THE MANCHESTER JUBILEE EXHIBITION.

ON Tuesday last this Exhibition was opened by their Royal Highnesses the Prince and Princess of Wales, under favourable auspices. The day opened with drizzling rain, and the public began to make up their minds for a dull, wet day, sloppy streets, and dripping decorations. Before ten o'clock, however, happily the rain had ceased, and from that hour the day continued fine and dry overhead. By the time the Royal party reached the Exhibition from Tatton Park, the residence of Lord Egerton, the interior of the building presented a brilliant appearance. So far as the eye could reach every exhibit appeared to be complete and in its place. This state of preparedness is no doubt mainly due to the energy and experience of Mr. Lee Bapty, the manager, who, it may be remembered, acted in a similar capacity at the Liverpool Exhibition last year, when he must have acquired an extensive experience of the numberless small matters that go so far to make or mar the success of an undertaking of this character. There may doubtless be many not very prominent features which are not yet complete; but to all intents and purposes the Exhibition is finished. The managing committee, who set themselves the task of completing the undertaking by the day fixed for opening, have sustained their energy from the first up to the present time, and have kept faith with the guarantors and the public.

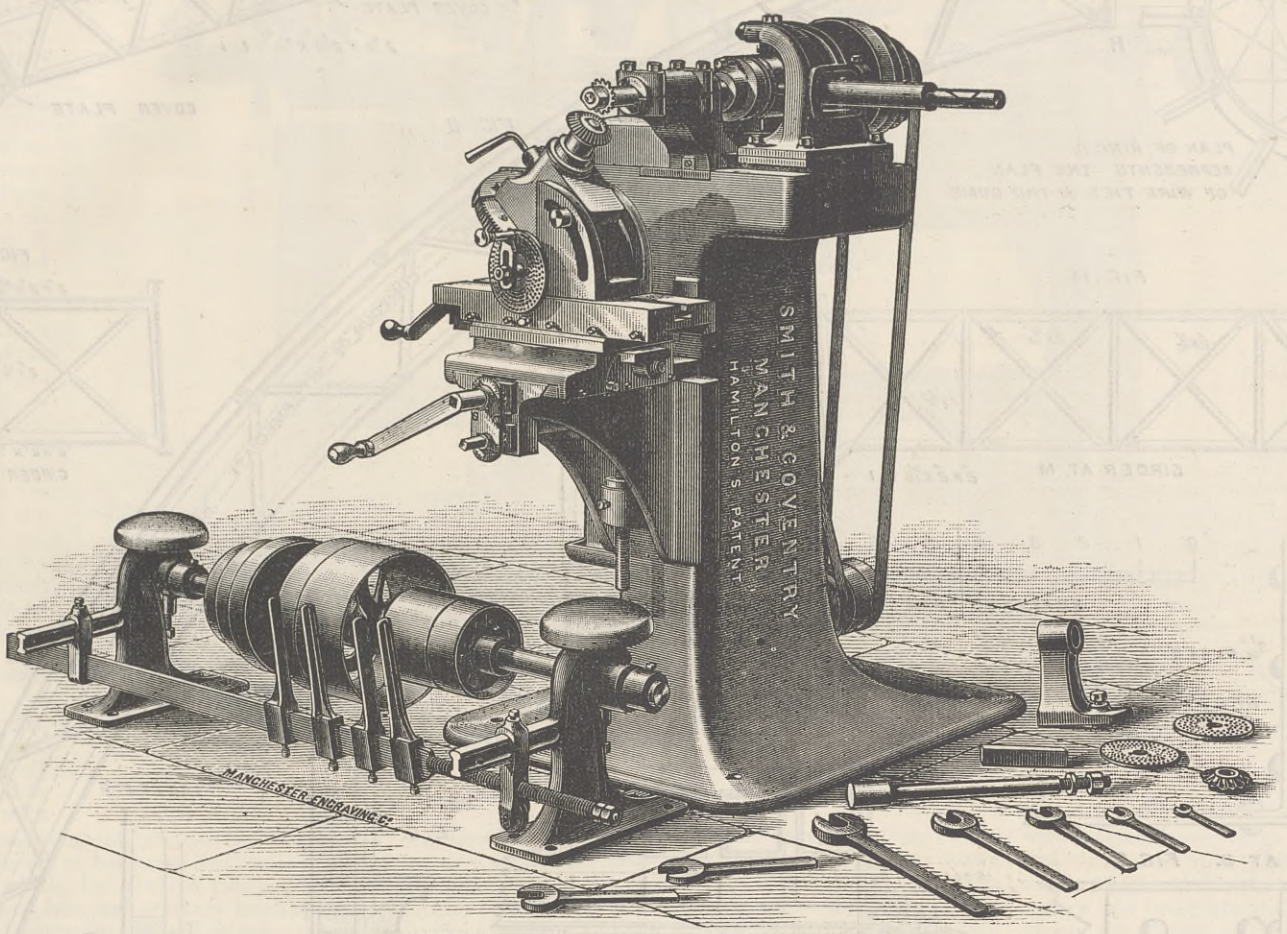
In many respects, as we have already pointed out, the Exhibition is superior, not only in extent, but in variety, to anything that has been seen in England for several years. All the conditions are favourable to its success, for it possesses those elements of attraction which have been found so popular in London, inasmuch as it closely adjoins the Botanic Gardens, and as these will be thrown open to the visitors, it will be easy to provide open-air attractions of no common order of merit. The experience obtained in London is being utilised to the best advantage, and the results ought to be all that the promoters of the enterprise can desire. The electric lighting arrangements are admirable, and the illuminated fountains in the gardens will no doubt charm a host of sightseers. As we have already explained, they will be worked on a simplified and improved system. The structures representing "Old Manchester and Salford" are on a scale which relegates even "Old London" to a second place. They are full of interest, and if care be taken that the visitor can see these old houses, gate-ways, towers, and market crosses, without being pestered to buy articles wholly incongruous to the surroundings, they cannot fail to prove instructive and attractive.

It is too soon yet to speak in detail of those portions of the Exhibition with which it is our special province to deal, but we may say that the contents of the great machinery gallery fully maintain not only the reputation of Manchester, but of England. Never, since 1862, has anything like the display of textile machinery been seen within our shores. It will be well, however, to say here at once that in steam machinery and machine tools there are no startling novelties for our readers. The exhibits represent the normal work of Manchester and the district surrounding it, and we most certainly have not done our duty by our readers in past years if we have not kept them pretty well informed concerning the latest developments of steam machinery and machine tools in Manchester, Leeds, Bolton, &c. &c. The word "novel" is, however, after all, a term of comparison. Thus, for example, the engines employed by Messrs. Galloway in producing the electric light are identical in all respects with those quite new in design and in fact, last year which were employed for a similar purpose at South Kensington. One point which will at once strike the visitor is the extended and extending use of rope gearing instead of toothed gear or belts in the Manchester district. It is not too much to say that the days of cogged main driving gear are ended. The rope-driving system lends itself admirably to cotton mill purposes. These mills rise floor above floor to great heights. The engine in the basement is provided with a many grooved fly-wheel, and from this endless ropes are led to each floor, the number being proportioned to the power required in each storey. The extent to which the system is pushed may be imagined when we say that Messrs. Hicks and Co., of Bolton, not very long since sent out to India a compound engine capable of indicating over 2000-horse power. The fly-wheel was grooved for thirty-six ropes, and weighed complete 120 tons. The power transmitted by each rope under ordinary circumstances varies with the practice of different makers, but it may be assumed that 40-horse power indicated can be safely transmitted with one rope, and so popular and flexible is the system that small engines can now be seen using only three ropes, and constituting a notable contrast to the monster machines to which we have referred above.

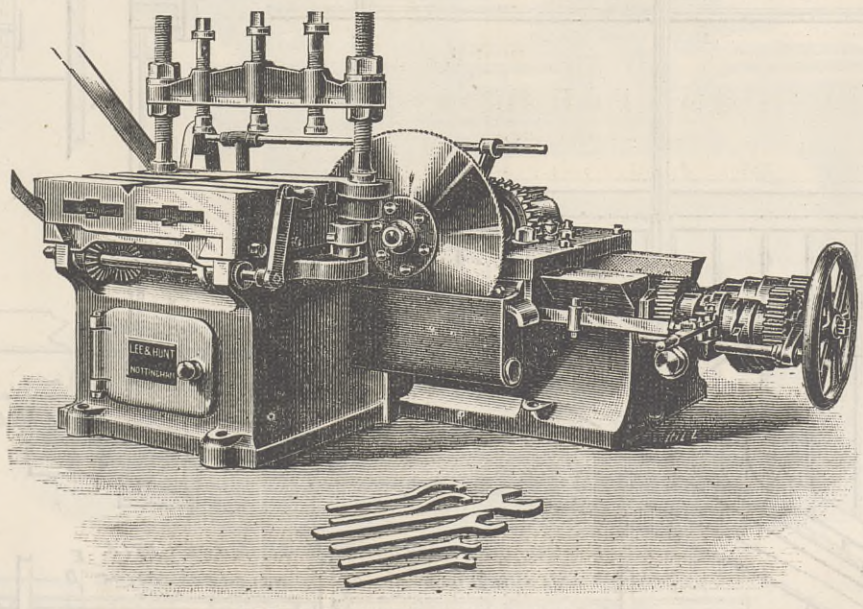
The main building of the Exhibition claims the special attention of all who are interested in iron structures. It is a remarkable example of the adaptation of means to an end. The building is in the nature of things to be temporary. Hitherto exhibition buildings, such as those at Liverpool and Edinburgh last year, and that at Newcastle-on-Tyne this year, have been usually constructed principally of wood. The disastrous experience obtained last year at Liverpool has, however, borne good fruit, and the Manchester building will probably serve as an illustration of what to imitate, to as great an extent as the Liverpool building taught the world what to avoid. The profane already call the Manchester Exhibition "The Piperies." The whole structure is built up of pipes and tubes in a most ingenious way, and as this is the first structure of the kind made on anything like so large a scale, we describe and illustrate it in detail.

We are indebted to the architects of the building, Messrs. Maxwell and Tuke, for the working drawings of the roofing, which are shown on pp. 346 and 351. As they give evidence of considerable skill and economy of construction, they will doubtless be interesting, and will be referred to in detail hereafter.

The principal building consists of a nave or main avenue, 1000ft. long, crossed at the middle point by transepts, surmounted by a graceful dome, which is finished above by a well-proportioned lantern. Near to the ends of the nave are situated two pavilions, which rise to a considerable height above the nave roof, making with the dome a pleasing sky line, not usually found in exhibition buildings. The interior of the building when viewed from one end presents a very satisfactory vista. The nave has a total width of 100ft., but as the sides are partitioned off to form rows for the display of furniture and other matters, the visible width of the main avenue is only 60ft. The dome is 90ft. in diameter, and is supported, as, indeed, is most of the roof covering, by slender, clustered iron columns. The approach avenue from the royal entrance in Old Trafford-road forms a most imposing corridor. It is 600ft. long, and is covered in for its entire extent. There is a broad causeway down the centre, and on each side there is a wide margin planted with exotic ferns, palms, and other foliage plants, which, as a whole, presents a feature that for luxuriance of vegetation is almost unique. This covered road is lighted after dark by electric arc lights with excellent effect. Both north and south of the main building there is a vast covered area of ground, where the aim has been to afford protection for machinery and other exhibits rather than to satisfy the eye by architectural effect. A special area of large extent has been devoted on the north side of the nave to the Irish section, which is well filled with exhibits of various kinds, some of which will be referred to in a future notice, but almost all of such a character as to show great excellence of workmanship and design. The large annexe on the south side of the main building is almost wholly occupied by machinery at rest and in motion. This area is separated from the main building by Talbot-road, across which is carried a footbridge of 70ft. span, which is used by all visitors arriving by rail at the Exhibition station. In addition to the Botanic Gardens, there is a considerable area available for open-air recreation. This ground is situated for the most part near Talbot-road, and it contains detached buildings, notably a creamery, conservatories, billiard-room and smoking-room. The proximity of the Botanic Gardens, as a matter of course, suggested the provision of all the accessories which made the Fisheries and the other recent exhibitions at South Kensington so enjoyable as a summer resort. The grounds have been rearranged to a great extent. A wide promenade has been formed, with a band stand at each end, and, as we have said, a magnificent fountain has been provided for display with electric light.



HAMILTON'S BEVEL WHEEL CUTTING MACHINE



LEE AND HUNT'S SAWING MACHINE.

The roofs of the Exhibition building contain several features of a novel kind. The architects have shown considerable ingenuity in using those forms and sections of iron that are commonly found in the market; by doing so the delay consequent upon the adoption of special designs has been avoided, for with the exception of some small castings of a special form, every portion of the roof could be procured in any desired quantity. The adoption of the ordinary forms of iron has, of course, been attended with economy in two respects. The material was doubtless cheaper at first cost, and if the building is to be taken down when its present purpose is served, the greater part of the material will be available for the purposes for which it was originally made.

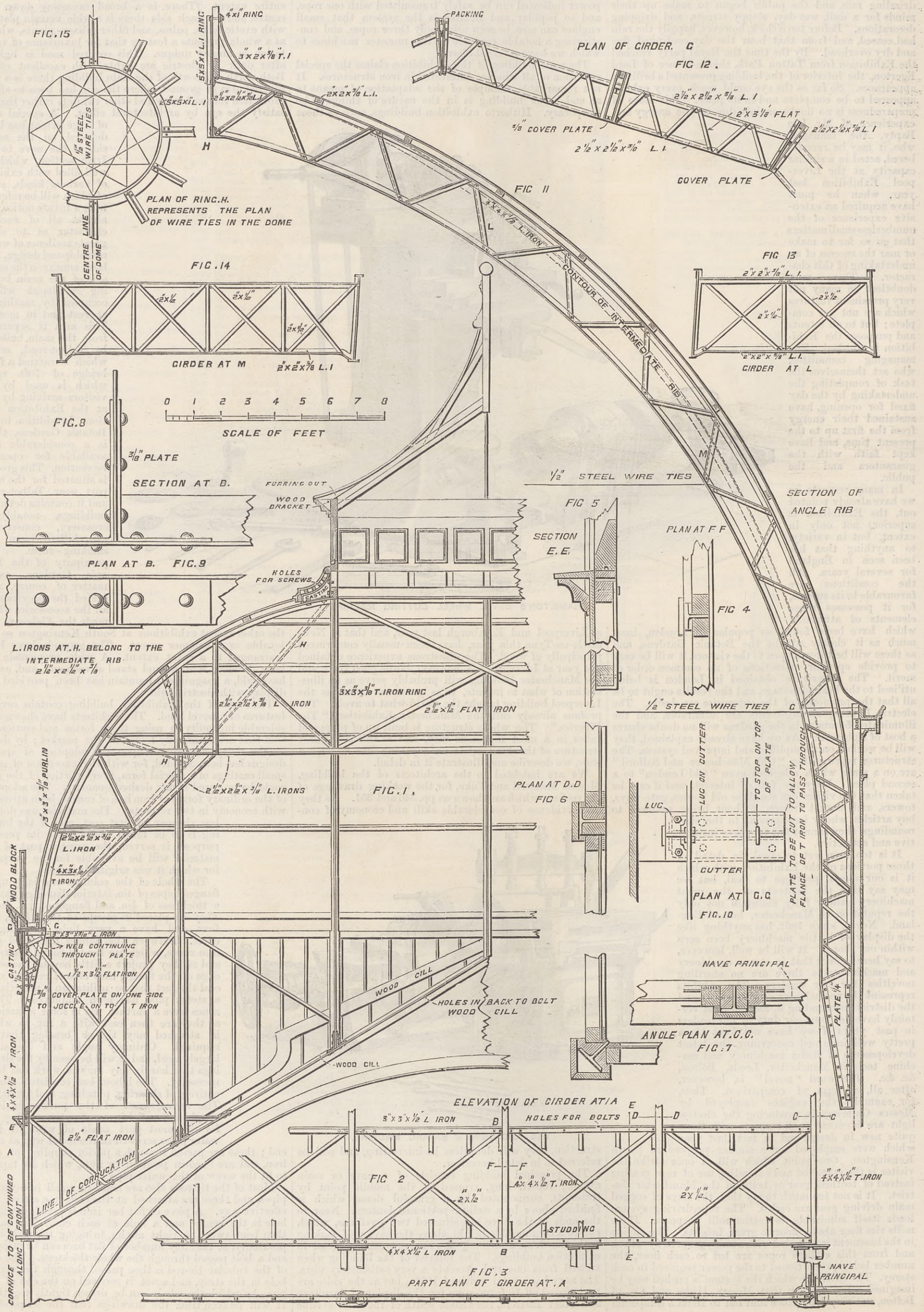
The whole of the columns are built up of flanged pipes of 4in. interior diameter, having a thickness of $\frac{1}{2}$in. and flanges of $\frac{3}{4}$in. faced. They are placed in groups of two, three, and four, and have a very light and elegant effect. Between the flanges are fixed cast iron zones, which are beaded round the edge, and as they project a little beyond the outer edge of the flange, they almost entirely conceal the fact that so utilitarian a material as a steam pipe has been employed. These zones have a further use in some situations, as they are then cast with a lug, to which is attached any tie or bracing that is required. Ordinary angle and T-iron is largely used, and it will be seen by the drawings that hardly any smiths' work has been necessary. The labour has consisted almost entirely of shearing, punching, and rivetting. The arrangement of the purlins is both simple and sound in construction. They are for the most part made of wrought iron water pipes screwed in the usual way at each end; these are passed through a purlin coupling of cast iron, and are fixed in position by nuts, which are tapped to fit the screw of the water pipe.

