the East India Railway with the Nagpore-Chattisgarh Railway, and securing more direct traffic between Calcutta and Bombay. There are three proposed lines. The northern route recommended is 393 miles in length, and passes through Ranchi, Jushpore, and Sirgooja. The southern route is 366 miles long, by Perulia, Singhboom, Gangpore, and the northern parts of the Sumbulpore district. The intermediate route is 375 miles long, and connects a portion of the northern route from Burrakur to Ranchi with the southern from Raighur to Bilaspur by a line from Ranchi *viâ* Basia and Suadic.

IT is satisfactory to find that the several railway companies are rapidly adopting the best system yet brought out for lighting carriages, and as it is also the cheapest yet invented, the shareholders must in this matter rejoice with the passengers. The Caledonian Railway Company has instructed the Pintsch's Patent Lighting Company to construct a large gasworks to produce gas on Pintsch's system for 500 carriages, and to fit 100 carriages before the 1st July next. Instructions have also been given to fit a train on the system on the Glasgow and South-Western, and this will commence running next week. It is a great pity that the system is not in use on the trains running long northward journeys, but now that the system is in use in the North and in the South, we shall probably have the long northward journey made less irksome by the use of the light throughout. One great advantage of the system is that every carriage is absolutely independent of the rest in a train, there being no coupling of any kind, and one charging at the gasworks is enough for two journeys from London to Glasgow and back.

To make the Channel Tunnel, if carried out, safe against invasion, Dr. Siemens recently proposed to charge the ends with carbonic acid gas as described in our last impression. With reference to this proposal, Dr. Tyndall writes from Haslemere, saying:—"Coming down here from London to-day, on a part of the line where our speed was about thirty miles an hour, I took out my watch and determined how long I could hold my breath without inhalation. By emptying my lungs very thoroughly, and then charging them very fully, I brought the time up to nearly a minute and a-half. In this interval I might have been urged through more than a half mile of carbonic acid gas with no injury and with little inconvenience to myself. Indeed, supposing the tunnel to be entirely filled with carbonic acid gas, I have sufficient confidence in my friend's ability to wager that in six hours he would be able to devise a means of sending troops safely through it. The problem of supplying fresh air to persons surrounded by an irrespirable atmosphere has been already solved by Mr. Fleuss and others." Dr. Siemens has since written to the effect that few people can hold their breath for 90 seconds, 60 seconds being the most coral divers can endure. He also says that 1000-horse power for ventilating would not prevent the action of his carbonic acid.

AT the request of some of the persons who a short time since appeared before the American Trunk Lines Advisory Commission, calculations were made of the loads which locomotives would haul on different grades and curves. The following table from the *Railroad Gazette* gives the results of these calculations, which may be of interest to some of our readers. The calculations are for three types of engine, designated in the column titles as type "A," type "B" and type "C," these being as follows: Type A.—American locomotive with four driving wheels and 12,000 lb. weight on each wheel, the total weight of engine being 36 tons. Type B: Mogul or 10-wheeled locomotive, with six driving wheels and 12,000 lb. weight on each wheel, the total weight of engine being about 42 tons. Type C: Consolidation locomotive with eight driving wheels and 12,000 lb. weight on each wheel, the total weight of engine being being about 54 tons.

Weights of train which locomotives can haul at a speed of 20 miles an hour under ordinary conditions, in tons of 2000 lb. (not including the weight of engine and tender).

	Type of Locomotive. Type "A."	Type "B."	Type "C."
On Straight Track:			
Level	1096	1664	2226
Grade 20ft. per mile	547	840½	1128
,, 40 ,, ,,	350	545	734
,, 60 ,, ,,	249	390½	522
,, 80 ,, ,,	188	302	410
,, 100 ,, ,,	148	242	330
On 5 deg. Curves:			
Level	921	1401½	1876
Grade 20ft. per mile	464	716	962
,, 40 ,, ,,	310	485	654
,, 60 ,, ,,	227	360½	488
,, 80 ,, ,,	173	279½	380
,, 100 ,, ,,	137	225½	308
On 10 deg. Curves:			
Level	662	1013	1358
Grade 20ft. per mile	401	621½	836
,, 40 ,, ,,	278	477	590
,, 60 ,, ,,	207	330½	448
,, 80 ,, ,,	160	260	354
,, 100 ,, ,,	128	212	290

Under the most favourable conditions loads about 50 per cent. greater than those given above may be hauled.

NOTES AND MEMORANDA.

THE production of Bessemer steel ingots in the United Kingdom during 1881 was 1,441,719 tons, being an increase of 397,337 tons on the quantity produced in the preceding year. This increase is more than equal to the total make of Bessemer steel throughout the world in 1868, and exceeds also the total production of the United Kingdom in 1874.

THE product of the Langley Mill at Augusta, Georgia, a large cloth mill, was last year 122,393 pieces, 2,146,219 lb. of cloth, or 6,374,886 yards; average number of looms in operation, 325½; average number of yards of cloth per loom per day, 62 76-100; average number of spindles running, 10,800; average number of ounces of yarn per spindle per day, 10 69-100; average number of hands employed, 328. The amount of cotton used during the year 1881 was 5637 bales, or 2,681,205 lb. Average cost of cotton used in 1881, 9¾c.

THE following formula for the angle of impulse of the wind upon windmill blades or sails at any point for maximum effect is from a paper by Mr. A. R. Wolff, before the American Society of Mechanical Engineers:—$a = \frac{v}{c} + \sqrt{1 + \left(\frac{v}{c}\right)^2}$, a being the angle, v the velocity of the blade or sail at the point taken, and c the velocity of the wind in feet per second.

AT the meeting of the Chemical Society of the 4th May, Prof. J. Dewar, F.R.S., gave a lecture "On Recent Developments of the Theory of Dissociation." In the course of the lecture he said: "The stability of the most stable body is in reality a function of temperature; as the temperature is lowered or raised the body becomes more or less stable. Thus iodide of mercury when heated to nearly the melting point of glass is dissociated, and free iodine is liberated. This was experimentally demonstrated to the meeting; a flask containing the iodide was projected on the screen, and the gas in it was seen to be colourless. On heating the salt with a blow-pipe, the gas soon became coloured violet with the vapour of the liberated iodine; on cooling the iodine re-combined and the colour disappeared."

METALLIC objects may be coloured by immersing them in a bath formed of 640 grains of lead acetate dissolved in 3450 grains of water, and warmed to from 38 deg. to 90 deg. Fah. This mixture gives a precipitate of lead in black flakes, and when the object is plunged into the bath the precipitate deposits on it. The colour given depends on the thickness of the skin, and care should be taken to treat the object gradually, so as to get a uniform tint. Iron treated thus acquires a bluish aspect like steel; zinc, on the other hand, becomes brown. On using an equal quantity of sulphuric acid instead of lead acetate, and warming a little more than in the first case, common bronze may be coloured red or green with a very durable skin. The *Scientific American* says, imitations of marble are obtained by covering bronze objects, warmed to 100 deg. Fah., with a solution of lead thickened with gum tragacanth, and afterward submitting them to the action of the above-mentioned precipitate of lead.

IN the five American States named below, where most of the ironworkers are employed, the wages of skilled and unskilled labour in the various branches were in 1881, according to recent reports:—

	Pa. dols.	Ohio. dols.	N.Y. dols.	Ill. dols.	N.J. dols.
Blast furnaces, S.	1.64	1.84	1.77	2.17	1.75
Blast furnaces, U.	1·09	1.25	1.14	1.3	1.20
Rolling mills, S.	3.03	3.87	2.93	3.67	2.78
Rolling mills, U.	1.17	1.32	1.22	1.25	1.22
Bessemer works, S.	2.46	3.96	2.18	5.00	—
Bessemer works, U.	1.17	1.34	1.07	1.15	—
Forges and blooms, S.	2.43	—	2.48	—	2.24
Forges and blooms, U.	1.11	—	1.14	—	1.19
All works, S.	2.32	2.89	2.43	3.43	2.32
All works, U.	1.13	1.30	1.18	1.27	1.21

The average wages of skilled labour throughout the country was 2.59 dols, and of unskilled labour, 1.24 dols.

ANTIMERULION is the name given by Dr. Zerener to a preparation for preventing mould, mildew, and dry rot. When properly employed it hinders the appearance of dry rot, *merulius destruens*, and serves to destroy it. The substance is made in three forms. The liquid preparation of 30 deg B. is made of boracic acid, common salt, and silica, and is applied by means of a brush or pencil to woodwork and masonry. In factories where moist fumes and vapours are evolved, which favour the production of mould and fungus, this acts as a protection for the building. The so-called doubly prepared antimerulion consists of infusorial silica, with the addition of 20 per cent. of boracic acid; it is to be scattered in moist or damp places. The simple dry antimerulion contains, besides the infusorial earth, only 8 per cent. of boracic acid, is less active, and used specially for protecting moist places from mould, for insulating material, and to exclude the atmospheric air and terrestrial heat—that is for ice cellars, ice chests, water pipes, and heating arrangements. In places where mould and dry rot are feared the dry antimerulion is packed in; but the *Scientific American* says it is better to expose these places to the air and paint them thoroughly with the liquid substance annually.

THE Mouchot solar engine, of which a description has been given in our pages, has formed the subject of experiment for a year at Montpellier, by a French Government Commission. The apparatus was of the known form—a concave mirror with blackened boiler in the focus, surrounded by a glass envelope. The steam from the boiling water was condensed in a coiled tube cooled by water. The weight of water distilled in an hour indicated the amount of heat utilised; and observations with an actinometer from hour to hour showed the amount of incident heat. These two quantities gave a measure of the economic efficiency of the apparatus. The temperature and moisture of the air, &c., were also carefully noted. The number of days of observation was 177, and of observations 930, and water was distilled to the amount of 2725 litres. The heat utilised in the most favourable circumstances per square metre per hour would be about equal to that utilised from 240 grammes, or under three-fourths of a pound, of coal, supposing about a half to be utilised—even the half of this is not attainable in our climate. The efficiency of the apparatus is not proportional to the heat intensity of the solar radiations, and hardly ever varies in the same sense. The absolute quantity of heat utilised, on the other hand, depends essentially on the temperature of the air.

THE process for making brick walls water-tight, known as the Sylvester process, which was applied to the interior walls of the gate-houses of the Croton reservoir in the Central Park, New York, in 1863, seems to have been successful and may be again described. The process consists in using two washes or solutions. The first, as described by the *Scientific American*, is composed of three-quarters of a pound of Castile soap dissolved in one gallon of water, laid on at boiling heat with a flat brush. When this has dried, twenty-four hours later apply in like manner the second wash of half a pound of alum dissolved in four gallons of water. The temperature of this when applied should be 60 deg. to 70 deg. Fah. After twenty-four hours apply another soap wash, and so on alternately until four coats of each have been put on. Experiments showed that this was sufficient to make the wall water-tight under 40ft. head of water. At the time of application to the Croton reservoir the walls had been saturated and the weather was cold. The gate chambers were covered over and heated thoroughly with large stoves. The drying, cleaning the walls with wire brushes, and applying the mixture, took ninety-six days. Twenty-seven tons of coals were used for the drying and one ton for heating the soap solution. 18,830 square feet of wall were washed with four coats. The drying and cleaning of the walls cost 6½ cents per square foot, and the plant, materials, and labour of applying the wash cost 3⅜ cents per square foot.

MISCELLANEA.

A NEW edition of a well-executed illustrated and descriptive catalogue of machine tools, machinery, and tools, has been sent us by Messrs. H. Hind and Son, of Nottingham.

THE convention for the railway between Athens and Patras has been submitted to the Chamber. Thus communication with Western Europe will be greatly facilitated. Various other lines will shortly be submitted to the Chamber.

AT the Shipwrights' International Competitive Exhibition the "Burt" prize of £50, given by ex-Sheriff Burt, J.P., for the best system of ventilation for ships, was gained by Messrs. Robert Boyle and Son, for their system of ventilation.

THE *Lumière Electrique* says the experiment has been made of lighting a Rhine steamboat with electric light, and it is proposed to organise a night service of boats lighted by Buergin machines and lamps, which are to be powerful enough to throw from the bows a light that will illumine the immediate scenery.

UNDER the auspices of Sir John Cowell, Master of the Royal Household, some interesting experiments with various systems of electric lighting are being made at Windsor Castle. Some parts of the Castle were illuminated by arc and by incandescent lamps during the recent marriage festivities by Mr. R. E. Crompton, and he is now occupied in the extension of the system.

AN extraordinary general meeting of the Society of Telegraph Engineers and of Electricians will be held on Thursday, the 18th inst., when, by special desire of the President and Council, Mr. Augustus Stroh, member, will repeat his interesting experiments in connection with attraction and repulsion due to sonorous vibrations, and will compare the phenomena with those of magnetism.

A NEW gas engine was shown at the Manchester Horse Show this week. It is called Barker's Universal Gas Engine, and is specially recommended on account of its cheapness. The engine, so far as construction is concerned, is certainly simple, the gas being exploded by means of a jet outside the cylinder, but the repeated loud reports, our Manchester correspondent says, would under many circumstances be a strong objection to its adoption.

A PARLIAMENTARY return just published gives the whole receipts from the Patent-office for the year 1881-82:—(1) Initial stages—petitions for letters patent, £29,520; applications, with complete specifications, £1385; notices to proceed, £21,500; warrants, £19,955; letters patent, £19,945; final specifications, £18,390; notices of objection to grant, £82; notices of objection to sealing, £32; on oppositions, £251—£111,060; (2) third year fees, £55,900; (3) seventh year fees, £30,600; (4) other fees, certificates, &c., £1005; (5) sales, £2864; (6) designs, £5149; trade-marks, £3956—£9105; total, £210,534.

AN agricultural show, at which trials were made, was held at Port Elizabeth in March last. Messrs. Hornsby and Sons were large exhibitors. The judges awarded the first prize, £25, to Hornsby's portable engine; first prize, £30, to Hornsby's thrashing machine; first prize, £10, to Hornsby "Indispensable" reaper; first prize, £5, to Hornsby's corn-dressing machine; first prize, £3, to Hornsby's corn and seed drill; first prize, £3, to Hornsby's clod crusher; first prize, £2, to Hornsby's ridging plough; first prize, £3, to Hornsby's harrows; second prize, £2, to Hornsby's harrows; second prize, £15, to Hornsby's centrifugal pumps.

THE judges of the Shipwrights' International Exhibition in the Fishmongers' Hall have made the following awards in respect of model and designs prepared by Earle's Shipbuilding and Engineering Company, Limited, viz.:—A gold medal for the best grain and cattle steamer for the Atlantic trade, this being a model of the s.s. Grecian Monarch, which Earle's Company is now constructing for the Royal Exchange Shipping Company, Limited; a silver medal for the steam fish carriers Europe, Asia, Africa, and America, which also took medals at the Exhibitions held at Norwich and Edinburgh; and a bronze medal for the design of the steam trawler Zodiac.

ON the 6th inst. Messrs. G. M. Dowdesdell, Q.C., and H. J. Marten, C.E., arbitrators under the South Staffordshire Mines Drainage Acts, held a court at Wolverhampton to hear appeals against making an award for levying rates in the Tipton district equal to 9d. per ton on ironstone, 3d. on fireclay and limestone, and 6d. on coal and other minerals. Among the appellants were the Earl of Dudley, the Patent Shaft and Axletree Company, and a large number of colliery owners, who asked for their rates to be reduced owing to the extensive pumping of water by machinery they carry on for the relief of a large mineral area. The Court reserved its decision in each case.

A PLEASING incident is reported this week from Sheffield—a presentation by the workmen in the employ of the Clay Cross Colliery Company to Mr. Charles Binns, J.P., who recently resigned the general managership of the company, after holding the position forty-three years. The gift was a complete dessert service and silver inkstand, costing £85. It bore the following inscription:—"Presented to Charles Binns, Esq., J.P., on his retirement from the management of the Clay Cross Collieries and Ironworks, by the workmen employed there, in grateful recognition of his untiring efforts in the cause of education, and in the promotion of their general welfare, during the forty-three years he acted as manager of the works."

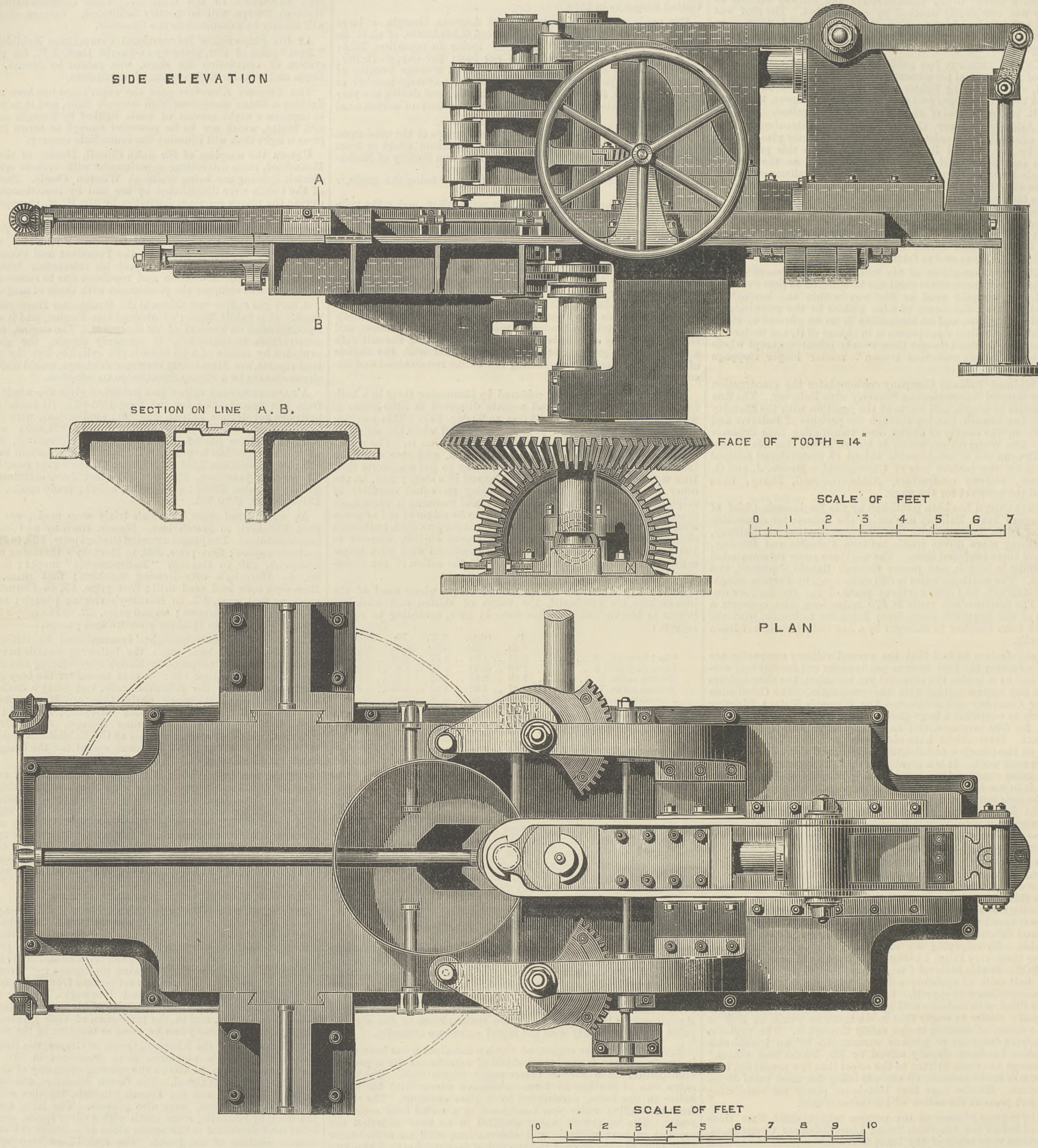
ON the 4th inst. the King and Queen of Greece, the Grand Duke Constantine, and a numerous suite proceeded in the war-ship Hellas to Kalamata, to attend the opening ceremony of cutting the Isthmus of Corinth Canal. The Greek Ministers, the diplomatic corps, the Russian and the French admirals, together with a large concourse of persons, were also present. The King commenced the work by removing some earth with a silver spade, and various coins were deposited in the corner stone as a monument erected in commemoration of the event. The rock where Nero commenced cutting the isthmus was blown to pieces by charges of dynamite, which were ignited by the Queen, an electric wire about 2000 metres long being connected with them.

ON Saturday, 6th inst., Messrs. Oswald, Mordaunt and Co. launched from their shipbuilding and engineering works, Southampton, a large screw steamer of 4500 tons, named the Woolston, of the following dimensions, viz.: Length, 385ft.; breadth, 44ft.; depth of hold, 32ft. The ship is built with topgallant forecastle, long bridge, and cape aft. She is fitted with Emerson and Walker's patent windlass for lifting anchors, and all the latest improvements. The engines, compound, which are made by the same firm, have cylinders 52in. by 94in., and a stroke of 60in. She has four double-ended boilers, with a working pressure of 90 lb., and a total heating surface of 12,500ft. She is also fitted with an auxiliary boiler, which can be used for the main engines or steam winches, as required.

A FINE iron steamer, the Grecian Monarch, built for the Royal Exchange Shipping Company, London, was launched last week from Earle's Shipbuilding and Engineering Company's yard. The Grecian Monarch is very much in outward appearance like the Assyrian Monarch, built by Earle's Company for the same owners, but with several improvements which experience has suggested. She is of the following dimensions:—Length, 380ft.; breadth, 43ft.; and depth of hold, 34ft. Her gross register tonnage is about 4400 tons, and her net register 2800 tons. She is barque rigged, with four pole masts, having yards on the fore and mainmasts, and fitted with double topsail yards. She is built on the longitudinal system, with double bottom water ballast arrangements, capable of carrying 640 tons of water. She has three iron decks, each of which is sheathed with wood. Her saloon house is built on the top of the awning deck amidships, and the captain's and officers' rooms are arranged round the engine and boiler casing, whilst the state rooms for the first-class passengers are situated beneath the saloon on the main deck. She has accommodation for 40 first-class passengers, and will carry about 1000 emigrants. She is also intended on her return voyages from New York to carry cattle, and fittings will be provided for about 600 head.

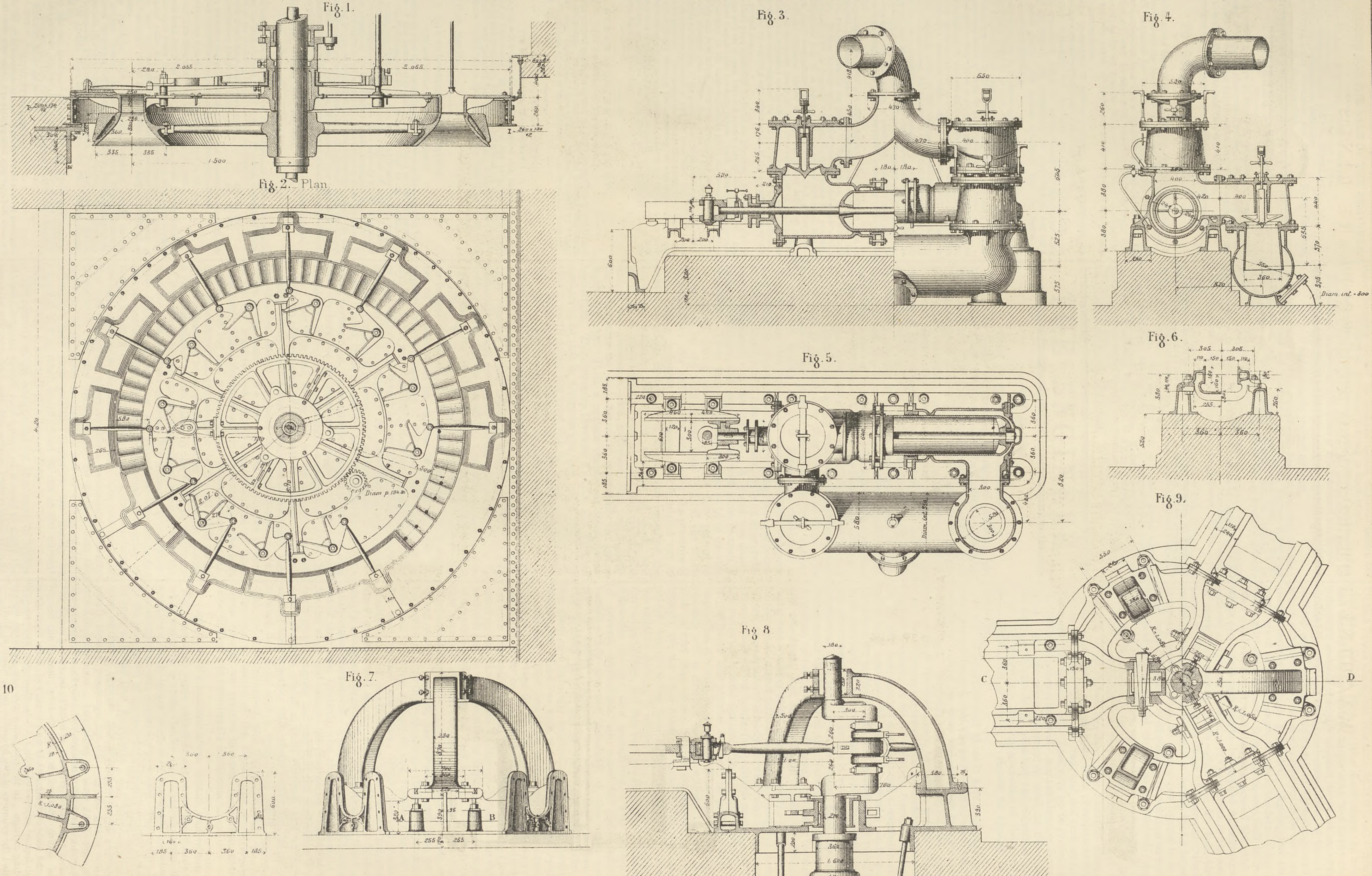
MACHINE FOR ROLLING BOILER PLATE RINGS.

MESSRS. DANIEL ADAMSON AND CO., DUKINFIELD, MANCHESTER, ENGINEERS.



THE invention of Mr. John Windle, of Manchester, of which we give illustrations in section and plan, has been specially designed with the object of rolling boiler-plates in the form of rings 4ft. 6in. in width, and up to any diameter, in order to dispense with the longitudinal seams which are unavoidable in boilers constructed of ordinary plates, and are necessarily a source of weakness. In the mill, as shown by our illustrations, there are a fixed and a movable roll. The fixed roll is fixed upon a vertical shaft which is mounted to revolve in bearings. One of these bearings is secured to a fixed standard, cast upon the foundation plate, and the other is formed on a strong bracket secured to the underside of the side-plate. The upper end of the shaft is sustained against the roll in pressure by means of a half bearing formed in a piece and secured to the top of the standard. The main shaft is connected by means of bevel gearing with another shaft driven from the engines. The movable roll is formed upon a vertical shaft mounted in bearings fixed to a movable carriage fitted to a slide in plain guide ways in the foundation plate, and a movable standard is also fitted to a slide in a similar manner, in ways formed in the foundation plate. To this standard is hinged a fork lever frame, and the outer end of this lever is fitted with a bearing in which the upper end of the shaft is seated, whereby this end is sustained against the rolling pressure, as in the case of the main shaft. The sliding standard is connected by means of side bars to the slide carrying the movable roll, and these side bars are each formed at one end with T heads, which enter recesses in the sliding carriage. In the standard supporting the fixed shaft are seated the cylinders of two hydraulic rams, which at their outer ends bear against the sliding standard carrying the fork lever. When the cylinders are changed the sliding standard is caused to move in a direction towards the right, and by the action of the slide carrying the movable shaft the latter is also caused to move in the same direction, thus approaching the fixed roll. As the fulcrum of the lever which carries the top bearing of the loose roll is fixed to the sliding standard carrying the fork lever, this lever moves also in unison with the standard and carriage, so that the efficiency of the bearing is not interfered with. In the carriage supporting the movable roll is contained the cylinder of a hydraulic ram which abuts upon the body of a ram cylinder connected with a sliding crosshead, which in turn is connected by rods with the slide carrying the movable roll. When this ram is forced outwards the slide carrying the loose roll is drawn to the left, whereby the rolls are separated, and when the T heads of the bars take their bearings in the recesses in this slide, the standard carrying the fork levers is compelled to move in unison. The ram connected with sliding crossheads is employed to move the slide after the fork lever has been lowered until the shaft takes the bearing of the fork lever, and also to move the slide away from the fixed roll for the introduction of the metal to be rolled, or subsequently for the removal of the finished rolled ring. When the ram in connection with the sliding crossheads is in action for moving the slide carrying the loose roll in the direction to the right, and in order that this movement may take place in unison with a corresponding movement on the part of the standard, clearances are formed for the T heads of the side bars, and when the slide is so moved the upper end of the shaft is released from the bearing. The independent action thus permitted to the slide is such that after this movement the fork lever may be turned upon its fulcrum so as to remove the bearing on the end of the lever out of the way, and in order that the lever may be readily tilted up, a hydraulic cylinder is provided to the right of the mill. Fixed shafts, bolted to the foundation plate, carry two vibrating frames, each of which is formed with arms carrying spindles, and upon each frame there are mounted three guide rolls. Upon these frames are formed worm spur quadrants which gear with worms fixed upon a shaft mounted in ordinary bearings. This shaft is turned by means of a hand wheel, and when in action causes the vibrating frames to revolve upon their shafts. The worm teeth of the two frames are made right and left, so that they turn in opposite directions, and all the rollers are thereby moved to or from the main roll simultaneously. The top of the foundation plate forms a level table upon which the work can be moved, but in order to facilitate this operation, whilst the iron is being rolled, carrying rollers are provided which revolve in recesses formed in the foundation plate, but projecting slightly above its surface. These rails are provided with extended axles, which are connected by means of bevel gearing with connecting driving shafts. The fixed roll is formed with top and bottom flanges, and the movable roll is a plain cylinder. When in operation, the metal to be rolled is formed into a hollow cylindrical shape, so as to slip into position over the loose roll whilst the fork lever is tilted up. The lever frame is then lowered, and the rams attached to the standard on the right are forced outwards, bringing the loose roll against the inner surface of the metal, and the rolling operation, which is shown in plan, commences. The worm shaft is moved in the direction which will so move the vibrating frames as to bring the guide rollers into contact with the metal and support the ring being rolled so that its centre is kept in the centre line of the two rollers. When the ring has been rolled to the required diameter the water is shut off from the hydraulic cylinders of the ram attached to the standard to arrest the movement of the sliding carriage, whilst water is admitted to the hydraulic cylinder connected with the slide crossheads, and this ram being forced outwards, the sliding carriage is drawn backwards so as to withdraw the roll from the ring. The hand wheel attached to the worm shaft is then turned in the direction which will withdraw the guide rollers from the ring, water is admitted to the cylinder in the movable slide, and the upper end of the loose shaft is moved out of bearing. The fork lever being then tilted up, the ring is free to be removed from the machine. The rolls, it may be added, are arranged to be changeable for other rollers, so that various forms of rings, either conical, flanged, or plain, may be produced.

