THE NATIONAL EXPOSITION OF RAILWAY APPLIANCES.

No. I.

This Exhibition, which has just been held at Chicago, was probably the most complete collection of the varied apparatus used in the construction, working, and maintenance of American railways that had ever been brought together, and the promoters are to be congratulated that, while little was omitted to make the show complete, still less was included that was foreign to the subject in hand. The Exhibition was entirely a private enterprise, and was managed by gentlemen engaged in the sale and manufacture of various articles used on railways, the only person unconnected with the railway world being the president of the Executive Committee, the Hon. Lucius Fairchild, late United States Minister at Madrid, and formerly consul at Liverpool. The great bulk of the exhibits came naturally from the United States, Great Britain and Canada being the only foreign contributors. The British exhibition consisted mainly of two of George Stephenson's earliest locomotives, some wagon wheels, tires, &c., and of some interesting views of the original Liverpool and Manchester railway, and photographs of the more recent developments of English railway enterprise, the interests of the absent British exhibitors being very efficiently represented on the committee by Mr. G. D. Peters, of London. The protective policy of the United States probably deterred many English manufacturers from exhibiting, the heavy duties rendering it difficult, and in most cases, impossible, to sell imported productions at a profit, while the high price of American manufactures forms an effective barrier to their importation into this country. It is to be regretted that no relaxation of the customs' tariff was possible, as much might be mutually learnt from even a partial interchange of commodities between the two countries. For instance, a locomotive built by an English railway company might have been exhibited, and retained by an American railroad, who, in return, would send a Mogul or a Consolidation to England; and thus much might be learnt by direct comparison of the results of working under similar conditions.

The population of America is advancing westward so fast that Chicago is becoming a central instead of a western city. Its geographical position and enormous importance as a railway centre combine to make it a most appropriate site for a Railway Exhibition. Some seventeen distinct railway companies run trains into terminal stations at Chicago. Four of these companies, the Chicago, Milwaukee, and St. Paul, the Chicago, Burlington, and Quincy, the Chicago and North-Western, and the Wabash, St. Louis, and Pacific, each own, lease, or operate a system of over 3000 miles of road; the first-named owning no less than 4528 miles of line, which is being rapidly extended westward. In all, the seventeen companies represent nearly 31,000 miles of line, earning annually about £40,000,000; while the food products sent eastward for shipment by six of the Chicago railways weighed, during the first six months of this year, no less than 1,180,000 tons. This figure is better appreciated when it is found that, assuming the load of an average English goods train to be 80 tons, which is fairly correct, it would take 100 of our goods trains per twenty-four hours to transport this weight of food alone, the enormous local traffic and the timber, iron ore, &c., being left out of the question. It is probable that, as regards mileage and tonnage, the railways centreing in Chicago surpass those radiating from any other great city on the globe. The low traffic receipts, averaging only £25 per mile per week, are partly accounted for by the low rates for the conveyance of goods, and partly by the fact that many of the lines have been but recently opened for traffic. The growth of Chicago as a city is proverbial, but two simple facts will bear repetition. Fifty years ago Chicago was a village of twelve houses, to-day it contains 560,000 inhabitants. The great fire of October 8th, 1871, destroyed, with one exception, every house in an area of three and a-third square miles in the centre of the city, and rendered 98,500 persons homeless; yet to-day nearly every trace of its ravages is hidden by magnificent and costly buildings, the two largest hotels, the Palmer House, and the Grand Pacific, each representing an outlay of about £750,000.

The Exposition was held in the Inter-State Exhibition building, which is interesting as the scene of the Republican Convention of 1880, at which General Garfield was virtually elected President, and is singularly well situated, near the centre of the twelve mile frontage which Chicago presents to the lake, close to the business portion of the city and the principal hotels, and adjoining the stations of the Illinois Central and other railways. The main building is 800ft. long by 240ft. wide, with side galleries, round the edge of which ran an electric railway—the first of its kind in the States. All the locomotives and many of the cars were accommodated in temporary sheds, while the snow ploughs, refrigerator cars, steam shovels, and many of the systems of railway signalling were placed in an open yard between the lines of shedding. The exhibits covered an area of over 500,000 square feet, and the exhibitors numbered about 1000, many individual firms contributing some £15,000 or £20,000 worth of locomotives, cars, machine tools, &c.

Great praise is due to the exhibitors generally, as the whole success of the Exhibition was due to their endeavours, most of the exhibits being carefully chosen and admirably arranged. Unfortunately, their enterprise was somewhat marred by the insufficient preparations of those in charge, the Exhibition, to use an American phrase, being a bigger "boom" than had been anticipated. The managers were certainly somewhat taken by surprise at the unexpected magnitude of the task set before them, and their arrangements as regards making a classified catalogue and selecting juries to award prizes, scarcely bore the strain imposed upon them. The Exhibition was nominally open one month; but, as usual in affairs of this kind, many of the exhibitors were not ready at the opening day, and the Exhibition was really only in full working order for about a fortnight.

America is a country of sudden changes and rapid development, and many evidences of this fact were to be found in the Exposition. The bright and clear atmosphere of even the largest towns demands brilliant colours to satisfy the eye, but the gaudy bad taste so general in America a few years ago, has given way to an universal prevalence of ornament almost invariably of artistic design, and in excellent taste, which cannot fail to strike a visitor to the America of to-day. The locomotives which dazzled the eye with a confused mass of bright vermilion, and still brighter brass, the cars literally bespattered with meaningless gilding, and the machine tools, more remarkable for the number of eagles painted upon them than for the strength of their framing, have all disappeared. Sam Slick's famous clock, the dial of which was ornamented by angels carrying rifles, is a thing of the past, and the adoption of artistic and appropriate decoration, which has made great strides in England during the last few years, is still more universal in the States. The weak and flimsy proportions so common in American productions are also fast disappearing, and the locomotives, machine tools, rails, tires, sleepers, and many other appliances, already equal in strength corresponding appliances made in England, while the frail wooden bridges of former days have given place to magnificent iron or steel structures, most carefully and exactly made, and which seem, from their depth of truss, to err only in the direction of superfluous strength.

The Exposition was especially strong in the display of locomotives and rolling stock generally, though few striking departures from established practice were shown in these classes. Very little was exhibited as regards bridges or permanent way, and the numerous forms of chairs, keys, and iron sleepers, which would form a feature of a similar exhibition in this country, were conspicuous by their absence, which would seem to show that the Americans are well satisfied with their present system of steel Vignoles section rails, weighing about 67 lb. to the yard, and 2000 to 3000 hard wood sleepers, 8ft. long, per mile. The climate of the new south-western States, Arizona and New Mexico, now being opened up by the Southern Pacific, Aitchison, Topeka and Santa Fé, Denver and Rio Grande, and other lines is very unfavourable to the life of wooden sleepers, while, owing to the absence of suitable forests, the cost of timber is considerable, and it is therefore probable that a system of permanent way formed entirely of iron would present many advantages. The signals employed on the vast majority of American railways are extremely crude and defective, though the evil is somewhat mitigated by the clearness of the atmosphere, the intelligence of the drivers, and the very general use made of continuous brakes. It was therefore satisfactory to observe a very large display of signals and signalling apparatus, though many of the exhibits were little better than the defective forms in use. One inventor showed a model of a simple junction, which required the movement of four pairs of points to admit a train to the branch, while but one signal was exhibited, which served alike for both up and down main line, and up and down branch trains. This "system" (?) was highly spoken of by some prominent railway managers, though apparently it could only be safely worked by the driver of every train coming to a stand, and inquiring verbally whether the signal applied to him or not. Some most elaborate automatic electric signals were shown in which the train itself works protecting signals both in its rear, and in advance in the case of a single line. The Union Switch and Signal Company, of which Mr. George Westinghouse, the well-known inventor, is president, exhibited a great variety of different methods of working signals, including the Saxby and Farmer method of interlocking, the Sykes electric interlocking, and hydraulic and pneumatic methods of moving points and signals, valves moved by electricity admitting the water or air under pressure to suitable cylinders connected with the point and signal rods. The Pennsylvania Steel Company exhibited an American adaptation of Saxby and Farmer's interlocking apparatus, and several useful and simple devices for allowing points in yards to be protected by interlocking, and to be at the same time capable under certain conditions of being moved by hand. There can be little doubt that within the next few years a great revolution in railway signalling will take place in the United States, and that characteristically going from one extreme to the other with great rapidity, very elaborate systems will be extensively used. In New England and the more thickly populated Atlantic States, interlocking apparatus, double lines, improved stations, and fast express trains are rapidly coming into use, though in the matter of luxurious dining and sleeping cars, &c., the West leads the way—another illustration of the strange fact that the older part of America is more English in speech and customs than the newly settled West, where the proportion of British born inhabitants is higher.

The display of locomotives and rolling stock generally was very complete, and both in number and quality exceeded the exhibits at the Centennial or any previous exhibition nearer home. No less than twenty-seven locomotives were shown, seven being by one maker, the Brooks Locomotive Works, situated at Dunkirk, N.Y., formerly the repair shops of the too well-known Erie Railway. While no very important departures from established practice were shown, there was a noticeable general tendency to employ larger bearing surfaces, better material, more strongly proportioned parts, and a plain and simple exterior finish. But one example of the old style of American engine was exhibited, its vermilion wheels and chimney, polished frame, and bright brass dome and cylinder cleading standing out in marked contrast to its competitors, all clad in sober black, relieved by a little gilding, presenting a remarkably neat and dignified appearance, which might well be imitated on this side of the water. Russia or planished iron, which is here only seen on the Westinghouse pumps, is universally used in America for cleading boilers, and as it can neither blister nor change colour by heat, and being very smooth, is easily cleaned, it too might be found worth a trial by some of our enterprising English locomotive superintendents. Though screw reversing gear was not shown, several forms of steam reversing gear were exhibited, while metallic piston and valve rod packing is generally used, and many engines were fitted with balanced slide valves, a variety of which we hope to illustrate in a later number. Nearly every engine was fitted with glass oil cups on the rods and bars, worsted syphons being dispensed with, and a species of needle, permitting of an adjustable feed, being substituted. A driver can thus ascertain at a glance whether his oil cups require refilling or not, while if a bearing requires a more liberal supply of oil, the feed can be altered in an instant. Glass oil cups are of course more liable to breakage, but Americans generally—with a marked exception as regards the gentlemen who handle the baggage—are lighter handed than the proverbially horny fisted English driver, who would be much astonished to see an American *confrère* driving an express train, seated in a comfortably sprung arm chair, and equipped with a neat pair of stout gloves. As every true American rigorously avoids any unnecessary physical exertion, it need hardly be said that drivers and firemen are at perfect liberty to sit down whenever they like, provided the work is done; though on many lines, especially in the West, a visit to a drinking bar or saloon when off duty ensures dismissal. While it is not unusual for American employers to take note of their men's behaviour in their leisure hours, an amusing story, which is believed to be true, further illustrates the curious contrast to English ideas concerning discipline. A passenger train on a well-known line in the far west was crossing a chain of mountains, when the driver perceived some antelope. He stopped the train, and taking down a rifle which he happened to have with him in his cab, proceeded to stalk the antelope, the conductor and some of the passengers looking on. While thus engaged a mist came on somewhat suddenly, and a following freight ran into the rear of the standing train, damaging two cars, and injuring three passengers. The driver escaped with a reprimand.

The general tendency to use heavier and stronger parts is well shown in the matter of wheels and tires. Many railways are now using driving tires 4in. thick, while the wheels of the engine bogie are often steel-tired paper wheels in place of the far famed chilled wheel. The Allan paper wheel, which resembles in principle the Mansel wheel, is being also largely introduced under the better class of passenger cars, while various forms of wrought iron wheels are being tried under freight cars, and it appears probable that in a few years the chilled wheel will become a thing of the past. Owing to the partial exhaustion of the best ores, and the excessive use of re-melted wheels, quality has deteriorated, while the heavier loads carried demand a better instead of a worse wheel, and the use of steel-tired wheels with an elastic or non-metallic body under passenger cars is attended with such a saving in renewals and diminution of noise that their increased first cost is more than compensated.

The cars shown embraced nearly every variety of rolling stock now used in the United States—sleeping cars, hotel cars, parlour cars, private or officer's car, ordinary or first-class cars, emigrant sleeping cars, smoking cars, passenger baggage cars, postal cars, express cars, parcel vans, cabooses, *anglice* goods brake vans, covered box cars, cattle cars, high-sided cars, flat cars, tipping or dumping cars, refrigerator cars, ballast cars, track-laying cars, snow ploughs, breakdown cranes or wrecking cars, and last, not least, a most ingenious apparatus for recording graphically the inequalities of the track, showing low joints and even the relative qualities of rails from different makers.

The Chicago, Milwaukee, and St. Paul Railroad showed two cars, built by Harlan, Hollingsworth, and Co., fitted up and decorated with an amount of luxury and good taste, which well deserved the name of "Palace," one being a parlour car, fitted with revolving chairs and furnished with anterooms, lavatories, &c., and the other an hotel car, fitted with a complete little kitchen, wine and coal cellars, ice house, wine cooler, and every possible appliance to serve a luxurious and well-cooked meal. It may interest those of our readers who have not been in America to peruse the annexed bill of fare from an hotel car running between New York and Chicago, which gives some idea of the comfort attending a long railway journey in America:—

"New York and Chicago, Limited," Pennsylvania Railroad.

Breakfast.

Fruit.

Oolong tea. Green tea. Coffee. Chocolate.

Bread.

Vienna bread. Corn bread. Hot rolls.
Dry toast. Dipped toast. Boston brown bread.
Oatmeal mush.

Fish.

Broiled salt mackerel. Broiled white fish.

Fried.

Veal cutlet breaded. Calf's liver, with bacon.

Broiled.

Tenderloin steak, plain, with mushrooms, or tomato sauce.
Breakfast bacon. Ham.
Sirloin steak.
Mutton chops, plain or tomato sauce.

Eggs.

Boiled. Shirred.
Fried. Scrambled.
Omelets.

Vegetables.

Baked potatoes. Stewed potatoes. Fried potatoes.
Saratoga. Lyonnaise.

Meals, one dollar.

Hotel cars are commonly attached to a train early in the morning in time for the usual American breakfast hour, 7 a.m., and are knocked off at nightfall, having served the three usual meals during the day. The contrast between dining at leisure in one of these cars and scrambling through a meal at a railway refreshment room must be felt to be fully appreciated.

The Pullman Palace Car Company, which has now undertaken the manufacture of all varieties of rolling stock at their new works at Pullman, near Chicago, exhibited a great variety of sleeping and other cars. The former were conspicuous as usual for their very beautiful workmanship, the interior being composed of most elaborate inlaid work in the great variety of woods used in America; the chief novel feature was the addition of a small buffet to the sleeping car, enabling passengers to be served with a "chota hazree," or light breakfast, when, as is very generally the case, the car arrives at its destination about 8 a.m. The emigrant sleeping cars are chiefly intended for those settling in the new south-west country on the northern borders of Mexico, and are also used by the Northern and Canadian Pacific. The car is arranged as an ordinary Pullman sleeper, the top berth, however, being a species of tray, formed of slats of hard wood, while the lower berth is formed as usual by drawing out the seat, but is of wood and unpadded. The emigrants, like steerage passengers, are expected to provide their own bedding. The Paige Sleeping Car Company exhibited a new style of sleeping car which appears to possess many advantages, the sleeping berths being constructed and stowed away in a totally different manner to that adopted by the Pullman Car Company.

Messrs. Jackson and Sharp, of Wilmington, Del., exhibited a first-class or ordinary passenger car, which, without the elaborate inlaid work often seen, was a model of good taste and workmanship, and deservedly obtained a gold medal. The interior was panelled with bay wood or light coloured mahogany, hand carved with flowers, leaves, &c., in relief, every panel being different. The car was lit by compressed gas, and was fitted with many little contrivances to increase the comfort and convenience of passengers, and we hope to illustrate it and describe it at greater length in an early number.

The travelling post-offices exhibited were very conveniently arranged, and contained many ingenious contrivances for facilitating work, and enabling the same van to be adapted to varying requirements, while it was interesting to observe that the details differed in nearly every particular from those in use on English lines.

The vehicles for goods or freight traffic were chiefly remarkable for the enormous loads they were marked to carry—40,000 lb., or 18 tons, being now the usual car load, while 50,000 lb. is not unusual, and one car, with a third truck under the centre of the vehicle, was marked to carry, 70,000 lb. or 31¼ tons. This increase of load has taken place within the last few years, and has necessitated stronger axles, draw gear, and framing, though the length or cubic capacity of the vehicle has not been materially added to.

The long distances to which fruit and other perishable articles are transported, and the extreme heat of the American summer, render refrigerator cars a necessary part of the equipment of a first-class railway, and they are now extensively used for the transport of yeast, beer, meat, butter, and many other ordinary articles of food. A large number, differing in details, were exhibited at Chicago. The ordinary plan of making a car with sides, top, floor, and doors 7in. thick, of layers of felt and planking, and placing an ice chest just under the roof, is not found entirely satisfactory, and the various inventors aim at securing a dry cold, which will permit of no mildew, and preserve the most perishable article without injuring its quality or flavour.

The term "railway" is understood in America to include tramways, or street railways, and therefore several tram cars were shown, three being suited for the system of cable traction used in San Francisco, Chicago, and West Philadelphia; two cars were arranged on different principles as gripping cars, and one for the body of the train of cars was provided with side entrances near the centre of its length, one end being a smoking compartment, the other being for non-smokers, as usual.

The question of continuous brakes upon freight trains is exciting much attention in the United States, the present system of employing five or even more brakesmen riding on the cars and walking over the car roofs to apply the brakes being dangerous to life, costly in wages, and unsatisfactory and crude to the last degree. The Westinghouse Brake Company show a cheap application of their well-known automatic brake, while several inventors exhibit different forms of brakes operated by the action of the buffers; a principle that, properly worked out, has many good points. The Waldumer Electric Brake Company exhibit an automatic electric brake, which appears simple in construction, acts with full force when applied by the guard or the train parts in two, and can be readily graduated by the driver, and we propose to describe it fully in a later issue.

A very complete collection was shown of the various appliances used in America to save hand-labour in making a railway—the deep, even soil of the western prairies being very favourable to the use of machines which, of course, are not easily adapted to work in rock, or in a great variety of geological formations presenting materials for excavations having widely different properties. One machine, the New Era grader, was stated to be capable of "grading," or making light cuttings and embankments, with little or no hand labour. Two teams of horses were attached to the front and rear of a species of plough, which delivered its excavated furrow on an endless rubber band, which formed a travelling path running over rollers in the manner used in grain elevators. The rollers being connected by a frame projecting at right-angles to the path of the plough, any earth deposited on the rubber band was delivered sideways some fifteen or twenty feet, and formed a side spoil bank or an embankment, as the case might be.

The display of both wood and iron-working machinery was very complete, but was distinguished more by good workmanship, excellent design, and strong proportions than by any novelties. Some fine specimens of steel rails, tires, axles, plates, and sheets of American manufacture were exhibited, one rail measuring 130ft. in length, and one plate ⅝in. thick being 4ft. 8in. wide, and no less than 27ft. 2in. long; some excellent forgings, including many complicated forms, chiefly for car work, were shown by Wilson, Walker, and Co., of Pittsburgh, and a careful examination of the various products in steel and iron conveys the impression that America has little to learn from this country, and that her natural disadvantages in the great distance apart of iron ore, coal, and flux alone prevents competition with us in the matter of price. The wages, though higher per man, are no more per ton, while, as usual in America, an enormous product is turned out with a comparatively small plant.

The miscellaneous exhibits ranged over a very wide field, embracing oils, varnishes, upholstery, copying and writing inks, ticket cases, maps, tickets and passes, uniforms, desks, car fittings, locks, heating apparatus, car couplings, lamps, injectors, lubricators, tubes, surveying instruments, fencing, lock nuts, pumps, scales, testing machines, platelayers' lorries, springs, cranes, timber dryers for artificially seasoning timber, tube expanders, belting, culvert pipes, grain elevators, railway watches, wire rope, veneers, baggage checks, and a type writer. Any detailed notice of these and various other exhibits must be deferred to a later date.

THE INSTITUTION OF MECHANICAL ENGINEERS AT LIEGE.

During the recent meeting in Belgium of the Institution of Mechanical Engineers several interesting excursions were made, and by no means the least interesting was the visit to the glassworks of Val St. Lambert.

THE GLASSWORKS OF VAL ST. LAMBERT.

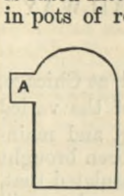
This is one of the largest glassworks in existence—entirely devoted to the production of domestic articles, such as tumblers, wine glasses, lamp chimneys, and suchlike. A good deal of ornamental work is also turned out, a staff of highly competent artists being employed in painting glass vases, &c., such as are used for the decoration of rooms.

The Val St. Lambert works stand on the right bank of the Meuse, in the commune of Seraing, and about seven and a-half miles from Liége. As the head offices of Cockerill's vast establishment are located in the old palace of the Bishops of Liége, so the Cristalleries of Val St. Lambert occupy the site of the Abbey de Rosières. Up to the year 1192 the site was almost a desert, but about that period the abbey was founded. In 1202 Hughes de Pierrepont, Bishop of Liége, gave to the monks a tract of land and woods situated in what was then called the Champ des Maures, whereon was built the abbey. It prospered and became powerful. At the end of the last century it was reconstructed, and at that time were raised the fine buildings now used as a manufactory. The re-building had hardly been finished when the Revolution came, and with it the expulsion of the monks. It was sold by the nation, and was used for various manufacturing purposes, until the year 1825, when it was purchased MM. by Kemlin and Lelièvre. There had previously existed, at Vonêche, near Givet, a glassworks carried on by M. d'Artigues, its owner, aided by M. Kemlin his nephew, and M. Aug. Lelièvre. This latter gentleman had left the Ecole Polytechnique of Paris with distinction, and was the son of Mr. Anselme de Lelièvre, Inspector-General of Mines, and a distinguished savant of the last century. MM. Kemlin and Lelièvre both became naturalised Frenchmen. However, the frontier traced by the Congress of Vienna for the new territory of Belgium cut Vonêche off from France. The glassworks accordingly lost their only market, cut off from it by a heavy tariff. M. d'Artigues left the place and went to France, while MM. Kemlin and Lelièvre found in the old Val St. Lambert Abbey what they wanted in Belgium, and this was the origin of the glassworks. Nor would it be easy to hit on a better site. In the heart of a rich country, on the borders of a fine river, in the centre of a coal basin, and close to the Marihaye Collieries, well provided with railway accommodation, the Val St. Lambert glassworks possess every advantage, and they have been proportionately successful.

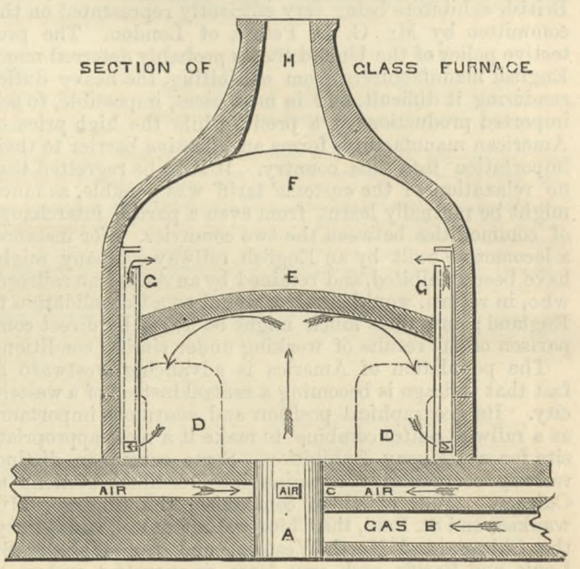
The establishment is worked by a company known as the Société Anonyme des Cristalleries du Val St. Lambert, under the presidency of M. Jules Deprez; and the company possess four distinct establishments, namely, that at Val St. Lambert; one at d'Herbatte, near Namur, founded in 1851; a third in the Rue Barre-Neuvill, at Namur, founded in 1753; and, lastly, one at Jambes, near the same town, founded in 1850.

We need not trace at length the history of the works. It will be enough to say that for a long time they were carried on with small or no profits; but a great advance was made when, in 1830, coal was first substituted for wood for heating purposes. Further capital was introduced in 1836, and operations have been carried on practically without intermission ever since. In 1850 the annual turnover was about £60,000; in 1880 the turn-over of the company was £200,000. To give an idea of the magnitude of the operations carried on, we may say that no fewer than 120,000 pieces are turned out *every day*. To pack this there are used 50,000 kilos. of heather, 55,000 kilos. of straw, and 250,000ft. of boards per month. The sand of all kinds used per year weighs 7,000,000 kilogs., and the weight of the fire-clay 1,500,000 kilogs. The weight of the finished goods sent out per year exceeds 9,000,000 kilogs. The company employs in all about 3000 hands, 1800 of whom are at Val St. Lambert. Much attention is paid to the welfare of the operatives by the company, and a species of co-operative store is worked with great success. Many of the hands have been on the works of the company for fifty years, and the managers speak in the highest terms of their servants. They know nothing of "Saint Monday." They are laborious, assiduous, intelligent, and attached to the works and the locality, which they rarely quit. These conditions are the most favourable possible for the employers, and they are far too rare in Great Britain. The Val St. Lambert hands, men, women, and children, work uninterruptedly for eleven hours a day all the week through, and some of the men even longer. This affords a remarkable contrast with the hours of labour and customs of our English glassworkers.

We take it for granted that our readers know generally how glass is made. That a mixture of sand and an alkali is fused into a kind of pasty mass. The fusion is effected in pots of refractory clay, of which the general form is something like that shown in the sketch. The mouth of the pot is shown at A. The pots at Val St. Lambert are of various sizes, the largest hold about 16 cwt. of glass. The duration of the pots is very variable; they last sometimes only a few days, at others several weeks, or even months, much depending on the quality of the pot. The temperature to which they are exposed is not excessively high. The great thing to be effected in a glass melting furnace is the perfectly equal distribution of the heat. At Val St. Lambert gas is used, generated in Siemens or Boëtius producers. There are in all twenty furnaces. They are grouped in threes or fours, in the large buildings, with high roofs. Formerly the furnaces were square, and held each eight melting pots, which did not hold more than 250 kilos. of glass. The modern furnaces each receive from twelve to fourteen melting pots. The modern melting pots as made by the Battersea Plumbago Crucible Company do not seem to be known here.



The peculiarities of the construction of the glass melting furnaces at Val St. Lambert will be gathered from the annexed sketch. The furnace is circular, 14ft. or 15ft. in



diameter, and from the roof E to the floor is about 5ft. 6in. high. In the centre of the floor is a cylindrical opening A, through which rise the mixture of gas and air, the latter being introduced through four openings, three of which are shown. Two of the pots are indicated by dotted lines at D D. The equitable diffusion of the heat is effected in the following way:—Inside the furnace are constructed as many vertical flues as there are pots. Two of these are shown at G G. They have small openings about 5in. by 8in. at the bottom. The course pursued by flame is indicated by the bent arrows. The flame rising strikes the crown E, and is deflected downwards and drawn off by the side flues, which deliver into the second vaulted space F. In this, in some cases, are annealed the finished articles of glass. In others is fixed a boiler, steam being generated by the waste heat. In others there is no opening at the top of F at H, but there is one at the side instead, through which the flame is led to raise steam in Belleville tubulous boilers. The steam is used to drive the engines in the grinderies. Not much power is required, and it is very easily obtained from the waste heat.

The operations of the glass blower have been too often described to need re-description here. One or two points, however, deserve notice. One is the large use made of wooden moulds. In these are formed all kinds of circular articles, such as tumblers and lamp glasses. The moulds are in halves, and are kept soaked with water to prevent them from burning. Inside they become lined with char coal. The glass-blower, getting a knob of glass on the end of his blowing rod, blows a very thick, small bulb; this he then places on the mould, which is closed by a very small boy; in but too many cases mere children, seven or eight years old, are employed. The child holds the two sides of the mould together while the blower rotates the bulb within, blowing all the time. The work is turned out very true. Up to a comparatively recent period the tumbler was cut to the proper depth while hot with a pair of scissors, but this has been abandoned, and an extremely ingenious little machine is now used for cutting lamp glasses, tumblers, &c. The article to be cut is placed vertically on a stand. At the proper height above the stand is fixed a sharp steel point, and by touching the glass against this a very small scratch is made. At the same level is fixed a little mouthpiece through which issues, under pressure, a tiny gas flame, not thicker than a sheet of note paper. This falls on the glass, which is turned round by the woman attendant. The glass is heated in an extremely narrow band all round. The touch of a moistened finger suffices for the complete separation of the two parts of the glass round the heated girdle. In fact, this is a very elegant application to manufacturing purposes of the well-known hot wire method of cutting glass so often tried with indifferent success by the enterprising amateur.

Glass grinding is carried out on a very large scale at Val St. Lambert in huge well-lighted shops. There are four grinderies at Val St. Lambert, and one at Herbatte, the total number of which is 800, and the floor space occupied is no less than 24,000 square feet. The first steam engine was put down to grind glass in 1836. A great deal of engraving is done with fluoric acid, the vessel to be engraved being protected with wax in which the design is etched. Tilghman's sand blast is also employed as well as the old copper disc system; flats are ground on tumblers by automatic machinery.

It would be impossible to do more than give a general idea of the operations carried on in this vast establishment, every portion of which was thrown open to the members of the Institution, while numbers of heads of departments went round and answered every question and explained every detail with a frankness and a courtesy beyond praise. It is impossible to inspect such an establishment as that at Val St. Lambert without feeling how hard is the battle which manufacturers in this country have to fight. There, as we have said, are to be found every advantage of position, and to this is added a body of workmen, active, sober, industrious, among whom is heard no talk of strikes, and who are content to work every day and all day long; such men, directed by heads possessed of no small scientific ability, and reinforced by the command of ample capital, cannot fail to make a mark in any market, and we only speak the truth when we regret that we have not such works and such men on English soil as there are to be found at Val St. Lambert.

This was one of three alternative excursions. The others were to the works of the Société des Ateliers de la Meuse, and to the Angleur Steelworks.

On Thursday, the 26th ult., the day was wholly occupied with two excursions, the one being to the Zinc Works of the Vielle Montagne Company, of which we gave some account in our impression of the 27th ult., and to the Hazard Collieries; and the other to Verviers, where several woollen fabric factories were open to inspection. A visit was also made to the great Gileppe Waterworks Reservoir.

VISIT TO ANTWERP.

On Friday the members paid a visit to Antwerp, the hon. local secretary to the reception committee being Mr. A. W. W. Wilmott, who represents at Antwerp the interests of Sir William Armstrong, Mitchell and Co., of the Elswick Works, Newcastle-on-Tyne. After a warm address of welcome from the Burgomaster, M. Léopold de Wael, and a suitable reply from the president, the secretary, Mr. Walter A. Brown, read a paper by Mr. G. A. Royers, engineer to the Antwerp Municipality, on the new harbour works at Antwerp. This paper will be found at page 116.

As time was short M. Royers undertook to answer questions on the spot, during the visit to the works; and after a vote of thanks, proposed by the president, coupled with a high compliment to the ability of this young engineer, the party proceeded on their excursion. They visited the docks, with their new hydraulic machinery, and then crossed the Kattendyk basin to the new dry docks. The 450-horse power engines and pumps in connection with these docks were made by M. Ch. Mercelis, of Liége, in 1864, and pump about 12,000 cubic metres of water per hour, the greatest height being 21ft. The horizontal cylinders are 1 metre in diameter, and have a stroke of 1½ metre. The pistons work directly on to spear rods with rocking levers resembling those of a mine pumping engine, and the rocking levers actuate the plungers of eight vertical pumps, sunk below the floor, four being 1·3 metre in diameter, and the other four 90 centimetres. The steam is supplied by four Lancashire boilers. Two bars descend in front of each fire-hole door, being connected by chains with dampers in the flues; and the arrangement renders it impossible to open the door without first closing the damper.

After witnessing the working of the draw-bridge, which is supplied with hydraulic machinery by Sir Wm. Armstrong, Mitchell and Co., the party went on board a river steamer and proceeded up and down the Scheldt, along the new river wall, the various points of interest being pointed out, notwithstanding the pelting rain, by M. de Matthys, ingénieur-en-chef des Ponts et Chaussées, who is directing the works for the State; M. Royers, the ingénieur de la Ville, who represents the Municipality of Antwerp; and M. Coisseau, who is carrying out the work for the contractors. The visitors went on shore to inspect one of the caissons, where the method of excavation, the discharge of the sand by means of water and compressed air, and the filling with concrete, were duly explained. They also visited the hydraulic pumping station for the movable cranes and capstans on the quay, &c. The 400-horse power horizontal pumping engines have been erected by M. Charles Beer, of Jemeppe. They are supplied with steam by five De Nayer tubular boilers of a type similar to that of Root, Belville, and the Barrow Shipbuilding Company, to be worked at a pressure of 75 lb. per square inch. There are two pairs of compound pumping engines, each pair calculated to force 1890 litres of water per minute at a pressure of 700 lb. per square inch. The piston-rods work the pump plungers direct, and force into two accumulators. The hydraulic cranes are mounted on a frame running along a wide—about 4ft.—way, leaving room for the ordinary narrow gauge wagons to run underneath.

The members also landed at the Hoboken shipyard of the Société John Cockerill, shown in the left-hand upper corner of the plan of the Seraing Works published as a supplement on the 27th ult. Here they found on the stocks a steamer and a barge, both apparently named Amour, both for the service of the company. The machine shop is light and airy, but the tools are not of the most modern description, while the speed they run at seemed rather to excite the pity of many present. Landing at the Canal au Sucre on Saturday afternoon, a party of the members visited the Antwerp Waterworks Pumping Station at Waelhem, about twelve miles from the city, under the escort of Mr. Rich, one of the partners in the firm of Easton and Anderson, the engineers of the company, and Mr. Devonshire, the resident engineer in Antwerp. One of the most interesting novelties in these works is the employment of spongy iron for filtering the very turbid waters of the Nethe—a sluggish river passing the works, from which the supply is taken. The water in the river is not only highly coloured and tainted with the sewage of Lierre, a town a few miles above, but the suspended matter contained in it is of such an impalpable character that it is impossible, by settlement in open ponds and filtration through sand filters, to remove these objectionable characteristics. It was found, indeed, in laboratory experiments before the works were constructed that even the passage of the water through a dozen folds of fine filter paper failed entirely to remove its colour, and it will remain for months in a state of turbidity in a clear glass bottle. Under these circumstances it is extraordinary to see how rapidly its characteristics are changed by simple passage of it, at the rate of about 100 gallons per square foot in the twenty-four hours, through a 3ft. layer of spongy iron and gravel, mixed in the proportion of one of the iron to three of gravel. After passing through this filtering medium it at once appears colourless, bright, and sparkling; but it then possesses chalybeate characteristics, which are removed by passing it through an ordinary sand filter at the lower level.

The water is raised from the settling ponds in which it is received from the river into the upper range of filters, by two of Airy and Anderson's patent screw pumps, working on a maximum lift of about 19ft. The ease with which these pumps worked was remarked by all who saw them. The filtered water is pumped through a 20in. main into the city by compound beam engines, four in number, coupled in pairs with a double-acting pump under each beam. With these coupled engines and adjustable expansion gear, the supply to the town is kept up satisfactorily day and night without any reservoir or stand-pipe anywhere; the pressure in the water mains throughout the town being uniformly about 175ft. day and night, and that at the pumping station 200ft. to 280ft.

An abstract of the paper read before the Institution of Civil Engineers by Mr. Anderson, on these works, was published in THE ENGINEER on January 26th, 1883. We hope we may be able to publish some details of the drawings of them ere long.

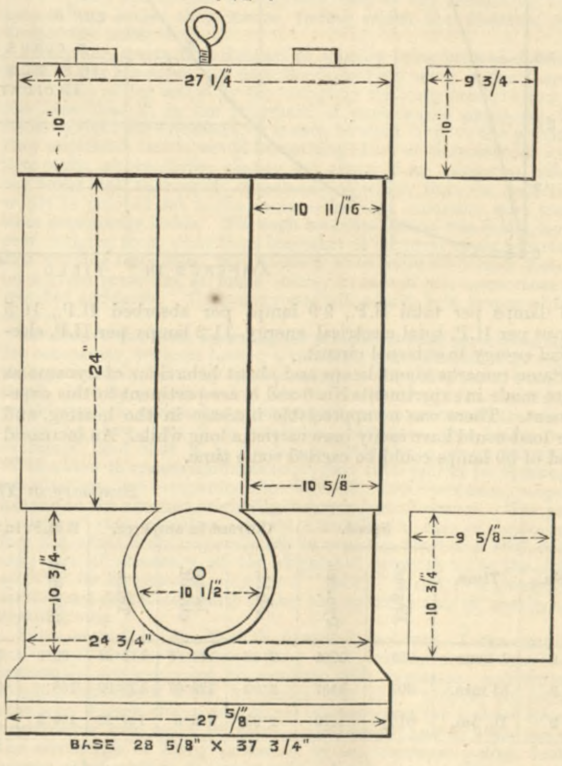
Some visitors witnessed the process of diamond-cutting at the works of Messrs. Kryn, Huybrechts et Fils, and those of Mr. Jean Coetermans. Others again inspected the old printing presses, types, and engraved blocks left at his ancient residence by Plantin, the famous printer. In the evening the members were received by the committee of the Cercle Artistique et Scientifique, who threw open their fine rooms, picture gallery, and garden; and thus ended the highly successful Antwerp excursion.

THE EDISON-HOPKINSON DYNAMO-ELECTRIC MACHINE.

THE following report by Mr. Frank S. Sprague, on the Edison-Hopkinson dynamo-electric machine, will be found of interest to electrical engineers, though rather "thick" in places. Amongst other things it points to a remarkable efficiency, and bears upon experiments which it is known are being made by more than one firm of electrical engineers on the relative weights of field magnet cores and poles, and the relation between the weight of wire and iron in field magnets necessary to give the best results.

Mr. Sprague says: I have to make the following partial report of the tests of the new dynamo-electric machine, built by Messrs.

FIG. 1



Mather and Platt, of Manchester. Fig. 1 shows the general shape and dimensions of the machine.

Additional dimensions and characteristic features of the dynamo are:—General arrangements—those of a shortened and differently proportioned Edison dynamo. The pulley, however, is outside of bearing, and with a face of 6⅜in., and diameter of $10\frac{1}{16}$in. projects 8¼in. outside the base plate. Field coils wound over a 9in. core with ten layers of No. 16 copper wire (B.W.G.). Two legs in series. Armature: Diameter of core 9in., 74 coils, single turn, 8 strands of No. 16 wire, average length 43in. Wire bound. Diameter, 10½in., with $\frac{1}{6}$in. clearance from pole faces. Zinc plate connecting pole faces; ends of magnets not scraped. Resistances: Field cold, 36·5 ohms; armature ditto, ·026 ohms. Field measured; armature calculated. Field warm, 37 ohms; armature warm, ·0325 ohms. Power supplied from a Lawrence—Armington and Sims—engine, high-speed and non-condensing, driven by a link belt through an Alteneck tension belt dynamometer.

Engine diameter	8½in. accepted.
Stroke	$9\frac{15}{16}$in. measured.
Piston-rod	1⅜in. "
Fly-wheel	40in. "
Indicator spring	56in. "

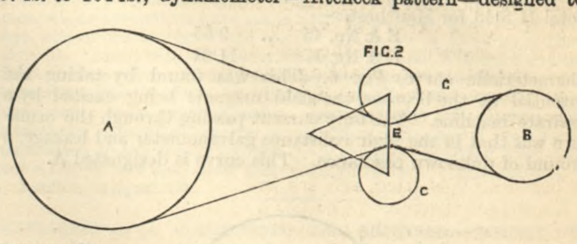
$$1\text{-H.P.} = \frac{2 \,.\, \text{P. L. A. revs.}}{33{,}000}$$

$$= \frac{2 \,.\, \frac{\text{P. } 9\frac{15}{16}}{12} \,.\, \frac{\pi}{2} (2{\cdot}425^2 - \frac{11}{16}^2) \text{. revs.}}{33{\cdot}000}$$

= Mean pressure × rev. × ·0028107.

The mean pressure is best found by taking area of cord with a planimeter, dividing by the length of cord and multiplying by the spring. Engine not permanently secured, but firm enough to drive well. Revolutions timed by reference to a continuous counter, running motion from valve stem; boiler pressure from 97 lb. to 104 lb.; dynamometer—Alteneck pattern—designed to

FIG. 2



measure difference of tension of two parts of belt. A, driving pulley; B, driven pulley; C C, pulleys with faces close together and gripping the two parts of the belt. The lower is the driving part, and the resultant pull is downwards, which pull is opposed by an upward external and measurable pull which keeps the dynamometer in a central position. The following were the dimensions:—Diameter A, 40in.; diameter B, $10\frac{1}{16}$in.; diameter C, $9\frac{5}{16}$in.; distance apart of centres of C C, 11½in.; thickness of belt, $\frac{9}{16}$in.; resistance A E, 117in.; resistance B E, 26¼in. To find constant, we have the following:—

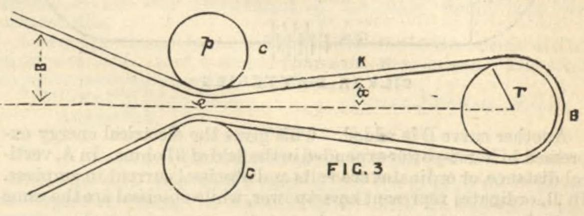


FIG. 3

T tension on lower belt.
T^1 " upper "
$2\,r$ and p diams. of small pulleys B and C.
2 R " large pulley A.
K thickness of belt.
α and β half enclosed angles on each side.
d distance from E to centre of B.
D " " " A.
l " apart of centres of C C.

Then net spring = difference of pulls
$= (T - T^1)\ (\sin. \alpha + \sin. \beta)$

$$\sin. \alpha = \frac{2 - \frac{1}{2}(l - p - 2\,K)}{d} = \frac{2 - \frac{l}{2} \times \frac{p}{2} \times K}{d}$$

$$\sin. \beta = \frac{R - \frac{l}{2} + \frac{p}{2} + K.}{D}$$

$r = 5\frac{1}{32}$in.	$d = 26\frac{1}{4}$in.
$l = 11\frac{1}{2}$in.	D = 117in.
$p = 9\frac{5}{16}$in.	R = 20in.
$K = \frac{9}{16}$in.	

Then
sin. α = ·17143
sin. β = ·16640
sin. α + sin. β = ·33783

$$7 - 7^1 = \frac{\text{spring}}{{\cdot}33783} = 2{\cdot}96 \text{ spring.}$$

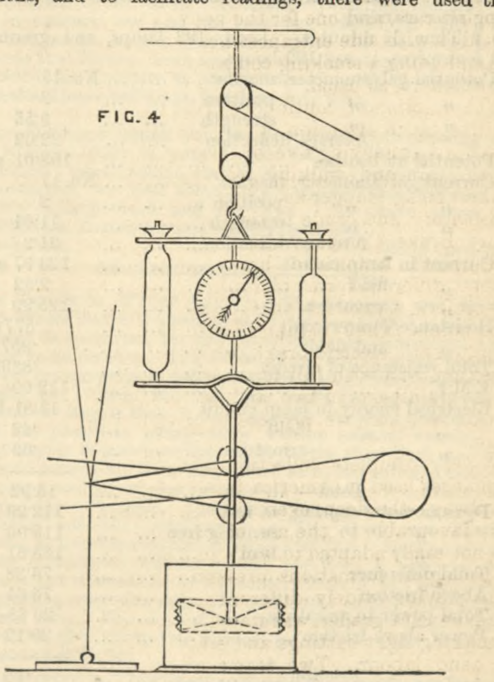
$$\text{H.P.} = \frac{\text{speed} \times (T - T^1)}{33{,}000}$$

$$= \frac{\text{rev. of B} \times \pi \times \frac{10\frac{1}{16}}{12} \times \frac{\text{spring}}{{\cdot}33783}}{33{,}000}$$

= ·0002363 × rev. × spring.

That is, the horse-power transmitted is the product of the increased tension on supporting spring, the revolution of the dynamo, and the constant factor ·0002363. To prevent violent vibrations, and to facilitate readings, there were used three

FIG. 4



springs and a dash pot. The ranges of springs were 60 lb., 100 lb., and 180 lb., two being direct and one circular. These were supported by bridle arms, and were raised or lowered by tackle.

The connection between corner bridle and dynamometer frame was by rubber band. The dash pot was a cylinder full of oil, in which moved an iron pulley, wrapped with Manilla rope.

The play of the dynamometer did not exceed $\frac{1}{32}$in. It was first balanced at rest, then free, and finally with load. Instruments for measuring potential and current were of the Thompson design, the current in the lamp circuit, and the potential at the brushes being taken.