Most of the tie-rods also are made of small iron water-pipes, and these are attached at the ends in a simple but effective way. A piece of flat bar iron is punched with a hole in the centre and a hole at each end. The bar is then bent twice at right angles, bringing the ends into proximity, so that any number of flat bars can be gripped and a bolt passed through the whole thickness. The end of the tubular tie-rod is then passed through the centre hole in the strap, and a nut is screwed on the end of the pipe, by which the whole can be drawn tightly together It will be seen from the drawings that the suspending

THE MANCHESTER EXHIBITION BUILDINGS.—DETAILS OF DOME.

MESSRS. MAXWELL AND TUKE, MANCHESTER, ARCHITECTS.

(*For description see page 345.*)



rods are also made of drawn tubes, and are attached to the tie-rods by ordinary T pieces or junctions. The clustered columns are secured to the brick foundation by being bolted down to a cast iron bed plate of 1¼in. thick. The heads of the bolts are countersunk, so as to ensure a uniform bearing on the brickwork, and the bed plates are secured by holding-down bolts, which are built into the brickwork.

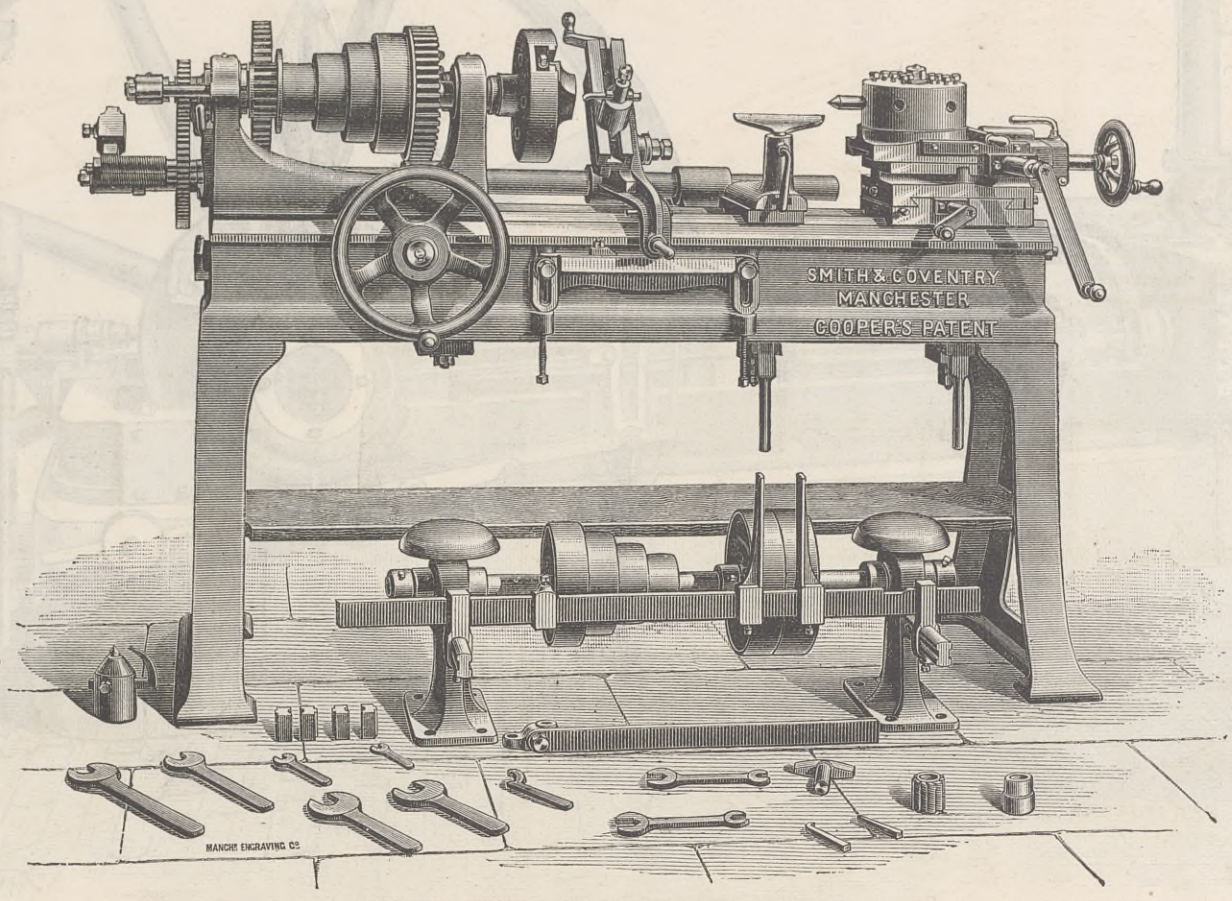
In the roofs of the low main buildings, not only are all the members which are in tension made of drawn pipes, but the rafters and purlins are of the same class of material. The struts are of angle iron, and are attached to the purlin couplings by rivets. The shoes of the principals, and what answers for a ridge piece, is made of flat bar iron punched and formed to a suitable shape to receive the ends of the pipes which are attached with nuts, as above described, for the tie rods. The dome, which is twelve-sided in plan, is of graceful form, and is very light in construction. Each rib is made up of two T irons, which are tied together by ordinary diagonal bracing of angle iron 2in. × 2in. × ⅜, each having a single rivet at each end. No pipes have been employed in this part of the structure, but the necessary ties are of steel wire rope, which is so light as to be hardly visible from the floor of the building. There are two complete sets of tie wires which cross the dome horizontally, but diagonally as shown on the plan of the lantern, touching each other as they pass.

The buildings are, with very few exceptions, covered with corrugated iron, and no other material is used with it, except in the music-room at the eastern end of the building, where the inside of both roof and walls is lined with thin boarding, which, for obvious reasons, is more suitable than galvanised iron and ordinary brickwork.

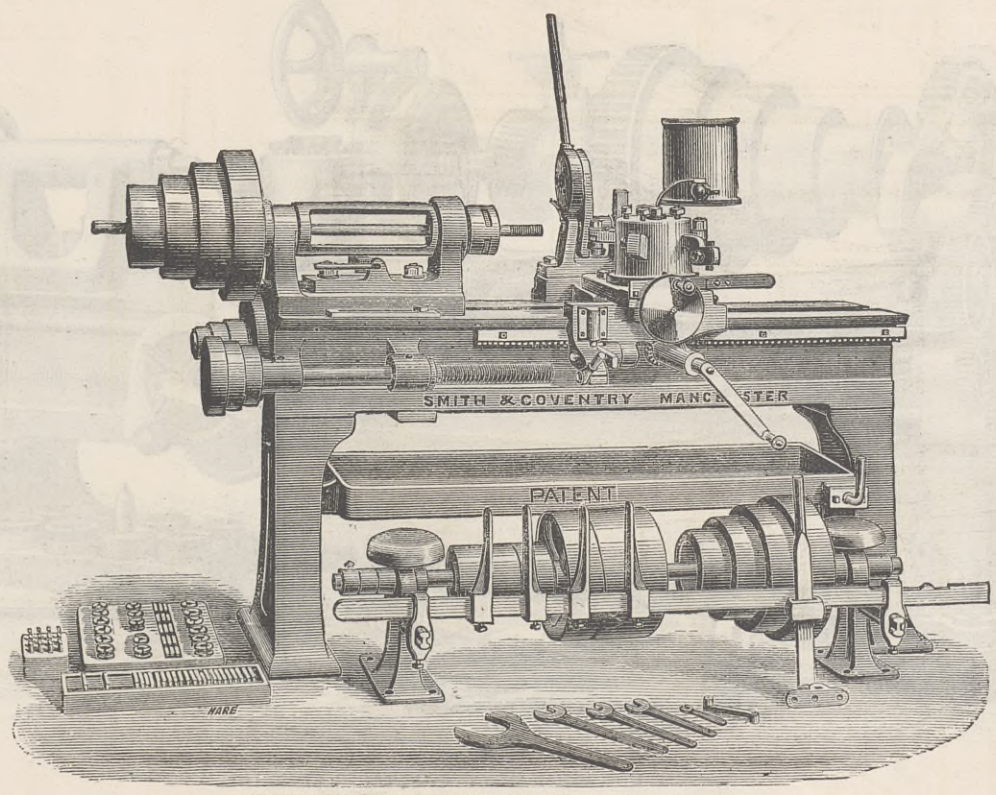
The Exhibition buildings are situated at some distance from the centre of the city, but there are ample facilities provided for reaching it by both road and rail. The principal, or as it is called, the Royal entrance, is in Chester-road, a few yards from the gates of the Botanic Gardens. The Exhibition is divided into two sections by Chester-road, a thoroughfare 70ft. wide; on the north side is the main building, on the south the great machinery hall 510ft. long and 210ft. wide. This will be devoted to machinery in motion; opening off it, still to the south, is an annexe 180ft. square for machinery at rest. The entire building is, as we have already stated, lighted by electricity. The contract for the whole of the arc lighting has been placed with the Anglo-American Brush Electric Light Corporation; the total number of lamps employed is 546, exclusive of those required for the private use of exhibitors. All the lamps are of the Brush standard pattern, working with a current of 10 ampères, and are maintained by twenty-six dynamos inclusive of spare machines; the engines employed to drive the dynamos are by Messrs. Robey, Hornsby, Davey Paxman, Ruston Proctor, and Yates, and are arranged to suit the requirements of the several circuits as nearly as possible. The types of the machines employed, and the lamps fed by each, are:—No. 8, 35 lamps; No. 7L, 25 lamps; No. 7, 15 lamps; so that in the event of failure of any of the dynamos a combination of fifty lamps may be easily formed for temporary purposes, thus—two No. 7L, 50 lamps; one No. 8, one No. 7 = 50 lamps.

At the Colonial Exhibition there was no failure of a Brush dynamo during the whole run from May to November. But as accidents may happen even with the most perfect system and apparatus, the above arrangement has been adopted to reduce the risk of failure to a minimum. The conductors are carried entirely on porcelain insulators, and are also as well insulated as though they were to be laid underground or fixed direct to the ironwork of the buildings. The arrangement of lamps and machinery has been designed by Mr. Bryson, who carried out the electrical work of the Edinburgh Exhibition with great success, and has assisted the contractors with his advice and support. It is claimed that owing to his thorough knowledge of the requirements of industrial exhibitions that the Manchester Jubilee Exhibition will have not only the most perfect illumination, but also the most scientifically installed system of electric lighting that has been produced up to the present time.

The whole of the lighting plant is established in the west end of the machinery-in-motion hall. It is here that the great battery of Galloway boilers, to which reference has already been made in our columns, is installed. These boilers supply steam not only to the electric light engines, but for general purposes throughout the Exhibition. The engines and dynamos are arranged in three sets close to the boilers. One set consists of seven dynamos driven by a large compound engine by Messrs. Yates, of Blackburn, which we shall illustrate in an early impression. The fly-wheel is grooved, and drives by ropes an overhead countershaft. At one side of the central driven pulley on this shaft, are three belt pulleys, driving as many dynamos, one on the engine side of the shaft, the others on the opposite side. The other end of the countershaft carries four belt pulleys driving as many dynamos, two before and two behind the shaft. Arranged at right angles to this installation are eight steam engines. Beginning at the boiler-house end are a very powerful pair of inverted engines by Messrs. Mather and Platt, of Salford. These we shall illustrate in an early impression, and therefore reserve our description. These engines have double fly-wheels of great breadth, which carry four driving bands, actuating as many dynamos. Close by is a pair of high speed vertical compound engines by Messrs. Davey Paxman, and Co., of Colchester, similar to a pair shown last year at the Colonial Exhibition, where they attracted a great deal of attention because of the solidity of their build, the excellence of their workmanship and design, and the smoothness of their working. Next comes a double-cylinder compound by Messrs. Robey and Co., with Proel's gear, similar in all respects to that which has already been illustrated in our pages. This engine drives four dynamos for the Manchester and District Edison Electric Light Company, which will supply current for incandescent lamps. The next engine is a compound of beautiful finish, by Messrs. Ruston, Proctor, and Co., of Lincoln. This engine can be fitted with a condenser; but the condenser has been removed, as there is no water available. We illustrate the engine on page 348.



COOPER'S TURRET LATHE FOR BRASS FINISHING.



OPEN SPINDLE CAPSTAN REST CHASING LATHE.

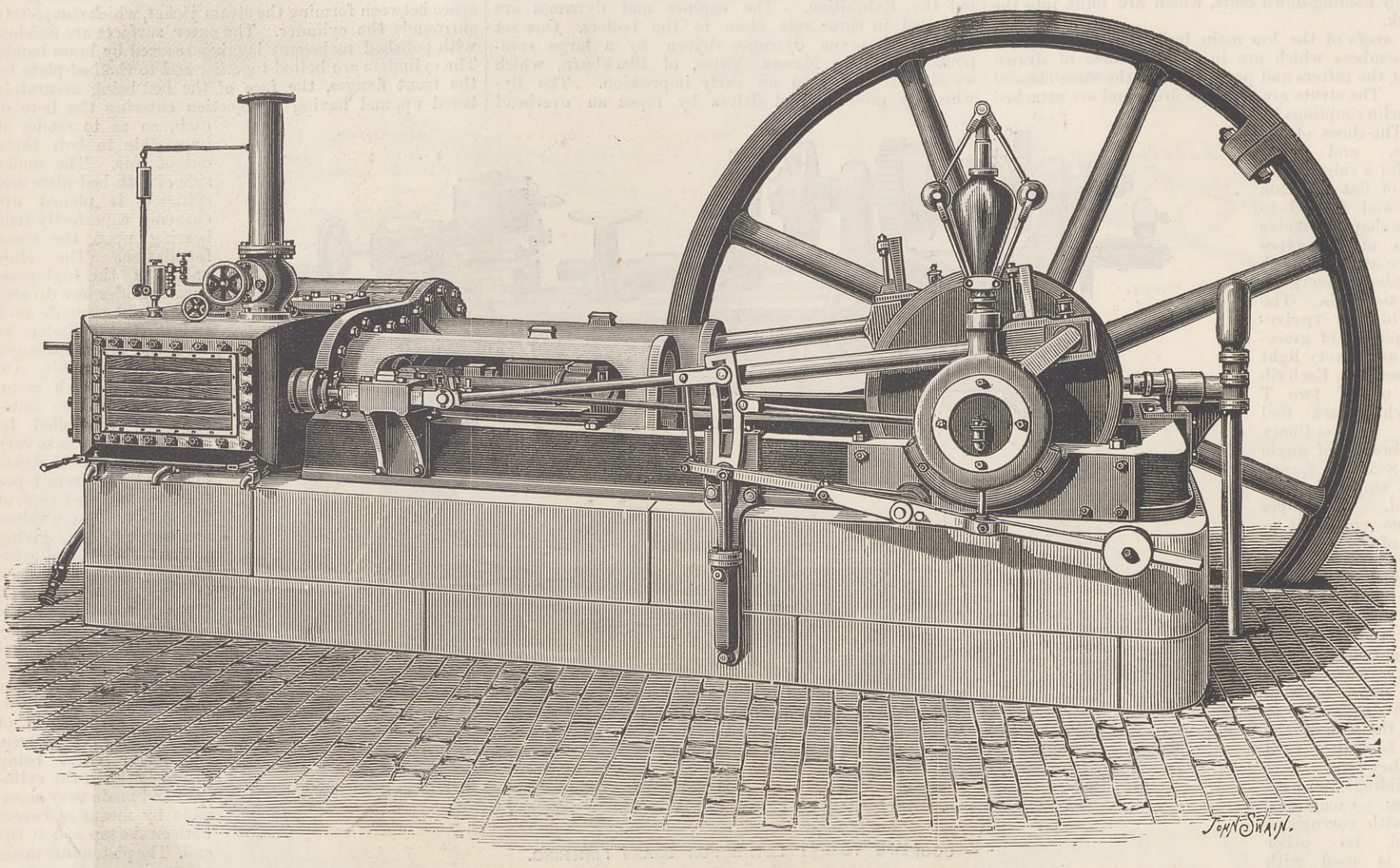
The cylinders are respectively 14in. diameter and 24in. diameter, with 32in. stroke. The working barrel of the high-pressure cylinder is cast separately of specially selected hard metal and forced into the main casting, the space between forming the steam jacket, which completely surrounds the cylinder. The outer surfaces are finished with polished mahogany lagging secured by brass bands. The cylinders are bolted together and to the bed-plate by the front flanges, the face of the bed being accurately trued up, and having a projection entering the bore of each, so as to render it impossible to bolt them out of line. The under side of both bed-plate and cylinders is planed up, ensuring a perfectly true bearing upon the stone foundation. The slide valves of the high-pressure cylinder are divided and placed towards each end of the cylinder, to keep the steam passages as short as possible. On the back of each is an expansion valve automatically controlled by the governor, so as to vary the admission of the steam to the cylinder from 1 per cent. up to 60 per cent. of the stroke. These valves are treble-ported, giving a smart cut-off, and actuated by expansion gear of the rocking slot-link type; the link and die are of steel, and driven by a separate excentric, and the whole construction being simple and durable. The slide valve to the low-pressure cylinder is of the ordinary D pattern, the steam chest being placed between the cylinders and made very accessible by means of covers both on the top and at the end. The pistons are made on an improved system, with internal spring rings, bored taper and secured by nuts and cotters to steel piston rods. The crossheads are of the box pattern of cast steel. The slide bars are circular, cast on the bed-plate and bored out by the same bar by which the flange of the bed-plate is faced for the cylinders, thus ensuring the guides and cylinders being absolutely in line. The slide blocks are of cast iron, with large wearing surfaces, and made adjustable. The connecting-rods are of wrought iron turned up bright, fitted with brasses at both ends, with strap, gib, and cotter at the large end, the small end brass being let into an eye in the rod and adjusted by a cotter. The length between the centres is two and a-half times the stroke of the engine. The slide rods are of steel, and work in large square cast iron guides, with large case-hardened pins. The excentric rods are of wrought iron turned bright, and fitted to straps with a T-foot and two bolts to each; the other ends are fitted with brasses and cotters to take up the wear. The excentric straps are of cast iron, extra wide, with solid oil-cups. The sheaves are keyed on to the crank shaft with sunk keys, and key-beds arranged so that the sheaves can be easily turned to run the engine in the opposite direction. The feed-pump is bolted to the end of the bed-plate, and driven by a separate excentric. The governor is of the "Porter" high-speed type, sensitive in action, connected directly to the expansion gear of the high-pressure cylinder, and driven by gearing. The crank shaft is of steel, forged solid, for the low-pressure cylinder, and for the high-pressure cylinder has a cast iron polished disc forced on the end by hydraulic pressure, and secured with a key. The accurately fitted steel crank pin is firmly rivetted in place. The centres of the cranks are 3ft., and the shaft is 8in. diameter in the bearings. The pedestals are cast on the bed-plate, the brasses in three pieces, fitted with wedge adjustments both horizontally and vertically. The caps are planed out to fit over the tops of the horns, and each secured by four bolts. The fly-wheel is 12ft. 2in. diameter by 15ft. wide on the face, of heavy pattern, turned to take the belt, and keyed on to shaft. The revolutions per minute are seventy. The bed-plate is of the strongest girder pattern, made extra deep. The pedestals and slide bars are cast on, and the cylinders bolted to the end as described; the centre of the engine being placed as low down as possible. The engine will indicate 120-horse power with 90 lb. boiler pressure, and will work up to 150 indicated horse-power.