TURBINE & PUMPS, PIERRE-LA-TREICHE



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*** *With this week's number is issued a Supplement, representing Turbine and Pumps at Pierre-la-Treiche. Every copy as issued by the Publisher contains this Supplement, and subscribers are requested to notify the fact should they not receive it.*

TO CORRESPONDENTS.

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

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

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

R. L. K.—*Apply to S. and E. Ransome and Co.*, 10, *Essex-street, Strand.*

J. J. M. (Inverness).—*There is no such thing to be invented as "Perpetual motion." Do not waste either your time or money on it.*

B. N.—*We presume you refer to the caloric engine. There are many varieties of this. Concerning which of them do you require information?*

H. L. (Birmingham).—*Your letter in reply to* Φ Π *is one of several which we do not publish, because the authors have obviously missed the point at issue. You are mixing up the resistance of inertia with that due to gravity, while other correspondents combine them. As we understand* Φ Π, *it matters nothing what name is given to the resistance, whether gravity, motion, friction, or all three combined, his contention being that the resistance in all cases equals the force applied, and consequently under all imaginable circumstances the pull at one end of the rope or draw-bar and the resistance at the other must be equal. If this be a correct statement of* Φ Π*'s doctrines, then, as we have said, the publication of your letter would be mere waste of space, because it assumes that* Φ Π *has overlooked something which he has not overlooked.*

HELIX.—*By increasing the pitch you will augment the resistance, and in order to maintain the same number of revolutions you must increase the boiler pressure, and consequently the power of the engines, and the boat will go faster. To keep the same speed of boat and indicated power with a screw of increased pitch is possible, but only by increasing the pressure. You will understand this in a moment if you regard each revolution as giving out so many horse-power—say* 10 *for example. Then at sixty revolutions you will get* 600-*horse power, at fifty revolutions* 500-*horse power, and so on. To get* 600-*horse power at fifty revolutions, it is obvious that each revolution must represent not* 10-*horse power, but* 12-*horse power; but to get the increase you must augment the average pressure in the cylinder, which may be done by working less expansively if the construction of the engines will permit you.*

CONDENSER.—*Make your condenser as large as you can.* 450 *square feet of cooling surface will do if you have* 850 *square feet of boiler surface. Use brass tubes—best tinned—⅝in. diameter inside; pack them with compressed wood ferules, driven in the holes in the tube plate, the ferules being outside the tubes. They can be obtained from any firm selling engine-room stores. They are much cheaper and better than tape or india-rubber. Practice varies as regards air pumps. If the pump has a capacity equal one-fifteenth that of the high-pressure cylinder it will do very well, but they are made both larger and smaller. The larger the circulating pump the better. The quantity of water passed through the condenser in any given time should not be less than thirty times as much as that fed into the boiler in the same period. It appears to us that as you are so much pressed for room, if you make your pumps as large as you can they will be none too large. See* THE ENGINEER *for Sept.* 23*rd*, 1881.

STEAM ENGINE ECONOMY.

(*To the Editor of The Engineer.*)

SIR,—Will you permit me to point out an error in my letter published in last week's ENGINEER. In lines 7 and 14 from the bottom, the words "light pistons" and "lightness of one of the pistons," should be "tight pistons" and "tightness of one of the pistons." WILLIAM INGLIS.

Bolton, May 8th.

THE ACTION OF LIGHTNING.

(*To the Editor of The Engineer.*)

SIR,—I hope you will kindly allow me to point out that in the review of "The Action of Lightning" in the issue of the 14th ult., two slight errors occurred in the quotation from my definition of electricity, viz., the word "fixed" was printed for "forced," and "with" for "into." These corrections would make the sense of the definition much more clear. A. PARNELL.

Mallow, Co. Cork, May 7th.

THE SHIPWRIGHTS' EXHIBITION.

(*To the Editor of The Engineer.*)

SIR,—We notice in your last issue that you have credited us with being the exhibitors of the beautiful model of the Viking at the Shipwrights' Exhibition in the Fishmongers' Hall. It is only due to the exhibitor of this model to point out that we are not the exhibitors of this model. We are, however, exhibiting there a working model of Halpin's Safety Syphon Sea Connections—of which you have already given illustrated notice in your paper—as we have lately made arrangements with Mr. Halpin for the sole right to introduce this invention in Great Britain. It may be gratifying to you to learn that the comments you made on this invention before it could receive the sanction of practical men, have been completely verified by the opinions of some of the best men in the country who have seen it whilst at the Naval and Submarine Exhibition, and also at the present Shipwrights' Exhibition.

LEWIS OLRICK AND CO.

27, Leadenhall-street, London, E.C., May 10th.

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

MEETINGS NEXT WEEK.

THE INSTITUTION OF CIVIL ENGINEERS.—Tuesday, May 16th, at 8 p.m.: Papers to be read and discussed:—(1) "On the Various Systems of Grinding Wheat, and the Machines used in Corn Mills," by Mr. W. Proctor Baker. (2) "High Grinding by Roller Mills in England," by Mr. Henry Simon. (3) "Roller Mills and Milling as Practised in Budapest," by Mr. William Bishop Harding.

CHEMICAL SOCIETY.—Thursday, May 18th, at 8 p.m.: The following papers will be read:—(1) "On the Precipitation of Alums by Sodic Carbonate," by Dr. E. J. Mills and R. L. Barr. (2) "On Rotary Polarisation by Chemical Substances under Magnetic Influence," by Mr. W. H. Perkin.

THE METEOROLOGICAL SOCIETY.—Wednesday, May 17th, at 7 p.m.: The following papers will be read:—"On the Diurnal Variation of Wind and Weather in Relation to Isobaric Lines," by the Hon. Ralph Abercromby, F.M.S. "Mechanical Conditions of Storms, Hurricanes, and Cyclones," by Mr. W. F. Stanley, F.M.S., F.R.M.S.

SOCIETY OF ARTS.—Monday, May 15th, at 8 p.m.: Cantor Lectures, "Book Illustration: Old and New," by Mr. J. Comyns Carr. Lecture II. Various modes of book illustration. Modern development of wood engraving. Wednesday, May 17th, at 8 p.m.: Twenty-second ordinary meeting, "The Constant Supply and Waste of Water," by Mr. George F. Deacon, Mem. Inst. C.E. Sir Frederick Bramwell, F.R.S., Chairman of the Council of the Society, will preside.

THE ENGINEER.

MAY 12, 1882.

TESTS OF STRUCTURAL MATERIALS.

THE two great engineering societies of America, the Institute of Civil Engineers and the Institute of Mining Engineers, are now combining together to obtain from Congress a grant of money and other facilities for testing the strength, elasticity, and other qualities of iron, steel, &c., "not simply the substances used as such, but the members of large structures composed of such materials, and of the forms and sizes in which they are actually used." It is scarcely possible to conceive the Institution of Civil Engineers and the Iron and Steel Institute, for example, combining together to make an attack for such a purpose on the Board of Trade, still less on the House of Commons; and it becomes interesting to discover, from the report of the recent Conference, exactly what our American friends are hoping to do, and how they propose to do it. The present state of the question seems to be very curious In 1872 the Society of Civil Engineers appointed a Committee on this subject, by whose exertions Congress was induced in 1875 to pass a law providing for the appointment of a Board to test iron and steel, with an appropriation of 75000 dols. for the purpose. A Board was constituted accordingly, and went to work with some flourish of trumpets. Their first duty was deemed to be to provide an accurate testing machine; but this duty proved so heavy that by the time it had been fulfilled the whole appropriation was exhausted; and under the pressure of some hostile influence the Board was legislated out of existence before it had done more than construct the machine, conduct about 150 analyses of steel, and draw up a report which was so little circulated that one of the gentlemen who addressed the recent meeting complains he had found it impossible to get a sight of a copy. It is a curious chapter in transatlantic legislation. The difference between America and England appears to be that in Congress you can get a thing done that is worth doing, but must risk its being undone again directly afterwards; while in the House of Commons you can never get anything that is worth doing done at all. Adverse political influences might, however, kill the Commission, but could not destroy the machine; and it accordingly remains at the Watertown Arsenal, near Boston, nominally at the service of private persons who may be willing to pay for the use of it. Concerning the real character and value of the machine opinions seem somewhat to differ. It is scarcely possible indeed to imagine any perfection or capacity in a testing machine which ought not to be secured at an expense of nearly £15,000. It appears to have a capacity of 400 tons; and we believe an English maker would willingly contract to supply a machine of that calibre, that would do anything a testing machine could possibly do, certainly for one-third of the amount named. But whilst its promise of giving results was abundantly lauded, there seemed to be some question as to its actual performance. One engineer was quoted who sent nine steel eye-bars for an important bridge to be tested, and found that it required seven and a-half days to make the test. This was said to be due to the lack of means to engage an efficient staff of assistants to handle the specimens promptly; and it was recommended accordingly that the machine should be placed in special charge of "an active young man." We are thus led to picture to ourselves the inactive and elderly superintendent of tests laboriously lifting the specimens into position by the help of the office boy and a screw jack. Some further mechanical appliances, not provided for in the £15,000, would therefore seem to be needed. Another gentleman quoted a very remarkable report, made by the Chief of Ordnance at Watertown to his commanding officer, stating that "the machine is in constant use when Mr. Howard is not otherwise engaged in making out reports of tests made for private parties;" and also that "the greatest number of tests made in a day of eight and a-half hours is seventy; the least number is one-half of a test." The particulars of this half-test are not given, so that a pardonable curiosity is baulked. On the whole it may be granted that the machine, from whatever cause, is not in a state of high efficiency; and that private engineers can hardly be expected to reap much benefit from its use at the current rates of half a test and 15 dols. per diem.

The remedy which is suggested for this state of things is that Congress should vote a sum of money to make the machine efficient, find out the active young man already referred to, and set him to work on a comprehensive series of tests. The suggestions as to these tests are exceedingly practical, as would be expected from the character of the engineers who made them. It was observed that, in the United States alone, not less than 80,000 tons of iron and steel were used in 1881 for the construction of bridges, and that of this upwards of 31 per cent. was in the form of compound sections specially adapted to resist compressive strains; yet that all the experimental data on which such sections are designed were obtained by testing machines which subsequent experience has shown to be very inaccurate, especially at high pressures. Again, the tension members of such bridges are mostly in the form of eye-bars, varying in sectional area from one square inch to twenty. Now until recently it was always supposed that the same strain per square inch might be applied indiscriminately, without any regard to the size of the section, or the amount of work done upon it in the rolls. The few bars already tested at Watertown, not to speak of tests and experience in other countries, have made it certain that a large bar is never, *cæteris paribus*, so strong per square inch as a small one; and a scale of diminution of working stress with increase of section should clearly be established. Again, the use of rolled girders, especially in buildings, is enormous, and is constantly on the increase, upwards of 50,000 tons being produced last year in America. Yet their strength is estimated by theoretical formulæ alone, the constants of which are deduced from experiments carried out on other than American iron, and not even on iron in that particular form at all. Lastly, to go no further as to particular branches of research—such as abrasion, corrosion, impact, &c.—the whole question of steel, as the metal of the future, remains to be attacked and solved, so as thoroughly to investigate the characteristics of the metal, and the conditions under which it should be applied to construction.

It will be admitted that there is here a tolerably extensive programme, and that the active young man will have enough to occupy his time and energies for two or three years at least. Supposing it to be adopted, the question next occurs of the best means by which it may be carried out. Mr. Chanute suggested that a Commission should be appointed—partly it would seem by Government, partly by the two institutions—and that this Commission should select and nominate to some man, "who shall possess the necessary technical skill, the executive ability, and the high standard of accuracy and thoroughness to conduct the experiments, as well as the talent to deduce general conclusions from them." On the other hand Mr. Alfred Boller urged the revival of the National Board for testing American metals, which had been previously constituted and dissolved. But such a Board would be difficult to bring into working order in any country, and these difficulties are increased tenfold in such a country as America, where, as events have already shown, it may at any moment become the field of battle for political parties, and lie at the mercy of hostile faction. To put the matter tersely, if the Board was popular, it would be jobbed; if it was unpopular, it would be quashed. The work of conducting research will be difficult enough, without loading it with such an Old Man of the Sea as a politically-constituted Board. On the other hand, to leave the whole matter to private enterprise has been sufficiently shown to be much the same as shelving it altogether. Professor Egleston, of Columbia College, put this very clearly in the course of the discussion we are now considering. The experiments of private individuals are made for their individual benefit; they are not generally of the exact character or extent required to solve the problem for the general public, and if they are, those who pay for them are naturally inclined to keep the results to themselves. Moreover, such tests as are here considered are so expensive that few private individuals or firms are likely to undertake them. It appears then that the proper organisation to conduct such tests is some body lying between the individual on the one hand and the Government on the other. Such bodies are found in the various societies for the advancement of engineering. An example of research undertaken by such a body is to be found at this moment in the Committees of the Institution of Mechanical Engineers; and though their progress, owing to one cause or another, has certainly been slow, yet it is impossible to deny that valuable results have been attained, and that in a more systematic and reliable manner than has been realised elsewhere. Would the two American Institutions but combine, they could surely achieve the same success, and at a far more rapid rate. Instead of simply besieging Congress for a subvention, let them make a subvention themselves. Let them appoint a Commission out of their own Councils, who shall select the right man for the work, and arrange his programme; they may then fairly go to Congress and ask that the machine at Watertown shall be placed at their disposal, and an efficient staff of men, together with steam power, &c., be provided to work it. Were such a work once fairly begun, with that quick intelligence and inventive sagacity which American engineers of the right type would be able to throw into it, we venture to assert that there would be little difficulty in securing its continuance.

MR. LAWSON'S EXPERIMENTAL BOILER EXPLOSIONS.

WE some time since called attention to the theory that when water in a steam boiler was suddenly relieved of pressure a much larger portion of the water might flash into steam than was commonly supposed. The result would be the generation of an enormous pressure, quite sufficient to rend a boiler into fragments. A marked distinction must be drawn between this theory and that enunciated nearly twenty years ago by Mr. D. K. Clark and the late Zerah Colburn. According to these gentlemen, when the pressure in a boiler was suddenly relieved in any way, the steam produced at once in the lower part of the boiler hurled the water above it against the top of the boiler with such violence that it rent the plates by sheer force of impact and momentum. According to the theory now under consideration this upheaving of the water plays but a secondary part, if any; the rending of the boiler being produced by an immense momentary increase of pressure due to the fact that heat being equally dispersed through the mass of water in a boiler, the instant it is relieved of pressure every portion tends equally to become steam, The heated water in a boiler may be regarded as in a condition of unstable equilibrium, and the reason why one portion is converted into steam and not another depends on the influence of conditions which differ very little among themselves. The result of the sudden vaporisation of all or nearly all the water in a boiler would, of course, be attended by a fall in temperature to far below boiling point, and that such an action possibly may take place is indicated by the instantaneous dispersion in cold mist of the water drawn off from a boiler gauge cock working under a high pressure. We do not propose here to go at length into the theory of the subject. We may point out that it accounts for the simultaneous explosion of a number of boilers which frequently occurs, and for which no more satisfactory explanation has ever been adduced.

Mr. D. T. Lawson, of Wellsville, Ohio, has recently carried out a number of costly experiments to test the truth or falsehood of the theory. He proposes to guard against accidents by putting inside every boiler, about the water line, a perforated diaphragm, which will effectually prevent the too sudden relief of pressure, no matter what happens in the steam space above. His experiments have consisted in raising steam to high pressure in small cylindrical boilers, and then opening—by pulling a string from a bomb-proof—a large sluice valve fitted in the steam pipe, connecting the boiler with a vessel answering to the cylinder of a steam engine. He has succeeded in this way in exploding boilers with great violence. The last impression of the *Scientific American* contains an account of an experiment which, beginning on the 7th of March, ended on the 22nd of that month with the total destruction of the apparatus. The experiments were made in Munhall Valley, on the west bank of the Monongahila, about eight miles from Pittsburg. The boiler was 30in. in diameter and 6ft. long, of three-sixteenths plate flanged and rivetted to each boiler head. Experiments were brought to a premature close by the cracking of one of the boiler ends, and a new boiler had to be provided. This was fitted with the diaphragm to which we have referred, but this was cut away all round. It could not be got out through the manhole, and was left lying in the boiler. The boiler was set in masonry, and connected with it were 15ft. horizontal and about 3ft. vertical lengths of $3\frac{1}{2}$in. wrought iron steam pipe, leaving the top of the boiler at the middle of its length, and entering the stuffing-box of an old empty steam engine cylinder 8in. diameter and 36in. long. Near the elbow of the pipe which turned downward toward the old cylinder was a $3\frac{1}{2}$in. quick-opening sluice valve. In the end of the old cylinder was a Mississippi gauge cock, which could be operated from the interior of the bomb-proof. The boiler furnace was fitted with a $\frac{1}{2}$in. iron pipe, which entered through the side wall just below the bottom of the boiler and extended in a perforated section across the furnace for the distribution, upon the incandescent coals, of liquid fuel supplied from a barrel placed at a safe distance in a cavity of the bluff. The flow of oil from the barrel could be regulated by a valve at the door of the bomb-proof. Inside the bomb-proof were two pressure gauges, both connected to the front head of the boiler, one above and the other below the diaphragm, to indicate the pressure and the disturbance in the steam and in the water pressure when the $3\frac{1}{2}$in. valve was suddenly opened.

After some preliminary trials, operations began on the 22nd March. With 20in. of water in the boiler the pressure rose in six minutes from 175 lb. to 235 lb., the valve being opened at every rise of 25 lb., and the last time after a rise of 10 lb., when the boiler immediately exploded. In the words of our contemporary—"When the valve was opened at 235 lb. pressure the boiler exploded with terrific force, all the water disappearing in an atomised form; each elementary globule of 1000 lb. of water, at 400 deg. Fah., simultaneously—not progressively as powder burns—exploded and was diffused in practically ultimate atoms, like a cloud of steam in the air."

By the formula $P = \frac{T \times c}{D}$, where P = bursting pressure in pounds per square inch, T = thickness of shell in sixteenths of an inch, and D = diameter in quarter feet, while c is a constant = 1097 for single rivetted iron plate, the bursting pressure for Mr. Lawson's boiler was $= \frac{3 \times 1097}{10} = 329$ lb. The ends of the boiler were stayed together by a 1in. stay bolt, fitted with nuts and washers. The ends of the boiler no doubt added to the strength of the cylinder, and we shall probably not be far wrong if we assume that 340 lb. was the bursting pressure. Consequently it appears that the boiler exploded at about 100 lb. less than it ought to have sustained. It is to be regretted that the pressure gauges in the bomb-proof did not give indications of much value as to what took place at the moment the steam valve was opened. They always fell at first, and then rose above the point at which they had stood; but the distance which intervened between them and the boiler was too great to allow percussive action to be indicated. So far as Mr. Lawson's experiments go, they appear to confirm the truth of the hypothesis that a large volume of water may be flashed into steam with disastrous results when an opening of considerable size is suddenly made above the water level. But it must not be supposed that Mr. Lawson's experiments are final on this point. His conclusions find some confirmation in the well-known fact that while cracks often occur below the water line in boilers, little or no harm being done thereby, a crack in the steam space is almost certain to be followed by a violent explosion. The phenomena remarked by Mr. Lawson and the gentleman who assisted him are eminently suggestive, but they cannot be regarded as more than suggestive. As such, however, they possess a great deal of interest, and are well worth the consideration of our readers.

HOT-BLAST STOVES.

In the North of England there is now in progress very quietly a marked change in the dimensions and the power of the hot-blast stoves attached to blast furnaces. In the North of England the two types of heating stoves preferred are Cowper's and Whitwell's; both are well known, the latter being the invention of the late Mr. Thomas Whitwell. It has been very largely applied, and his executor, Mr. William Whitwell, of the Thornaby Ironworks, is now erecting at that establishment new stoves which, in size and other particulars, embody all the teaching of experience gained in many parts of the world. New Whitwell stoves on a large scale are, we believe, being also erected at the Jarrow furnaces of the Palmer's Iron Company at Jarrow, and also at those of the Seaton Carew Iron Company at West Hartlepool; and of the Cowper stoves there are some on a most extensive scale now being built for Bolckow, Vaughan, and Co., at Eston, and for other firms. These stoves are on a scale so large that the heating surface will in many instances be doubled, and the heated air will be raised some hundred degrees higher than usual. It is evident that this will have a very marked effect on the smelting of iron in the North of England, and probably much more marked in the consumption of coal and coke. Although much has been done of late years to induce economy in the use of fuel, yet it may be said that in some branches of metallurgy much remains to be done; and although our coal supplies may not be in danger of extinction for many years, yet it is evident that those supplies are nearer to exhaustion, and with the vast addition to the consumption that every year brings, it cannot but be a matter of national importance that every step that can be taken to lessen the waste of fuel should be taken. In that direction, then, the increased use of larger and more powerful heating stoves in the iron trade is nationally important, and it is also sufficiently so to make the example of the Cleveland ironmasters of very great interest.

REMOVING THE SPOIL IN CHALK TUNNELLING.

Mr. T. Russell Crampton has devised a system of removal of the spoil from tunnels made in chalk, which is applicable in part to cement and whiting making, brickmaking, and for other manufacturing purposes. It is the employment of a plain cylindrical iron drum mounted on a horizontal, or nearly horizontal, slowly rotating shaft, one end of the drum being provided with an opening for the admission of water and the chalk in a broken-up state—not necessarily as small as that which comes from the Beaumont-Inglis tunnelling machine—and the other end a similar opening to permit the egress of the material when converted into slip in the drum by self-attrition in the water. Mr. Crampton has several years used one of these drums in connection with brickmaking, and has thus the means of finding the speed at which the work can be done by it, and has also found that the thing works for years without requiring repair. This drum is about 4ft. in diameter and the same in length, and revolves at about one revolution in two minutes. This has been proved to be capable of reducing 15 tons of broken chalk to the consistency of cream per hour. If a Channel tunnel is made, one of the great difficulties to contend with will be the removal of spoil, especially when the work has proceeded a considerable distance. In order to avoid the loss of time which the removal of this spoil by trucks and engines would cause, not only in doing the work of bringing the spoil to shaft bottom, but by occupying so much room in the tunnel and preventing free conveyance of the required building material, Mr. Crampton proposes to place machines of this kind down near the boring machine at the heading, and to take a supply of water down to the same place in pipes. The machines and the boring machines would be driven by water under some pressure, instead of the air now used for that purpose, and would deliver the chalk cream into a return pipe in connection with other pumps at bank. The spoil would thus be continually pumped up as slip, and if not employed for some purpose there would be sent out to sea by a pipe. There is nothing in the pumping work which presents greater difficulties than in the pumping of many coal mines. The difficulties attending removal of spoil from tunnels, so long as it is convertible into slip, are thus apparently overcome; and even if not employed for this work the applications of Mr. Crampton's machines are numerous.

LORD F. CAVENDISH.

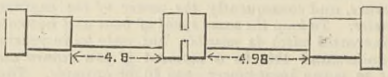
The assassination of Lord F. Cavendish, so deeply deplored by all classes of the community, will be by none more keenly felt than by those engaged in the mining operations of South Yorkshire and Derbyshire. The family, it may be stated, is deeply interested in and identified with mining operations. The Duke of Devonshire is not only a Derbyshire coalowner but he is lessee of the Staveley coal-field, and chairman of the Barrow Iron and Steel Company. Lord Edward Cavendish has, since the formation of the Chesterfield and Derbyshire Institute of Mining Engineers, been president, and has taken great interest in the proceedings of the institute, often presiding at their meetings. Lord Frederick Cavendish himself was one of the directors of the Barrow Iron and Steel Company, was a local magistrate, and until recently a guardian of the poor at Barrow. On several occasions he has visited and inspected the new Barrow Colliery, near Barnsley, which is sunk to the Silkstone coal, and on these occasions he exhibited a great amount of ability and knowledge relating to mining pursuits. His connection with the rising town of Barrow was very great, as through his exertions and that of his co-directors a large and prosperous community has been brought together there.

THE IRON AND STEEL INSTITUTE.

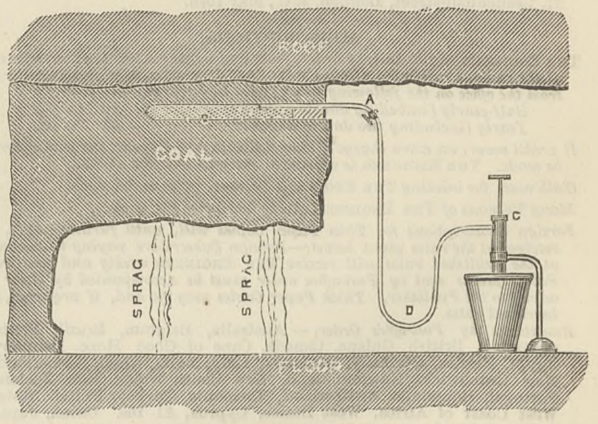
The annual general meeting of the Iron and Steel Institute began at 10.30 a.m. in the Hall of the Institution of Civil Engineers, Great George-street, on Wednesday morning, Mr. Josiah Smith, president, in the chair. The attendance throughout the day was very small, and those present took so little interest in the papers read, that there were practically no discussions. Early in the afternoon all the papers in hand were exhausted, and the meeting in consequence adjourned until this—Friday—morning, when some excitement will perhaps be caused by the reading of a paper on the compression of fluid steel, by Mr. William Annable, of Glasgow, which, it was no secret on Thursday, asserts very plainly that the Whitworth process of compression has no effect whatever on the quality of the metal produced.

The proceedings commenced on Thursday morning with the reading by Mr. Jeans, the secretary, of the thirteenth annual report, which states that 120 new members have joined the Institute during 1881. Of these new members, twenty-three resides in foreign countries, and the remainder in the United Kingdom. The total number of members is now 1110, and there are sixty-eight candidates for election. The Council have accepted an invitation to hold the autumn meeting in Vienna. Among the retiring vice-presidents was the name of the late Lord Frederick Cavendish. The chairman moved the adoption of the report, and in doing so alluded in feeling terms to the death of Lord Frederick Cavendish, by which they had lost a diligent worker, as well as one of the earliest members of the Institute. Mr. I. Lowthian Bell seconded the motion, which was carried. The chairman then proposed the following resolution, which was carried, all the members standing:—"That the meeting of the Iron and Steel Institute desires to express its most profound sorrow for the deplorable death of Lord Frederick Cavendish, M.P., who, in his capacity as vice-president, and a member of the Council, has always taken a very active interest in the affairs of the Institute; and that the most sincere sympathy and condolence be respectfully tendered to the Duke of Devonshire, past President of the Institute, and the other sorrowing members of the family of the deceased nobleman." The Bessemer medal for 1882 was awarded to Mr. A. L. Holley, but on account of his death, a deputation of the Council waited in the afternoon upon the American Minister to hand the medal for presentation by him to the family of the deceased. The meeting subsequently passed a resolution adjourning the meeting until Friday morning, in consequence of the funeral of Lord Frederick Cavendish. The Council and a large number of the members attended the funeral.