The magnets were tested by the Poggendorff method, as in Fig. 5.

$$\text{Total H magnetic field} = \text{Gr.} \times E \times \frac{\text{position}}{\text{resis.} \times \text{dif.}}$$

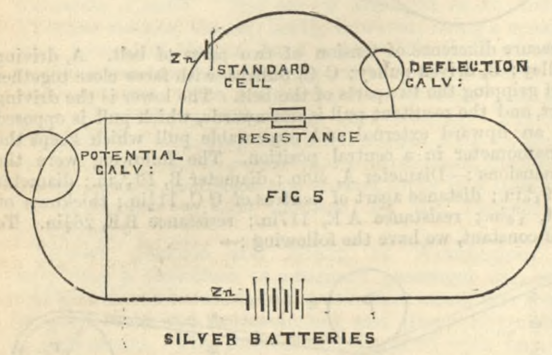
E = 1·457 Clarke's standard
Gr = 6428

Mean force in laboratory—Westminster:

	Earth.	No. 45	No. 17
May 7	·121	9·41	11·40
May 8	·122	9·46	11·45
May 12	·122	9·40	11·52

Total H field for Manchester—
E & No. 45 ... 9·55
E & No. 17 ... 11·61

Characteristic curve, Fig. 6. This was found by taking the potential at the brushes, the field magnets being excited by a separate machine. The only current passing through the armature was that in the high resistance galvanometer and leakage, a ground of unknown resistance. This curve is designated A.



Another curve B is added. This gives the electrical energy expressed in horse-power expended in the field of 37 ohms. In A, vertical distance, or ordinates are volts and abscissal current in ampères. In B, ordinates represent horse-power, while abscissal are the same as in A.

The results of three fairly full loads are given. No. 6 Time, about one hour; load, 192 lamps and ground of about 5 ampéres. Lamps not up to candle power.

Potential galvanometer, magnet... ... ... No. 45
„ „ position 2
„ „ strength ... ... 9·55
Average deflection... ... ... 20·79
Potential at brushes ... ... 99·27 volts.
Current galvanometer, magnets ... ... No. 17
„ „ position 2
„ „ strength ... ... 11·61
Average deflection... ... ... 19·39
Current in lamp circuit ... ... 112·56 amp.
„ field ... ... 2·68 „
„ armature ... ... 115·24 „
Resistance, lamp circuit ... ... ·882 ohms
and field ... ... ·861 „
Total resistance of circuit ... ... ·8935 „
E.M.F. ... ... 102·97 volts.
Electrical energy in lamp circuit ... ... 14·97 H.P.
„ „ field ... ... ·36
„ „ armature ... ... ·58

Total ... ... 15·91 H.P.
Dynamometer spring, at rest ... ... 112·23 lb.
„ „ running free ... ... 115·00 „
„ „ load ... ... 180·11 „
Total difference ... ... 67·88 „
Above friction ... ... 65·11 „
Total power to armature ... ... 17·34
Power above friction ... ... 16·63

Friction ... ... ·71

Dynamo speed, 1081; engine speed, 289·3; efficiency of conversion, 97·7 per cent.; commercial efficiency, 86·3 per cent.

Dynamo behaved well. Fields cold. Armature moderately warm. Wrist not uncomfortable on coils. Can also be held on commutator. Little sparking.* Bearings cool. No increased heating after standing.

No. 8 Time, 31 minutes. Load, 192 lamps, and ground of about 5 ampéres, = say 199 lamps.

Potential galvanometer, magnet... ... ... No. 45
„ „ position 2
„ „ strength ... ... 9·55
Average deflection ... ... 22·62
Potential at brushes ... ... 108·01 volts.
Current galvanometer, magnet ... ... No. 17
„ „ position 2
„ „ strength ... ... 11·61
Average deflection... ... ... 21·2
Current in lamp circuit ... ... 123·07 amp.
„ field ... ... 2·92 „
„ armature ... ... 125·99 „
Resistance, lamp circuit ... ... ·877 ohms
„ and field ... ... ·857 „
Total resistance of circuit ... ... ·8895 „
E.M.F. ... ... 112·09
Electrical energy in lamp circuit ... ... 17·81 H.P.
„ „ field ... ... ·42 „
„ „ armature ... ... ·69 „

Total ... ... 18·92 „
Dynamometer spring, at rest ... ... 112·23 lb.
„ „ running free ... ... 115·00 „
„ „ load ... ... 188·61 „
Total difference ... ... 76·38 „
Above friction ... ... 73·61 „
Total power to armature ... ... 20·88 H.P.
Power above friction ... ... 20·12 „

Friction ... ... ·76 „

Dynamo speed, 1157; engine speed, 309; efficiency of conversion, 94 per cent.; efficiency, 85·3 per cent.; 9·5 lamps per total H.P.; 9·9 lamps per total absorbed H.P.; 10·6 lamps per total H.P. electrical energy; 11 2 lamps per total H.P. of electrical energy in external circuit.

Remarks.—Lamps not being close to machine, they were probably not quite up to candle-power, although all in the room seemed well up.

Similar remarks about behaviour of dynamo as were made in experiment No. 6. There was no apparent increase in heating.

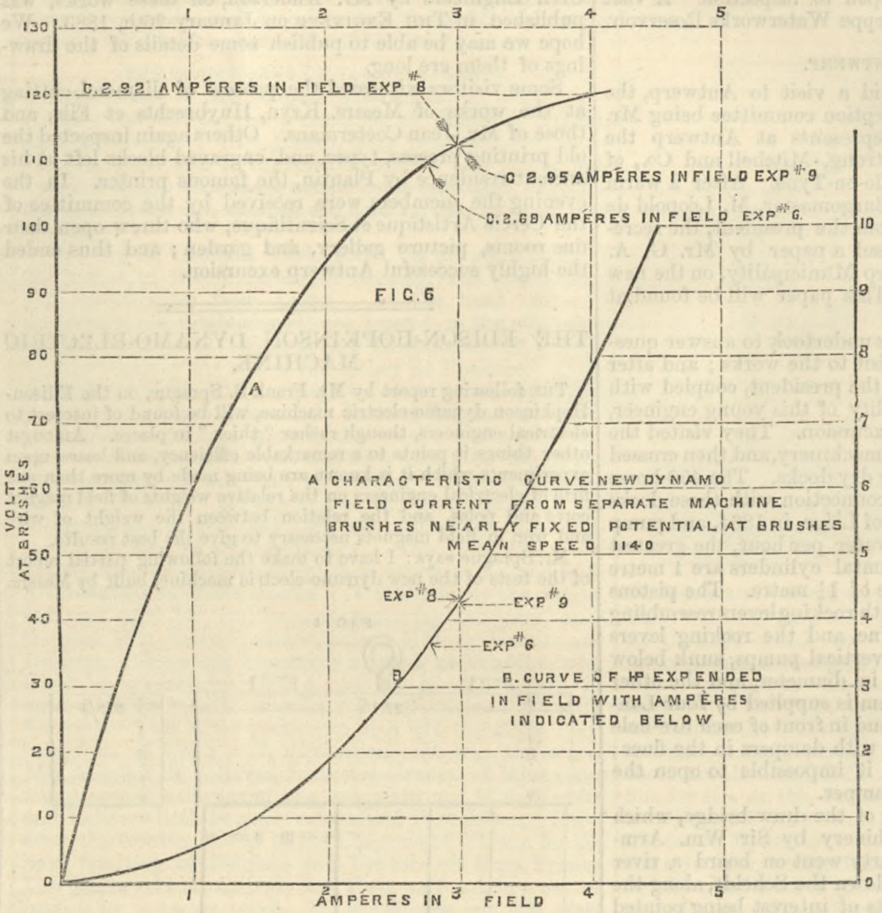
No. 9. Time, one hour and one minute; load, 230 lamps and ground of 5 ampères = say, 237 lamps.

Potential galvanometer, magnet... ... ... No. 45
„ „ position 2
„ „ strength ... ... 9·55
Average deflection .. .. 22·89
Potential at brushes ... ... 109·3 volts.
Current galvanometer, magnet ... ... No. 17
„ „ position 2
„ „ strength ... ... 11·61
Average deflection... ... ... 24·91
Current in lamp circuit ... ... 144·60 amp.
„ field ... ... 2·95 „
„ armature ... ... 147·55 „
Resistance lamp circuit ... ... ·756 ohms
and field ... ... ·741 „
Total resistance of circuits ... ... ·7735 „
E.M.F. ... ... 114·13 volts.
Electrical energy in lamp circuit ... ... 21·18 H.P.
„ „ field ... ... ·43 „
„ „ armature ... ... ·95 „

Total ... ... 22·56 „
Dynamometer spring, at rest ... ... 112·23 lb.
„ „ running free ... ... 115·00 „
„ „ load ... ... 200·4 „
Total difference ... ... 88·17 „
Above friction ... ... 85·40 „
Total power to armature ... ... 24·56 H.P.
Power above friction ... ... 23·79 „

Friction ... ... ·77 „

Dynamo speed, 1179; engine speed, 315½; efficiency of conversion, 94·8 per cent.; commercial efficiency, 86·2 per cent.;



9·6 lamps per total H.P., 9·9 lamps per absorbed H.P., 10·5 lamps per H.P. total electrical energy, 11·2 lamps per H.P. electrical energy in external circuit.

Same remarks about lamps and about behaviour of dynamo as were made in experiments No. 6 and 8, are pertinent to this experiment. There was no appreciable increase in the heating, and the load could have easily been carried a long while. An increased load of 30 lamps could be carried some time.

Summary or Three Experiments.

No.	Time.	Speed.		Current in ampères.			E M.F. in volts.		Elec. H.P. appearing.				H.P. delivered to pulley.		Efficiency.	
		Engine.	Dynamo.	Field.	Lamp circuit.	Total.	Brushes.	Total.	Field.	Armature.	Lamp circuit.	Total.	Absorbed.	Total.	Conversion.	Commercial.
6	1 hour	289	1081	2·68	112·56	115·24	99·3	103 0	·36	·58	14 97	15 91	16·63	17·34	95·7	86
8	31 min.	309	1157	2·92	123·07	125·99	108·	112 1	·42	·69	17·81	18 92	20·12	20·88	94·0	85
9	1h. 1m.	315½	1179	2·95	144·6	147·55	109·3	114·1	·43	·95	21·18	22·56	23·79	24·56	94·8	86

Means: 94·8°/。 86°/。

(Signed) Frank S. Sprague,
London, May 17th, 1883.

To E. H. Johnson, Esq., Royal Hotel.

LETTERS TO THE EDITOR.

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

THE PROBLEM OF FLIGHT.

Sir,—Now that the science of flight is so thoroughly mastered, and as our French friends say, "We know all about it," no more remains to be done than reduce such knowledge to practice. To do this successfully, we must have a clear understanding of the principles which govern successful flight, the chief of which are:—(1) The weight of a body sustained in air bears a definite proportion to the weight of air on the area of its sustaining surface. (2) Air motion varies definitely with its weight and pressure, so that its velocity under increased weight bears a definite proportion to its velocity under its own pure and simple pressure. (3) As the length and breadth of sustaining surface is to weight of body, so is the consumption of power to the velocity required of such sustaining surface for its sustentation. A few examples will suffice to establish the trustworthiness of these principles.

Mr. I. Lancaster gives the weight of man-of-war bird at 4 lb.; area of wing surfaces equal to 4 square feet, and alar dimensions about 8ft. This bird, therefore, carries one pound weight per square foot of sustaining surface; so that its relative density to that of air, on its wing surface when fully extended, is one of body to 2100 of air; whereby its efforts are rendered so effective as to elude the keenest observation, as described by Mr. Lancaster in his interesting papers. M. P. Harting gives the weight of a bat (*Pteropus edulis*) at 3·04 lb.; area of wing surface equal to 126¼ square inches, and envergure 47in. The weight of the lark he gives at ·07 lb., area of wing surface 11·6 square inches, and length of wings 6·2in. These animals carry respectively 3½ lb. weight, and 14 ounces to the square foot. And among the pigeons with which I have experimented, one bird weighed 16½ ounces; area of wings equal to 83½ square inches, and length from tip to tip 26in. This bird carried 1 lb. 13 oz. per square foot. The greatest load that it could lift, but not carry scarcely a foot, was ¾ lb. It would consume 200 grains weight of peas at a feed, and the weight of air displaced by its body—about 60 cubic inches—was nearly 20 grains; a weight totally insignificant and absurd to reduce by buoyancy in favour of bird-power, which would be rendered ineffective without weight.

The barometer assures us that the air pressure and weight is nearly 15 lb. per square inch at sea level; and vessels exhausted of air have shown its velocity under that pressure and weight to be near 1300ft. per second. Such velocity would, however, be reduced in mid air under equally superior pressure to probably 1200ft. or less per second. We thus compare or measure air motion by earth motion, and obtain a basis for the second principle from their relative definite proportion; the weight being due to the earth's attractive force, but the ascensive pressure is due to the repellent force existing so excessively in air. By the mutual operation of these forces the earth's diurnal rotation is maintained, and the science of aërotransition rendered so complex and mysterious. Simply stated, these data show sufficiently near for practical purposes that a surface equal to one square inch requires an expenditure of power equal to 15 lb. to impel it in mid air at a velocity of 1200ft. during a space of time—or earth motion—equal to one second. And the query of most vital importance to this science which we have to decide by these quantities is: What is the equivalent of the power expended by flying animals upon their wing surfaces when sustaining themselves in air?

Applying the above principles to the achievements of frigate birds, we find:—By first principle, its relative density to that of air on its extent of wing surface, to be one of body to 2100 of air; *i.e.*, the air is fully 2100 times greater weight than the animal upon its wing surface when fully extended. By second principle we find the velocity of air motion under the increased weight of body sustained, and also the ascensive pressure imparted by the repellent face to the sustaining surface when worked at such increased velocity. In this example we have three quantities — weight, surface, and relative density—given to find a fourth — velocity per second — and this should be as easily attainable as any proposition by the simple rule of proportion. Now an additional 1 lb. per square foot—as carried by frigate bird—is equivalent to an increased ordinary air pressure by its 2100th part. Therefore, 15 lb. plus its $\frac{1}{2100}$th, is to one square inch as 1200 plus $\frac{1}{2100}$th feet is to one second in mid air; because 15 lb. is to one square inch as 1300ft. is to one second when air rushes into vacuous space. This additional weight produces an increased air pressure of 50 grains per square inch, and impels the surface on which it acts at a velocity of 7in. per second, in mid air, to any extent of surface whose boundary is, at all points, equidistant from its centre. By third principle, this result is wonderfully modified; for an elongated surface economises power at the expense of velocity. The extent of frigate bird's wings are equal to the area of a circle having a radius of 1·15ft., and this extent can, at the bird's will, be elongated to 4ft. The arc of vibration must therefore be made through an angle of 17 deg. to obtain a stroke of 14in. for to gain the average distance of 7in. to the whole wing surface and sustain the body in air. By the advantage of the elongated wing, however—which is nearly four times the radial length—such velocity would double the effective results of the power on the body, or the power would make such length of stroke at only one-half of the velocity; *i.e.*, 7in. per second, or occupy two seconds in passing through an angle of 17 deg. So that a velocity of wing motion or air motion not exceeding a quarter mile per hour, suffices to sustain a frigate bird with fully extended wings, worked by a power equal to the weight of bird.

Flying animals can no more exert on the air greater pressure than equals their own weight, than ships can displace more water than equals the weight of their individual burthens. A power, therefore, equal to the animal's weight is always available to them for forward motion, whether projected horizontally, spirally, or obliquely, in ascending or descending; and which may of course be accelerated by continuous strokes made with increasing rapidity. In the absence of definite dimensions of cross section of frigate bird, I will assume the bird to offer 30 square inches of resisting surface to forward motion. This surface will be driven forward by the weight of the bird—equal to 4 lb. pressure—at every stroke of its wings, even when soaring or standing in moving air, with apparently, but not really, motionless wings, its rate of motion being dependent on intensity of wing motion and the weight of body. To neutralise such pressure, a velocity of about 120 miles per hour would be attained. Mr. Lancaster states that he has witnessed in their flights that sometimes these birds pass over as many miles in as many minutes without apparent fatigue, so that in emergencies their speed may possibly exceed 150 miles an hour. What encouragement this position of affairs offers to enterprise!

The following examples will afford a clear insight of the remarkable divergence existing in the relative densities of flying animals and air, and also assist in establishing the trustworthiness of the preceding principles. And although far from the extremes—which range from about 400 to even more than 10,000—they show the bat

* Some lateral play of armature and spindle.

to carry four times the load to surface as that carried by the lark or even the large man-of-war bird! and this becomes still further instructive in showing the requisite velocity at which they work their wings, and also the effect of moving air at various velocities upon them; light, large-winged birds being the least able to withstand strong winds. For, as we may perceive, the velocity of moving air, or of wing motion, that would enable each bird respectively, with fully expanded wings, to obtain support therefrom equal to its weight, will be for the lark ⅙ mile, the frigate bird ¼, the pigeon 1¾, bat 2⅙, and the aërotransive carriage 6 miles per hour. So that the bat could withstand a wind of thirteen times the strength that the lark could, without flexing its wings, and nine times as strong as the frigate bird could, without flexing the wings; whilst the aërotransive carriage could, with 4¾ lb. load to the square foot, withstand a wind nearly three times as strong as the bat could before it would be carried with the current—as a balloon—were its wings held motionless horizontally. The resemblance also between the frigate bird and lark is worthy of note; both are soaring birds, and carry nearly the same weight to surface, have nearly equal length to area of wing, and make nearly equal velocity of wing motion.

By tracing the quantities described in reference to frigate bird, the explanation of other examples will be seen:—

Name.	Weight per sq. ft.	Relative density of body to air.	Increased air pressure.	Increased air motion.	Area of wing.	Radius of circle of = area to wing.	Length of wing.	Ratio of wing length to radius.	Length of stroke through arc of 17°.	Ratio of stroke velocity through arc of 17°.	Ratio of wing velocity in miles per hour.
	lb. oz.		grains.	ft. in.	s. ft. s. in.	ft. in.	ft. in.		ft. in.		
Bat	3 8	600	170	2 0	0 126¼	0 6·35	1 8½	1 to 3¼	0 6·12	26	2⅙
Pigeon	1 13	1160	87	1 0	0 83½	0 5·15	1 0	1 to 2⅓	0 3·57	21	1¾
Frigate Bird	1 0	2100	50	0 7	4 0	1 1·6	4 0	1 to 3½	1 2·23	3	¼
Lark	0 14	2400	42	0 6	0 11⅓	0 1·9	0 6¼	1 to 3⅓	0 1·8	2	⅙
Aërotransive carriage ..	4 12	450	240	3 0	60 0	4 6	12 0	1 to 2¾	thro' arc of 105° 22 0	thro' 105° 12	6

If we now consider the results of a perpendicular down stroke made with a perfectly plane surface, as a kite or a parachute, we find the adjacent air tends to disperse itself equally around its edges. By a segmental surface, however, of a bird's or an artificial wing, with stroke delivered in precisely the same direction, the air will be twice as much retarded by the aft part of the wing as by its fore part, and would in consequence receive an oblique forward motion from such perpendicular down stroke. If now, however slightly, we incline the fore margin upwards, we must decidedly increase the obliquity of air motion. By this act of downward pressure with the segmental wing surface the air in contact therewith is wholly pressed forward obliquely, and the external underlying air resisting its forward progress causes the antagonistic particles to force each other upwards and forwards, until they form so dense a crest that the air wave rolls over, carrying forward with it the down-driving wing surface and body also. This I find by experience to prove a supporting and propulsive, or rather, drawing-forward, element in air motion. Now, let us trace the returning-up or back stroke. At the commencement of this action the wing surface involuntarily changes its angle, *i.e.*, the weight of air on its back surface becoming heavier than the air pressure below can support, the aft wing surface falls, and the fore rises, till checked by adjustment. The wing is now efficiently feathered, and the whole resisting influence of the air presses forward the wing surface, and is thus thoroughly utilised for impelling the body forward. No necessity exists for evading this available and most valuable impelling force, which so many attempt to evade and try to render useless.

If we now consider the application of these principles to a structure competent to sustain a man and its requisite machinery in air, we shall obtain a very gratifying idea how near we approach by art the achievements of flying animals.

Many gentlemen are disposed to allow from 200 to 500 square feet or more sustaining surface for the weight of a man and apparatus, weighing together about 300 lb. This quantity is, however, by far too much surface to manœuvre even in a clear state of the atmosphere. My own aërotransive carriage is furnished with about 60 square feet of wing surface, and, including myself, weighs 280 lb. This quantity of surface greatly taxes my power to wield at so low a velocity as even seven strokes per minute—not second—or under four miles an hour when experimented with in the open field.

By first principle.—Its relative density is 1 of body to 450 of air, or 4¾ lb. is the load per square foot.

By second principle.—15 + $\frac{1}{450}$th lb. is to 1 square inch as 1200 + $\frac{1}{450}$th feet is to one second. This gives an increased air pressure equal to 240 grains, or little over ½ oz., per square inch, and an increased velocity of air motion equal to 3ft. per second, or 180ft. per minute, to any extent of surface, equidistant at all points of its circumference from its centre. Such velocity imparted to 60 square feet of surface, all points of whose circumference is equidistant from its centre, will demand in mid air an impelling force equal to 280 lb.—the weight of body—to neutralise its weight, the force of gravity thereon, and sustain it

By third principle.—This principle operating in the successful actions of flying animals is conspicuous in the effective actions of frigate birds and swallows possessing it, and the laborious actions of domestic fowls wanting it. This shows the importance of disposing the above surface of 60 square feet in such manner as best to attain it. By constructing four wings, measuring 12ft. each from wing to shoulder tip, and about 20in. extreme breadth near the middle, we obtain two pairs of wings equalling the above extent, and equal to the area of a circle having a radius of 4½ft. Hence the length is nearly three times such radial length, and by making the arc of vibration through an angle of 105 deg., the length of stroke, which is 22ft., will be equal to the whole surface, having an average velocity of 11ft.; so that it will require 16½ strokes per minute to obtain the required velocity of 180ft. But as the length of wing is nearly three times the above radial length, the power is proportionally increased on the body, or the velocity is decreased on the wings nearly one-third; so that twelve strokes per minute—not second— is near the maximum velocity required; and twelve perfect strokes are twelve revolutions of motive crank shaft, and equal to a six-mile velocity, thus affording time for the generation of power. And the operation of these antagonistic forces, impelling and repellent, through such length and breadth of wing surface at the above velocity will produce those results by the law of density which has ever enveloped this science in obscurity, and rendered its observable effects so mysterious; for we here see that a six-mile velocity of 60 square feet of wing surface will support 280 lb. in the air, whether the power be applied by wing motion or air motion, and as effectually as with flying animals, although we can only utilise wing motion for independent transition.

During an experiment made in the open field a moderate gust of wind—scarcely a five-mile wind—exerted such force upon the wing surfaces as to twist the two centre armatures fully 25 deg. out of their original position, though of good iron ⅝in. diameter each; and this allowed the wing to be driven fully up. Had not the armatures yielded, the whole weight of 280 lb. must have been lifted off the ground.

Trials should be made on a suitable piece of water, so that the carriage might rise therefrom like water fowls, if sufficiently powerful, and if not, we should have the advantage of ascertaining by a float how much it could be actually lifted without risk of any serious accident. W. QUARTERMAIN.

Fransham, Norfolk.

ELEPHANT BOILERS.

SIR,—I have carefully read Mr. Swift's reply to my letter, in which I contradicted his statement in THE ENGINEER of July 6th, that "the insurance companies were glad to get hold of any sort of boilers," but I cannot find in it that he has even attempted to prove the charge he there made. Common sense tells any man that there are no persons and no companies in existence but what would refuse to insure any boiler which they knew to be unsafe; and, in my opinion, no one is better able to decide this than the engineers and inspectors of a boiler insurance company, who, among their varied duties, have the responsibility of seeing that the boilers insured are neither "any sort" or "improper" ones—that is, calling a spade a spade, boilers liable to explode or collapse at any moment. Mr. Swift certainly throws new light on the apparently dark doings of a boiler insurance company, and shows his knowledge of the business when he states that "it does not rest with the inspector or the engineers of the company to accept boilers for insurance." Really, Mr. Editor, I do not wish to be funny or appear at all sarcastic, but can anyone suppose that either their inspection or acceptance rests with, say, the post boy? What are the inspectors and engineers engaged for, and especially at the high salaries Mr. Swift mentions, unless it is for doing the very thing he says that they do not? There are boilers insured that have not been thoroughly examined by the companies' inspectors, but Mr. Swift may, with perfect equanimity, accept my assurance that they are neither "any sort" or "improper" ones.

The companies have, I admit, at long intervals been called "over the coals" by juries, but it is still left to Mr. Swift, or anyone else, to prove where a company "was censured for insuring boilers which they knew were not sound—safe—at the time of insuring." It has, I believe, been invariably shown on the same occasions that the insuring company has repeatedly "requested" and "urged" the importance of a thorough examination being made, and although the boiler may have exploded whilst it was insured, it was no fault of the company's that one had not been made. All admit that a thorough examination of every boiler by an efficient inspector is of the greatest importance; to none is it more so than the owner and the company insuring it, for, whilst the former by an explosion might lose his all, the company must also necessarily lose considerably more than they could ever expect to receive from the firm in premiums. It therefore logically follows that it is to the interest of the company, irrespective of any expense—which is in some above the premium—to prevent, as far as possible, by efficient inspection—if only to endeavour to save their own pocket—the occurrence of such disastrous accidents. Although the companies do not, except in special cases, make thorough examination one of the "conditions of insurance," one of the principal clauses in the policy is one which provides that the company's inspector or engineer may at any reasonable hour inspect any boiler they insure, failing which the directors may declare the policy void.

Every one knows that the fact of a boiler being insured does not make it any the safer, nor does the fact of its being under inspection. The policy issued by the company certainly tends to convey the idea that if, in the judgment of experienced engineers, the boiler is right for insurance, it is safe to work it up to the pressure they stipulate; but it would be nothing short of preposterous were it to state, or even infer, that in the event of an explosion before the boiler was thoroughly examined—at which time its condition would be pointed out to the owner—that the company were more than pecuniarily liable. Till such an examination was made, however, judging from what their inspector or engineer could ascertain at a working inspection, the company were prepared to risk losing, for a given premium, so much money in case of the occurrence of specified accidents. This, every one will admit, is in favour of the assured.

To remove the idea, assuming for a moment that one exists, that the companies, without having a thorough examination, were more than pecuniarily liable by their issuing a policy, they have, I understand, recently commenced to issue after thorough examination—provided all is satisfactory, but not otherwise—a certificate which states for how long it is available, the date the boiler was examined, and that it is absolutely fitted for a given pressure. With a view to encourage firms to prepare their boilers for thorough examination, the companies also offer an extra insurance, proportionate to the amount originally insured, free of charge. The production of such certificate would naturally, in case of explosion, free the owner from responsibility in working the boiler with ordinary care, if necessary, at the stipulated pressure up to the date specified for its renewal, whereas a "policy" is simply a guarantee on the part of the company to pay the owner in case of accident a specified sum.

With regard to Mr. Swift's financial problem. I can readily understand that he finds inspecting most expensive, and that it is impossible single-handed to compete with insurance companies. Possibly Mr. Swift, when he states that the "number of young men who accept the appointment of inspectors for a short time" explains his own mode of gaining experience; and in firms seeing the advantage of being protected by an insurance policy, feels, among other things, the unmerciful hand of competition. And, as he says that "inspection without insurance is positively disliked," I suggest, although to give advice is the cheapest thing imaginable, that it might be to his advantage—I do not say credit—to remember his own remarks as to inspectors and the sale of boiler physic, and leave boiler inspecting alone. From my knowledge of boiler insurance companies I am able to say decidedly, and perhaps with a little authority, that the inspectors of the principal companies are not "young men," but men who have had from ten to twenty years'—and some more—practical experience in boiler inspecting.

Now, Mr. Editor, I dislike postscripts, and therefore avoid using them, because one finds, and particularly so is it the case with anyone discussing a subject in a newspaper, that the writer usually states in them in a half dozen words or so what he believes to be so very confirmative, and occasionally conclusive, evidence in favour of what he has just written; but, candidly speaking, did it not occur to Mr. Swift before posting you his last letter, that the insurance company—whichever of them it was—might possibly have had a thorough examination of the boiler that was fifty years old before they insured it? It did to me on reading it, pretty quickly.

Mr. Swift's letters appear to me to be written in a spirit of antipathy, although not against me; for, Sir, you may remember he says that "he has not the pleasure of my acquaintance." I assure Mr. S. that whatever there may be learned from this correspondence, or whatever is the verdict of your readers, I bear no antipathy towards him. My only desire is, with your permission, to free the subject under discussion, so far as the insurance companies are concerned, from the unwarrantable attack which Mr. Swift has made upon them. J. SMITH.

Manchester, August 7th.

[It is quite unnecessary that the subject taken up in the letters by Mr. Swift and by Mr. Smith should be further discussed. The subject properly under discussion is elephant boilers, and not the work of boiler insurance companies.—ED. E.]

WANTED—TWO AUTOBIOGRAPHIES.

SIR,—The widespread interest created by the publication of Mr. Nasmyth's "Autobiography," suggests that there are two other men whose inventions have made their mark deep upon the present age, and of whom the world would fain know a little more than they do. I allude to Sir Henry Bessemer and Sir William Siemens. Both these gentlemen would probably be inclined to say that they are busy with other matters, and that, in a word, "they would rather not" write their autobiography. But posterity will certainly be curious to know what manner of men they were, and I would beg permission to ask them, through your columns, whether they will not sit down now and draw their own portraits. HISTORICUS.

London, August 4th.

EXPLOSION OF A COMPRESSED AIR RECEIVER.—EFFECT OF COMPRESSED AIR ON ANIMAL OILS.

SIR,—I am rather surprised to find that spontaneous inflammability of animal oil in contact with compressed air is not generally known, for in experiments I made about the year 1865, I found that to be the fact; my attention being called to it by a narrow escape I had during the charging of an air gun.

In 1868, when I explained my mode of working torpedoes to the Floating Obstruction Committee, I told them there were dangers in connection with compressed air which I was aware of.

Several explosions have occurred in experimenting with the Whitehead torpedo, and one would have expected the skill at the service of the War Department of the State would have discovered this.

I have unfortunately mislaid my notes, but I have some of the apparatus, which is of a simple character, now in use. The oil I experimented with is called neatsfoot.

7, Miles's-buildings, Bath, PHILIP BRAHAM, F.C.S.
August 6th.

TAKING THE SPEED OF TRAINS.

SIR,—In your last week's issue, under the heading of "Taking the Speed of Trains," a correspondent states that he counts the number of fishplates passed in 14½ seconds, which equals the number of miles gone through per hour if the rails are 21ft. long. May I be permitted to point out that on the 15th of January, 1875, you were good enough to insert a letter of mine in which I advocated that method of taking the speed of trains, and showed how the figure of 14½ seconds—or rather 14·3 seconds—was arrived at. Since that time a great many steel rails have been laid down, their average length being, I believe, 30ft., which makes it necessary to count up to about 20½ seconds for ascertaining the correct speed. It is only necessary to ascertain the average length of rails used on any railway in order to be able afterwards at any time to find out the speed of the train in which we are travelling by taking out a watch and simultaneously counting the rail joints passed over. This can be done with greater ease upon some permanent ways than upon others. I thank you beforehand for the insertion of the above. JOSEPH BERNAYS.

96, Newgate-street, London, E.C.,
August 7th.

COMPOUND CONDENSING ENGINE AT THE R.A.S. SHOW, YORK.

SIR,—Your correspondent John Pinchbeck is, we think, somewhat hypercritical in his remarks last week under the above title. When the editor, speaking of our exhibit, makes use of the words, "We believe this is the first condensing engine shown at work at any of these shows," he is strictly correct; he is writing of the Royal Agricultural Show. The word "these" applies to those shows, and shuts out Mr. Pinchbeck's objection altogether. We take it the sentence, if quoted complete, really means to imply what is stated in our published circular, that this was the very first compound engine ever exhibited at any of the R.A.S. shows, and further, we think we are correct in stating that it is the very first combined compound engine and boiler arranged in one sole plate ever exhibited at work at any public exhibition, international or otherwise.

Dukespalace Ironworks, RICHES AND WATTS.
August 7th.

BECK'S WATER WASTE PREVENTER.

SIR,—In your notes of the Engineering Exhibition at Islington you describe and illustrate Beck's waste water preventer. Will you allow me to state that this waste water preventer, as described and illustrated, appears to be not only identical in principle with that invented by Mr. T. H. P. Dennis, my partner, and which has been in constant use and has been largely sold for many years past; but, as far as the illustration goes, the resemblance is so complete that Messrs. Beck might even have taken one of Dennis's and used it for a pattern to mould from. R. E. CROMPTON.

Mansion House-buildings, London, July 28th.

SIR,—We beg to thank you for your courtesy in allowing us to reply to above letter in your present issue. We have examined Mr. Dennis's specifications, and as far as any patentable features are concerned, we find there is no resemblance between Mr. Dennis's arrangement and our own. We have never seen one of Messrs. Dennis's waste water preventers.

Southwark. BECK AND CO.

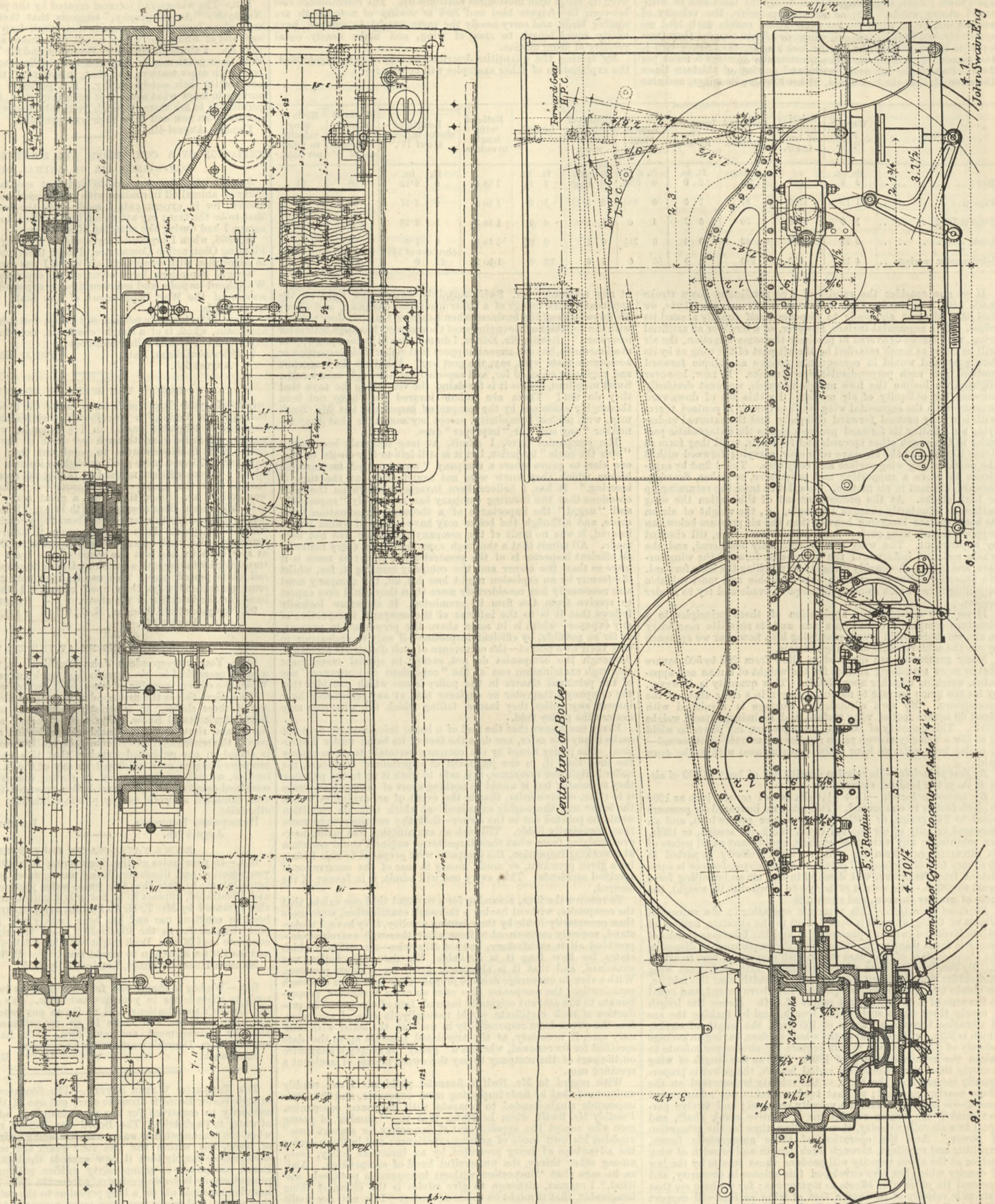
THE TEES-SIDE WATER SUPPLY.—The Stockton and Middlesbrough Water Board is about to carry out one of the works it has authority to construct for the provision of an additional supply of water to its district. The Board was formed seven years ago, when the consumption of water was decreasing owing to the dulness of trade, but within the last four years the consumption has advanced so largely that it now exceeds the legal maximum the Board has power to pump—sixty million gallons weekly. The present supply is drawn exclusively from the river Tees, and there have been compla nts for a long period as to the polluted nature of that source, and power was given seven years ago to construct large works in Upper Teesdale. One part of this scheme is now about to be carried out—the construction of the Hury and Blackton reservoirs at an estimated cost of about £365,000. By it an ultimate addition of forty-six million gallons per week is expected to be obtained; but it would be by the construction of the reservoirs as compensating reservoirs only, the additional supply being pumped from the river. The cost of the Hury reservoir alone, which is expected to give thirty-two million gallons of water weekly, is estimated at £286,000.

COAL MINING IN YORKSHIRE.—Mr. F. W. Wardell, her Majesty's Inspector of Mines for the district of Yorkshire, in his report for 1882 states that in that year 61,548 persons were employed about the mines, as against 60,531 in 1881, and 18,525,406 tons of coal were raised, as against 18,287,141 tons in 1881. There were last year eighty-seven fatal accidents, causing ninety-five deaths, so that one life was lost to every 648 persons employed. In 1881 there were seventy-five fatal accidents, each causing one death; and there was one life lost to every 807 employed. Last year one life was lost to every 199,812 tons of mineral wrought, whilst in 1881 a life was lost to every 249,376 tons wrought. Viewed in this light, mining in the district appears to have been more dangerous last year. It is rather remarkable that throughout the kingdom the result is similar, the average loss of life last year being one to every 152,161 tons wrought, as against one to every 177,106 tons wrought in 1881. In Yorkshire there were last year 452 mines at work, whilst in 1881 there were 471, a decrease in the year of nineteen. Mr. Wardell observes that the mines of the district are not fully employed, and that the large output does not show nearly their full limit of production, as last year's total could be largely increased.

COMPOUND LOCOMOTIVE—LONDON AND NORTH-WESTERN RAILWAY.

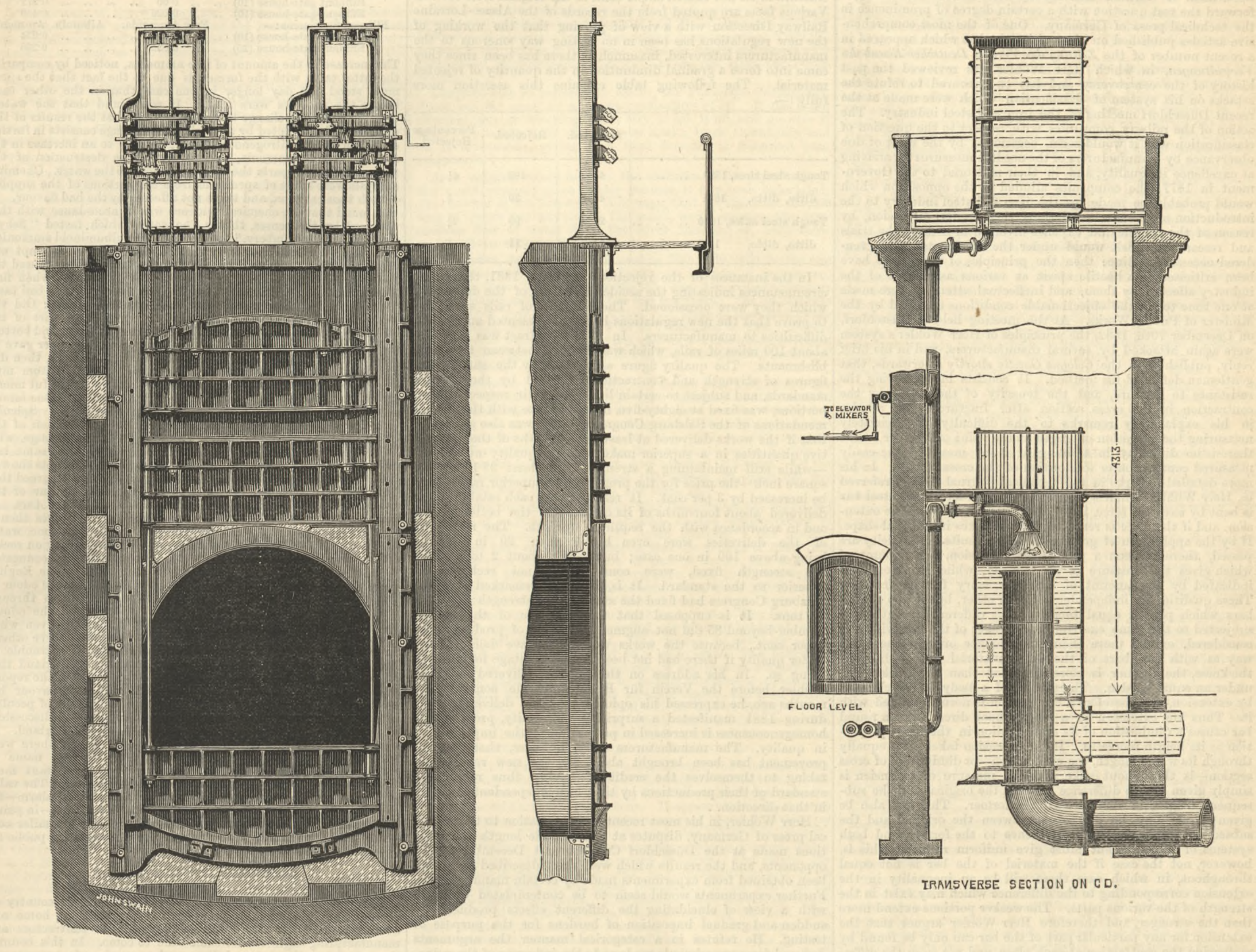
MR. FRANCIS W. WEBB, ENGINEER.

(For description see page 92.)



MACHINERY AT THE SALFORD SEWAGE WORKS.

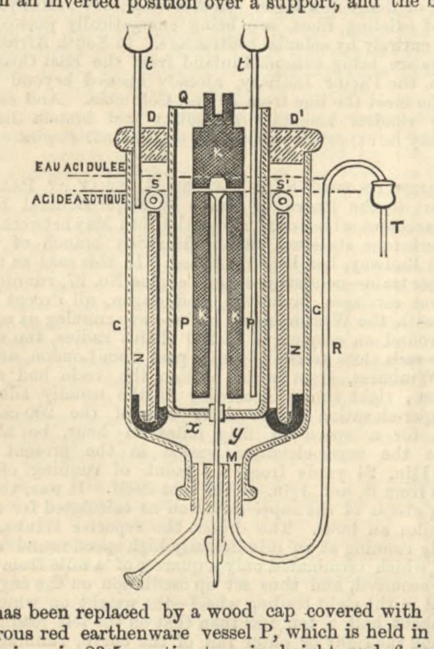
(*For description see page 35.*)



TRANSVERSE SECTION ON C D.

A CONSTANT CURRENT BATTERY CELL.