This engine drives three dynamos for the Edison Company, of which more presently. Beside it is a compound engine of much the same size by Messrs. Hornsby and Sons, Grantham, driving two large and two

THE MANCHESTER EXHIBITION.—COMPOUND ENGINE.

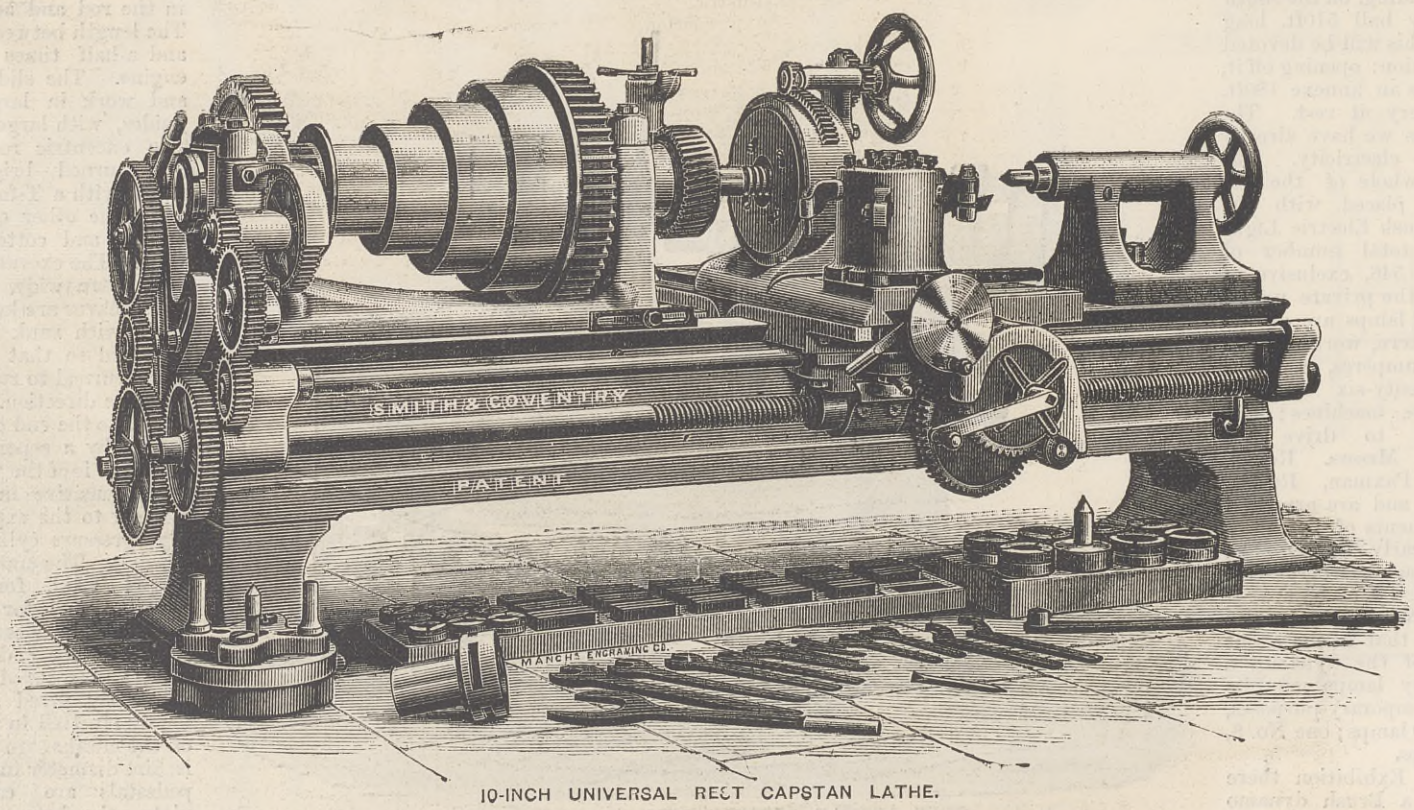
MESSRS. RUSTON, PROCTOR, AND CO. LINCOLN ENGINEERS.

(*For description see page* 347.)



small dynamos for the Brush Company. Next comes a double-cylinder twin engine, non-compound, by Messrs. Robey, of Lincoln, driving two large and two small dynamos for the Brush Company. Next to it is a Hornsby twin engine, also driving two large and two small Brush dynamos. The last engine in the house is a girder type single cylinder Robey, driving one large and three small dynamos. It is worth adding that nearly nine miles of wire leads are used in connection with the 4000 incandescent lamps. These have been supplied by Messrs. Walter T. Glover and Co., of Salford, the weight of copper used being close on ten tons. It will be understood that Messrs. Galloway's installation for lighting the gardens and fountains, as described in our last impression, is quite independent of the installation with which we have just been dealing.

The Manchester and District Edison Electric Light Company, which has been established in Manchester for more than five years, was entrusted with the carrying out of the work for lighting certain portions of the building with about 3000 incandescent lamps. The plan adopted by the executive, under the advice and guidance of Mr. William A. Bryson, electrician to the Exhibition—who occupied a similar position at Edinburgh last year—was to divide the incandescent lighting into three sections—first, the fine art galleries, consisting of a series of splendid rooms, with a total of 1620 lamps; next, the palm house of the Botanical Gardens, to be used as a series of dining rooms, with 750 lamps; and lastly, the various quaint buildings, shops, and houses forming the unique representation of "Old Manchester and Salford," with about 600 lamps, thus making a total of over 3000 incandescent lamps. The fine art galleries, which are built of brick and fireproof, contain a collection of pictures valued at £2,000,000, covered by insurance. Every precaution has been adopted in carrying out this important section of the installation, and the arrangements have received the sanction of the insurance offices upon the reports received from Mr. Musgrave Heaphy, C.E., of the Phœnix office, who was deputed by the various offices interested to examine the installations. These galleries consist of fourteen rooms in all, each being of the same width, but five being of slightly greater length, containing nine principals for supporting the roof, instead of seven, as in the others. Of these latter rooms, the two next the larger rooms are without a partition and form a double room. The lamps are suspended from a neat casing, which is attached to and under each principal in such a manner as not to be unsightly. There are fifteen incandescent lamps attached to each principal at a height of about 18ft. from the floor, so that in the larger rooms there are 135 lamps in each, and in the small rooms 105 lamps. These lamps are of the type known as the Edison-Swan, with the well-known Swan curled filament; they are of 16-candle power, and require a current of 0·6 ampère with an electro-motive force of 100 to 104 volts. They are fitted into brass sockets of a special form, and above each lamp is a 5in. opal shade, which is effective in reflecting the light and preventing its being wasted upwards. Each lamp is attached in the ordinary way to branch wires of the ordinary size; these again are connected to the large subsidiary mains which run on each side the length of the rooms. These subsidiary main cables are passed through the walls of the galleries, where they are joined on to the heavy main cables which are brought from the dynamos. Within the rooms, and also outside, are placed numerous safety fuses and cut-outs, so that any excess of current beyond a certain point will be prevented from doing any harm. From the dynamo switch board there are carried four pairs of main cables of large conducting area to the fine art galleries. Two pairs of these run to the extreme end of the galleries—a distance of 360 yards—and feed the farther portion of the rooms, whilst the two other pairs of cables, feeding the first portion only, go to the middle of the galleries—a distance of 280 yards. The mains are placed underneath the flooring of the Exhibition, until they arrive at the corner of the galleries in the east nave, where they are carried up and along the external brickwork of the galleries, being carefully secured. Each room throughout the galleries is connected with two of the circuits, so that the lighting of each alternate principal is from a different main. In the event of any dynamo breaking down or anything happening to any one circuit, the result would be to diminish

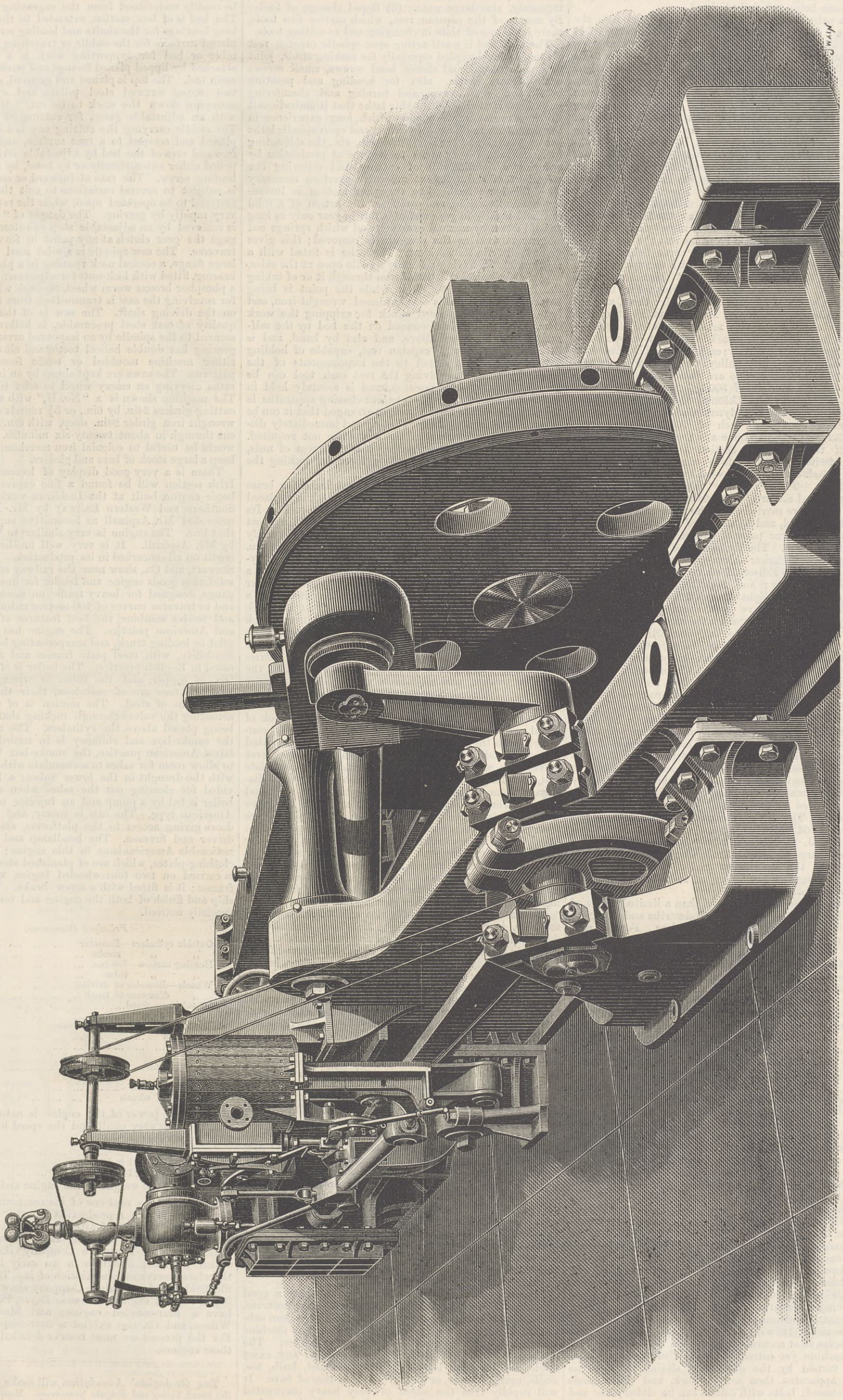


10-INCH UNIVERSAL RECT CAPSTAN LATHE.

ROLLING MILL ENGINE, NEWPORT MILLS, MIDDLESBROUGH.

MR. J. HEAD, M. INST. C.E., ENGINEER.

(*For description see page 360.*)



the number of lights by one-half, the alternate principals in the rooms being left fully lighted.

In the palm house, which has been altered into the "Victoria" dining-room, a very brilliant and pretty effect has been obtained. Hanging from the roof are numerous lamps, and amongst the foliage and ferns are others to be seen, whilst the general effect is that of a soft clear light on the dining-tables without offence to the eyes. There are three pairs of main cables from the dynamo house to this section, a distance of over 400 yards, and running alongside them and carried further to a total distance of about one quarter of a mile from the dynamos are three more pairs of main cables, which light up "Old Manchester and Salford." From a mast 100ft. high two arc lamps (worked on the incandescent circuit) are fixed, in order to give a moonlight effect to the various streets of the old city.

The various dynamos, which are utilised for producing the current required for illuminating the 3000 incandescent lamps, are placed, as we have already explained, in that portion of the dynamo room nearest the machinery annexe, and are eleven in number, three being used in connection with the art galleries, with one spare, five in the Victoria dining-rooms and "Old Manchester and Salford," and two spare. The four dynamos in the fine arts section, and the engines which drive them, are lent to the Exhibition by Messrs. Mather and Platt, of Salford. The engines are two massive vertical engines—ultimately intended for their works at Salford—mounted together but working separately; each fly-wheel has two short belts, driving with jockey pulleys two dynamos. In connection with the first engine are two Edison-Hopkinson dynamos—shunt wound—of 500 lights each, which were in use at the Indian and Colonial Exbipition last year. The second drives two new dynamos of the "Manchester" type, compound wound, each of 700-light capacity—400 ampères. These dynamos are connected to the main cables of the fine arts section through a fine and massive switch-board, which controls the various circuits. Each circuit is protected by an automatic magnetic cut-out. The "Victoria" dining rooms and "Old Manchester and Salford "sections are divided into three circuits, which are carried on to the terminals of a second large switch-board, and by means of sliding contacts are connected with three pairs of dynamos, or any one with the spare dynamo. The dynamos are of different type, one large Elwell-Parker—slow speed—compound wound for 500 lights; two Edison-Hopkinson shunt wound, each of 250-light capacity; and four Edison dynamo shunt wound, each of 250-light capacity. The two Edison-Hopkinson dynamos have been running for the Edison Company at their central station for more than two years. Special interest attaches to the four Edison dynamos, which are of the original type, manufactured by Mr. Edison himself in New York some six years ago. They have been in constant daily work in Manchester lighting the Theatre Royal since December, 1882, and during that time they have not worn out a single pair of brushes, neither has any interruption occurred to them.