There is really very little to be said concerning the papers read. The first was by Mr. Edward Richards, on the well-worn subject the properties of mild steel, and it detailed at considerable length a number of experiments carried out by the author. One object had in view was the determination of the work in foot-pounds done in testing a specimen, and the formula deduced from results obtained in testing one specimen by the author was $u = {\cdot}90$ P, l. Another sample of very soft ingot metal made for tin bar purposes, and having a tensile strength of 25 tons per square inch, gave results which would also agree with the formula $u = {\cdot}90$ P, l. Soft Bessemer steel having a tensile strength of 31 tons per square inch gave the formula $u = {\cdot}89$ P, l. The mean of the three soft qualities of steel gives ·90 as the coefficient; and this was confirmed by the results obtained in testing some Siemens steel plate having a tensile strength of 32 tons per square inch. In the formula u = the mechanical work, P is the tension in pounds, l the elongation reduced to forms of length. Another question to be settled by these experiments was the effect of sudden change in the form of a specimen. In one there were two cylindrical portions



each 4in. long by $1\frac{1}{8}$in. diameter near the ends, and a central portion between them 4in. long by $1\frac{5}{8}$in. diameter. A narrow groove, $\frac{3}{32}$in. in width, was turned in the middle of this boss, so as to leave the diameter of the specimen at the bottom of the groove 1in. in diameter. The sectional area of the specimen at the groove was upwards of 20 per cent. less than at the ends, and the form of the specimen would at first sight appear to be highly favourable to fracture across the groove. The result of tensile test, however, proves the contrary: the metal is perfectly homogeneous, yet the specimen breaks, not at the groove, but at one of the ends, because the metal in the notch has not room to contract in area. It has been remarked by Dr. Siemens that "it is possible by careful manipulation to raise the breaking strain of a bar of a given sectional area to a remarkable extent by gradually accustoming it to the strain. By taking a bar of mild steel of 1in. square sectional area, and loading it with a weight of, say, 15 tons, and leaving the weight on twenty-four hours, it would be found that the elastic limit and the breaking strength of the bar were materially increased." The author's experiments did not confirm this view, but the contrary. Other experiments described prove that the elastic limit of a steel bar varies according to the treatment of the bar previous to testing, and the tensile strength depends upon the cohesive force, and the amount of contraction of area at the maximum strain, the latter quantity being affected by the form of the specimen and by previous train. In one sense these experiments go to support the opinion held by Dr. Siemens that any mechanical treatment to which mild steel is subjected has invariably the effect of increase of strength. Mr. Adamson and Mr. Wrightson made a few remarks on this paper, but there was no discussion. Mr. Bauermann, however, pointed out that we have probably two factors to deal with in breaking steel, namely, the force required to separate the crystals from each other, and to break any crystal through its own substance. It was not known whether the steel crystal had or had not a cleavage; nor could any one tell what force was required to part a crystal.



After the chairman had done his best, without success, to get some member to speak, Mr. Richards said a few words in reply to Mr. Adamson, and a vote of thanks was passed. A paper by Mr. Moseley on a new system of bringing down coal was read. This was a short and useful paper, describing a system of getting coal by the aid of quicklime and water, of which something has recently been heard. The accompanying diagram shows the method in question, which is used with great success in

Messrs. Smith and Moore's Shipley Collieries, Derbyshire. The mode of operating is to employ lime in a specially caustic state made from mountain limestone. This is ground to a fine powder, and consolidated by a pressure of about 40 tons into the form of cartridges 2½in. in diameter, having a groove along the side. These are then packed into air-tight boxes to protect them from damp, and are ready to be conveyed to the mine for use. The shot-holes are first drilled by means of a light boring machine, and an iron tube, about ½in. in diameter, having a small external channel or groove on the upper side, and provided also with perforations, is then inserted along the whole length of the bore-hole. This tube is enclosed in a bag of calico, covering the perforations and one end, and has a tap A fitted on to the other end. The cartridges B are then inserted and lightly rammed, so as to ensure their filling the bore-hole. After the cartridges have been enclosed by tamping, in the same way as with gunpowder, a small force pump C is connected with the tap at the end of the tube by means of a short flexible pipe D, and a quantity of water, equal in bulk to the quantity of lime used, is forced in. The water being driven to the far end of the shot-hole through the tube, escapes along the groove and through the perforations and the calico, flowing towards the tamping into the lime, saturating the whole of the charge, and driving out the air before it. The tap is then closed, so as to prevent the escape of the steam generated by the action of the water on the lime, and the flexible pipe attached to the pump is disconnected. The action of the steam first takes place, cracking the coal away from the roof, and this is followed by the expansive force of the lime. The sprags are left in under the coal so as to allow the force to exert itself as far back as possible, and in many instances the coal is forced off and falls for a distance of several inches behind the end of the drilled holes. In ten to fifteen minutes, on the removal of the sprags, the coal falls clean from the roof, in large masses ready for loading, practically making no small. Of course this system has the great advantage of doing away with all danger of igniting gas and causing an explosion. No discussion followed the reading of this paper. One member asked if the system could be used with Welsh coal, and Mr. Moseley replied that it was now being tried in Wales. Nothing the president could say would induce any of the few members and visitors present to speak. One gentleman threw out the hint that the lime becoming mixed with the coal would absorb sulphur, and so do good. He has evidently never tried the effect of a little lime in a fire. A very moderate quantity will suffice to establish a clinker in furnace bars not easily removed.

After an adjournment for luncheon, a very long paper on "Iron Mining at Bilbao," by Mr. W. Gill, was read. Nearly all that Mr. Gill had to say has already been published in our pages—certain improvements and developments have been effected since, that is all—and it is, therefore, unnecessary to reproduce his paper even in part. It took nearly an hour to read, so that it was at least twice too long, and not a word of discussion followed. After the usual vote of thanks, a paper was read by Professor von Tunner on the use of lignite in the blast furnace. There were probably not thirty persons in the hall at the time, and no one took the slightest interest in the paper, which, however suitable for the Transactions of the Institution, possessed no possible value as regarded English ironmasters, or indeed anyone, for it appears that only the best Austrian lignite can be used at all, and that not alone.

When this paper was concluded the president announced that although the Council had some papers in hand the authors were not present, and another paper had not arrived, although the author was in the hall, and consequently he suggested the adjournment of the meeting, which suggestion was received with applause. It is not easy to give any explanation of the fact, but it is none the less true that the meeting so far has been anything but a success. The attendance has been small, the papers unsuitable for discussion, and the interest taken in them by members the least possible. Perhaps the members are reserving their energies for the Vienna meeting.

THE FOUNDATIONS OF MECHANICS.

By WALTER R. BROWNE, M.A.

No. VIII.*

125. *D'Alembert's Principle.*—The branch of mechanics called Rigid Dynamics is usually founded upon a principle known as that of D'Alembert, and generally laid down (Routh, "Rigid Dynamics," ch. ii.) as an independent deduction from the facts of nature, not to be proved by abstract reasoning. It will be well to show therefore—as has already been done by Thomson and Tait—that it is really a simple deduction from the elementary principles of mechanics, and in fact from the definitions laid down in this treatise.

126. The principle is expressed in words by saying that "The internal actions and reactions of any rigid system are always in equilibrium, and may be neglected in writing down the equations of motion." This, however, requires some explanation. It is clear that the equation of motion of a point or centre which moves in a straight line, and is acted only by forces in that line, is

$$m\frac{d^2 s}{d t^2} = \text{P} - \text{Q}.$$

Here m is the mass of the point, P and Q are what we have called the effort and the resistance, $\frac{d^2 s}{d t^2}$ is the increment of the velocity, or the acceleration.

127. If, instead of one point, we have to do with a system of points, *i.e.*, with a body, as in rigid dynamics, the obvious way of forming the equations of motion would be to calculate the effort and the resistance for each individual point, and then write down its equation in the form just given. The general equation for the whole body would be formed by adding together all the particular equations thus obtained. Now in calculating the effort or resistance for any given point, there are two sets of forces to be dealt with—(1) The impressed forces, *i.e.*, those which act upon the system from without; and (2) the internal forces, or the forces acting between the points of the system themselves. Now the former set, the impressed forces, are generally few and simple, or may at least be regarded as such by neglecting those which are insignificant. But the latter set, the internal forces, will clearly, in any body of finite size, be immensely numerous and obscure. Now D'Alembert's principle asserts that if all the equations were thus formed and added together, the whole of the internal forces would disappear from the resulting equation, being in fact in equilibrium amongst themselves, and therefore exercising no effect on the motion of the body. This being so, we need not stop to calculate these forces in the first instance (if, as in rigid dynamics, we are only concerned with the body as a whole) but can at once write down the resulting equation as follows:—

$$\Sigma\, m\frac{d^2 s}{d t^2} = \Sigma\,\text{P} - \Sigma\,\text{Q},$$

where the symbol Σ signifies, as usual, that the sum of the quantity before which it stands is to be calculated for each point of the system.

128. This explanation relates to motion in one direction only. It can be generalised, in the way indicated in former cases of the same kind, by resolving the forces acting along three rectangular axes.

129. But this explanation is itself sufficient to show that D'Alembert's principle is only an extension of the Third Law of Motion, as the case is stated by Thomson; or, as we should here state it, a deduction from the definition of matter. For, by this definition, the forces which act between any two centres of force are equal in magnitude and opposite in direction; hence in any algebraical sum which includes both these forces, they will cancel each other, and the sum will be the same as if they did not exist. But it is evident that the algebraical sum of all the internal forces of any system will embrace both of the equal and opposite forces which act between any two centres of that system; hence in such a sum the whole of those internal forces will disappear. And this is precisely what D'Alembert's principle asserts.

130. *Elasticity.*—In our discussions upon energy we supposed throughout that the centres concerned were separated from each other by a finite distance, and that the forces acting between them were actually or approximately constant. But it is clearly conceivable that two centres may come within an indefinitely small distance of each other—in other words, may meet; and all experience shows that, as expressed in the definition of matter, the forces between the centres as actually existing are not constant, but vary with the distance. It becomes therefore necessary to consider what will happen if two centres meet; and to do this we must examine more closely what the laws of the forces acting between them really are. This branch of the subject, which is called Elasticity, involves entirely fresh considerations, and therefore requires some notice here.

131. Let us, as a preliminary, examine what would happen in the meeting of two equal centres, if the forces were really constant. Suppose them to start from rest, at a distance from each other of 2ft. Then by the principle of symmetry they would meet at the midway point, each with a finite velocity due to the action of the constant attractive force over the space of 1ft. There being nothing to stop this velocity they would pass through each other—in this ideal state of things we need not discuss the question of penetrability—and go forward each in its old direction. But the attractive force on either centre, being now in the opposite direction to that of motion, would check this velocity, and destroy it at the end of the same space in which it was generated, *i.e.*, 1ft. Hence when each centre had arrived at the precise spot originally occupied by the other, it would be at rest. The circumstances would now be the same as at first; the centres would begin to approach each other again, would again pass through each other, and return to their original positions. This process would go on for ever, the two centres describing regular oscillations about the midway point.

132. Let us now make another supposition. Suppose that, when each of the centres had moved half way to the middle point, or through 6in., the constant attractive force was suddenly changed to an equal and opposite repulsive force. This would destroy the velocity thus acquired in exactly the same space in which it was generated. Consequently at the instant when the two particles met each other, they would both come to rest. The repulsive forces would then drive them asunder; but if, when the two were once more 1ft. apart, it was changed back into an attractive force, the velocities would be again checked, and the centres would come to rest precisely in their original positions. They would then again approach each other as before, and would thus continue to oscillate backwards and forwards, alternately approaching to and receding from the midway point.

133. It is needless to say that nothing approaching either of these processes has ever been observed; and therefore we are justified in concluding that the forces of the universe are not constant. At the same time the two cases illustrate clearly a way in which a stable or conservative movement—or an oscillatory movement, using the word in its most general sense—may be produced by the action of attractive forces, or of attractive and repulsive forces combined; and we know that the world is, on the whole, in such a stable condition.

134. Let us now inquire what the laws of the forces acting in Nature can be made out, by observation and experiment, to be. On this head it must be confessed that our knowledge is as yet miserably imperfect. We have, indeed, one proved and almost perfect generalisation, due to the genius of Newton; and as it is the only one to which such epithets can be applied, we had better begin with it. It is generally stated as follows:—"Every particle in the universe attracts every other particle with a force varying directly as the product of their masses, and inversely as the square of the distance between them."

135. Using symbols, let M m be the masses of the two particles, r the distance between them, and c a constant; then the moving force acting between the bodies is an attractive force, represented by $\text{M}\,m\,\frac{c}{r^2}$.

136. I have called this generalisation "almost perfect," and for this reason. We know the character of the force, viz., that it is attractive; we know its law, viz., that it varies inversely as the square of the distance; we know its amount, at least as measured according to an arbitrary standard of mass. We do not, however, fully know its scope, viz., whether it extends to all matter that exists, or only to a part. Thus, it is known to hold in the heavenly bodies, by the case of double stars, but it is still disputed whether it holds across the void of space between those systems and our own. And if the principle of continuity be invoked to decide this in the affirmative, it would still remain doubtful whether it holds with respect to the luminiferous ether—a kind of matter whose existence Newton, of course, did not recognise. It would seem safe, therefore, to restrict the expression of the law of gravitation for the present to our own solar system.

137. Making this restriction, and remembering our definitions of a particle, as merely a small collection of centres of force, and also of mass, as expressing the number of centres comprised in a particle, we should formulate the law of gravitation as follows:—"Every centre of force in the solar system attracts every other centre with an equal force, varying inversely as the square of the distance between them." By equal forces are, of course, meant forces which are equal at equal distances.

138. To give the proof of this law is no part of the present treatise. Assuming it to be true—as all competent judges assume—we have next to inquire whether it is the only law. In other words, whether it will, by itself, account for all the phenomena of the universe. It is obvious that this must be answered in the negative. Were two centres left to themselves under this law, they would rush together with a velocity which, at the instant of meeting, would become infinite, since, the distance being nothing, the force would then be infinite. What would happen I will not take upon myself to say, but at least it would not be anything like what we see around us. Nor is the case altered by the existence of other centres. A system starting from rest, under the action of gravitation alone, would coalesce in like manner at its centre of gravity. Hence there must be something beyond gravitation—something which acts as a repulsive force, and prevents the centres from thus dashing themselves against each other. Can we give the law, scope, &c., of this force as we can in the case of gravity? Unfortunately, we cannot. This is the great problem of physical science, which awaits the coming of a second Newton. But without being able fully, or even partially, to explain this force, we may at least glean a few facts respecting it. It must be practically insensible at sensible distances; otherwise, the law of gravity would not be found fully to account for the facts of astronomy and of falling bodies, which it is known to do. Hence it must diminish as the distance decreases; in other words, it must vary inversely as some power of the distance. But this power must be higher than the square; otherwise it would increase or diminish just as fast as gravity, and no faster, and would only have the effect of diminishing the apparent absolute value of gravity. These conditions are satisfied by assuming that the real law of force acting between two centres is represented, not by the expression $m\,\text{M}\,\frac{c}{r^2}$, but by the fuller expression

$$m\,\text{M}\left(\frac{c}{r^2} - \frac{c^1}{r^{2+n}}\right),$$

where n is some positive quantity.*

139. It may perhaps be objected that the second term of this expression could not possibly disappear from view so completely as it does in all questions relating to the attraction of gravity at sensible distances. To examine this point, let us suppose that the attractive and repulsive forces are equal in amount at a distance of one-millionth of an inch, and also that the repulsive force varies as the fourth power of the distance. Then we have—

$$c \times (1{,}000{,}000)^2 = c^1\,(1{,}000{,}000)^4$$
$$\text{or } c = c^1\,(1{,}000{,}000)^2.$$

If the distance is one-thousandth of an inch, the expression becomes—

$$m\,\text{M}\,[c\,(1000)^2 - c^1\,(1000)^4$$
$$\text{or } m\,\text{M}\left[c\,(1000)^2 - c\,(1000)^2 \times \frac{1}{1{,}000{,}000}\right].$$

Hence, at the distance of one-thousandth of an inch, the repulsive force will be only one-millionth part of the attractive force, and therefore quite insensible.

140. The assumptions here made are, of course, arbitrary; but they are sufficient to show how easily the repulsive force may really exist at all distances, yet may be imperceptible, by the most delicate measurements, unless at distances which are almost inconceivably small.

141. Assuming the law of force to be something like what has been described, let us now consider what will happen when two centres of force are left to its operation. We may consider the motion of one of them B, relatively to the other A, taken as fixed. Suppose, first, that A is placed exactly at the point of equilibrium, that is at the point where the attractive and repulsive forces balance each other. Then B will clearly remain at rest. Suppose next that B is slightly beyond this point of equilibrium.

* See THE ENGINEER for 24th March, page 205.

* It will be noticed that in the text I have not introduced the conception of initial rotating motions in the centres. Sir Wm. Thomson appears to hold—see his recent lecture on "Elasticity as Possibly a Mode of Motion"—that the repulsive actions in nature may be accounted for by the fact that the centres composing each atom have—as on the vortex theory they would have—a very high velocity of rotation about each other, or about a common centre. Into the question of the adequacy of such motion to produce the observed facts I will not enter. If it should prove to be true, the repulsive action must still have the form of a force obeying something like the laws given in the text, just as that which is called centrifugal force, but is really an effect of motion, may be represented by a force whose law is expressed by $\frac{v^2}{r}$. Meanwhile, it seems better to retain, for the purposes of explanation, the simpler conception of an actual force; at least, until it is proved that we must replace it by the much more complicated and difficult conceptions of the effects of rotary motion.

Then, the attractive force being slightly the largest, B will move towards A, and will pass the point of equilibrium with a certain small velocity. From this moment, however, the repulsive force will be the largest; the velocity of B will consequently be checked, and at a certain small distance within the point of equilibrium it will come to rest. The repulsive force being still the largest, the same operations will then begin in the reverse order; B will be repelled from A, and pass the point of equilibrium with the same velocity as before, but in the reverse direction, and will then be checked by the attractive force, and brought to rest exactly at the point from which it originally started. The same cycle will then begin. In other words, B will continually describe, with regard to A, a series of small oscillations about the point of equilibrium. If B is placed at first slightly within this point, instead of beyond it, the same events will follow, but in the reverse order.

142. In either of the above cases, suppose a third force to act upon B, tending to move it towards A. Then so soon as B is within the point of equilibrium, the repulsive force will be larger than the attractive force, and the excess will increase very rapidly as B continues to approach A. Hence this excess of the repulsive force will soon counterbalance the external force, and B will remain at rest at the new point of equilibrium thus defined, or rather will continue making small oscillations about it. If, on the contrary, the third force tends to move B away from A, then the attractive force will be in excess, will counterbalance the third force, and will form a new point of equilibrium further away from A than the original one. In the first case the force is compressive, and the net result is that, so long as the force acts, the distance between A and B will be permanently shortened. In the second case the force is tensile, and the net result is that, so long as the force acts, the distance between A and B will be permanently lengthened.

143. Again, let us suppose that B starts from a point at a considerable distance beyond the point of equilibrium (or, which comes to the same thing, that it starts with a considerable impressed velocity towards A). Then, by the time it reaches that point, the attractive force, which throughout this distance is largely in excess, will have imparted to B a very considerable velocity. As soon as B has passed this point, its velocity will be checked by the excess of the repulsive force; and it will be destroyed, and B brought to rest, somewhere in the very small space between the point of equilibrium and A, so that it will never come in actual contact with A. For if A and B were in actual contact, the distance between them would be indefinitely small, and therefore the repulsive force would be indefinitely great. But the accelerating force which would destroy any given finite velocity v in any given finite distance s is simply given by the expression $\frac{v^2}{2s}$: and, however large v may be, or however small s may be, this will always have a finite value. Hence the effect will be that B will be stopped in an exceedingly short space and time—much too short for our measurement—and will then have a very large excess of repulsive force acting upon it. Hence it will begin to return with very great rapidity, will pass the point of equilibrium with the same high velocity, but in the reverse direction, and will then be checked by the excess of attractive force, finally coming to rest at the point from which it started. If no other cause intervenes, the same cycle will then begin again.

144. Lastly, let us suppose that in the last case B becomes fixed in space at the moment when it is stopped by A, while A becomes free to move; or, which comes to the same thing, let us consider the motion relatively to B, instead of relatively to A B. Then, since A, by the Third Law of Motion, has exactly the same repulsive force acting upon it as B has, it will fly off with the same rapidity as was ascribed to B in the last section, will travel to exactly the same distance, and there will come to rest and begin to return, unless some other cause supervene.

145. It should perhaps be remarked that this second point of rest will be very much further away from the point of equilibrium than the point from which A is supposed to have started. For when B is within the distance of the point of equilibrium from A, the excess of the repulsive over the attractive force increases, as B moves towards A, very much more rapidly than the excess of the attractive force increases, as B moves away beyond the point of equilibrium. This is due to the forces varying inversely with the distance. Thus let the point of equilibrium be at one-millionth of an inch, as before, and let the expression be $\left[\frac{c^1(1{,}000{,}000)^2}{r^2} - \frac{c^1}{r^4}\right]$. Then if B be half a millionth of an inch within this point, the value of the expression will be $c^1(1{,}000{,}000)^4(4-64)$, or $-60c^1(1{,}000{,}000)^2$. But if B be half a millionth of an inch beyond this point, the value of the expression will be $c^1(1{,}000{,}000)^4[(\frac{2}{3})^2 - (\frac{2}{3})^4]$, or $0{\cdot}247\,c^1(1{,}000{,}000)^2$, which is about $\frac{1}{250}$ of that given above.

146. I have preferred to place these deductions from the assumed form of force together, because they follow naturally and clearly upon each other. It now remains to show how fully they accord with the facts of the universe, as relates to the behaviour of the particles of solid bodies in close contact with each other. Of course, the matter is greatly complicated by the fact that we can never observe the motions of single centres of force, or even single particles. What we observe are bodies, greater or less in size, but of which the adjacent particles act in various ways upon each other, and are also acted upon in various ways by external forces, such as gravity. Nevertheless, the effects here described are in many cases plainly discernible.

147. Thus, in accordance with Art. 141, the particles of any solid body do take up apparent positions of equilibrium with each other—which, however, are known not to be really positions of rest, but centres of small oscillations which the molecules are continually describing. If an external force be brought to bear upon such a body, then, in accordance with Art. 142, the body becomes extended, if the force be tensile, or shortened if the force be compressive; and, having thus taken up a new position of equilibrium, it retains it until the force is withdrawn.

147. Again, if a body be projected against another with considerable velocity, which is equivalent to the supposition of Art. 143, then, after apparently striking it, it flies back in the direction from whence it came, the reversal of the motion being effected far too rapidly for any ordinary means of observation to follow it. It is this property of rebounding which forms what is called the elasticity of bodies. Newton, who investigated it, found that the effects might be represented by supposing that, at the moment of impact, the momentum of the striking body was stopped by a very large force brought into existence by the action, and that, the bodies having thus been brought to rest, a force continued to act in the same direction, and drive the striking body back again towards the point whence it started. If it actually reaches that point, the body is called "perfectly elastic." As a matter of fact, no substance in nature is found to be perfectly elastic; some, however, as glass and ivory, approach the limit pretty closely, while others can scarcely be said to have any visible elasticity. For some time it was supposed that in practice the force of restitution, causing the rebound, was somewhat less than the original force of impact, in a varying ratio, generally expressed by the letter e; and hence it was inferred that *vis viva*, or energy, was always lost in cases of collision. But it is now universally admitted that this difficulty simply arises from the fact that we can only observe the action of finite bodies as a whole, and not that of their minute parts. For instance, when a billiard ball strikes the cushion, it is but a very small area of each which is actually opposed to the other; all the rest of the billiard ball is caused to stop and to rebound by the lateral cohesive action of the parts nearer the centre. These actions set up movements between the particles, in which more or less of the energy due to the impact becomes expended, and is not therefore available for the repulsion of the body as a whole. It is not doubted by anyone that the ultimate atoms of any body are perfectly elastic, as indeed, by the conservation of energy, it is necessary that they should be.

148. Lastly, if the body struck be free to move, instead of being fixed, the result stated in Art. 144 is actually seen to follow, that is, the struck body flies away with a velocity which depends on the momentum of the striking body; or, in other words, upon the force of the blow. Familiar instances are the striking of one billiard ball by another, the propulsion of a football, &c. In such cases the striking body may either be brought to rest, or may follow in the same direction as the struck body, but with diminished speed, or may rebound again in the direction whence it came. These variations depend upon variations in the masses and velocities of the two bodies, and need not here be considered further.

149. It appears therefore that the fundamental facts of elasticity are all accounted for by the hypothesis that the law of the force subsisting between any two centres is substantially of the character represented by $\left(\frac{c}{r^2} - \frac{c_1}{r^2+n}\right)$. Of course we do not affirm that this is its exact representation. It may be much more complicated; *e.g.*, there may be other factors which may bring about the differences existing between the chemical elements considered as kinds of matter. But the fact remains that, as regards the general phenomena of mechanics, the type given above must be an approximation to the truth, and we may hope that the progress of physical science will ere long enable us to fix it more exactly.

150. I do not propose to continue these papers further; but I believe that all the main principles on which the science of mechanics is founded have been touched upon, and have been shown to flow directly from the definitions as to motion, force, and matter laid down at the beginning, and from the two established generalisations, which I have called the principles of conservation and of symmetry. If so, I have achieved all which I proposed to myself at starting. I have only two supplementary remarks to make. One is that these papers will not have been useless if they have brought into light, and in some measure dissipated, what appears to be a somewhat common mistake, namely, that in the third law of motion, Action is always to be interpreted as Force, so that, whenever we have a force acting, there must always be an equal force opposed to it. Thus, when an engine is taking a train out of a station, and getting up its speed, it is held that the pull of the engine is no greater than the resistance of the train! It need hardly be stated that this idea derives no countenance from Newton—who, as Thomson and Tait have shown, saw that the action was measured in dynamics by the energy exerted—or from any other authority; that it is altogether at variance with experience; and that to admit it would simply annihilate the present science of dynamics. The other remark is merely intended to guard against any possible conception, that among the great writers on mechanics there is any fundamental difference of opinion as to the physical foundations of the science. It is just possible this might arise from the fact of my having taken occasion to point out the difference in terminology, as to the term Work in particular, between the works of Rankine and those of later writers; and I therefore repeat that the difference is one of terminology only, and in no way affects the fundamental principles or conceptions of the subject. Anyone who doubts this may be recommended to study the books in the annexed list, which have been consulted in connection with these papers, and are here tabulated for the convenience of students of the science.

Newton's Principia (Glasgow, 1871).
Rankine, Applied Mechanics (1st and 3rd editions).
Rankine, Miscellaneous Scientific Papers (Griffin, 1880).
Rankine, Rules and Tables (Griffin, 1875).
Maxwell, Theory of Heat, Edit. 1877 (Longmans).
Maxwell, Matter and Motion (S.P.C.K.).
Thomson and Tait, Elements of Natural Philosophy (Clarendon Press, 1873).
Navier, Application de la Mecanique, by St. Venaut (Paris, 1864).
Reuleaux, Theoretische Kinematik (Brunswick, 1875).
Clausius, Mechanical Theory of Heat (Macmillan, 1879).
Balfour Stewart, Lessons in Elementary Physics (1873).
Whewell, Mechanics (Cambridge, 1819).
Goodwin, Course of Mathematics (Deighton and Bell, 1857).
O. Byrne, Practical Mechanics (Spon, 1872).
Twisden, Practical Mechanics (Longmans).
Routh, Rigid Dynamics (Macmillan).
Tait and Steele, Dynamics of a Particle (Macmillan).
Herbert Spencer, First Principles (Williams and Norgate, 1867).
Todhunter, Mechanics for Beginners (Macmillan, 1878).
Moseley, Mechanical Principles of Engineering and Architecture (Longmans, 1843).
Goodeve, Principles of Mechanics (Longmans, 1880).
Magnus, Lessons in Elementary Mechanics (Longmans, 1881).

TURBINES AND PUMPS AT PIERRE-LA-TREICHE.

THE machinery which is in part illustrated by the supplement which we publish this week, is a portion of that of a large installation at Pierre-La-Treiche for pumping a supply of water from the Moselle into the Pagny-Meuse branch of the Marne-Rhine Canal. These works and also reservoirs in the upper catchment of the Meuse and at Paroy, and pumping station near Pagny, became necessary in consequence of the deficiency in the Marne and Meuse Canals, a deficiency which was aggravated when certain reservoirs and catchment area became German territory. The whole of the works are very fully described in a volume by M. Alfred Picard, engineer-in-chief of Ponts et Chaussées, entitled "Alimentation du Canal de la Marne au Rhin et du Canal de l'Est. Travaux exécutés depuis 1870, pour l'alimentation commune à ces deux voies navigable et pour l'alimentation spéciale à la première." The work is published in Paris by J. Rothschild and in London by Dulau and Co., by Williams and Norgate, and D. Nutt.