The battery illustrated by the accompanying engraving was made by Dr. E. Obach, while experimenting with his movable bobbin galvanometer, to furnish a constant current of long duration. It is described by *La Nature* as a Bunsen battery, employing zinc, water acidulated with sulphuric acid, carbon, and nitric acid, and so arranged as to secure a continuous renewal of the liquids. The internal resistance of each element is, on an average, 0·07 ohm, and the electro-motive force is 2·09 volts. It is able, then, to furnish nearly 30 ampères in a short circuit. G G is a jar, 20 centimetres in height and 12·5 in diameter, placed in an inverted position over a support, and the bottom of



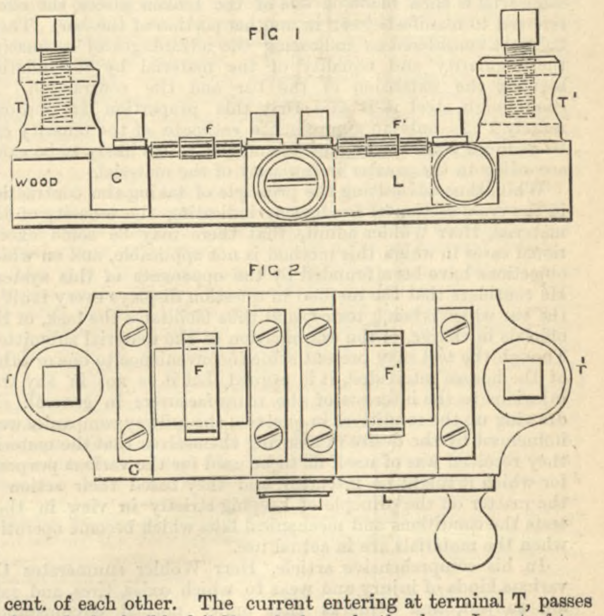
which has been replaced by a wood cap covered with paraffine. The porous red earthenware vessel P, which is held in place by a cork ring, is 23·5 centimetres in height and 6 in internal diameter. The choice of the porous vessel is very important, and the proper working of the element depends much upon the quality of it. Those employed by Dr. Obach became entirely saturated one minute after having been filled with water, this giving the measure of their porosity. The porous vessel is closed with a cork saturated with paraffine and traversed by a carbon K. This latter, which is retort carbon, is 22·5 centimetres long by 3·5 in diameter, and contains in its centre an aperture 15 millimetres in diameter and 18 in length. In its upper part there is a series of small radiating holes; and a glass tube M, whose upper extremity is funnel-shaped, reaches its summit and traverses the porous vessel as well as the cap of the jar. The bottom of the porous vessel is paraffined, as is also its upper edge and the head of the carbon. Upon the bottom of the jar there rests a gutta-percha ring which forms a channel x y that is filled with mercury, and into this dips the lower part of a zinc cylinder 16 centimetres in length, 6 in diameter, and weighing 2 kilogrammes. Through the cork at the lower part of the jar there pass two tubes R and r, and through the wooden cover the two funnel tubes t and t^1. The former of these t terminates in the upper part of the zinc, while the latter runs to the bottom of the porous vessel. The liquids circulate as follows:—The fresh nitric acid reaches the bottom of the porous vessel through the funnel tube t^1, while the spent acid flows off through the radiating holes in the carbon into the central tube M, and into a receptacle placed at the lower part. The water containing sulphuric acid enters, on the contrary, at the upper part at t, and, being rendered denser through the formation of sulphate of zinc, flows through the syphon tube R into the tube T. The level of the liquids is not very different, as may be seen in the figure, but that of the sulphuric acid water is a little the higher of the two in the external vessel. S S^1 is a section of a glass tube bent into a circle and arranged at the upper part of the liquid, where it is warmest. This tube is traversed by a current of cold water in order to keep the liquid at a constant temperature. The tube r serves to empty the pile, and is always kept corked while the latter is in operation.

All the communications are established by mercurial contacts. The zinc cylinder is connected with a strip of copper contained in a glass tube that traverses the cover, and which dips into the mercury in the gutta-percha trough. The square end of the carbon is hollowed out at Q, and the cavity is filled with mercury, which serves to establish communication with the external circuit.

HEDGES' DUPLEX SAFETY CUT-OUTS AND FUSES.

The extension of the use of electricity as an illuminant is not entirely unattended with danger, but it has this advantage over its rival, gas, in that a few simple precautions are all that are necessary to render its use perfectly safe. The principal risk is that from fire, caused by the overheating of the wires either from their being badly proportioned or by turning on accidentally a stronger current than they are designed to carry. The committee appointed to consider the fire risks from electric lighting, in their rules, which have been very carefully drawn up, state at paragraph eight that "there should be in connection with the circuit a safety fuse constructed of easily fusible metal, which would be melted if the current attains any undue magnitude, and would thus cause the circuit to be broken;" also that "changes of circuit from a larger to a smaller conductor should be sufficiently protected with suitable safety fuses, so that no portion of the conductor should ever be allowed to attain a temperature exceeding 150 deg. Fah." The ordinary form of fuse as used by Edison and others for powerful currents consists of a bar of lead or alloy inserted in the circuit. This plan is attended with many disadvantages common to all fuses containing a mass of metal, which are very uncertain in action, and must be worked at not more than a quarter of their melting point. The rupture of a solid rod also constitutes an element of danger by scattering the molten metal in all directions.

The new form of cut-out and safety fuse which we illustrate above, as invented by Mr. Killingworth Hedges, of Westminster, consists of one or more strips of foil composed of alloy which is found best to resist the disintegrating action of the current. For small currents only one strip is used, but for larger several strips are placed together between layers of mica, and are built up like the leaves of a book, the ends being connected to the terminals as shown. When the current exceeds the amount which can be carried safely the foil is ruptured through the centre, but the mica itself is not injured and can be used over again. The mica prevents the metal being thrown about and equalises the heat, so that it is quite possible to test a number of fuses and find them all to melt within, we are informed, 2 per



cent. of each other. The current entering at terminal T, passes through the fusible foil F, and through the lever L, out of terminal T^1. In the event of the fusible foil F fusing through excess of current or short circuit, the lever L is switched over to C, thus bringing F^1 into circuit, and the cut out foil can be replaced at leisure. These cut-outs have been passed by the fire insurance companies, and fifty arranged to give way, some with a current of 60, and some with 120 ampères, have been employed in the new Law Courts, London, since the opening. In installations with secondary batteries a sensitive cut-out, preventing the current being discharged in a reverse direction through the dynamo, is a very essential detail.

GERMAN RAILWAY TESTS FOR IRON AND STEEL.

A controversy between the Association of Ironfounders and the Union of German Railway Administrations has brought forward the test question with a certain degree of prominence in the technical press of Germany. One of the most comprehensive articles published on the subject is that which appeared in a recent number of the *Zeitung des Vereins Deutscher Eisenbahn Verwaltungen*, in which Herr Wöhler has reviewed the past history of the controversy and has endeavoured to refute the attacks on his system of classification which were made at the recent Düsseldorf meeting of the iron and steel industry. The action of the railway companies with respect to the question of classification was, it would seem, occasioned by the want of due observance by manufacturers of the needful measures for arriving at excellence in quality, and in their memorial to the Government in 1877, the companies alluded to the opposition which would probably be made by the iron and steel industry to the introduction of the new regulations then under discussion, by reason of the trouble and expense involved in making the trials and researches which would under the circumstances be rendered necessary. Since then the principles of these tests have been criticised in a hostile spirit at various assemblies of the industry affected by them, and ineffectual attempts were made at one time to get the objectionable conditions modified by the Minister of Public Works. At the meeting held at Düsseldorf, on December 10th, 1882, the principles of Herr Wöhler's system were again attacked by several manufacturers, and in his brief reply, published in the *Cologne Gazette* shortly afterwards, that gentleman defended his method. It consists in measuring the resistance to fracture, and the tenacity of the metal by the contraction in the cross section after fracture. He alludes in his explanatory remarks to the difficulty of accurately measuring the extension of length at the point of fracture, while there is no difficulty in arriving at it by means of the easily measured contraction or diminution of the cross section. In his more detailed remarks in the technical journal already referred to, Herr Wöhler alludes to the fact that if an iron or steel bar is bent by external force, it is first subjected to an elastic extension, and if the force is removed it again takes its original shape. If by the application of greater force the limits of elasticity are passed, there is then a permanent extension, the amount of which gives the measure of its tenacity, while its strength is indicated by the amount of force necessary for its fracture. These qualities are independent of each other, but if two similar bars which possess equal tenacity, but different strengths, are subjected to the same exertion, the weaker of the two will, it is considered, extend more than the stronger one, in the same way as with two bars of the same material but of different thickness, the thinner is more extended than the thicker one under an equal burden. The volume of a body is not changed by extension, and therefore a contraction is normally allied with it. Thus the extension in a longitudinal direction of a round bar causes a diminution of its cross section in the same proportion as its length increases. If the extension takes place equally through its whole length, the contraction—or diminution of cross section—is throughout alike, and the measure of extension is simply given by the difference between the original and the subsequent length, in reference to the former. This can also be given correctly by the difference between the original and the subsequent cross section, in reference to the former, and both systems of measurement must give uniform results. This is, however, not the case if the material of the bar is not equal throughout, in which case there will be an inequality in the extension corresponding to the difference which may exist in the strength of the various parts. The weaker portions extend more than the stronger, and therefore Herr Wöhler argues that the extension for any particular part of the bar can only be found by measuring the contraction at each place, and not from the difference in length.

From these facts he infers that every iron or steel bar which is extended acquires in the direction of the extension a greater degree of strength. In order to extend it further the burden must be increased, and then the extension is increased until the strength has again been sufficiently augmented to allow the bar to support the increased weight. With an equal increase of the burden the corresponding increase of extension is not the same, but gradually increases, while the cross section diminishes. If the extension has reached a point where the diminution of the cross section surpasses the increase of strength arising from the greater extension, then, provided the tenacity is not exhausted, the extension can, it is true, be continued; yet the burden cannot be increased, but further extends the bar in a more rapid manner until it is broken. Even an unavoidable difference in the strength of a material suffices to produce this effect at one part of the bar somewhat earlier than in other portions. If the same trial is then made on one of the broken pieces, the effect referred to manifests itself in another portion of the bar. These facts are considered as indicating the advantages of estimating the regularity and equality of the material by the relation between the extension of the bar and the contraction. In good tough steel it is said that this proportion is approximately 1 : 2—only an approximate estimate of the tenacity can be deduced from the extension, and this is less likely to be exact according to the greater irregularity of the material.

While thus advocating the principle of taking the contraction in the cross section of fracture as indicating the tenacity of the material, Herr Wöhler admits that there may be some exceptional cases in which this method is not applicable, and on which objections have been founded by the opponents of this system. He considers that the method in question displays every fault of the bar which is being tested, and thus facilitates the task, of the officials in charge, of the examination of the material submitted. Though the test may present some inconvenience to one or other of the houses interested, it is argued that it is not in any way injurious to the interests of the manufacturers in general. In drawing up the conditions in question the railway companies were influenced by the desire of assuring themselves that the material they received was of itself fit to be used for the various purposes for which it might be intended, and they based their action in the matter on the principle of keeping strictly in view in their tests the conditions and mechanical laws which become operative when the materials are in actual use.

In his comprehensive article, Herr Wöhler enumerates the various kinds of injury and wear to which axles, tires, and rails are subject, and remarks that under normal circumstances railway material is not forcibly torn, bent, or broken, and that when such violent force is brought to bear on it, then the limit of human precaution has already been passed. On the other hand, he considers that scientific tests have to be arranged in view of those small and sometimes almost imperceptible movements which, by their frequent repetition, affect the durability of the material subjected to their influence.

The test applied by the Imperial Railways of Alsace-Lorraine, of which Herr Wöhler is manager, in the acceptance of axles, involves the sample bar being subjected to a load of 34·92 tons per square inch of the cross section during ten minutes, without any further extension taking place during that time. If this test is withstood, the bar is subjected to a further weight until it is broken. After being broken, the cross section of fracture must not exceed 65 per cent. of the original cross section. Various facts are quoted from the records of the Alsace-Lorraine Railway Direction with a view of proving that the working of the new regulations has been in no lasting way onerous to the manufacturers interested, inasmuch as there has been since they came into force a gradual diminution in the quantity of rejected material. The following table explains this assertion more fully :—

	Accepted.	Rejected.	Percentage Rejected.
Tough steel tires, 1880	4763	196	$4\frac{1}{7}$
ditto, ditto, 1881	4461	30	$\frac{2}{3}$
Tough steel axles, 1880	2089	99	$4\frac{3}{4}$
ditto, ditto, 1881	3259	11	$\frac{1}{3}$

In the instances of the rejections made in 1881, there were circumstances indicating the accidental nature of the defects by which they were occasioned. The deliveries of rails seem also to prove that the new regulations have not presented any serious difficulties to manufacturers. In 1879 a contract was made for about 100 miles of rails, which was divided between two establishments. The quality figure arrived at by the sum of the figures of strength and contraction reckoned by the German standards, and subject to certain limits in their respective proportions, was fixed at eighty-five, in accordance with the recommendations of the Salzburg Congress; but it was also stipulated that if the works delivered at least three-fourths of their respective quantities in a superior make with the quality number 90—while still maintaining a strength of at least 38·1 tons per square inch—the price for the proportion of superior rails would be increased by 3 per cent. It resulted that each establishment delivered about four-fifths of its quantity in the better quality and in accordance with the required strength. The remainder of the deliveries were even higher than 90 in quality, being above 100 in one case; but being about 2 tons under the strength fixed, were consequently not reckoned as superior to the standard. It is, however, remarked that the Salzburg Congress had fixed the standard of strength at about 32 tons. It is supposed that this increase of the quality number beyond 85 did not augment the cost of production by 3 per cent., because the works would not have delivered the better quality if there had not been some advantage for them in doing so. In his address on the subject delivered by Herr Wöhler before the Verein für Eisenbahnkunde some twelve months ago, he expressed his opinion that the deliveries made during 1881 manifested a surprising uniformity, proving that homogeneousness is increased in proportion to the improvement in quality. The manufacturers deny, however, that this improvement has been brought about by the new regulations, taking to themselves the credit of having thus raised the standard of their productions by their own independent exertions in that direction.

Herr Wöhler, in his most recent communication to the technical press of Germany, disputes at considerable length the assertions made at the Düsseldorf Congress last December by his opponents, and the results which were there described as having been obtained from experiments made by certain manufacturers. Further experiments would seem to be contemplated by them with a view of elucidating the different effects produced by sudden and gradual imposition of burdens for the purpose of testing. He refutes in a categorical manner the arguments deduced from experiments made as to the influence of the reduction of thickness by hammering on the effective properties of steel. He maintains that railway engineers have many difficult problems to solve, for which perfection of material is indispensable, and expresses his surprise that manufacturers should oppose such a requirement if railway companies are willing to pay for it.

The manufacturers' organisation has published a letter in the *Cologne Gazette* stating that the cause of the quality of the rails alluded to being above the standard was that the application of the tests is sometimes made in a stringent manner, and under circumstances which treat insignificant defects in such a way that, as a measure of precaution, the quality is made above the standard. The part of Herr Wöhler's remarks dealing with the question of the business profit which must have resulted to the manufacturers does not seem, however, to have been dealt with.

THE CAUSE OF A PECULIAR CONDITION OF SOME AMERICAN WATER SUPPLIES.

The following paper, by Chas. R. Fletcher, Lecturer on Chemistry, Boston University, and State Assayer of Massachusetts, is of some interest to those engaged in water supply questions. It was read before the Society of Public Analysts on 27th June last :—The peculiar, disagreeable, and truly alarming condition of the public water supply of the city of Boston, about a year ago, caused anxiety and alarm ; for the cause of the contamination was unknown, although sought for at different times by the chemist of the Water Commissioners; and the bad flavour and odour caused illness and disgust; and the waterworks had already cost several millions of pounds, and now the supply had been several times affected by a similar flavour during several years, for a short period and in less degree. The valuable water supplies of eleven other cities had been also affected, since 1864, with probably the same trouble. In the winter of 1881-2 the Boston supply was very bad, not fit for domestic purposes on account of the odour and flavour. This has been commonly recognised under the name of "cucumber taste," as it resembles somewhat the taste of water in which cucumbers had been soaked. But now the taste was worse, almost fishy, and often caused nausea, and always disgust. It gave me pleasure to examine the water from a chemical point of view, with analyses, and report to a leading society of physicians, called together to discuss the situation ; for the physicians were aroused, and the people anxious. The only thing I noted was the higher percentage of "albuminoid ammonia" than that reported in previous analyses of this water. Expressing the belief that with an appropriation of a small sum the cause could be now detected in some low form of vegetable—possibly animal—growth, the sum was being raised when the Water Commissioners were aroused by the public cry, and compelled to order an investigation. A chemist had been employed to make analyses for years, but had never found the cause, possibly in consequence of unfavourable conditions. The common sense and scientific examination carried out in 1881-2 was successful, and is of great value. It was found that the bad flavour was intensified by heat, and also the odour—which was slight when the water was cold—became very strong and disagreeable. Samples of the water were collected under many different conditions, from the surface and at depth, and from all points of the supplies. It was found by chemical analysis of filtered and of unfiltered water, taken from the different positions in the lakes and reservoirs :—First, that there was considerably more nitrogenous matter in suspension at the effluent gate-house—of the storage basin, which was particularly affected—than at the influent gate-house ; and Secondly, that there was not much difference in the amount of such matter in solution in the two specimens :—

Unfiltered Specimens :—	Free Ammonia.	Albumin. Ammonia.
Influent gate-house (10)	0·00	0·272
Effluent gate-house (10)	0·026	0·450
Filtered Specimens :—	**Free Ammonia.**	**Albumin. Ammonia.**
Influent gate-house (10)	0·034	0·274
Effluent gate-house (10)	0·032	0·296

The increase in the amount of free ammonia, noticed by comparing the latter table with the former, is due to the fact that the specimens stood one day longer in one case than in the other case, before the analyses were made. It was found that the waters undergo a gradual change by standing, and that the results of this change can be detected by analysis. This change consists in further oxidation of the nitrogenous matter, leading to an increase in the amount of free ammonia, and finally to the destruction of the material which imparts the taste and odour to the water. Chemical analyses were made of specimens from all portions of the supplies—both those affected and those not affected by the bad flavour. It was found that the chemical evidence was in accordance with that obtained by the senses, that is, the waters which tasted "fishy," "metallic," "cucumbery," contained more "albuminoid ammonia" than those which did not carry the bad flavour. An attempt was then made to determine where the substance which caused the taste was at the bottom of the lake or not. The mud, when first filtered from the water, had no odour, nor the water any bad taste at such depth. The question at once suggested itself : Did the taste come from something situated on some other part of the bottom, or might it be developed by contact of the mud and bottom water with air? A thin layer of the mud on a filter paper gave in half-an-hour the same odour, which increased for a time, then disappeared. There was evidently something in the bottom mud capable of giving the odour by contact with air. A careful microscopic examination revealed plants belonging to the Nostoc family in quantity. Some were separated, but gave no odour. Spicules of a sponge were also noticed, and later an examination of the screens at the gate-house showed an amount of this sponge, with the grass and leaves which had collected there. The same bad odour was there more manifest, and a series of experiments showed that the odour came from this fresh water sponge. All agreed that the odour from it was identical with the peculiar flavour of the water. The specimen is known as *Spongilla fluviatilis Anct.* It abounds in some localities, easily decomposes, and gives then a very strong odour. By drawing off the water from one water basin, large quantities were found in some places growing on rocks, from which it was easily detached. The experiments connected with this investigation were conducted according to the English rules of chemical analysis. The best way to detect the odour in water but slightly affected was to pass a pint or so through ordinary filter paper. This paper will then reveal the odour, though it may be quite impossible to detect it directly, even when the water is heated. This test is delicate, and may serve others. Indeed, it is in the hope that a knowledge of this trouble in America may be of service to the public analysts of England that I have requested of the Water Commissioners access to the report, the substance of which is here presented. As this flavour has been occasionally noticed since 1854 in this country, it is of peculiar interest in connection with the valuable statistics and discussions on water supplies of the Society of Public Analysts, England. In connection with this condition of the Boston water, there were various representatives, unjustly dignified by the name of "theories," sometimes by intelligent, usually by ignorant men, who possessed practically no knowledge of the subject. The value of this successful investigation in stopping anxiety and alarm—for as soon as the cause was known, a remedy soon followed—in pointing out to other large cities the probable cause of a similar condition, and in regaining the respect of the press and the public for chemical analysis of waters, was large.

Railway Construction is not very active in this country at present, but the work in progress and projected at home and abroad is likely to afford full employment to contractors and manufacturing engineers for some time to come. In this country the main trunk lines are spending much money in enlargements and widenings ; the Hull and Barnsley line approaches completion, and the last link of the London Inner Circle Railway, which is being constructed through the heart of the City by a most ingenious system of street tunnelling, will be finished next year. The proposed Hull and Lincoln Railway has been rejected by a Parliamentary Committee because of the supposed obstruction to navigation of the high-level bridge over the Humber, which was its essential feature; the new line to Eastbourne, and the Bristol line of the London and South-Western Railway, are also lost for this session. In France, the authorised new lines which were to have been made by the State are to be constructed by the existing companies on terms more favourable to them than advantageous to the community; in Germany, the acquisition of the railways by the Government, mainly for strategical purposes, will involve the making of many new lines. In Australia, new railways, or extensions of existing lines, are being energetically pushed forward, almost entirely by colonial contractors. In South Africa, also, the railways are being extended inland from the East Coast; and in Canada, the Pacific Railway, already opened beyond Winnipeg, will soon meet the line from British Columbia. And as each new railway renders necessary subsidiary and branch lines, ample work may be expected.—*Matheson and Grant's Engineering Trades Report.*

Accident on the Great-Eastern Railway at Parkstone.—A report to the Board of Trade by Major-General Hutchinson on the accident which occurred on the 15th May between Wrabness and Parkstone stations, on the Harwich branch of the Great Eastern Railway, has been published. In this case as the 9 a.m. passenger train—consisting of tank engine No. 97, running chimney first, four carriages, brake-van, and wagon, all except the wagon fitted with the Westinghouse brake—was running at considerable speed round an easy curve of 200 chains radius, the whole train left the rails close to the $67\frac{1}{4}$ mile post from London, and $2\frac{1}{4}$ miles from Wrabness, from which station the train had started at 9.16 a.m., right time. According to the usually adopted rule, the super-elevation of the outer rail of the 200-chain curve should, for a speed of fifty miles an hour, be about $\frac{3}{4}$in., whereas the super-elevation varied in the present case between $1\frac{1}{2}$in. 24 yards from the point of running off to $2\frac{1}{2}$in. 8 yards from it, and $1\frac{3}{4}$in. at the spot itself. It was, therefore, in varying excess of the super-elevation as calculated for a speed of fifty miles an hour. The driver, the reporter thinks, had been probably running at an injudiciously high speed round the reverse curves, which terminated only a quarter of a mile from where the run-off occurred, and thus set up oscillation on the engine, which resulted in the right leading wheel—the weight on which was probably about half a ton less than that on the left leading wheel—mounting the right or outer rail of the curve, running obliquely along the top of it for about 24ft., and then dropping off on the outside, after which it was quickly followed by the rest of the wheels of the train. There is no doubt, Major-General Hutchinson says, the application of the Westinghouse brake by the guard as soon as he had recovered from his fall was useful in keeping the vehicles of the train in a straight line, and from overrunning each other. The driver and fireman, having been both knocked down, were incapacitated from applying it for the first few moments. This engine was the one which ran off the rails near Leiston last August, on which occasion there is but little reason to doubt but that the permanent way was more in fault than the engine. There is more in the frequent derailment at curves than is dreamed of in the usual philosophy of the subject. That engines do not more often mount the rails is rather remarkable than surprising.

RAILWAY MATTERS.

THE average cost of repairs to coal and freight cars, per ton carried per 100 miles on the Philadelphia and Reading Railroad Company's lines, is given as 8·2c. for coal cars and 13·6c. for freight.

THE opening of the Wodonga and Albury Railway, New South Wales, took place on June 14th, and the meeting on the occasion was a great success, the banquet and the ball being very numerously attended, as much as 30s. a ticket being paid for admission to the second event.

THE proposed trans-continental railway is an absorbing subject of discussion throughout Western Queensland. The scheme, however, is regarded as being in advance of requirements, and the more gradual extension of the present Government lines is recommended by the more cautious among the colonists.

THE Brighton Town Council have just decided, by 25 to 1, to give general approval to a scheme for a second railway from Brighton to London, but deferred passing definite judgment until details were submitted. Dissatisfaction was expressed at the accommodation provided by the present company and the rates charged. A letter was read stating that the maximum charge for first-class passengers would be 2¼d., second 1½d., and third 1d. per mile.

THE Public Works Committee of the Birmingham Corporation, reporting upon the use of steam on the tramways, announce that they have not come to the conclusion that steam is not a very fitting power for tramways, but that in face of accidents in other places, and of the fact that an experimental trial only is at present being made on part of the Birmingham tramway system, they have deferred the consideration of the extended use of steam until they have had some further opportunity of judging of its safety and general advantages.

THE French Minister of Public Works has just completed a census of the rolling stock on the French railways, which is thus summed up:—Nord, 1138 locomotives, 2021 passenger carriages, 33,971 goods wagons; Est, 922 locomotives, 2359 passenger carriages, 22,401 goods wagons; Ouest, 1045 locomotives, 2881 passenger carriages, 17,465 goods wagons; Orleans, 970 locomotives, 2100 passenger carriages, 20,433 goods wagons; Paris and Lyons, 1960 locomotives, 3489 passenger carriages, 62,200 goods wagons. Taking all the smaller lines as well, there are in France 6893 locomotives, of which 2826 are for passenger traffic and 4067 for goods traffic; 15,432 passenger carriages, of which 3208 are first-class, 5315 second-clsss, and 6909 third-class. The total number of goods wagons is 182,089.

AT the seventh annual convention of the Master Mechanics' —Locomotive Superintendents'—Association, recently held in Chicago, a report was presented on the use of metallic packing for piston and valve rods, instead of hemp cotton or any of the more commonly used gland stuffing materials. The report contains the results of several years of experience on many lines. It is almost unanimously in favour of metallic packing on every point for piston rods, but not quite so favourable with respect to valve rods. One contributor to the report says:—"Once the engine equipped, the cost for repairs does not exceed 1 dol. per annum. The difficulty in keeping valve stems packed is due chiefly to the unequal wear on account of the variation of the travel, and to reduce this to the lowest minimum I have adopted the plan of a case-hardened sleeve on valve stems, which works well."

BY a law passed on the 2nd of August, 1875, the French Channel Tunnel Company acquired a concession of the French portion of the proposed tunnel, with power to renounce it within a certain period. Engineers and navvies have been at work more or less ever since that date. Up to last May the length of the excavated passage was 1840 metres, being a distance from the coast of 800 metres. A Government Commission inspected the works at Sangatte on the 5th of May last, and certified that the conditions of the concession had been duly complied with. The 2nd of August inst. was the date at which the French company, conformably to Article 3 of their Convention, had to decide whether they would retain the concession or abandon it. Notwithstanding the abandonment of the scheme by England, the Paris correspondent of the *Standard* says, the French company have within the last week officially communicated to the Government their decision definitively to retain the concession, in the conviction that sooner or later there will be a revulsion of opinion in England.

A PARAGRAPH has been going the round of the daily papers about the Scotch collie dog "Help," who collects funds in almost every part of the kingdom for the Orphan Fund of the Amalgamated Society of Railway Servants. He has just returned to its headquarters at the chief office of the Society, City-road, from a trip to France, where he has been getting money for the orphans of railway men. Introduced by Mr. Raggett, chief officer of the steamship Brittany, to the Vice-Consul at Dieppe, the "Railway Dog of England" received in a short time 138f.; on his journey back to England "Help" got 17s. 9d. and 26f., while at Newhaven and on board the steamer he collected £3 1s. 9d. The general secretary of the Society, Mr. E. Harford, has now on hand numerous invitations to the animal distributed over the leading railway systems. "Help," trained by Mr. John Climpson, guard of the night-boat train on the London, Brighton, and South Coast Railway, is expected, the *Times* says, to be the medium of collecting some hundreds of pounds for the orphan fund during the present year.

EARLY next year there will be a new line opened which will tend to shorten the distance between Cologne and Frankfürt-on-Main. The concession was obtained in 1873 by the Rhenish Railway Company, but the execution of the work has only been effected since the acquisaition of the railway by the State. The line in question is through the Westerwald district, which is bounded by the valleys of the Rhine, the Sieg, and the Lahn. On account of the mountainous character of that part of Germany, the difficulties met with have been in some portions of the line exceptionally great. Between Sayn and Grenzau—a distance of five and three-quarter miles—there were twenty-three viaducts and six tunnels, the gradient being 1 in 60. According to a paper lately read by Herr Paul, at the Lower Rhenish Engineers' Society, the tunnels have all been constructed upon the Belgian system, and only cost per metre of tunnel about £20 to £22 10s. For the permanent way longitudinal sleepers on Menne's system have been employed, this description being in use upon the Rhenish line. The entire length of the railway is sixty miles, and its cost is stated to be about £900,000.

THERE is an instructive table attached to the report of the Metropolitan Railway for the past half-year—one that shows the fluctuations in the passenger traffic of the company. When the railway was opened twenty years ago the passengers numbered less than 1,000,000 monthly, but they rose to 3,000,000 monthly in 1869. When the line was extended to Bishopsgate in 1875, they had swollen to 4,000,000 monthly. It was 1879, when the extensions to West Hampstead and Willesden were opened, that the passengers rose in numbers to 5,000,000 monthly; and now in the past half-year the numbers of the travellers on this little railway, from and to the heart of the city of London, have passed 6,000,000 monthly, the total for the half-year being 36,753,321. This is the largest number of passengers carried by any railway, and when it is remembered that the mileage and line owned and partly owned by the company is only 15, the conveyance of so large a number is certainly remarkable. It is worth notice, too, that they have been conveyed with great safety, the entire sum paid by the Metropolitan Railway for injuries to passengers for the past half-year being only £98 6s. 2d. It is expected that by the beginning of the next year the main works of the last link in the Inner Circle and the Whitechapel connection with the south side of the Thames may be so far completed that an opening for a preliminary train service is expected.

NOTES AND MEMORANDA.

THE average illuminating power of the Leeds gas for the past month was 17·27—a candle and a-quarter more than the Act requires. When tested at the office in Wharf-street, twenty-six tests showed the average illuminating power to be 16·61.

THE annual rate of mortality for the week ending July 28th, in twenty-eight great towns of England and Wales, averaged 20·1 per 1000 of their aggregate population, which is estimated at 8,620,975 persons in the middle of this year. The six healthiest places were Birkenhead, Huddersfield, Blackburn, Plymouth, Hull, and Portsmouth.

LEATHER may be restored in colour, the *Furniture Gazette* says, if not too far gone, by a slight application of oil. If this is not effectual, put on blacking, let it dry, brush it off, and go over it again very lightly with oil. If very brown, black thoroughly and oil it afterwards, giving it a final dressing of dissolved gum tragacanth.

AS a supplementary note to the statistics of the paper mills of the world, recently given in this column, it has been calculated, the *Journal* of the Society of Arts says, that to make the 959,000 tons of paper per annum for the world, would require 430 days' medium flow of water down the River Thames; or, 1432 days' metropolitan water supply.

IN London, during the week ending 28th July, 2631 births and 1605 deaths were registered. Allowing for increase of population, the births were 14 and the deaths 165 below the average numbers in the corresponding weeks of the last ten years. The annual rate of mortality from all causes, which had steadily increased in the six preceding weeks from 16·9 to 23·5, declined to 21·2. During the past four weeks of the current quarter the death rate averaged 21·9 per 1000, against 25·0 and 18·0 in the corresponding periods of 1881 and 1882.

THE mortality returns for England in the year 1881 record the death of ninety-one persons who were registered as 100 years old and upwards when they died. Of these aged persons, twenty-five were men and sixty-six women. The ages of the men are recorded as follows:—Nine were 100, five 101, three 102, one 103, two 104, three 105, one 108, and one, who died at Hockham, in Norfolk, if the register is to be relied upon, had attained 112 years. Of the women, twenty-four had reached 100, fifteen 101, eight 102, five 103, six 104, two 105, three 106, and three 107.

FOR some time past the Belgian War Department has conducted a series of experiments at Valvorde, on the waterproofing of soldiers' uniforms by means of liquid alumina. The medical authorities have satisfied themselves that the articles of dress thus treated permit the perspiration to pass off freely, and chemical analysis has proved that the preparation used in no way injures the materials, or destroys their colour. More than 10,000 metres (10,936 yards) of materials, re-dressed two or three times over, notwithstanding the rinsing and washing to which they have been subjected after having been soiled, and after constant wear, remained perfectly waterproof. The process is not very economical, and must be conducted on a large scale. The following, according to the *Journal d'Hygiène*, is the process employed:—Acetate of alumina is obtained by making solutions of equal parts of alum and acetate of lead in separate vessels, and then mixing them together. Sulphate of lead will be thrown down, leaving acetate of alumina in solution, which must be decanted. The materials to be waterproofed are soaked in this solution, and then withdrawn without being wrung, and dried in the air.

STATISTICS relating to twenty-one industries in Massachusetts, and covering about 80 per cent. of the entire manufactures of the State, have recently been issued by Mr. Carroll D. Wright, chief of the Bureau of Statistics and Labour. It appears that the labourers including men, women, and children, average about 1·23 dols. per day in wages. The average for the year was 358·19 dols., and the time 290·60 days. The highest sums were paid by musical instrument factories; the lowest by cotton factories. The capital employed paid in interest 6 per cent. in maunfacturing, and 10 per cent. on the value of the goods produced. 67 per cent. of the factories made a net profit. The building trade showed the largest proportion of non-paying firms, shoemaking being the next. The most profitable manufacture was salt, with 48 15 per cent.; the least profitable, arms and ammunition; in fact, this industry showed a net loss of nearly 17 per cent. Cottons yielded in profit 7·04 per cent.; machinery, 5·94; metals and metallic goods, 6·64; printing and publishing, 15·71; calico printing, bleaching, and dyeing, 31·81; woollens, 6; worsteds, 4·11 per cent.; and boots and shoes only ·78. These statistics are for the year 1880, and a comparison with those of 1875 shows that, while the percentage of capital had advanced 11·52 per cent., the profits had fallen off 3 per cent., the loss in the whole State being 7·19 per cent., and for Boston alone no less than 14·89 per cent. Wages had been reduced 4·35 per cent., expenses had slightly increased, and the net profit had fallen off 7·19 per cent., the capitalist bearing two-thirds of the loss, and the operative one-third.

FROM the reports of the Chamber of Commerce of Besançon it appears that the French watch trade, known as the "fabrication bisontine," is on the whole in a fairly flourishing condition. In 1875 the number of watches turned out—mainly from the Department of Doubs—was 424,916, of which 139,624 were of gold, and 285,292 of silver, while during the past year the total production was 493,933, of which 172,716 were gold, and 321,227 silver. The average value of a gold watch is estimated at 85f., and of a silver one 25f., which brings the value of the trade for 1882 to 22,710,685f. Of this about half may be apportioned for the labour. The first quarter of the present year does not compare so favourably, showing a reduction of 5164 gold watches, though the silver ones increased by 5094. The importation of foreign watches was 92,710 in 1881, and 76,922 in 1882, of which about one-half were supervised at the Assay Office at Pontarlier, the remainder being distributed through the offices at Bellegarde, Lyons, Paris, Besançon, Havre, Nice, Annecy, Bordeaux, Marseilles, Nancy, and Chambéry. Including 397 watches made in other French towns, and the 76,922 imported watches, the total trade of the year amounted to 568,722. The first commencement of the Besançon industry dates from 1793, when 411 skilled artisans from Neuchatel were expelled from Switzerland, and settled in the Department of Doubs. At the present time the number of employers is between 190 and 200, while some 40,000 persons find occupation in watchmaking either in the shops or at their own homes.

FROM the returns of the Prussian industrial census on the 5th of June, 1882, it appears that there were at that date 27,287,860 inhabitants, of whom 9,261,882 were children under fourteen years of age, and therefore unfit for labour, 6,313,573 persons occupied with their households, and 11,742,485 representing the economic power of the nation. Broadly speaking, these last were grouped as follows:—Agriculture, gardening, and forestry, 4,692,348, of whom 1,230,080 were women; mines, factories, and building, 3,065,218 men and 585,408 women; commerce and transport, 766,127 men and 145,579 women; day labourers, 160,640 men, 118,283 women; army, Church, and professions, 352,431 men, 60,661 women; no profession, 352,431 men, 353,064 women; servants, 30,752 male, 855,425 female. The first four groups, comprising those who are employed in industrial undertakings, are further subdivided into managers and foremen, 2,805,728 men, 612,720 women; clerks, 181,583 men, 8339 women; operatives, 4,466,942, men—or 46·85 per cent.—1,458,231 women—or 15·30 per cent. A census was also taken last January of domestic animals, with the following results:—Cattle used in cultivation, 3,124,046, being an increase of 5 per cent. over the corresponding date in 1873; horses, 2,403,288, being an increase of 6 per cent.; mules, 572, a decrease of 39 per cent.; donkeys, 6313, a decrease of 28 per cent.; oxen, 8,735,589, about the same as before; sheep, 14,716,730, a decrease of 25 per cent.; pigs, 5,801,795, an increase of 35 per cent.; goats, 1,671,368, an increase of 13 per cent.; beehives, 1,232,231, a decrease of 16 per cent.

MISCELLANEA.

PROFESSOR G. M. HUMPHREY, M.D., F.R.S., has accepted the Presidentship of the Congress of the Sanitary Institute of Great Britain, to be held at Glasgow in September next.

AT the meeting of the Chester Farmers' Club on Saturday, a discussion took place on the necessity of taking immediate steps to secure the Exhibition of the Royal Agricultural Society at Chester in 1885, and a deputation was appointed to wait upon the council for the same object.

THE works for a supply of water to Towcester were opened last week. The town is now furnished with an excellent supply of water by gravitation. The source of supply is the oolite hills on the south-west of the town. The cost has been under 15s. per head of the population. The scheme has been carried out by the Rural Sanitary Authority, from the plans and under the direction of their engineer, Mr. John Eunson, C.E., F.G.S., of Northampton.

MR. GUSTAV ALSING, C.E., formerly engineer and manager of the Bradford Sewage Works, is now in Sheffield making arrangements for the construction of the new sewage works which the Sheffield Corporation intend to establish at Blackburn Meadows, on ground which they have leased from the Shrewsbury Hospital trustees. The scheme is expected to cost £150,000, and the contracts will probably be given out at the beginning of next year.

THE official report of the German postal and telegraphic authorities calls attention to the fact that there are five instances of telephonic communication between neighbouring towns, Elberfeld-Barmen, Cologne-Deutz, Hamburg-Altona, Mulhouse-Gebweiler, and Mannheim-Ludwigshafen, the distance between which is only a few miles at most. As to long-distance transmission reference is made to the telephone between Berlin and Potsdam—twenty miles—while a still longer communication is now being arranged between Bremen and Bremerhaven—forty miles.

THE new Army and Navy Hotel, Westminster, London, S.W., is lighted throughout by electricity, and it is one of the few installations which have been carried out as a permanent part of a new building. The reception rooms and hall are lighted by about 180 Swan high resistance lamps, the large coffee-room having four crystal glass chandeliers, in each of which are suspended sixteen lights. The current is generated by a steam engine working a Schukhert Brush dynamo, and is stored in fifty-five 3-E.H.P. Faure-Sellon-Volckmar cells. The whole of the work has been carried out by Messrs. Holmes and Vaudrey, engineers of the Liverpool Electric Supply Company, Limited.

ON Saturday the Juana Nancy, belonging to Mr. C. O. Fawcus, of London, was taken on her trial trip. She is 220ft. long, 31ft. 6in. beam, by 14ft. 6in. depth of hold. She is to class 100 A1 at Lloyd's, and is built considerably in excess of the requirements for this their highest class, and is fitted with all modern improvements. She left Dundee and proceeded out to sea, averaging a speed of 10½ knots. Both hull and machinery have been built by Messrs. Pearce Bros., of Dundee, the engines having cylinders of 26in. and 50in. diameter, and 36in. stroke, developing 570 indicated horse-power, with 80 lb. boiler pressure. The engines and ship have been built under the superintendence of Messrs. Flannery and Fawcus.

AT recent meetings of the Corporations of Newcastle and Gateshead considerable attention was given to the question of erecting a new bridge across the river Tyne to meet the great increase of traffic that has taken place during the last few years. The only high level connection at present is the bridge belonging to the North-Eastern Railway Company, on which a toll of one halfpenny is charged for each foot passenger, and the feeling seemed to be that unless the railway company would agree to free the bridge immediate steps should be taken to obtain parliamentary powers for the construction of a second one by the joint Corporations. It was stated during the discussions that the revenue from the existing bridge is between £35,000 and £40,000 a year, the original cost having been about £300,000. The new bridge is estimated to cost about £200,000.

THE annual report of the Crinan Canal says: "The navigation of the Crinan Canal has been maintained throughout the year without interruption or casualty, but the new stone pier, which is approaching completion, was seriously injured by a gale on the 24th of January last, by which upwards of 600 tons of stone were dislodged from the unfinished structure. In the present session the sanction of Parliament has been obtained to a scheme for constructing a ship canal between East Loch Tarbert and West Loch Tarbert, for the purpose of shortening the sea passage between the Clyde and the west and north of Scotland, and avoiding the circuitous route round the Mull of Cantyre. An Act was passed for promoting a similar enterprise in 1846, but the work having been abandoned in 1849, the scheme has now been revived. Should this canal be ultimately completed, it may divert some portion of the traffic of the Crinan Canal; but it will probably be chiefly used by vessels too large to pass through the contracted locks of that navigation."

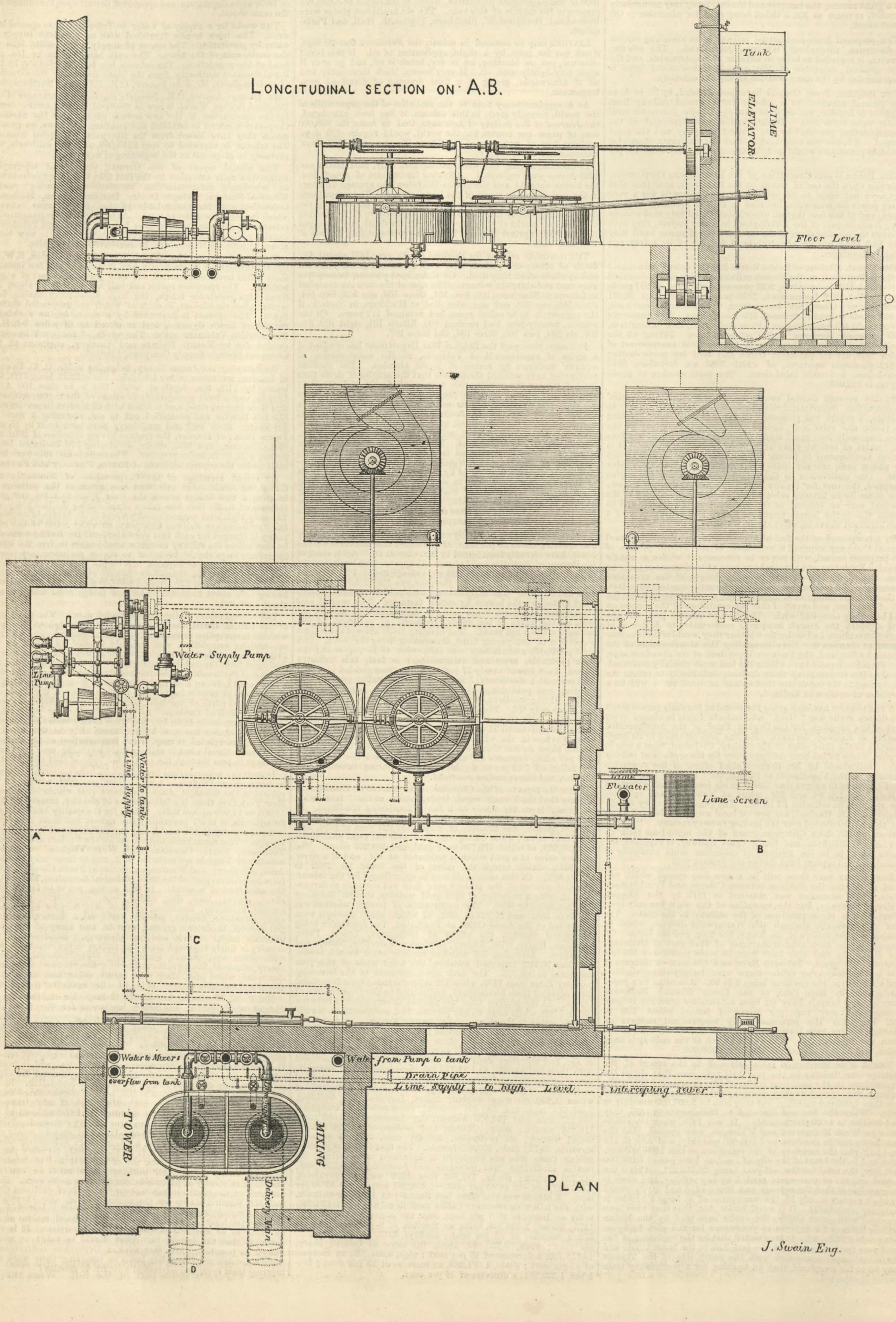
IMPORTANT mineralogical investigations have recently been made in South-West Virginia. A well-known geologist, writing on the subject in the *Scientific American*, states that within 500 miles of New York City there is a large section of country, comprising from 12,000 to 14,000 square miles, which, for the quality and variety of its minerals, is in all probability the richest and most interesting mineral country in the world, and one not surpassed by Saxony, in Europe. This remarkable section lies on the borders of Kentucky, Tennessee, North Carolina, and West Virginia. Seventeen counties of Virginia are included in it, and to these may be added Ashe, Alleghany, and Wantanga counties in North Carolina, which form an integral part of the same geological formation, and contain the same kind of minerals. In this section are to be found gold, silver, copper, lead, zinc, nickel, iron, manganese, plumbago, arsenic, antimony, limestone, gypsum, salt, barytes, kaolin, feldspar, soapstone, fireclay, asbestos, talc, mica, umber, millstone grit, marble, sandstone, granite, syenite, and many of the minor minerals useful in arts and manufactures. Besides this, the country is finely timbered from the valleys to the mountain tops with white oak, walnut, maple, tulip tree, basswood, hickory, cherry, chestnut, buckeye, cucumber tree, chestnut and other oaks, dog wood, white pine, black pine, spruce, cedar, and many other useful and valuable woods. It is also a fine agricultural district.