The two switch-boards, to which reference has been made, are 52in. by 36in., and are mounted on enamelled slate fixed in a mahogany board. They are provided with an automatic "cut-out" for each circuit, and the connections are massive, with more than sufficient metal to carry the currents used. They have been designed by Mr. J. R. Williamson, and manufactured to his order by Messrs. Charles L. Baker and Company, Cornbrook, Manchester. The entire incandescent installation has been carried out under the personal supervision and direction of Mr. J. R. Williamson, by an able staff of men, under the charge of Mr. H. Taffs, who have had at times to carry out the operations under great difficulties, especially as regards the laying of such long lengths of heavy main cables.

It is too soon to attempt more than a limited notice of the exhibits. In due time we shall describe and illustrate all that is most interesting to our readers. For the present we must be content to notice the exhibits of a few firms. We need scarcely say that machine tools, for which Manchester is famous, are shown in abundance. A very fine display is made by Messrs. Smith and Coventry, of Ordsal-lane, Salford. We illustrate a number of these tools on pp. 345 and 349. First, we have a 10in. universal rest capstan lathe. This lathe has been designed to meet the requirements of marine engineers and others who require to cut square threads quickly. It embodies all the principles and advantages of capstan rest chasing lathes, and is at the same time a complete screw-cutting and sliding lathe, with a hollow spindle so that bars can be passed through, gripped by the cone chuck, turned, pointed, and screw-cut; the thread can be cut with one run up or by two or three cuts according to the finish required; work can also be placed between the centres and operated upon by the chasing apparatus and capstan rest, the lathe being capable of using five tools of varying forms. The chasing apparatus is controlled by the same screw as the capstan rest, and as the latter is brought away from the work after the operation of turning, the chasing apparatus is brought simultaneously into position for chasing, but when not in use it can be run over to the far side of the saddle and disengaged from the screw by a lever provided for the purpose. The spindle of the fast-headstock is case-hardened and ground, with parallel necks running in hard cast iron steps. The saddle is fitted with capstan rest and patent chasing apparatus, guide screw, clasp nut, quick hand traverse and self-acting rack traverse, Clement's driver, cone chuck, set of change wheels, top driving apparatus, and the necessary screw keys. The advantages claimed for this lathe are—(1) Rapidity of production: It will screw-cut large V and square thread bolts most accurately, and more quickly than any other machine yet introduced. (2) Universality: Bolts can be turned by the self-acting sliding motion, the chasing apparatus then set to work, and the threads rapidly chased; bolts with collars can be slided over and the collars turned and the threads chased; bars can be put through the spindle, turned, chased, pointed, and parted off; bolt heads can be turned and chamfered advantageously, also large nuts. (3) Rapid change of tools: By means of the capstan rest, which carries five tools, there is no loss of time in changing and re-setting tools.

The next tool is a self-acting open-spindle capstan rest chasing-lathe, designed especially for making studs, joint pins, countersunk and cheese head screws, small screws with square heads, also for heading and pointing bolts and set screws, and turning and chamfering nuts, &c. It is claimed for this lathe that it embodies all the most recent improvements which long experience in the manufacture of patent chasing and open spindle lathe has suggested, and the latest addition, viz., the self-acting feed, has added very much to its rate of production by ensuring a definite rate of cutting, and relieving the attendant of the constant muscular exertion necessary with the hand feed. The engaging motion is instantaneous in its action, and combines the action of a solid nut held rigidly in gear and of a nut in gear only as long as held down by manual exertion, and which springs out of gear as soon as the pressure is removed; this gives great facility in its working. The lathe is fitted with a fast headstock, having a hollow spindle open at the sides, capable of admitting a bar of iron through it or of taking the head of a bolt within it while the point is being turned. The spindle is case-hardened wrought-iron, and is provided with a coned chuck for gripping the work true. The saddle is traversed on the bed by the self-acting feed described above, and also by hand, and is fitted with a revolving capstan rest, capable of holding five tools of forms suited to the requirements of the work; by simply revolving the rest each tool can be brought quickly into position, and is securely held in position while cutting. The patent chasing apparatus is fixed on the saddle at the back, so arranged that it can be at once fixed in position for chasing and immediately disengaged and swung out of the way when not required. A stop is provided for regulating the thickness of nuts, bolt heads, &c., being turned; a lever for locking the saddle on bed when surfacing.

A third tool is Cooper's patent turret lathe for brass finishing. In this lathe the loose headstock is replaced by a turret rest, which is arranged for six tools. Its special function is the production of brass work in great repetition, the tools employed having to be carefully adapted and set for each change of work. It has 8in. centres, and consists of a strong bed on standards, carrying a double-geared or single-speed fast headstock with a steel spindle, having conical necks carefully ground after hardening. The screw chasing apparatus consists of a tool slide, swinging on a strong steel shaft at the back of the lathe, a lever being keyed on to the fast headstock end of the same shaft carrying a half-nut, which, when the tool slide is brought over, falls into gear with a short guide screw driven from the lathe spindle, and carries the chasing tool forward in correct pitch for chasing the required thread. An adjustable stop secures the exact diameter of thread, and an adjustment is provided for setting the tool half an inch above or below the centre of the work. The turret rest, which is a turned block of metal accurately drilled to carry six tools exactly concentric with the spindle of the fast headstock, is mounted on compound slides with longitudinal and transverse movements, worked by screws and handles as in a slide rest, the longitudinal slide being also arranged to disengage from the screw and move quickly by rack and pinion. The slide can also be set at an angle for taper work, and stops are provided to secure a rapid change from parallel to taper turning. Adjustable stops are also fitted to the lathe to secure an exact repetition of size for both boring and chasing. The turret rest is secured to the bed by an instantaneous locking lever, and is traversed on the bed by a hand wheel and chain. An arrangement can be fitted to the lathe for taper chasing, and for knocking off the chasing tool when chasing into a blind hole.

Messrs. Smith and Coventry also exhibit the beautiful machine, invented by Mr. Tighe Hamilton, and already described in our columns, for cutting bevel wheels. We illustrate and describe it again in its most improved form. It will cut tapered teeth in bevelled wheels whether straight or skew; tapered teeth in spur, crown, and contrate wheels or racks, so that when geared in reverse, any convenient end adjustment of either takes up all shake between them; teeth of ordinary form in spur or worm wheels, with the power of regulating the thickness of the tooth. The machine consists of a hollow body casting, the top being spread out and formed into a slide for carrying the headstock, which has a self-acting traverse and automatic stop motion connected with the overhead gear, whereby the machine is brought to a stand at the end of each cut, remaining in this state until started again by the operator on a fresh tooth. The spindle carrying the cutter has a reciprocating movement, which, by an ingenious arrangement of excentric, decreases as it approaches a certain point, the amount of decrease being regulated at will. It is by this medium that the taper groove in a bevel wheel is cut. A knee bracket carries the table which has longitudinal and transverse slides, the former having an index attached to it by means of which the work to be operated upon can be set exactly under the centre of the cutter. The table is fitted with a universal head, having a hollow spindle so arranged that it can be set to any angle, while the dividing is done by means of a worm and worm wheel, the latter being carefully cut and made in halves, with means provided for taking up wear.

Messrs. Lee and Hunt, of Nottingham, show a good machine for cutting cold iron or steel, which we illustrate. Samples of the work done by this machine have been submitted to us, and we are unable to name any machine which will execute work of a better character. The machine will cut off perfectly square or to any exact angle, and to dead lengths, girder, channel, bulb, tee, angle, round, square, or any irregular section of bars. It will rapidly true the edges of very heavy corrugated plates or square the ends of heavy wrought iron tubes. Perhaps one of the most useful purposes to which it can be applied is slotting out engine cranks. Its construction will be readily understood from the engraving on page 345. The bed is of box section, extended to the ground with long bearings for the shafts and leading screw, and broad planed surfaces for the saddle or travelling carriage. The table or bed for supporting work is a heavy casting attached by lipped planed facings and strong bolts to the main bed. The top is planed and grooved, and fitted with two strong screwed steel pillars and a cross-bar for cramping down the work to be cut. It is also fitted with an adjustable gauge for cutting off exact lengths. The saddle carrying the cutting saw is a strong casting, planed and scraped to a true surface, and fitted to the face and vees of the bed by adjustable strips. It is propelled either automatically or by hand, by means of steel leading screw. The rate of forward or cutting traverse is subject to several variations to suit the resistance of material to be operated upon, while the return is effected very rapidly by gearing. The danger of "over-running" is removed by an adjustable stop to automatically disengage the gear clutch at any point in forward or return traverse. The saw spindle is a solid steel forging with a large flange, a conical neck running in a phosphor bronze bearing, fitted with lock-nuts for adjustment, and carrying a phosphor bronze worm wheel, through which the power for revolving the saw is transmitted from the steel worm on the driving shaft. The saw is of the very highest quality of cast steel procurable, is hollow ground, and secured to the spindle by an improved arrangement. The gearing has double helical teeth, and all the wheels are either machine moulded or made from machine-cut patterns. The saws are kept sharp by an ingenious apparatus carrying an emery wheel to affix to the machine. The machine shown is a "No. H," with a 24in. saw for cutting girders 24in. by 6in., or 5½ rounds or squares. A wrought iron girder 24in. deep, with 6in. flanges, can be cut through in about twenty-six minutes. The machine would be useful to colonial iron merchants who have to keep a large stock of bars and girders.

There is a very good display of locomotives. In the Irish section will be found a fine express four-coupled bogie engine, built at the Inchicore works of the great Southern and Western Railway by Mr. Ivatt, who has succeeded Mr. Aspinall as locomotive superintendent of that line. The engine is very similar to those designed by Mr. Aspinall. It is very well finished, and reflects credit on all concerned in its production. Messrs. Sharp, Stewart, and Co., show near the railway entrance a Consolidation goods engine and tender for lines of one metre gauge, designed for heavy traffic on mountain railways, and to traverse curves of 100 metres radius. The engine and tender combine the best features of both English and American practice. The engine has the American pilot or leading truck, and compensating beams, to secure flexibility, with steel plate frames and attachments, as usual in English practice. The boiler is of steel, the fire-box of copper, and the tubes of wrought iron. The wheel centres are of cast iron, their tires, axles, and crank pins of steel. The motion is of the link type, actuating the valves through rocking shafts, the valves being placed above the cylinders. The arrangement of the smoke-box and chimney is in accordance with the latest American practice, the smoke-box being extended to allow room for ashes to accumulate without interfering with the draught in the lower tubes; a hopper is provided for clearing out the ashes when standing. The boiler is fed by a pump and an injector of the builders' American type. The cab is roomy, and provided with doors giving access to the platforms, and seats for the driver and fireman. The headlamp and cowcatcher are noticeable Americanisms in this engine; also the boiler clothing-plates, which are of planished steel. The tender is carried on two four-wheeled bogies, with steel-plate frames; it is fitted with a screw brake. The workmanship and finish of both the engine and tender should be specially noticed.

Principal Dimensions.

Outside cylinders—diameter	15¼in.
,, ,, stroke	18in.
Heating surface—fire-box	66 sq. ft.
,, ,, tubes	681 sq. ft.
Wheels—diameter of driving	3ft. 0in.
,, diameter of truck	2ft. 2in.
Wheel-base—fixed	11ft. 6in.
,, total	17ft. 8in.
Weight of engine in working order:	
On drivers	24 tons.
On truck	3¾ ,,
Total	27¾ tons.
Tender:	
Capacity of tank	1400 gals.
Diameter of wheels	2ft. 2in.

The tractive power of the engine is naturally high, the wheels being very small, and the speed low. The calculated duties are:—

On a level	1200 tons.
On an incline of 1 in 100	330 ,,
,, ,, 1 in 50	175 ,,

Exclusive of the weight of the engine and tender.

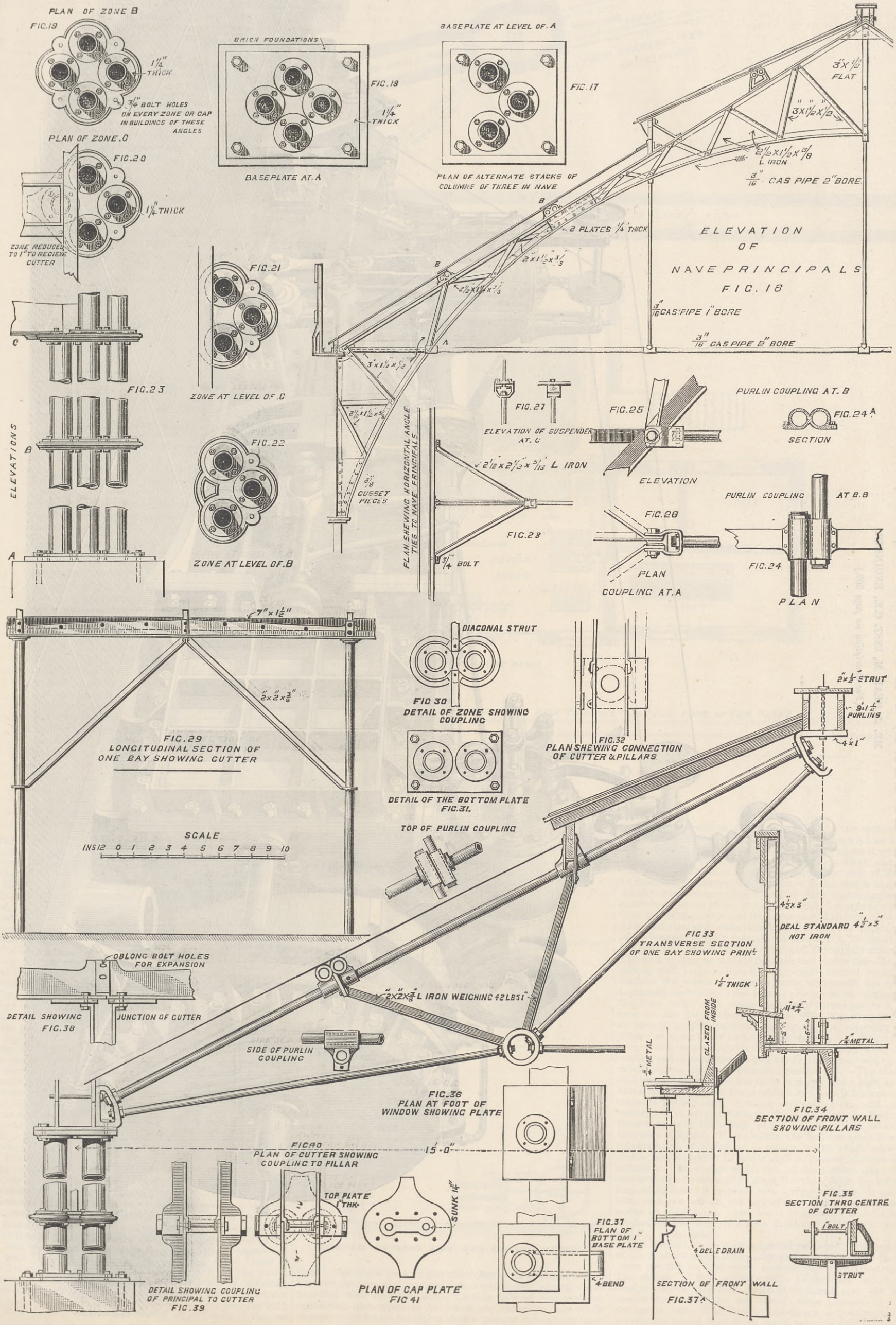
Mr. Webb has sent one of his compound engines, and beside it is the reproduction of the Rocket, which attracted a good deal of attention at Liverpool last year, and was illustrated not long since in our pages. The Lancashire and Yorkshire Company show an engine which we shall illustrate in an early impression, and therefore reserve our description of it. The Manchester, Sheffield, and Lincolnshire Company show a four-coupled bogie express engine. Messrs. Beyer, Peacock, and Co. have a four-coupled engine; and Messrs. Nasmyth, Wilson, and Co. also exhibit a four-coupled locomotive. For the present we must reserve detailed descriptions of these engines.