Three weirs were made in the Moselle near Toul, and the turbines, which we illustrate from M. Picard's book, were constructed of about 850-horse power to supply by the pumps shown, from about twenty to thirty cubic feet of water per second from the river, through an elevation of about 130ft. into the above-mentioned branch canal. The construction of the turbines is clearly shown by Figs. 1 and 2. The wheel is keyed on a hollow shaft, within which is a fixed solid shaft, the lower end of which rests in a socket bedded in the masonry of the tail race. The upper end of the hollow shaft is seen at Fig. 8; but just below the part there seen the shaft is swelled so as to leave room for the adjustment of the bearing step and screw on the top of the fixed shaft, which therein terminates. The upper end of the hollow shaft is attached to the pump crank, as shown. The guide wheel of the turbine having a mean diameter of 9ft. 10in. is, like the turbine wheel, of cast iron, and is provided with seventy-one openings, sixty-six of which, in eleven groups of six, are 8·85in. by 2in., the remaining five having a sectional area of 8·85in. by 2·16in., the total discharge area through the orifices being a little over 8½ square feet. The curve given to the guide blades is helicoidal, the curvature being rapid toward the upper part, while the lower part is a straight tangent to the curve at an angle of 24·5 deg. The passage through the water guides is regulated by eleven valves, each covering six openings, and five small valves covering the larger openings mentioned above. Each of the large sluices is connected to a three-armed bell crank by a rod. On the spur wheel, shown in Figs. 1 and 2, is a short projecting finger. This takes against either one or the other of the two main arms of the three-armed bell crank levers, and so operates the valves when the pinion on the regulating shaft is turned. Each turbine works three double-acting Girard pumps, as shown by Figs. 3, 4, 5, 6, 7, 8, 9, the connecting rods of three pumps taking on to one crank, as shown at Fig. 8. The plungers are 15·35in. diameter, and have a stroke of 23·625in., the mean volume displaced per stroke being 2·5 cubic feet. The pumps, valves, seats, &c., are all of cast iron, and the effective head under which the turbines work is about 7ft. on an average. The whole of the machinery was made by MM. Callon and Feray, Paris.

TENDERS.

NORTHAMPTON.

FOR the erection of a new boiler-house, rain-water tanks, entrance gates, and other work, for Mr. S. L. Seckham, Northampton Brewery Company. Messrs. Scamell and Colyer, architects and engineers, 18, Great George-street, Westminster, S.W. Quantities by Messrs. R. L. Curtis and Sons.

CONTRACT No. 1.—BUILDINGS.	£	s.	d.
Mr. J. Garlick, Birmingham	4225	0	0
Mr. G. Heap, Northampton	3622	0	0
Mr. J. Cosford, Northampton	3146	0	0
Mr. H. Lovatt, Wolverhampton	3018	0	0
Mr. R. Dunkley, Northampton	3002	0	0
Mr. J. Watkin, Northampton	2930	0	0
CONTRACT No. 2.—BOILERS.			
Messrs. Bellis and Co.	2150	0	0
Messrs. Forrester and Co.	1876	0	0
Messrs. Piggott and Co.	1550	0	0
Messrs. Horton and Sons	1543	0	0
Messrs. Thornewill and Warham	1423	0	0

NOTTINGHAM.

ADDITIONAL class-room to All Saints Schools. Mr. Frederick Jackson, architect. Quantities supplied.

	£	s.	d.
Messrs. Bell and Son	382	0	0
Mr. R. Middleton	355	0	0
Mr. Jno. Cooper	318	0	0
Messrs. Marriot and Wartnaby	314	0	0
Mr. A. B. Clarke—accepted..	302	0	0

CITY OF LONDON DIRECTORY, of which we have just received a copy of the edition for 1882-3, is increasing in number of pages much more rapidly than the number of names and trades, &c., to be catalogued. In 1878 it contained 912 pages, and it now has 976, or an increase of sixty-four pages, or 7 per cent. in four years. This gives some idea of the additional information which the directory contains. The great alterations in streets and buildings in the City have made many changes during the year, and these the directory shows, as well as the very numerous changes which always take place in offices at the new year. As usual the directory contains a street guide, alphabetical directory, trades guide, public companies directory, list of liverymen, livery companies guide, conveyance guide, corporation directory, bankrupts' list, &c. It is well arranged and is provided with sufficient indexes, so that with the map which also accompanies it, it is very easy to find any required information relating to City inhabitation.

LETTERS TO THE EDITOR.

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

RAILWAY BRAKES.

SIR,—If you will allow these few remarks in your paper on the subject now most seriously engaging public attention, viz., the most useful continuous railway brake, as Earl de la Warr has brought this subject before the House of Lords, a diversity of opinion may lead to the best one being adopted. I see by railway brake returns there are still 3822 passenger engines and 36,700 carriages running without efficient brakes. A very natural question to ask is—How is it when there are such numerous accidents costing so many lives, and such enormous sums for compensation and destruction of property, more brakes are not fitted? I believe most directors will endorse what I say—there is not a cheap practical brake yet before the public, and that the brakes yet in use are complicated, expensive, both in fitting, working, and keeping in order; and as each company sticks to their favourite inventor, there is little chance for a fresh invention being tried, be it ever so simple. I will quote a few facts as to power required for working present brakes I saw from the pen of one well skilled in working continuous brakes. He says the vacuum requires about 2600 cubic inches space to each carriage, which, at only 12 lb. per inch, is 31,200in. so a train of ten carriages will require 312,000 inch-pounds to be kept up by ejector to efficiently apply brakes, and when often used, as in short stoppages, must take a very large amount of power off engine, *i.e.*, steam.

The air or Westinghouse requires 330in., which at 75 lb. per inch is 24,700 lb. to each carriage, or 247,000 inch-pounds for ten carriages for efficient working. This has to be kept up by steam pump, and there is still a loss of power in pumping, therefore it is quite evident the power required to work these brakes must be considerable. Then there is the delicate and elaborate mechanism of the various parts required to work so subtle a fluid as air, which is always subject to accident, however perfect the fittings, as one faulty leak renders the whole useless and may cause a serious accident; or it may be necessary to use an engine unfitted with apparatus to work brakes, or a foreign carriage may break communication, for there appears little prospect of making the various kinds work together. Yet all honour is due to those who studied and brought such clever mechanism to perfection. Yet I believe these brakes to be wrong in principle, and it is a maxim well understood—improvement in details can never make a bad system into a good one, or overcome difficulties caused by the principle being wrong from the commencement.

It is a well-known fact to engineers that in the motion of any train, at whatever speed, its momentum contains a power, if rightly applied, to lock its wheels in a reasonable time; and many inventors, from George Stephenson to the present time, have had various methods to effect this purpose. Take, for instance, Messrs. Clarke and Webb's chain brake, in which by the use of friction wheels, a small power by hand on one pair of wheels is used to apply brakes to four carriages, or sixteen wheels. Yet it could be increased twenty-fold, if required, in power, without losing speed, for applying brakes to each carriage only. Yet at present these brakes, being used in sections and not self-acting, do not fulfil the requirements of the Board of Trade.

I have patented an invention which does, by such friction wheels, fulfil all the conditions of the Board of Trade, and requires no extra fittings on engine; and all extra fittings to such carriages as have brakes already on can be done at a little expense by any ordinary mechanic. This is accomplished by affixing an automatic arm to one of the front buffers, with a movable dog on it, which can be set to act at any pressure, which acts on or brings friction into contact, the chain wheel axle of which passes over sheaves and wheels to any suitable place under the carriage to lift a lever bar or other mechanism, and so apply brakes by the momentum of each carriage on the application of any brake in front, causing sufficient obstruction to press the buffer so as to actuate the arm with its dog, as before described, yet instantly releases the brakes when the momentum is reduced below that pressure. By a very simple yet efficient suitable connection between driver and guard, the automatic arm is lifted out of or dropped into gear, and when pulled in, as it should be before leaving a station, it is nearly an impossibility for anything to get wrong. Yet any one carriage having its brakes deranged does not affect the remainder, nor does a foreign carriage, if the guard has a suitable cord to complete the communication. This brake will not interfere with any brakes used by air or vacuum, but can be made to actuate these when drawn by an engine not fitted to work them. Also, by a simple mechanism and chain loosely coupled throughout the train by strong spring links, should a draw-bar or chain break, or train by any means become parted, before these spring links break, the wheels of each carriage would be locked in a moment, and the left carriages would apply a continuous brake to that portion of the train, thus fulfilling a very essential condition of the Board of Trade. It also forms a useful hand brake to use when stopping at a station or in sidings. As all brakes are acted on by front buffer only, there can be no rebound, but the pressure left in the buffers when the train stops suddenly is power stored to start the train when the engine moves forward; so less power is expended in stopping a train by automatic action than by hand brakes, and as the brakes prevent any undue pressure on the tender buffers, there will be less jerk by brakes applying themselves than by the most experienced brakesman.

I am not in a position to fit a train of carriages at my own expense, being a working man, and it has already cost me years of study and months of labour to complete my models; yet some engineers to whom I have shown them say it is a most expansive invention, well thought out, and as perfect as can be made. Should these remarks be of use to any railway directors or company of shareholders, or engineer not interested in other patents, I shall be glad to show models to any wishing to try the system, as all I require is a fair trial, and let the invention stand on its own merits. This brake can be fitted to heavy goods trains as well as passenger carriages; therefore there is no reason why it should not become a universal brake.

The cost of application to each carriage cannot exceed £10, and the cost of working is nothing. W. B. HOLBECH.

Enderby, Leicester.

WIRE GUNS.

SIR,—Having been absent from England, I have only just seen your article on my recent letter to the Secretary of State for War in your issue of the 31st ult. Will you allow me a few words in reply?

In my letter I did not explain my system of gun construction, consequently I did not say how I provide the longitudinal strength. This was explained first in the Institution of Civil Engineers in 1860; then more fully in a second paper which I sent to the Institution in 1867; then again in my paper at the Institution in 1879, which contained diagrams and descriptions of the system applied both to breech and muzzle-loaders; and I also exhibited a 3in. breech-loader made in 1860. This system I have never departed from, and in the various endeavours I made to get the Government departments to give my system a trial, I prominently brought this feature forward as well as the wire system of construction both by diagrams and models and by verbal and written explanation. The principle is that of providing independent material outside the chase to carry the strain from the breech to the trunnions. I am informed that this is the method adopted by Capt. Schultz in the wire guns which he has made for the French Government.

In the next place I never said that increasing the length of the gun was a retrograde step; on the contrary, I have always advocated long guns; but what I did say was that slow burning powder was a retrograde step, and one which necessitated a longer gun than quick burning powder.

In the remarks which I made on the strains in the 8in. Woolwich gun, I see now that I did not make my meaning so clear as I ought to have done. In speaking of the variation of strain from $-11{\cdot}70$ to $+15{\cdot}83$, I had in my own mind the results arrived at by Mallet and others on the effect of variation of strain, and I should have said that the above variation was on the double strain hypothesis equal to a variation of strain of 55·06 tons, not to a standing strain of that amount. So far I stand corrected. The statement that a suddenly applied strain is in effect double that of a slowly applied strain is not an assumption of mine. It is a principle that has been demonstrated long ago, and although Captain Noble dissented from the statement, all he did say was that "he believed that many guns, owing to the almost infinitesimal time during which the highest pressure acted, withstood pressures that would undoubtedly cause their failure were such pressures of longer duration." This is a mere opinion, that of a high authority no doubt, but unsupported by any fact.

Again, as to the difference between myself and Sir Wm. Armstrong about the tension. I am quite aware that Sir Wm. Armstrong has a machine for putting on the wire with a duly regulated tension; but of what avail is that if he does not regulate the tension according to a proper formula, but puts the wires on with an excess of tension, leaving it "to the explosive force of the powder to effect an adjustment?" Nor do I forget that M. Canot in the discussion on my paper supported Sir Wm. Armstrong's view; neither do I ignore the facts you allude to about the links of suspension bridges. But this does not alter my opinion that a perfect gun should never be subject to permanent set.

The law of permanent set, if indeed there be a law, is so little known, and is so variable in different specimens of the same material that it is quite impossible to introduce it into any formula for gun construction, and therefore I maintain that a gun should be so constructed that it will never be subjected to permanent set, and this is what is attained by my formula, and therefore it is that I object to Sir William Armstrong's practice, who, having the proper mechanism for applying the tensions according to a proper formula, does not use it for that purpose, but lays in his wires with a higher tension, leaving the adjustment to the haphazard action of the explosive forces.

Lastly, allow me to say that you have quite mistaken the drawing at p. 27 of my paper of 1879. The wrought iron bolts there shown have nothing to do with the longitudinal strain of the discharge. I explained this on p. 38 in reply to Sir H. Lefroy, and again at p. 78 in reply to Mr. Parsons. In the design in question, Fig. 9, the trunnions were behind the breech, and the only office of the wrought iron bolts was to hold the outer casing together. Figs. 10 and 11, pp. 28 and 29, show the mode of taking up the longitudinal strain between the breech and trunnions in muzzle and breech-loading guns respectively. J. LONGRIDGE.

Greve d'Ayette, Jersey, April 28th.

THE FOUNDATIONS OF MECHANICS.

SIR,—The terms "attraction" and "repulsion," as applied to bodies, are scarcely likely to be defended as definitions of a tendency or power to generate or produce motion therein, either with or without contact, or at a distance, by their reciprocal and inherent force. But no doubt any explanations of the phenomena to which these terms are applied, which will more consistently describe the behaviour or cause of motion in bodies than the terms attraction and repulsion, would be recognised as useful and suggestive aids to the attainment of clearer views. But is the opinion generally entertained of the law of gravity such as your correspondent "Φ. Π." implies? that is, is it adverse to the conservation of energy? or does this law, as understood, necessarily involve the creation of additional motion in the universe? I fail to see that it does so, for the supposition held is, that only can motion take place between bodies when they are or have become separated from each other, and that the motion expended in their separation is but equivalent to what is restored again in the passage of these bodies to their former relative position.

Leeds, May 5th. J. RAMSBOTTOM.

SIR,—Those interested in this subject must have been a good deal disappointed at the letter of "Φ. Π." in your last issue. He proposed to tell us how it was that an engine was able to move a train, whilst the pulls at the front and rear ends of the drawbar remained exactly equal and opposite. He says he has some difficulty in hunting for the cause, but he finds it at last in the furnace. Now we really did not need any one to tell us that it is ultimately the furnace which causes the work to be done upon the train; but it is generally supposed that it operates by producing, through the mechanism of the engine, the pull on the drawbar. In what other way it operates your correspondent omits to explain.

In the same letter I find myself credited with the statement that "motion, once called into existence, cannot die"—by which is meant, as appears by the next line, that it is indestructible. In reality I have always maintained precisely the opposite view, as any one who reads my recent papers on the subject will see.

There are several other points I might discuss, but I will not occupy your space further. I may, however, be allowed to point out that the interesting experiments of Mr. Stroh have not the slightest influence on the question whether action at a distance exists. In fact the vibratory motions on which he relies are, perhaps, of all others the most difficult to explain without the aid of action at a distance. WALTER R. BROWNE.

Westminster, May 9th.

STEAM ENGINE ECONOMY.

SIR,—Concluding the correspondence respecting "tight"—not "light"—pistons, allow me to say that I do not doubt Mr. Inglis's version of the experiments, but I do doubt indeed that 104 indicated horse-power was ever absorbed or caused by a tight piston made by any reputed firm of piston makers. The majority of pistons—those worthy of the name—are now made with a minimum of friction, even when screwed down home, and the old type of "packed" pistons must have very strong springs indeed ever to allow such an amount of friction as one-third of the gross indicated horse-power to exist.

In answer to Mr. Inglis's concluding remark about my ordering pistons with a certain degree of tightness, I should not think of doing anything so silly, but what I should do would be to say, make me a piston that would move in a true cylinder perfectly steam-tight without producing any friction at all, or with a minimum amount of friction, certainly not more than 5 per cent., instead of 30 per cent., as Mr. Inglis still maintains there was, in his opinion, in the engine he refers to. I am very much obliged to him for his information, but must certainly demur to the correctness of his premises. I think the cause of the 30 per cent. of friction was elsewhere than in one of the pistons.

Iron Exchange, Birmingham. JOHN SWIFT.
May 10th.

DIVING.

SIR,—In your article on "Diving" in your last number we notice some inaccuracies which we trust you will correct. On page 308 you state that "one enterprising firm" "recognising the advantage of the two systems of diving, *i.e.*, by having air pumped down to the diver, and that in which the diver takes down a supply of oxygen, manufactured both systems." We must draw your attention to the fact that the firm you name are not manufacturers of the oxygen apparatus, as we are sole makers of this for Messrs. Fleuss, Duff, and Co., and have been connected with Mr. Fleuss from the time of his earliest experiments.

With regard to your remarks upon the present system of communication between the diver and his attendant, we have carried out experiments with the telephone and are now getting it to work with better results, and hope ere long to have it working in a manner that will justify our adopting it. You mention that a speaking tube with a diaphragm connected to the air supply tube might be applied; we have done this, but found the noise of the air pump valves made it difficult for the diver to hear. Also it must be borne in mind that the diver has to communicate with his attendant more frequently than the attendant with the diver; hence the disadvantage of using the air tube as a means of communication. SIEBE, GORMAN AND CO.

187, Westminster Bridge-road,
London, May 3rd.

SLIDE VALVES.

SIR,—I have read with some astonishment the remarkable letter by "A Weekly Reader of THE ENGINEER," respecting Mr. Hackworth's lecture on valve gears, expressing surprise that he did not refer to Church's circular valve. Your correspondent has evidently very inflated ideas as to the merits of this valve, for he says, "No steam engine without Church's valve is perfect." Really if this is true let every engineer at once adopt this wonderful valve, and I have a perfect engine. But what are the facts. "A Weekly Reader" speaks of their use in two of Messrs. Fowler's 8-horse engines. Can he say why Messrs. Fowler discontinued making them nearly two years ago, and resorted to the ordinary valve? Does he know of the practical difficulties involved in their construction? and even their working has, I believe, not always been perfect. There is a certain amount saved in lessened friction on the excentrics, but those who think the engines thus fitted give out more power than if fitted with ordinary valves are in error. They certainly do not. There are, however, certain points which the inventor insists upon having carried out in connection with his valves, such as a longer port to give more lead and a quicker admission, which, when run in comparison with engines having short ports and slow admission, of course show up more favourably as to power; but engines fitted with ordinary valves with the same length of port give out as much power as engines fitted with Church's valves.

My impression is that a good many engineers have not seen Church's equilibrium circular slide valve. I have never seen it illustrated in THE ENGINEER. Several abridged printed illustrations with descriptions are in my possession, and to any who may feel an interest in the matter I shall be pleased to send one upon receipt of name, address, and postage.

48, Junction-road, London, N. W. HENRY NEAL.

NAVAL ENGINEER APPOINTMENTS.—The following appointments have been made at the Admiralty:—Harry Williams, inspector of machinery, to the Victor Emmanuel, for Hongkong Yard; John T. Goff, engineer, to the Flirt; and William H. Bramsdon, engineer, to the Agincourt, vice Goodyear, deceased.

DIVING.—In the article on "Diving" which appeared in the issue of THE ENGINEER for April 28th, the name of Mr. A. F. Leale, of Westminster Bridge-road, should have appeared in the list of manufacturers of diving apparatus on the air-pumping system, who exhibited at the Naval and Submarine Exhibition in the Agricultural Hall, Islington, last month.

SOUTH KENSINGTON MUSEUM.—Visitors during the week ending May 6th, 1882:—On Monday, Tuesday, and Saturday, free, from 10 a.m. to 10 p.m., Museum, 9270; mercantile marine, building materials, and other collections, 3708. On Wednesday, Thursday, and Friday, admission 6d., from 10 a.m. till 6 p.m., Museum, 1866; mercantile marine, building materials, and other collections, 332. Total, 15,176. Average of corresponding week in former years, 15,534. Total from the opening of the Museum, 20,905,589.

THE GAS AND WATER COMPANIES DIRECTORY, AND GAS AND WATER STATISTICS.—The sixth edition of the Gas and Water Companies Directory has just been published by Mr. C. W. Hastings, of Buckingham-street, Adelphi. The work is chiefly in a tabular form, and names and particulars are given which previously had been omitted, apparently making the Directory now complete. The information given for water companies is under the following heads:—Name of town, date of formation (of the company), special Act, limited liability Acts, capital, name of chairman, engineer and manager, secretary, lessee, owner, or corporation, population, distance from London, railway. For gas companies the information is given under similar headings. An index to the names is also given. The pamphlet, which is a second edition of Waterworks Statistics, contains a good deal of useful statistical information relating to 205 towns. Of the gasworks statistics the present is the fourth edition, and the varied statistical information is given as relating to 886 towns.

THE INSTITUTION OF CIVIL ENGINEERS.—At the meeting on Tuesday, the 2nd of May, Mr. E. Woods, vice-president, in the chair, it was announced that the Council had recently transferred W. Harvey, J. Hopkinson, and S. Stent to the class of Members; and had admitted W. M. Beckett, R. Highet, H. S. Jones, H. H. Roden, A. C. Smith, R. F. Smith, and J. Trump, as Students. At the monthly ballot R. Askwith, Bishop Auckland; A. B. Gatherer, Ex-Eng., P.W.D., India; and J. C. Vertannes, Supdg. Engr., P.W.D., India, were elected Members; A. C. Bagot, Strand; C. W. Best, Stud. Inst. C.E., Westminster; F. S. Brunton, Richmond; F. C. Caffin, Stud. Inst. C.E., Dundee; E. Case, Dimbula, Ceylon; J. H. Dale, Leeds; J. P. Davidson, Assist. Engr., P.W.D., Madras; J. D. Davies, Ex-Engr., P.W.D., India; A. T. Davis, Stud. Inst. C.E., Solihull, Warwickshire; J. B. Finney, Rio de Janeiro; R. Gould, L. C. and D. Railway, Wandsworth-road; F. C. P. Jones, Metropolitan Board of Works; T. N. Kirkham, jun., Leeds; C. G. Lawson, Southgate Local Board; G. A. H. F. Lloyd, Stud. Inst. C.E., P.W.D., Dunedin, N.Z.; R. R. Menneer, Assist. Engr., P.W.D., India; R. M. Parkinson, Stud. Inst. C.E., Westminster; E. S. Preston, M.A., L. and N. W. Railway, Bangor; W. F. Robinson, Birmingham; D. C. Simpson, Harbours and Rivers Department, Sydney, N.S.W., and E. Spon, Pembrey, South Wales, as Associate Members; and W. J. C. Cutbill, Old Jewry, as an Associate.

AMERICAN SOCIETY OF CIVIL ENGINEERS.—The Society met on Wednesday evening, April 19th, Major Geo. W. Dressor in the chair; Mr. John Bogart, secretary. The deaths of two members were announced—Professor C. G. Forshey, of New Orleans, and Captain C. W. Howell, Corps of Engineers, U.S.A. Mr. Ricard Orozco, C.E., of Mexico, exhibited and explained the plans and profiles of the proposed works of drainage of the valley and city of Mexico. The explanations were translated by Mr. Theophilus Masac, C.E. The city of Mexico is situated in a basin without natural outlet. The lake Texcoco, within a very short distance of the city, in times of flood overflows and affects prejudicially the city to such extent that its sanitary condition has become very bad. A short distance farther from the city are the lakes Chalco and Xochimilco, which also overflow towards the city. Three other lakes, at more considerable distances, are in the same basin. There are no natural outlets, only evaporations lowering the areas of the waters. The extreme desirability of securing drainage from this basin has been long felt. In the 17th century Senor Enrico Martinez, an engineer under the Spanish authorities, constructed a tunnel partially through the mountain Nochistongo, which, however, never was completed. Many years afterwards the Jesuit fathers made an open cut down to the tunnel. This work cost a very large amount of money and many lives. Proper slopes were not maintained, and the earth caved in frequently. The drainage has never been properly kept up. Senor Orozco's plan is to construct an open canal upon such grade as will entirely drain the lakes Xochimilco, Chalco, and Xaltocan, and also maintain at regulated surfaces the lakes Texcoco and Zumpango. Through the city of Mexico are to be constructed sewers flushed by the waters from the lakes, which are carried to a common conduit, where the sewage is purified by deposition, the solid matter to be used for fertilisation, and the water carried away in the canal. The whole length of the canal would be about fifty miles; expense about 7,000,000 dols. Maps, profiles, and plans, executed in a remarkably fine manner, were exhibited.

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

(*From our own Correspondent.*)

THE attendance on 'Change to-day—Thursday—in Birmingham, as well as yesterday in Wolverhampton, was unfavourably affected by the occurrence of the meeting of the Iron and Steel Institute.

The concern at the assassination of Lord F. Cavendish amongst those present was too great to permit of a resolute attention to the business routine. His lordship was known to the principal ironmasters hereabouts on account of his close connection with the Barrow Iron Company.

The interest of the market was most displayed in connection with the important new Mines Drainage Bill and the strike in Cleveland. The outlook by the coal trade of having to pay, it may be, the new maximum toll of 9d. per ton on coal and slack, instead as heretofore a maximum of 6d., is gloomy at a time when hardly a colliery is being worked at a profit; but the prospects of the localities now drowned out are at the same time thereby greatly improved. There will now be no impediment in the way of the Drainage Commissioners borrowing the further £19,000 which they require at once to enable them to procure and keep going another pumping engine; while they will not hesitate to do other work which will entail a total expenditure of some £30,000. Ironworks and collieries about Wolverhampton and Bilston are thus more valuable now than they were a week ago, at the same time that the proprietors of similar property in the heart of South Staffordshire, in the Tipton district, have not now any reason to fear the inability of the Commission to effectually keep back the water which has long been threatening them with so serious issues.

It is hoped that the Cleveland ironmasters will take such steps as will prevent the ironworkers again getting the upper hand, since it is deemed certain that if this should not be the case, the ironworkers in Staffordshire and the rest of England would not remain content without an advance in wages corresponding to those which might be secured by the Cleveland men.

Boiler plates are selling quietly this week at £8 10s. to £9 and £9 10s. for the general run. The charcoal plates of Messrs. E. T. Wright and Co., of the Monmoor Works, were priced at £17, and best charcoal plates—William Barrows and Sons—were quoted £19 5s. per ton.

Makers of best working-up sheets announced that orders were coming in in satisfactory style. Quotations ranged from £12 to £14 according to brand. Makers of stamping sheets also reported a fair demand on home and foreign account alike. Prices, they said, were firm on the basis of "list" quotations, but what these were it was not easy to ascertain.

Sheets for use by the galvanisers were in rather better demand. Makers quoted £8 10s. to £9 for doubles and £9 10s. to £10 for trebles. The demand for sheets in the galvanised state is improving somewhat, and one firm have in two lines effected sales this week of 500 tons on foreign account, after the sample sheets had been approved by the buyer's inspector. For sheets up to 24 w.g., galvanisers quoted to-day £14 10s. delivered London, up to 26 w.g., £16 10s.; and up to 28 w.g., £18 10s.

Bar and hoop makers are running their mills and forges with satisfactory regularity, but the new orders arriving are mostly of a hand-to-mouth sort. The list houses still quote £7 10s. to £8 2s. 6d. for bars, but it is difficult to get such figures. Common Staffordshire bars, rolled by good houses, are to be had at £6 5s. per ton; but at this figure makers will not book forward. Hoops of ordinary make are quoted £7 to £7 2s. 6d., but can be bought at £6 17s. 6d. per ton.

Ironmasters in this district note with satisfaction that the exports of April were better than those of April last year. The total in April just expired amounted to 345,704 tons, against 329,100 tons in the same month last year, and 414,991 tons in April two years back. Of pig iron, 146,575 tons were shipped, as compared with 132,518 tons in April, 1881. Only 47,326 tons went to the United States; but in the same month of 1880 no fewer than 125,524 tons were sent. Of bar, angle, bolt, and rod iron, 23,665 tons were shipped, against 21,793 tons in 1881, and 34,577 tons in April, 1880. The exports to our colonies, especially India and Australia, have been much better than usual, but the United States did not take an average. Of hoops, sheets, and plates, this market last April took 24,825 tons, as against 26,842 in April of last year.

Pig iron of foreign brands sold rather more freely, but the improvement was not conspicuous. Makers of native sorts announced that the weekly production was going away from the furnaces steadily in satisfaction of old contracts. New contracts, however, are scarce, for the chief consumers are mostly well bought forward. Derbyshire brands were 47s. 6d. to 50s., with here and there agents who would accept 45s. Hematites were 67s. 6d., and agents firmly refused to take anything less, notwithstanding buyers' unwillingness to give the quoted price, and for large orders, such as 1000 ton contracts, they refused to quote as low as 67s. 6d. This firmness was particularly observable as to the Barrow Company's hematites. Native all-mine hot-blast pigs were £3 7s. 6d. to £3 10s. as the general quotation. Part mines were 47s. 6d. to 50s., and cinder sorts £2 to £1 17s. 6d.

NOTES FROM LANCASHIRE.

(*From our own Correspondent.*)

Manchester.—The condition of the iron market continues without material change. The Manchester market on Tuesday was characterised by an absence of inquiry, except of the most limited description, and prices could scarcely be said to be tested. Nominally, however, they were without alteration, and a small business was reported in local and district brands on the basis of about 46s. and 46s. 6d. for forge, up to 47s. and 47s. 6d. for foundry, less 2½ per cent. delivered equal to Manchester. Middlesbrough iron is quoted at 51s. 10d. net cash, but this is simply a prohibitive price so far as business here is concerned.