MR. F. W. WARDELL, her Majesty's Inspector of Mines for the district of Yorkshire, has issued his report for the year. Mr. Wardell points out that an explosion is not necessarily the result of a defective ventilation. Many accidental circumstances arise in the shape of unexpected outbursts or "blowers" of gas, which in a moment fill the workings. The suddenness of these discharges with the enormous pressure at which gas is evolved, renders the best ventilation for the time being powerless, and it is then when an open light, or a defective lamp, may furnish the cause, perhaps hastily described to lack of adequate ventilation. In the Yorkshire district, says Mr. Wardell, several cases occurred during last year, where, but for the most perfect state of safety lamps in use, and the vigorous discipline maintained, the death-roll of the district for the year would have been largely increased. Whilst advocating the best possible ventilation, and that by means of a fan—which means, he observes, are being more extensively used—rather than by furnace, he insists on the necessity for every precaution being taken to ensure the use of the best and most perfect form of safety lamp. All working places must be carefully examined as shortly as possible before the men go to work. Sixty per cent. of the deaths in mines occur from falls of roof and sides, and Mr. Wardell insists on the necessity of an ample supply of, timber for propping. Whilst these accidents are the most frequent they are the least preventable, and the experienced, careful man is as liable to be suddenly caught as the most careless. It is very desirable that the inspector's report should be made as widely known as possible. Only last week a Derbyshire conference of miners condemned the safety lamp as retarding their work and injuring their eyes, and advocated a return to candles!

MACHINERY AT THE SALFORD SEWAGE WORKS.

MR. A. JACOB, M.I.C.E., SALFORD, ENGINEER.

(*For description see page 35,*)



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THE ENGINEER.

AUGUST 10, 1883.

PETROLEUM STORAGE.

THE storage of petroleum is a matter with which the law has hitherto dealt in a very clumsy fashion. The Home-office never seems to have arrived at a clear conception of what was the proper thing to be done in this respect, and the only fear is lest the Petroleum Bill which has been brought forward by the Government at the fag end of the present session should itself prove to be seriously imperfect. Yet it would not be difficult to improve on the present state of things. So far as the safety of the public is concerned, the law which now exists, though better than nothing, is in one aspect simply absurd. We have more than once pointed out the radical error which admits of the unlimited storage of petroleum in any locality so long as the oil does not give off an inflammable vapour at less than a certain specified temperature. The "flashing point," as it is termed, governs the whole question, and practically serves as an inlet by which a flood of petroleum is allowed to enter the metropolis with as little restriction as so much water. The statute very properly specifies that nothing contained in its provisions shall be deemed to exempt any person from any penalty to which he would otherwise be subject in respect to a nuisance. The value and necessity of this saving clause has lately been illustrated at Deptford, where an enormous store of petroleum has been formed, concerning which it is authoritatively declared that the oil "is not petroleum within the meaning of the Act." Supposing the oil to become ignited, it is obvious that a tremendous conflagration would be the result, such as would require very careful arrangements in order to prevent the spread of the flames to the contiguous property. It may be shown that due provision has been made to prevent the escape of the oil in an ignited state so as to endanger the neighbourhood. But the law makes no provision for the purpose, and this enormous store, comprising 20,000 casks, or more than 700,000 gallons of petroleum, would probably remain unmolested were it not that a wealthy company, whose premises are close at hand, have seen fit to take the matter up in their own defence. The peril, whatever it may be, is aggravated by the presence of a large quantity of jute stored within fifty yards of the petroleum. Jute has the reputation of being liable to spontaneous combustion, and is at best a suspicious article. The state of affairs may be held to justify considerable anxiety, but the Petroleum Act offers no relief. The only remedy consists in proceeding by indictment, and accordingly the parties who are storing the petroleum have been summoned before the magistrate for having unlawfully deposited, or caused to be deposited, divers large, excessive, and dangerous quantities of petroleum and jute, to the common danger of the inhabitants of the district. Within a quarter of a mile of the premises there are stated to be about a thousand inhabited houses, together with the premises of the General Steam Navigation Company, some shipbuilding yards, and the gasworks which formerly belonged to the Phoenix Gas Company, now merged in the South Metropolitan.

How this particular case may end we do not pretend to say. The defendants may prove that they have taken such precautions that even if a fire broke out and burned up all the petroleum, the adjacent property would suffer no damage. But if the public are thus secured against peril, no credit for such a circumstance is due to the Petroleum Act. This huge store of mineral oil exists exactly as if no such Act had ever been passed. This is precisely the defect which has been the subject of comment for years, and the provinces are just in the same predicament as London with regard to petroleum storage. But London, as a great centre for the distribution of the commodity, possesses depôts of this description which are pre-eminently large. Sir E. Watkin drew attention to the subject a short time back by asking a question of the Home Secretary in the House of Commons, in the course of which he intimated that there were stored at seven wharves in the metropolitan area as many as 335,000 barrels of petroleum, one wharf alone having more than 80,000 barrels. These quantities are enormous, but we can go a slight step further by estimating the total storage of petroleum in the metropolis at 400,000 barrels, equal to about 15,000,000 gallons. Possibly a great portion of this oil is under regulation of some kind, but the law allows a loophole which may be turned to account at any moment, and the Deptford case shows that petroleum may be stored in immense quantities without any statutory guarantee for the safety of the public. The attention of the Government having been drawn to the subject, the Bill to which we have already referred has been introduced in the House of Lords, and was read a second time on Friday last. The Petroleum Association of London have petitioned against the Bill, declaring that if it were passed it would annihilate the petroleum trade. We hope this may prove to be an exaggeration, or at least that the Bill may be capable of effective amendment at the hands of the Select Committee to whom it is referred. The Bill is drawn very much on the lines of the Explosives Act, and substitutes registration for licensing, rigid rules being laid down for the registered stores. By this plan uniformity would be secured, and all parties complying with the regulations would have a right to storage. Certain abuses of which petty local authorities have been guilty would thus be prevented; but the generally judicious action of the authorities in large towns would be superseded. Unfortunately, the Exeter authorities appear to have been remiss, and a serious fire is attributed to the laxity of the supervision exercised. It might, perhaps, be provided that the local authorities in towns having a certain population should retain the power of granting licences and prescribing their own regulations for the storage of petroleum, as heretofore, the smaller localities being required to enforce the regulations laid down in the statute. Another distinguishing feature in the Bill, and that which is the most important, consists in recognising petroleum of all kinds, so that none shall escape control. This is a right principle, and, if properly applied, will be of immense benefit. The Bill provides that the petroleum which now comes under the law shall be called "low test petroleum," inasmuch as it gives off an inflammable vapour at a temperature less than 73 deg. of Fahrenheit's thermometer. The expression, "high test petroleum," is introduced as meaning all petroleum which is not "low test petroleum." The term "petroleum" is to include mineral oils in general, whatever may be the temperature at which they give off inflammable vapour.

The quantity of petroleum to be stored on the registered premises is specified in the Bill upon a scale regulated by the distance between the depôt and the contiguous buildings. Thus if the intervening distance have a range of between seventy-five and a hundred yards, the quantity of petroleum may amount to 750 gallons, but shall not exceed it. It is at the same time specified that the quantity of low test petroleum on the same registered premises shall not exceed one-fourth of the total amount of petroleum allowed to be kept. It is to be feared that this scale of storage will be fatal to business. Fifteen barrels of high test petroleum, and five of low test will make a very poor stock. If the isolation is made to extend to one hundred yards, then the quantity stored is to be "unlimited." The restrictions are also to be inapplicable with respect to petroleum kept at a distance exceeding twenty-five yards from the specified buildings, in those cases where the registered premises are not situated in a town, as defined by the Act.

It may be conceded that the public safety would be abundantly secured by this measure, the only remaining difficulty being whether an important and increasing trade would be unduly hampered. We fear whether the question is one which can be satisfactorily settled in the little time which intervenes before the rising of Parliament. In addition to the strict requirement with regard to distance, the Bill stipulates that the petroleum shall be kept in such a place, or in such a manner that it cannot escape in the form of liquid, whether ignited or otherwise, so as to reach other premises. Where the registered premises are situated in a town, the depôt is to be covered with a roof. This is very different from the present order of things, by which petroleum is stacked in the open air eight barrels high, being an altitude of 20ft. Doubtless the stack would be raised still higher were it not for the risk of crushing the lower barrels. In hot weather it is customary to have jets of water playing on the barrels to check evaporation. These immense stores represent a demand for the commodity they contain, while at the same time there is an inherent danger about them. If such stores are henceforth only to be kept where the actual depôt is at a distance of a hundred yards or upwards from any other petroleum store or "protected work," the question to be considered is whether such a stipulation will drive the petroleum stores out of London. A "protected work" is defined to mean "any building in which persons dwell, or in which persons not dwelling therein collect or assemble, whether for purposes of religious worship, work, education, amusement, discussion, travelling, or otherwise; and any harbour, canal, or navigable water, whether inland or tidal, or any dock." Provisions such as these are evidently suggested by the apprehension of a serious peril. That there is reason to take every possible precaution which can be enforced without positive injury to trade is proved by experience already gained. It is possible, by means of underground tanks, or properly constructed parapets, to limit the outburst of oil in the event of its ignition. Subterranean tanks may also be so contrived as almost to exclude the possibility of the oil being set on fire. The large stores of petroleum in London are generally constructed in such a way as to keep the oil within bounds in the event of a conflagration. But the Deptford case bids us not be too confident, so long as the Petroleum Act exists in its present form. Even the combustion of petroleum within the limits of the depôt may threaten surrounding property, if it should happen that a high wind prevails at the time. A few months ago there was a fire at a petroleum store on the river side at Battersea, when the flames from the ignited oil rose to an altitude of 150ft. A strong gale might play strange havoc with such a column of fire. Precautions also fail sometimes in an unexpected way. At Swinton, near Manchester, some tanks containing petroleum to which the Act does not apply, were constructed of sheet iron rivetted and soldered. A fire broke out in the depôt, and the solder in some of the tanks melted, allowing the oil to escape. The burning liquid ran into a brook, accompanied by other ignited oil which had been stored in casks, the latter having a low flashing point. The fiery flood was happily checked by the prompt action of some workmen in either draining or damming the brook. But for this happy intervention the blazing liquid, travelling along the course of the stream, would have made its way under the Worsley railway station, which would most likely have been destroyed.

The peril producible by petroleum not under the Act is shown by a large fire at Bristol, when more than 1600 barrels of petroleum, having a flashing point of 84 deg. Fah., were consumed. Considerable quantities of the inflamed oil escaped into the drains and sewers connected with the property on which the fire occurred, and high volumes of flame burst forth from various openings at a distance, to the danger of property and life, though, fortunately, no casualty occurred. The oil which consumed the railway carriages in the Abergele collision, when a fearful sacrifice of life took place, had a flashing point as high as 140 deg. Fah. When once ignited, it generally matters little what the flashing point may be, though the extent of the mischief may sometimes be affected by the amount of volatility in the oil. The initial danger of ignition, of course, depends largely on the temperature of the flashing oil. In the great conflagration at Exeter, the vapour of benzoline was ignited by a lamp placed on the ground at a distance of 27ft. from the open door, which led into the rock-hewn cell or cavern in which the spirit was stored. This cell being fired, others followed, the vapour exploding with great force, and igniting the casks. The burning benzoline, as it poured forth from the stores, flowed over the side of the quay into the river, and gave the stream the appearance of being on fire from bank to bank. Vessels had to be hurriedly released from their moorings, and it was with difficulty that some of them escaped. One vessel lying close to the quay was practically destroyed, and two persons who were on board nearly perished. The fire raged for sixteen hours, despite all that the fire brigade could do, and the flames only ceased when the liquid fuel was all burned up. But while the risk is so much the greater when the oil is of a volatile nature, careful regulations are required in all cases, let the flashing point be what it may. In some shape or other the law ought to take cognisance of petroleum in all its forms, whether known as oil or spirit, and should the present Bill fail to remedy the existing defect, the attempt must be renewed. But while caring for the public safety, the Legislature will have to be on its guard against any undue amount of interference with an important branch of trade.

THE PATENT BILL.

IN a thin House, which might have been counted-out at any moment, consisting as it did of a mere handful of members, this important measure was read a third time in the Commons on Saturday, and sent to the Lords. In its present form it bears evidences of hurry and want of revision, and on the whole is not a creditable piece of work. We do not, of course, intend to go through the Bill, but as a matter of duty we feel bound to point out certain defects in the hope that those in charge of the measure may at the eleventh hour see fit to remedy them. Unless they do so, patentees will find themselves in some respects in a worse position than they are under the present law.

Opinions may differ upon the policy of submitting specifications to an examiner, but the principle once admitted it ought to be thoroughly carried out. If an applicant chooses to file a complete specification at once, it will be referred to an examiner, who will report "whether the nature of the invention has been fairly described, and the application, specification, and drawings, if any, have been prepared in the prescribed manner, and the title sufficiently indicates the subject matter of the invention." But when the applicant files a complete specification after a provisional document, the examiner is only directed to ascertain "whether the complete specification has been prepared in the prescribed manner, and whether the invention particularly described in the complete specification is substantially the same as that which is described in the provisional specification." The intention of the framers of the measure probably is that a complete specification at whatever stage of the proceedings it may be filed shall be examined as to sufficiency, but they have certainly not expressed their intention with clearness.

Much has been said with regard to opposition upon open documents, which still forms part of the Bill. When the officials have done with the applicant, his specification is to be made public, and all the world is at liberty to pick holes in it. Oddly enough, the general plea that the invention is not new is not allowed; the objector must show "that the invention has been previously patented in this country." The Comptroller-General, as the principal officer of the Patent-office is to be called, is entrusted with considerable discretionary powers, but the exercise of those powers is clogged with a curious proviso. Before doing anything adverse to the interests of an applicant, or a patentee, he is required to give notice that he is about to do so, notwithstanding the fact that his decision is in every case subject to review either by the law officers or the Board of Trade. We may here mention that the "Board of Trade" is nowhere defined. More than one attempt has been made to draw from Mr. Chamberlain a definition, but without success. The tribunal may be the President himself; it may consist of a committee of officials appointed *ad hoc*, or it may be a junior clerk. A few weeks ago we pointed out that the measure could not possibly come into operation at the date fixed by the Bill — the 1st of January, 1884—for the very good reason that the rules necessary for working the Act could not be made operative until they had been laid before Parliament for forty days. As the House will not be sitting for a period of forty days before the first day of next year, it is obviously impossible to comply with the condition. This proviso was inserted in committee at the instance of certain gentlemen interested in trade marks; but the effect of it upon the clauses relating to patents seems to have been overlooked.

Amongst the new clauses inserted on the occasion of the third reading is one which is directly at variance with some of the earlier provisions of the measure. We refer to Clause 100, which orders that "copies of all specifications, drawings, and amendments left at the Patent-office after the commencement of this Act, printed for, and sealed with the seal of the Patent-office, shall be transmitted to the Edinburgh Museum of Science and Arts, and to the Enrolments Office of the Chancery Division in Ireland, within twenty-one days after the same shall respectively have been left at the Patent-office." It is a matter of surprise how such a clause could have been accepted by Mr. Chamberlain, as it would involve the immediate publication of all provisional specifications. The clause goes on to say that certified copies of these documents shall be given to any person on payment of the prescribed fee, and that such copies shall be admitted as evidence in any legal proceedings. Seeing that the authorities refuse to certify the reduced photo-lithographs of the specification drawings now published, it will apparently be necessary to provide a large staff of draughtsmen to copy all the drawings by hand. Have the authorities calculated the expense of such an establishment? The sceptre has long ago departed from Judah, and separate patents for Ireland and Scotland have been a thing of the past for thirty years; but our fellow-subjects in those portions of the empire seem never to have forgotten the privileges they once enjoyed. They still wish to preserve the tradition of the time when they each had a little Patent-office of their own. Let Ireland and Scotland be liberally supplied with sets of the patent publications, but surely no lawyer would be satisfied with an office copy of a *copy* of a document. He would prefer an office copy certified directly from the original.

There is something in the second schedule of the Bill which is so puzzling that we can only imagine that there is a misprint. We are strengthened in this supposition by the fact that an obvious misprint does occur in the immediate neighbourhood, the words "date of payment" being substituted for "date of patent." As our readers are aware, this Bill provides that a four years' patent may be had for four pounds. A further fee of £50 paid before the expiration of the four years, continues the patent for three years more, or seven in all. Before these seven years have expired, the payment of £100 prolongs the protection for another seven years, making a total of fourteen years. So far all is plain, but the schedule also provides for the optional payment of these progressive fees by annual instalments, instead of in two lump sums of £50 or £100. Should a patentee be short of money—a not uncommon state of things—he would naturally prefer the former plan, and he would find to his delight and astonishment that four annual payments of £10 each, or £40 in all, would place him in precisely the same position at the end of the seventh year as if he had paid £50 down to begin with. This may be intentional, but looking at the thing from a business point of view in these days of "ready money" transactions, surely something in the way of "discount" should be given as an encouragement to those who are prepared to "take a quantity."

The Bill has already made some progress in the House of Lords, and before these lines are in the hands of our readers, it will probably have passed its second reading. We earnestly hope that some of the points we have dwelt upon will not escape attention before it becomes law.

MR. LYNALL THOMAS AND THE GOVERNMENT.

MR. LYNALL THOMAS'S claims on the Government have recently been again brought to notice. He has sent a printed letter to members of the House of Commons, in which he speaks of the hardship of putting off the claim awarded to him on the trial of his case before the Lord Chief Baron, and also he states his power to prove that fraud was used by certain individuals in the framing of the matter for the Government defence. The latter question is a very serious one, and must be left to Mr. Lynall Thomas to substantiate. We regret that such a question should be at issue, whatever may be the result.

Mr. Lynall Thomas, leaving out this point, briefly puts his case, as we understand it, as follows:—Previous to his efforts the action of fired powder was so imperfectly understood, that neither the full violence of the strain about the seat of the charge was recognised, nor, on the other hand, was the fact recognised that the violence of a charge increased in a larger gun out of all proportion to that in a smaller one. In proof of the first of these two assertions, he urges that guns were formerly not made of due thickness about the breech, a fact that may be seen if the drawings of any guns, which existed before his, including, he maintains, all the first Armstrong guns, be measured.

In proof of the second claim he urges that the old 68-pounder gun had the same proportionate thickness as the 6 or 9-pounder gun, and that in the larger and smaller Armstrong guns the same rule of proportion generally existed, that is, that thickness in the large gun bore nearly the same proportion to the calibre as in the smaller. He pleads that he publicly showed that this was the case, and that it was wrong, which was proved by the habit of 68-pounder guns to burst, also by the bursting of the first larger Krupp and Armstrong guns, that he made experiments and calculations on which he based the proportion of a 7in., 8in., and 9in. gun, of which he made two and had drawings of the third. That this gun, having obtained a great victory at Shoeburyness, owing to its greatly increased strength and the heavier charges he was consequently able to use, the so-called 7in., 8in., and 9in. Woolwich guns were made. He has models of his own and of these, and shows that one is scarcely to be detected from the other. He maintains that this had been achieved in spite of great discouragement; that he was told again and again that his guns were far too heavy for the Navy to carry; but that when he had showed their power they were, as far as proportions were concerned, adopted. He then relates that his claims were denied, and that at length he was driven to law, and in spite of his case being taken up at a great disadvantage, he obtained an award of £8790 11s. 6d. and costs; that on this the Government appealed and threatened to carry the case on in a manner which would involve him in an enormous expense and waste of years, so that he was compelled to abandon the struggle with a powerful department having the purse of the country at its back.

With regard to the foregoing, we are not prepared to endorse all that Mr. Lynall Thomas urges, and we could state the points where we are unable to follow him; but we may say at once that there is a great deal on which we think he has a good claim, and that he has been very badly treated. To those who have not the opportunity of going thoroughly and carefully into the case, surely the following is plain. A private individual who, contending against the War-office, obtains a distinct award of considerable magnitude, has established a case under very disadvantageous circumstances. Surely the man who shows that he has done as much as this must imply in the public service ought not to be treated as an enemy or fenced with any further. The services in this case, which we must allow to have been performed, had been rendered in 1860 and 1861—for we maintain we are bound to stand by the decisions of our own legal tribunals, and it had so been decided. It was hard enough then to have waited and have his claims disputed step by step until 1877, and when he had fairly obtained a decision by law, after seventeen years' disappointment, it seems as cruel to raise further difficulties as it is unfair. Of course it is conceivable that a decision might be given wrongly by a court, and that an appeal might succeed; but ought this to be done on a technical point? Looking at the case without any further interest than that of any Englishman, we feel that we should have hoped that while a Secretary of State might doubtless feel that all the technicalities of the case were out of his province, and so might fairly depend on his technical advisers up to a point, yet after he saw the decision in the Chief Baron's Court, surely he would feel that the time had come to take a broader view. Is there not, at all events, as great a likelihood of the case having been decided, even as it stood, with a leaning towards Government as towards Mr. Lynall Thomas? Supposing it, however, to be a right decision, Mr. Lynall Thomas is shown to him to have been a man who has rendered considerable public service, and yet who has been driven to struggle on in the difficulties and the disappointment accompanying the refusal of his claims for seventeen years. Is this a case in which we ought to wish our rulers to urge a technical objection for further delay and trial, or practically to put it out of the means of an impoverished man who has been declared to have rendered great public service to obtain even his own money?

REACTIONS BETWEEN SULPHUR, SULPHUR OXIDES, CARBON, AND CARBON OXIDES.

IT is shown by Berthelot that carbonic oxide is decomposed into carbon and carbon anhydride at a bright red heat, and even at the softening point of glass, but the amount of decomposition is very small. Sulphurous anhydride, as Buff and Hofmann have stated, is decomposed by the electric spark into sulphuric anhydride and sulphur. No oxygen is set free; part of the sulphur unites with the platinum electrodes; the remainder combines with the sulphuric anhydride to form a viscous liquid which absorbs a certain quantity of sulphurous anhydride. This is the intermediate product of the reaction. It is decomposible in the reverse direction, and the tensions of sulphuric and sulphurous anhydrides which it gives off limit the decomposition of the sulphurous anhydride. When sulphurous anhydride is passed over purified charcoal heated to redness in a porcelain tube, carbonic oxide, carbon oxysulphide, and carbon bisulphide are formed in the proportion indicated by the equation $4\,SO_2 + 9\,C = 6\,CO + 2\,COS + CS_2$, and a small quantity of sulphur is set free. Probably the carbon combines with the oxygen of the sulphurous anhydride, liberates sulphur, which then unites partly with carbon and partly with the carbonic oxide formed. When electric sparks are passed for a long time through a mixture of equal volumes of carbonic anhydride and sulphurous anhydride the residual gas has the composition SO_2, 31; CO_2, 30; CO, 20; decrease, 19 = 100. Each gas decomposes independently, and the oxygen liberated from the carbonic anhydride combines with the sulphurous anhydride to form sulphuric anhydride which condenses. The sulphurous anhydride is apparently somewhat more stable than the carbonic anhydride. When a mixture of equal volume of sulphurous anhydride and carbonic oxide is passed through a narrow porcelain tube heated to redness, the issuing gas has the composition SO_2, 37; CO_2, 20; CO 43 = 100. Sulphur is liberated, but neither carbon oxysulphide nor carbon bisulphide is found in notable quantity. The carbonic oxide evidently reduces the sulphurous anhydride, thus $2\,CO + SO_2 = 2\,CO_2 + S$, but the reduction is not complete. If a mixture of two volumes carbonic oxide with one volume sulphurous anhydride is subjected to the action of electric sparks, the sulphurous anhydride is partially reduced, but a portion of it decomposes independently without giving up oxygen to the carbonic oxide, and forms a compound of sulphur, sulphurous, and sulphuric anhydride, which condenses on the sides of the tube. In presence of mercury, the sulphurous anhydride is completely decomposed, and the residual gas has the composition CO_2, 24; CO, 75; O, 1. The mercury absorbs the sulphuric anhydride produced, forming a basic sulphate. Sulphurous anhydride has no action on potassium sulphate at a bright red heat, but at a red heat it converts the carbonate into sulphate, with a trace of sulphide. If the current of the gas is slow, the proportion of the sulphide increases. A slow current of dry carbonic anhydride has no action on boiling sulphur, but if sulphur vapour and carbonic anhydride are passed through a porcelain tube heated to redness a slight but distinct reaction takes place. The issuing gas contains 2·5 per cent. of a mixture of 1 volume carbon oxysulphide, 1 volume carbonic oxide, and 0·5 volume of sulphurous anhydride. The carbonic anhydride probably does not directly attract the sulphur, but first dissociates into carbonic oxide and oxygen. Carbonic anhydride has no action on potassium sulphate at a bright red heat. When it is passed over the sulphite the latter is converted into sulphite and polysulphide, with a small quantity of carbonate. The acid sulphite gives the same products, but this latter dissociates even when heated in a current of an inert gas, such as nitrogen. Carbonic anhydride acts on potassium polysulphide at a red heat, sulphur being liberated and a mixture of carbonic oxide, sulphurous anhydride, and carbon oxysulphide being formed, together with a small quantity of carbonate. This reaction is probably due to the dissociation of the carbonic anhydride. Sulphur can be distilled off potassium sulphate below a red heat without any reaction taking place, but in a porcelain tube heated to redness sulphur vapour reduces the sulphate, forming sulphurous anhydride and polysulphide, thus: $K_2SO_4 + 5\,S = K_2S_3 + 2\,SO_2$. The action of sulphur on potassium carbonate is well known. The importance of these reactions in the study of the decomposition of gunpowder is evident.

DISTILLATION IN A VACUUM.

AT the outset of his paper the author, A. Schuller—see *Ann. Phys. Chemie* [2], 18, 317—calls attention to the advantages of the automatic mercury pump. By its aid he has devised a form of apparatus to study fractional distillation and sublimation in a vacuum, and the separation of metals from impurities with which they are contaminated. In the course of his experiments the author arrives at the conclusion that sufficient attention is not paid to the substance used for lubrication and to the so-called anhydrous phosphoric acid used as a desiccating agent; the latter contains phosphoric anhydride—P_2O_5—which sublimes at 50 deg. in large translucent crystals. The author considers that the best substance for lubrication is a mixture of wax and vaseline, and for desiccation metaphosphoric acid. Of the elements examined, selenium, tellurium, cadmium, zinc, magnesium, arsenic, and antimony are easily sublimed; but the fusible metals, bismuth, lead, and tin, distil only with difficulty. The author's observations on this point differ from those of Demarçay, but he explains this discrepancy by supposing that the metals used by Demarçay were contaminated with impurities, which, according to his observations, caused the volatilisation of the metals in question; but if the distillation be frequently repeated, those impurities are separated. Secondly, it is found that sodium, selenium, tellurium, cadmium, zinc, arsenic, and antimony, distil so readily in a vacuum that this process may be used for their purification. Thirdly, during the first distillation of these metals, there is an evolution of gas, but this ceases after the process has been repeated. Fourthly, it is found that many metals require to be heated slightly above their point of sublimation to effect their distillation; this phenomenon the author attributes to the slight difference in pressure caused by the rise of temperature, which causes a more or less mechanical impulse to the metallic vapour. Fifthly, organic substances, such as tallow, wax, resin, distil in a vacuum without decomposition, and can thus be separated from impurities; but crude sugar, dry grape sugar, and quinine sulphate decompose during or even before distillation. Caoutchouc distils in two separate layers, of which the more volatile has the smell of caoutchouc, whilst the less volatile has but little smell, and is of the consistency of fresh caoutchouc. In conclusion, the author recommends this process of fractional distillation in a vacuum for the purification of organic substances.

AN IRON TRADE SUBSIDY.

THE Staffordshire ironmasters have faithfully carried out the pledge which the other day they made to the firms whose ironworkers yet remained upon strike in the Smethwick and West Bromwich districts. At a meeting in Birmingham on Monday of the Sustentation Committee some seventeen firms were voted contributions at the rate of £5 per puddling furnace standing. Cheques of the aggregate value of £1420 were sent out. The individual amounts varied from £10 to £165 and £310. The greatest sum was taken by Messrs. John Dawes and Sons, West Bromwich, on account of their sixty-two furnaces, and to the District Iron and Steel Company, Smethwick, there went, for their thirty-three furnaces, the next highest amount. Obviously there has been a prompt response by absent ironmasters to the resolution of those present at the earlier meeting, calling upon the firms at work to contribute £1 per furnace per week to the firms against whom the strike was being continued. It is gratifying that as to the future of the strike this first contribution is all that will be called for, since the malcontents amongst the ironworkers have been now fairly beaten all along the line. This week no strike hands remain out for whom work can be found. Operations have been resumed at the 3d. per ton drop, which the official accountant's returns showed was called for by the operation of the sliding scale. This form of self-acting arbitration agreement for settling wages' rates has therefore in Staffordshire received further sanction under circumstances which should lead to its becoming more firmly established, for while the employers have thus practically shown their loyalty to it, the great majority of the men have, by declining to contribute pay to the strikers, with scarcely less emphasis, made a like satisfactory declaration.

GATESHEAD TRAMWAYS.

AN official inspection of the newly-completed tramways at Gateshead has recently been made by Major-General Hutchinson on behalf of the Board of Trade, and has resulted in a series of recommendations which it is estimated will prevent the lines being opened for public traffic for some three to four months. The report, a copy of which has just been received by the Corporation, draws attention to some curious mistakes in construction, which we should have thought would have been first seen to by the company's engineer before requesting a Board of Trade inspection. The level of the setts adjoining the rails is generally too high and would cause injury to the wheels, while some of the curves have been so laid that the cars cannot run round them without leaving the rails. The use of mechanical power on these tramways is sanctioned in the Act, and two Wilkinson engines, constructed by Messrs. Black, Hawthorn, and Co., were employed at the inspection. In one the governor would not work, and in neither have the necessary means been provided for preventing the driver from tampering with the governor, while the connections for working the car brakes from the engine were not completed. Triangles, sanctioned by the Corporation, have been put in at the terminus for enabling the engines and cars always to run with the same end foremost. This, as General Hutchinson points out, is a most desirable arrangement when the triangles are suitable to the purpose, but in the present case it appears that some of them could not be safely worked, being situated on steep inclines, and in the midst of heavy traffic where it would be most inexpedient that a driver should be away from the front of the car during the operation of using the triangle. It is recommended that a single line should be substituted for a double line of rails round a sharp corner so as to obtain a better curve, unless bogie cars with flexible wheel bases are adopted in place of the present ordinary four wheel cars carrying roof passengers; and it is submitted as a grave question for the licensing authorities whether, in view of the recent accident at Huddersfield, outside passengers should, under any circumstances, be carried on the present cars. The report concludes with the regret that the Board of Trade cannot be recommended to certify that the tramways are fit for public traffic.

LITERATURE.

Elementary Applied Mechanics, Part II. By T. ALEXANDER and A. W. THOMSON. Macmillan and Co. 1883.

THIS book is wholly mathematical. Over the ground it covers, it is an excellent text-book that must be found most useful both to the student of mechanics and to the practical engineer who has to design bridge and roof work. But the title is somewhat of a misnomer, as it indicates an immensely wider range than is dealt with either by the present volume, or by it and its predecessor, Part I., together. Ostensibly the volume expounds three subjects only. These are bending of beams, bending of struts, and twisting. But as only eighteen pages out of 354 are devoted to the latter two subjects, namely, struts and torsion, and as these are, therefore, treated with a meagreness out of all proportion to the full development given to the first, it might have been as well to omit this latter part altogether. The book might then have been properly entitled, "The Mathematics of Transverse Stress and Strain within Elastic Limits." As the authors have done their work on this subject in a thoroughly praiseworthy manner, perhaps they may not take it amiss, or may rather take it as a compliment, if we suggest that they should in a future edition omit the latter part, and write another volume on its subject with the same degree of completeness with which they have expounded beam bending. This is the more to be recommended since, on the subject of struts, the authors have contented themselves with reproducing the Tredgold-Gordon formula. It is strange that this should still be believed in as a rational formula. Although Rankine gave it his undoubtedly weighty sanction as a rational rule, the theory has long ago been shown to be simply mistaken; and, taking it simply as an empirical rule, the experimental evidence for it is insufficient.

By dedicating their work to their teacher, Professor Rankine, Messrs. Alexander and Thomson present themselves to their readers with as good an introduction as they could have—that of having been Rankine's pupils. Rankine's English style is the best and most vigorous in which any engineering books have been written, and his pupils have adopted that style with nearly equal success. They say what they have to say succinctly and always without ambiguity. It is never possible to misunderstand what is meant; no words are wasted in circumlocution or in repetition. In some respects the style is pleasanter than Rankine's; it is easier and more familiar, with less invariable adherence to scientific formality. A good deal of wordiness in the text is avoided by the excellent plan of writing a few condensed explanations along the chief lines of the diagrams.

Throughout most of the book the mathematical knowledge demanded of the reader is simple, nothing beyond ordinary algebra, trigonometry, and the geometry of plane curves of the second degree being required. Where higher mathematics is needed to obtain useful results, these results are for the most part simply stated without demonstration. This plan has been, however, departed from in treating of curvature and deflection, where the integral calculus is freely used. By explaining graphic methods more than they do, our authors might have avoided a good deal of this. For the many problems in calculation of bending moments given, graphic methods are usually explained; but the examples of their application to frameworks, and indeed to anything beyond bending moments and shearing forces, are far too few. Diagrams containing curves showing the variations of certain calculated quantities are very liberally used, and this is a most excellent feature of the book; but we would have been glad to see more illustrations of graphical methods of making these calculations. Another capital characteristic of this work is the abundance of numerical examples fully worked out, all of them being of a practical nature. We are glad to observe that these examples are not relegated either to the end of the book or to small print, because if that is done the student is apt to consider them of relatively small importance.

We must say, however, that we consider that the book, taken as an exposition of one portion of applied mechanics, is a great deal too simply mathematical; that not nearly enough attention is paid to description of the purely physical phenomena which serve as the data for the mathematical investigation. This is the common tendency of the Scotch school of scientific writers; they seem to enjoy the mathematics so much that they tend to neglect the experimental investigation of the data. Thus, in the present book many premises which ought to be established by experiment are assumed without explanation and sometimes even without mention. Thus, at the outset the "neutral axis" and "neutral plane" of a beam have to be explained. It is here tacitly assumed that in a beam which is strongest in its unstressed condition, the neutral axis runs through particles which all lie in one straight line when the beam is unstressed. Now this is not even true unless the section is uniform from end to end or else varied in certain special fashions—that is, it is not generally true. It is also not even mentioned that the basis for the whole theory of bending is the supposition that transverse sections that are plane in the unstressed condition remain accurately plane when the beam is bent. Indeed, in reading from p. 13 to p. 15 one is led to suspect that the writers imagine that if one draws a plane normal section through a point in the unstrained neutral axis, and if one again draws a plane normal section through the same point in the axis after it is bent, that these two plane sections pass through the same particles of material. If the writers have not fallen into this error their elementary readers would certainly do so if they trusted entirely to this book. Again, no hint is given of the peculiar relations subsisting between strain and stress beyond the elastic limits. As to the mode of gradual development of stress and strain when the loads are applied in different manners, and with different rapidities, nothing is said regarding the effect of more or less rapid and frequent repetition of loading. The term "live load" is used to indicate a suddenly-applied load, as distinguished from the "travelling load," which is gradually applied and removed again. The latter phrase seems a much better one to use; but we must demur to the statement that a live load as defined above produces double the strain and stress produced by an equal dead load, this being a somewhat crude mathematical deduction from incomplete hypotheses. We would also take exception to the phrases "intensity of strain" and "intensity of stress." The first is used in this book to mean the elongation or transverse displacement per unit of length, but this is properly called simply "strain," the words "elongation," "contraction," &c., being quite sufficient to indicate integral relative displacement. Similarly "stress" simply, properly means what the authors call "intensity of stress," namely, two-sided force per unit of sectional area. On page 19 we find the book badly blemished by the very remarkable statement that the resistent shearing force exerted by the material over a given section, and the moment couple of the integral stress on the same section, "depend only on the size and form of the cross section, and upon the material of which the beam is made." What is meant is, of course, that the safely allowable amounts of the above force and couple depend only on the above data, and not only the external forces; but this not being explained, we are sure that the above passage will cause much confusion of mind to the elementary reader.

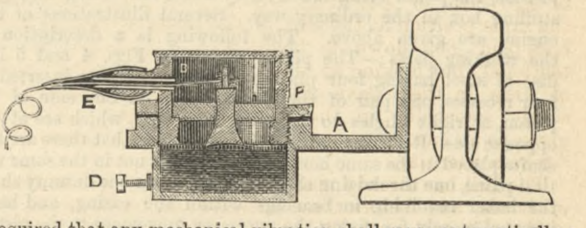
In drawing parabolic moment curves, the authors recommend always using one and the same wooden template, and calculating new scales for this invariable curve for each particular case. This is an ingenious idea, which involves not much labour in carrying out; but we doubt whether it would be found practically convenient, especially since different moment curves have very frequently to be added together. A parabolic curve to a convenient vertical scale is always easily and rapidly drawn, and the advantage of being able to apply one's wooden scale directly to the curve is very great. In explaining the drawing of the parabola, it would have been convenient to give a method of constructing it when two points, the tangents at these points, and the direction of the axis are given as data. This problem is of frequent applicability in moment diagrams. The treatment of the shear stresses is much more complete than is usual in English books. One interesting fact that is pointed out is that, although in solid sections no approximation to the maximum shear stress is obtained by supposing the whole shear force equally distributed over the section, such an approximation is obtained when the section is composed of two relatively large upper and lower flanges connected by a thin web. On the other hand the section devoted to "Allowance for Weight of Beam" is meagre and inadequate to an extreme degree. There is such a large variety of useful cases worked out in the book that it would be an improvement to introduce condensed tabular statements of results. We can heartily recommend the volume as a decidedly superior treatise on the mathematics of beam bending.

THE BIRMINGHAM WATERWORKS.

THE new storage reservoir at Shustoke, the property of the Birmingham Corporation, which was ceremoniously opened on the 28th ult., is a fine addition to the resources of the Corporation for the supply of water to Birmingham. The extreme length of the reservoir is 1300 yards, and the average width 400 yards, while the area is 90 acres; the average depth is 20ft., and the reservoir has a capacity of not less than 400,000,000 gallons. Its site is an admirable one—a better, indeed, could hardly be desired—midway between Whitacre Railway Station and Shustoke, and near it is a smaller reservoir, capable of containing 20,000,000 gallons, and designed to intermediately receive water from the river Bourne. The water flows from the larger reservoir by pumps to the filter beds at Whitacre, which are capable of passing 12½ million gallons in twenty-four hours. The reservoirs and additional pumping machinery which has recently been provided at the Whitacre station have deen designed by Mr. J. W. Gray, the engineer to the water department. The contract for the construction of the two reservoirs was taken at £78,900, by Messrs. John Aird and Sons, Lambeth, and the cost of the site £35,000 being reckoned, the total expenditure upon them is £113,900. The work of construction was commenced two years ago, and upwards of 800 navvies have been constantly employed upon it. The work has been carried out under the superintendence of Mr. J. W. Gray, assisted by Mr. N. T. Gray. The land obtained for the construction of the reservoir was about 162 acres in extent, and it was acquired by the late waterworks company under the powers of their Act of 1870, at the cost of about £35,000. The works immediately adjoining the station at Whitacre were carried out by the late company. The Corporation largely added to these works, and have now satisfactorily completed the undertaking. Rather more than 100 acres of land are covered with water; the storage capacity is about 420 millions of gallons, equal to many weeks' consumption in a time of absolute drought, together with a certain addition from the deep wells which have never yet failed. The greatest width of the reservoir is a quarter of a mile, the greatest length three-quarters, and the circumference a mile and three-quarters. Of the whole distance about one-third consists of the natural formation of the valley and about two-thirds is an artificial embankment. The bottom of the reservoir consists first of about 14ft. or 15ft. of drift or glacial deposit. Below that is a solid bed which has been tested in all parts to the depth of 40ft., and found to be a mass of impervious marl and clay, and it is believed from geological surveys that the depth extended to 400ft. or 500ft. Therefore, the natural formation of the valley and strata affords admirable facilities for the construction of a reservoir. The embankment is 237ft. wide at the base, and it has a uniform breadth of 20ft. at the top, the inside of the slope being four to one, and the outside three to one. The embankment is 31ft. high, and there is a puddle wall 6½ft. in thickness, pugged and rammed into solid consistency, and carried through the drift into the solid mass of clay and marl beneath. The construction of the reservoir occupied two years, and engaged from 800 to 900 men the greater part of that time. Four locomotive engines were employed, nine portable engines, fifty horses, some hundreds of wagons, and ten miles of rails. During the construction of the reservoir there were in active operation a surgery, a post-office, a savings bank, and a mission room supplied by the contractors with the daily, and weekly and illustrated papers. Sunday and day schools were also established in connection with the works. The quantity of water required to be delivered daily at the time of the transfer from the late company to the Corporation was 8½ millions of gallons, and at the present time it is 12 millions of gallons. In addition to these reservoirs the water department has other reservoirs, the total storage capacity being 650 millions of gallons; and they are now in a position to deliver at least 12 millions of gallons a day for seventy or eighty days during a period of drought or continued frost. The capacity of the department for delivering water is :—In the reservoirs 8 million gallons daily, deep wells 9¼ millions, and streams 7½ millions, making a total of 24¾ millions of gallons daily, or rather more than double the existing demand upon the resources of the department. In carrying out those enterprises the Water Committee, under the authority of the council, expended no less than £340,000, and by the time the works now in progress are completed and paid for, the total outlay will not be less than £400,000. If such works had been executed by a trading company, by the Old Waterworks Company for instance, the water rents in all probability would have been increased. The Corporation, however, being able to borrow the capital at 3½ per cent., have, besides paying the annual instalments, of principal and interest, been able to reduce the water rents £20,000 a year, in addition to adding £2000 a year to the reserve fund. That as nearly as possible effects a reduction of 3d. to 4d. in the pound in the rates. The department has under its control an engine power of between 3400 and 3500-horse power. The engines have been built by Messrs. James Watt and Co., of Soho, Messrs. Hathorn, Davey and Co., of Leeds, supplying the differential gearing; the Root Patent Boiler Company, of Birmingham, the boilers; and Messrs. J. and T. Vickers, of Liverpool, the self-acting stokers, with which the furnaces are fitted. The engines are from the designs of Mr. J. W. Gray, M.I.C.E., and consist of a pair of compound condensing differential engines, Davy gear. Each high-pressure cylinder is 33in. in diameter, and each low-pressure 60in., the stroke being 10ft. Under each cylinder is a load box, similar to that of a waterworks Cornish engine, and at present loaded to the actual lift, the pressure being 100 lb. per inch on ram, which is 26in. in diameter. It will become a question of experiment whether the friction ought not to be added to this load, so that the power applied to lift the one load box will be the whole power exerted by the steam and vacuum in the cylinders, the second load box falling by its own weight and free from the power exerted. The boilers are the same as those in use at the other pumping establishment, being Root's patent, of which there are now eleven in use under one roof. The Vickers' patent stokers are driven by a high-pressure table engine, made by Joy, of Birmingham. The condensers are copper tube, encased in suction.

ELECTRICAL RAILWAY SIGNALLING.