The Geologists' Association will make an excursion to the Brent Valley and Reigate to-morrow. Members will assemble at Neasden Station at 3 o'clock, and will proceed thence under the direction of Mr. J. Logan Lobley, F.G.S.

THE MANCHESTER EXHIBITION BUILDINGS.

MESSRS. MAXWELL AND TUKE, MANCHESTER, ARCHITECTS.

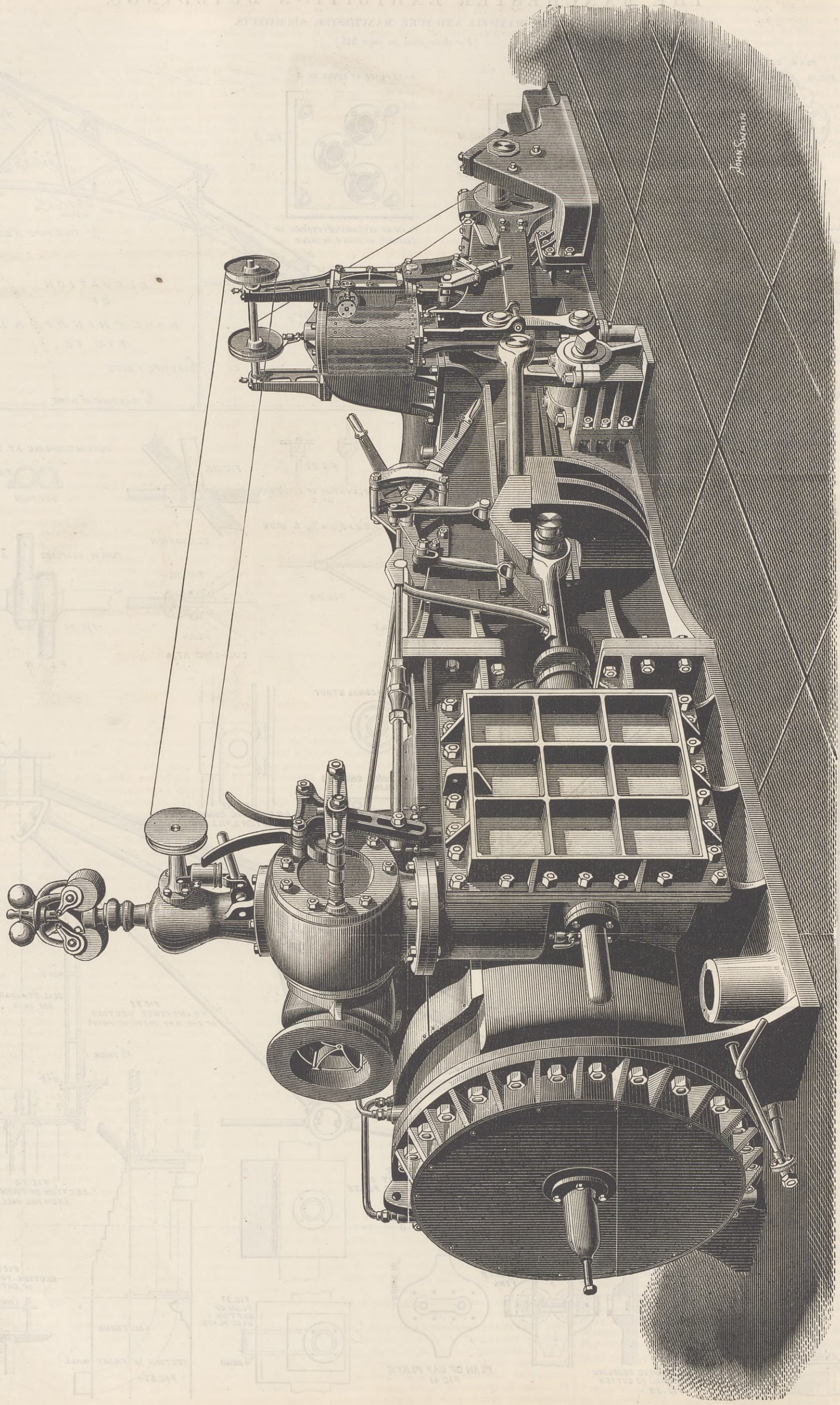
(*For description see page* 345.)



ROLLING MILL ENGINE, NEWPORT MILLS, MIDDLESBROUGH

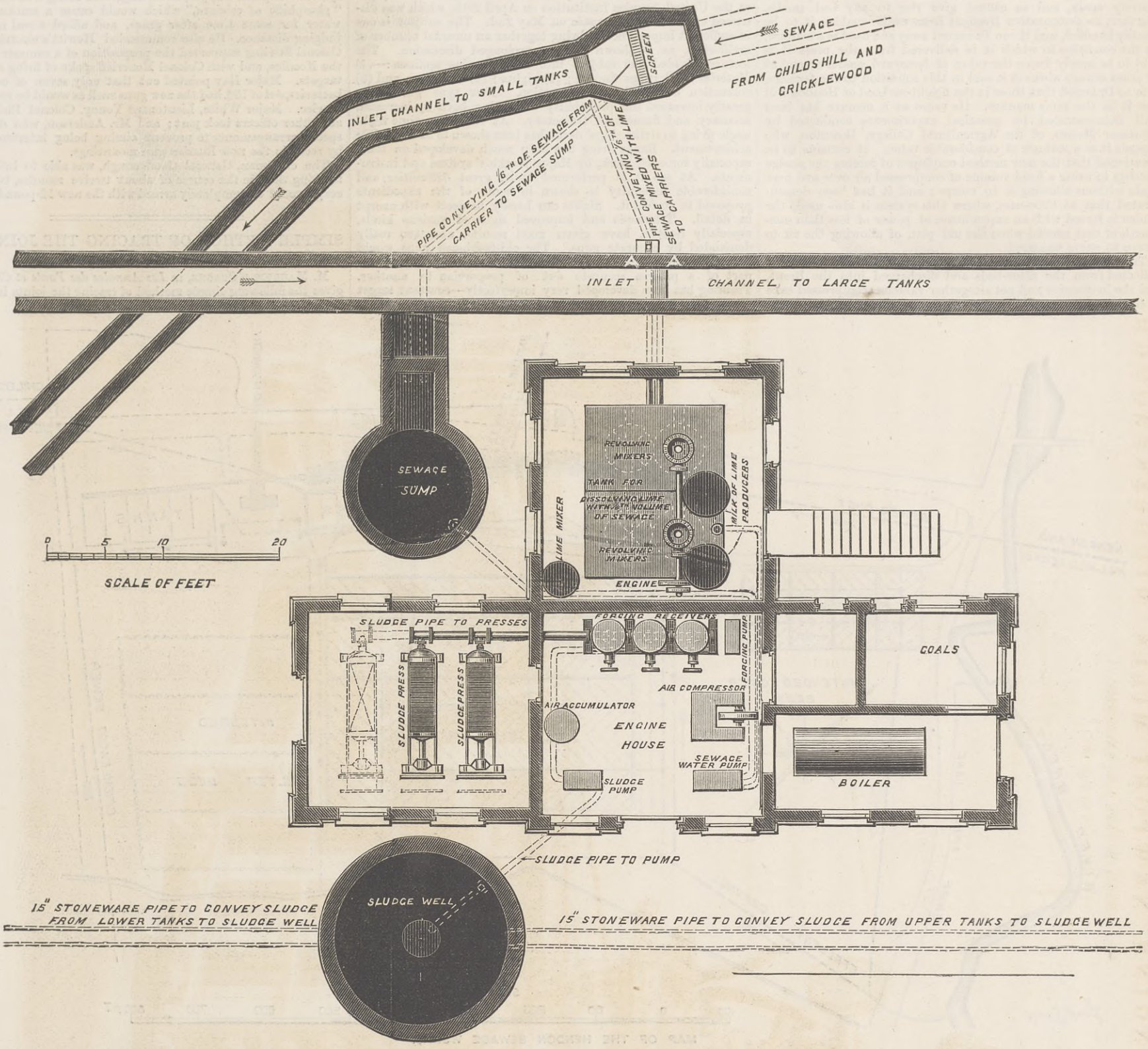
MR. J. HEAD, M. INST. C.E., ENGINEER.

(For description see page 360.)



THE HENDON SEWERAGE AND SEWAGE WORKS.

MESSRS. EDWARD COUSINS AND SON, WESTMINSTER ENGINEERS.



HENDON SEWAGE WORKS.

THE new sewage works at Welsh Harp, near Hendon, constructed from the designs and under the instruction of Messrs. Edward Cousins, M.I.C.E., and Son, Westminster, were opened on the 23rd April by Mr. E. R. Bartley Dennis, Chairman of the Hendon Local Board.

The new sewers for the drainage of Hendon, Child's Hill, Cricklewood, Golder's Green, and Temple Fortune districts, are completed, and connected with the new sewage works, and in future the whole of the sewage from these districts will be treated at the new works, and the old tanks at present in use will be abandoned. The total length of the sewers now in use for the drainage of these districts is 14½ miles. The Hendon Local Board District contains 8382 acres, and the rateable value of Hendon is £101,000.

The plan used at the Hendon works for the treatment of the sewage is as follows :—Firstly: The removal of the coarse, solid, floating matter by straining. Secondly: The addition of lime for the purpose of defecation and the precipitation of some of the organic matter in solution. Thirdly: The removal, by means of settlement in tanks, of the suspended matter, and that precipitated by the lime. Fourthly: The decantation of the clear water from the tanks, and its purification by filtration through specially prepared filtering beds.

Experience has shown that unless sewage be previously defecated, filtration through land is not effectual, because the solid matter suspended in the sewage, and matters in solution readily removed, clog up the pores of the soil and destroy its efficacy, both as a mechanical filter and as a purifying agent. It is therefore necessary to remove the matters which would destroy the filtering bed, and leave only the clarified water from the tanks to pass through the soil. During this passage through the soil the organic matter in solution is decomposed by the organisms which exist in the soil, and live upon the kind of organic matter contained in the sewage. The result is that the nitrogenous matter which would otherwise putrefy is broken up and transformed into salts of ammonia, which are innocuous.

The treatment at Hendon, although lime is used, differs from the lime treatment pursued elsewhere, and in this respect: It has been found that the addition of what is called "milk of lime" is not so effectual as if the lime is added as lime water, because it is only the dissolved lime, or that in solution, which is effectual. All sewage is highly charged with carbonic acid, and the particles of lime in the milk of lime combine with the carbonic acid, and form a coating of carbonate of lime on the outside of the particle which is insoluble, and the lime cannot enter into solution, and is prevented from doing its work. This loss Messrs. Cousins claim to have avoided at the Hendon works by preparing lime-water almost saturated with

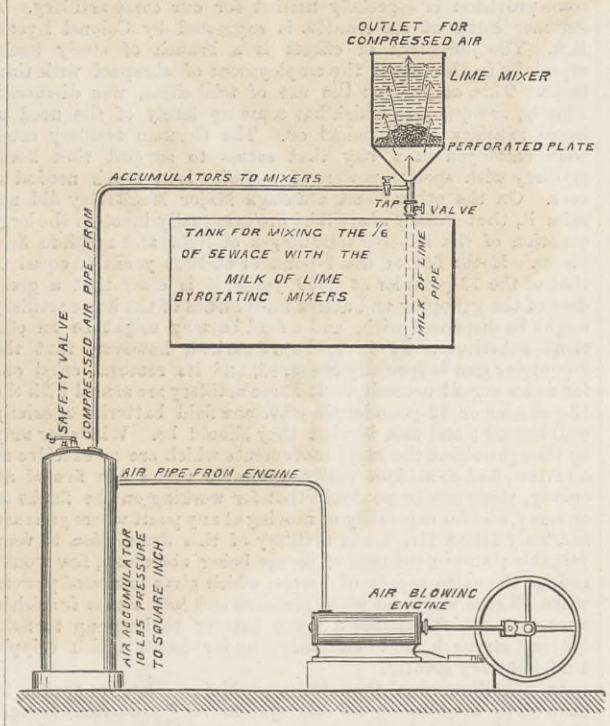


DIAGRAM SHOWING LIME AND SEWAGE MIXERS.

lime. One-sixth part of the whole sewage is withdrawn from the two carriers, and pumped into a continuous mixing vessel provided with agitating arms. A thin milk of lime is added, containing lime equal to 15 grains per gallon on the whole sewage, or 90 grains per gallon on that passing through the lime-water mixing apparatus. The lime is thoroughly dissolved, and the lime-water so obtained is added to the remaining five parts of the raw sewage, mixed by the Salmon ladder arrangement, and run into one of the settling tanks, where it remains in a state of quiescence; another tank is then filled, and so on. The action of the lime mixers for making the milk of lime may be described as follows, with reference to the sketch annexed:—An air compressing engine forces air into an accumulator at a pressure of about 10 lb. per square inch. A pipe is connected with this accumulator and the lower part of the mixer as shown. After the lime and water has been put into the mixers, the air tap is opened, and the compressed air at 10 lb. escapes through the lime and water, and agitates and thoroughly mixes them. The milk of lime so made is then allowed to flow into the sewage mixing tank below, where it is thoroughly mixed up with one-sixth of the volume of sewage under treatment, by means of horizontal revolving rake arms. From these mixing tanks the lime water and sewage pass out to the points A and A seen on the plan, where it mixes with the other five-sixths of sewage in the channels running to the subsiding tanks. After five or six hours' rest, the clear water is run off by a floating arm, which accommodates itself to the varying level of the sewage, and the effluent is run on to the filter-beds, as before described, for the more complete purification. The sludge, or thin mud, remaining in the tanks is swept into a pipe, and run into a sludge-well. In the condition in which it arrives there it contains 95 per cent. of water and only 5 per cent. of solid matter; it is very putrescent, as it contains the foul matter thrown down by the sewage, and if not dealt with would soon become a nuisance. Up to within the last few years it was the accumulation of sludge on a sewage works which rendered it almost impracticable to work such a process without serious nuisance. The sludge could not be dealt with, and as it was run into pits, to attempt to drain the water from it—an almost impossible task—it entered into a vigorous state of putrefaction, and gave off all the evil odours which rendered sewage works so unbearable. All this it is intended to avoid by the method of disposing of sludge developed by Messrs. Johnson and Co., of Stratford.

This method, on its most approved principle, has been adopted at the Hendon works, and sludge-pressing machinery has been there erected on the most modern and economical system. The sludge is first mixed with 1 per cent. of lime in forcing vessels, and from these it is forced into the sludge presses by compressed air stored at a pressure of 100 lb. per square inch. The sludge presses are so constructed that everything forced into them must pass through a straining-cloth before it leaves the machine. Consequently nothing but

clear water can leave the chambers, and the solid matter is retained between the plates, where it accumulates and, under the pressure produced by the air, forms a firm, coherent cake; 90 per cent. of the water originally present is got rid of, and the sludge is brought into a condition in which it cannot liquefy or putrefy again, and so cannot give rise to any bad smells. Further, its comparative freedom from water enables it to be readily handled, and it can be carted away and used as a manure. In the condition in which it is delivered from the press it is said to be nearly twice the value of farmyard manure; and as at other sewage works it is sold in this condition to the farmers, it is to be hoped that those in the neighbourhood of Hendon will use it in the same manner. Its value as a manure has been well demonstrated by practical experiments conducted by Professor Munro, of the Agricultural College, Downton, who regards it as a manure of considerable value. It remains to be mentioned that the new method employed of forcing the sludge consists in using a fixed volume of compressed air over and over again without allowing it to escape; and it has been demonstrated that at Crossness, where this system is also used, the sludge is forced with an expenditure of power of less than one-fourth of that needed when the old plan of allowing the air to escape to waste was used.

The treatment at the Hendon Works results in a pure effluent collected from the filter-beds and discharged into the Brent, and the inoffensive and not altogether valueless compressed cake from the sludge presses. The appliances in use at the works are as follows:—A duplex pumping engine for raising one-sixth part of the sewage; a continuous mixing apparatus, with milk of lime mixers for making the lime-water; a blowing engine and air stove for mixing purposes, a sludge lift pump for elevating the sludge, a set of hydro-pneumatic forcing receivers, with hydraulic pumps; and two sludge presses, each capable of turning out 9 cwt. of pressed cake at an operation, which occupies about an hour. The steam is supplied to the whole by a 20-horse power semi-portable boiler. The settling tanks are six in number, capable of holding 651,000 gallons of sewage. The filter beds at present constructed are ten in number; additional beds are intended to be shortly constructed, making a total of fourteen, fed by concrete and pipe carriers from the tanks, and covering an area of 30,300 square yards. They are constructed of a layer of soil 12in. deep, under which is 12in. of burnt ballast, the whole thoroughly underdrained, the trenches over the pipes being filled with burnt ballast, and communicating with the Brent by a white brick effluent carrier.