In the finished iron trade, makers are working off their old contracts with comparatively very few new orders coming in, although there is still a fair home consumption going on generally. There is, however, at present only a very limited shipping inquiry, and what export trade there is doing is being cut up by competition. For delivery into the Manchester district prices are about £6 10s. to £6 15s. for bars; £6 15s. to £6 17s. 6d. for hoops; £8 5s. to £8 10s. for good Staffordshire plates; and £9 to £9 10s. for good boiler plates.

A couple of instances of the manner in which trades' unions carry out their methods of working have come under my observation this week, and are worth noticing as an illustration of the high-handed manner in which the dictates of these societies are enforced. The last issued report of the Ironfounders' Society concludes with the following received from the No. 2 Manchester district:—"I am requested by the members of this branch to ask you to insert the following names in the monthly report as members who have worked against us, and also to call the attention of brother secretaries to the rule respecting members who have been excluded. The following names not to be re-entered without the sanction of Manchester No. 2 branch." Then follows a list prominently given of twenty-two men of whom the faithful unionists are cautioned to beware. The other instance is outside the district, but as I receive the information through an authoritative source I may mention it. This week 52 platers, 210 rivetters and 95 caulkers in the employ of Messrs. Harland and Wolff, of Belfast, have struck work because the firm have refused to discharge two men in their employ who had been regularly apprenticed and trained to their work in the usual way. In consideration of the great injustice of the demand made upon them Messrs. Harland and Wolff have, however, resolved to protect the two men and to vindicate their right to retain them in their employ.

I may suitably follow up this by an extract from the appeal which has just been issued to the various trades' societies in this district, in connection with the forthcoming Trades' Union Congress to be held in Manchester. In this it is urged that, in order to make the Congress worthy of the representatives of Lancashire, as the stronghold of unionism, it is essential that all the trades' unions in the district should take a warm interest in the matter, and assist the committee by grants from their funds, or by the subscriptions of their members. Every unionist, it is added, should regard this as a personal duty, and use all opportunities that present themselves for stimulating interest in the Congress, and securing financial help, in order that the visit of the delegates to Lancashire may render substantial service to the workmen of the United Kingdom, in securing many, if not all, the advantages which the Trades' Union Congress was designed to promote.

Except that the coal trade of this district has been somewhat helped up by the continued strike in North Wales, enabling Lancashire colliery proprietors to ship an extra quantity of coal which has cleared off a good deal of stock and kept the pits better employed, there is no material change, the local demand being still only dull and prices very low. At the pit mouth prices average about as under: Best coal, 8s. to 8s. 6d.; seconds, 6s. 6d. to 7s.; common, 4s. 9d. to 5s. 6d.; burgy, 4s. 3d. to 4s. 6d.; good slack, 3s. 6d. to 4s. per ton.

Coke has been in somewhat better demand.

Barrow.—A most unsatisfactory position has been reached in the hematite pig iron market during the week, and prices have reached even a lower figure than I last quoted. The outlook of the market is the reverse of cheering, nor can I say it is reassuring, for the indications are that even a still lower state of things will be reached. Stocks have not increased, but shipments show a considerable falling off. A heavy tonnage of metal is being transmitted over local railways. Smelters are beginning seriously to consider the advisability of reducing the production of metal. One furnace has been already put out, and this example is likely to be followed by others if a reaction does not set in very shortly. No. 1 Bessemer is quoted at 54s.; No. 2, 53s.; and No. 3 forge, 52s. per ton, net f.o.b. West Coast ports, three months' delivery. In the steel trade much activity prevails, and there is a steady demand. Prices are unchanged, steel rails being quoted at £5 17s. 6d. Iron ore is quoted at 13s. 6d. to 15s. per ton at the mines. Iron shipbuilders are fairly active, but have not booked any fresh contracts. Engineers, boilermakers, ironfounders, and others appear to be in steady employment. Coal and coke unchanged.

THE SHEFFIELD DISTRICT.

(*From our own Correspondent.*)

THERE is still much reluctance to buy in the iron departments. Both pig and manufactured iron are in poor demand in the adjoining districts of Notts and Derbyshire, and the fitting and machine shops, as well as the foundries, have very little business of importance in hand. Boiler-makers, wagon-builders, and repairers are better off. One or two of our local ironmakers are fairly employed; but the tendency noted last week—to hold off in expectation of lower rates—is still noticeable. The armour-plate mills are full of work, both on home and foreign account, and ship-plates and steel rails are quite as much in request as before, with keen competition in the latter department.

The Sheepbridge Iron and Coal Company are stated to have some trouble with their ironworkers, who are agitating for an advance of wages. I notice that the Staveley Coal and Iron Company is said to have dismissed a number of workmen owing to diminished trade. If the latter statement is correct, it proves how injudicious is any demand for higher wages at present.

In Barnsley and district—the headquarters of the South Yorkshire coal trade—there is very little business doing with London and the South, and the short time being worked at the pits is more than sufficient to supply the markets. Though prices are exceptionally low, dealers are withholding orders, in the hope of values falling still lower. In gas coal the demand has greatly diminished, owing to the season of the year. For the new contracts which are now being advertised for there will be a very keen competition. For slack and small coal Lancashire is making fair demand; the output not being excessive, small coal is somewhat firmer. The coke trade is brisk, and the inquiry quite equal to the production.

In the crucible steel trade manufacturers are not quite so busy as they were in the closing quarter of 1881, but leading houses like Messrs. Wm. Jessop and Sons, Limited, are well employed. Engineering firms are very busy on orders of considerable importance both on home and foreign account. In Bessemer and other steel castings there is a brisk business.

In the lighter branches I hear of excellent orders still pouring in for files and razors. The file-workers have this week obtained the concession in wages for which they successfully agitated a few weeks ago. Manufacturers were anxious to clear out old orders before the advance took effect, but the workmen did not care to lessen the quantity of work in hand, and though there were more files turned out than usual in the same time, the quantity produced was not quite equal to what might have been done.

In saws, edge-tools, surgical instruments, the recent improvement is sustained. Several of our cutlery firms have recently had heavy orders from the seaside and other health resorts, as well as from restaurants and ocean-going steamers. The old-established houses are well off for work, but generally the cutlery trade is rather quieter.

The silver and plating trades are somewhat languid, the active condition of the larger houses not being a fair indication of the general business. Some good foreign orders have recently come to hand.

THE NORTH OF ENGLAND.

(*From our own Correspondent.*)

THE prolongation of the strike of the ironworkers of the Cleveland district into a second week, without any immediate prospect of its termination, is beginning to have a marked effect on the iron and coal markets. This will be readily understood when it is remembered that about 10,000 tons less of manufactured iron was produced last week than would otherwise have been the case. This represents about 13,300 tons of pig iron thrown upon the market, and 27,000 tons of coal. It is now certain that the strike will extend throughout the present week, whereby the above figures must be taken to be increased two-fold, and the effect will be continued indefinitely and proportionately if peace be not restored. Taking advantage of the turn things have taken, "bears" were comparatively jubilant at the iron market held at Middlesbrough on Tuesday last, and began to chuckle and boast that they were not quite so much in a corner as the ironmasters had proclaimed, and as was generally believed. But neither were the ironmasters insensible to the new danger which threatened them with defeat. They met as usual before the market to consider their position; and they came to the conclusion that if the strike lasted beyond the present week, they would damp down their furnaces, so as to contract their production in proportion to the diminution of demand. This decision becoming known, the prices of pig iron did not fall, but remained the same as the previous Tuesday. Makers' price for No. 3 g.m.b. was 43s. 6d. f.o.b. Middlesbrough, and merchants' quotations were from 6d. to 9d. less. There were, however, very few transactions, and these only for small quantities. Holders of Connal's No. 3 warrants asked 43s., but very few changed hands. The stock in Connal's stores has decreased during the week by 2879 tons, and now stands at a total of 144,370 tons.

The ironfounding and engineering works are said to be better off for orders; no doubt a natural result from the putting into operation of so many works which have been idle for years. Steel rails are in but poor request, and prices tend downwards.

The coal trade is also in a depressed state, because of the stoppage for the time being of all demand from the manufactured ironworks.

As to the finished iron trade, it was decided by the employers to pay the men their back money on Saturday last without question. Inasmuch as the latter had everywhere ceased work without notice, it was quite within their employers' rights, as well as power, to retain this money as damages, and no doubt in so doing they would have been upheld in any law court. They decided, however, not to withhold it, but on the other hand so to act towards their *employés* that the latter, when they came to their senses, and the public now, could not but admit they had acted throughout generously as well as justly. The action of the operatives has been, on the other hand, peculiar—to say the least of it. The Board of Arbitration is their own child. Their leaders have for long preached it up on every available occasion. At some works the operatives, by repeated petitions, have pressed and almost forced their employers to join it. They have always elected their representatives and sent them to argue in their interests at all Board meetings. Where questions could not be decided, they have taken part in electing an umpire, and in requesting him to act in the joint interests of themselves and their employers. One of the leading rules of the Board of Arbitration is that all decisions of umpires so chosen shall be final. They have been so regarded in all cases by the employers, whether palatable to them or not. And so they have by the operatives when the decisions were in accordance with their wishes. But in several cases when they have been otherwise, they have set all law, rules, and usage at defiance, and virtually constituting themselves a court of appeal, they have given a revised decision in their own favour, and have enforced it by striking. The mental condition of these men will be better understood by noting what took place at a mass meeting held in the Star Theatre, Stockton, on Monday last. The chairman, Mr. Daniels, called upon any Board of Arbitration representatives to come upon the platform. None came forward, for, as these gentlemen put it, they "get nothing but cursing" unless they speak in accordance with the passions ruling at the moment. The chairman then proceeded, amid applause, to throw doubt upon the figures of Mr. Waterhouse, public accountant—originally appointed at the operatives' request. The next speaker, Mr. Samuels, a retired ironworker, also, amid applause, spoke in a disparaging way of Mr. Pease and his award, and contended that his appointment as umpire was unknown to the ironworkers, and would not have been approved if known! The next speaker, Mr. Cox, made a tirade against the Board and the workmen's representatives there, who, he said, were in league with the employers' foremen against the interests of the operatives. The next speaker, Mr. Toole, admitted that the workmen did know of Mr. Pease's appointment, and did not object to it. He thought the Board was bad beyond reformation, and proposed they should all give notice to leave it in three months—after having several times refused to act according to its decisions, to adopt the *rôle* of the injured innocent is really excellent. At this moment a Mr. Jones, Board representative for the Thornaby Ironworks, and a staunch and sensible upholder of the Board and of its decisions, appeared on the platform, and was received with a storm of howls and execrations. He offered to explain his views and past conduct but was not allowed, and only when he retired from the scene was peace restored. Mr. Toole's resolution to leave the Board was then carried unanimously, as also another to join the Ironworkers' Union, and yet another to remain on strike till they "obtain fair and reasonable consideration of their claims apart from the selling price of iron!" Among the employers the opinion is gaining ground that the Board of Arbitration must fall. It has perhaps done good service in its day, but its day is over. The men, finding they cannot convert it simply into a lever for enforcing their demands, are casting it aside with contempt. The employers are coming to regard it as a means of wasting much valuable time to secure an end from which they are at the moment further off than ever. The employers' mistake latterly has been in trusting to the Board instead of their own resources when acting in a strong union. They find that the men's union officials who represent them at the Board have no real power, and very little influence over their constituents; notwithstanding that personally they are mostly intelligent and straightforward men. The policy for the future to be aimed at, equally in the interests of capital and labour, as well as those of consumers and the general public, is—(1) A strong employers' combination; (2) a strong ironworkers union; (3) a joint committee by whom all wages questions should be settled, and with power to refer in case of difference. It has been for want of the two strong unions able to enforce decisions that the Board of Arbitration has fallen into impotency and contempt.

NOTES FROM SCOTLAND.

(*From our own Correspondent.*)

THE iron market has been very quiet during the past week, and on some days hardly any speculative business was done in warrants, the prices of which have, however, been comparatively steady.

Business was done in the warrant market on Friday morning at from 47s. 3d. to 47s. 2d. cash, and from 47s. 5½d. to 47s. 4½d. one month. In the afternoon transactions took place at 47s. 3d. to 47s. 4d. cash, and 47s. 5½d. to 47s. 6d. one month. On Monday the market opened dull, with business in the forenoon at 47s. to 47s. 2½d. cash, and 47s. 4½d. one month, the afternoon prices being 47s. 2d. to 47s. 1½d. cash. On Tuesday morning the warrant market was quiet but steady at 47s. 1½d. to 47s. 2d. cash, and 47s. 3½d. to 47s. 4d. one month, the prices being a little firmer in the afternoon. A moderate business was done on Wednesday at 47s. 3½d. and 47s. 5d. one month. To-day—Thursday—the market was easier, with business at 47s. 2d. cash, and 47s. 4d. one month.

There is not much change in the quotations of makers' iron, which are as follows:—Gartsherrie, f.o.b. at Glasgow, per ton, No. 1, 58s. 6d.; No. 3, 53s. 6d.; Coltness, 59s. and 54s. 6d.; Langloan, 59s. and 54s.; Summerlee, 57s. and 50s.; Calder, 57s. and 50s. 6d.; Carnbroe, 51s. 6d. and 48s. 6d.; Clyde, 51s. and 49s.; Monkland and Quarter each, 48s. 6d. and 47s.; Govan at Broomielaw, 49s. and 47s.; Shotts at Leith, 58s. 6d. and 54s. 6d.; Carron at Grangemouth, 49s. 6d., specially selected, 52s., and 48s. 6d.; Kinneil at Bo'ness, 47s. 6d. and 46s. 6d.; Glengarnock at Ardrossan, 51s. 6d. and 48s. 6d.; Eglinton, 48s. 6d. and 46s. 6d.; Dalmellington, 48s. and 47s.

The malleable iron trade continues quiet, with no new feature worthy of particular notice.

The activity which has characterised the general engineering trade for some time past is fully maintained, and engineers engaged on almost all departments of work are better supplied with employment than they have been for a long time.

A large business continues to be done in coals, there being a steady inquiry for use at the public works. During the past week the shipments from the different Scotch ports have exceeded those of the corresponding month by nearly 20,000 tons. No change, however, has taken place in prices, competition being very keen and supplies of coals abundant.

The wages question is threatening to cause some disturbance in Fifeshire. The workmen are of opinion that the condition of the coal trade is such as to warrant the masters in returning them the reduction of 12½ per cent. which was some weeks ago taken from their wages. A conference has been asked on the subject, and the employers while willing to meet the men through their representatives, point out that since the wages were reduced, the prices of coals have fallen. The employers also complain that the colliers are not working in accordance with the rules of the collieries, and state that they must insist that these rules be observed. The rules referred to provide that the miners were to work not less than eleven days per fortnight, and the breach of the regulations has arisen from some of the men resolving to work short time in order to produce a scarcity of coals, and if possible increase the prices.

WALES & ADJOINING COUNTIES.

(From our own Correspondent.)

IT may be stated that a restart at Cyfarthfa is likely, if not positively certain, in July, by which time the Cyfarthfa Bill now before the Houses will have passed with all formalities.

The iron and steel trades are moderately buoyant. I saw a great deal of activity in the neighbourhood of Swansea a few days ago, and if the tin-plate trade looked up there would not be much cause for complaint in that quarter.

The Harbour Trust have decided to accept Mr. Walker's contract for extending the new dock 710 lineal feet.

I hear that an Australian order for 20,000 tons of steel rails is likely to find its way to Swansea.

A distressing accident has occurred to a leading colliery-owner, Mr. J. W. Kelly, of The Elms, Llandaff. He had entered a level of his at Treveley with an overman, to make an examination of the place, and from some incautious act on the part of the overman, the gas exploded, and both are seriously, if not fatally injured. Mr. Kelly was one of the principals of the Pentre Colliery, Rhondda, previous to the great explosion there.

Messrs. Burgess and Co. are about establishing a limited liability company at Swansea, for the purpose of working the Cambrian line of steamers to and from New York. Several fine vessels have left the port of late. The City of Lincoln left this week with 2500 tons of tin-plates for America.

A large tin-plate firm, Messrs. Jenkins and Lewis, Aberavon, failed this week for £34,000. A petition has been filed.

An accident happened to the shaft of the ventilating fan at the Great Western Colliery this week. The bearings, it is thought, became overheated, and the shaft of the fan broke. By dint of great effort the men were got up safely.

Several members of the Royal Commission on Mines were at Llwynpia this week, conducting experiments with the gas. Professor Warrington Smyth, Mr. Lindsey Wood, Dr. Kellnar, assistant to Professor Abel, and others were present. Professors Tyndall and Chaplin, and Mr. Burt, M.P., are expected.

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.

2nd May, 1882.

2061. FIRE-ARMS, J. Williams, Birmingham.
2062. STOPPERS, J. Bussey, London.
2063. FIRE-ARMS, H. H. Lake.—(*J. Schulhoff, Vienna.*)
2064. LINEAR MEASUREMENT, H. H. Lake.—(*V. von Reitzner, Vienna.*)
2065. MICROPHONIC CONDUCTORS, J. H. Johnson.—(*Dr. A. D'Arsomal, Paris.*)
2066. FIRE-PROOF DOORS, S. B. Wilkins, Edinburgh.
2067. COFFEE, G. W. von Nawrocki.—(*E. Geist, Bavaria.*)
2068. SECONDARY BATTERY, C. H. Cathcart, Sutton, and C. B. G. Cole, London.
2069. SUPPORTING HEALDS, J. Aspinall, Ravensthorpe.
2070. SEPARATION of ORES, H. J. Haddan.—(*L. de Soulages, Paris.*)
2071. SMELTING FURNACES, H. J. Haddan.—(*L. de Soulages, Paris.*)
2072. ELECTRIC LIGHTS, T. Handford.—(*T. Edison, U.S.*)
2073. CATHETERS, T. and W. J. Nicholls, London.
2074. TRANSMITTING HEAT, W. Beesley and J. Beesley, Barrow-in-Furness.
2075. CALORIC ENGINE, J. Buckett, London.
2076. MALTING, B. J. B. Mills.—(*W. F. Howe, U.S.*)
2077. REFINING OILS, E. W. Bell.—(*E. C. Kattell, U.S.*)
2078. CONNECTING LINKS, G. Turton and J. Brunlees, London.
2079. COMBING WOOL, H. H. Lake.—(*C. Fletcher, U.S.*)
2080. TESTING MATERIALS, W. Porter, Lee, Kent.

3rd May, 1882.

2081. ELEVATING MACHINERY, J. V. Hope, Wednesbury.
2082. IRON and STEEL, T. Lishman, West Hartlepool.
2083. ADDRESS LABELS, C. Keith, Inverness.
2084. WINDOW SASH FASTENERS, D. Walker and W. S. Simpson, London.
2085. SCREW PROPELLERS, A. J. Davison, Sunderland.
2086. DEODORISER, O. Bowen and A. Miller, London.
2087. SPONGE FISHING NETS, H. J. Haddan.—(*E. Arapian and L. Isaacs, U.S.*)
2088. HATS, H. J. Haddan.—(*C. Vital, Paris.*)
2089. SECURING TIES, N. J. Crow, London.
2090. LOOMS, J. Brownlee, Glasgow.
2091. LOCOMOTIVES, J. H. Johnson.—(*L. Brière, Paris.*)
2092. ELECTRIC LIGHT, C. Lever, Bowdon.
2093. DRIVING ENGINES, H. F. Maitland, Henley-on-Thames.

4th May, 1882.

2094. PRESERVERS, V. Manuel, London.
2095. FIRE-LIGHTERS, J. Templeman, London, and T. Carmichael, Glasgow.
2096. SLIDE VALVES, J. Hopwood, Poulton-le-Fylde.
2097. ARTIFICIAL MARBLE, B. Guelton, Brighton.
2098. PAPER BAGS, H. J. Haddan.—(*M. Stanley, U.S.*)
2099. SOFA, &c., C. Klemetson, Christiania, Norway.
2100. STAMPING HOLES, J. Westwood and R. Baillie, London.
2101. WHEELS, R. Hadfield, London.
2102. STEAM GENERATORS, J. I. Thornycroft, Chiswick.
2103. IRONS, G. W. von Nawrocki.—(*A. Brecher, U.S.*)
2104. BURNERS, E. Hagen.—(*L. Q. Brin, Paris.*)
2105. WIRE FENCING, C. J. Dawson, Leeds.
2106. COATING METAL PLATES, H. F. Taylor, Briton Ferry, and G. Leyshon, Tividale.
2107. ELECTRIC SAFETY APPARATUS, P. Jensen.—(*R. J. L. Haviland, Vienna.*)
2108. WATER WHEELS, C. Megow and J. L. Markel, San Francisco, U.S.
2109. REPEATING FIRE-ARMS, P. Mauser, Wurttemberg.
2110. CARBONATE of SODA, S. Pitt.—(*T. Schloesing, Paris.*)
2111. TUBULAR BOILERS, A. F. Yarrow, London.

5th May, 1882.

2112. ADVERTISEMENTS, J. Hickisson, London.
2113. VELOCIPEDES, H. Whitehouse, Reading.
2114. PERAMBULATOR WHEELS, T. Cooke, Manchester.
2115. PURIFYING WATER, A. Goldthorpe, Wakefield.
2116. VENTILATORS, A. W. Kershaw, Lancaster.
2117. GRINDING FLINT, J. Goodwin, Stoke-upon-Trent.
2118. STEAM GENERATORS, A. J. Boult.—(*F. Bosquet, Lyons, France.*)
2119. CALCULATING INSTRUMENT, A. J. Boult.—(*G. Charpentier-Page, France.*)
2120. URINALS, W. McGill, London.
2121. WATER-CLOSET BASINS, T. W. Helliwell, Brighouse.
2122. TEXTILE MATERIALS, G. J. Jaeger, Germany.
2123. BOXES, H. J. Haddan.—(*B. Rückert, Saxony.*)
2124. LOCKS, J. M. Hart, London.
2125. ELECTRIC CURRENTS, K. Parzelski, London.
2126. GAS ENGINES, S. Worssam, London.
2127. PIANOS, R. H. Bishop and W. Down, London.
2128. ELECTRIC CURRENTS, W. Arthur, London.
2129. AIR PUMPS, D. Johnson, Chester, and S. C. Tisley, London.
2130. ARMOUR PLATES, A. Wilson, Sheffield.
2131. LEADS, G. Daubenspeck, London.

6th May, 1882.

2132. NON-CONDUCTORS, E. C. C. Stanford, Glasgow.
2133. STOVES, &c., F. J. Duggan, Bristol.
2134. WET GAS METERS, W. C. Parkinson, London.
2135. PREPARING LEAD, T. Cuttriss.—(*C. Cuttriss, U.S.*)
2136. INCANDESCENT LAMPS, J. Rapieff, London.
2137. HARROWS, &c., E. Button, Stanway.
2138. ELECTRIC CURRENTS, A. Millar, Glasgow.
2139. VELOCIPEDES, B. Bennett, Coventry.
2140. SAFETY PINS, G. F. Redfern.—(*F. S. Peshine, U.S.*)
2141. TEACHING MUSIC, E. M. Easson, Slough.
2142. PLOUGHS, C. A. Snow.—(*J. Quin, U.S.*)
2143. ESPARTO GRASS, D. Smith and C. Robertson, Lydney.
2144. ELECTRIC LAMPS, J. H. Johnson.—(*J. M. A. Gerard-Lescuyer, Paris.*)
2145. CABINETS, &c., A. Black, Paisley.
2146. MEASURING LIQUIDS, E. G. Rivers, Thornton Heath.
2147. TOBACCO POUCHES, B. L. James, Wanstead Park.
2148. TRICYCLES, W. Dawes and J. Tankard, Leeds.
2149. PURIFYING MIDDLINGS, J. Beal, Sheffield.
2150. SELF-CLOSING VALVES, A. Sweet, London.

8th May, 1882.

2151. GAS PRODUCERS, F. W. Dick and G. S. Packer, Glasgow.
2152. COMBUSTION of FUEL, W. Beazley, Birmingham.
2153. PENHOLDER, W. Sinclair, East Linton.
2154. LUBRICATING COMPOSITION, H. Montgomerie, Cleaden.
2155. PIPE COUPLINGS, C. L. Hett, Brigg.
2156. PHOTOGRAPHIC PLATES, F. Wirth.—(*G. Meisenbach, Germany.*)
2157. CLEANING STONE STAIR, J. M. Gray, Kingston-upon-Hull.
2158. BICYCLES, &c., H. F. D. Miller, Birmingham.
2159. PLAYING PIANOFORTES, A. Wilkinson, Bradford.
2160. BOTTLE CLEANER, A. M. Clark.—(*W. S. Wood and L. H. Livingstone, jun., U.S.*)

Inventions Protected for Six Months on Deposit of Complete Specifications.

2035. PRODUCING INTENSE WHITE LIGHT, J. Imray, Southampton-buildings, London.—A communication from C. Clamond, Paris.—*29th April*, 1882.
2049. FIRE-EXTINGUISHERS, J. R. Brown, Providence, U.S.—*1st May*, 1882.
2107. ELECTRIC SAFETY APPARATUS, P. Jensen, Chancery-lane, London.—A communication from R. J. L. Haviland, Vienna, Austria.—*4th May*, 1882.

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

1773. DIGGING MACHINES, T. C. Darby, Chelmsford.—*5th May*, 1879.
1838. KNITTING MACHINES, L. Woodward and F. Chadwick, Nottingham.—*8th May*, 1879.
1740. NUTS, &c., J. Cowdy and H. Andrews, London.—*2nd May*, 1879.
1747. FEEDING HORSES, V. H. B. Barrington-Kennett, London.—*2nd May*, 1879.
1754. FIRE-ARMS, A. Wyley, Birmingham.—*3rd May*, 1879.
1813. PRINTING TELEGRAPH, G. J. Droste, Germany.—*7th May*, 1879.
1885. FURNACES, W. L. Wise, London.—*12th May*, 1879.
1942. RAILWAYS, &c., A. C. Pain and J. Cleminson, London.—*14th May*, 1879.
1772. PIANOFORTES, J. C. Mewburn, London.—*5th May*, 1879.
1789. MECHANICAL TOYS, J. G. Tongue, London.—*6th May*, 1879.
1909. VELOCIPEDES, T. Butler, Eversley.—*13th May*, 1879.
1956. DRAWING FRAMES, W. R. Lake, London.—*15th May*, 1879.
1957. FEED REGULATING, W. R. Lake, London.—*15th May*, 1879.
1786. FIRE-ARMS, W. R. Lake, London.—*6th May*, 1879.
1903. ACCUMULATING HEAT, J. Gillingham, Chard.—*13th May*, 1879.
1931. GAS METERS, G. F. L. Foulger, London.—*14th May*, 1879.
2386. SULPHURETTED HYDROGEN GAS, W. E. A. Hartmann, Swansea.—*16th June*, 1879.
1785. CLEANING METAL PLATES, W. H. N. Knight, Pontypridd.—*6th May*, 1879.
1844. UTILISING FUEL, W. R. Lake, London.—*8th May*, 1879.
1954. PRESERVING TIMBER, S. B. Boulton, London.—*15th May*, 1879.
2082. STEERING SHIPS, &c., T. B. Heathorn, London.—*26th May*, 1879.
2110. PRODUCING LIGHT, &c., C. W. Siemens, London.—*27th May*, 1879.

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

1631. FIRE-GRATES, S. Russell, Shepherd's Bush, London.—*3rd May*, 1875.
1657. ROCK DRILLING, W. Walker, Saltburn-by-the-Sea.—*4th May*, 1875.
1774. TREATING SACCHARINE MATTERS, C. Richardson, London.—*12th May*, 1875.
1809. METALLIC PISTONS, M. Prior, Sheffield.—*14th May*, 1875.
1658. BLOWERS, &c., R. R. Gubbins, London.—*4th May*, 1875.
1704. TREATMENT of SUBSTANCES containing ALUMINA, P. Spence and F. M. Spence, Manchester.—*7th May*, 1875.
1669. WEAVING, W. H. Hacking and T. Hacking, Bury.—*5th May*, 1875.
1737. CULTIVATING LAND, F. Savage, King's Lynn.—*10th May*, 1875.

Notices of Intention to Proceed with Applications.

Last day for filing opposition 26th May, 1882.