WE know the difficulty of making a good electrical contact when it is to be worked by a train running at a high speed, and that this contact is exposed to all kinds of atmospheric changes with scarcely any attention. It is to meet the requirements of a contact of this kind that M. L. Mors has invented the contact represented below, of which the principle and disposition are easily understood by reference to the description which accompanies the figure. It consists in utilising the vibrations produced by the passage of the train upon the rail to which it is fixed, to produce, by the movement of the mercury, a contact in a hermetically closed space, which continues during the passage of the train. The contact works any apparatus whatever—bell, signal, disc. Experiments made upon the Paris-Lyons-Mediterranean line have given satisfactory results. The apparatus may be applied in any case where it is



required that any mechanical vibration shall cause automatically a corresponding signal. A is a lever, bent at the end to be rivetted to the fish-plate. B is a contact cone, insulated from the iron box by a piece of ebonite or wood, upon which is a small plug, which is removed to replenish the mercury in the cup, if necessary. The large surface of the cone is about 2 mm. from the surface of the mercury in a state of repose. C is a cup containing mercury. This cup communicates with the rail by a lever, and forms the earth pole—copper or zinc, according to position. D is a small screw for regulating height of mercury; also for emptying the cup. E is a nipple, through which is forced the junction cable, covered with a thick india-rubber tube. Upon this tube is placed another tube, which covers the nipple in such a manner as to form a hermetically closed joint. F is an iron cup containing mercury.—*Electrical Review.*

A TRIAL of the electric light has been made for the first time in the Edinburgh Theatre Royal, introduced by the Electric Manufacturing Company of Scotland. The theatre is to be supplied with 200 incandescent lamps, of 20-candle power each, and of this number 150 were lighted. Four of Dr. Higgs' dynamo machines, each giving light to 50 incandescent lamps, have also been fitted up; but when in full working order, storage batteries, which have been placed near the engine-house, can at any time supply light to 600 lamps of 50-candle power each. The machines make about 1340 revolutions a minute, and the E.M.F. is only 50 volts. They are compound shunt, or self-regulating.

THE TOWER SPHERICAL ENGINE.

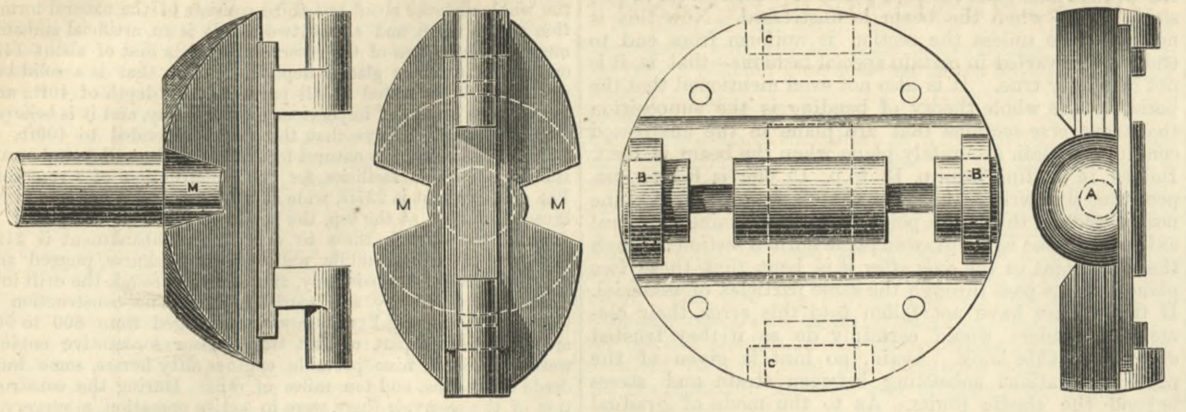
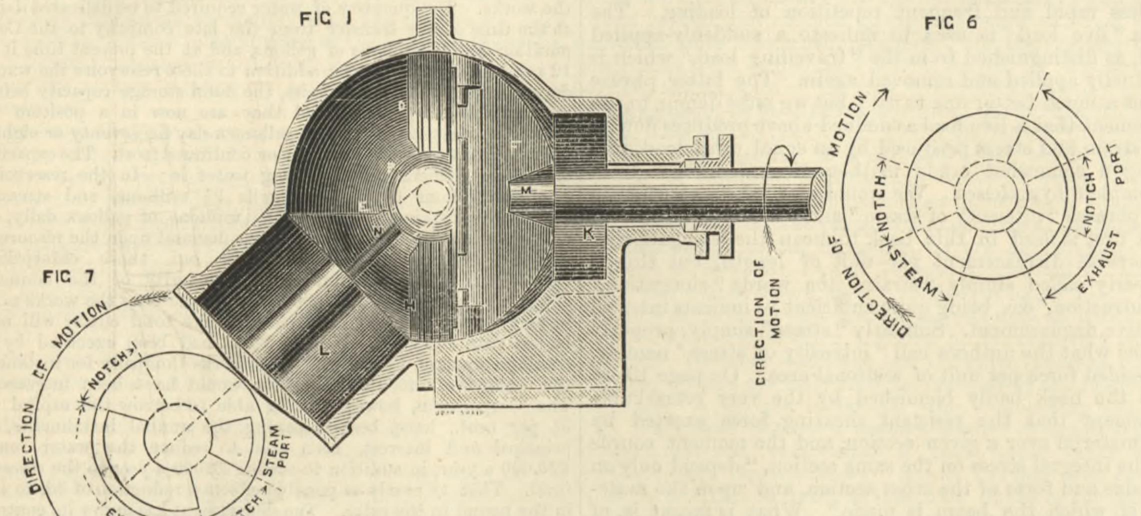
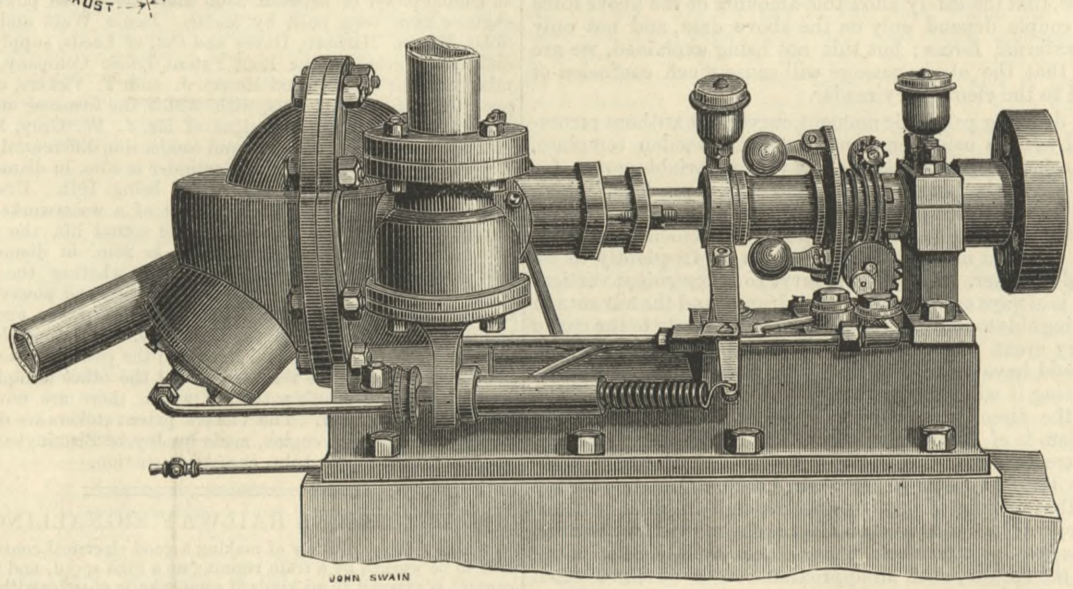


FIG 2 FIG 3 FIG 4 FIG 5





One of the most remarkable exhibits at the Engineering and Metal Trades Exhibition, and one which attracted a great deal of attention, was the "Tower" spherical engine, which is now being introduced by the patentees and manufacturers, Messrs. Heenan and Froude, Newton Heath Ironworks, Manchester, and which was shown in operation driving an Edison dynamo. It is a rotary engine of entirely novel character, and, as the name almost implies, it consists of a sphere of cast iron truly bored out, forming a chamber, within which the steam acts on suitably arranged pistons, the power being taken off by a shaft revolving through a stuffing box in the ordinary way. Several illustrations of this engine are given above. The following is a description of the working parts:—The piston shown in Figs. 4 and 5 is a disc of steel having four phosphor bronze bearings inserted in four recesses, one pair of these, B B, being on one side of the piston, at right angles to the other pair C C, which are at the opposite side. Referring to Fig. 1, it will be seen that there are two shafts placed in the same horizontal plane but not in the same vertical plane, one the driving shaft and the other the dummy shaft, the latter revolving in bearings within the casing, and being inserted merely for giving the necessary movement to the piston. On the end of each shaft is a blade, Figs. 2 and 3, these being of wedge shape, convex towards the shaft, and having on their faces turned gudgeons or trunnions, which fit into the bearings B B and C C on the piston. When the blades and piston are thus coupled together the interior movement is complete, and it may be described as a universal joint with solid matter built up round it so as to form, when revolving, four expanding and contracting chambers. The angle of the shafts is best chosen at 135 deg. In revolving from the position shown in Fig. 1, the area D E, which constitutes one chamber and is shown fully open, closes, F G opens, that on the further side of F G closes, and H, which is now closed by contact between the blade and piston, opens. Steam is admitted to the chambers when they require to expand, and released when they require to contract, and this is accomplished in the following manner:—Two cylindrical excrescences K and L are formed on the sphere, and each contain a cylinder — not shown on engravings — having on the face towards the sphere openings or ports for the ingress and egress of steam, see Figs. 6 and 7, and also having around the circumference other openings or ports corresponding with openings formed in the cylindrical shells, communicating by steamways with the supply and exhaust. M, Figs. 1, 2, and 3, are notches in the sides of the blades, arranged so that when a blade revolves, a notch comes over the steam port and admits the steam, which is then cut off by a further movement and allowed to expand, while the notch travels between the inlet and outlet ports. A still further movement brings the notch in communication with the exhaust port, and permits the steam to escape when the chamber is contracting.

The engine at the Exhibition worked well and silently, there being no vibration whatever. The power given out is very great in proportion to the weight of material employed, a 7in. engine indicating no less than 18-horse power at 600 revolutions per minute, with steam at 80 lb. pressure. This, coupled with the fact that the makers guarantee a very considerable saving in steam compared with other rotary engines, will no doubt recommend the "Tower" engine for use in a great number of cases where an ordinary engine could not be conveniently applied, such, for instance, as for the direct driving of dynamo machines.

THE NEW HARBOUR WORKS AT ANTWERP.

By M. G. A. Royers, Engineer to the Municipality of Antwerp.*

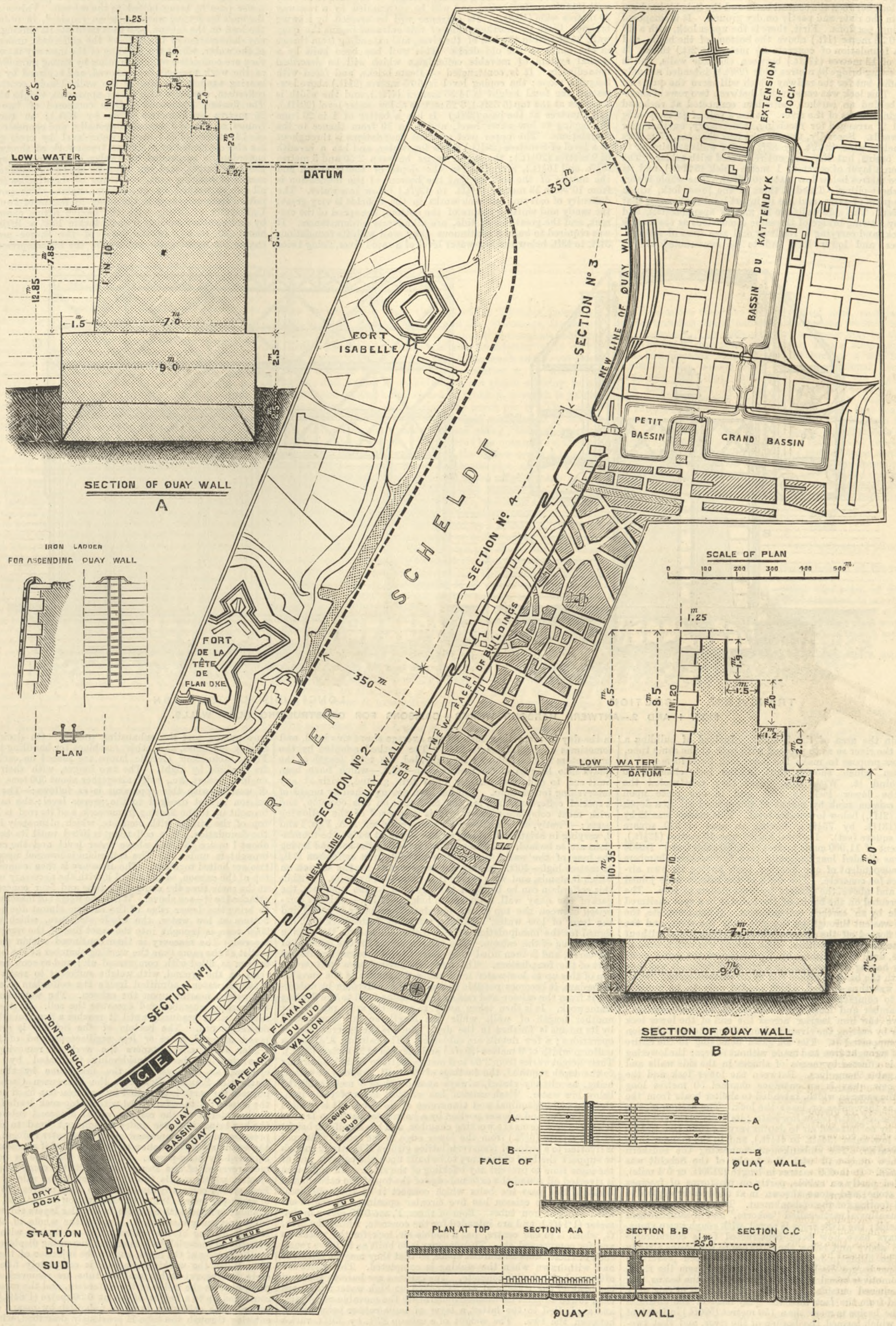
Before describing the important harbour works now under construction at Antwerp, the author will devote a few words to the situation and history of the port. It is not necessary to carry our researches far into the past; we need go no further than the beginning of the present century to find a condition of things which was merely the embryo of that which now exists. There were no basins, no docks properly so called, and scarcely any quays. In front of the town was a foreshore, which was partly dry at low water, and on which vessels lay; and besides this there were half-a-dozen creeks opening into the river, but also dry at low tide. The position of Antwerp is, however, so favourable, and the river on which it stands offers so many advantages for navigation, that freedom was the only thing required to create, or rather to restore, a maritime trade of great importance. These natural advantages have grown with time. The great depth of the river, which was formerly a mere superfluity, is now a notable element of the town's prosperity, in consequence of the continually-increasing draught of vessels and the growing importance of saving time in discharging. Canals, roads, and above all, railways, have still further increased the importance of the position of Antwerp, which may now be considered as one of the most advantageous in the world from a commercial point of view. Nevertheless, all is not yet complete; the river is excellent as regards navigation; but measures must be taken to preserve its depth, and if possible to improve it. Navigation may be interrupted in the middle of winter—not that the Scheldt is actually closed, but that steering becomes difficult; and although this inconvenience is reduced to an interval of some five days per annum on an average, yet it should be still further diminished, or if possible, done away with altogether. The railways needed have not all as yet been made, and the possible improvements have not all been introduced; nevertheless, despite the efforts of competition, progress has been so extremely rapid, beyond that of other places, that at present the trade is doubling every eight or ten years. Glancing back at the trade existing at the commencement of this century, we see that the development has been immense, nay, even in 1850 the tonnage entering the port was only 250,000 tons, while in 1865 it was 750,000 tons, and in 1882 it had reached 3,450,000 tons. The period of the consulate and empire is that which marked the execution of the first important works in the harbour, including two lengths of quay upon the Scheldt, and the two first docks, now called the Old Docks, constructed by Napoleon. Of these the smaller, or entrance basin, is about 150 metres wide (490ft.) and 173 metres long (567ft.); the large basin was 402 metres long and 173 metres wide (1320ft. and 567ft.), but has lately been reduced to 380 by 150 metres (1240ft. by 490ft.) in order to enlarge the quays. These docks were well constructed and joined to the Scheldt by a lock of 18 metres width (59ft.); and these with some lengths of quay wall, in all about 1500 metres (5000ft.), and the creeks mentioned above, were sufficient for the trade until 1843. At that date a new length of quay wall, about 350 metres long (1150ft.), was added, which, with the prolongation constructed in 1862, forms what is now called the Quai du Rhin. In 1853 it was decided to construct outside the fortifications a dock which now forms part of what is called the Kattendyk dock, together with a large dry dock, and a lock of 25 metres width—82ft.—opening into the Scheldt. These works were finished in 1860; and the fortifications being demolished shortly afterwards, the new dock was connected with the old ones, and three other basins, all of large size, were constructed. These were completed in 1873.

The following, then, was the position of the port of Antwerp at the period when the works which form the subject of the present paper were commenced. There were, first, quay-walls along the river having a total length of about 2100 metres (7000ft.); secondly, four old creeks, still opening into the river; thirdly, the old docks of Napoleon, having an area of about 8 hectares (20 acres), connected to the Scheldt on one side and to the new docks on the other; fourthly, the four new docks, with an area of about 30 hectares (75 acres); fifthly, three dry docks for repairs. The total length of the quays within the docks was about 6500 metres (21,300ft., or 4 miles). Most of these quays and a part of those on the river wall were in connection with railways, and several of them were occupied by sheds. In the last few years the erection of sheds and mechanical appliances has been largely extended. Steam and hydraulic travelling cranes, fixed cranes of great power, hydraulic machinery for working the lock gates and bridges, have been constructed, whilst the quays are connected with immense railway stations, having a total area of 31 hectares (77 acres), and a total length of sidings of 65 kilometres (40 miles); at the same time the docks are in direct communication with the Campine canal, connecting the Meuse with the Scheldt. Nevertheless, despite these large works, and the efforts made to utilise them to the utmost, their insufficiency for the present trade of the port became every day more evident. In addition, the quay walls on the river, constructed bit by bit on very irregular lines, were ill adapted for any important trade. Except on the Quai du Rhin, there were no means of working these river walls by railways, and they could not even be approached at low water, their footings being laid at the low-water level; ships were obliged either to lie on the mud or keep at a distance from the walls. Finally, the irregular form of the quays, a marked projection which occurred about the middle of their length, and the necessity of providing projecting jetties, produced a retardation in the river currents, and in consequence deposits of sand and other inconveniences; whilst the ground available was insufficient for a complete and regular working of the traffic. It was therefore decided to re-construct the whole of the quays upon a regular curve, concave towards the river. This curve is formed of several circular arcs tangential to each other and has a total length of 3500 metres (11,500ft. or 2·2 miles). At the same time the creeks which divided the then existing quays were to be replaced by large floating basins for smaller vessels. The docks being also insufficient, it was resolved to lengthen one of them, and to add three new dry docks to the three already existing. The new quays are being executed by the State, but will be furnished with the necessary appliances at the cost of the town; the other works on the docks are being executed by the town alone. The portion to be provided by the State was contracted for in 1877 by Messrs. Couvreux and Hersent, of Paris, and comprised the following works:—(1) The construction of a quay wall 3500 metres long (2·2 miles), resting on a sound foundation, laid without any timber footings, and giving a depth of not less than 8 metres of water (26¼ft.) against the face at low tide. In this wall are three recesses, rectangular in plan, which are intended to accommodate floating landing stages, and give access for boats. The landing stages will not project beyond the line of the quay, and will be made of iron, having a movable platform joined to the wharf by a movable bridge. Two of these landing stages are 20 metres long by 10 metres wide (66ft. by 33ft.); the other is 100 metres by 20 metres (330ft. by 66ft.). (2) The building at the south end of this quay wall of an embankment connecting it with the land, this embankment to be 650 metres long (2130ft.), and to be properly protected against the action of the river. (3) The construction of a basin for small craft, having an area of about 4 hectares (10 acres), and divided into three parts, a lock 13 metres wide (42ft.) connecting this basin with the Scheldt, and an entrance channel 50 metres wide (160ft.) (4) The filling-in necessary behind the new quay wall, and in the creeks which were to be done away with, as well as the dredging required to maintain the full sectional area for the river throughout the period of executing the works. The walls of the new quay and of the floating basin are calculated to stand a distributed load of 6 tons per square metre (11 cwt. per square foot), the load extending over the top of the wall itself and the quay space behind it. The works were divided into four sections, the whole to be completed within six years and seven months from the commencement. They included the provision and fixing of twelve million kilogrammes (12,000 tons) of wrought iron for the caissons in the foundations, the landing stages, swing bridges, &c.; 375,000 cubic metres (490,000 cubic yards) of brickwork and concrete; 25,000 cubic metres (33,000 cubic yards) of masonry in Soignies stone, and more than 2½ million cubic metres (3,300,000 cubic yards) of earthwork in filling, dredging, &c. The cost is estimated at more than 38 million francs (£1,520,000); being augmented or diminished, according to an agreed schedule, with any augmentation or diminution in the depth of foundations which may have become advisable. To this will be added about 1,500,000 francs (£60,000) for additions to the foundations. The whole should be completed about the commencement of 1884. The above sketch is sufficient to show the important character of the works now under construction. The author will now describe briefly the first section of these works—which are constructed in front of the position occupied by the old southern citadel, now demolished—and the methods employed by the contractors in their execution. This section of the works includes in the first place the new basins for small craft, which are already completed. They run parallel to the river, and are three in number. The central basin, from which branches the lock connecting them with the Scheldt, is 266·5 metres long and 65 metres wide (874ft. by 213ft.); the two others are respectively 246 and 225·5 metres long (807ft. and 740ft.), with a width of 50 metres (164ft.). They are joined to the central basin by openings 10 metres wide (33ft.), each crossed by a swing bridge carrying a roadway 5¼ metres wide (17¼ft.), and two footways, each of 1 metre (3¼ft.). The bottom of the basins is 2 metres (6½ft.) below the level of low water at Antwerp; and the coping of the walls 6·35 metres (21ft.) above the same level. The total length of these walls is about 1800 metres (5900ft. or 1⅛ mile). They rest at the bottom level on a layer of concrete 1 metre thick and 5 metres wide (3¼ft. and 16½ft.), enclosed by two rows of sheet

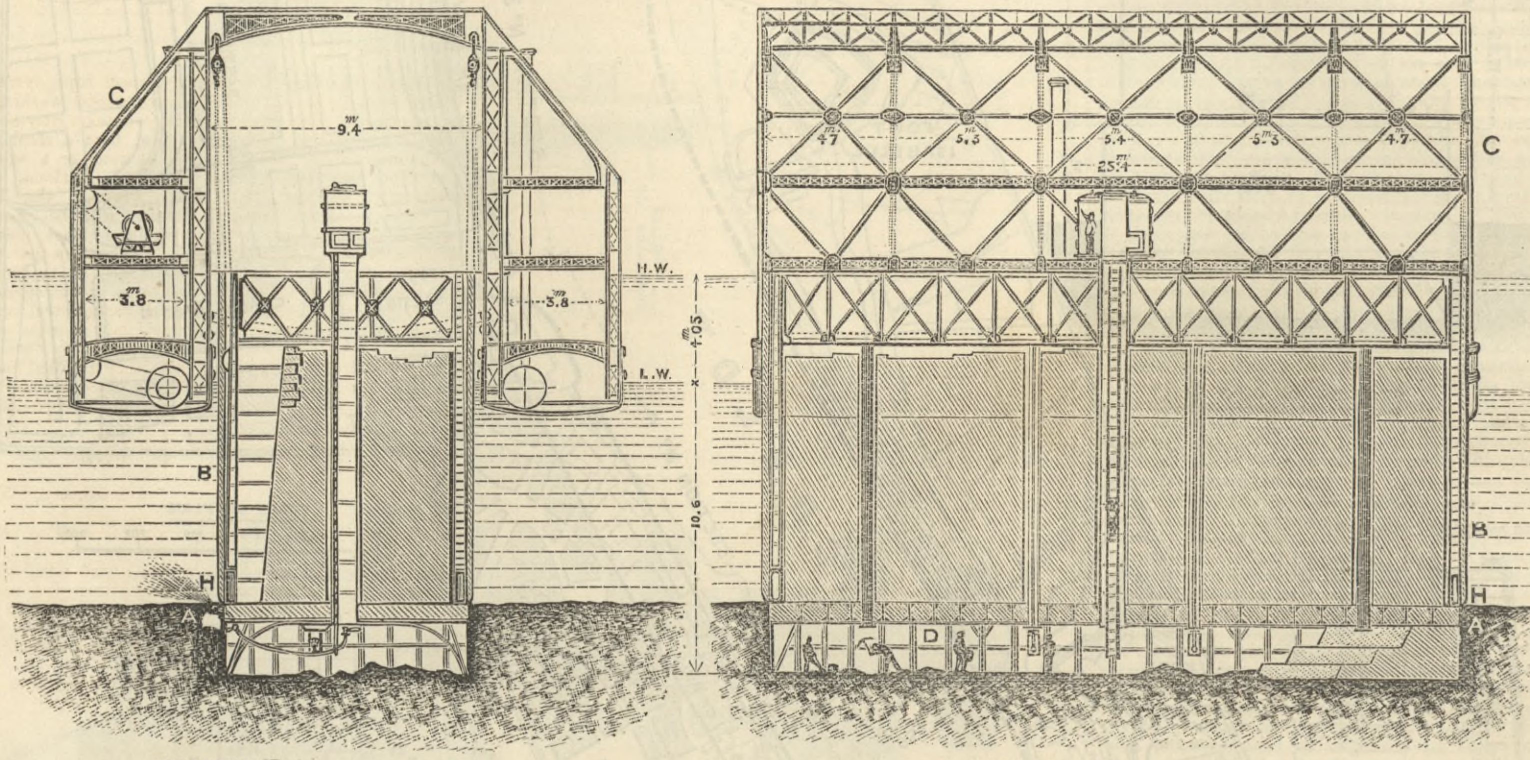
* Institution of Mechanical Engineers.

ANTWERP NEW HARBOUR WORKS—GENERAL PLAN, AND SECTION OF QUAY WALLS.

(For description see page 116.)



piling. The wall, built of Boom bricks, is 8·35 metres high (27·4ft.), including the coping; 4 metres wide at the base, and 2½ metres at the top (13·1ft. and 8·2ft.). The wall has a batter of 1 in 10, and is faced with hammer-dressed stone from the coping to a height of 2½ metres (8·2ft.) above low water. The quay space of these basins has a width of 30 metres (98ft.); it has been paved and has still to receive the necessary appliances for working. The walls are furnished with cast iron mooring posts, with cast iron fenders, and with wrought iron ladders. The basins are kept filled to a level of about 3·60 metres above low water (12ft.). The lock between the central basin and the Scheldt has been built partly in the river and partly on dry ground. It is composed of three distinct portions. First, there is the upper lock, with a sill of masonry 0·30 metre (1ft.) above the bottom of the basin, and resting on a foundation of concrete 2½ metres (8·2ft.) thick. It has a width of 13 metres (42⅔ft.) between the side walls, and is crossed by a swing bridge 8½ metres wide (28ft.), intended not only for horse traffic, but for the railway which will serve the quays on the Scheldt. This lock was constructed between two rows of sheet-piling, and behind an earthen cofferdam connected at each end with the original banks of the river. It has a pair of gates opening inwards, and is arranged for receiving, if necessary, another pair opening outwards. Secondly, there is the lock chamber, 75 metres long by 25 metres wide (246ft. by 82ft.). Its walls are similar to those of the basins, but they are entirely faced with ashlar. The invert rests on a layer of concrete 1 metre thick (3·28ft.), and its surface is two metres below low water (6·56ft.). The whole is surrounded by sheet-piling. Thirdly, there is the lower lock, which contains two pairs of gates, and has its invert level the same as that of the chamber. The side walls are 13 metres apart (42⅔ft.), and are crossed by a swing bridge of the same dimensions as that across the upper lock, and carrying a roadway and two lines of railway. The chamber and lower lock had to be constructed almost station, having an area of 20 hectares (50 acres), and specially intended for the service of the new quays. At some future date it is probable that this station may be made to communicate with the left or western bank of the Scheldt by a bridge carrying a roadway and one or two lines of railway, which would be constructed by the State. Immediately above, or south of this bridge, in the corner between the railway and the fortifications, the town intend to construct a small basin, dry at low water, and especially intended for barges carrying materials for construction. It will be 115 metres by 50 metres (377ft. by 164ft.), having a length of 340 metres of quay wall (1115ft. or 0·21 mile), and will be surrounded by a roadway 30 metres wide (100ft.). Its entrance will be crossed by a swing bridge. From the northern side of this entrance begins the quay wall, built within the bed of the river, and extending from thence in one curve to the old docks. This wall has been built by a special system of movable cofferdams which will be described immediately. It is constructed of Boom bricks, and faced with Soignies stone; the coping level is 6·35 metres (21ft.) above low-water; the total height is 14·35 metres (47ft.), and the width is 2 metres at the top (6·56ft.), 6·25 metres at low-water level (20½ft.), and 7 metres at the base (23ft.). It has a batter of 1 in 20 from the coping to low-water level, and 1 in 10 from thence to the foundations. The upper part of these foundations is throughout at a level of 8 metres (26¼ft.) below low-water, and has a breadth of 9 metres (29½ft.); the depth varies between 2·50 and 5 metres (8¼ft. and 16½ft.), according to the depth of the river-bed and the nature of the soil, so that the bottom of the foundation is from 10·50 to 13 metres (34½ft. to 42⅔ft.) below low-water. The difficulty of carrying out such works in the Scheldt is very great; the sandy and shifting nature of the bottom, the speed of the current, and the great rise of tide, are all adverse circumstances. It was required to build a continuous quay wall with its foundations 34ft. to 43ft. below the low-water level of a rapid river, rising twice rolled girders and diagonals. Round the lower edge of the box runs a wrought iron rectangular tube H, 1·50 metre high, and 0·50 metre wide (4·92 and 1·64ft.), through which a man can pass to bolt or unbolt the joint between the caisson and the cofferdam. There are four manhole tubes, 1 metre by 0·50 metre (3·28ft. by 1·64ft.), through any of which the workman can enter; when within he is then protected by means of compressed air. These tubes are rivetted to the outside of the cofferdam, stiffened by gussets, and furnished with air locks. The upper part of the cofferdam is stiffened by strong lattice girders inside, and the lower part by being bolted to the caisson. Valves are placed at the ends for letting water in when required, in order to increase the load on the caisson, and thus facilitate its sinking. To prevent any deformation of the walls of the cofferdam under the pressure of the water, whilst the building of the masonry is going on inside, they are connected with each other by strong movable stays, which as the work proceeds are removed, and replaced by shorter stays bearing against the face of the wall already constructed. The cofferdam, complete with all its apparatus, weighs about 200 tons. The floating framework C C is composed of two iron barges, 26 metres by 5 metres (85ft. by 16ft.); on these are built frames of iron J J braced diagonally, and connected at a height of 13 metres (43ft.) above water-level by cross girders; they are also connected by a similar framework at the two ends. The cofferdam is suspended by twelve chains in the space between the two barges, and can thus be raised or lowered at will by means of hoisting gear, consisting of six winches in each barge, all twelve worked by one steam engine. The power is transmitted from one barge to the other by means of two pitch-chains. Uniformity of lifting with the twelve lifting chains is secured by india-rubber springs; each tackle has a lifting power of about 20 tons. In the hold of the barges are the steam engine for working the cofferdam, the air-compressors, the pres-



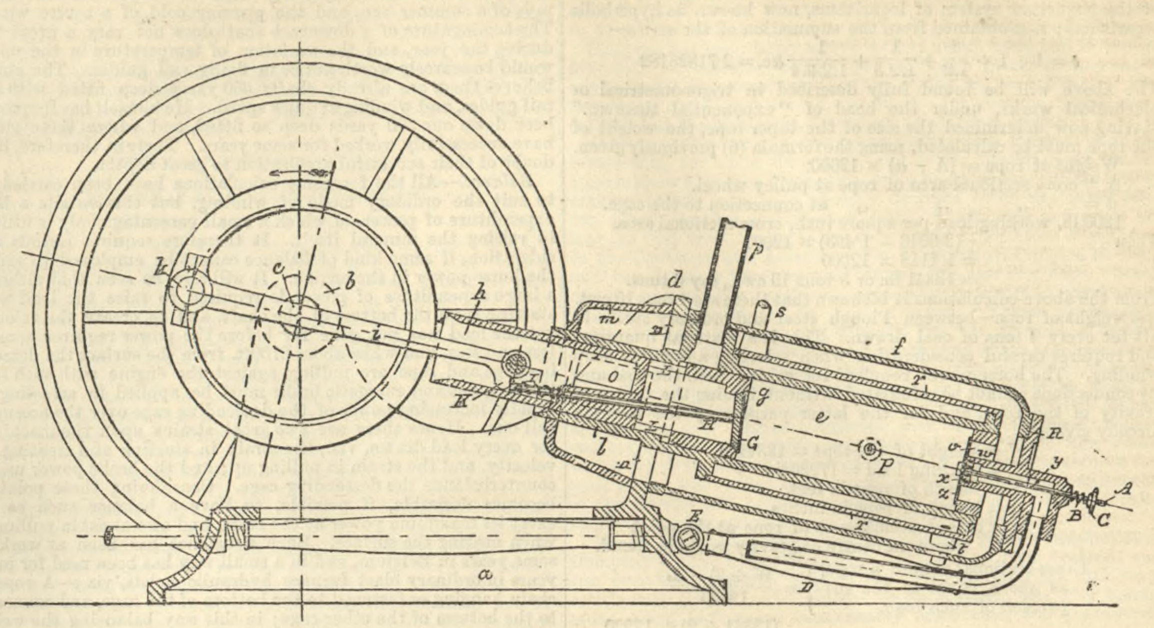
TRANSVERSE SECTION LONGITUDINAL SECTION

FIGS. 1 AND 2.—ANTWERP HARBOUR WORKS—CAISSONS FOR CONSTRUCTING QUAY WALLS.

entirely within the area of the Scheldt. Instead of building a cofferdam in the river so as to proceed with both at the same time, the contractors propose to make the lower lock itself form part of the cofferdam which should shut in the lock chamber to be built behind it. With this object they constructed the whole of the lower lock *in situ*, and in one piece upon an immense caisson sunk by means of compressed air to a depth of 6½ metres (21ft.) below low-water level. This caisson was 40 by 23 metres (131ft. by 75½ft.), having an area of 920 square metres (9890 square feet). Its total height was 13 metres (42⅔ft.), giving a content of 11,960 cubic metres (420,000 cubic feet.) Inside the roof it was divided longitudinally into five working chambers completely independent of one another, each having its own air-lock and tubes for concrete. The walls of the caisson were joined near the top and above the girders by cross girders of iron. The caisson was erected on the banks of the Scheldt in a spot sheltered from the tide by an earthen embankment. When complete, the embankment was cut through on the side near the river, and the tide entering floated off the caisson, which was then towed without any damage to its proper position. The sinking was commenced in August, 1878, and was finished by November of the same year. The masonry having been carried up a certain distance, it was then connected with the bank at either end by an earthen embankment. A vast basin was thus formed, which needed only to be pumped dry in order to commence the foundations of the lock chamber. When the chamber and locks were completed, all that remained was to remove the iron barrier across the end of the lower lock next the river by cutting the rivets and unbolting the wrought iron knees which supported it. The six gates belonging to the entire lock are all of wrought iron and made without rollers; the lowering of the water is effected by means of sluices in the side walls and valves in the gates themselves. Between the lower lock and the line of the new quay is an entrance channel 50 metres long (164ft.) and the same in width, intended to shelter boats from the river current as they enter or leave the lock. The bottom of this channel is 2½ metres (8ft.) below low water; its walls were built upon caissons sunk by compressed air to depths varying from 10·5 to 12·6 metres below low water (34½ft. to 41½ft.), and in the manner to be described hereafter. The embankment connecting the southern end of the new quay-wall with the banks of the Scheldt was finished in 1878. It is 650 metres in length (2130ft. or 0·4 mile), and is founded partly on rubble, partly on platforms of fascines loaded with stone, and stone thrown in at the greater depths to form a sound footing for the embankment. This is constructed of an argillaceous alluvial earth called "schorre," and of sand dredged from the Scheldt; the river slope is paved with rough hewn stone. The new quays have now been constructed for a considerable distance both above and below the entrance to the basins already described. The filling in behind the walls has been performed partly by hopper barges discharging spoil dredged from the river, partly by locomotives bringing earth removed from the basins, and from lands acquired outside the works. The extent of this work may be judged from the fact that the quay head of the entrance channel to the basins is more than 150 metres (500ft.) in front of the old dyke which formed the border of the river, and that two-thirds of the ground between the basins and the new quay wall has been won from the river bed. Behind the basins extends the new southern quarter, occupying the site of the ancient Spanish citadel, and bought in 1874 by the Société Anonyme du Sud d'Anvers. It is intersected by wide streets, and is being covered with new buildings. Altogether it has an area of 115 hectares (284 acres); and to the south of it, close to the new fortifications, is the southern railway in the day to more than 13ft. on the average above this level, and sometimes at high tides to 21ft. The method adopted by the contractors was as follows: they divided the total length of the quays into lengths of 25 metres each—82ft.—which have been built end to end, and directly upon firm ground, without any intervening foundations. This has been accomplished by means of a special cofferdam used for the first time on this occasion, and with most complete success. It is composed of the following parts:—Firstly, an iron caisson for compressed air, A A, Figs. 1 and 2, varying in height according to the depth at which the foundations are to be laid, and intended for removing the soil and laying the base of the wall. Secondly, a movable iron cofferdam B B, 12 metres high—40ft.—having the same shape as the caisson on which it stands, and with which it is connected by bolts. Within this cofferdam can be built, in the dry and in the open air, the part of the quay wall, 8 metres in height—26½ft.—which is comprised between the top of the foundations properly so called and the level of low water. Thirdly, a floating framework C C, designed for the manipulation of the cofferdam and for the placing and sinking of the caisson. The caisson serves for the removal of the earth, and is then filled with concrete and becomes an integral part of the foundations. The masonry having been built on the top of this up to low-water level under the shelter of the movable cofferdam, it becomes possible to remove the cofferdam by unbolting it from the caisson and raising it by chains fixed to the floating framework. It is then taken away to serve the same purpose for another length of wall, while the length so far constructed by its means is finished in the dry. Such is the general plan of operations; a few details are subjoined. The caissons A A have a uniform width of 9 metres (29½ft.) and a length of 25 metres (82ft.). Their height varies from 2·60 to 5 metres (8½ft. to 16½ft.), according to the depth required, the footings of the wall, properly so called, being, as already stated, always at a depth of 8 metres (26¼ft.) below low water. Each caisson has vertical sides of plate iron, rivetted to longitudinal and transverse angle irons. It is divided into an upper and a lower portion by a horizontal partition D; the lower portion forms the working chamber, and has a uniform height of 1·90 metres (6¼ft.) from the lower edge to the roof. This roof is rivetted to a series of transverse lattice girders E E, strong enough to support the load of masonry to be built upon the caisson, and at the same time to prevent any buckling of the sides. An angle-iron is rivetted all round the external edge of the top of the caisson, and through this pass the bolts which connect it to the cofferdam. The roof of the caisson has five circular openings, in which are fixed wrought iron tubes. Four of these, F, are 0·50 metre in diameter (1·14ft.), and are intended for the concrete, whilst the fifth, G, which is in the centre, has a double-air lock for the workmen and for compressed air. The masonry is so built as to leave round each of these tubes an annular space, so that they may be unbolted and withdrawn when the sinking is completed. The spaces are afterwards filled with concrete. The caissons are built in yards on the bank of the river, and are launched at high water; they are then towed to their destination underneath the movable cofferdam, and are bolted to the latter, a layer of india-rubber being placed between the two. The weight of a caisson 82ft. by 29½ft. varies from 65 to 100 tons, according as the height is 8½ft. or 16½ft. The movable cofferdam B B is composed of a large wrought iron rectangular box, 25 metres by 9 metres (82ft. by 29½ft.), and 12 metres (40ft.) high. This height is sufficient to protect the interior against ordinary tides, which at Antwerp have a rise of 4·05 metres (13¼ft.). The sides have a thickness varying from 7 mm. at the top to 12 mm. at the bottom (0·28in. to 0·47in.), and are stiffened externally by sure pumps, and the exhausting pumps. On deck are mortar-mixing machines, and other machines for handling the materials. Four Jablochkoff electric lamps are placed on each framework for working by night. The two barges, with their framework, engines, boilers, &c., weigh altogether about 300 tons. The method of working with this apparatus is as follows:—The site for the caisson is first dredged to the proper level; the caisson is then brought up to the floating framework, and its roof is loaded to the top of the girders with concrete, which ultimately forms part of the foundation. The cofferdam is lifted until its bottom edge is about 1 metre (3·28ft.) above water level, and the caisson is then brought in under it. The cofferdam is lowered upon it, and the two are bolted together. The masonry is then commenced on the top of the caisson, so as to load it with the necessary weight, whilst at the same time the central air tube and four concrete tubes are attached to it—see above. When the weight of masonry is sufficient to bring the lower edge of the caisson almost down to the river bottom at low water, the whole structure, which weighs about 2000 tons, is brought into the exact line of the quays and firmly moored. The masonry is then continued within the cofferdam, whilst at the same time the working chamber at the bottom of the caisson is filled with compressed air; and as soon as the caisson rests on the ground, with weight sufficient to resist the upward pressure, water is admitted inside the cofferdam so as to increase the weight bearing upon the caisson. The workmen then enter the working chamber and excavate the soil. As they do so, the caisson sinks gradually until it reaches a firm foundation at the desired depth. The bottom of the Scheldt is generally composed of sand, more or less argillaceous, and of loamy earth. Under these circumstances the work of removing the earth excavated has been considerably facilitated by the use of ejectors, as employed for the first time by the same contractors at Selzaete Bridge on the Terneuzen Canal. For this purpose the earth is shovelled into an iron box fixed to the roof of the caisson; a tube furnished with a stop-cock leads from this box to the exterior of the caisson, whilst a second tube opening into the box brings in water under a sufficient head to overcome the pressure of the compressed air. This water reduces the earth in the box to slush, the action being quickened if necessary by stirrers actuated by hand-power. When the mixture is complete, the mere reversal of the stop-cocks admits the compressed air to the ejector, which expels the slush through the side of the caisson. Each ejector can easily discharge two cubic metres (2·6 cubic yards) of earth per hour. When the excavation is finished, the working chamber is filled with concrete in regular layers through the four tubes previously mentioned. During the whole of this time the further loading of the cofferdam is continued, with a sufficient quantity of materials to balance the increasing displacement caused by the sinking of the mass, and by the injection of the compressed air. When the working chamber is completely filled with concrete, the concrete tubes and air tube are removed, the water is pumped from the inside of the cofferdam, and the masonry is then continued up to a height of about 0·50 metre (1·64ft.) above low-water. The cofferdam is then unbolted by means of workmen entering through the tube H previously described, which is filled with compressed air. The cofferdam is then lifted by means of the winches, and taken away to another caisson for a similar operation. It follows from this method that almost the whole of the masonry below water is built in the open air, the filling of the working chamber being all that is done under compressed air. The superintendence of the working is therefore easy, and the construction cheap. In addition to the economy thus obtained in the masonry, this method presents also the great advantage of almost entirely avoiding the loss of the iron plates, which in the older systems were rivetted to the caisson as it descended, and were withdrawn as best they could be after completion of the masonry. A single cofferdam now serves for any number of caissons. At first the putting in of the foundation for one 25-metre length of wall (82ft.), and the raising of the masonry to low-water level, occupied thirty-five to forty days; the time has now been reduced to about twenty-five days. The interposition of the sides of the cofferdam leaves, of course, an interval, of about 1 metre (3¼ft.), between the successive lengths of wall. The sides of this gap are temporarily closed by wooden sheeting, and the gap is then filled in with concrete thrown down under water up to the height of low-water. Vertical grooves are left in the ends of the adjacent lengths of walling, and are filled in with concrete, which thus forms a sort of joggle between the two lengths of wall. Above low-water the masonry is carried up by tidal work in a continuous length. Throughout the whole length of the new quays there will be two main lines of railway, separated by an iron railing from the street of 20 metres width which extends along the front of the houses. Running parallel to and connected by switches with these main lines there will be three other roads—one for wagons arriving loaded, the second for wagons arriving empty, and the third, covered by the sheds, for the operations of loading and unloading. Along the quay itself will run a sixth road united to the main line by transverse roads passing between the various sheds. For transferring merchandise direct from vessels on to wagons on this line, overhead movable hydraulic cranes will roll on a special way laid outside this road, with a passage through their pedestals to allow free circulation of wagons. Between the fourth line of rails and the quay will be built iron sheds occupying a total width of about 50 metres (160ft.). These lines and sheds have already been completed for a length of about 1400 metres (4600ft.) of the quay. The sheds when complete will cover an area of about 100,000 square metres (1,076,000 square feet, or 25 acres). The total width of the new quays is 100 metres (328ft.). To obtain this width it has been necessary to pull down more than 600 houses, the purchase of which has cost more than 25,000,000f. (£1,000,000). The total cost of the quays, including machinery, earthworks, dredging, paving, works above ground, and property purchased, will be about 80,000,000f. (£3,200,000). The new quays will be worked by hydraulic machinery. For this purpose steam pumping engines of 400-horse power have been placed in a building near the southern basin for small craft. From this building a line of pipes is already laid, passing round the small-craft basin and along the first section of the quays. This first section is worked by twenty-two portable hydraulic cranes. Hydraulic capstans will be used to haul the wagons and cranes along the quays. The steam pumping engines with their boilers and accumulators, and the portable cranes, will be open to the inspection of the members. It remains to mention the works at the other or northern end of the quay, towards the old dock. Following the line of the new river wall, the visitor passes one of the recesses previously mentioned, in which is placed a landing stage, 20 metres by 10 metres (66ft. by 33ft.), provided with a flying bridge, and intended for passengers and goods arriving from the Waes Railway Station on the other side of the Scheldt. He also passes the entrance of the old docks and the Quai du Rhin, and then has on his right the Kattendyk basin. Here are three dry docks previously constructed, and three which have been constructed during the progress of the present works. These new docks are 133 metres long (436ft.), with entrances 15 metres wide (50ft.), and are faced throughout with hewn stone. The gate chambers are each founded on 280 piles, about 6 metres (20ft.) long, covered with a gridiron of timber. Sunken cofferdams of sheet piling filled with concrete prevent the passage of any water under the gates. The walls of the dock are founded on the ground, within a casing of sheet piling; they rest on a layer of concrete, 0·80 metre thick (2½ft.), and all are of brick faced with stone. Throughout the length intended to receive vessels the bottom has an invert of masonry strong enough to resist the pressure of water when the dock is empty. At the same time this invert has been filled up with masonry, so as to give the bottom of the dock a slope from the middle towards the sides, thus preventing the rain water from settling in the middle under the vessel's keel. The steps are wider than in the old dry docks, which assists the workmen in placing the shores, and also gives the dock greater width; at the same time the coping is brought down almost to the level of the water in the dock outside, so that the depth of the dry dock is as small as possible, and thus gives more air and light round the vessel docked. The keel blocks, instead of being of wood, as usual, are all of cast iron, each in three pieces. Of these the lowest is fixed into the floor of the dock; the uppermost carries the vessel's keel, and the ntermediate piece, which is wedge-shaped, is driven in between the two others so as to support the keel firmly at all points. The construction of these three new dry docks has required 28,700 cubic metres (37,540 cubic yards) of brickwork and nearly 5000 cubic metres (6540 cubic yards) of hewn stone, while more than 100,000 cubic metres (130,800 cubic yards) have been excavated. The large dry dock previously existing is emptied by means of pumps capable of drawing 200,000 litres (7000 cubic feet or 44,000 gallons) per minute. It was desired to make the same pumping engine serve for the new dry docks, but there was great difficulty in doing so, from the fact that the conduit leading the water from the new docks to the engine was obliged to pass below the existing docks. For this purpose a tunnel, about 90 metres long (300ft.) was driven and lined with cast iron tubbing. A well was first sunk by means of compressed air, and the driving of the tunnel was carried on by the same means, the successive lengths of cast iron tubbing being bolted on to one another, and the water kept back by the pressure of the air. This operation succeeded perfectly, and the extremity of this tunnel has been united with the head of each of the dry docks. Beyond the dry docks the Kattendyk basin has been extended so as to give it a total length of about 1 kilometre (32,800ft.), communicating by one entrance with the old docks, and by another entrance direct with the Scheldt. The northern docks just described are also worked by hydraulic machinery. A special building contains a 150-horse power steam pumping engine and boilers, and two accumulators weighing 120 tons each. This engine supplies a water-pressure of 700 tons per square inch to the movable and other cranes round the docks, the bridge and gate machinery and capstans for hauling ships, &c., and also the hydraulic engines which drive the dynamo-electric machines for lighting the entrance of the old docks. Among the machines worked by this pressure-water may be mentioned a forty-ton crane altered to the hydraulic system and a sheer leg capable of lifting 120 tons. These are on the eastern wall of the Kattendyk basin. The lock of this basin is crossed by a drawbridge having a length of 48·36 metres (158ft.) carrying a roadway 90ft. wide, and weighing 375,000 kilogrammes (370 tons). In order to open this bridge it is raised 1 metre (3·28ft.) by means of two hydraulic rams 0·80 metre in diameter (31·5in.), and is then drawn forward by chains which are worked by rams 0·61 metre in diameter (24in.); the bridge can be completely opened in three minutes twenty seconds, and closed in two minutes ten seconds.