The works are capable of dealing with the sewage of a population of 24,000 as a maximum. The quantity of lime used for treatment is a little less than 2 cwt. for every 100,000 gallons of sewage entering the works, and about 100 lb. of lime for every ton of compressed cake turned out by the presses. The cost of the whole works is about £59,000, and the annual cost of working is estimated at about £570 per annum.

The method of precipitation by the lime process as described, supplemented by land filtration, adopted at Hendon, was recommended by Professor Frankland and Dr. Stevenson, and approved by Dr. Duprez. They considered that any other addition as a precipitant is unnecessary. They consider that lime, when properly applied, affords as good an effluent as any other and more costly precipitant, except, perhaps, lime and sulphate of alumina; but they consider the use of sulphate of alumina is unnecessary, when precipitation is to be supplemented by land filtration, and that where possible the cost of this substance should be avoided. To carry out their recommendation for properly dissolving the lime in one-sixth the volume of sewage, and afterwards mixing it with the remaining five-sixths, required specially designed machinery, which has been manufactured by Messrs. Johnson and Co., and which completely answers the purpose.

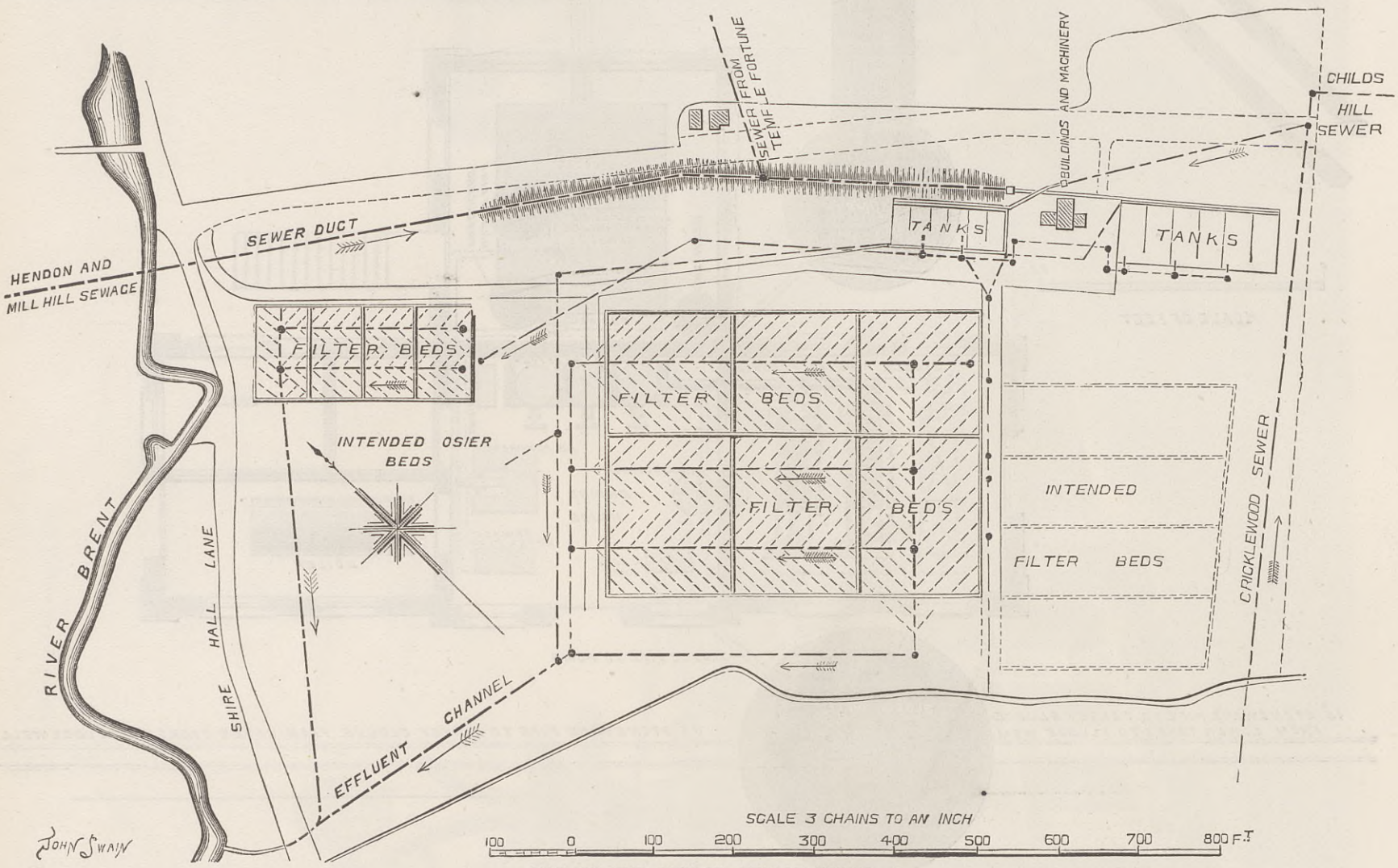
The Staveley Iron Co., Chesterfield, has appointed Messrs. Joseph Taylor and Co., 110, Cannon-street, its agents for London and South of England.

ACCURACY OF ARTILLERY FIRE.

Major Mackinlay, R.A., the author of the "Official Text-book on Gunnery," read a paper on the accuracy of artillery fire at the United Service Institution on April 29th, which was discussed on that day and again on May 2nd. The subject is one of sufficient importance to bring together an unusual number of artillerists, as is shown by the prolonged discussion. The lecturer divided the subject into the following sections:—(1) Material; (2) range finding; (3) sights; (4) training; and (5) correction of fire from observation. New type guns have greatly increased the probability of hitting both by increased accuracy and flatness of trajectory. At the same time high-angle firing to strike ships' decks has been shown to be a possible achievement. Range firing has been much developed on land, especially for coast work, by Major Watkins' system and instruments. At sea it is performed under great difficulties, and considerable ingenuity is shown in some of the expedients proposed to perfect it. Sights can hardly be dealt with except in detail. Telescopic and improved sight of various kinds, especially Scott's, have given good results, and are really demanded by accurate guns. The old-fashioned guns would hardly have benefitted by them, as there is no use in having one part of a process accurate out of proportion to another. Training has been developed very imperfectly—constant target practice is not what is required. In India practice, field operations have for several years given the opportunity of firing under conditions representing those of actual war. For a few years past Lydd and Oakhampton have furnished something in this direction for our field artillery; some provision is especially needed for our coast artillery. A summer camp at the Needles is suggested by Colonel Lyons, R.A. The judgment of effects is a branch of study itself, especially in the case of the employment of shrapnel with time fuzes. This, as well as the use of trial shots, was discussed. Finally, the question which has come up lately of the need of horse artillery was touched on. The German artillery often were employed in a way that seems to suggest that horse artillery with special powers of mobility is as much needed as ever. On the other hand, although Major MacKinlay did not raise it, the accuracy of artillery fire eventually involves the large question of the relative advantages of light and medium field pieces. If the fire of the 9-pounder at 1000 yards is equal to that of the 13-pounder at 2000 yards, it is clear that a great deal of the galloping and active movements of the horse artillery might be dispensed with, and a field battery might be an efficient substitute. It is to be remarked, however, that the 9-pounder gun is specially censured, and its removal cried out for as an urgent necessity. If horse artillery are armed with the 13-pounder or 12-pounder they become field batteries specially well horsed; and this is what they should be. Whatever may be thought about the rapid movements which are so effective at a review, and so seldom really advisable under the fire of an enemy, there can be no doubt that for working on the flanks of an army, and for capability of moving at any point where guns are suddenly called for, horse artillery of this description is very valuable; and in the case of forage being abundant, few would grudge the extra supply of horses, which gives increased powers when all goes well, and when pressure and loss comes furnishes a reserve which enables a horse battery to keep up to field battery strength and efficiency, under losses which cripple a field battery greatly.

In the discussion that followed Major Watkin spoke, in answer to a question, on his system of "predicted firing." This consists in following the course of a ship on a species of diagram, so as to be able to take a point in advance of her position any distance along her predicted course, and aiming at this point so as to be able to fire by electricity when the ship is seen to reach it. By this system the measuring accuracy is about equal to that obtained in firing at a fixed target. Colonel Hughes, M.P., complained of volunteers not being allowed to go through more than one course and not being able to purchase the "Proceedings of the Royal Artillery Institution." Major Scott and General Smyth spoke on the system of biennial practice, by which a battery obtains a special supply every third year. There is reason to think that a triennial supply, with scarcely any every alternate year, would be a better system. Captain Tupper, R.N., suggested firing trial shells with "phosphide of calcium," which would cause a smoke on the water for some time after graze, and afford a real means of judging distance. He also commended Hewitt's electric sights. Colonel Stirling supported the proposition of a summer camp at the Needles, and with Colonel Moncrieff spoke of firing at towed targets. Major Hay pointed out that only seven of our field, batteries, out of 120, had the new guns such as would be needed for service. Major White, Lieutenant Young, Colonel Richardson, and other officers took part; and Mr. Anderson, who described special arrangements to prevent aiming being interfered with by recoil in the new Russian gun mountings.

The chairman, General Goodenough, was able to inform the meeting that, in the course of about twelve months, two army corps would be completely armed with the new 12-pounder guns.



MAP OF THE HENDON SEWAGE WORKS.

SIMPLE METHOD OF TRACING THE JOINTS IN ELLIPTIC ARCHES.

M. Maurice d'Ocagne, in *Les Annales des Ponts et Chaussées*, gives the following simple method of tracing the joints in elliptic arches:—

Let m^1, m^2, m^3 . . . m^7 (Fig. 1) be points in the quarter ellipse A B on which it is required to trace the joints normal with the ellipte. The tangents to the points A and B intersect at C; we then draw the lines A B and O C. The perpendiculars to

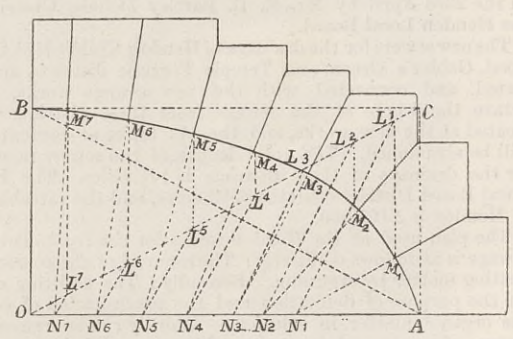
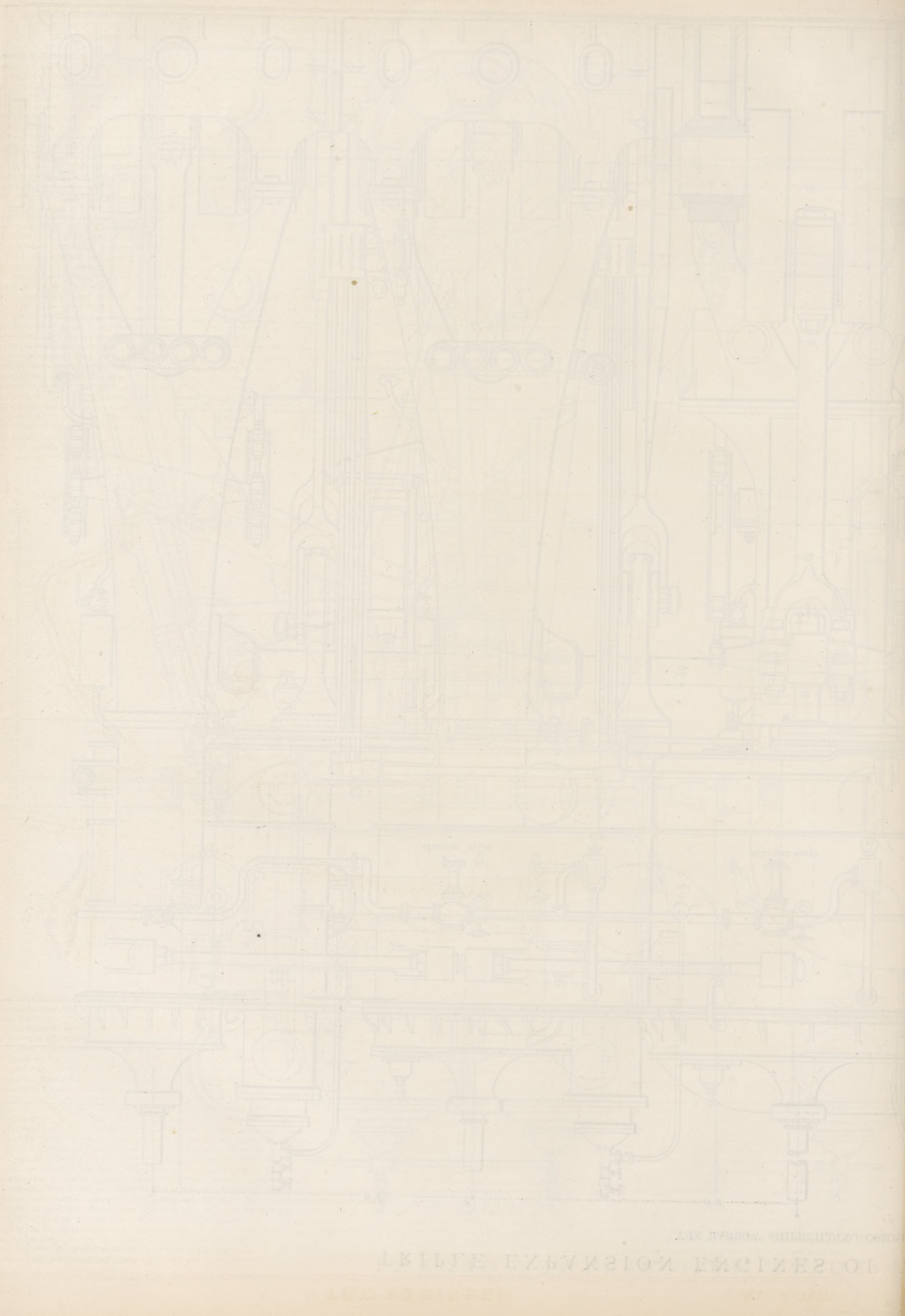


Fig. 1

O A, dropped from m^1 m^2 . . . m^7, cut the line O C at the points L^1, L^2, L^3 . . . . L^7. The perpendiculars to A B, carried from the points L^1, L^2, &c., cut the line O A at the points N^1, N^2, N^3, . . . N^7. Then the lines M^1 N^1, M^2 N^2, &c., are the normals sought for.

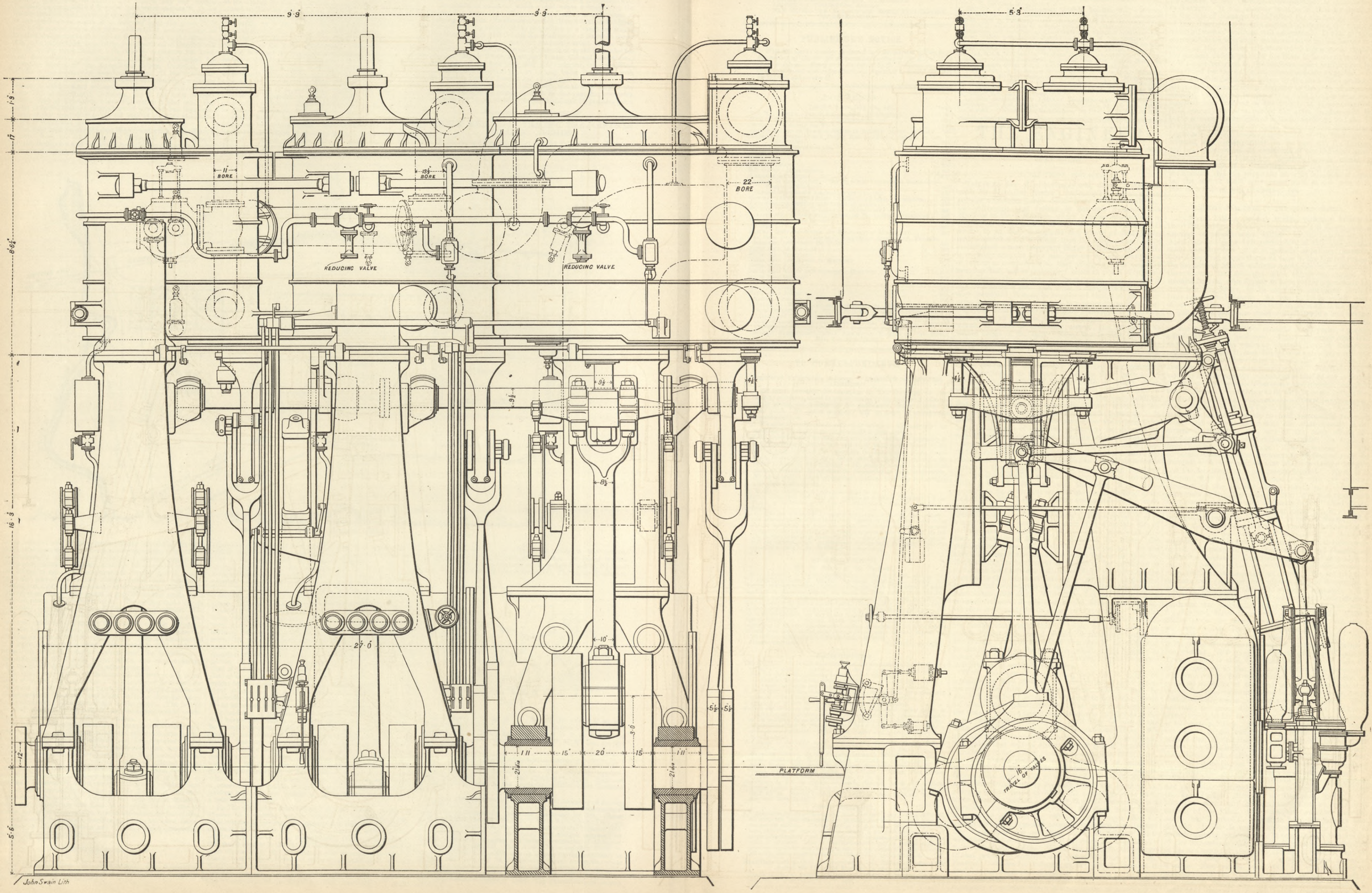
Naval Engineer Appointments.—The following appointment has been made at the Admiralty:—Fleet Engineer Reginald C. Oldknow, to the Pembroke, additional, for Chatham Reserve.