5704. EDGE-SETTING, W. R. Lake, London.—A communication from G. Copeland.—*28th December*, 1881.
5710. BATHING, C. E. Winterros, Christiania.—*29th December*, 1881.
5736. SHIRTS, J. Ridley, Cripplegate, London.—*31st December*, 1881.
5737. ORNAMENTAL GLASS, J. Hewitt, London.—A com. from R. W. Harris.—*31st December*, 1881.
5738. ELECTRIC LAMPS, J. G. Lorrain, London.—*31st December*, 1881.
5746. NUMBERING for PRINTING, W. R. Lake, London.—Com. from P. L. Hanscom.—*31st December*, 1881.
5748. CONSUMING SMOKE, J. MacDonald and A. J. M. Bolanachi, Dulwich.—*31st December*, 1881.
1. TABLE CUTLERY, E. A. Lynde, Sheffield.—*2nd January*, 1882.
3. PRESERVING TIMBER, H. Aitken, Falkirk, N.B.—*2nd January*, 1882.
4. LOCKS for BAGS, V. Huppe and A. P. Bender, Germany.—*2nd January*, 1882.
5. MASHING MALT, L. A. Groth, London.—A communication from M. Seitz.—*2nd January*, 1882.
6. NICKEL-PLATING, J. E. Chaster, Manchester.—*2nd January*, 1882.
7. DOUBLE-ACTING HOT-AIR ENGINES, T. Morgan, London.—Com. from S. Sudheim.—*2nd January*, 1882.
8. DEAD-WEIGHT SAFETY VALVES, J. S. Stubbs, Manchester.—*2nd January*, 1882.
14. ELECTRIC LIGHTING, A. Mackie, London.—*2nd January*, 1882.
18. WHALEBONE, W. Morgan-Brown, London.—A communication from G. H. Phelps.—*3rd January*, 1882.
27. BALL BEARINGS, A. J. Boult, London.—A communication from H. Büssing.—*3rd January*, 1882.
28. TREATING FIGS, J. W. Wood, Liverpool.—*3rd January*, 1882.
31. VESSELS, W. R. Lake, London.—A communication from C. Petersen.—*3rd January*, 1882.
63. UNINFLAMMABLE FABRICS, P. Jensen, London.—A com from H. Suillot & H. David.—*5th January*, 1882.
64. MAGNETO-ELECTRIC MACHINES, L. Groth, London.—A com. from R. J. Gülcher.—*5th January*, 1882.
69. INCANDESCENT LAMPS, E. Liveing, London, and C. Boys, Wing.—*6th January*, 1882.
71. AUTOMATIC REGISTERS, A. J. Boult, London.—A com. from B. Valentine.—*6th January*, 1882.
92. PIANOFORTES, F. C. Glaser, Berlin.—A communication from G. Knake.—*7th January*, 1882.
101. WRITING PADS, W. R. Lake, London.—A communication from E. Engel.—*7th January*, 1882.
156. TREATING PHOSPHATES, D. Perry, Glasgow.—*11th January*, 1882.
176. BEDSTEADS, A. M. Clark, London.—A communication from A. Oudry.—*12th January*, 1882.
192. OCHRE PIGMENTS, J. Cameron, London.—*13th January*, 1882.
242. LOADING SHIPS, A. Clark, London.—A communication from C. Meserole.—*17th January*, 1882.
245. REGULATING ELECTRIC CURRENTS, W. Lake, London.—A communication from A. de Khotinsky.—*17th January*, 1882.
269. PERMUTATION LOCKS, J. Nottingham, U.S.—A com. from G. Athaway.—*19th January*, 1882.
300. FIRE EXTINGUISHING, W. R. Lake, London.—A com. from H. S. Maxim.—*20th January*, 1882.
319. SECONDARY BATTERIES, J. S. Sellon, London.—*21st January*, 1882.
406. BOLTS, A. M. Clark, London.—A communication from T. J. Bush.—*26th January*, 1882.
466. SEWING, J. F. McLaren, Glasgow.—*31st January*, 1882.
538. ELECTRICAL ACCUMULATORS, W. R. Lake, London. A com. from J. Barrier.—*3rd February*, 1882.
603. PROPELLERS for SHIPS, G. C. Parini, Italy.—*8th February*, 1882.
759. PURIFYING ANTHRACHINONE, J. Dixon, Glasgow.—A com. from J. Brönner.—*16th February*, 1882.
1153. GUTTA-PERCHA SUBSTITUTE, M. Zingler, London.—*9th March*, 1882.
1414. PULLEYS, G. W. Beynon, Reading.—*23rd March*, 1882.
1506. MAKING ICE, J. J. Coleman, Glasgow.—*29th March*, 1882.
1567. CONCENTRATED MILK, E. Kunkler, London.—*31st March*, 1882.
1630. CAUSTIC SODA, J. Spence, London, and A. Watt, Carlton.—*4th April*, 1882.
1634. INDIA-RUBBER COATED FABRICS, W. Lake, London.—Com. from H. W. Burr.—*4th April*, 1882.
1686. LABEL-HOLDER, J. Parker, Woodstock.—*6th April*, 1882.
1689. ELECTRIC LAMPS, G. Young, Blackwall, and R. Hatton, Stratford.—*6th April*, 1882.
1763. IRON, H. C. Bull, Brooklyn, U.S.—*13th April*, 1882.
1845. MAINS, W. T. Whiteman, London.—A communication from the American Heating and Power Company.—*18th April*, 1882.
2035. WHITE LIGHT, J. Imray, London.—A communication from C. Clamond.—*29th April*, 1882.

Last day for filing opposition, 30th May, 1882.

21. WIRE, W. R. Lake, London.—A communication from O. Chaplin.—*3rd January*, 1882.
33. CLEANING STREETS, S. L. Hunt, London.—*3rd January*, 1882.
42. STOVES, E. G. Lakeman, Modbury.—*4th January*, 1882.
50. LOCOMOTIVES, T. Morgan, London.—A communication from D. Reid.—*4th January*, 1882.
51. PARCHMENT, C. Weygang, London.—*5th January*, 1882.
55. DISTRIBUTING ELECTRICAL ENERGY, J. Perry, London.—*5th January*, 1882.
76. STOVES, J. H. Johnson, London.—A communication from M. Perret.—*6th January*, 1882.
77. MOULDING CEMENT, H. Reid, London.—*6th January*, 1882.
78. PRINTING, T. A. Briggs, Providence, U.S.—*6th January*, 1882.
80. CONVERTING IRON, W. F. Jackson, Bradford.—*6th January*, 1882.
81. WHITEWASH, J. I. Fordham, London.—*6th January*, 1882.
88. CUTTING TOBACCO, C. J. Fox, London.—*7th January*, 1882.
90. BACK SIGHTS, P. Taylor, Manchester.—*7th January*, 1882.
100. WEIGHING, F. Wolff, Denmark.—A communication from F. Casse.—*7th January*, 1882.
102. TEACHING READING, E. Sykes and O. Abbott, Huddersfield.—*7th January*, 1882.
104. LAMINATED STEEL SPRINGS, R. B. Hansell, Sheffield.—*7th January*, 1882.
106. PAPER BARRELS, W. R. Lake, London.—A communication from G. Laraway.—*7th January*, 1882.
111. CRUSHING MINERALS, J. Spencer and J. Consterdine, Hollinwood, and N. Kimberley, Hornsey.—*9th January*, 1882.
116. KNIFE CLEANING, E. M. Knight, Manchester.—*9th January*, 1882.
143. LOCOMOTIVES, R. Brandon, Paris.—A communication from A. Cottrau.—*11th January*, 1881.
144. SECONDARY BATTERIES, H. J. Haddan, London.—A com. from E. Boettcher.—*11th January*, 1882.
158. SEWING, W. R. Lake, London.—A communication from Messrs. E. Thimonieurs, Fils, and Vernay.—*11th January*, 1882.
201. SKATES, J. Yelloly and A. Elwes, Royal Navy.—*14th January*, 1882.
247. GUNS, W. R. Lake, London.—A communication from D. Mefford.—*17th January*, 1882.
338. KNIVES, H. H. Lake, London.—A communication from P. Brion.—*23rd January*, 1882.
686. TELEPHONE CALL, A. M. Clark, London.—A communication from G. Hopkins.—*11th February*, 1882.
687. TELEPHONIC EXCHANGE, A. M. Clark, London.—A com. from G. Hopkins.—*11th February*, 1882.
688. REPEATING SOUNDS, A. Clark, London.—A communication from G. Hopkins.—*11th February*, 1882.
689. TELEPHONE RECEIVERS, A. Clark, London.—Com. from G. M. Hopkins.—*11th February*, 1882.
714. LAMP-WICK, W. R. Lake, London.—A communication from G. Beck.—*14th February*, 1882.
794. COLOURING LEATHER, W. Barlow, London.—A com. from E. Fernbach.—*18th February*, 1882.
1180. DRESS for FIRE PROTECTION, O. Rhodes, Leeds.—*11th March*, 1882.
1234. PUMPS, G. V. Fosbery, Britton.—*14th March*, 1882.
1340. TRENCHES, J. W. Wailes, Walsall.—*20th March*, 1882.
1512. LADDERS, T. Jones, Sedgley, near Dudley.—*29th March*, 1882.
1518. PROJECTILES, W. Naylor, Penistone.—*29th March*, 1882.
1538. LOOMS, G. Hodgson and J. Broadley, Bradford.—*30th March*, 1882.
1554. TREATING GRAIN, E. Beanes, London.—*30th March*, 1882.
1560. GLOVE FASTENINGS, E. Horsepool, London.—*31st March*, 1882.
1564. DRINKING VESSELS, J. Tams, Longton.—*31st March*, 1882.
1604. VAPORISING FLUIDS, C. Scott, Belfast.—*3rd April*, 1882.
1622. ROCK DRILLING, H. D. Pearsall, London.—*4th April*, 1882.
1627. SEPARATING BODIES, B. Tillet, Leytonstone.—A communication from E. Bennett.—*4th April*, 1882.
1642. ELECTRIC LAMPS, W. Akester, Glasgow.—*5th April*, 1882.
1644. EXTINGUISHING FIRES, M. Vinning, Walbrook.—*5th April*, 1882.
1666. STEAM BOILERS, G. Stevenson, Airdrie.—*6th April*, 1882.
1667. TRICYCLES, &c., T. Forshaw, Smalley.—*6th April*, 1882.
1682. RAILWAY SIGNALS, J. Harrison, London.—*6th April*, 1882.
1694. CORNICE POLES, C. Grimmett and J. Cook, Birmingham.—*8th April*, 1882.
1706. DISTILLING, C. Pielsticker, London.—*10th April*, 1882.
1715. HYDRAULIC ENGINES, B. and F. Walker, Leeds.—*11th April*, 1882.
1746. ECONOMISERS, T. Sykes, Manchester.—*12th April*, 1882.
1747. DYNAMO-ELECTRIC MACHINES, D. Chertemps and L. Dandeu, Paris.—*12th April*, 1882.
1778. BURNING COKE, J. Cropper, Brimington.—*14th April*, 1882.
1787. DYNAMO-ELECTRIC MACHINES, B. Antill, London.—*14th April*, 1882.
1794. GENERATING CURRENTS, E. Voice, London.—*14th April*, 1882.
1817. SUGAR, J. H. Johnson, London.—A com. from A. Wernicke and W. Pfitginger.—*17th April*, 1881.
1824. DISTILLING, W. Dicey, Brockley.—A communication from C. Bilroth.—*17th April*, 1882.
1860. DRYING GOODS, J. Worrall, Ordsall, and J. Kershaw, Wadsworth.—*18th April*, 1882.
1870. LOCKS, W. S. Frost, Peckham.—*19th April*, 1882.
1880. STOPPING MOTION, P. Pfleiderer, London.—A com. from W. Kankelwitz.—*19th April*, 1882.

Patents Sealed.

(List of Letters Patent which passed the Great Seal on the 5th May, 1882.)

4730. LOCKS, &c., T. Galloway, Gateshead-on-Tyne.—*28th October*, 1881.
4865. FORKS of BICYCLES, S. Armstrong, Birmingham.—*7th November*, 1881.
4869. PACKING, J. Williams and H. Dansey, London.—*7th November*, 1881.
4874. MOULDING PLOUGHS, F. Wolff, Copenhagen.—*8th November*, 1881.
4883. WINDING CLOCKS, M. Bauer, Paris.—*8th November*, 1881.
4887. AERIAL NAVIGATION, E. Edwards, London.—*8th November*, 1881.
4888. SULPHURIC ACID, T. Richters, Breslau.—*8th November*, 1881.
4894. KNITTING MACHINES, W. Harrison, Manchester.—*8th November*, 1881.
4900. EXCAVATING, J. W. H. James, London.—*9th November*, 1881.
4901. VELOCIPEDES, R. E. Phillips, London.—*9th November*, 1881.
4905. TRANSMITTING SOUND, W. C. Barney, London.—*9th November*, 1881.
4907. WATER-GAS, P. Jensen, London.—*9th November*, 1881.
4917. BICYCLES, &c., L. E. Broadbent, London.—*9th November*, 1881.
4921. RAISING WATER, W. Tasker, near Andover.—*9th November*, 1881.
4927. ARTIFICIAL STONE, E. de Pass, London.—*10th November*, 1881.
4932. GOVERNING ENGINES, T. Hunt, Fairfield.—*10th November*, 1881.
4934. TUNE-PLAYING TOPS, M. A. Weir, London.—*10th November*, 1881.
4938. STOPPING CARS, C. E. Davison, London.—*11th November*, 1881.
4945. HAND-RAKES, W. R. Lake, London.—*11th November*, 1881.
4967. CAMERA OBSCURAS, A. Pumphrey, Birmingham.—*12th November*, 1881.
4970. PHOTOGRAPHIC CAMERAS, A. M. Clark, London.—*12th November*, 1881.
5008. CORRUGATED TUBES, S. Fox, Leeds.—*15th November*, 1881.
5009. MOULDING STEEL, S. Fox and J. Whitley, Leeds.—*15th November*, 1881.
5066. SHAPING WOOD, H. J. Haddan, London.—*19th November*, 1881.
5075. SLASHERS, A. P. Dickinson and W. Rossiter, Blackburn.—*19th November*, 1881.
5099. AUTOMATIC ATTACHMENTS, W. P. Thompson, London.—*22nd November*, 1881.
5141. HATCHING EGGS, C. E. Hearson, London.—*24th November*, 1881.
5184. KNOBS, E. W. Buller, Birmingham.—*28th November*, 1881.
5197. MALLEABLE IRON, W. R. Lake, London.—*28th November*, 1881.
5234. FIRE-ALARMS, W. T. Braham, Manchester.—*30th November*, 1881.
5492. RANGE-FINDING, T. Bolton, Calcutta.—*15th December*, 1881.
5573. TELEPHONES, W. R. Lake, London.—*20th December*, 1881.
323. SPINNING, B. Dobson, E. Gillow, and D. Davies, Bolton.—*23rd January*, 1882.
398. SUGAR, C. Scheibler, Berlin.—*26th January*, 1882.
465. KNITTING, J. Byfield, London, Canada.—*31st January*, 1882.
923. FILTER PRESSES, H. E. Newton, London.—*25th February*, 1882.
944. GLANDS, H. J. Haddan, London.—*27th February*, 1882.
995. STARCH, W. R. Lake, Southampton-buildings, London.—*1st March*, 1882.
1025. LOCK NUTS, W. R. Lake, London.—*3rd March*, 1882.
1051. ARMOUR PLATES, J. D. Ellis, Sheffield.—*4th March*, 1882.
1073. STEAM SHIPS, J. E. Mouland, Roby.—*6th March*, 1882.
1245. CREELS, W. R. Lake, Southampton-buildings, London.—*14th March*, 1882.

(List of Letters Patent which passed the Great Seal on the 9th May, 1882.)

4697. ELASTIC COTTON, G. By n, Brighton.—*27th October*, 1881.
4924. PRINT IMPRESSIONS, J. Marquez, Lima.—*10th November*, 1881.
4939. LIGHT, A. F. St. George, London.—*11th November*, 1881.
4950. EXPANSIBLE BASKET, H. Bale, London.—*11th November*, 1881.
4952. PACKING CASES, G. Robson, Liverpool.—*12th November*, 1881.
4954. CROSSING MOTION, A. Metcalf, Preston.—*12th November*, 1881.
4959. ELEVATING GRAIN, J. Higginbottom and O. Stuart, Liverpool.—*12th November*, 1881.
4960. CLEANING CARPETS, C. D. Abel, London.—*12th November*, 1881.
4961. NAILING BOXES, F. Blood, Liverpool.—*12th November*, 1881.
4962. ILLUSTRATING, E. Sykes and O. Abbot, Huddersfield.—*12th November*, 1881.
4963. OVENS, J. L. Hancock, London.—*12th November*, 1881.
4982. KEY GROOVES, J. Roemmele, Glasgow.—*14th November*, 1881.
4997. LUBRICATOR, T. Allison and G. Senior, Milnsbridge.—*15th November*, 1881.
4999. SEWING, W. Morgan-Brown, London.—*15th November*, 1881.
5010. SEPARATING MINERALS, B. Hart, London.—*15th November*, 1881.
5018. GAS COOKING, W. Sugg, London.—*16th November*, 1881.
5086. KNITTING, H. M. Mellor, Nottingham.—*21st November*, 1881.

5121. Folding Chair, L. Field, Birmingham.—23rd November, 1881.
5165. Dislodging Germs, T. Voss, London.—26th November, 1881.
5188. Looms, J. Bullough, Accrington.—28th November, 1881.
5305. Bicycle Saddle, C. Hamilton, Greenwich.—5th December, 1881.
5311. Pulley Blocks, T. H. Ward, Tipton.—5th December, 1881.
5348. Glycerine, W. Clark, London.—7th December, 1881.
5387. Steam Engines, H. Young, London.—9th December, 1881.
5444. Boots and Shoes, W. R. Lake, London.—13th December, 1881.
5514. Driving, W. P. Thompson, London.—16th December, 1881.
5568. Dynamo-electric Machine, Sir W. Thomson, Glasgow.—26th December, 1881.
5743. Electrical Resistance, G. Pfannkuche and R. Dunstan.—31st December, 1881.
49. Recording Quantity, J. Hopkinson, London.—4th January, 1882.
122. Shears, W. Smith, Sheffield.—10th January, 1882.
183. Buttons, W. Willeringhaus, London.—13th January, 1882.
257. Motive Power, A. Lehman, West Hartlepool.—18th January, 1882.
391. Writing, W. P. Thompson, London.—26th January, 1882.
414. Carriages, A. Cracknell, London.—27th January, 1882.
661. Telephone, H. Eldred, London.—11th February, 1882.
749. Telephonic Exchange, G. Anders, London.—16th February, 1882.
791. Buttons, W. Willeringhaus, London.—18th February, 1882.
803. Fires, J. K. J. Foster, Bolton.—18th February, 1882.
828. Smelting, W. Ferrie, Calderbank.—21st February, 1882.
905. Secondary Batteries, J. W. Swan, Newcastle-on-Tyne.—24th February, 1882.
913. Rolling Mills, P. Kirk, Workington.—25th February, 1882.
924. Cocks, H. E. Newton, London.—25th February, 1882.
1006. Draw-off Cocks, S. Goslin, London.—2nd March, 1882.
1105. Chains, W. Penman, Gateshead-on-Tyne.—7th March, 1882.
1126. Indicators, H. J. Haddan, London.—8th March, 1882.
1137. Telegraph, W. Davies and F. Higgins, London.—8th March, 1882.
1205. Feeding Boilers, C. Wardle, Leeds.—13th March, 1882.
1213. Fire-grates, R. Wright, Richmond.—13th March, 1882.
1337. Twisted Fabrics, A. M. Clark, London.—18th March, 1882.

List of Specifications published during the week ending May 6th, 1882.

3440,* 4d.; 3573, 8d.; 3627, 2d.; 3778, 6d.; 3956, 6d.; 3984, 6d.; 4078, 6d.; 4117, 6d.; 4124, 1s.; 4138, 8d.; 4141, 4d.; 4146, 6d.; 4156, 6d.; 4159, 6d.; 4180, 6d.; 4184, 6d.; 4188, 6d.; 4189, 6d.; 4193, 4d.; 4194, 6d.; 4196, 6d.; 4199, 4d.; 4207, 6d.; 4208, 6d.; 4209, 6d.; 4213, 6d.; 4215, 1s. 10d.; 4219, 4d.; 4225, 6d.; 4227, 4d.; 4229, 6d.; 4230, 4d.; 4237. 6d.; 4241, 6d.; 4244, 1s. 2d.; 4253, 8d.; 4268, 6d.; 4269, 6d.; 4272, 6d.; 4273, 2d.; 4275, 6d.; 4276, 2d.; 4277, 4d.; 4278, 2d.; 4279, 6d.; 4280, 2d.; 4281, 2d.; 4283, 2d.; 4284, 6d.; 4286, 2d.; 4287, 6d.; 4288, 6d.; 4291, 2d.; 4292, 2d.: 4264, 2d.; 4235, 6d.; 4296, 2d.; 4298, 4d.; 4299, 2d.; 4300, 6d.; 4301, 4d.; 4302, 2d.; 4303, 4d.: 4305, 2d.; 4306, 6d.; 4307, 2d.; 4308, 2d.; 4309, 6d.; 4311, 6d.; 4312, 6d.; 4314, 6d.; 4315, 4d.; 4316, 2d.; 4317, 10d.; 4318, 4d.; 4320, 2d.; 4321, 2d.; 4322, 2d.; 4323, 2d.; 4325, 2d.; 4326, 6d.; 4328, 4d.; 4333, 2d.; 4335, 10d.; 4336, 2d.; 4337, 2d.; 4338, 2d.; 4339, 2d.; 4341, 2d.; 4343, 6d.; 4344, 2d.; 4347, 6d.; 4354, 2d.; 4355, 4d.; 4358, 2d.; 4364, 4d.; 4365, 2d.; 4367, 2d.; 4370, 2d.; 4371, 2d.; 4372, 4d.; 4376, 2d.; 4378, 2d.; 4380, 2d.; 4382, 2d.; 4383, 6d.; 4384, 4d.; 4385, 2d.; 4387, 2d.; 4389, 4d.; 4393, 6d.; 4394, 8d.; 4397, 4d.; 4403, 6d.; 4406, 6d.; 4408, 4d.; 4409, 4d.; 4410, 6d.; 4411, 6d.; 4419, 6d.; 4423, 6d.; 4432, 6d.; 4444, 4d.; 4776, 4d.; 5058, 6d.; 5532, 2d.; 345, 6d.; 479, 6d.; 507, 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.*

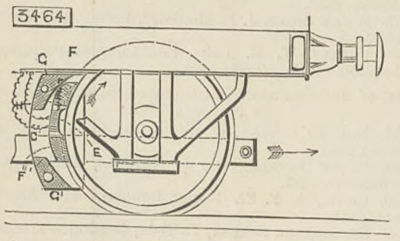
3301. Improvements in Apparatus for Lighting Gas by Electricity, *E. B. Burr, Walthamstow, Essex.—28th July*, 1881. 6*d*.

This consists in a portable gas lighter, consisting of a pole having a battery in a case at its lower end and at its upper a platinum wire. This latter is so connected with the battery that on pressing a spring the platinum is heated to incandescence, wherewith the gas can be lighted.

3464. An Electric Brake, *S. von Sawiczeski, Paris.—10th August*, 1881. 6*d*.

The figure represents the brake block in action. The electro-magnets E are enclosed in the box formed by the sheet iron C^1, suspended by spiral spring. The wedging of the brake blocks is produced against the

3464



wooden or metal pieces F F^1. Each electro-magnet has two brake blocks of special form, one upper and one lower, and are intended one for forward and the other for backward running. The action is as follows:—An electric generator in the train is connected by wires and commutators with the carriages and electro-magnets, so that the driver or guard may send a current acting on the electro-magnets, causing their instantaneous adhesion to the wheels, which then act as armatures. The impulsive force of the wheel carries the brake blocks in the form of wedges round into between the abutments G and G^1 and the wheel, which will cause a wedging action of a strength proportional to the current and the speed of the train.

3573. Smoke Consuming Grate for Warming and Cooking Purposes, &c., *A. Ball, Spalding.—17th August*, 1881.—(*Provisional protection not allowed.*) 8*d*.

Hot-air chambers are provided round the grate, and serve to admit fresh air from the outside, and discharge it when heated into the apartment. A chamber is formed above the fire so as to consume the smoke, and from it a flue leads down one side, underneath, and up the other side of the grate, and then opens into the chimney.

3627. Lubricants, *W. R. Goodfellow, Cornwall.—20th August*, 1881.—(*Not proceeded with.*) 2*d*.

This relates to a mixture of cerosine with animal, vegetable, or mineral oil.

3665. Improvements in the Division and Regulation of Electric Currents, *R. E. Dunston, Donhead St. Mary, Wilts; and G. Pfannkuche, Westminster.*)—*22nd August*, 1881. 6*d*.

This invention consists in the application of the solenoid principle to the division and regulation of electric currents, the suction exercised in the solenoid cores being made to throw resistances in or out of circuit as required.

3771. An Improvement or Improvements in the Production of Voltaic Electricity, *A. Banks, Birmingham.—30th August*, 1881. 6*d*.

This consists in the utilisation of the pickling vats in which iron and steel are cleaned, preparatory to being electro-plated, as generators of electricity. The iron sheets placed in the vat to be cleaned are connected by a metal hook to a rod supported on the top of the vat. In the latter are placed one or more upright porous vessels, the tops of which are above the dilute acid in the vat; in these are placed strong nitric acid and carbon plates. These carbon plates are connected by metal wires. Thus the iron acted on by the dilute acid is the analogue of the zinc in an ordinary battery, and the carbon in the nitric acid is the analogue of the carbon in a Bunsen cell.

3778. Actuating and Opening Window Sashes, *W. Leggott, Bradford.—30th August*, 1881. 6*d*.

This relates to means for raising and lowering window sashes without the use of cords and weights, and also to enable them to be turned so as to bring the outside of the window inside the room, and when so turned the sash may be raised to bring it almost vertical. The sashes are provided with racks on each side, actuated by toothed pinions so as to raise and lower them, and they are pivotted at the bottom to the racks, the top end being secured by sliding bolts, which, when disengaged, permit the sashes to turn inwards, after which, by raising the racks, the sashes can be brought into a nearly vertical position.

3799. Improvements in the Construction and Manufacture of Electric Lamps, *W. Crookes, F.R.S., London.—31st August*, 1881. 6*d*.

This relates to incandescent lamps. Having blown his glass globe, the inventor, while the neck is still hot, presses the end inwards with a two-pointed metal tool like a fork, so as to make a hollow projection into the neck, terminating in two hollow points of glass. A small glass tube is attached to one of these, by which the lamp can be exhausted. The neck is then cut in two, and the two points are opened so as to admit of the conducting wires being passed through and sealed in each of the projections by means of white enamel or arsenic glass. Each wire has a small cylinder of glass sealed to it, before it is passed through, so that glass is sealed to glass. The carbon is now attached to the wires, and the two portions of the neck are sealed together again. The lamp is then exhausted by the small tube mentioned above. To overcome the difficulty of joining glass and metal, other than platinum, or the cracking of the glass produced by using thin platinum wires, the inventor uses a compound wire, having a core of copper and a platinum sheathing. The inventor tests his carbons in an exhausted receiver, into which, should one or more be below the standard, a hydrocarbon of some kind can be introduced, by means of which the carbon will be thickened.

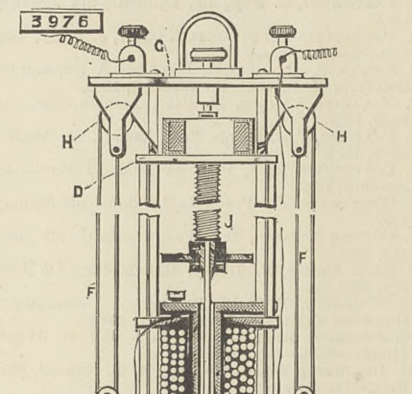
3956. Manufacturing Plates, Girders, and the like, by Hot Rolling Iron or Steel, &c., *J. Larue, Paris.—13th September*, 1881. 6*d*.

The iron is passed through rolls having the desired form of lattice work cut into them, so that the girders produced consist of lattice work with thin panels between, which can afterwards be removed by punching and stamping if desired.

3976. Improvements in Electric Arc Lamps, *P. Jensen, London.—14th September*, 1881.—(*A communication from A. J. B. Cance, Paris.*) 6*d*.

This is a continuous current lamp, though it can be converted into one for alternate currents. The lower carbon is regulated by the pulleys and cords shown. One end of cord F is fastened to plate G, having a hook for suspending the lamp, and the other end

3976



passes round pulley H, fixed to the base plate, and is fixed to upper cross bar D, uniting side rods of upper carbon holder. Cross bar D forms a movable weight, and has a receptacle for shot. D constantly tends to descend, and thus causes screw J to turn, so that the lower carbon is pulled up by cords F, while the upper carbon by the turning of screw J is made to descend. The electro-magnet and solenoid core shown are placed in the lamp circuit, and serve to start the arc and regulate it also.

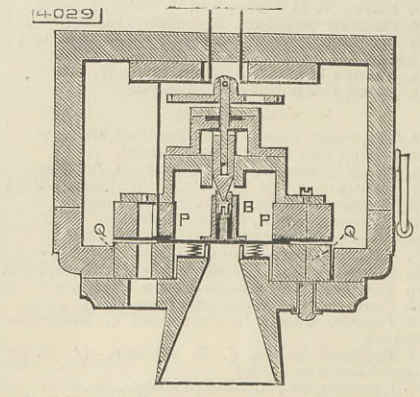
3984. Pitch Chains, *A. H. Wallis, Basingstoke.—15th September*, 1881. 6*d*.