Besides these great works for the enlarging of the quays on the Scheldt, the extension and improvements of the docks is also in progress, as mentioned above. The city has issued forms of tender for an extension of the docks towards the north, reaching as far as the northern citadel, which they have purchased. These works comprise the making of two new docks, having a quay length of 3700 metres (12,136ft., or 2·3 miles), and an area of 21 hectares (50 acres), and a depth of 9 metres (30ft.). These works will cost, including acquisition of property, nearly 20,000,000 francs (£800,000), and are to be completed in three years. Thus from 1877, when the present works were begun, to the date when they will be completed—say 1887—the kingdom of Belgium and the city of Antwerp will have executed maritime works, and acquired property for this purpose, costing a total sum of 100,000,000 francs (£4,000,000), irrespective of improvements made in the works previously existing.

EDWARDS' GAS ENGINE.



The accompanying engravings illustrate Edwards' patent gas engine, made by Messrs. Cobham and Co., Stevenage, Herts, and to which we referred in our recent notice of the engines exhibited at York. In our engravings *a* is the foundation plate of the engine, having the bearing *b* in which the crank shaft *c* revolves; *d* is an inclined plate upon the foundation *a*, to which the cylinder *e* and casing *f* are bolted; *g* is a piston working in the cylinder *e* and having a hollow rod or trunk *h*, to which is jointed the connecting rod *i*, which drives the crank pin *k*. The guide *l* fits upon the hollow trunk *h*, and is itself surrounded by the air casing *m*, which communicates with the casing *f* through openings *n n* in the inclined plate *d*. The guide *l* has openings *o o*, through which air enters the casing *m*, when the hollow trunk *h* is at the inner end of its stroke; *p* is the exhaust pipe, and *r* is a casing round the cylinder *e*, through which water may be made to circulate by pipes at *s*, *t*. The valve seat *v* fits into the cylinder *e*, and has holes *w* for the admission of air, and *x* for the admission of gas through the central pipe *y*. The valve *z* consists of a disc of metal covering these holes and guided by a spindle A, the outer end of which is fitted with a metal or india-rubber spring at B, and a regulating nut C. The gas pipe *y* is shown supplied from a flexible bag D, the supply to which from any convenient source is regulated by a cock or valve at E. The piston *g* contains a disc exhaust valve G, the spindle H of which is fitted with a closing spring I, and the end of the spindle is pressed down during the inner stroke of the piston by a tail-piece K on the inner end of the connecting rod *i*. Holes L open from the hollow piston above the exhaust valve G into the cylinder round the hollow trunk *h*, and thence to the exhaust pipe *p*. At or near one-third of the stroke of the piston a firing valve P is arranged, having an inlet hanging valve of the usual kind, through which a flame burning outside is drawn when the valve is uncovered by the piston *g*. The outer end of the casing *f* is closed by a cover R, to which the valve seat *v* and gas inlet pipe *g* are connected.

The operation of the engine is as follows:—The piston *g* being at the inner end of its stroke, the crank is turned round in the direction of the arrow, and the piston draws air in through the holes *w* and gas through the holes *x*, the two mixing as they pass under the inlet valve *z*. When the piston has advanced far enough to uncover the firing valve P the flame is drawn in and the inflammable mixture exploded, the expansion of the air and gas closing the inlet valve *z* and carrying the piston to the end of its stroke. The momentum of the fly-wheel then carries the piston back through its return stroke, during which the tail-piece K presses the spindle H and opens the exhaust valve G, through which expanded air and gas escape to the exhaust pipe *p*. It is claimed that this arrangement is very effective in securing a complete clearance from the cylinder of the products of combustion, which, when not wholly removed, vitiate the incoming charge and reduce efficiency.

When the piston arrives at the inner end of its stroke, the exhaust valve G is closed by the spring I and a fresh supply of air and gas are drawn in through the inlet valve seat *v*, as the piston again commences its outer stroke. In order to keep the cylinder *e* sufficiently cool, whether the water casing at *r* be used or not, the whole supply of air is drawn from the front end of the cylinder through the openings *n n*, and thence between the cylinder *e* and the casing *f*, and round the end of the latter to the inlet valve *v*. And in order to prevent or lessen the noise of the explosions, the hollow trunk *h* is made of such length that its front edge closes the openings in the guide *l*, through which air is drawn into the air casing *m* and through the openings *n n*, just before the explosion takes place, the noise of which therefore cannot escape. For the same purpose fibrous or porous material, such as mineral or slag wool, may be placed loosely in the space between the cylinder *e* and the casing *f*.

The engine may be made to revolve in the opposite direction to the arrow by turning the piston and connecting rod round so that the tail-piece upon the latter is above instead of below, and instead of the water casing *r*, radial ribs may be formed upon the cylinder *e*, from which the air passing between them inside the casing *f* absorbs the heat. The cylinder is arranged preferably in the inclined position shown, but it may, of course, be fixed in any other convenient position.

COAL WINDING IN DEEP SHAFTS.

By Mr. Arthur H. Stokes, F.G.S., H. M. Inspector of Mines.

(*Concluded from page* 48.)

Plough steel wire rope.—Wire ropes made of Plough steel have lately been introduced for winding coal, where thin and light weighted ropes are required. The wire takes its name from the purpose it is used for in agricultural work. The author believes it is made specially for steam plough work, and of a very tenacious and hard quality of steel. The wire being drawn through various sized rollers, is crushed or thinned down by pressure to its required gauge, and it is guaranteed of the highest breaking strain. The author does not express any opinion on this, or upon either the merits or demerits of this class of wire rope for winding purposes. Time will prove its adaptability, and its measure of safety. It is, however, quite clear that a steel wire rope of lighter weight, and less dimensions than the ordinary steel rope, combined with a greater breaking strain, and of course greater working load, can be manufactured. The author thinks, whatever may be the working result of the Plough steel wire ropes, that a steel winding rope equal to a breaking strain of, say, 54 tons, or a working load of 12,000 lb. per square inch of cross sectional area can be produced; and that, for deep winding, the lightest rope with the greatest breaking strain will be used, so as to combine the strongest rope with the least material. From the calculations previously given it will be seen that the weight of the rope is a serious item. It may therefore be both instructive and interesting to calculate the same requirements supposing Plough steel wire ropes to be used, or rather steel ropes having a working load of 12,000 lb. per square inch of cross sectional area. In doing this, a variation may be made in the formulæ, and the former calculations being given in a very detailed manner, it will save both time and space to employ a more concise form, and to explain those points only which have not clearly been given before.

Cross sectional area of Plough steel wire rope to carry a working load of 8 tons $\Big\} = \dfrac{17920}{12000}$

$= 1{\cdot}493$, say, $1{\cdot}50$ sq. inches.

Then, $\sqrt{\dfrac{1{\cdot}50}{{\cdot}07958}} = 4{\cdot}34$in. circumference of the rope.

It has already been shown that a steel wire rope, of 4000ft. long, suspended in a shaft without any load attached, is nearly equal to the working load; therefore it is now sufficient to calculate the form or size of taper rope required in Plough steel wire, and for this purpose the author will adopt another, although more difficult formula.*

(12) Rule for finding the section at any point of a taper rope of uniform strength:—

$$^{*}\ S = \frac{W}{f}\, e^{\frac{wx}{f}}$$

In the case under examination, S = section of rope in inches; W = weight of cage, load, &c., applied at end of the rope = 17920 lb.; w = weight of one foot in length of the small end of the rope, one square inch of sectional area = 1·67 lb.; x = distance in feet from the end at which W is applied to the section S = 4000; $e = 2{\cdot}7182$ a constant; f = working or safe strain in pounds per square inch section of rope = 12,000. It will be seen from the above formula that it would be a most laborious operation to work the above out by the ordinary rules of arithmetic. It is here done by logarithms, and the operation is simplified as much as possible—

Thus $S = \dfrac{17920}{12000}\, e^{\frac{wx}{f}}$

$= 1{\cdot}493 \times 2{\cdot}7183^{\frac{wx}{f}}$

$= 1{\cdot}493 \times \overline{2{\cdot}7183}^{\left(\frac{1{\cdot}67 \times 4000}{12000}\right)}$

$= 1{\cdot}493 \times \overline{2{\cdot}7183}^{(5566)}$

$= 1{\cdot}493 \times \overline{2{\cdot}7183}^{({\cdot}5566)}$

Now log. $\dfrac{W}{f} \times e^{\frac{wx}{f}} = \text{log. } 1{\cdot}493 \times \overline{2{\cdot}7183}^{({\cdot}5566)}$

But „ „ „ „ $= \text{log. } \dfrac{W}{f} + \text{log. } e^{\frac{wx}{f}}$

$= \text{log. } \dfrac{W}{f} + \dfrac{wx}{f} \times \text{log. } e$

$= \text{log. } 1{\cdot}493 + {\cdot}5566 \times \text{log. } 2{\cdot}7183$

Or log. $1{\cdot}493 \times \overline{2{\cdot}7183}^{({\cdot}5566)}$, $= \text{log. } 1{\cdot}493 + {\cdot}5566 \times \text{log. } 2{\cdot}7183$
$= {\cdot}1740598 + {\cdot}5566 \times {\cdot}4342944$
$= {\cdot}1740598 + {\cdot}24172826304$
$= {\cdot}41578806304.$

And ·41578806304 = log. 2·6048 square inches.
Hence S = 2·6048 square inches.

Again, it perhaps may be more clearly defined as follows:—

$S = 1{\cdot}493 \times \overline{2{\cdot}7183}^{({\cdot}5566)}$

Thus log. $\overline{2{\cdot}7183}^{({\cdot}5566)} = {\cdot}5566 \times \text{log. } 2{\cdot}7182$
$= {\cdot}5566 \times {\cdot}4342944$
$= {\cdot}24172826304$

And ·24172826304 = log. 1·7447

Now $S = 1{\cdot}493 \times \overline{S2{\cdot}7183}^{({\cdot}5566)} = 1{\cdot}493 \times 1{\cdot}7447$
$= 2{\cdot}6048$ square inches.

From the above two ways of carrying out the formula, the answer is the same, viz.:—

S = 2·6048 square inches.

Hence then—

Cross sectional area of rope at cage end = 1·493 square inches.
„ „ „ „ pulley wheel = 2·6048 „ „

Or— $\sqrt{\dfrac{1{\cdot}493}{{\cdot}07958}} = 4{\cdot}33$in. circumference.

$\sqrt{\dfrac{2{\cdot}6048}{{\cdot}07958}} = 5{\cdot}72$in. „

* Rankine's "Applied Mechanics," page 297—6th Edition.

The whole of the figures in the above calculation will not be difficult to understand, but it may be asked how the constant $e = 2{\cdot}7182$ is obtained. This constant is termed the *radix*, or base of the Napierian system of logarithms, now known as hyperbolic logarithms; it is obtained from the summation of the series—

$$e = 1 + 1 + \frac{1}{1.2} + \frac{1}{1.2.3} + \frac{1}{1.2.3.4}\,\&c. = 2{\cdot}71828182$$

The above will be found fully described in trigonometrical or algebraical works, under the head of "exponential theorem." Having now determined the size of the taper rope, the weight of the rope must be calculated, using the formula (6) previously given.

Weight of rope $= (\mathrm{A} - a) \times 12000$.
A = cross sectional area of rope at pulley wheel.
a = ,, ,, ,, at connection to the cage.
1200 lb. working load per square inch, cross-sectional area.

Then
$$(2{\cdot}6048 - 1{\cdot}493) \times 12000$$
$$= 1{\cdot}1118 \times 12000$$
$= 13341$ lb. or 5 tons 19 cwt., say 6 tons.

From the above calculations it is shown that there are 4 tons 10 cwt. less weight of rope—between Plough steel and ordinary steel—to lift for every 4 tons of coal drawn. This is a material quantity, and requires careful consideration when selecting a rope for deep winding. The horse-power required for raising both the coal and its connections cannot be calculated without finding the centre of gravity of the rope, and for the latter purpose by the formula already given.*

W = weight of the rope = 13341 lb.
L = working load = 17920 lb.
F = length of rope in feet.
y = length of rope in inches.
a^1 = cross-sectional area of rope at the point where the centre of gravity would be found.

Cross-sectional area of a rope, as above, equal to the suspension of such load.
$$= \frac{\mathrm{W} \div 2) + \mathrm{L}}{12000}$$
$$= \frac{(13341 \div 2) + 17920}{12000}$$
$a^1 = 2{\cdot}05$ square snches.

Upon reference to the formula previously given—(5)—

$$y = \frac{f}{m} \times hyp.\ log. \frac{a^1}{a}$$

$$\frac{y}{12} = \mathrm{F} = \frac{12000}{12 \times {\cdot}14 \times {\cdot}4342944819} + log. \frac{a^1}{a}$$

But F being an unknown quantity, and a^1 and a known quantities, it follows—

$$\mathrm{F} = 16447{\cdot}02 \times log. \frac{a^1}{a}$$
$$= 16447{\cdot}02\ (log.\ 2{\cdot}05 - log.\ 1{\cdot}493)$$
$$= 16447{\cdot}02\ ({\cdot}3117539 - {\cdot}1740598)$$
$$= 16447{\cdot}02 \times {\cdot}1376941$$
$= 2264{\cdot}67$ft.

Then $4000 - 2264{\cdot}67 = 1735{\cdot}33$ft. from the surface.

Hence, to find the horse-power (by 8)—

$$\text{Horse-power} = \frac{\text{weight of rope} \times 1735{\cdot}33}{\text{time in minutes} \times 33000}$$
$$= \frac{13341 \times 1735{\cdot}24}{1{\cdot}50 \times 33000}$$
= 467-horse power required to wind the rope.

Then— 467-horse power required to wind the rope.
1448 ,, ,, ,, raise the load.
1915 total H.P. executed in winding every 4 tons of coal.
Add 20°/₀ 383 for friction.
2298 total H.P. required.

The traverse of the rope on the drum will be as follows:—
Drum 12 yards diameter.

$$\text{Circumference} = 12 \times 3 \times 3{\cdot}1416$$
$= 113{\cdot}1$ft. circumference.

$$\text{Revolutions} = \frac{4000}{113{\cdot}1}$$
$= 35{\cdot}36$ revolutions.

$$\text{Diameter of rope at pulley wheel} = \frac{5{\cdot}72}{3{\cdot}1416} = 1{\cdot}82\text{in.}$$

$$\text{,, ,, cage} = \frac{4{\cdot}32}{3{\cdot}1416} = 1{\cdot}37\text{in.}$$

and $1{\cdot}82 + 1{\cdot}37 \div 2 = 1{\cdot}60$in. average diameter of rope.

From the above it is seen that the rope winding round the drum will average about 1·60—say $1\frac{3}{4}$—inches diameter, and the traverse say $1{\cdot}75 \times 35{\cdot}36 = 61{\cdot}88 = 5$ft. 2in.

The size of cylinder required has now to be calculated, and the remarks previously made, and the formula used in the calculation given with an ordinary steel rope may be applied in this case.

Thus (by 9)—

$$\text{Horse-power} = \frac{\mathrm{A} \times \mathrm{V} \times \mathrm{P}}{33000} = 2298\text{-horse power}$$

$$\text{H.P.} = \frac{2 \times d^2 \times {\cdot}7854 \times 282{\cdot}84 \times 50}{33000} = 2298\text{-H.P.}$$

Hence (by 10)—

$$d^2 = \frac{33000 \times 2298}{2 \times {\cdot}7854 \times 282{\cdot}84 \times 50}$$

$$d = \sqrt{\frac{75834000}{22214{\cdot}25}} = \sqrt{3413{\cdot}75}$$
$= 58{\cdot}42$in. diameter of cylinder.

The above calculations may be summed up as follows:—
1000 tons of minerals per day.
4000ft., depth from which the mineral is raised.
4 tons, weight of mineral drawn at each lift of the cage.
4·33in., circumference of rope at cage connection.
5·72in., ,, ,, pulley wheel.
6 tons, weight of the rope.
1·50 minute in raising the load.
·16 ,, banking the mineral.
2298-horse power to raise the load, rope, cage, &c., or horse-power expended to raise every 4 tons of mineral.
58·42in. diameter of cylinder—coupled engines.

Guides.—It has been previously stated and shown with regard to ropes of uniform sectional area, that for a depth of 4000ft., iron wire ropes would not carry their own weight as a working load; consequently they could not be employed for guide ropes. Also that steel ropes, although their own weight will not exceed the working load for that depth, would not be able to be weighted beyond a few hundredweights when placed in so deep a shaft, and would therefore be very unsteady. Hence attention must be turned to rigid guides, either of wood or iron. From the calculations already made it will be found that the cage would travel at a great velocity in the shaft—average 45ft. per second—or at the rate of 30·7 miles per hour; and, considering the starting and stopping, the cage would probably travel at the rate of fifty miles per hour when in the centre of the shaft; at this rate it is not improbable that the wood guides might take fire, and should the shoe of the cage ever strike a shake in the timber, or any other uneven place, either from wear and tear, or joints or knots, it would make a complete wreck of such part of the shaft. The author therefore falls back on iron or steel rails for conductors. These should be dovetailed into each other at the joints, to prevent the slightest possible chance of presenting an uneven joint; or in other words, the iron or steel rail conductors should be quite as even and as strongly secured as the rails upon which express trains travel. The use of iron rails for conductors is nothing new; they are used in some of our deepest shafts and in cases of the fastest winding. They have been in use for some years, and have therefore stood the test of applicability. Each rail should be secured to the shaft side in the strongest possible manner, and every care must be taken not only to make them rigid, but that the gauge be strictly adhered to. Steel rails once fixed should last a great number of years, and require little if any repairs. They might be affected a little by change of temperature, but this even, in a shaft, will be far less than with railway rails, which are exposed to the direct rays of a summer sun, and the piercing cold of a severe winter. The temperature of a downcast shaft does not vary a great deal during the year, and the variation of temperature in the upcast would be scarcely worth notice in fixing rail guides. The author believes there are already shafts 600 yards deep fitted with iron rail guides, and winding at quick speed. He himself has frequently been down one 300 yards deep so fitted, and where these guides have successfully worked for some years. There is, therefore, little doubt of their successful application to great depths.

* Given by Mr. Joseph Timms, of Linby Colliery, Nottingham.

Balance.—All the foregoing calculations have been carried out to suit the ordinary mode of winding, but this entails a large expenditure of power, of which a small percentage only is utilised in raising the mineral itself. It therefore requires serious consideration, if some kind of balance cannot be employed to reduce the horse-power in the engine. It will also be seen that although a large expenditure of power is required to raise the load when starting from the bottom of the shaft, and to create the velocity, yet the load has not gone far before the power required becomes less and less, and when about 2700ft. from the surface the descending cage and rope are pulling against the engine with such force that a quick and energetic brake must be applied in arresting the rapidly increasing power of the descending cage over the ascending full one. Hence there are two great strains upon the machinery for every load drawn, viz., the strain in starting and creating the velocity, and the strain in pulling up; and the brake power used to counterbalance the descending cage. Considering these points, it becomes desirable, if possible, to have a balance such as will exert its maximum power at the start, and also assist in pulling up when nearing the surface. Such a balance has been at work for some years in Belgium, and in a small way has been used for many years in ordinary blast furnace hydraulic hoists, viz.:—A rope or chain hanging or fastened to the bottom of the cage, and connected to the bottom of the other cage; in this way balancing the weight of the rope, and where a rope of six to ten tons weight is to be used this is a serious consideration. The author does not intend giving merely a description, for he is well aware that engineers prefer facts before opinions, and figures before theories; hence it is best to proceed to calculate the effects of such a balance, and to show some special and sufficient advantages for adopting it. It will be seen that the winding rope might almost be termed an endless rope broken in two places by the insertion of the cages; so that, when the cage is at the surface, there is, supplementary to the winding rope, a rope hanging from the underside of the cage the full depth of the shaft, and after passing under the "sump planks," attached at its other end to the underside of the cage resting at the bottom of the shaft. This system of winding will perhaps be best illustrated by showing its application to shafts of, say, 400 yards—1200ft.—deep, because, in considering its application to shafts of 4000ft. deep, other considerations will render its application not so effective. The size of the under or balance rope should, if possible, be the same as the winding rope. This having to carry only its own weight, affords plenty of margin in strength, and the winding ropes, perhaps, might be utilised for this purpose, but iron wire being more pliable is preferred. Calculations for a shaft 400 yards, or 1200ft. deep:—

Ascending Cage.	T.	C.	Q.
Coal	2	10	0
4 tubs	1	0	0
Steel cage	2	0	0
Ordinary steel Winding rope	2	0	0
	7	10	0

Descending Cage.	T.	C.	Q.
4 tubs	1	0	0
Steel cage	2	0	0
Balance rope	2	0	0
	5	0	0

Size of ordinary steel winding rope of uniform thickness 2·2 square inches area

or
$$\sqrt{\frac{2{\cdot}2}{{\cdot}07958}} = 5{\cdot}25 \text{ circumference.}$$

Weight of rope = 1 ton 19 cwt. 36 lb., say, 2 tons.

From the above it will be seen that at the moment of starting to wind there is a length of rope on the descending side, equal in weight to the rope attached to the ascending cage—using its maximum force to create velocity, and assisting the engine at the very moment it requires to exert its greatest power; also acting as a brake, at the time the ascending cage is nearing the surface—and arriving at its maximum power as a brake, when the descending cage touches the bottom of the shaft. It follows that the engine has only to raise the weight of the mineral, and this is a uniform load for the whole depth, whereas without this balance it is an ever varying load throughout the whole distance. The great advantage of this system of winding will be best shown by calculating the size of engines required with and without such a balance rope. The author will give the calculations in a short way.

Without the balance.

D = Depth of shaft, 400 yards = 1200ft.
L = Load ascending, 5 tons 10 cwt. = 12,320 lb.
L^1 = Load descending, 3 tons = 6720 lb.
R = Winding rope, 2 tons = 4480 lb.
S = Speed of winding, say 30ft. per second.
P = Steam pressure, say 30 lb. per square inch.
V = Velocity of piston, say 300ft. per minute.

The calculation is taken for the first ten seconds, this being the period of maximum exertion of engine power.

$$\text{Horse-power} = \frac{(\mathrm{L} + \mathrm{R}) \times \mathrm{S}}{\text{Time} \times 33000}$$
$$= \frac{(12320 + 3920) \times 300}{{\cdot}16 \times 33{,}000} = 923\text{-horse power.}$$

Deduct horse-power exerted by the descending empty cage:—

$$\text{Horse-power} = \frac{(6720 + 560) \times 300}{{\cdot}16 \times 33000} = 413\text{-horse power nearly.}$$

Then 923 — 413 = 510
Add 20% for friction 102
612 total horse-power.

Hence (by 10)—

$$\text{H.P.} = \frac{2 \times d^2 \times {\cdot}7854 \times 300 \times 30}{33000} = 612$$

$$\text{Then } d^2 = \frac{33000 \times 612}{2 \times {\cdot}7854 \times 300 \times 30} = 1428{\cdot}57$$

$d = \sqrt{1428{\cdot}57} = 37$in. diameter of cylinder.

With the balance.—In this case the weight of the coal only is in consideration, because the winding rope and ascending cage and tubs are equally balanced by the balance rope, cage, and tubs, on the descending side.

Therefore— Load 2 ton 10 cwt. = 5600 lb.

$$\text{Then—}\quad \frac{5600 \times 300}{{\cdot}16 \times 33000} = 318\text{-horse power.}$$

Add 20 per cent. for friction, &c. 63
381 total horse-power.

Hence (by 10)—

$$\text{H.P.} = \frac{2 \times d^2 \times {\cdot}7854 \times 300 \times 30}{33{,}000} = 381$$

$$\text{Then}\quad d^2 = \frac{33000 \times 381}{2 \times {\cdot}7854 \times 300 \times 30} = 889{\cdot}35$$

$d = \sqrt{889{\cdot}35} = 29{\cdot}82$ say, 30in. diameter of cylinder.

The above shows—

	Horse power.	Diameter of cylinder.
Without the balance rope	612	37in.
With the balance rope..	381	30in.
In favour of the balance	231	7in.

It will scarcely be necessary to point out the great saving in wear and tear to machinery by using this balance. Without the balance there are great strains and large horse-power exerted to raise the load and give it impetus at starting—an ever varying power required for the whole distance, and heavy brake power to stop the engine. In fast winding it is not only legitimate brake power is used, but often steam is thrown against the engine, creating strains which require considerable strength of machinery to resist the great torsion caused by such strains. It will be seen that in winding from a depth of 4000ft., a balance rope, equal in weight to the winding rope, cannot be used, because a steel rope of 4790ft. long and of uniform size throughout is equal to its own working load, without cage or material attached; hence, then, a taper winding rope must still be used. The balance rope may be of uniform size throughout, because there is no weight attached, and whatever its weight may be, so in proportion must the taper rope be increased in size. Suppose the balance rope to be of $3\frac{1}{2}$in. circumference, or 1 square inch cross sectional area, and weighing 10 lb. per fathom, or 1·67 lb. per foot, the balance weight will then be $1{\cdot}67 \times 4000$ = say 3 tons. This will increase the size of the taper rope at the cage end to 3·08 square inches, and at the pulley wheel to

By (5)—

$$\log.\ \mathrm{A} = \frac{4000}{10964{\cdot}68} + \log.\ 3{\cdot}08$$
$$= {\cdot}364807 + {\cdot}4885507 = {\cdot}8533577$$
= log. 7·134 square inches cross sectional area.
= 9·46in. circumference.

In the "Plough Steel" wire winding rope, the weight of the balance rope may be further increased, for the tenacity is so much greater. It is not, however, necessary to use "Plough Steel" for a balance rope, as ordinary steel will answer quite as well, there being no load to carry. But iron wire cannot be used because its own weight exceeds its working load at a depth of 3000ft. Taking therefore an ordinary steel rope for the balance, say 1·50 square inch sectional area, or 2·5 lb. per foot,

Then $2{\cdot}5 \times 4000$ = say 4 tons 10 cwt.

This will increase the size of the rope at the cage end by $10{,}000 \div 12{,}000 = {\cdot}83$ square inch of cross sectional area.

Then (by 12)—
$1{\cdot}493 + {\cdot}833 = 2\ 326$ sectional area at cage end
$$\log.\ 2{\cdot}326 + {\cdot}5566 \times \log.\ 2{\cdot}7183$$
$$= {\cdot}3666097 + {\cdot}5566 \times {\cdot}4342944$$
$$= {\cdot}3666097 + {\cdot}2417282$$
$$= {\cdot}6083379.$$

Hence—
·6083379 = log. 4·0582 square inches cross sectional area
= 7·14in. circumference.

Whence— 5·40in. circumference at cage end,
7·14in. circumference at pulley wheel.

It would be a repetition of figures and calculation, to show here the advantage arising from using the balance rope in winding from great depths. The formulæ and figures have already been given in full and can be easily applied by the members of this Institute to any actual or hypothetical winding. There is little doubt, the author thinks, that in winding from such depths as 300 to 600 yards, where the balance rope can be of uniform size with the winding rope, there will be a great saving, both in size and wear and tear of engine and in boiler power. The advantages have been fully set forth, and do not require recapitulation.

The balance rope is shown on Plate XIII., Fig. 1. Plate XIV. represents it passing through the sump planks, and turning under without any mechanical assistance.

This arrangement is already at work in a shaft 300 yards deep in this district, and acts well, but it is necessary to box the rope, to prevent it from twisting, and to use rope of a pliable nature.

Fig. 2, Plate XIV., represents the rope running round a movable wheel, which probably may be required when using steel rope, and which keeps the rope taut; but in this case it requires boxing off.

It may be asked, Is there any danger in using such a rope? The author anticipates one, viz., the rope getting fast in passing through the sump planks, either from a tub being accidentally run into the sump whilst winding, or coal or other material falling and wedging the rope fast. In such a case there would be an excessive and very sharp strain put upon the winding rope attached to the ascending cage; and possibly such a sharp strain in fast winding would break the winding rope, and a serious accident would occur. To prevent this the author suggests that all such balance ropes should be attached to the bottom of each cage by means of a self-shearing or detaching apparatus, set so as to sever the connection whenever the strain exceeds a certain weight. This might be done either by a shearing pin of copper, similar to a detaching hook, or a spring coupling; in fact, anything which would sever, and only sever, the connection in case of unusual strain.

Tabulated Statement of Calculations.

Description of wire rope.	Depth of shaft.	Weight of load drawn. Mineral.	Cage.	Tubs.	Rope.	Taper rope. Circumference at cage.	Circumference at pulley wheel.	Balance rope.	Horse-power expended.	Average pressure of steam on the piston.	Size of cylinders required (coupled).	Time in winding.	Time in landing and changing.	Size of drum diameter.	Remarks.
Without Balance.															
	ft.	tn. ct.	tn. ct.	tn. ct.	tn. ct	in.	in.	tn. ct.		lb.	in.	min.	sec.	ft.	
Charcoal iron	4000	—	—	—	—	—	—	—	—	—	—	—	—	—	Its own weight exceeds the working load.
Best steel	4000	4 0	2 10	1 10	10 10	5·3	8·07	—	2648	50	62·71	1·50	10	36	1000 tons per day.
Plough steel	4000	4 0	2 10	1 10	6 0	4·33	5·72	—	2298	50	58·42	1·50	10	36	
Best steel	1200	2 10	2 0	1 0	2 0	5·25	5·25	—	612	30	37	·16	—	20	First 300ft.
With Balance Rope.															
Best steel	1200	2 10	2 0	1 0	2 0	5·25	5·25	2 0	381	30	30	·16	—	20	First 300ft.
Best steel	4000	4 0	2 10	1 10	—	6·2	9·46	3 0	—	50	—	1·50	10	36	
Plough steel	4000	4 0	2 10	1 10	—	5·4	7·13	4 10	—	50	—	1·50	10	36	

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

(*From our own Correspondent.*)

MUCH satisfaction is expressed in the iron trade this week, for the puddlers and millmen in the West Bromwich and Smethwick districts who have resisted the reduction in wages of 3d. per ton for puddlers and millmen in proportion longer than any other of the South Staffordshire districts, resumed work at the drop on the night of Tuesday, thus closing a strike of five weeks' duration. Puddlers' wages are now, therefore, 7s. 6d. per ton.

The determination last week of the employers whose works were on to aid those whose works were still off by granting £5 for every idle furnace was on Monday night carried out, for cheques to the total of £1420 were then posted, the money being distributed among seventeen firms, owning altogether 284 idle furnaces.

The Strike Committee published a letter in the local press on Wednesday, in which, after officially announcing the end of the strike and returning thanks for the support received, they say:—"We also wish to inform the public that we have some black sheep in our flock, for out of seventy-two contribution books, only fifteen were returned last week."

As usual at the termination of an affair of this kind, there are now expressions of surprise at the lack of organisation, and endeavours to remedy this defect are beginning. The Central Strike Committee would have it understood that they are busy making arrangements for the formation of lodges at the various works. It is proposed by these self-styled leaders that the South Staffordshire district shall in future be joined to the Lancashire division of the National Amalgamated Association of Iron, Steel, and Blast Furnace Workers. Should this combination be effected—and at present this seems scarcely likely—the headquarters of the Association, which are now at Darlington, "will probably," we are told, "be removed to a more central locality."

It is significant of the light in which the men's repudiation of the sliding scale is regarded by the employers, that one Pennington, who was amongst the foremost of the strike leaders, is being "boycotted," not only in his own, but in northern districts. Attempts to obtain employment for him alike in Staffordshire and in Scotland have been repelled with firmness so far.

On 'Change in Wolverhampton yesterday and in Birmingham today—Thursday—lack of funds was universally assigned as the reason why the strikers had given way. Most of the Smethwick and West Bromwich works having now resumed, and other masters having determined to relight the fires next week, buyers found no difficulty in placing all the contracts they desired, when the terms offered were such as makers could accept. But such terms were by no means universal. Consequent upon this orders had in numbers of cases to be refused. Some buyers will after a little negotiation consent to advance upon their first offers, and the contracts will then be booked. But other export buyers will place their orders in cheaper competing districts.

Makers of tank plates reported to-day a brisk business. Thin plates, that will flange cold and need no angles in the construction of the tanks, were selling at £7 15s. to £8 per ton. Makers of girder plates and other common qualities spoke of the North of England, and one or two other competing districts, as having practically stolen the trade from us now. But the supremacy of the Cleveland district in ship plates does not prevent orders being received here occasionally for best plates of high quality. Boiler plates are steady at £8 10s. to £9 for common, and £9 10s. to £10 for superior sorts.

Sheet makers are well booked forward. They were, therefore, firm in price, though on the week the demand is hardly so pressing as it was. Merchants tried to get singles for export at a little below £7 15s. per ton, but were not generally successful. For galvanising singles £8 was the minimum that would be accepted by good firms. Doubles were £8 10s., and lattens £9 10s. Best thin sheets for working up purposes ranged from £11 upwards at the works.

Pigs show a little more vigour this week. Consumers have again begun to accept deliveries, but there are still loaded trucks waiting on the railway sidings that consignors cannot yet get permission to deliver. Prices are easy. Native hot-blast all-mine are 62s. 6d. in actual sales, part-mines 47s. 6d. to 45s., and cinder pigs 40s. Hematites are quiet at 60s. to 62s. in actual sales. Barrow brand No. 4 foundry has changed hands at 64s., and forge is quoted 62s. Derbyshire pigs 47s. 6d. still, and Northamptons 46s. 3d. nominal.

By the mail to hand this week from Melbourne, merchants learn that at the date of advices galvanised iron out there was getting very scarce, but that large shipments were on the water. Lysaght's brand had seen sales at £22. Gospel Oak brand was in fair request, and trade sales were reported at late rates. One hundred and fifty cases had sold on private terms. Black sheets were in ready sale at, for Nos. 8 to 18, £10 10s. For bars and rods there was a good business at prices ranging from £8 10s. to £9 10s. For hoops £10 was obtained. Pig iron was in good demand at £4 10s. Holders of fencing wire would not accept the prices ruling at date of despatch, and quotations stood at £12 to £13 10s. for best brands.

The manufacturers of constructive ironwork are fairly well employed on girder work, and tank orders are numerous. For certain railway materials there is a moderate call on home and foreign account alike.

Hardware merchants report this week that the continental orders now arriving are only of little worth, and that the Mediterranean ports are quieter than is customary at this date; but India is placing some acceptable orders, mostly by buyers who are now in this country, for machinery, cultivating tools, and certain builders' requisites. Canada still looks well, and there are yet evidences of a little further movement towards the United States.

At meeting in Birmingham to-day of the committee of the iron trade, at which strike was reported as over, it was announced that the employers' section of the Wages' Board intend to adhere strictly to the terms of the sliding scale award concerning present and future wages until some alteration has been amicably arranged; failing an agreement any disputed question must be referred to the president, Mr. Averley, as arbitrator. Mr. J. B. Cochrane, of Dudley, was to-day elected chairman of the masters' section of the new Coal Trade Wages' Board. The men's delegates meet the masters on Monday.

Some idea of the terms which some of the colliers are expecting to obtain under the new sliding scale may be gathered from observations made in public a few days ago by a miners' agent in the Old Hill district. He asserted that the men were not in any way prepared to accept the Board unless the basis of the wages gave to the thick-coal men 3s. 8d. per "day" or stint, and the thin-coal men 2s. 10d.; but he was afraid they would not get this amount unless they were united to a man.

At the conclusion of this same address, in which the agent went on to warn the men against working overtime, a resolution was passed to continue working at the present rate of wages until the Wages' Board came into operation, and a second resolution expressed the opinion of the meeting "that the time had come when all miners should be more closely united."

Mr. J. T. Harrison, C.E., Local Government Board inspector, has held an inquiry at Birmingham into the application by the Corporation for sanction to borrow for various public improvement works sums aggregating £25,966. The chief individual expenditure there-out-of is £16,085 for a new fish market. The present market covers an area of 715 square yards; but it is proposed to add adjoining property, so as to increase the area to 1624 square yards, exclusive of approaches. This scheme included the widening of certain streets. It was pointed out that in the present market 100,000 tons of fish were sold annually, representing £3,000,000, and the trade was growing.

An interim dividend of 5 per cent. per annum on the ordinary original capital, and 6 per cent. per annum on the preference capital, has been declared by the Birmingham Railway Carriage and Wagon Company, Limited, for the half year ending June 30th.

Satisfaction is expressed at the Parliamentary progress of the Bills for confirmation of electric lighting provisional orders relating to West Bromwich, Balsall Heath, Aston, Walsall, Dudley, and other midland towns, which Bills passed their second reading in the House of Lords on the 3rd.

NOTES FROM LANCASHIRE.

(*From our own Correspondents.*)

Manchester.—The iron market here continues very quiet, and the holidays during the past week have tended to reduce still further the small flow of business. The market, however, is strongly supported by the fact that makers have in most ca es plenty of work to go on with, and although present transactions are comparatively small there is a large quantity of iron going into consumption, deliveries of which under contracts already in hand keep works pretty well employed. Pig iron makers are, as a rule, so fully sold over the remainder of the year that they are only open to book small quantities, and they are therefore under no necessity to press sales, occasional orders, which buyers have to place out at the full rates, sufficing to take away any surplus output they may have to dispose of. Forge proprietors are also generally well supplied with work for the present, and although there is no very great weight of new business offering they are able to secure orders in sufficient quantity to keep them going, and except that bar iron is if anything a trifle easier in some cases, manufacturers are able to maintain their prices without difficulty. In the condition of the engineering trades there is no very material change to notice. Activity is still maintained amongst locomotive builders and tool makers, and in special classes of engineering work there is also a fair amount doing, but machinists continue only moderately employed, and in the ordinary run of engineering work business is very quiet.

There was only a quiet market at Manchester on Tuesday. For pig iron there were very few inquiries stirring, and but for the fact that makers are indifferent about orders, it might be said that there was nothing doing to test values. But whether there are inquiries or not, makers are very firm at their full rates. For Lancashire pig iron, 45s. to 45s. 6d., less $2\frac{1}{2}$, for forge and foundry qualities delivered equal to Manchester, are the quotations still rigidly adhered to, whilst in district brands, although buyers show no disposition to pay higher prices, there is even a tendency to stiffen upon the minimum quotations for Lincolnshire brands, and it would now be difficult to place orders on the basis of 44s. 10d. to 45s. 10d., less $2\frac{1}{2}$, for forge and foundry numbers delivered here.

In finished iron there is only a moderate business doing, and shipping orders do not come forward at all freely. In bar iron orders could be placed more freely on the basis of £6 2s. 6d. than of late, but in most cases makers hold for £6 5s.; hoops are quoted at £6 12s. 6d. to £6 15s., and sheets at £8 to £8 7s. 6d. per ton, delivered into the Manchester district.

The reduction in the wages of the finished ironworkers in the Lancashire district following upon the award of the Staffordshire Board of Arbitration, but which was held in abeyance owing to the strike at the Staffordshire forges, has now been put into force. At several of the finished ironworks the reduction was put into operation last week, and this week it has become general, the leading firms having decided to commence paying on the reduced scale from Monday last. There is no indication that the action of the masters in this district in following the Staffordshire award is likely to result in any trouble with the men who are now throughout Lancashire working at the reduction of 3d. per ton on puddlers' wages and $2\frac{1}{2}$ per cent. on the wages of the finished ironworkers, which I understand represents about 6d. per ton on the cost in labour for the production of the manufactured iron.