Glasgow International Exhibition.—The ceremony of cutting the first sod for the foundation of the Glasgow International Exhibition buildings was performed yesterday by Mr. James King, the Lord Provost. The site is in the Kelvingrove Park, on the plain immediately in front of the University at Gilmore Hill. The buildings, which will be erected from designs prepared by Messrs. Campbell, Douglas, and Sellars, architects, of Glasgow, will cost about £30,000. They show a main building 880ft. in length and 360ft. in breadth, with an annexe for the machinery at one end, and there will be a transverse avenue across the whole breadth of the main building about half-way down. At the point of intersection the intention is to erect a dome 80ft. in diameter, which will rise to a height of 110ft. The guarantee fund is over £200,000.

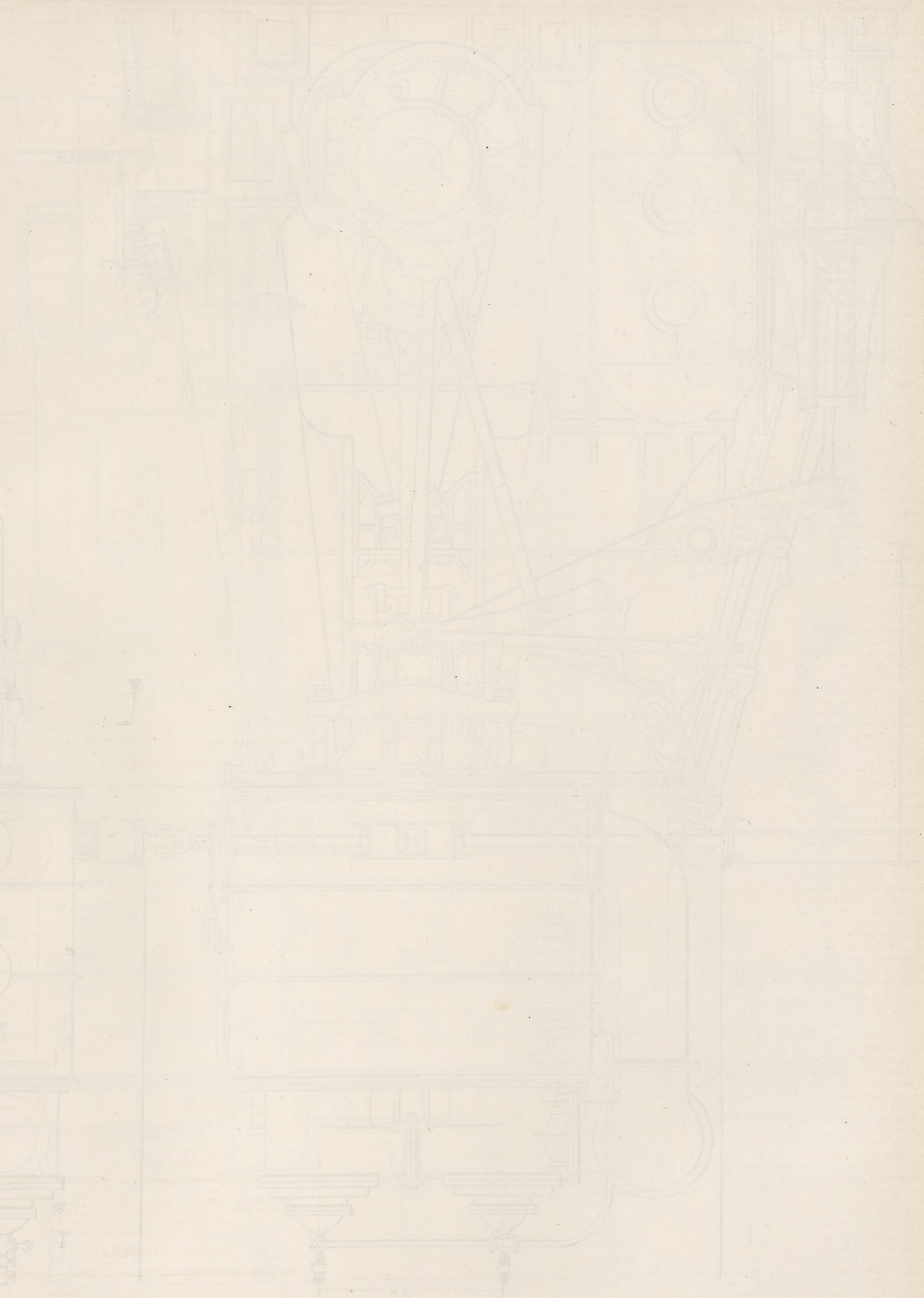


TRIPLE EXPANSION ENGINES OF THE ROYAL MAIL STEAMER OROYA.

THE BARROW SHIPBUILDING COMPANY, BARROW-IN-FURNESS, ENGINEERS.



John Swain Lith



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PARIS.—Madame BOYVEAU, *Rue de la Banque.*
BERLIN.—ASHER and Co., 5, *Unter den Linden.*
VIENNA.—Messrs. GEROLD and Co., *Booksellers.*
LEIPSIC.—A. TWIETMEYER, *Bookseller.*
NEW YORK.—THE WILLMER and ROGERS NEWS COMPANY, 31 *Beekman-street.*

PUBLISHER'S NOTICE.

*** *With this week's number is issued as a Supplement a Two page Engraving of the Triple Expansion Engines of the Royal Mail Steamer Oroya. Every copy as issued by the Publisher contains this Supplement, and subscribers are requested to notify the fact should they not receive it.*

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THE ENGINEER, May 6th, 1887. PAGE

TO CORRESPONDENTS.

Registered Telegraphic Address "ENGINEER NEWSPAPER, LONDON."

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

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

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

E. W. H.—*A letter awaits your application for it.*

SPENCE.—*You will find what you require in Professor Prestwich's "Water Supply of the London Basin," or W. Whittaker's "Geology of the London Basin."*

A. G.—*Tin can be dissolved by several acids—as, for example, hydrochloric—and muriate of tin is used in dyeing. Scores of patents have been taken out for recovering tin from tin scrap, and large quantities of tin-plate scrap are bought, especially by Germany, apparently for the sake of the tin. The question is too large to handle here. Your best course would be to consult the various patent specifications dealing with the subject. You can probably see them at the free library in your town.*

STOWING ANCHORS.

(To the Editor of The Engineer.)

SIR,—Referring to the paragraph in your issue of 1st inst., stating that "a large proportion of the new tonnage building has adopted Mr. Wasteneys Smith's patent anchors, combined with the method of stowing them up the hawse pipes," we write to draw attention to the fact that the method referred to should properly be described as "stowing the anchors partly drawn up the hawse pipes," and that "stowing them up the hawse pipes" is a patent of which we are the proprietors. The latest vessel fitted in our way is the Rajapuri, belonging to the Bombay Steam Navigation Company, which went on her official trial trip the beginning of this month, the self-housing arrangement for her anchors having been tested at the same time with complete success. She is the third steamer similarly fitted for the same owners.

Glasgow, April 30th. MACNICOLL AND CO.

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THE ENGINEER *can be had, by order, from any newsagent in town or country at the various railway stations; or it can, if preferred, be supplied direct from the office on the following terms (paid in advance):—*

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Remittance by Bill on London.—Austria, Buenos Ayres and Algeria, Greece, Ionian Islands, Norway, Panama, Peru, Russia, Spain, Sweden, Chili, £1 16s. Borneo, Ceylon, Java, and Singapore, £2 0s. 6d. Manilla, Sandwich Isles, £2 5s.

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Advertisements cannot be inserted unless Delivered before Six o'clock on Thursday Evening in each week.

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

MEETINGS NEXT WEEK.

THE INSTITUTION OF CIVIL ENGINEERS, 25, Great George-street, Westminster, S.W.—Session 1886-87. Tuesday, May 10th, at 8 p.m.: Ordinary meeting. Paper to be read with a view to discussion:—"The Conversion of Timber by Circular and Band Saws in the Saginaw Valley," U.S.A.," by L. H. Ransome, Stud. Inst. C.E

SOCIETY OF ARTS, John-street, Adelphi, London, W.C. — Monday, May 9th, at 8 p.m. Cantor Lectures: "The Chemistry of Substances taking part in Putrefaction and Antisepsis," by J. M. Thomson, F.C.S. Lecture II.—Resolution of complex into simpler substances during fermentation and putrefaction—Classification of common substances produced during putrefaction—Special characters of the proximate and ultimate products. Tuesday, May 10th, at 8 p.m.: Applied Art Section: "The Architecture of London Streets," by E. J. Tarver, F.S.A.; E. C. Robins, F.S.A., will preside. Wednesday, May 11th, at 8 p.m.: Ordinary meeting: "Cottage Industries in Ireland," by Mrs. Ernest Hart; Sir Philip Cunliffe-Owen, K.C.B., K.C.M.G., C.I.E., will preside.

THE SOCIETY OF TELEGRAPH ENGINEERS AND ELECTRICIANS.—Thursday, May 12th, at 25, Great George-street, S.W., at 8 p.m.: I. "Measuring the Coefficients of Self and Mutual Induction"—adjourned discussion. II. "Driving a Dynamo with a very Short Belt," by Professors W. E. Ayrton, F.R.S., and John Perry, F.R.S.

LONDON ASSOCIATION OF FOREMEN ENGINEERS AND DRAUGHTSMEN.—Saturday, 7th inst., at the Cannon-street Hotel, at 7.30 p.m. Paper to be read:—"Notes on Gas Manufacture," by Fred. A. Darlington, C.E.

THE ENGINEER.

MAY 6, 1887.

OCEAN PENNY POSTAGE.

THERE are few of us probably who do not sympathise with Mr. Henniker Heaton's endeavour to secure a boon such as a uniform penny ocean postage rate would be; but although that feeling is natural, it should not blind us to the difficulties which present themselves in opposition to the success of Mr. Heaton's advocacy. It seems to us that throughout the whole of that gentleman's speeches and writings upon the subject there is the omission of a most important factor in the question. He invariably cites the price paid per ton for the conveyance of letters as compared with that charged upon ordinary merchandise, and so places *pari passu* in point of urgency of delivery the national correspondence with a bale of silk or a chest of tea. Can such a comparison be in any way justified? It must be recollected that a single letter, upon which a charge of but a few pence is made for carriage and delivery, may determine transactions involving thousands of pounds. Such a single letter may be worth in point of insurance almost the value of the whole cargo of the ship. Now, how is that insurance to be secured? Only by arrangements which shall assure to the conveyance of the mails both speed, regularity, and safety. Those qualifications can be in part insured for in the case of merchandise by the ordinary system of underwriting. In the case of letters, they have to be secured by the payment by the State of heavy subsidies to steamship companies which shall make it worth the while of these to undertake the responsibility. But in some way or other the State must be recouped for the cost paid by it for such insurance. It must be manifest that this cannot be attempted to be done by any rate of excessive postage to be charged by way of registration on letters sent by ocean routes. All letters so sent must sink or survive together, and all correspondence therefore, whatever its nature or relative importance, must perforce be compelled to contribute towards repaying the State the outlay it has to make to secure the greatest possible amount of security and dispatch. This point of insurance, and the cost it involves, appears to us, as we have said, to have been entirely overlooked in Mr. Heaton's public statements of his case. We all can realise what the cost is. We know the tremendous expenditure necessary to add a speed of even a single knot per hour to a steamer after a certain rate of mileage has been attained. We also know how constantly that expenditure has to be incurred to insure the punctuality demanded of the mail service; and we are also all aware of the extra rate which has to be paid for the building and equipment of vessels to be employed in our ocean mail services. All these items of extra charge constitute the insurance rate on every letter dispatched beyond the seas—a rate not imposed by the necessities of land conveyance only. What claim has the public to be entirely relieved at the cost of the State from the insurance it demands for its ocean correspondence? If the penny rate could be found adequate to afford such relief, we could understand that it might perhaps fairly be claimed; but even then it would be relatively unfair to our inland correspondence that this should be subjected to almost the same charge as that which could be made to cover, not alone the mere transit charges, but the insurance in addition, of ocean-borne letters.

With the view of ascertaining how far it would be possible for mail steamers to carry without extra remuneration the increased correspondence which must be assured in order to bring the revenue to be derived from an ocean penny postal rate up to that now obtained from the rate at present ruling, we have made inquiry as to the space usually taken up by the mail bags of one of the most important of our mail-carrying steamer lines. We are told that it is ordinarily between forty and fifty tons. Assuming that half of this weight is due to letters, the remaining moiety being that of newspapers, parcels, &c., we may reckon probably on twenty tons as being the weight gross—the net being as low, we should say, as fifteen tons—with which we have to deal. On the Eastern mails we should have to increase this bulk by about an average of five times to bring the postal receipts up to their present standard if a penny the half-ounce only was payable. Instead of twenty tons, therefore, space would have to be provided for 100 tons, and even then we should no nearer approach covering what we have termed the State insurance rate than we do at present. It is well known that our ocean mail expenses are very largely in excess of our receipts. Would the reduction of postage to the penny so multiply the correspondence with our Eastern Colonies, for instance, as not only to increase it fivefold—at which rate of increase we should be no better off financially than at present—but to the largely increased proportion which it must attain if the State is ever to be fully recouped its present rate of outlay? Although we may hope that it would, such a realisation must at best be doubtful. By far the larger proportion, we believe, of our oceanic correspondence is commercial in character. It can scarcely be expected that a reduction in the rate of postage would affect the number of letters of that description to any appreciable degree, for reasons which all men of business will understand. It is to private correspondence therefore we should have to look for the increase in the number of letters which alone would enable the present deficit paid by the State to be ever recouped.

We have referred to the increased space which must be demanded for the extended correspondence expected. It is certain this cannot be given by the mail lines without adequate remuneration in addition to the present rates of subsidy. Although it may at the most involve some two hundred tons instead of the twenty at present carried, it is scarcely to be expected the extra burden will be borne so many thousands of miles for nothing; and should the present scale of freights improve, the imposition might add heavily to the expenditure of the Postmaster-General, and, consequently, to the necessity for further and not to be relied on extension of our Colonial correspondence. Mr. Henniker Heaton's figures would be assuring enough if a consideration of the other side of the question did not prove the error he falls into of classing the cost of mail conveyance with, as we have said, that of a bale of silk or chest of tea.

BRIDGE FAILURES IN THE UNITED STATES.