This relates to a chain consisting of equal and symmetrical links that can be readily put together and taken apart, such links being secured against lateral opening resulting from strain, and when desired being provided with means of taking up slackness resulting from wear. Each link consists of a tubular boss with two fork arms projecting from it. Through the boss is a plain hole to receive a pin, and in the arms are elongated holes or slots, in each of which are internally projecting ribs extending from the front end of the slot to about half way backwards, the pin being recessed to receive the ribs. The links are put together by placing one at right angles to the other, with the hole in the boss of the slot in the arms coinciding, the pin is then introduced, and when the link is turned straight the ribs in the slot engage with the recesses in the pin. To take up slack the hole in the boss is made of hexagonal form at one end, and a bush introduced between it and the top of the pin.

4029. A New Construction of Telephone Transmitter, *S. Pitt, Sutton, Surrey.—19th September*, 1881.—(*A communication from H. Machalski, Lemberg, Austria.*) 6*d*.

This relates to a battery telephone in which graphite in a powdered state is used. The construction is as follows:—The vibrating plate is made of a thin sheet of iron or other similar metal, in the centre of which is attached by gum a small tube B of elastic gum; within this is a second small tube, filled with pure pulverised graphite moderately compressed. The tube is closed by a metallic plug, the diameter of which enlarges as it enters the tube, as its upper end is a conical hollow. Its base is also cylindrical, and contains a cylindrical cavity; upon this reduced end a

4029



small piece of elastic gum tube is applied, having the same height and exterior diameter equal to that of the plug. The plate with these accessories is placed between two rings P and Q. Between the plate and one of the rings a very thin conducting wire is placed, the other end of which goes to the holder. The figure will explain the arrangement of the apparatus.

4058. Improvements in and Relating to Electrical Cables or Lines for Telegraphic, Telephonic, and other Purposes, *H. H. Lake, London.—20th September*, 1881.—(*A communication from B. J. Henck, jun., Boston, U.S.*) 6*d*.

The object of this invention is to overcome the retardation of electrical signals in long cables or lines. This the inventor accomplishes by causing the various sections of his cable or line to overlap one another in such a manner that a charge of electricity entering upon one section immediately begins to produce its inductive effect upon the next section, and so on.

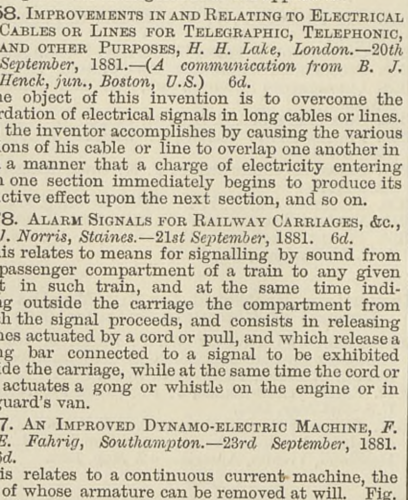
4078. Alarm Signals for Railway Carriages, &c., *J. Norris, Staines.—21st September*, 1881. 6*d*.

This relates to means for signalling by sound from any passenger compartment of a train to any given point in such train, and at the same time indicating outside the carriage the compartment from which the signal proceeds, and consists in releasing catches actuated by a cord or pull, and which release a spring bar connected to a signal to be exhibited outside the carriage, while at the same time the cord or pull actuates a gong or whistle on the engine or in the guard's van.

4107. An Improved Dynamo-electric Machine, *F. E. Fahrig, Southampton.—23rd September*, 1881. 6*d*.

This relates to a continuous current machine, the coils of whose armature can be removed at will. Fig. 1 is a side elevation. The magnetic field is composed of magnets A. To the poles of each two upper and two lower magnets are attached by means of countersunk screws received in holes tapped in the cores, heavy semicircular pole pieces N S S N of malleable

4107



cast iron, which letters indicate their polarity. The armature Fig. 2 consists of a number of transverse coils arranged round and parallel to the shaft, these being held in holes in pairs of segment-shaped plates, of which the annular frame of armature is built up. The coils are connected by wires, each with a metal strip of the collectors.

4117. Self-filling and Emptying Skeps or Buckets, *G. Allix, jun., Isle of Dogs.—24th September*, 1881. 6*d*.

This consists essentially in effecting the closing,

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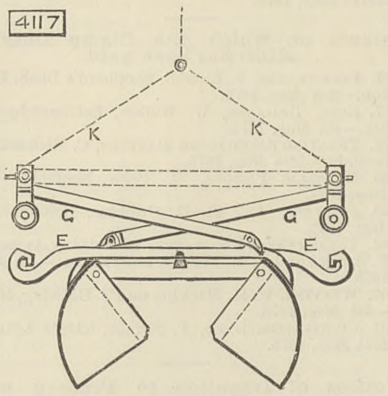

lifting, and opening of skeps, buckets, grabs, forks, or like apparatus by means of rigid bars E, hinged bars G, a tumbling saddle, worked by a chain K.

4124. Operating Switches, Signals, and Barriers on Railways, *H. J. Haddan, Kensington.—24th September*, 1881.—(*A communication from Dr. H. Aron, Berlin.*) 1*s*.

This relates to switches, &c., which are controlled from a common centre by hydraulic pressure, a simple pressure of the hand on a lever sufficing to operate the said appliance. So as to secure switches and barriers in the position they are intended to take, a pneumatic accumulator or air vessel is combined with this system, and may be common to all the apparatus of one system, and which begins to act only in the last moment of the depression of the lever, thus allowing a train to pass over the switch independently from the lever, and causing the switch to automatically assume its former position after the passage of the train. The accumulator also compensates for the expansion of the liquid through temperature and small losses of the liquid. The hand lever is placed between two hydraulic cylinders, with the pistons of which it is connected, so that when depressed to the right or left one piston is up while the other is down. Before either piston reaches its lowest position it depresses the stem of the valve and opens communication with the accumulator.

4128. Improvements in the Methods and Apparatus for Distributing and Regulating the Transmission of Electrical Power, *J. Imray, London.—24th September*, 1881.—(*A communication from M. Duprez and J. Carpentier, Paris.*) 6*d*.

This invention consists in the regulation of the transmission of power by electricity. Where a number of machines or lights are worked from the main circuit, the use or disuse of one or more affects all the others. To provide against this, the inventors, instead of connecting each of the lights or machines directly to the circuit, connect each of them to one of two secondary batteries which has been charged from the main circuit, the other of the two in the meantime receiving its charge from the circuit so as to be ready for use when the former is exhausted. The patent is illustrated by diagrams of the connections necessary to carry out the invention, the kind of commutator employed, &c. Other means of regulating the current from dynamos are described, consisting principally in the combination of two machines so that the one regulates the other.

4138. Filling Bottles or Vessels with Aerated Liquids, &c., *A. M. Davis and H. des Forges, Westminster.—26th September*, 1881. 8*d*.

The liquid is admitted near the bottom of the bottle. The apparatus consists of a pipe leading from the aerated liquid cylinder and fitted with a cock at the end, on the nozzle of which is fixed a nipple through which a tube passes, and can be raised or lowered by a lever. This tube has a hole at its upper end, which, when the tube is moved down inside the bottle—the mouth of which fits on to the nipple—first opens communication with the top end of the aerated liquid cylinder, and when moved still further downwards opens communication with the bottom end of such cylinder which contains the liquid. The passage of the pipe also communicates with an escape valve.

4141. Supplying Lamps with Petroleum and other Oil, *J. Wilby, Barnsley.—26th September*, 1881. 4*d*.

The object is to supply lamps with oil in regular and uniform quantities without disturbing the lamps or interfering with the wicks, and it consists in employing an oil vessel with a valve placed in an elevated position above the lamps, such vessel being connected to a second vessel fitted with tubes leading to the lamps.

4146. Artificial Fishing Baits, *G. Burt, Birmingham.—26th September*, 1881. 6*d*.

This consists in artificial spinning or trolling baits with hooks governed by springs, so arranged that the hooks concealed within the body of the bait are only protruded when the fish is struck. The hooks are formed with cranked heads, and the springs bear on the cranks, so that when the fish is struck the hooks are thrown out and are returned within the bait when the fish is missed. To prevent the bait catching in weeds a cover is attached to the line and fits over the nose of the bait.

4165. Improvements in Telephone Exchange Apparatus and Systems, *E. de Pass, London.—27th September*, 1881.—(*A communication from F. Shaw, New York, and W. A. Childs, Englewood, New Jersey, U.S.*)—(*Not proceeded with.*) 4*d*.

This relates to improvements in switchboards whereby space and expense as well as time are saved, and consists in reducing their size so as to put them under the control of fewer operations than at present.

4174. Improvements in Electric Lamps and the Manufacture thereof, *E. G. Brewer, London.—27th September*, 1881.—(*A communication from T. A. Edison, Menlo Park, New Jersey, U.S.*) 8*d*.

Part of this invention refers to a cheaper method of providing the neck of incandescent lamps with the collar for attaching the lamp to its socket support. This is done by dropping the metal rings of the collar into a mould, wires being first soldered to the inner surface of such rings, which are arranged to project upwards on opposite sides of the mould. The wires of the lamp are bent up in opposite sides of its neck, and the lamp is dropped into the centre of the mould and held upright there. The wire ends of lamp and collar rings are twisted together and turned down

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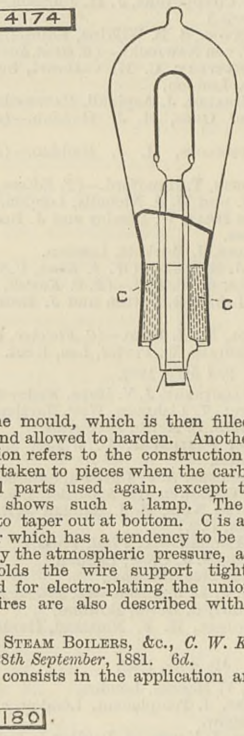

into the mould, which is then filled with plaster of Paris and allowed to harden. Another portion of the invention refers to the construction of a lamp which can be taken to pieces when the carbon is destroyed, and all parts used again, except the carbon. The figure shows such a lamp. The glass globe is made to taper out at bottom. C is a tapering rubber stopper which has a tendency to be pressed into the globe by the atmospheric pressure, and which therefore holds the wire support tight. The methods adopted for electro-plating the union of the carbon and wires are also described with other improvements.

4180. Steam Boilers, &c., *C. W. King, Manchester.—28th September*, 1881. 6*d*.

This consists in the application and use of water

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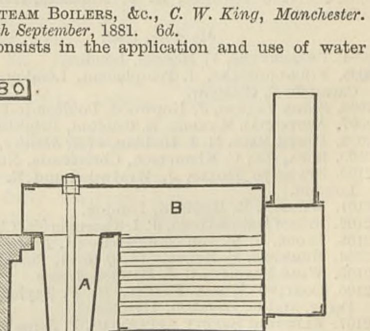

tubes or chambers A, which tubes or chambers are connected to the boiler B, and are placed within the combustion chamber or fireplace C of steam boilers.

4184. Printers' Type, *W. R. Lake, London.—28th September*, 1881.—(*A communication from J. E. Perrachon, Lyons.*) 6*d*.

This relates to machines for manufacturing printers' type from copper, iron, or steel. A band of copper or other metal is led from a drum and passes between four rollers, the distance between which may be varied, and the other two vertically, the band being straightened as it passes through them. The end of the band is then led to a matrix for stamping the character, and is held firmly while pressure is applied to the matrix. A cutting device then severs the necessary length off the band, and the operation is repeated.

4188. OUTSIDE SPANISH SUN BLINDS, *G. Hatton, Southport.*—29*th September*, 1881. 6*d.*

This relates to means for raising and lowering Spanish sun blinds by actuating a single cord, so that the blind when lowered presents a full bonnet with wings, which automatically assumes the desired position, and which when raised is wound on a roller and drawn out of sight under the usual housing. The top of the blind is fastened to a roller provided with an operating cord, and the bottom to a falling frame which forms the bonnet frame. The wings are attached to this frame and also to the under one of two confining rollers between which the blind passes. The falling frame is pivotted near the bottom of slides moving on guides, and the confining rollers are fas ened near the top of such slides.

4189. STEAM WINCHES, *E. Latham, Birkenhead.*—29*th September*, 1881. 6*d.*

This winch consists essentially of a strong framework B carrying two steam cylinders C with pistons and rods D. The said rods are attached to a lever E free to rock on a supporting or carrying link N. A connecting rod O couples each lever with a disc crank secured to each end of the axle carrying the winding or

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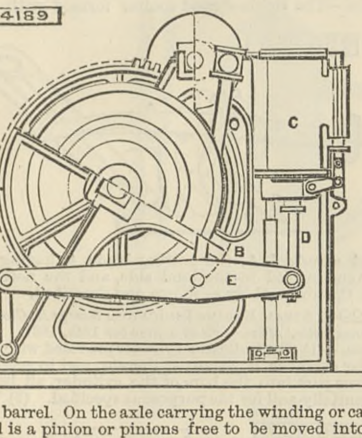

cargo barrel. On the axle carrying the winding or cargo barrel is a pinion or pinions free to be moved into or out of gear with a spur wheel or spur wheels secured to a shaft or shafts. The said shaft or shafts is fitted or provided with one or more warping ends, and may also carry a winding barrel or winding barrels.

4191. GAS COOKING AND HEATING STOVES, &c., *G. J. Cox, Maidstone.*—29*th September*, 1881. 8*d.*

This relates partly to improvements on patent No. 2636, A.D. 1881, and consists, First, in making provision in cooking stoves to receive the dripping made in roasting; Secondly, in making the division plates forming the spaces through which air for supporting combustion of gas is required to travel of asbestos, cloth, or other good non-conductor of heat; also to paint, japan, or enamel any of these plates so to reflect back radiant heat; Thirdly, in substituting for the double exit flue with bright radiating surface fire-clay tiles corrugated or plain on one side, with their surfaces sunk or flat; Fourthly, in utilising the heated exit current by causing it to pass through a water cistern; Fifthly, in suspending a fire brick over the burner of reflecting cooking stoves; Sixthly, in making the tubular burner running round the bottom of the closed stove all in one piece, dispensing with an air ball, and combining therewith a compound burner supply, so as to be able to supply three distinct and definite quantities to the burner at will. The invention also relates to an improved stove with instantaneous water heater, a burner to be used therewith, and an improved gas griller.

4193. IMPROVEMENTS IN ELECTRIC LAMPS, *C. H. Gimingham, Newcastle-on-Tyne.*—29*th September*, 1881. 4*d.*

This relates to a mode of fixing the carbons of incandescent lamps. The inventor flattens out the ends of the platinum or metal connecting the carbon with the conductors, then forms the flattened ends into tubes by drawing through a wire plate, and inserts the ends of the carbon in such tubes.

4196. AGGLOMERATING OR CONSOLIDATING SCRAP IRON OR STEEL, *W. R. Lake, London* —29*th September*, 1881.—(*A communication from H. Reusch, Germany.*) 6*d.*

This relates to the treatment of small particles of waste iron and steel by subjecting them to a reducing frame in a furnace until red hot, when they are spread out evenly and compressed by strong pressure into bloom plates or flat pieces of quadrangular form. The welding process is facilitated by impregnating the bloom with alkaline silicates.

4199. PROTECTOR FOR GLASS BOTTLES, *A. Michel, Brussels.*—29*th September*, 1881. —(*Not proceeded with.*) 4*d.*

A number of arms are joined together at one end and at the other are connected by a ring, the whole being made of caoutchouc, if necessary strengthened with metal, and forming an elastic frame, and to fit over and protect bottles.

4202. IMPROVEMENTS IN AND RELATING TO INCANDESCENT ELECTRIC LAMPS, *J. W. Swan, Newcastle-on-Tyne.*—29*th September*, 1881. 4*d.*

This relates to the welding together of the platinum sockets and carbon filaments by means of a deposit of hard carbon. Having shaped the sockets so as to receive the carbon filament, the inventor attaches them to a short stem of glass rod by fusion. He then inserts the carbon filaments into the sockets. The carbons, except in the immediate neighbourhood of the sockets, are copper electro-plated; they are then washed and dried, and immersed in a bath of some suitable liquor which will deposit carbon by the action of heat, and while thus immersed an electric current is sent through them, so that the sockets and parts not electro-plated are thickly coated with carbon, and the socket and carbon thoroughly welded together. To deposit the carbon exactly where wanted the inventor immerses the carbons in a bath of mercury nearly up to the point where it is required to deposit the carbon.

4207. IMPROVEMENTS IN DYNAMO-ELECTRIC MACHINES, *C. A. Barlow, Lancaster.*—29*th September*, 1881.—(*A communication from A. de Meritens, Paris.*) 6*d.*

This relates to a continuous current magneto-electric machine. It is composed of two magnetiser clusters of horseshoe form, each cluster having two arms, formed of sixty-four plates, which are arranged in a curve, so that their inner surface is equidistant from the periphery of the armature. The magnet carrier is of bronze, and the arms of the magnet pass through openings in it. The second magnet carrier is of cast iron, and forms the base plate or magnetic yoke, common to all the clusters. Outside the bronze carrier, on the driving shaft, is a ring containing sixteen bobbins of soft sheet iron, each of which contains four separate small bobbins wound with wire. The collector is composed of sixty-four plates of copper. The indicators of the machine are made of two clusters of permanent horseshoe magnets, the four poles of which form an almost complete circle. The brushes are carried in an adjustable frame. The inventor claims the base plate or magnetic yoke, improved collector and bobbins, and frame for carrying brushes.

4232. WATCH WINDERS AND REGULATORS, *H. J. Haddan, Kensington.*—30*th September*, 1881.—(*A communication from B. Etcheverry, France.*) 4*d.*

A pusher is used both for winding and regulating, and is so fixed as to be capable of being pulled out far enough to touch a lever below, and by a quarter turn from right to left, and pushing the pusher back, its teeth gear into the minute wheel, and act on the hands. The pusher is pushed until the hands cease to turn, and by an inverse motion the pin of the pusher is made to touch the lever from above; the pusher is pushed again, and its teeth gear into the minute wheel, and cause the hands to move. For winding the pusher is pulled, and at the same time turned a quarter of circle, whereby an abutment on it becomes parallel to the plane of the lever; the lever is depressed, and a pawl acts upon a ratchet and upon the axle of the barrel or drum on which it is fixed.

4234. TREATMENT OF INDIA-RUBBER, &c., *H. J. Haddan, Kensington.*—30*th September*, 1881.—(*A communication from Dr. U. Kreusler, Germany, and Dr. E. Budde, Rome.*)—(*Void.*) 4*d.*

The principle of the process consists in saturating india-rubber with paraffine, whereby it is rendered more durable, especially against chemicals.

4235. PUMPS, *H. J. Haddan, Kensington.*—30*th September*, 1881.—(*A communication from Capt. C. Arentsen, Norway.*)—(*Void.*) 2*d.*

This consists in rendering pumps more efficient by applying two pistons to each instead of one, such pistons being actuated so as to alternately approach and recede from each other.

4236. STEAM GENERATOR INCRUSTATION PREVENTIVE, *H. J. Haddan, Kensington.*—30*th September*, 1881.—(*A communication from J. F. Baudet, France.*)—(*Not proceeded with.*) 2*d.*

1500 grammes of hyposulphite of soda, 1000 grammes of rain water, and 1000 grammes of crude glycerine are mixed together, and the mixture added to the water in the boiler.

4237. APPARATUS FOR MIXING FLOUR, *H. J. Haddan, Kensington.*—30*th September*, 1881.—(*A communication from C. le Mee, Yffiniac, France.*) 6*d.*

This consists in the combination of rakes and mixing chambers, distributors and distributing chambers, an endless screw revolving in its channel, together with delivery helices and driving and controlling mechanism.

4238. PROTECTING LOCOMOTIVE ENGINES AND TRAINS FROM DAMAGE BY COLLISION, &c., *C. Colwell, Southtown.*—30*th September*, 1881. 6*d.*

This relates to apparatus for protecting locomotives from the first shock by collision, and is placed in front of the engine and coupled thereto, and it consists of a frame carrying a set of cylinders for each buffer, communicating by pipes. In the lower cylinder of each set move pistons connected to buffers, the cylinders containing water supplied from reservoirs on the frame by pipes leading to the sides of the piston. The upper cylinders are provided with air holders.

4239. SELF-COMPENSATING PRESSURE REGULATING APPARATUS FOR GAS, WATER, &c., *J. C. Stevenson, Liverpool.*—30*th September*, 1881.—(*Not proceeded with.*) 2*d.*

The object is to regulate the flow of fluid into a main so as to produce a constant pressure, and it consists in providing the main with two unequal branch openings, between which is a fulcrum carrying a lever extending right and left across the openings, both of which are closed by flexible diaphragms. The lesser opening at the inlet end is provided with a valve, the rod of which passes through the diaphragm and is secured to the lever, while a rod secured to the other diaphragm is also secured to such lever.

4240. CORRUGATED PLATES AND TUBES SUITABLE FOR THE USE OF BOILERMAKERS, *R. Armitage and T. Gillott, near Leeds.*—30*th September*, 1881. 8*d.*

Rectangular plates of suitable dimensions are heated and then subjected to the action of a pair of rolls grooved longitudinally, one roll being mounted in fixed bearings, and the other in bearings which are held in position by hydraulic apparatus. If intended to be made into tubes, the plates are re-heated and passed through rolls formed with transverse grooves.

4244. MOTOR ENGINES WORKED BY COMBUSTIBLE GASES OR VAPOURS AND STEAM, *C. D. Abel, London.*—30*th September*, 1881.—(*A communication from J. Spiel, Berlin.*) 1*s* 2*d.*

An arrangement is provided whereby the heat produced by the combustion is caused to heat a perforated metal sphere, into which water is then forced, and being converted into steam is utilised to assist in

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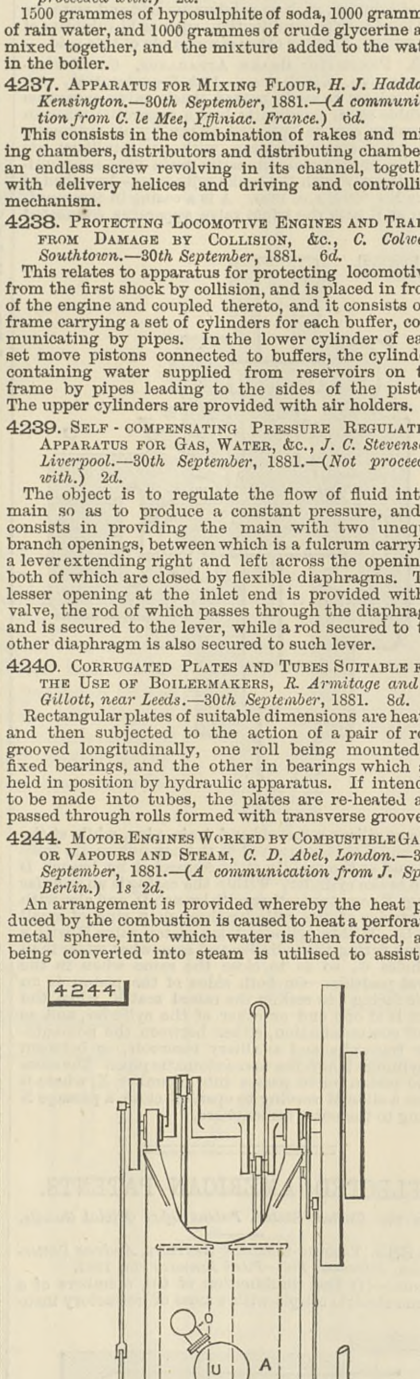

working the engine. Two cylinders A A are employed, in which the explosions take place alternately at every second revolution, being ignited through the valve X and pipe O. The gaseous charge, consisting of petroleum vapour and air, is produced by the spherical vessels U and Z, and is drawn in by the pistons and compressed. In the lower part of the cylinder is a perforated metal sphere, to which water is supplied to generate steam.

4245. ATTACHMENTS TO MILITARY SADDLES, &c., *E. Purdon, London.*—30*th September*, 1881.—(*Not proceeded with.*) 2*d.*

This relates to a curved arched bar fixed to the under flap of a saddle on each side, the two lower ends being connected by a girth strap. The rider's feet are held under the bar so as to give greater confidence.

4246. PURIFICATION OF HOPS FOR BREWING PURPOSES, &c., *A. Walker, Edinburgh.*—1*st October*, 1881.—(*A communication from J. Walker, Cincinnati, U.S.*) 6*d.*

This consists in steeping hops in water heated to about 100 deg. Fah. until the water enters the decaying portions and removes the same, while the resinous covering of the sound hops protects them from the water by resisting saturation.

4247. COUPLING AND UNCOUPLING RAILWAY WAGONS, *J. Jackson, Dumbarton, and T. Ballantyne, Lanark, N.B.*—1*st October*, 1881.—(*Not proceeded with.*) 2*d.*

This relates to crank bars secured to the wagons so that the links of the coupling chains may be raised for coupling or uncoupling the wagons, without having to get between them.

4251. FLOORCLOTH, *F. Versmann, Kent.*—1*st October*, 1881. 2*d.*

This consists in substituting a peculiar kind of moss peat, of genus sphagnum, for the cork dust or powder usually employed in the manufacture of floorcloth.

4252. ORNAMENTING SURFACES OF TIN-PLATE, &c., *A. N. Hopkins, Birmingham, and G. Hatton, Kidderminster.*—1*st October*, 1881. 4*d.*

The design is formed on the surface to be ornamented in glycerine, or gum and sugar, or glue and treacle, or other material capable of being dissolved in water, and the whole surface is then covered with a ground-work material, such as japan, colour, lacquer, &c., and the design removed by washing. Other methods are described.

4253. FEEDING FUEL TO FURNACES, &c., *J. McMillan, Glasgow.*—1*st October*, 1881. 8*d.*

The fuel-box A slides on guides parallel to the furnace bottom, in which an opening C is formed of the same size as the box, and beneath the opening is placed a dead plate B. The box A when moved for-

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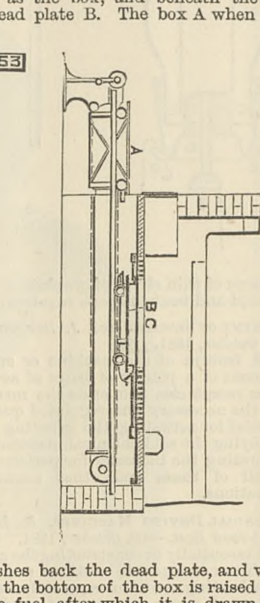

wards pushes back the dead plate, and when under opening C the bottom of the box is raised so as to discharge the fuel, after which it is drawn back again, bringing the dead plate under the opening. The box is automatically connected to and disengaged from the dead plate.

4269. SEWING MACHINES, *F. Cutlan, Cardiff.*—1*st October*, 1881. 6*d.*

he shaft working under the table is provided with a toothed wheel, into which gears a quadrant centred below said shaft. The lower part of the quadrant below this centre is provided with a roller working preferably in a grooved cam. On one side of toothed wheel which gears into the quadrant a shuttle carrier is attached, the said carrier carrying the shuttle. In action, on the needle coming down into position, the shuttle is thrown forward through the loop by the action of the quadrant on the toothed wheel, the said quadrant being operated by the cam. On the needle rising the shuttle returns to its normal position and the stitch is complet.

4270. CONSTRUCTING FOUNDATIONS FOR THE PIERS OF BRIDGES, &c., *E. A. Brydges, Berlin.*—1*st October*, 1881.—(*A communication from G. Gregersen, Budapest, Hungary.*)—(*Not proceeded with.*) 2*d.*

This relates to a pneumatic method of constructing foundations for the piers of bridges and other similar constructions, whereby double buckets are employed, and the raising and workmen's compartments are attached to the caisson.

4271. IMPROVEMENTS IN ELECTRO-MAGNETIC APPARATUS, *W. R. Lake, London.*—1*st October*, 1881.—(*A communication from A. D. Maikoff and N. de Kabath, Paris.*) 6*d.*

The inventor constructs his electro-magnets so that the core surrounded by the wire coil acts not as heretofore upon an exterior armature, but upon one placed within the coil.

4272. SCOURING AND WASHING WOOL, &c., *J. and W. McNaught, Rochdale.*—3*rd October*, 1881. 6*d.*

This relates to the combination with machines for scouring and washing wool of double or alternately-acting propelling rakes, and also their combination in such machines with double or alternately-acting harrows. The submerged material is delivered directly from the washing trough to a descent from which it passes to the squeezing rollers.

4273. GRINDING OF CAUSTIC SODA, &c., *R. H. Davis, Liverpool.*—3*rd October*, 1881.—(*Not proceeded with.*) 2*d.*

Great rapidity of grinding is ensured by use of Carr's disintegrator or other like machine which grinds by force of impact.

4274. STOWING AND LOWERING SHIPS' BOATS, *I. A. Timmis, Westminster.*—3*rd October*, 1881. 6*d.*

The invention consists in the stowing of ships' boats along the centre line, or nearly along the centre line, together with suitable means to run them or get them to either side of the ships carrying them.