During the past week I spent an afternoon in the industrial section of the Oldham Exhibition which is being held in connection with the opening of the Free Reference Library and Museum. At present the exhibition can scarcely be said to be in a very perfect state of arrangement. None of the stands have yet been numbered, and anything like an attempt at a methodical inspection of the exhibits by means of the first catalogue which has been issued as a guide is an utterly hopeless and bewildering undertaking. Though somewhat spoiled by defective arrangements, the exhibition, however, contains a very good collection of machinery. Prominent, of course, is the branch of engineering connected with the leading industry of the town, and Messrs. Platt, Bros., and Co., and Messrs. Asa, Lees, and Co. have a most interesting display of textile machinery for the manufacture both of cotton and wool, embracing the most modern improvements introduced by these well-known makers. Apart, however, from cotton machinery, there are a large number of general engineering exhibits, which have been sent in by some of the leading firms in Manchester and the surrounding district. A very fine pair of horizontal compound steam engines, with a new cut-off motion, and which are employed, by means of rope gearing, for driving some of the machinery, are shown by Messrs. Buckley and Taylor, of Oldham. Sir Joseph Whitworth and Co. show a number of their specialities, including standard gauges, measuring machines, specimens of steel castings, and one of their nine-pounder breech loading Whitworth guns. Messrs. Hulse and Co., Manchester, have a good collection of modern engineers' and machinists' tools, amongst which is the improved vertical milling and drilling machine, with reversible traversing motions, of which I recently gave a short description in my notes, and several other new machine tools. Messrs. B. and S. Massey, of Manchester, show several of their steam hammers, double-acting, self-acting, and hand worked. F. Pearn and Co. have a collection of their pumping engines. Messrs. Woolstenhulmes, Rye, and Co., Oldham, show a horizontal compound steam engine on the tandem principle, specially designed for driving electric light dynamos, and fitted with a new cut-off gear. Amongst other exhibits there is a most varied collection of appliances. Steel standards for both English and foreign measures are shown by Wm. Whitham, of Manchester; cast steel for tools, spindles, &c., by Howell and Co., of Leeds; crucible steel castings and special tool steels by Jessop and Sons, Sheffield; patent rolled shafting, &c., by the Kirkstall Forge Company, Leeds; an improved horizontal double-action stationary steam fire engine by Wm. Hanson, Bradford; and a stationary steam fire engine by Chas. Walmsley, of Bury, which is guaranteed to throw ten $\frac{3}{4}$in. jets 100ft. high, or to deliver 60,000 gallons of water per hour; whilst several horizontal double-acting steam pumping fire engines are also shown by S. Walker, of Radcliffe. Of small machine tools, steam engine fittings and requisites, there are a large number. Mechanical stokers by several of the well-known makers are also shown, and gas engines, including the well-known "Otto" and "Bisschop" types, with the new Robinson hot-air engine, of which a description has recently been given, are exhibited. Of various other appliances connected with the use of gas, there are the well-known manufactures of meters, governors, &c., with also a collection of heating and cooking stoves. I have only very briefly sketched the contents of the industrial section of the Exhibition, which, although it does not present very many features which are actually new in the general engineering class of work, is nevertheless one of considerable interest throughout, and as regards machinery specially connected with the manufacture of cotton and wool, is probably the best of its kind that has ever been brought together.

In the coal trade business shows but little material change. The demand continues very steady for the time of the year, prices are being well maintained, and pits are being kept running about four to five days a week, with comparatively very little coal going into stock. The general feeling is that the next movement in prices will be in an upward direction, and there is a good deal of pressure to place orders for forward delivery, but colliery proprietors in many cases decline to sell beyond present requirements, and where they are prepared to contract it is only at advanced rates. Prices at the pit mouth remain at about 9s. for best coal, 7s. for seconds, 5s. 6d. to 6s. for common coal, 4s. 6d. to 5s. for burgy, 4s. to 4s. 3d. for best slack, and 3s. to 3s. 6d. for common qualities.

Shipping has been fairly active both in steam coals and in house fire coals for coasting cargoes, and although prices do not show any material improvement, they are steady at 7s. 3d. to 7s. 9d. for steam coals, and 8s. 6d. to 8s. 9d. for seconds house coal, delivered at the high level, Liverpool, or Garston docks.

Barrow.—The tone of the hematite pig iron market is much firmer than for some time past, and better inquiries are made. Buyers show a keener disposition to do business and are accepting makers' prices, who have steadily declined to reduce below 50s. for mixed samples of Bessemer iron. Stocks are not quite so large as they were, owing to the very heavy exportation of pig iron to the Continent and America. No. 3 forge is still quoted at 49s., and the demand has increased during the last few days. Steel makers are steadily employed, especially in the rail department. Merchant qualities are in fair demand. Prices unchanged. Prices for iron ore have not altered, but the demand is firmer, and the stocks of ore which have been banked at the pits have been slightly reduced. Nine shillings to 11s. are the market quotations. Iron shipbuilders are not so well employed as could be wished; the number of hands employed is considerably below what it was six months ago. Other industries, such as ironfounders, boilermakers, engineers, are fairly supplied with work. The new works which are to be started at Barrow have a few contracts secured for steel plates, &c. When these works are in full operation, the trade of the district will receive considerable impetus. Coal and coke steady at unchanged rates. Shipping well employed.

The s.s. Takapuna, which was built by the Barrow Shipbuilding Company for the Union Steamship Company, of New Zealand, was run over the measured mile on the Clyde on Saturday with very satisfactory results. The highest speed attained was 15·1 knots, mean speed 14·6, being considerably more than the guaranteed speed.

THE SHEFFIELD DISTRICT.

(*From our own Correspondent.*)

BANK holiday has been more generally observed than usual this season by various firms who have not previously paid great attention to it. The prevailing dulness has caused both manufacturers and *employés* to have a change from town to country. In spite of the incessant rain all the forenoon, I think I never saw so many people of the working classes leave the town by road, taking their pleasure sadly under dripping umbrellas. In several cases work was not resumed till Wednesday.

The steel rail trade is anything but encouraging to manufacturers. A continental railway company recently desired quotations for 25,000 tons of steel rails. None of our local firms succeeded in obtaining the order, the lowest quotation being stated to be 8s. per ton less than the Barrow Company. It ought to be stated that the order is to be delivered at Liverpool, so that the difference in price will be fully made up by the consideration of carriage, which would have been quite equal to the 8s. per ton. It becomes increasingly evident that local houses cannot compete in such heavy goods with establishments situated on the coast. Messrs. Charles Cammell and Co., of the Cyclops Works, Sheffield, are very busy with large steel forgings and castings for guns for home and foreign Governments, as well as with steel marine cranks, straight shafts, connecting and piston rods, &c. They have lately started a lathe for turning heavy marine pieces, and the three-throw crank shaft for one of the largest Atlantic steamers is being made and finished by them. This shaft requires three ingots, one twenty-two tons, one thirty tons, and one forty tons, to make up the complete three-throw shaft, and from this some idea may be formed of the capacity of the lathe for finishing. There are 6000 cubic feet of masonry in the foundations, and the lathe will take in 13ft. diameter by 32ft. in length. There are four compound rests, arranged to work at any angle, and in all directions. The weight of material in this lathe is about 150 tons. The 30-ton steam hammer is well employed. The largest steel casting that has been made in this district—forty tons weight—was recently successfully made by this firm.

Messrs. Charles Cammell and Co., Limited, expect to have their rail mills at Workington in full operation by the middle of September. The capacity of the new mills is put at somewhere near 3000 tons of rails per week. At Workington the output of steel rails is said to be very brisk, forming a marked contrast to the business in the Sheffield district. The Workington ironmasters are agitating for a revision of the rates charged by the North-Eastern and London and North-Western Railway Companies respecting the rates now charged for the importation of raw material into their district. It is urged by the manufacturers that rates remain the same as during the times of good trade, although on the East Coast important reductions have been made. Our Sheffield ironmasters and rail makers made very little out of their agitation with the railway companies, and they had certainly, from their inward position, a much stronger case than their rivals at Workington.

The varying character of the weather—warm and fine one day, and wet and cold the next—is telling upon country dealers and factors, who buy for immediate requirements only, and there is not likely to be any improvement till after the harvest. The implement makers say that so far they have had a fairly good season. They are now turning their attention to root and chaff-cutters, in which Messrs. John Crowley and Co., of this town, have produced several interesting novelties. Cutlery generally is only in light demand both on home and foreign account, table and spring-knife workers being occasionally given only half a week's work. Edge tools and joiners' tools are in fair demand, though edge tool orders are not equally divided, one house having six months' orders on its books, and others kept no more than employed from week to week.

It is not generally known that on the occasion of the coronation of the Czar at Moscow, the entire motive power for the electric illuminations of the Kremlin was supplied by twenty-nine of Hornsby's—Grantham—steam engines, representing 292 nominal horse-power. Messrs. Hornsby's engines, which are specially constructed for electric lighting, have been successfully employed at the Imperial Palace at Gatschina, at St. Petersburg, the General Post-office, Edinburgh; Royal Aquarium, London, 1882, and other places.

Mr. George Barnsley, senior partner in the firm of Messrs. George Barnsley and Sons, merchants and manufacturers of steel, files, &c., Cornish-street, is now Master-Cutler elect in succession to Mr. A. A. Jowitt, of the Scotia Steelworks, Attercliffe. Mr. Barnsley's formal installation to the ancient office will take place on the 6th September with the usual formalities. The cutler's feast is fixed for that date.

THE NORTH OF ENGLAND.

(*From our own Correspondent.*)

THERE was but a scanty attendance at the Cleveland iron market held at Middlesbrough on Tuesday last, and not much buying and selling was done. There was, however, no falling off in prices, as compared with the previous week. Merchants refused to take less than 39s. per ton for No. 3 g.m.b. for August and September delivery, and some of them were firm at 39s. 3d. Makers generally asked 39s. 6d. per ton for No. 3, but firms outside the combination offered various lots at 39s. 3d. per ton.

The stock of Cleveland pig iron in Messrs. Connal's store at Middlesbrough was, on Monday last, the same as on the previous Monday, namely, 73,667 tons.

Shipments have been so far but small this month; but it is expected that they will improve, as there are large orders for foreign account. Up to Saturday night 11,408 tons of pig iron and 5740 tons of manufactured iron and steel had been shipped.

Consumers are pressing hard for delivery of finished iron, but are giving out few new orders. They expect shortly to be able to buy at lower rates, now that the price of pig iron is somewhat easier. Manufacturers are, however, unwilling to make further concessions, being well off for work at present. Last week's quotations still hold good. Ship plates are £6 5s. per ton for small lots with prompt delivery, and £6 for forward delivery in larger quantities. Shipbuilding angles are £5 12s. 6d. to £5 15s., and common bars £5 15s. to £6 per ton, all free on trucks at works, less 2½ per cent. discount. At Middlesbrough and Stockton the mills and forges will be laid idle next week, on account of Stockton Races.

The Cleveland Ironmasters' returns of the make and disposal of pig iron for July were issued on Friday last. They show that 118 furnaces are at work, eighty-five of which are producing Cleveland iron, and thirty-three other kinds of iron. There were only 117 furnaces in blast in June. The make of Cleveland pig iron in July amounted to 155,680 tons, being an increase of 2983 tons on the previous month. The output of other kinds of iron, including hematite, spiegel, and basic pig iron, was 75,504 tons, being an increase of 2220 tons. The total quantity of iron made, of all kinds, was therefore 231,184 tons, or 5203 tons more than in June. The stocks in makers' stores show an increase of 8162 tons. There is a decrease of 1930 tons in warrant stores, and of 11,085 tons in makers' stocks. The net decrease for the month is 4853 tons. The total quantity of pig iron in stocks and store is 270,241 tons, being a reduction of 61,095 tons since July, 1882.

The North-Eastern Railway Company's report for the half-year ending June 30th shows that the total expenditure for that time has been £1,673,002, whilst the gross receipts amounted to £3,267,967. The net receipts are thus £1,594,965. After providing for interest and other preferential charges, there is a balance of £906,418 available for dividend on North-Eastern consols. The directors recommend a dividend of 7¾ per cent. per annum, which will leave a balance of £31,072 to be carried forward. A special meeting of shareholders will be held on Friday, the 10th inst., when resolutions will be submitted for authorising the creation of £2,000,000 4 per cent. preference stock.

The opening of the Whitby, Redcar, and Middlesbrough Railway has been postponed for a month.

An important meeting of the Middlesbrough Chamber of Commerce was held on the 7th inst. The sub-committee appointed to draw up a uniform contract note for pig iron sent in their report, which contains the following:—"Tees River dues to be paid by buyers." "In case of strikes or combinations of workmen, or accidents causing the stoppage or partial stoppage of the works of either the purchasers or sellers, deliveries of the iron hereby contracted for may be partially or wholly suspended—as the case may be—during the continuance of such interruptions; such suspensions, however, shall not in any wise invalidate this contract, but on the resumption of full work, deliveries shall be continued at the specified rate." The report was adopted, and it was resolved to recommend ironmasters, merchants, and others engaged in the iron trade, to use in future the new form of contract note. The following resolution was also adopted, viz.: "That this Council of the Middlesbrough Chamber of Commerce, recognising the great need for the erection of a lighthouse on the Saltscar Rock, off Redcar, hereby supports the application which has already been made by the ratepayers of Middlesbrough to the Elder Brethren of the Trinity House, to the effect that they will recommend the erection and maintenance of a lighthouse on the site named." It was ordered that a copy of the resolution be forwarded to the Board of Trade.

NOTES FROM SCOTLAND.

(*From our own Correspondent.*)

The Glasgow warrant market has been comparatively quiet in the course of the week, with not much speculative business. On Friday last a good number of transactions took place up to 47s. 8d. per ton, but the market closed slightly weaker, and there was no further business done until Tuesday. The foreign demand for Scotch pigs is, on the whole, well maintained, and the shipments are fully up to expectation. In the past week they amounted to 13,722 tons, as compared with 13,579 in the corresponding week of last year, and of the whole quantity 10,547 tons were sent abroad and 3175 tons coastwise. The stocks of pig iron in Messrs. Connal and Co.'s warrant stores are decreasing.

Business was done in the warrant market on Friday forenoon at 47s. 7d., and in the afternoon at 47s. 8d. cash. There was no market on Monday, and on Tuesday a fair business took place, with little change in quotations. Iron market yesterday flat, sales 47s. 3d. to 47s. 1d. cash, 47s. 5d. to 47s. 3d. month. Market this forenoon quiet, business 47s. 1d. to 47s. 2d. cash, 47s. 0½d to 47s. 4½d. month; afternoon, 47s. 1d. to 47s. cash, 47s. 4d. to 47s. 3d. month.

There is a large business in makers' iron, the current quotations of which are as follows:—Gartsherrie, f.o.b. at Glasgow, per ton, No. 1, 57s.; No. 3, 53s.; Coltness, 61s. and 53s. 6d.; Langloan, 60s. and 53s. 6d.; Summerlee, 57s. 6d. and 51s. 3d.; Chapelhall, 57s. and 54s.; Calder, 57s. 6d. and 50s. 6d.; Carnbroe, 55s. and 49s. 3d.; Clyde, 50s. 9d. and 48s. 9d.; Monkland, 48s. 6d. and 46s. 6d.; Quarter, 47s. 6d. and 45s. 6d.; Govan, at Broomielaw, 48s. 9d. and 46s. 9d.; Shotts, at Leith, 59s. 6d. and 54s. 6d.; Carron, at Grangemouth, 48s. 6d. (specially selected, 54s. 6d.) and 47s.; Kinneil, at Bo'ness, 49s. 6d. and 48s.; Glengarnock, at Ardrossan, 55s. 3d. and 48s.; Eglinton, 48s. 9d. and 46s.; Dalmellington, 49s. 6d. and 48s. 6d.

The different branches of the manufactured iron trades continue to be well employed.

In coals there is much activity, and coalmasters and merchants in the Lanarkshire district are hopeful that they will be able soon to obtain the full advance of 1s. per ton on all qualities. A large proportion of this advance has already been got for f.o.b. coals, and the chief obstacle to the rise in domestic coals is that one or two firms are keeping aloof, and seem fully determined to sell at the old rates. There is a very extensive inquiry for coals for shipment at the western ports. The f.o.b. prices at Glasgow are, for main, 7s. 3d. to 7s. 9d.; ell, 8s. to 8s. 6d.; splint, 8s. to 8s. 6d.; steam, 8s. 6d. to 9s. 6d. At Glasgow the shipments for the past week were very heavy, and large orders are now in course of execution. In Fife the feeling has, if anything, been a shade quieter, but prices continue firm, at from 7s. 9d. to 8s. and 8s. 6d. for shipping qualities. There is a good demand in this district for gas coal, but for household sorts there is less inquiry. At Leith the shipments of coal have been larger than of late, while a good business has been done at Grangemouth and Bo'ness.

The coalmasters of the Slamannan district, at a meeting held in Glasgow, have resolved to raise prices 6d. per ton at once.

As it was natural to expect, the upward movement in the value of coals has directed attention to the wages question, and in several localities the miners are bestirring themselves in the hope that they may be able to improve their position. The colliers of the Motherwell district held a largely attended meeting a few days ago, at which Mr. John Donnelly presided. Mr. Robert Steel addressed the meeting, pointing out that the volume of trade had at no time been so great as at present, and it was unanimously resolved, "(1) That, considering the present price of coal and the advancing state of the market, we are fully entitled to an advance of wages, and that we use all lawful means to obtain it; (2) that we solicit all the mining districts of Scotland to agitate and cooperate in the movement; and (3) that we invite delegates from the Hamilton district to meet us at a conference to consider what further steps should be taken in the movement."

The Secretary of the Fife and Clackmannan Miners' Association has addressed a letter to Mr. Connell, the employers' agent, soliciting, on behalf of the men of these counties, an advance of 6d. per day.

Messrs. Russell and Co., of Greenock and Port-Glasgow, have obtained an order to build ten steel paddle steamers for the East India river and coasting traffic. They are each to be 270ft. in length.

The shipping trade of the Clyde, as disclosed in the Custom-house returns for the past month, are quite satisfactory. The export of gunpowder was 40,000 lb., valued at £770; but there was besides £5530 worth of dynamite and other explosives despatched in the course of the four weeks.

WALES & ADJOINING COUNTIES.

(*From our own Correspondent.*)

Judging from dividends at some of the principal railways and industries lately, the condition of things in Wales may be regarded as satisfactory. The Rhymney Railway Company will announce shortly a dividend of 10 per cent., the Taff Vale 10 per cent., and 8 per cent. bonus, and the Merthyr Wire Works 10 per cent.

Mr. George Fisher is expected to take the post of resident director on the Taff Vale Railway, vacant by the death of Mr. Bushell, and Mr. Hurman will take his position, retaining the designation of traffic superintendent.

The Taff Vale Railway, once regarded as narrow in its liberality, has of late years attained quite a different reputation. The public interests have been well considered, large concessions made to freighters, and this week its extensive and newly erected engine shed—400ft. in length, and capable of holding 20,000 people—has been placed freely at the services of the National Eisteddfod.

The holding of this popular institution has somewhat affected trade this week, the colliers from the Rhondda Valley flocking thither in considerable numbers. Trade, however, is good, and both colliers and coalowners can afford a little indulgence. Over 200,000 tons of coal left the Welsh ports last week, of which Cardiff sent 149,000 tons. The activity in Cardiff has been very great, and some fine vessels have come into port, one of which—over 4000 tons burden—is being exhibited to the Cardiff public.

Newport, Swansea, and some of the smaller ports have also exhibited increased activity of late, and this gives a good momentum to the various new movements that are being floated. Dock extensions or improvements at Swansea, Neath, and Newport are on the cards, and "Barry" is only said to be adjourned. Vigorous prosecution at the earliest possible date is promised.

Mr. Edmonds, of the Bute Docks, was the successful competitor for a prize this week at the National Eisteddfod, on "The History of the Rise and Progress of the Steam Coal Trade," and Mr. Williams, the "father of the Welsh press," for an essay on "The Coal Resources of South Wales."

The iron and cognate trades are moderately active; prices rule somewhat more firmly than they did, but there is not the buoyancy in trade which I should like to see. Compared with the coal trade the sister industry is flat. I am glad to hear within the last day or two of a few more enquiries. Tasmania is putting in an order, and Canada getting more anxious about deliveries.

The price of best steam coal is looking up decidedly, seconds and small about the same. House coal has not moved much of late. We must wait another month for the autumnal spurt to be made.

The foreign iron ore trade is dull. Supplies of Welsh ore well weathered are enquired after, and cinders are in demand.

Pitwood has become somewhat scarce of late, and prices are looking up.

The colliers of Mountain Ash, always a hotbed of disaffection, have agreed to the arrangement ably sketched out by Mr. W. T. Lewis with regard to the "Doctor question," and the troubled spirit is now finally laid. The colliers settled this at a large meeting on Saturday, and when retiring passed a vote of thanks to those who had brought about so satisfactory a state of things.

The notice of the ship canal in The Engineer of last week for connecting Cardiff with Devonshire and London has attracted a good deal of attention, and it is felt in circles of influence that the scheme is worthy of close attention. If the extra capital of Cardiff, which some appear desirous of flinging away on visionary schemes, could be enlisted upon this, great results might be expected. Some of the details have been copied from The Engineer into the *Mail*.

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.

31*st July*, 1883.

3727. Packing, &c., Abrasive Plates, A. G. Brookes.—(*L. D. Shepard, Boston, U.S.*)
3728. Burners, J. S. Muir, London.
3729. Drilling Machines, A. Shedlock, New York.
3730. Obtaining Colouring Matters, R. Holliday, Huddersfield, and W. R. Hodgkinson, London.
3731. Locks or Dams, W. P. Thompson.—(*J. Du Bois, Pennsylvania, U.S.*)
3732. Carbonising Wood, &c., W. P. Thompson.—(*J. A. Mathieu, Detroit, U.S.*)
3733. Type Matrice Machine, M. H. Dement, London.
3734. Stereotyping Apparatus, M. H. Dement, London.
3735. Electro-dynamic Machines, H. J. Allison.—(*R. N. King, Dayton, U.S.*)
3736. Hats, &c., W. R. Lake.—(*A. C. Couch, Boston.*)
3737. Umbrellas, &c., E. G. Charageat, Paris.
3738. Barbed Fencing, W. C. Johnson and S. E. Phillips, London.
3739. Pencil Cases, &c., F. Haeffner.—(*E. Mahla, Nürnberg, Germany.*)
3740. Water-closets, T. W. Helliwell, Brighouse.
3741. Stays, W. H. Symington, Market Harborough.
3742. Regenerative Gas-lighting Apparatus, A. S. Bower, St. Neots, and T. Thorpe, Whitefield.
3743. Looms, W. Houghton and E. Knowles, Gomersal, and H. Bradbury, Leeds.
3744. Furnaces, W. Brierley.—(*E. Rosskam, Germany.*)
3745. Combined Pot, Urn, &c., H. de M. Wellborne, London.
3746. Tobacco-pipes, &c., H. de M. Wellborne, London.
3747. Nut-lock, W. R. Lake.—(*W. J. M'Tighe, U.S.*)
3748. Binding Books, A. Brehmer, Leipzig, and G. Brown, Glasgow.
3749. Releasing Harnessed Cattle from Vehicles, W. Corbould, Peckham.
3750. Dollying Clothes, &c., J. Sample, Newcastle-upon-Tyne.
3751. Pencils, &c., J. Hickisson and W. Lee, London.
3752. Engraving or Cutting Glass, &c., J. H. Johnson.—(*R. Josia, Florence.*)
3753. Tools, J. Jefferies, Luddesdown, and C. Thomson, Peckham.
3754. Ventilating Apparatus, C. M. Tate, London.
3755. Tricycles, J. and T. Webb, Coventry.
3756. Shoes and Boots, E. Edwards.—(*P. D. Fréchingle, Paris.*)
3757. Mowing Machines, E. Pratt, Uxbridge.
3758. Coating with Gelatinous Compounds the Drawing Rollers, &c., of Spinning Machinery, E. Edwards.—(*J. Appelt, Reichenberg.*)

1*st August*, 1883.

3759. Trawling Shafts, J. Faulkner, Gorleston.
3760. Automatic Flushing, &c., Tank, F. J. Austin, London.
3761. Stair Pads, T. Griffith, Ivy Lea.
3762. Gun Carriages, &c., D. Walker and W. S. Simpson, London.
3763. Electric Clocks, G. M. Herotizky, Hamburg.
3764. Street Cleaners, B. J. B. Mills.—(*A. J. Reynolds, Chicago, U.S.*)
3765. Supporting Trousers, J. H. Topham, Deansgate.
3766. Damping, &c., Stamps, J. H. Topham, Deansgate.
3767. Shear-legs, J. and E. Gledhill, Lindley.
3768. Invalid Couches, &c., W. Dickinson, Manchester.
3769. Preparing Infants' Food, N. Davies, Sherborne.
3770. Gates, R. Allen, Tettenhall.
3771. Envelope, &c., Machines, J. C. Mewburn.—(*A. T. Howard, Brooklyn, U.S.*)
3772. Cutting Metals, W. W. Hulse, Manchester.
3773. Glass Tablets, J. Forrest, sen., Glasgow.
3774. Automatic Stopper for Bottles, &c., W. Samson, Dundee.
3775. Constructing Roofs, T. W. Webber, Ireland.

2*nd August*, 1883.

3776. Grinding, &c., Metals, R. Wallwork, Manchester.
3777. Producing Golden Sulphuret of Antimony, A. G. Brookes.—(*T. Sanders, Haverhill, U.S.*)
3778. Gongs or Bells, F. U. Bolton, Birmingham.
3779. Regulating Carbons, &c., of Electric Lamps, E. G. Brewer.—(*La Société Anonyme des Ateliers de Construction Mécaniques et d'Appareils Electriques, Paris.*)
3780. Horseshoes, R. Wood, Manchester.
3781. Razors and Sheaths, T. Clarke, Sheffield.
3782. Telephone Transmitters, T. Morriss, London.
3783. Hoisting Apparatus, J. P. Bayly, London.
3784. Railway Locomotive Exhaust Apparatus, J. Armstrong, New Swindon.
3785. Setting and Distributing Type, W. R. Lake.—(*P. P. y Albizu, Madrid.*)
3786. Fog-signals, E. Ludlow, Birmingham.
3787. Plaiting Machines, L. J. Pirie, Birkenhead, and H. Findlay, Battersea.
3788. Chimney Tops or Cowls, A. J. Boult.—(*J. Wüstner, Annecy, France.*)
3789. Washing Apparatus, E. Edwards.—(*E. and J. Paape, Angleur, Belgium.*)
3790. Automatic Brakes, E. B. Price, Portrush.
3791. Direct-acting Pumping Engines, W. Clark.—(*E. G. Shortt, Carthage, U.S.*)

3*rd August*, 1883.

3792. Egg Decapitator, A. C. Henderson.—(*L. Olivier, Paris.*)
3793. Cream, W. Horner, Cuddington.
3794. Applying Printed Designs to Stoneware, &c., J. Miller, Glasgow.
3795. Lifeboats, G. Skelton, Millwall.
3796. Embroidering Frames, W. Brabner, Manchester.
3797. Screw Nuts, J. Heap, Ashton-under-Lyne.
3798. Mills, T. T. Crook, Bolton.
3799. Weighing Apparatus, H. J. Haddan.—(*C. Munnem, Cologne.*)
3800. Painting Photographs, A. M. F. Caspar, London.
3801. Twisted Yarns or Threads, C. D. Abel.—(*P. Olombel, jun., Mazamet, France.*)
3802. Dobbie Machines for Weaving, P. Burns, Gillis, and R. G. M'Crum, Milford.
3803. Packing Cases, W. R. Lake.—(*J. H. Livermore and C. L. H. de Hundermark, Paris.*)
3804. Furnaces, &c., W. J. Williamson, Deptford.
3805. Ovens, J. B. Petter, Yeovil.
3806. Printing from Engraved Plates, J. H. Johnson.—(*H. F. Marcilly and Utzschneider & Co., Paris.*)
3807. Railway Passenger Carriages, T. Clapham.—(*W. H. Holmes, Chicago, U.S.*)
3808. Winding Yarns or Threads, W. Clark.—(*La Société Ryo, Frères, Roubaix, France.*)
3809. Rivetting Machines, W. Clark.—(*D. M. Redmond, Philadelphia, U.S.*)

4*th August*, 1883.

3810. Cooling, &c., Liquids, B. H. Remmers, Glasgow.
3811. Railway Chairs, S. Leadbeater, Morley.
3812. Folding Boxes or Cases, S. Cropper, London.
3813. Crutches, &c., H. J. Haddan.—(*G. N. Thurzó, Vienna.*)
3814. Detaching Gear for Ships' Boats, &c., W. Mills, High Southwick.
3815. Supports for Telephone Wires, J. C. Mewburn—(*O. N. André, Neuilly, France.*)
3816. Poles for Lawn Tennis Nets, S. C. Davidson, Belfast.
3817. Grinding Metallic Tubes, &c., C. Harvey, jun., Yardely, and W. Paddock, Birmingham.
3818. Pen Reservoir, M. Myers & J. Lowe, Birmingham.
3819. Umbrellas, &c., M. Hyam, London.
3820. Treating Liquors for Obtaining Hydrochloric Acid, L. Mond, Northwich.
3821. Gas Generating Furnaces, L. Mond, Northwich.
3822. Imitating Stained, &c., Glass, G. Rydill, London.
3823. Spring Mattresses, &c., A. Lawrie, Birmingham.
3824. Treating Vat Waste for Obtaining Sulphur, &c., H. Kenyon, Altrincham.
3825. Velocipedes, H. J. Lawson, Coventry.
3826. Treating Brewers' Yeast, J. S. Lord, Newark-on-Trent.
3827. Electric Lamps, W. R. Lake.—(*La Société F. Girard et Cie., Paris.*)
3828. Calculating Machines, W. R. Lake.—(*K. Duschanek, Freiburg, Germany.*)
8829. Tanning, W. Clark.—(*G. dalla Zonca, Venice.*)

6*th August*, 1883.

3830. Hoists for Raising and Lowering Weights, T. Brown, Walkden, and W. Brown, Little Hulton.

Inventions Protected for Six Months on Deposit of Complete Specifications.

3690. Alcohols, H. A. Bonneville, London.—Com. from A. Ralu, Ermont.—28*th July*, 1883.
3704. Feed for Rollers and Purifiers, R. S. Piercy, Blackburn.—28*th July*, 1883.
3705. Racks for Storing Whiskey, &c., E. Smith, Liverpool.—A communication from C. M. Johnson, Lexington, U.S.—28*th July*, 1883.
3713. Radiating Axles, L. S. Zachariasen, Christiania.—30*th July*, 1883.
3728. Burners, J. S. Muir, London.—31*st July*, 1883.
3733. Type Matrice Machine, M. H. Dement, London.—31*st July*, 1883.
3734. Stereotyping Apparatus, M. H. Dement, London.—31*st July*, 1883.
3747. Nut-lock, W. R. Lake, London.—Com. from W. J. M'Tighe, Pittsburg, U.S.—31*st July*, 1883.
3748. Binding Books, A. Brehmer, Leipzig, and G. Brown, Glasgow.—31*st July*, 1883.

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

3184. Flue or Tube for Steam Boilers, J. A. and J. Hopkinson, Huddersfield.—4*th August*, 1880.
3258. Tubes, &c., for Steam Boiler Flues, J. A. and J. Hopkinson, Huddersfield.—9*th August*, 1880.
3377. Sheets of India-rubber, D. Gaussen, Lechlade.—19*th August*, 1880.
3478. Bicycles, &c., N. K. Husberg, Stockholm.—27*th August*, 1880.
3257. Chilled Articles of Steel and Iron, H. Springmann, Prussia.—9*th August*, 1880.
3182. Gas Motor Engines, F. W. Turner, St. Albans.—3*rd August*, 1880.
3185. Edging Grass Machinery, P. Adie, London.—4*th August*, 1880.
2240. Upholstery Nails, W. Pitt, Tarrington.—7*th August*, 1880.
3215. Bleaching, &c., W. Goode, Nottingham.—6*th August*, 1880.
3327. Water Heaters and Purifiers, W. L. Wise, London.—17*th August*, 1880.
3338. Railway Carriages, J. Wetter, London.—17*th August*, 1880.
3379. Steam Engines, D. Joy, Anerley.—20*th August*, 1880.
3172. Purifying, &c., Apparatus, W. Lyon, London.—3*rd August*, 1880.
3161. Treating Copper, J. H. Johnson, London.—3*rd August*, 1880.
3189. Screw Propellers for Navigable Vessels, J. Robertson, Govan.—4*th August*, 1880.
3212. Steam Generators and Furnaces, A. M. Clark, London.—5*th August*, 1880.
3186. Tie and Core Metal, T. Hyatt, London.—4*th August*, 1880.
3221. Liquid Composition for Washing, &c., W. Haworth, Burnley.—6*th August*, 1880.
3224. Stop-watches, L. A. Groth, London.—6*th August*, 1880.
3255. Recovering Bicarbonate of Ammonia from Liquors Produced in the Manufacture of Soda, J. Imray, London.—9*th August*, 1880.
3263. Seams of Boots, &c., W. P. Thompson, London.—10*th August*, 1880.
3290. Treating Wheat and other Cereals, W. B. Dell, London.—12*th August*, 1880.
3323. Money Tills, H. E. Sambrook, London.—16*th August*, 1880.

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

3107. Preserving Animal and other Substances, W. F. Grier, Glasgow.—4*th August*, 1876.
3125. Treating Town Refuse, A. Fryer, Wilmslow.—5*th August*, 1876.
3093. Railway Fish-joints, &c., A. M. Clark, London.—2*nd August*, 1876.
3200. Weaving Apparatus, H. Ainley, Kirkheaton.—14*th August*, 1876.

Notices of Intention to Proceed with Applications.

(*Last day for filing opposition*, 24*th August*, 1883.)

1401. Top Notches for Umbrellas, W. Milner, Carbrook.—16*th March*, 1883.
1568. Saddles for Bicycles, &c., J. B. Brooks, Birmingham.—28*th March*, 1883.
1575. Electro-magnetic Printing Telegraph Apparatus, W. P. Thompson, Liverpool.—A communication from H. V. Hoevenbergh.—28*th March*, 1883.
1576. Electro-magnetic Printing Telegraphs, W. P. Thompson, Liverpool.—A communication from H. V. Hoevenbergh.—28*th March*, 1883.
1577. Manufacture of Alumina, W. P. Thompson, Liverpool.—A communication from J. D. Darling.—28*th March*, 1883.
1584. Distillation of Glycerine, F. J. O'Farrell, Dublin.—29*th March*, 1883.
1585. Heating Apparatus, W. P. Thompson, Liverpool.—Com. from C. Launay.—29*th March*, 1883.
1587. Coupling, &c., Carriages, J. T. Leighton, Edinburgh.—29*th March*, 1883.
1591. Paper Feeding Apparatus, A. Godfrey, New Reddish.—29*th March*, 1883.
1592. Stoves, L. C. Besant, Greenock.—29*th March*, 1883.
1597. Wire Fencing, W. J. Smith, Inverness, N.B.—29*th March*, 1883.
1599. Smoke-preventing Grates, A. F. Andresen, Hampstead.—29*th March*, 1883.
1606. Spring Scales, C. Pieper, Berlin.—A communication from E. Ubrig.—30*th March*, 1883.
1619. Puddling Furnaces, J. Imray, London.—Com. from P. Dujardin & J. Fredureau.—31*st March*, 1883.
1628. Crucibles, J. C. Waterhouse, Alverthorpe.—31*st March*, 1883.
1630. Ground Colour, F. Wirth, Frankfort-on-the-Main.—A communication from O. Fischer.—31*st March*, 1883.
1631. Traction Engines, W. Wilkinson, Wigan.—31*st March*, 1883.
1636. Oscillating Apparatus, A. J. Boult, London.—A communication from P. Schwarz and P. Treutler.—31*st March*, 1883.
1638. Corking Bottles, J. J. H. Schultz, Hamburg.—31*st March*, 1883.
1645. Telegraphic Wire, L. Elmore, New York.—Com. from W. B. Hollingshead.—2*nd April*, 1883.
1648. Laces for Machine Belts, R. Paton, Johnstone.—2*nd April*, 1883.

1650. Photographic Shutters, R. Reynolds and F. W. Branson, Leeds.—*2nd April*, 1883.
1655. Turbines, F. H. F. Engel, Hamburg.—Com. from G. de Laval.—*2nd April*, 1883.
1662. Folding Chair, E. Smith, West Dulwich.—*3rd April*, 1883.
1706. Lubrication of Bearings, R. Balderston, Paisley.—*5th April*, 1883.
1716. Propelling Tricycles, &c., W. Brierley, Halifax.—A communication from R. Perl and F. Teschek.—*5th April*, 1883.
1717. Spinning Fibres, W. Walker and A. Binns, Halifax.—*5th April*, 1883.
1738. Ordnance, P. M. Parsons, Blackheath.—*6th April*, 1883.
1748. Distributing Apparatus, W. R. Lake, London.—Com. from E. Shepard.—*6th April*, 1883.
1760. Feeding Electric Carbons, J. Henry and H. B. Bourne, London.—*7th April*, 1883.
1807. Ensilage, T. Potter, Alresford.—*10th April*, 1883.
1809. Wine Vessels, R. Dunlop, Cardiff.—*10th April*, 1883.
1939. Boxes, &c., for Protecting Articles, A. G. Speight, Hoxton.—*17th April*, 1883.
1961. Slide Valves, J. F. Johnstone, Belvedere.—*18th April*, 1883.
1967. Galvanising Sheet Iron, J. Tinn, Bristol.—*18th April*, 1883.
1978. Printing Fabrics, W. Mather, Manchester.—*19th April*, 1883.
1995. Obtaining Aluminium, H. A. Gadsden, London.—Com. from E. Foote.—*19th April*, 1883.
2354. Motive Power, O. Trossin, London.—*9th May*, 1883.
2535. Artificial Stone, F. H. F. Engel, Hamburg.—A communication from E. Murjahn.—*21st May*, 1883.
2750. Refined Sugar, J. Allen, Stepney.—*2nd June*, 1883.
2805. Pencil-point Protectors, F. Byron, Chesterfield.—*6th June*, 1883.
3028. Sewing Machinery, A. G. Brookes, London.—Com. from R. Whitehill.—*19th June*, 1883.
3029. Coupling, &c., Shafting, A. G. Brookes, London.—Com. from R. Whitehill.—*19th June*, 1883.
3079. Gas Motor Engines, F. W. Crossley, Manchester.—*21st June*, 1883.
3084. Products of Combustion, J. H. Darby, Brymbo.—*21st June*, 1883.
3115. Dynamo-electric Machines, G. Forbes, London.—*22nd June*, 1883.
3133. Coupling Hoses, J. C. Hudson, London.—*23rd June*, 1883.
3189. Metallic Tubes, R. Heeley, Shirley.—*27th June*, 1883.
3253. Wringing, &c., Fabrics, J. Kenyon, J. Barnes, and R. W. Kenyon, Accrington.—*30th June*, 1883.
3274. Clasps for Corsets, H. M. Dyson, Honor Oak.—*2nd July*, 1883.
3304. Spinning Machinery, J. Farran, Manchester.—*4th July*, 1883.
3310. Circular Saws, A. W. McMurdo, Scotby.—*4th July*, 1883.
3326. Garment called "Drawers," G. Macaulay-Cruikshank, Glasgow.—A communication from W. Benger Sons.—*5th July*, 1883.
3336. Gas Motors, H. Holden, Manchester.—*5th July*, 1883.
3690. Alcohols, H. A. Bonneville, London.—Com. from A. Ralu, jun.—*28th July*, 1883.
3728. Burners, J. S. Muir, London.—*31st July*, 1883.
3733. Type-matrice Machine, M. H. Dement, London.—*31st July*, 1883.
3734. Stereotyping Apparatus, M. H. Dement, London.—*31st July*, 1883.

(*Last day for filing opposition, 28th August*, 1883.)

1647. Safety Plugs, C. V. Boys, Wing, and H. H. Cunynhame, London.—*2nd April*, 1883.
1651. Concentrating Sulphuric Acid, W. P. Thompson, Liverpool.—A communication from W. West.—*2nd April*, 1883.
1652. Electric Safety Lamps, T. Coad, London.—*2nd April*, 1883.
1657. Slags, &c., J. Wright, London.—*3rd April*, 1883.
1658. Treating Cement, J. Wright, London.—*3rd April*, 1883.
1664. Tassels for Umbrellas, &c., M. H. Harris, London.—*3rd April*, 1883.
1665. Impressing Typographic Characters, C. H. Davids, New York.—*3rd April*, 1883.
1668. Tramways, &c., R. G. Fairlie, London.—*3rd April*, 1883.
1669. Silk, &c., Hats, M. Haslam, Stockport.—*3rd April*, 1883.
1670. Protective Coverings for Bottles, F. Hall, Sheffield.—*3rd April*, 1883.
1674. Food for Cattle, P. Jensen, London.—A communication from S. O. Kjœr.—*3rd April*, 1883.
1682. Propelling, &c., Vehicles, F. J. Clarke, J. W. Graham, and J. Kirby, Lincoln.—*3rd April*, 1883.
1715. Drying Excreta, &c., J. M. Sutton, Manchester.—*5th April*, 1883.
1719. Paper Fastenings, M. Bauer, Paris.—A communication from A. Lotz.—*5th April*, 1883.
1725. Cab Communicator, F. Armstrong, Beckenham.—*5th April*, 1883.
1731. Heating Apparatus, W. H. Williams, Birmingham.—*6th April*, 1883.
1741. Fly-wheels, &c., W. Hargreaves and R. Harwood, Bolton.—*6th April*, 1883.
1743. Phosphatic Metallic Scoria, G. Pitt, Sutton.—A communication from G. Rocour.—*6th April*, 1883.
1746. Velocipedes, A. L. Bricknell, Brixton.—*6th April*, 1883.
1747. Velocipedes, A. L. Bricknell, Brixton.—*6th April*, 1883.
1754. Electrodes, F. E. Elmore, London.—*7th April*, 1883.
1755. Furniture Vehicles, J. W. and H. J. Davey, Bristol.—*7th April*, 1883.
1779. Registering Apparatus, J. Imray, London.—A communication from F. Bisson.—*9th April*, 1883.
1789. Galvanic Batteries, G. B. de Overbeck, London.—Partly a communication from Doctor F. Hornung.—*9th April*, 1883.
1805. Electric Pile, J. C. Mewburn, London.—Com. from M. and P. Azapis.—*10th April*, 1883.
1814. Meter, A. M. Clark, London.—Com. from G. Hochreutiner and A. Boucher.—*10th April*, 1883.
1852. Shag, &c., Fabrics, H. J. Haddan, London.—Com. from F. A. Parellada.—*12th April*, 1883.
1933. Gum Tragacanth, A. C. Duncan, Manchester.—*17th April*, 1883.
2010. Cutting Fodder, J. H. Johnson, London.—Com. from A. Albaret.—*20th April*, 1883.
2035. Concentrating Sulphuric Acid, S. B. Bowen, Llanelly.—*21st April*, 1883.
2056. Working Brakes, &c., J. Armstrong, New Swindon.—*23rd April*, 1883.
2109. Combing Cotton, &c., J. Thompson and T. Barker, Manchester.—*26th April*, 1883.
2383. Knitting Machinery, S. Lowe and J. W. Lamb, Nottingham.—*10th May*, 1883.
2395. Contact Boxes, W. E. Ayrton and J. Perry, London.—*11th May*, 1883.
2521. Coal, &c., Derricks, A. Lewsley, London.—A communication from W. E. Ludlow.—*21st May*, 1883.
2862. Refined Cast Steel, T. Sheehan, London.—*8th June*, 1883.
3094. Friction Gearing, W. E. Ayrton and J. Perry, London.—*21st June*, 1883.
3188. Piled Fabrics, D. Marcon, Paris.—*27th June*, 1883.
3263. Stiffening Fustians, &c., J. Sellars, Manchester.—*2nd July*, 1883.
3280. Gas Engines, W. Foulis, Glasgow.—*3rd July*, 1883.
3306. Theodolites, A. L. H. Holmes, India.—*4th July*, 1883.
3342. Ferrocyanides, Dr. H. Kunheim, Berlin, and H. Zimmermann, Wesseling.—*5th July*, 1883.
3350. Treating Tin Dross, T. Lloyd, Aberdylais.—*6th July*, 1883.
3359. Carburetting Gas, &c., J. Thomas, London.—*6th July*, 1883.
3400. Oiling, &c., Hemp, A. V. Newton, London.—A communication from J. Good.—*10th July*, 1883.
3419. Carpets, T. Tempest-Radford, Kidderminster.—*11th July*, 1883.
3462. Cylinders for Picking, &c., Machines, W. R. Lake, London.—A communication from F. G. and A. C. Sargent.—*13th July*, 1883.
3486. Valves, J. Kroog, Halle-on-the-Saale.—*16th July*, 1883.
3519. Rolling Mills, A. W. L. Reddie, London.—A communication from Messrs. Wilmot Hobbs and Co.—*17th July*, 1883.
3559. Lasting Boots, &c., W. R. Lake, London.—Com. from J. R. Scott.—*19th July*, 1883.
3705. Racks for Spirits, E. Smith, Liverpool.—Com. from C. M. Johnson.—*28th July*, 1883.