4275. STEAM BOILERS, *J. L. Rastrick, London.*—3*rd October*, 1881. 6*d.*

Instead of forming the body A of the boiler and the descending chambers B as distinct and separate structures, which when completed are rivetted to-

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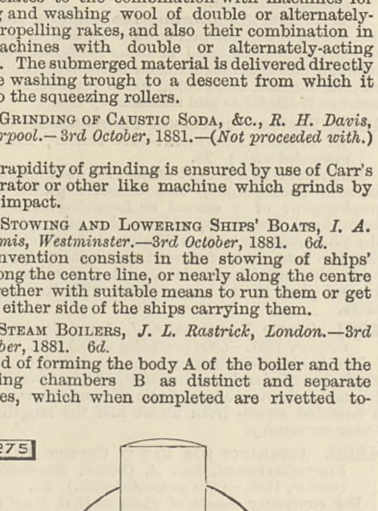

gether and communicate with each other by holes formed in a plate fixed between the two parts, each boiler is formed with a pair of descending water chambers B, formed in such manner that a single plate without joint or seam is presented to the fire, and the upper part and the body A of the boiler is formed cylindrical, but from about the centre A[1] of such cylinder the lower part of the boiler is divided into two parts, the inner sides of which are preferably formed as shown to curves similar to those of the body A, thereby producing two symmetrical portions, the sides of each of which approach each other at their lower parts and gradually merge into the descending water chambers B.

4276. STEAM BOILERS, *C. Pieper, Berlin.*—3*rd October*, 1881.—(*A communication from A. Knaudt, Essen, Prussia.*)—(*Not proceeded with.*) 2*d.*

The flue of a Cornish boiler is so arranged that its centre line lies sideward of the perpendicular plane laid through the centre line of the shell.

4277. MANUFACTURE OF A SUBSTANCE FOR INCORPORATING WITH VARIOUS ARTICLES OF FOOD, *E. J. T. Digby, Hammersmith.*—3*rd October*, 1881. 4*d.*

This consists in the preparation or manufacture of a substance of a suitable nature for compounding with farinaceous and other foods for human use, and with horse and cattle food, by subjecting oyster shells to a washing, chemical separation, grinding, and dressing treatment.

4278. SLIDING SEATS FOR BOATS, *H. Goatley, Oxford.* —3*rd October*, 1881.—(*Not proceeded with.*) 2*d.*

The runners are of lignum vitæ wood, two for each seat, which bear on glass at each end.

4288. GAS ENGINES *R. Simon and F. Wertenbruch, Nottingham.*—3*rd October*, 1881. 6*d.*

This consists in an improved form of cylinder and piston in combination with a new form of inlet and outlet valves for drawing in, compressing, and moving the gaseous charge to the part where the explosion is to take place, and then exhausting the products. When the trunk piston F travels outwards the charge passes into the cylinder through port T from port L, to which it is supplied by a rotating valve actuated by a governor, communication between ports L and T being established by moving the slide J by an excen-

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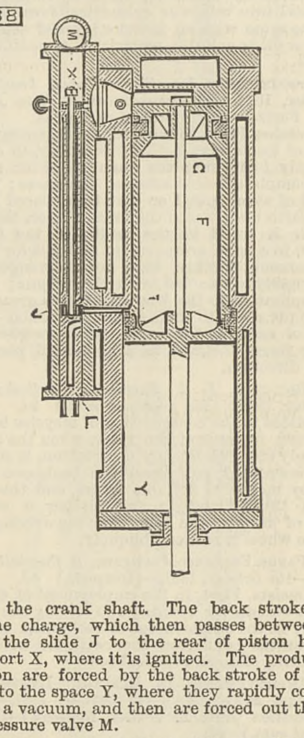

tric from the crank shaft. The back stroke compresses the charge, which then passes between the trunk of the slide J to the rear of piston head G through port X, where it is ignited. The products of combustion are forced by the back stroke of piston head G into the space Y, where they rapidly contract and form a vacuum, and then are forced out through a back-pressure valve M.

4291. SCISSORS, &c., *D. Peres, Solingen, Germany.*—4*th October*, 1881.—(*Not proceeded with.*) 2*d.*

This relates to the means for securing the two blades together. Each blade is provided with a slot and a stud, the stud of one blade projecting into the slot of the other. One stud is provided with a head.

4292. MALT LIQUORS, *A. E. Wood, Wavertree, Lancaster.*—4*th October*, 1881. 2*d.*

This consists in the use and application of salicylic acid in the preparation of malt liquors.

4294. IMPROVEMENTS IN THE MANUFACTURE OF INCANDESCENT ELECTRIC LAMPS, *A. G. Schaeffer, Newcastle-on-Tyne.*—4*th October*, 1881.—(*Not proceeded with.*) 2*d.*

This consists in introducing a platinum pipe into the glass globe through which the globe is exhausted, and which is closed up after exhaustion. It is also used as a support for the carbon and one of the conductors.

4295. STEAM ENGINES, *H. E. Newton, London.*—4*th October*, 1881.—(*A communication from J. Ericsson, New York.*) 6*d.*

This relates, First, to the connection between the connecting rods and piston of a steam engine, consisting of the combination of a pin in the said connecting rod, two discs, each having a slot or opening for the said connecting rod, and two half bearings for the said pins, and a screw follower for holding the said discs against a shoulder in the piston; Secondly, to

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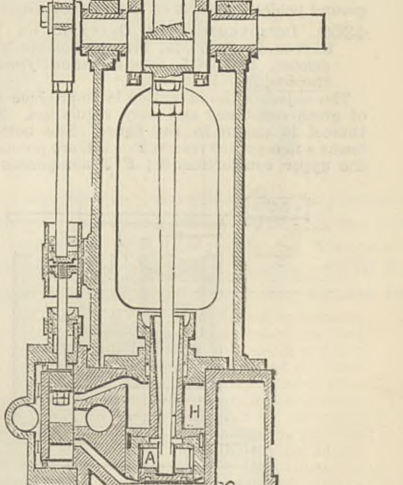


the combination with the piston, its trunk, or hollow piston rod and connecting rod and the pin A, discs C, and the follower D, forming the connection between the piston and connecting rod of an oil or grease reservoir H within the piston communicating with the interior of the trunk or hollow piston rod; Thirdly, to the combination with the crank wrist for operating the slide valve and the valve connecting rod having a slotted head, and having the lower half of the crank wrist box fitted to the slot in said head of a screw on the upper part of the said rod, and a nut or nuts on the said screw for setting up the said half of the said box; Fourthly, to a connection between the valve stem and its connecting rod of a steam engine and a guide for the said stem, consisting of the combination of a packed piston formed or secured on the valve stem, a joint pin connecting the said rod with the said piston and a stationary cylinder in which the said piston works, and which forms an oil reservoir.

4296. CONDUITS FOR TELEGRAPHIC CONDUCTORS LAID IN STREETS OR ROADWAYS, *C. D. Abel, London.—4th October*, 1881.—(*A communication from L. A. Brasseur and O. Dejaer, Brussels.*)—(*Not proceeded with.*) 2d.

The conduit is made of trough shape, open at top along its entire length, and is provided with a flanged cover fitting over it, the cover being either separate or hinged to the trough on one side.

4298. DEVICE FOR SECURING IN ITS PLACE A BOLT OR SIMILAR ARTICLE, *W. R. Lake, London.—4th October*, 1881.—(*A communication from G. B. Taylor, J. Wood, and B. S. Clark, U.S.*) 4d.

This relates to a device comprising a key or jib for locking or holding a bolt in its position, so that no jar or shake will cause the same to fall out, and it consists essentially in the peculiar construction of the key or jib, and its use in combination with a spring.

4299. FOUNTAIN PENS, *F. Wirth, Frankfort.—4th October*, 1881.—(*A communication from the Hannover Gummi Kamm Company, Hanover.*—(*Not proceeded with.*) 2d.

This relates to a fountain pen in which a rod serving for the purpose of clearing the tube from any objects that may clog the same, and to effect the closing and opening of passages for the ink.

4300. MANUFACTURE OF PIPES FOR CONVEYING WATER, GAS, &c., *F. des Voeux, London—4th October*, 1881.—(*A communication from M. Marx, New York.*) 6d.

This consists in the manufacture of pipes for conveying gas, water, and other fluids, by rolling smooth sheet metal into volute or cylindrical form and providing the same with an interior layer of asphaltum, cement, or other suitable material. A modification is described.

4301. LOCOMOTIVES, &c., *F. des Voeux, London.—4th October*, 1881.—(*A communication from J. F. E. Roy, Paris.*)—(*Not proceeded with.*) 4d.

This relates, First, to a novel arrangement of the furnace of locomotive boilers; Secondly, to a means for directly furnishing the quantity of air required for the complete combustion of the gases; Thirdly, to a hood of sheet metal or cast iron placed in front of the hearth underneath the furnace door, the length of which is equal to the width of the furnace; Fourthly, to a novel arrangement of stays for the roof of the furnace; Fifthly, to a novel arrangement of tender rigidly connected with the engine; Sixthly, to the application to the bearings and to grease-boxes with oblique slides in their vertical direction—for the purpose of causing the axles to converge—of two planes or forces inclined in a horizontal plane in an opposite direction.

4302. BICYCLES, *J. E. Surridge, Windlesham.—4th October*, 1881.—(*Not proceeded with.*) 2d.

This relates to the construction of bicycles by which the forward impetus of the rider, when the machine is suddenly stopped by any obstruction, is converted into a downward pull upon the backbone of the bicycle by means of suitable levers, and the risk of overturn thus obviated; and further a means is afforded of keeping the rider over the driving cranks when the wheel is turned obliquely.

4303. PAPER FOLDING MACHINES, *R. Cundall, Thornton.—4th October*, 1881.—(*Complete.*) 4d.

This consists, First, in the employment of right and left-hand screws for opening and closing the gauges; Secondly, in the employment of racks and segments and apparatus connected therewith for actuating a reciprocating slide and vertical rods.

4305. IMPROVEMENTS IN ELECTRIC LAMPS, *H. J. Haddan, Kensington.—4th October*, 1881.—(*A communication from L. Somzee, Brussels.*)—(*Not proceeded with.*) 2d.

This relates to the production of light by means of a thin carbon rod and a rod of refractory material, the light being produced by the incandescence of the carbon combined with the voltaic arc formed at the circumference of the rod of refractory material.

4306. CONSTRUCTION OF FURNACES AND KILNS, *G. Eyre, Codnor.—4th October*, 1881. 6d.

In each wall or lining of the fire-box or furnace are formed grooves or openings which are preferably narrow in the opening to the fire, widening preferably as they recede into the body of the wall or lining of the fire-box or furnace. These grooves or openings rise to a certain height in the furnace opening into same. The lower ends of these grooves or openings communicate with the ash-pit under the fire-bars.

4307. SERVING MALLETS AND BOARDS USED BY RIGGERS AND SAILORS, *W. Griffiths, Port Madoc.—4th October*, 1881.—(*Not proceeded with.*) 2d.

The mallet or board is rendered self-serving, thereby requiring only one person to use it, for which purpose the ball is given on the top through the rod or handle of the said mallet or board, and turns along therewith so as to pay off the yarn or service as required, or the ball may be given at the centre or round the handle itself.

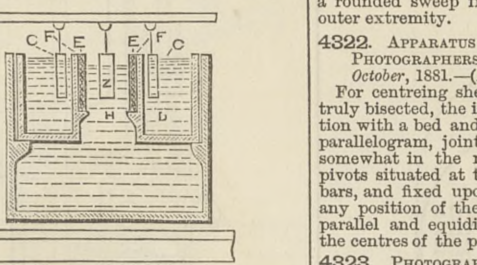
4308. SOLE PLATES FOR BOOTS AND SHOES AND CLOGS, *J. R. Alexander, Edinburgh.—4th October*, 1881.—(*Not proceeded with.*) 2d.

The sole plates are made of any suitable metal or composition of metals, or they may be made of gutta-percha or wearable composition, and cast in moulds in such a manner as to fit or lie close to or solid on the soles. They have on the part which treads on the ground projections cast on them to represent nails.

4309. IMPROVEMENTS IN GALVANIC OR ELECTRIC BATTERIES, *F. Wirth, Frankfort-on-the-Main.—4th October*, 1881.—(*A communication from Dr. J. Stebbins, New York.*) 6d.

The object of the invention is to produce a battery of great constancy and easy regulation. The form thereof is shown in the figure. The bottom of H forms a non-porous reservoir. E E are porous walls of the upper compartments; F F non-porous material

4309

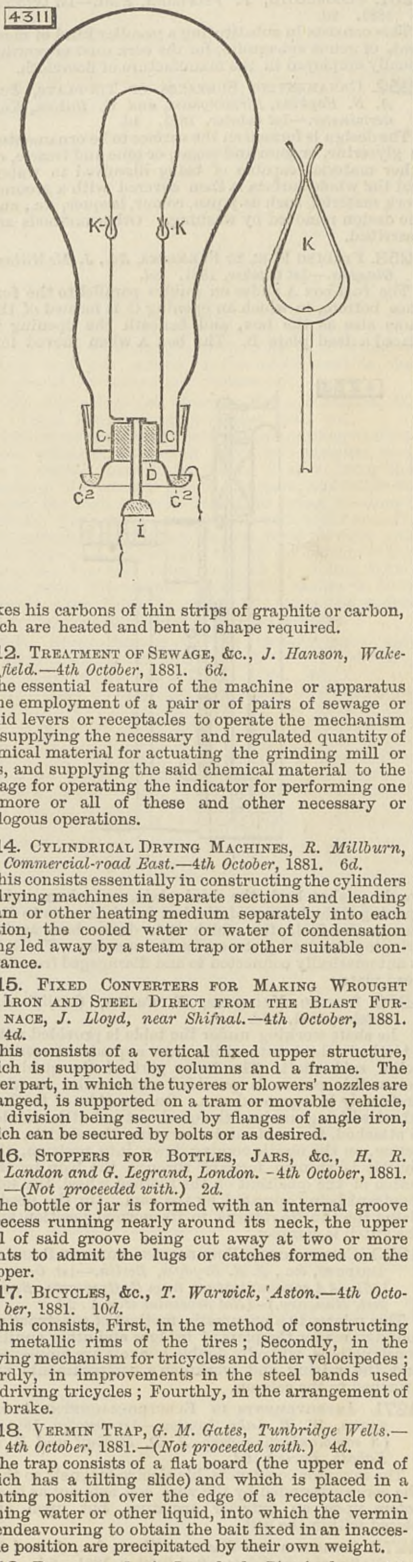


which can be adjusted to permit as much action as required to take place through E E. The letters D D represent non-porous cups, through the bottom of which is an opening Z to represent the zinc plate in dilute sulphuric acid, C C being carbon plates in a solution of bichromate of potassium.

4311. IMPROVEMENTS IN ELECTRIC LAMPS, *J. H. Johnson.—4th October*, 1881.—(*A communication from C. A. Faure, Paris.*) 6d.

This relates to incandescent lamps. The inventor fixes a metallic socket to the stem of the glass globe, by fusing said stem to the inside of the socket, or by electro-plating the stem, then turning the socket and soldering the latter on to the electro-plated deposit. The carbon holder consists of a metal tube C closed by glass plug D, the tube being splayed out into trough C^2, so as to contain a metal which fuses at a low temperature, to receive the outer edge of the socket so as to make an air-tight joint, the object being to enable the carbon holder and the carbon to be withdrawn by simply fusing the metal so as to unsolder the parts. The carbon holder C and socket form one conductor, and tube I forms the other. The carbon is secured between two spring clips K of platinum. The inventor

4311



makes his carbons of thin strips of graphite or carbon, which are heated and bent to shape required.

4312. TREATMENT OF SEWAGE, &c., *J. Hanson, Wakefield.—4th October*, 1881. 6d.

The essential feature of the machine or apparatus is the employment of a pair of pairs of sewage or liquid levers or receptacles to operate the mechanism for supplying the necessary and regulated quantity of chemical material for actuating the grinding mill or rolls, and supplying the said chemical material to the sewage for operating the indicator for performing one or more of all of these and other necessary or analogous operations.

4314. CYLINDRICAL DRYING MACHINES, *R. Millburn, Commercial-road East.—4th October*, 1881. 6d.

This consists essentially in constructing the cylinders of drying machines in separate sections and leading steam or other heating medium separately into each section, the cooled water or water of condensation being led away by a steam trap or other suitable contrivance.

4315. FIXED CONVERTERS FOR MAKING WROUGHT IRON AND STEEL DIRECT FROM THE BLAST FURNACE, *J. Lloyd, near Shifnal.—4th October*, 1881. 4d.

This consists of a vertical fixed upper structure, which is supported by columns and a frame. The lower part, in which the tuyeres or blowers' nozzles are arranged, is supported on a tram or movable vehicle, the division being secured by flanges of angle iron, which can be secured by bolts or as desired.

4316. STOPPERS FOR BOTTLES, JARS, &c., *H. R. Landon and G. Legrand, London.—4th October*, 1881.—(*Not proceeded with.*) 2d.

The bottle or jar is formed with an internal groove or recess running nearly around its neck, the upper wall of said groove being cut away at two or more points to admit the lugs or catches formed on the stopper.

4317. BICYCLES, &c., *T. Warwick, Aston.—4th October*, 1881. 10d.

This consists, First, in the method of constructing the metallic rims of the tires; Secondly, in the driving mechanism for tricycles and other velocipedes; Thirdly, in improvements in the steel bands used for driving tricycles; Fourthly, in the arrangement of the brake.

4318. VERMIN TRAP, *G. M. Gates, Tunbridge Wells.—4th October*, 1881.—(*Not proceeded with.*) 4d.

The trap consists of a flat board (the upper end of which has a tilting slide) and which is placed in a slanting position over the edge of a receptacle containing water or other liquid, into which the vermin in endeavouring to obtain the bait fixed in an inaccessible position are precipitated by their own weight.

4319. BICYCLES, *J. A. Lamplugh, Birmingham.—4th October*, 1881. 6d.

This consists in supporting the saddle or seat upon and fixing it to a strong band of leather or webbing, or a strong flexible band of other material, stretched between two brackets fixed on to the backbone of the bicycle, the said band being made capable of adjustment as it stretches and slackens by use.

4320. PORTABLE OR POCKET PHOTOGRAPHIC CAMERA, *W. Brookes, Manchester.—4th October*, 1881.—(*Not proceeded with.*) 2d.

This relates to a pocket camera for obtaining instantaneous photographs, and consists partly in the employment of a second or focussing lens of the same focal length as, and in the same plane with the photographic lens, and connected thereto, so that the two lenses are focussed simultaneously, the one upon the sensitised plate, and the other upon a ground glass in the same plane with the sensitised plate.

4321. SCREW PROPELLERS, *J. Jones, Liverpool.—5th October*, 1881.—(*Not proceeded with.*) 2d.

The blades, which may have a varying or uniform pitch, are of novel construction. They have the leading and following edges of the alternate ones cut off in a rounded sweep from about half the length to the outer extremity.

4322. APPARATUS FOR USE IN CUTTING GLASS FOR PHOTOGRAPHERS, &c., *A. Cowan, Bayswater.—5th October*, 1881.—(*Not proceeded with.*) 2d.

For centreing sheets of glass so that they may be truly bisected, the invention consists in the combination with a bed and flap of a frame in the form of a parallelogram, jointed at the corners and working, somewhat in the manner of a parallel rule, upon pivots situated at the middle of its top and bottom bars, and fixed upon the face of the bed, so that in any position of the frame the side bars are always parallel and equidistant from a line passing through the centres of the pivots.

4323. PHOTOGRAPHIC CHANGING BOX, *C. Sands, Leicester-square.—5th October*, 1881.—(*Not proceeded with.*) 2d.

The improvements consist in the arrangement of the opening and closing of the box and dark slide or back, and also the mode of constructing the carriers and fixing the plates in same, by which means one or more plates can be inserted or taken out at the same time.

4325. CLEANSING HOLLOW BOTTLES, *C. Davis, Mile-end, and H. T. Arthy, Brentwood.—5th October*, 1881.—(*Not proceeded with.*) 2d.

This consists essentially of a spring or springs, actuated upon by such mechanical arrangements that will cause such spring or springs to expand or to be released according to the will of the operator.

4326. STOP VALVES, COCKS, OR TAPS FOR STEAM, WATER, OR OTHER FLUID UNDER PRESSURE, *J. Margerison, Preston.—5th October*, 1881. 6d.

This consists in the manufacture of stop valves, cocks, or taps for steam or other fluid under pressure, in which the valve opens against the direct pressure of the water by means of a cam or lever pressing or pulling it off its seats.

4328. MANUFACTURE OF PAPER WIRES, &c., *M. M. Whiting, Manchester.—5th October*, 1881. 4d.

This consists in the use and application of either phosphor bronze or phosphorised bronze, and also the use and application of either phosphor brass or phosphorised brass applied to the purpose of fine wire drawing, and weaving into paper wire cloth or wire gauze from one mesh to the lineal inch up to one hundred and fifty meshes or more to the lineal inch.

4329. PROJECTILES FOR SMALL ARMS AND ORDNANCE, *H. Simon, Manchester.—5th October*, 1881.—(*A communication from F. Vetterli, Paris.*) 6d.

This consists, First, in providing the projectiles with a coating of nickel; and Secondly, in forming them with a projecting collar.

4333. CABINET WITH WASH BASIN AND URINAL BASIN COMBINED, *G. Nobes, Paddington.—5th October*, 1881.—(*Not proceeded with.*) 2d.

The object is to construct a cabinet with wash basin and urinal basin combined, the two articles being so arranged that the discharged contents of the first shall enter and flush the latter in order to deodorise and disinfect the surface of any atoms or moisture that may remain thereon or therein, and then discharge itself into a receptacle in which a further deodorisation and disinfection of the contents takes place.

4335. CONSTRUCTION OF HARBOURS, &c., *W. R. Kinipple, Westminster.—5th October*, 1881. 10d.

This consists, First, in the construction of harbours, breakwaters, docks, and other submerged or partly submerged structures of plastic concrete; Secondly, in the arrangement and construction of movable and adjustable casings for enabling breakwaters and other submarine or submerged works to be constructed.

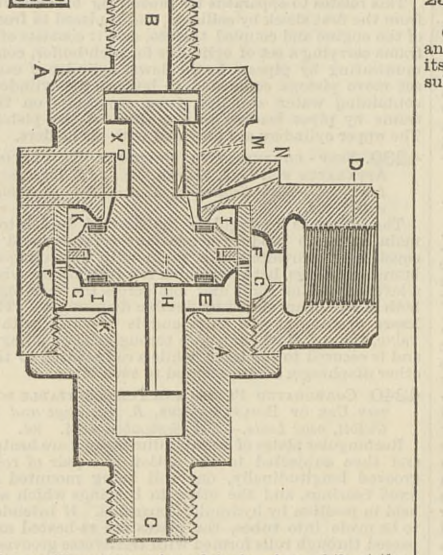
4336. TREATING RAW HIDES, *D. R. S. Galbraith, Edinburgh.—5th October*, 1881. 2d.

The raw hides are treated with sulphurous acid in a state of solution, such as sulphurous acid and water or other liquid, or in combination, such as bi-sulphites of soda, potash, lime, or other compounds of this acid.

5058. PNEUMATIC BRAKE APPARATUS, *G. Westinghouse, jun., King's Cross.—18th November*, 1881. 6d.

This relates to an improved check valve apparatus applicable to all pneumatic brake apparatus wherein the brakes can be operated either by an automatic train pipe communicating with an auxiliary air reservoir, or by a non-automatic train pipe communicating directly with the brake cylinder, as described in patent No. 5129, A.D. 1880. A is a casing in communication at B with the triple valve apparatus connected

5058



to the auxiliary reservoir and train pipe, while at the other end C it is connected to the non-automatic train pipe, and at the middle it is connected by branch D to the brake cylinder. Within the casing is an annular passage F communicating with branch D, and also with the interior of the cylinder through a ring of small holes G. Within cylinder E is a piston valve H with a packing fitting the cylinder and somewhat wider than the holes G, so as to close the same when in the central position. On both sides of the piston is an elastic facing I to rest on the raised seat K when the piston is at one end or other of the cylinder, and so cut off communication, either between the non-automatic train pipe and auxiliary reservoir, or between the cylinder E and the non-automatic pipe. The stem of the piston valve passes into chamber X, where it carries a slide M serving to open or close a passage N leading to the outer atmosphere.

SELECTED AMERICAN PATENTS.

From the United States' Patent Office Official Gazette.

255,885. THERMO-ELECTRIC BATTERY, *Andrew Patterson, Idlewood, Pa.—Filed January 9th*, 1882.

Claim.—(1) The combination of the members of a thermo-electric couple with a mass of refractory insu-

255.885

lating materials in which they are embedded, whereby fusible or oxidable materials may be used for the couple without injury from fusion or oxidation, substantially as described and set forth.

256,028. FIELD ROLLER, *Andrew R. Moore, Charlotte, Mich.—Filed December 6th*, 1881.

Claim.—The combination, with the front frame C, provided with the plank E, of the rear frames C^1, the

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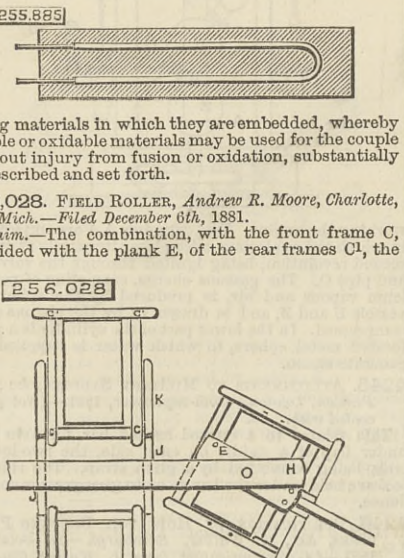

cross bars K, between which the rear frames are pivotted, the standards J, and the plank H, pivotted to the plank E and rigidly secured to the standards J and projecting in the rear of the said frames C^1, substantially as and for the purpose set forth.

256,055. COMPOUND ENGINES, *John B. Root, Port Chester, N.Y.—Filed October 9th*, 1880.

Claim.—(1) In a compound engine, the conduits E E, formed in the walls of the steam chest, in combination with the exhaust port B of the cylinder A, substanti-

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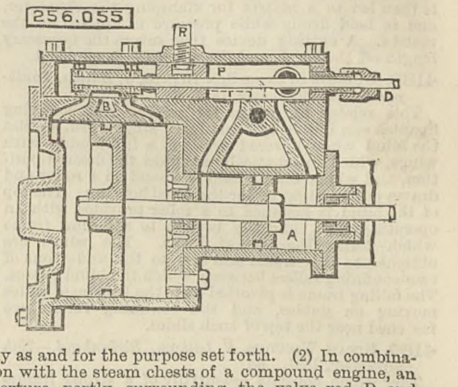

ally as and for the purpose set forth. (2) In combination with the steam chests of a compound engine, an aperture partly surrounding the valve rod D and adapted to receive steam packing, a plate P and screw R, substantially as and for the purpose set forth.

256,250. PLOUGH COULTER, *Morris A. Spink, Crown Point, Ind., assignor of one-half to Jacob A. Weis, same place.—Filed January 3rd*, 1882.

Claim.—The sickle-shaped coulter formed with the

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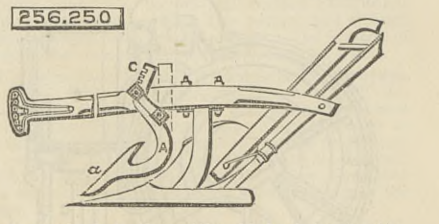

curved standard A, the cutting blade A, having its upper end curved to the land side, and the notched shank C, substantially as shown and described.

256,294. STEAM ENGINE INDICATOR, *George H. Crosby, Somerville, Mass.—Filed September 12th*, 1881.

Claim.—(1) The indicator cylinder provided with the annular chamber H, arranged therein, and to open at its lower part into the bore of the cylinder, all being substantially and for the purpose as specified. (2) The

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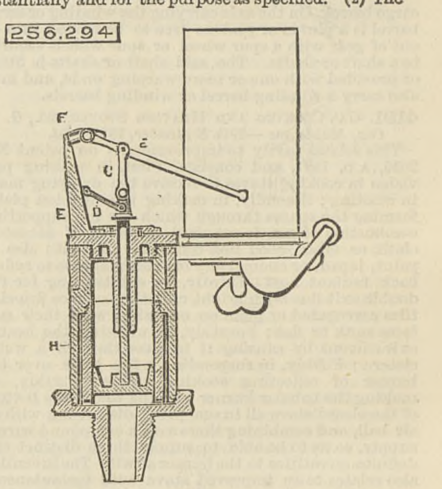

post E and its projection F, slotted as described, arranged and combined as set forth, with the marker lever E^1, connected with the piston by the lever C, having its shorter arm jointed to the said post by a link D, all being substantially as specified and represented.

CONTENTS.

THE ENGINEER, May 12th, 1882.

THE SMOKE ABATEMENT EXHIBITION.—A correspondent writes:—"This Exhibition was held at South Kensington from November last year up to February of the present year. May I ask through the *Times* why its awards are not yet published?"