Patents Sealed.

(*List of Letters Patent which passed the Great Seal on the 3rd August*, 1883.)

612. Covered Wire, W. Halkyard, Providence, U.S.—*5th February*, 1883.
616. Globes for Candles, J. B. Goodwin, London.—*5th February*, 1883.
619. Hinges for Doors, G. W. von Nawrocki, Berlin.—*5th February*, 1883.
638. Gas Motor Engines, C. W. King, Manchester, and A. Cliff, Forest Gate.—*6th February*, 1883.
650. Drills for Sowing Turnip, &c., P. Pierce, Wexford.—*6th February*, 1883.
651. Raising, &c., Weights, H. C. Symons, Southwark.—*6th February*, 1883.
654. Preventing Explosions, T. C. Fawcett and J. C. Hargreaves, Leeds.—*6th February*, 1883.
655. Fastenings for Wearing Apparel, &c., W. M. and J. C. Newey, Birmingham.—*6th February*, 1883.
661. Dynamo-electric Machines, J. Munro, West Croydon.—*6th February*, 1883.
662. Artificial Stones, F. Wirth, Frankfort-on-the-Main.—*6th February*, 1883.
674. Preparing Castings, D. P. G. Matthews, Newport.—*7th February*, 1883.
684. Sewerage Apparatus, J. G. Stidder, London.—*7th February*, 1883.
685. Drying Grain, &c., J. J. Turner, Kington.—*7th February*, 1883.
691. Combing Wool, F. Fairbank and J. Robertshaw, Allerton.—*8th February*, 1883.
705. Kitchen Ranges, W. Russell, Pendleton.—*9th February*, 1883.
728. Hand Rakes, W. R. Lake, London.—*9th February*, 1883.
733. Wheels for Railway Carriages, R. R. Gubbins, New Cross.—*9th February*, 1883.
734. Unhairing Skins, W. H. Beck, London.—*9th February*, 1883.
735. Rinsing Wool, W. H. Beck, London.—*9th February*, 1883.
745. Points for Tramways, H. Scott, Liverpool.—*10th February*, 1883.
774. Spinning, &c., Cotton, W. and C. G. Bracewell and A. Pilkington, Barnoldswick.—*12th February*, 1883.
776. Self-acting Excavators, T. Whitaker, Horsforth.—*12th February*, 1883.
780. Potato Steamer, C. F. Bower, London.—*13th February*, 1883.
787. Breaking Pig Iron, J. Evans, Gaythorne, and S. Mason, Leicester.—*13th February*, 1883.
788. Railway Brakes, A. M. Clark, London.—*13th February*, 1883.
790. Box Irons, J. Gautherin, Paris.—*13th February*, 1883.
803. Walls for Buildings, W. Mullett, Brierley Hill.—*14th February*, 1883.
837. Coffee Cups, C. D. Abel, London.—*15th February*, 1883.
900. Water Heater, W. Carrington, Openshaw, and W. H. Bowers, Gorton.—*19th February*, 1883.
942. Metallic Ores, J. H. Johnson, London.—*20th February*, 1883.
956. Colouring Matters, E. G. Brewer, London.—*21st February*, 1883.
1036. Cartridges, T. Nordenfelt, London.—*26th February*, 1883.
1172. Securing Excentrics on Crank Shafts, F. Holt, Derby.—*5th March*, 1883.
1207. Filtration, W. R. Lake, London.—*6th March*, 1883.
1431. Breech-loading Repeating Fire-arms, B. Burton, London.—*19th March*, 1883.
1482. Measuring, &c., Apparatus, A. C. Campbell, Blythswood, and W. T. Goolden, London.—*21st March*, 1883.
1813. Carriage Wheels, B. J. B. Mills, London.—*10th April*, 1883.
2184. Colouring Matter, H. O. Miller, Moscow.—*30th April*, 1883.
2190. Drilling, &c., Apparatus, R. K. Jones, Birkenhead.—*1st May*, 1883.
2520. Coupling, &c., Apparatus, W. Vaux, Bradford.—*21st May*, 1883.
2524. Laundry Blue, M. H. and T. L. Hargreaves, Hull, and J. E. Hargreaves, Isle of Wight.—*21st May*, 1883.
2552. Sizing Machines, J. Dugdale, Blackburn.—*22nd May*, 1883.
2598. Wrenches, H. W. Atwater, Orange, U.S.—*24th May*, 1883.
2616. Corset, W. R. Lake, London.—*25th May*, 1883.
2706. Gas Caloric Motive Engines, E. and E. Crowe, Manchester, and H. Crowe, Middlesbrough.—*31st May*, 1883.

(*List of Letters Patent which passed the Great Seal on the 7th August*, 1883.)

225. Belting, H. J. Haddan, London.—*15th January*, 1883.
712. Fireplaces, &c., G. Ermen, Holcombe.—*9th February*, 1883.
714. Warming Houses, S. Deards, Harlow.—*9th February*, 1883.
716. Manufacturing Soda, L. Mond, Northwich.—*9th February*, 1883.
718. Crystallised Sugar, G. W. von Nawrocki, Berlin.—*9th February*, 1883.
726. Furnace Bars, &c., F. Livet, London.—*9th February*, 1883.
730. Gas Furnaces, J. H. Selwyn and R. Walker, London.—*9th February*, 1883.
744. Water, &c., Hydrants, T. Suffield, London.—*10th February*, 1883.
750. White Pigment, T. Griffiths, Oxton.—*10th February*, 1883.
766. Smoke Consumer, A. Perkins, London.—*12th February*, 1883.
768. Fastening Armour-plates, L. W. Broadwell, Paris.—*12th February*, 1883.
778. Brushes, C. Jack, London.—*12th February*, 1883.
798. Latches, &c., W. B. Shorland, Barton-on-Irwell.—*14th February*, 1883.
840. Lead, &c., Bending Apparatus, T. Drake, Huddersfield.—*15th February*, 1883.
843. Holding Dry Plates or Films Before, &c., Changing them in the Photographic Camera, T. Samuels, Monken Hadley.—*15th February*, 1883.
845. Sanitary Pipes, H. Tugby, Woodville.—*15th February*, 1883.
872. Softening, &c., Hides and Skins, A. M. Clark, London.—*16th February*, 1883.
882. Boot and Shoe Tips, J. Foster, Kettering.—*17th February*, 1883.
899. Joint or Union Contact for Electric Fittings, W. Defries, London.—*19th February*, 1883.
905. Fire-grates, I. Dunbar, Coalbrookdale.—*19th February*, 1883.
917. Bread Loaf-cutter, D. M. Ford, Bristol.—*20th February*, 1883.
931. Printing Telegraphs, H. J. Allison, London.—*20th February*, 1883.
943. Drying Animal, &c., Substances, W. R. Lake, London.—*20th February*, 1883.
948. Sewing Machines, W. Jones, Guide Bridge, and H. Gamwell, Liverpool.—*21st February*, 1883.
1049. Producing Figured Designs on Textile Fabrics, C. D. Abel, London.—*27th February*, 1883.
1060. Gas Motor, F. von Martini, Frauenfeld.—*27th February*, 1883.
1071. Printing Machines or Presses, W. R. Lake, London.—*27th February*, 1883.
1077. Substitute for Ebonite, &c., W. Smith, London.—*27th February*, 1883.
1179. Roller Mills, H. Simon, Manchester.—*5th March*, 1883.
1198. Dynamo-electric Machines, C. Lever, Bowden.—*6th March*, 1883.
1214. Clipping Machines, J. Range, Nottingham.—*7th March*, 1883.
1215. Breech-loading, &c., Fire-arms, G. Macaulay-Cruikshank, Glasgow.—*7th March*, 1883.
1233. Barbed Fencing Wire, W. R. Lake, London.—*7th March*, 1883.
1423. Refrigerating or Cooling Air, G. H. Lloyd, Birmingham.—*17th March*, 1883.
2469. Separating and Utilising Alkali, J. Lane, Elland, and D. Steuart, Manchester.—*17th May*, 1883.
2484. Jacquards and Dobbies, W. Davenport and W. Crossley, Failsworth.—*18th May*, 1883.
2579. Electric Lighting, W. Stroudley, Brighton, and E. J. Houghton, Peckham.—*23rd May*, 1883.
2903. Printing and Embossing Presses, M. Gally, New York, U.S.—*11th June*, 1883.
3035. Gear-cutting Machines, H. J. Allison, London.—*19th June*, 1883.

List of Specifications published during the week ending August 4th, 1883.

5233, 8d.; 5243, 6d.; 5429, 6d.; 5671, 4d.; 5730, 8d.; 5766, 4d.; 5769, 4d.; 5785, 2d.; 5794, 2d.; 5799, 2d.; 5857, 2d.; 5858, 2d.; 5867, 8d.; 5868, 4d.; 5870, 6d.; 5872, 2d.; 5874, 6d.; 5875, 2d.; 5876, 6d.; 5877, 2d.; 5878, 6d.; 5879, 6d.; 5881, 2d.; 5882, 6d.; 5883, 10d.; 5884, 2d.; 5886, 2d.; 5887, 2d.; 5888, 2d.; 5889, 2d.; 5891, 6d.; 5894, 4d.; 5896, 2d.; 5897, 2d.; 5899, 8d.; 5900, 8d.; 5901, 6d.; 5902, 4d.; 5903, 8d.; 5904, 4d.; 5909, 6d.; 5914, 4d.; 5917, 6d.; 5918, 8d.; 5920, 8d.; 5923, 6d.; 5924, 2d.; 5925, 6d.; 5928, 4d.; 5931, 6d.; 5932, 4d.; 5933, 4d.; 5934, 6d.; 5935, 6d.; 5937, 6d.; 5939, 6d.; 5943, 2d.; 5944, 6d.; 5945, 4d.; 5949, 6d.; 5950, 6d.; 5951, 4d.; 5953, 6d.; 5957, 6d.; 5958, 6d.; 5959, 4d.; 5961, 6d.; 5963, 6d.; 5964, 6d.; 5968, 6d.; 5969, 6d.; 5970, 6d.; 5972, 4d.; 5973, 4d.; 5974, 6d.; 5976, 6d.; 5977, 4d.; 5978, 8d.; 5980, 6d.; 5982, 6d.; 5985, 8d.; 5986, 4d.; 5997, 6d.; 5998, 4d.; 6006, 6d.; 6012, 8d.; 6019, 6d.; 6025, 6d.; 6063, 8d.; 6071, 6d.; 6103, 4d.; 1763, 6d.; 1945, 10d.; 2081, 4d.

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

ABSTRACTS OF SPECIFICATIONS.

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

5233. Bathing and Vaporising Apparatus for Medical Purposes, &c., *F. J. Drewry, Burton-on-Trent, executor of W. Morgan-Brown, London.—2nd November*, 1882.—(*A communication from W. Rosenfield, New York.*) 8*d*.

The apparatus is capacitated to administer a steam or vapour bath as well as a shower bath, and also the vapour generated may be tinctured or medicated so as to be used not only for medical bathing, but for inhalation or for disinfecting purposes.

5243. Horseshoes, *F. J. Drewry, Burton-on-Trent executor of W. Morgan-Brown, London.—3rd November*, 1882.—(*A communication from G. Brandt, H. Sarre, and H. Beyerhaus, Berlin.*) 6*d*.

This relates to the construction of metal shoes provided around their underside with a dovetail groove permitted to fasten as well as to change conveniently the calkins, toes, and elastic joggles or bearers.

5429. Storage and Treatment of Grain, &c., *K. J. Dance, Chadwick-road, Kent.—14th November*, 1882. 6*d*.

This relates to the process of treating wheat grain, so that it can be stored without being liable to fermentation, decomposition, or corruption.

5671. Obtaining Colouring Matters, *C. D. Ekman, London.—29th November*, 1882. 4*d*.

This relates to the method of treating wood, plants, or parts of plants containing colouring matter, by subjecting them under steam pressure in a closed boiler to the action of solutions containing sulphurous acid and a base or alkali.

5730. Methods of and Apparatus for Surveying, Levelling, and Plotting Land, *A. J. Boult, London.—1st December*, 1882.—(*A communication from Dr. L. Cerebotani, Germany.*) 8*d*.

This relates to a process whereby, by means of simple instruments, distances can be determined and curves laid off in an elementary trigonometric manner, without the calculation of angles and without the use of a nonius.

5766. Treatment of Materials used in Purifying Coal Gas for the Recovery of Useful Products therefrom, *J. Walker, Leeds.—4th December*, 1882.—(*Not proceeded with.*) 4*d*.

This relates partly to the process of extracting a sulpho-acid liquor.

5769. Electro-magnets and Electro-dynamo Machines, *E. G. Brewer, London.—4th December*, 1882.—(*A communication from A. L. Bonnefils, Paris.*)—(*Not proceeded with.*) 2*d*.

This refers to the construction and employment of electro-magnets of a spherical or spheroidal form, "a magnetic sphere," and in the application of these magnetic spheres or spheroids to the construction of ordinary induction machines, combining them with other forms of known electro-magnets, either as a magnetic fixed or movable sphere excited by ordinary electro-magnets or as a hollow magnetic sphere exciting other kinds of bobbins placed inside the sphere, or as a hollow magnetic sphere exciting another magnetic sphere.

5785. Process for Preparing Fluid Isinglass from Bladders of Cod Fish, &c., *L. A. Groth, London.—5th December*, 1882.—(*A communication from C. A. Sahlstrom, Jönkoping, Sweden.*)—(*Not proceeded with.*) 2*d*.

This relates to the chemical treatment of the bladders.

5794. Apparatus for Filling Sacks, *H. J. Haddan, Kensington.—5th December*, 1882.—(*A communication from L. and E. Laplace, Issoudun, France.*)—(*Not proceeded with.*) 2*d*.

The object is to control the weight of materials to be filled into sacks.

5799. Cake for Cattle Food, &c., *T. Earp, Newark-on-Trent.—5th December*, 1882.—(*Not proceeded with.*) 2*d*.

This relates to the employment of germinated or partially malted grain in combination with malt and other products.

5857. Stamps for Forging and Shaping Metals, *A. W. Wills, Birmingham.—8th December*, 1882.—(*Not proceeded with.*) 2*d*.

This relates to the general arrangement of the parts.

5858. Construction of Wheels for Velocipedes, &c., *E. A. Tice, Clapham.—8th December*, 1882.—(*Not proceeded with.*) 2*d*.

This consists in fitting a metallic hoop or tire over the face of the rubber tire.

5867. Ordnance, *A. M. Clark, London.—8th December*, 1882.—(*A communication from A. H. J. Suel, Paris.*) 8*d*.

This relates partly to a breech-loading cannon in which the breech is closed by a cap screwing upon an excentric enlargement of the breech, and provided with an orifice which may be brought opposite the bore, and with a tray for supporting and guiding the charge.

5868. Apparatus to be used with Circular Saws to Prevent Accidents therewith, *J. H. Johnson, London.—8th December*, 1882.—(*A communication from A. I. A. M. Trincano.*)—(*Not proceeded with.*) 4*d*.

The apparatus consists essentially of a guard in the form of a slotted bar or lever suspended from overhead supports, and capable of moving in various directions in a vertical plane, and also provided with a device for effecting the advance of the wood when finishing the cut, whereby the necessity for the workman to touch the wood with his hands at this dangerous part of the operation is obviated.

5870. Increasing the Efficency of Telephones, *W. R. Lake, London.—8th December*, 1882.—(*A communication from A. E. Dolbear, Sommerville, Mass., U.S.A.*) 6*d*.

This consists in combination with the receiver plate or plates composed of metal coated with a dielectric, an inductorium whose primary contains a circuit breaker, adapted, when in operation, to induce a high electro-motive force in the secondary circuit, and thereby charge the dielectric.

5872. Signalling in Railway Trains, &c., *J. Sansom, Glasgow.—9th December*, 1882.—(*Not proceeded with.*) 2*d*.

The object is to produce visible signals in connection or combination with audible signals.

5874. Construction of Ring Spinning and Doubling Frames, *J. Young and E. Furniss, Mellor.—9th December*, 1882. 6*d*.

The apparatus consists of a split ring E E attached to and made adjustable in a longitudinal direction upon a bar F F, which is supported upon brackets or standards G G. The feet of these standards are made with

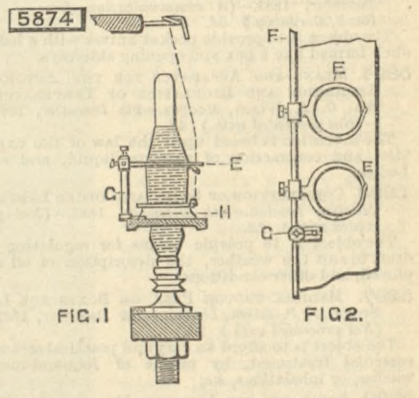


FIG. 1 FIG 2.

slots, whereby the said standards are bolted to, and can be adjusted in a transverse direction upon the traversing or rail ring B B. The split ring E E is held parallel with the ordinary ring H H, so as to embrace the spool or cop about 1in., more or less, above it on the same central line.

5875. Preparing Waxes and Oils for Use in Treating, Lubricating, or Finishing Textile Materials, &c., *J. B. Hannay, Glasgow.—9th December*, 1882.—(*Not proceeded with.*) 2*d*.

Olive oil or other suitable vegetable or saponifiable oil is employed as a vehicle or medium for applying a wax or non-saponifiable oil to textile materials or fabrics.

5876. Ventilating Buildings, *T. H. Thompson, Manchester.—9th December*, 1882. 6*d*.

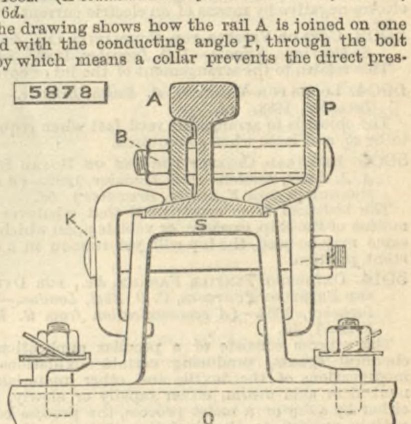
This relates to the employment of a ridge to be formed with a ventilating opening, or with two or more such openings, covered and sheltered to prevent the passage of rain, and to cause the wind to have an inductive action.

5877. Perambulators, *W. Hatchman, London.—9th December*, 1882.—(*Not proceeded with.*) 2*d*.

This relates to a hinged flap, so that the child can recline at full length when asleep.

5878. Iron Permanent Ways for Railways and Tramways, *J. E. Walsh, Halifax.—9th December*, 1882.—(*A communication from C. Verhœsen, Utrecht.*) 6*d*.

The drawing shows how the rail A is joined on one hand with the conducting angle P, through the bolt B, by which means a collar prevents the direct pres-



sure when the nut of the bolt is screwed on, while, on the other hand, the rail A appears sufficiently firmly joined to wrought iron chair S through the cramps K and K1, which are joined one to the other by bolts; the chair S rests on an ordinary sleeper Q.

5879. Joints, Bearers, and Coverings for Roofing, Pillars, &c., *J. E. Walsh, Leeds.—9th December*, 1882.—(*A communication from M. G. Mitter and Dr. L. A. Hoffman, Berlin.*) 6*d*.

This consists in various forms and arrangements of metal plates to form joints, bearers, and channels for roofs, &c.

5881. Means and Apparatus for Manufacturing "Sizes," *J. W. Harland, London.—9th December*, 1882.—(*Not proceeded with.*) 2*d*.

It consists in the application and use of cassawa roots, yams, cocos, and the horse chesnut for the manufacture of sizes.

5883. Spring Motors for Sewing Machines, *A. M. Clark, London.—9th December*, 1882.—(*A communication from J. B. T. Bandouin, H. L. Mathieu and A. F. Conchon, Paris.*) 10*d*.

This consists in an automatic spring motor driving the main shaft directly without the intervention of a belt, the said motor being provided with means for winding it up, with a brake for enabling the speed of the machine to be varied when running, and with an adjustable fly regulator or governor for rendering the motion of the machine uniform.

5882. VELOCIPEDES, *J. R. Trigwell, London.—9th December*, 1882. 6*d*.
The inventor claims, First, in the steering portion of a bicycle or other velocipede, arranging the bearing balls in grooves or channels formed in the closed ends of the head, and confining the balls to the said grooves; Secondly, screwing or otherwise forming or fixing the closed ends containing the bearing balls to the head.

5884. COMBUSTION MODERATOR OR REGULATOR FOR STOVES, &c., *W. H. Beck, London.—9th December*, 1882.—(*A communication from E. J. Petit-Badré, Paris.*)—(*Not proceeded with.*) 2*d*.
The moderator consists of an arrangement of the fireplace doors, which allows them to slide round the fireplace, so as to close or open the inlet according to the requirements of the combustion.

5886. APPLYING TO THE SOLES OF BOOTS AND SHOES RETICULATED WORK TO PREVENT SLIPPING IN PLAYING GAMES, *H. Craston, London.—9th December*, 1882.—(*Not proceeded with.*) 2*d*.
This consists in the method of applying to the sole of the shoe reticulated work in catgut, string, wire, leather, or any suitable fibrous material, and either made to go over the sole, and fastened by cords or loops or laces, or other suitable means.

5887. VOLTAIC BATTERIES, *L. Hartmann, London.—9th December*, 1882.—(*Not proceeded with.*) 2*d*.
The inventor employs as the exciting liquid caustic potash or caustic soda in solution, and for the positive electrode he uses zinc, while for the negative electrode he employs either iron, copper, nickel, cobalt, silver, or gold.

5888. SAFETY VALVES, *A. Haigh, Halifax.—9th December*, 1882.—(*Not proceeded with.*) 2*d*.
This consists in forming a valve with two seats.

5889. MANUFACTURE OF STEEL AND APPLIANCES RELATING THERETO, *J. A. Jones, Middlesbrough-on-Tees.—9th December*, 1882.—(*Not proceeded with.*) 2*d*.
The object is to prevent the heat of an ingot after it has been cast from escaping too rapidly, which renders reheating necessary, but to allow it to depart so slowly and uniformly as will enable the ingot to be hammered or rolled without reheating.

5891. POCKET KNIVES, &c., *A. J. Boult, London.—9th December*, 1882.—(*A communication from J. W. Rauh, Germany.*) 6*d*.
The object is to provide pocket knives with a haft or shell formed like a box and opening sideways.

5894. MEANS AND APPARATUS FOR THE AUTOMATIC INDICATION AND REGULATION OF TEMPERATURES, &c., *G. L. Winch, Madras.—9th December*, 1882.—(*Not proceeded with.*) 4*d*.
The invention is based upon the law of the expansion and contraction of gaseous, liquid, and solid bodies.

5896. CONSTRUCTION OF SHIPS' AND OTHER LAMPS, *E. Martin, London.—9th December*, 1882.—(*Not proceeded with.*) 2*d*.
The object is to provide means for regulating the draft to suit the weather, the description of oil employed, and other conditions.

5897. MEDICAL TROUGH PENS OR BOXES FOR LIVE STOCK, *J. P. Smith, London.—9th December*, 1882.—(*Not proceeded with.*) 2*d*.
The object is to afford an easy and practical means of remedial treatment, by means of foot-and-mouth washes, or inhalations, &c.

5899. APPARATUS FOR LIGHTING, HEATING, AND COMMUNICATING BY ELECTRICITY, &c., *P. R. Allen, Lambeth.—9th December*, 1882. 8*d*.
This relates partly to an electrical coupling, independent of the brake coupling.

5900. TOOL TO SERVE AS A SPANNER OR PIPE-CUTTER, &c., *W. R. Lake, London.—9th December*, 1882.—(*A communication from G. L. B. Duhayon, Paris.*) 8*d*.
This consists in a tool which may be used either as a pipe cutter or a spanner, of the arrangement of a double-armed piece having a rib provided with notches to allow of the alteration of the tool.

5901. BELT FASTENERS, *W. H. Sleep, St. Germans, Cornwall.—9th December*, 1882. 6*d*.
This consists in constructing belt fasteners with two excentric tongues, holders, or rollers, capable of turning in a suitable frame, so that when the ends of a belt are placed between the tongues, holders, or rollers, and a straining is brought upon the belt, the said tongues, holders, or rollers being excentric are drawn towards one another, so as to firmly grip the ends of the belt.

5902. MEANS OR APPARATUS FOR PREVENTING THE CORROSION AND FOULING OF THE BOTTOMS OF IRON OR STEEL SHIPS, &c , *J. B. Hannay, Glasgow.—11th December*, 1882. 4*d*.
This consists in preventing the corrosion and fouling of the bottom of an iron or steel ship by keeping it uncoated with paint or composition and rendering it electro-negative by means of an electric current.

5903. CANS OR VESSELS FOR CONTAINING OIL, &c., *T. S. Marriage, Reigate.—11th December*, 1882. 8*d*.
This relates to the arrangement of the lid or cover.

5904. LOOMS FOR WEAVING, *A. Smith, Bingley.—11th December*, 1882. 4*d*.
The object is to arrange the reed fast when required to be so, and loose when so required.

5909. BEDSTEAD, CHIEFLY FOR USE ON BOARD SHIP, *A. J. Boult, London.—11th December*, 1882.—(*A communication from F. Lebacq, Bruxelles.*) 6*d*.
The bedstead is so constructed that whatever the motion of the ship, carriage, or vehicle upon which the same may be used, the top will yet remain in a constant position.

5914. OXIDISING TEXTILE FABRICS, &c., FOR DYEING AND PRINTING PURPOSES, *C. D. Abel, London.—11th December*, 1882.—(*A communication from G. Witz, Rouen.*) 4*d*.
The process consists of a peculiar application of chemical agents, producing certain oxidations or modifications of the textile and other materials in neutral or acid media, either rapidly or slowly, and either by a dry or a moist process, the process being mainly applied to the dyeing or printing the said materials.

5917. PLANING AND MILLING MACHINES, *W. F. Smith and A. Coventry, Salford.—12th December*, 1882. 6*d*.
This consists in combinations and arrangements of mechanism by which the tool box and slides are, or may be, adjusted as required, and proper movements for actuating the tool box and giving the feed for the cut are imparted by gearing and other arrangements dispensing with ropes or catgut commonly used for the purpose.

5918. DYNAMO-ELECTRIC MACHINES, *H. H. Lake, London.—12th December*, 1882.—(*A communication from R. H. Mather, Windsor, U.S.*) 8*d*.
This consists essentially in the form of constructi on of the armature.

5920. AIR PUMPS OR MACHINERY FOR VENTILATING, APPLICABLE IN PART TO BLOWING ENGINES, *J. C. Baker, Liverpool.—12th December*, 1882. 8*d*.
This relates to the construction of an air pump or blowing engine with a steam cylinder placed inside an outer or air cylinder, the piston-rod from the steam cylinder driving, through a crosshead and other piston-rods, the piston of the air cylinder without the intervention of crank or gearing.

5923. SEA-GOING VESSELS, *J. H. Johnson, London.—12th December*, 1882.—(*A communication from D. Ammen, Beltsville, U.S.*) 6*d*.
The object is to produce a vessel of very great strength of construction, of great handiness of movement, and capable of being kept afloat, and even temporarily repaired at sea, should a hole of considerable size be made in the bottom, by whatever cause.

5924. DECORATION OF WALLS, &c., *J. H. Johnson, London.—12th December*, 1882.—(*A communication from C. Juncker, Paris.*)—(*Not proceeded with.*) 2*d*.
This consists in preparing and applying natural and other objects or materials suitable for decorating purposes to the walls.

5925. MINERS' SAFETY LAMPS, *W. Morgan, Pontypridd.—12th December*, 1882. 6*d*.
This consists in the arrangement and construction of miners' safety lamps in which the air for combustion is admitted through passages protected by a shield and up between two glass cylinders and through wire gauze into the combustion chamber, the products of combustion being conducted away through wire gauze screens.

5929. COLLAPSIBLE TUBES FOR CONTAINING COLOURS, PERFUMES, &c., *C. E. H. Cheswright, London.—12th December*, 1882.—(*A communication from C. Cheswright, Cognac.*) 4*d*.
This relates to the manufacture of collapsible metal tubes from lead or its alloys plated or coated with tin.

5931. MANUFACTURE OF CAPSULES FOR BOTTLES, &c., *C. E. H. Cheswright, London.—12th December*, 1882.—(*A communication from C. Cheswright, Cognac.*) 6*d*.
This consists in the manufacture and use of capsules, for bottles and other like receptacles, wherein the connecting parts or branches between the lateral openings in such capsules are fluted, corrugated, rounded, doubled, or folded longitudinally, so as to reduce their width, thereby presenting a neater appearance whilst adding to their strength, and enabling a lighter gauge of metal to be employed in this class of capsules than has heretofore been attainable.

5932. PREPARATION OR COMPOUND FOR USE AS A SUBSTITUTE FOR LINSEED OIL, *P. G. Oster, Cöln-am-Rhein.—12th December*, 1882. 4*d*.
The compound consists of petroleum 610 parts by weight, cotton seed oil 170, thick oil 90, white resin 100, siccative 28, litharge 2.

5933. ORNAMENTATION OF GLASS, &c., *R. E. Frank, London.—12th December*, 1882.—(*A communication from L. Micciullo, Rossano, Italy.*) 4*d*.
This consists in copying and multiplying works of art and others on glass, china, &c.

5934. MACHINERY FOR SAWING WOOD, *W. R. Lake, London.—12th December*, 1882.—(*A communication from R. S. Greenlee, United States.*) 6*d*.
The chief object is to furnish means for feeding various thicknesses of wood to circular and other saws.

5935. AUTOMATIC MUSICAL INSTRUMENTS, *W. R. Lake, London.—12th December*, 1882.—(*A communication from A. H. Hammond, Worcester, Mass., U.S.*) 6*d*.
This relates partly to the combination in a mechanical musical instrument, wherein a travelling music sheet is employed, of a take-up roller, on which the music sheet is wound during the playing of the instrument.

5937. APPARATUS FOR DISPLAYING ADVERTISEMENTS, *W. R. Lake, London.—12th December*, 1882.—(*A communication from W. Akin, New York.*) 6*d*.
This consists in mechanism whereby the cards, sheets, or similar advertising mediums are automatically displayed at intervals in rotation.

5939. APPARATUS FOR REMOVING GREASE, AIR, AND OTHER IMPURITIES FROM FEED-WATER, *A. M. Clark, London.—12th December*, 1882.—(*A communication from D. D. Wass, S. Stuart, J. C. Henderson, and T. Motley, New York.*) 6*d*.
This relates partly to the combination of a vessel provided with transverse partitions, of a device for collecting the grease, and of an automatically operating outlet for the air that collects in the vessel.

5943. SPOOLING MACHINES, *T. Hand and J. T. Wibberley, Blackburn.—13th December*, 1882.—(*Not proceeded with.*) 2*d*.
This relates to improvements for spooling machines for winding sewing thread.

5944. COVERS OR STOPPERS FOR BOTTLES, JARS, &c., *E. Edwards, London.—13th December*, 1882. 6*d*.
This relates to the methods of fixing caps or covers upon bottles or other vessels, or of attaching together separate articles by means of arms or plates having turned-in projections which are forced inward when required.

5945. MANUFACTURE OF CUP AND SCREW HOOKS, SCREW PEGS, SCREW RINGS, &c., *A. H. Adams, Handsworth.—13th December*, 1882. 4*d*.
This consists in forming the bosses, roses, or collars of solid brass stamped into the required form, and attaching these bosses, roses, or collars to the iron or other metal screws, shanks, or spikes.

5949. SAFETY APPARATUS FOR SHIPS' HOLDS, *R. C. Scott, near Liverpool.—13th December*, 1882. 6*d*.
The apparatus consists of a cage constructed of bars jointed together and capable of being raised or opened out to surround the space about the ladder by which the men ascend and descend, and of folding out of the way when not in use.

5950. RAILWAY SIGNAL APPARATUS, *W. R. Sykes, Nunhead.—13th December*, 1882. 6*d*.
This relates to arrangements for working railway signals by means of a spring affixed to one of the rails of the railway, so as to be acted upon by a passing train, and thereby complete the electric circuit of a line in which are one or more electro-magnets or solenoids, or break a circuit previously complete or short circuit a line.

5951. WATCHES, *A. B. Cole, Coventry.—13th December*, 1882. 4*d*.
This relates to means for facilitating the winding up, the setting of the hands, and the regulation of watches.

5953. APPARATUS FOR PURIFYING AND INCREASING THE ILLUMINATING POWER OF COAL GAS, *J. F. G. Kromschröder, Westminster.—13th December*, 1882. 6*d*.
This relates to an apparatus for purifying and increasing the illuminating power of coal gas by passing it through hydrocarbon liquid.

5957. CONSTRUCTION OF TABLES, *A. Thompson, Glasgow.—13th December*, 1882. 6*d*.
This refers to improvements in that class of dining and other tables which have double tops.

5958. MACHINERY FOR COMBING WOOL, &c., *T. H. Whitehead, Leeds.—13th December*, 1882. 6*d*.
This relates, First, to the arrangement and construction of the feed knife divided into two parts; Secondly, to the arrangement, construction, and application of guides or a flanged roller.

5959. TANNING SKINS AND HIDES, *P. Jensen, London.—13th December*, 1882.—(*A communication from S. A. Garveri, Stavanger, Norway.*) 4*d*.
The invention consists in using both a tannic and a mineral material simultaneously.

5961. DYNAMO OR MAGNETO-ELECTRIC MACHINES, *G. L. Anders, London, and J. B. Henck, jun., Boston, U.S.—18th December*, 1882. 6*d*.
The invention relates to machines for the production of electric currents by the rotation of a conductor in a magnetic field, and has for its chief object the construction of a machine which will produce a continuous and uniform electric current without reversing the magnetic polarity of any part, and therefore without the necessity of a commutator for reducing or converting alternating or contrary into continuous currents as in previous machines for the production of continuous currents.

5963. ENGRAVING MACHINES, *F. Wirth, Frankfort-on-the-Main.—13th December*, 1882.—(*A communication from L. Limbert and M. Salni, Hanan, Germany.*) 6*d*.
This relates to a machine in which a pantograph is employed.

5964. SHEDDING APPARATUS OF LOOMS, *J. Irving, Barnsley.—13th December*, 1882. 6*d*.
This relates to the employment of excentrics or cranks to impart positive up-and-down movements to the healds in looms for weaving.

5968. CONSTRUCTION OF VERTICAL STEAM BOILERS, *A. H. B. Sharpe and F. Palmer, Lincoln.—14th December*, 1882. 6*d*.
This relates to the construction of vertical steam boilers with a vertical fire-box having an inner projecting horizontal water vessel, which is in communication with the water space surrounding the fire-box, and is traversed by a series of fire tubes, or by one or more fire flues, leading from within the fire-box to an external smoke-box and chimney.

5969. VALVES OF MOTIVE POWER ENGINES, *W. Hargreaves and W. Inglis, Bolton.—14th December*, 1882. 6*d*.
This relates, First, to the fitting of motive power engines having liberating valve gear with two or more admission valves, in place of each single valve as ordinarily used, such two or more valves being opened separately and alternately or in rotation; Secondly, the arrangement of mechanism for imparting two to-and-fro movements to a valve for each rotation of the valve shaft.

5970. PENTAGRAPH ENGRAVING MACHINES, *J. Mowat, Barrhead, N.B.—14th December*, 1882. 6*d*.
This refers specially to means or appliances for varying the extent of motion of the roller or cylinder being engraved, to compensate for irregularities in the diameters of different rollers or cylinders employed.

5972. APPARATUS FOR IGNITING GAS, &c., *T. Rowan, Westminster, and S. Williams, Newport.—14th December*, 1882. 4*d*.
This relates, First, to a portable instrument for igniting gas and the like; Secondly, to the use of a dynamo-electric machine for signalling by telephone bells and for other signalling purposes.

5973. MACHINERY FOR SPINNING FIBRES, *F. Ripley, Bradford.—14th December*, 1882. 4*d*.
This relates to the use and employment of a traversed tube within, and in combination with, a stationary ring.

5974. LOOMS FOR WEAVING, *D. Eastwood, Yorkshire.—14th December*, 1882. 6*d*.
This relates to an apparatus for working the healds.

5977. GALVANIC BATTERIES, *J. Rapieff, London.—14th December*, 1882. 4*d*.
This relates to improved galvanic cells and to the construction of new cells for the same purpose, namely, for generating electric currents.

5991 TRICYCLES, BICYCLES, &c., *O. Pihlfeldt, Redcar.—15th December*, 1882. 6*d*.
This relates principally to the driving gear.

6019. DYNAMO-ELECTRIC MACHINES, *W. S. Horry, London.—16th December*, 1882. 6*d*.
This relates principally to the armature composed of several segmental conductors so connected up by means of a pin and cross link at one end of each section, and by rivetting, fastening or soldering at the other end, as to form one continuous conductor, in the shape of a wheel, or part of a wheel, or disc, this conductor only being exposed to the inductive effect of the magnetic field.

6025. SEWING MACHINES, *T. Chadwick and T. Sugden, Oldham.—18th December*, 1882. 6*d*.
This consists in arranging the spool for the thread in the shuttle, so that it will be free to unwind from a stud or pivot in the shuttle, and so that the rotation of the shuttle will tend to wind the thread upon the spool, but the thread between the cloth and the shuttle spool will prevent the spool from revolving with the shuttle, and consequently the pivot will have to rotate in the axis of the spool as the shuttle rotates, the spool only rotating contrary to the direction in which the shuttle rotates to give off thread as it is required by the fabric being sewn.

6027. LATCHING BOLTS OF LOCKS AND LATCHES, *J. Woodward, Wolverhampton.—18th December*, 1882. 6*d*.
The inventor claims in a latching bolt of a lock or latch the combination of a dome-ended head with a short length of parallel-sided part, either cylindrical, rectangular, or of other convenient section (but preferably cylindrical), such parallel-sided part projecting forwards from the fore-plate of the case when such bolt is in its latched position, and also passing through such fore-plate.

6047. MANUFACTURE OF BICHROMATES, *J. H. Johnson, London.—18th December*, 1882.—(*A communication from O., A., and A. Neuhaus, Elberfeld, Germany.*) 4*d*.
This consists in the manufacture of bichromates of potash, soda, calcium, barium, and magnesia from their chromates by adding under pressure (and heat if necessary) carbonic acid.

6063. TRICYCLES, &c., *E. Marshall, Birmingham.—19th December*, 1882. 8*d*.
This relates, First, to transmitting the motion of the crank or pedal shaft to the travelling wheels; Secondly, in the construction of parts for driving at two different speeds.

6129. INSERTING AND SECURING MOVABLE TYPE IN STEREOTYPE PLATES, *J. E. Taylor, P. Allen, W. Evans, and C. P. Scott, Manchester.—22nd December*, 1882. 6*d*.
The object is to insert and secure movable type in stereotype plates, so that upon receipt of latest telegrams, &c., special editions of journals may be printed.

564. BRAKE APPARATUS FOR TRAMWAY VEHICLES, *W. R. Lake, London.—1st February*, 1883.—(*A communication from H. Marneffe, Liége.*)—(*Complete.*) 6*d*.
The chief object is to store the energy or momentum of vehicles when being brought to a standstill, so that it can be utilised at any time when an extra supply of power is required.

785. FEED WATER PURIFIERS FOR BOILERS, *W. P. Thompson, Liverpool.—13th February*, 1883.—(*A communication from C. Elliot, San Francisco.*)—(*Complete.*) 4*d*.
This relates partly to the combination with a settler of a feed pipe, a branch pipe attached to the feed pipe, and means for forcing chemicals through the branch pipe into the settler.

1462. NON-CONDUCTING COMPOSITION FOR COVERING STEAM BOILERS, &c., *G. W. Redfern, London.—20th March*, 1883.—(*A communication from H. C. Goodell, Atchison, U.S.*)—(*Complete.*) 6*d*.
The composition consists of a base or adhesive coating applied to the surface to be protected, composed of slaked lime, cement, or equivalent substances and asbestos, in combination with one or more outer coatings composed of lamp-black and fibrous material, applied to the base coating.

1468. LASTING MACHINES, *P. M. Justice, London.—20th March*, 1883.—(*A communication from J. E. Martzeliger, C. H. Delnow, M. S. Nichols, and G. S. Forbush, Massachusetts.*)—(*Complete.*) 1*s*. 2*d*.
The object is to last boots and shoes by machinery in an expeditious and economical manner, the invention including mechanism to hold the last in place and allow it to be turned and fed forward step by step, so that the mechanism for drawing over the leather may operate successively and at proper intervals. Pincers draw the upper over the last, and suitable mechanism turn the pincers, so as to plait the leather at the heel or toe. Mechanism is provided to feed the nails and hold them in position to be driven in at the proper instant.

1562. SEWING MACHINES, *S. Pitt, Sutton.—27th March*, 1883.—(*A communication from L. B. Miller and P. Diehl, New Jersey, U.S.*)—(*Complete.*) 4*d*.
This relates especially to single thread or chain-stitch machines, the objects being to provide a simple and durable and efficient mechanism for producing the "twisted" chain stitch, and also to provide means for simultaneously sewing two or more seams, and varying and adjusting their distances apart. A looper is adapted to oscillate and co-operate with a reciprocating needle so as to form a twisted chain stitch. Two or more of such loopers are used in combination with an equal number of reciprocating needles so as to form the desired number of seams simultaneously.

1564. DISINTEGRATING MACHINES, *W. R. Lake, London.—27th March*, 1883.—(*A communication from S. and E. B. Dodson, New York.*)—(*Complete.*) 6*d*.
This consists in the combination of a rotary part and a fixed abutment composed of sections, and serving to disintegrate between them the material to be treated, the rotary part having V-shaped circumferential ribs or projections, and the abutment V-shaped grooves, which at the bottom are closer to the ribs than at top, and extend outside the sides of the rotary part, with devices for adjusting and securing the abutment.

1608. GELATINO-BROMIDE FILM PAPER FOR PHOTOGRAPHIC NEGATIVES, *R. H. Brandon, Paris.—30th March*, 1883.—(*A communication from A. C. A. Thiebaut, Paris.*)—(*Complete.*) 2*d*.
This consists in the preparation of a gelatinised bromide of silver film paper, from which the pellicle or film after the photographic negative has been produced by exposure and development in the usual manner, is detached or peeled off in a dry state by hand without the assistance of any dissolving or other agent.

1616. PNEUMATIC SIGNALS FOR RAILWAYS, *E. M. Chase, Boston, U.S.—30th March*, 1883.—(*Complete.*) 10*d*.
This relates to a class of automatic railway signals in which the weight of a locomotive, acting upon a lever pivotted along the track, operates a pair of bellows to drive a column of air through a tube, such column of air, by suitable mechanism, being adapted to operate a visual signal, and put in motion an audible alarm, to announce the approach of a train considerably in advance of its arrival at a station or highway crossing.

SELECTED AMERICAN PATENTS.

From the United States' Patent Office Official Gazette.

280,903. CINDER CAR, *Jerome L. Boyer, Columbia, Pa.—Filed April 9th*, 1883.
Claim.—(1) In a cinder car for the dumpage of fluid cinder, the floor constructed of two or more parts, having a central thickened end projection as bumpers thereon, provided with fulcrum ears R^2 beneath the face, oscillating upon a pin R^3, and hinge ears S^1 at the rear end of the car on the face of the floor, in combination with the box O O^1, of the form shown, and provided with hinge ears P P, mating the hinge S^1, a pintle S^2, common thereto, and trunnions Q, whereby the same is adapted to be raised at an angle with the

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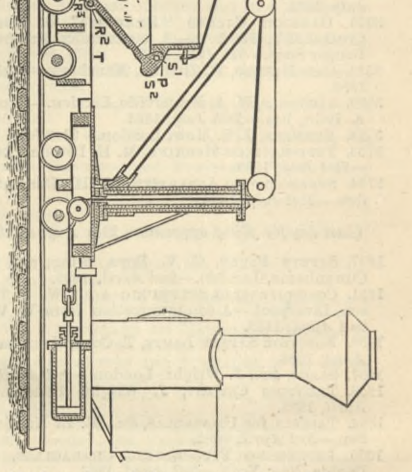

track, the box clear of the car contents and the same at liberty to slide therefrom, substantially as shown and for the purpose specified. (2) In a cinder car for carrying fluid cinder, a movable connected top box of truncated form, its four sides of taper section rigidly combined or cast as a whole, in combination with a suitably arranged hoist acting on trunnions Q, and connected with the floor S R S by the ears P, mating with floor ears S^1, a pintle S^2, common to both, the floor, as described, fulcrumed on the truck T by ears R^2, and pin R^3, the whole arranged to operate as and for the purpose set forth.

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