ON March 14th a railway bridge, variously known as the "Tin Bridge," Bussey Bridge, &c., fell down, and a number of people were killed. In our impression for April 1st, we gave full particulars of this and certain other catastrophes of a singularly appalling character which occurred about the same time in the United States. On the 16th of March we drew reasonable deductions from these events, and amongst other things we warned our colonial friends, who appear to have rather a *penchant* for American engineers, to be careful in obtaining bridges from the United States. As was to be expected, some of our American friends are very angry with us for daring to hint that Americans could or would build a bad bridge. If our critics would but agree as to the grounds on which we are to be blamed their remarks would perhaps possess a force which they lack now. The *Engineering News* tells us that it was in no sense or way the fault of American engineers that the Bussey Bridge was a structure entirely unfit to discharge the duties it was called on to perform. It throws all the blame on the directors. "THE ENGINEER," says our contemporary, "should have studied our report of the Bussey Bridge somewhat closer, and it would have seen that engineers had nothing to do with it, as the bridge was neither designed by an engineer, nor did the railway company have an engineer to care for it after erection. American engineers cannot properly be held responsible for such work; and we must agree with our contemporary in the statement that this was one of the cases where the 'economy' of a rich corporation prevented the engineer from having 'a fair chance.' The 'nearness' of the corporation and not the engineering profession must be charged with this and similar abortive bridge designs, and the too frequent consequences thereof." Now, it so happens, that we expressly found fault with the railway directors of the United States, taking very much the same view as the *Engineering News*. We said that there were numbers of first-rate engineers in the United States, but that they did not get a fair chance; in a word, we held the companies to be in fault as well as the men who, calling themselves engineers, have neither the knowledge, the talent, or the honesty of purpose of a thorough engineer. All this our contemporary seems to have overlooked. Turning to the American *Railroad Gazette*, we find not a defence of American engineers but of American railway directors who—we gather from our contemporary—are really an immaculate set of men. We are told that we have only repeated the vulgar slander of demagogues, when we hinted that they did not give engineers a fair chance; and, to convince us of our error, our contemporary produces an elaborate table to show how much freights and fares have been reduced in the United States since the early days of railways. We think we may safely leave our contemporaries to fight out this aspect of the case between them. Even in its praise of directors, however, the *Railroad Gazette* is inconsistent. Referring to the slaughter at Woodstock Bridge, when, it will be remembered, a whole train fell off the track on to the ice below, where those passengers who survived the fall were burned to death in about ten minutes, we spoke of the bad quality of American steel rails. Our contemporary assures us that we are in error; that steel rails made in the States do not break. They are really too good; they bend and wear out, and are, it seems, too light for their work. They are, besides, made in too great a hurry. However, if only directors would use rails of proper weight, things would be all right. It is more than hinted that in parsimony is to be found the reason why rails sufficiently strong are not used. It would seem therefore that, after all, we were not so far wrong, and that the "demagogues" have some ground for complaint when their families are smashed up or burned alive.

The *Engineering News* is driven to use a *tu quoque*, and says that "probably we have forgotten all about the Tay Bridge disaster of December, 1879." We hasten to assure our contemporary that we have done nothing of the kind. No subsequent event of a similar nature has occurred to obliterate from our memory that disaster. It stands out a unique fact in the history of British railway enterprise. It was the only iron bridge of any dimensions which has ever given way causing loss of life in Great Britain; and it may, at least, be said for it that it gave way under a most abnormal stress of weather. But let us grant that the case presented by the failure of the Tay Bridge was as bad as possible, what then? Surely our contemporary does not mean to imply that because a Scotch bridge tumbled down in a

hurricane we are to refrain from criticising American practice. The contention is too absurd. We quite agree with our contemporary, who, after citing the Tay Bridge, seems to have seen the folly of resorting to such a weapon, and admits that "this sort of 'you're-another' argument is poor business." The action taken by our contemporaries is not without a spice of humour. The *Engineering News*, indeed, was loudest in its denunciations of the bridge, and everyone who had had anything to do with it at first. We suppose it desires to retain a monoply of invective. It has not yet finished with the directors. On the same page from which we have quoted is an attack on the conduct of an inquiry into the cause of the catastrophe. "The delay," we read," in making public the official finding as to the 'Tin Bridge' disaster is so astounding, and so far beyond all reasonable and rational explanation on an ordinary basis, that one can only believe that there must be some peculiar and exceptional cause for such strange delay, or in some elaborate technical presentation of the facts, or carefully-prepared piece of legislation, which, when it appears, will amply excuse it; yet it is hard to see how anything can do so altogether." This is another instance of how well they do things at the other side of the Atlantic. We venture to hazard a guess—only a guess—at the cause of the delay. The directors who, by putting up the "tin bridge," saved money—as we gather from our contemporary—now see a way to save more money. There are no doubt very large claims made by widows, orphans, and other relatives against the company. Now, it is fair and reasonable to assume that these claims can be settled on a far more satisfactory basis—to the company—*before* a damning report is made public than afterwards. Hence the delay. There is nothing so far as we know illegal in this, nor, judged by the railway standard, is it immoral. It seems that the five experts called in are entirely unanimous, so that we agree with our contemporary that the delay in the publishing of the report is astounding, save on the one hypothesis, that the directors do not wish it to be made public till the latest possible moment. The delay will permit men's minds to cool, and it is always on the cards that another bridge may fall down any moment, and so direct attention from the Bussey affair.

While our statements stand a chance of being misrepresented, it is worth while to go over ground already traversed, so that we may make our meaning perfectly clear. We have to repeat therefore that in the United States there are numbers of engineers of the highest ability—honourable, competent, professional men in the fullest sense of the term. We do more than believe this; we know it to be a fact. Such men do not build "tin bridges." But we also know that in the United States men are allowed to practice as engineers, and get work as contractors, who are not indeed without talent, but who are unfit to be trusted with the carrying out of any work on which the life of men may depend. Albert Smith used to tell a story of a Vauxhall waiter who, being asked *how* thin he could cut ham for sandwiches, replied that "he really did not know, but that he would undertake to cover the whole garden with four hams." On the same principle American engineers exist and practise, who can carry the art of sub-dividing material and workmanship to an incredible extent. Asked how many bridges they can build with 500 tons of iron, they may reply that they do not know, but that with four times five hundred tons they will equip a thousand miles of line through a mountainous district. The workmanship will be on a par with the quantity of material. Such men, as we have said, really do possess talent, and directors like talent of this kind. It is folly to deny that many—a great many—of the railway structures of the United States are worked within an inch of their lives. The factor of safety is appallingly little. We are told that this is inseparable from a new country. Perhaps so. We shall not dispute the point; but we venture to repeat our warning to our colonial friends, and beg them to be very cautious in dealing with men who hold that a new country is bound to have bridges with a moderate margin of safety. Men can be killed in a new as surely and as painfully as in an old country. The theory is, we submit, unsound. It is only fair to add, however, that the *Engineering News* thinks that there is no danger that American practice will be carried out to the bitter end in, let us say, Australia. Our contemporary holds that it is railway directors, and not engineers, who are to blame for the construction of bad bridges; "and as railway directors are not likely to carry their ideas of bridge construction into foreign colonies, where somebody else is to pay for them, the American engineer has a fair chance, and the English colonists need have no fear of his works." This would be eminently reassuring if only we could be certain that American corporations or companies taking contracts for colonial work would give the engineer a fair chance. On this point, however, our contemporary maintains a discreet silence.

METALLIFEROUS MINES AND LIFE.

Whilst very great attention has been given to the official statistics for the coal mines, the corresponding figures referring to the metalliferous mines of Great Britain and Ireland have not had that attention which their importance deserves. In the mines under the Metalliferous Mines Acts not fewer than 41,122 persons were employed at the end of last year; and alike in the number of persons employed, in the total life-loss, and in the very varying proportion of the loss of life in the different districts, there is ample food for thought. Last year there were 65 lives lost by accidents in metalliferous mines—one more than in the previous year. The Durham district was the safest, the loss of life being one to every 1422 persons employed in and about the mines; whilst the South-Western district follows with one life lost for every 1333 persons employed. South Staffordshire was the least safe for the year, one life being lost in that district for every 150 persons employed in and about the mines, and other districts come between. The causes of the accidents were—falls of ground, 21 lives lost; ropes and chains breaking, and other accidents in shafts, 11 lives; miscellaneous underground accidents, 23 lives lost; and accidents on the surface, 10 lives. As compared with the previous year there is a decrease in the lives lost by falls of ground, and an increase in each of the other classes. The actual lives lost in the different districts again were most in Cornwall, Devon, &c., in which district 25 lives were lost in the year, and least in the Midland, South-Western, and West Scotland districts, in each of which one life was reported lost for the year. The total loss, it may be said, is considerably below the average of the decade from 1874 to 1883, during which 89 lives were annually lost by accidents in these mines, and with one exception it is lower than in any year since 1880. But the fact has to be held in remembrance that the output of mineral has not been constant in the period referred to; and taking this, the fairest test, we find that last year the death rate from accidents in and about the mines was 1·580 per thousand persons employed, which is higher than in the two preceding years, and not as much below the average for the preceding decade as was the total number of deaths last year when compared with that of the average number for the decade. The least loss of life in proportion to the yield of the mines was in the year 1876, when it was 1·217 per thousand persons employed, and the highest has been in 1875, when it was 2·049 per thousand. There is another fact which is very significant—that the number of persons employed in and about these mines has varied very much, but chiefly in a downward direction. It was 58,073 in the year 1875, and it has fallen to 44,122 in the year 1886. But it is significant that the fall has been largest in proportion amongst the females employed, who were 4136 in number for the year 1874, and that number has shown a decrease almost yearly down to last year, when only 1437 were employed. These facts are of interest. They show that there has been a decrease in the number of persons employed in these mines over a long period, and that female employment therein is especially diminished; but they also show that there is on the whole a reduced loss of life in the working of the mines, though the reduction has not quite kept pace with the reduction in the yield from these mines. There is no need to draw attention to the relative safety further, for the figures we have given are for one year only, and it is evidently unwise to draw deductions of the kind from one year's working alone. Still the facts have an interest, and it is as well to show that in the past year the fatalities were much more numerous in proportion to the yield than they were in other districts. Possibly the attention thus directed may have beneficial results in the future in obtaining more care in mine working, and in thus tending to lessen the fatality of the metal mines of the kingdom.

LITERATURE.

Explosions in Coal Mines. By W. N. and J. B. Atkinson. 8vo. pp. 144. London: Longmans and Co. Newcastle: A. Reid. 1886.

In this volume the authors, two of H.M. Inspectors of Coal Mines, have described with great detail the particulars of six disastrous explosions that occurred at different mines in Cumberland and Durham in the years 1880, 1882, 1885, and which, in consequence of the great loss of life with which they were attended, were made the subjects of special inquiries by the Home-office. The Cumberland accident which occurred at Whitehaven is given as an example of a gas explosion without any additional complications from coal dust; but the five in Durham, at Trimdon Grange, Tudhoe, West Stanley, Usworth, and Seaham, were, in the author's opinion, essentially dust explosions, the violence of the blast being most manifest in the intake air ways and at the bottom of the downcast shaft, so that the real damage was done mainly by the explosive ignition of large quantities of coal dust, which, when disturbed by the first explosion, became mixed with the air from the downcast and spread the flames against the direction of the ventilation. In support of this view the whole of the evidence elicited at the different inquiries is minutely discussed and most lavishly illustrated with plans of the workings. The authors believe that the chief danger in dry mines connected with shot firing is due to coal dust; but that if equal precautions were taken in such mines to those that have long been the rule where fire-damp prevails, it is probable that the danger arising from the use of explosives would be so reduced as to allow of greater freedom in their use than would otherwise be possible. The greatest source of danger is, however, the dust collecting on the upper part of the haulage roads, and if this could be prevented from accumulating no explosion could be originated on them, nor could dust columns act as carriers of the flame from one district to another.

The methods by which such dust accumulations might be diminished are as follows:—(1) Reduction of the velocity of the ventilating current. (2) Reduction of speed of haulage, and covering tubs. (3) Damping the roadways. (4) Isolating the districts by sections kept free from dust. The first of these remedies would require the air ways to be increased in section or doubled. The second might be done by substituting endless chain or rope haulage for that by main and tail ropes, when the travelling speed may be reduced from ten to fifteen miles an hour to four or five miles. At one colliery in Durham a spray of water playing on the tops of the tubs as they pass under it has been found to be very effective in preventing dust flying off from the coal. The use of tarpaulin covers is also suggested by the author. The third remedy, namely, the removal or efficient damping of the dust, is not unattended with difficulty. An ordinary water tub is not of much use, as it only wets the bottom, leaving the more dangerous upper dust about the sides and roof of the gallery. A more efficacious method is to fix a small water pipe with cocks at frequent intervals along the roads for the attachment of a hose and jet. Coarse salt, either with or without water, has also been found beneficial in some cases for its hygroscopic properties, which cause the dust to adhere and solidify. The fourth remedy suggested, that of isolating sections, is intended to be effected by arching the main roads, which are to be made perfectly smooth so as to afford no lodgment for dust, and kept scrupulously clean and whitewashed. The length of such in places might be about one hundred yards.

In addition to the special discussion of the six explosions forming the main subject of the volume, a considerable amount of other matter of a more general kind relating to the working and ventilation of mines has been added in the introductory and final sections. The book is exceedingly well got up, and is likely to be of some permanent value; but as it is without index, table of contents, and headlines, it will be a troublesome one to use. We strongly recommend the authors to prepare and issue at least a table of contents, and if possible an analytical index, if they wish their book to be as useful as it deserves to be.

Die Galvanostegie. By Jos. Schaschl. 8vo., pp. 216. Vienna, Pest, and Leipzic. Hartleben. 1886.

This treatise, forming vol. xxx. of the Electro Technical Library, is devoted to electrotyping, or the production of thick deposits of metals on plates by the galvanic current. About half the volume is, however, devoted to the consideration of accessory subjects, such as definitions of electric units, magnetism, currents, resistances, and other matters usually contained in elementary works on electricity; the chemicals used are also described in a rather superficial manner. The various sources of electricity used in electrotyping, such as Clamond and Hancks' thermopiles, the Daniell, Reyner, Bunsen, and Lalande batteries, and several forms of dynamo are next reviewed, after which the main object of the work, namely, the composition of the baths required for depositing the different metals, is reached. This contains brief but generally sufficient notices of the processes in use in different countries, and wherever it is possible to do so, the strength of current and other details required for operating successfully are given in describing each bath. An ingenious method devised by the author of depositing brass from a cyanide bath by the use of platinum cathodes with anodes successively of copper, zinc, and good sheet brass, is worthy of notice. The work is admirably illustrated, and contains a large amount of information in a very handy form.

BOOKS RECEIVED.

Journal of the Society of Telegraph Engineers and Electricians. Vol. xvi. No. 66. Edited by F. H. Webb, secretary. London: E. and F. N. Spon. 1887.

The Treatment and Utilisation of Sewage. By W. H. Corfield, M.A., M.D. Third edition, revised and enlarged. London: Macmillan and Co. 1887.

The Wood Turner's Handybook: a Practical Manual for Workers at the Lathe. By Paul N. Hasluck. London: Crosby Lockwood and Co. 1887.

Transactions of the American Society of Mechanical Engineers. Vol. vii. 1886. New York: Published by the Society.

Isaac Pitman's Jubilee Reporting Note-books. London: I. Pitman and Sons, Amen-corner.

Berly's Universal Electrical Directory and Advertiser. The Electrician's Vade Mecum, containing a Complete Record of all the Industries Directly or Indirectly Connected with Electricity and Magnetism. London: W. Dawson and Son. 1887.

MODERN CALAIS.

Within four hours' distance of Paris and opposite Dover very important and costly works are being carried out at Calais, without at present attracting much attention to it, or to the advantages shortly to be derived therefrom for passengers and goods. Calais is being metamorphosed, and within two years it will be one of the most important places on its side of the Channel. Adjoining it, but separated from it by the canal, is the manufacturing town—St. Pierre, or St. Pierre ès Calais—which fifteen years ago was a mere village. St. Pierre has now 40,000 inhabitants, broad and well-paved streets. An Englishman, in order to escape the protective and even prohibitive duties on English twills, set up a factory, and has made St. Pierre the chief producer of French twills. The Paris correspondent of the *Times* says:—"St. Pierre and Calais are about to be amalgamated, and the street, starting from the railway station, will be continued without interruption to the chief street of St. Pierre. The station will be removed to the middle of this long artery, and will have a large square in front, while one side of the station will look on the new canal, branching off from the old St. Omer Canal, which goes to Paris, and serves Holland, Belgium, and the north, and by which merchandise can be sent into German waters, is about to be widened by 12 metres, so as to enable large vessels to enter, and convey by the most economical route goods of English and French origin. At the junction of the new boat canal and of the St. Omer Canal, an English company—as always happens when a commercial town or seaport undergoes improvement—has bought twenty-four acres of land, on which it will build immense general and bonded warehouses, at first on four acres, and afterwards on the remaining space, should the development of Calais render an extension necessary. It will possess an immense frontage, looking on the new harbour and the new docks—that is to say, the buildings will be placed in such a way as to be reached by the railway, the boat canal, the St. Omer Canal, and the new harbour, thus lying in the very centre of the improvements and of the two united towns. Link railways will pass through the warehouses, and arrangements based upon the latest improvements and will permit of the unloading and loading of goods with despatch and security hitherto unknown in France.

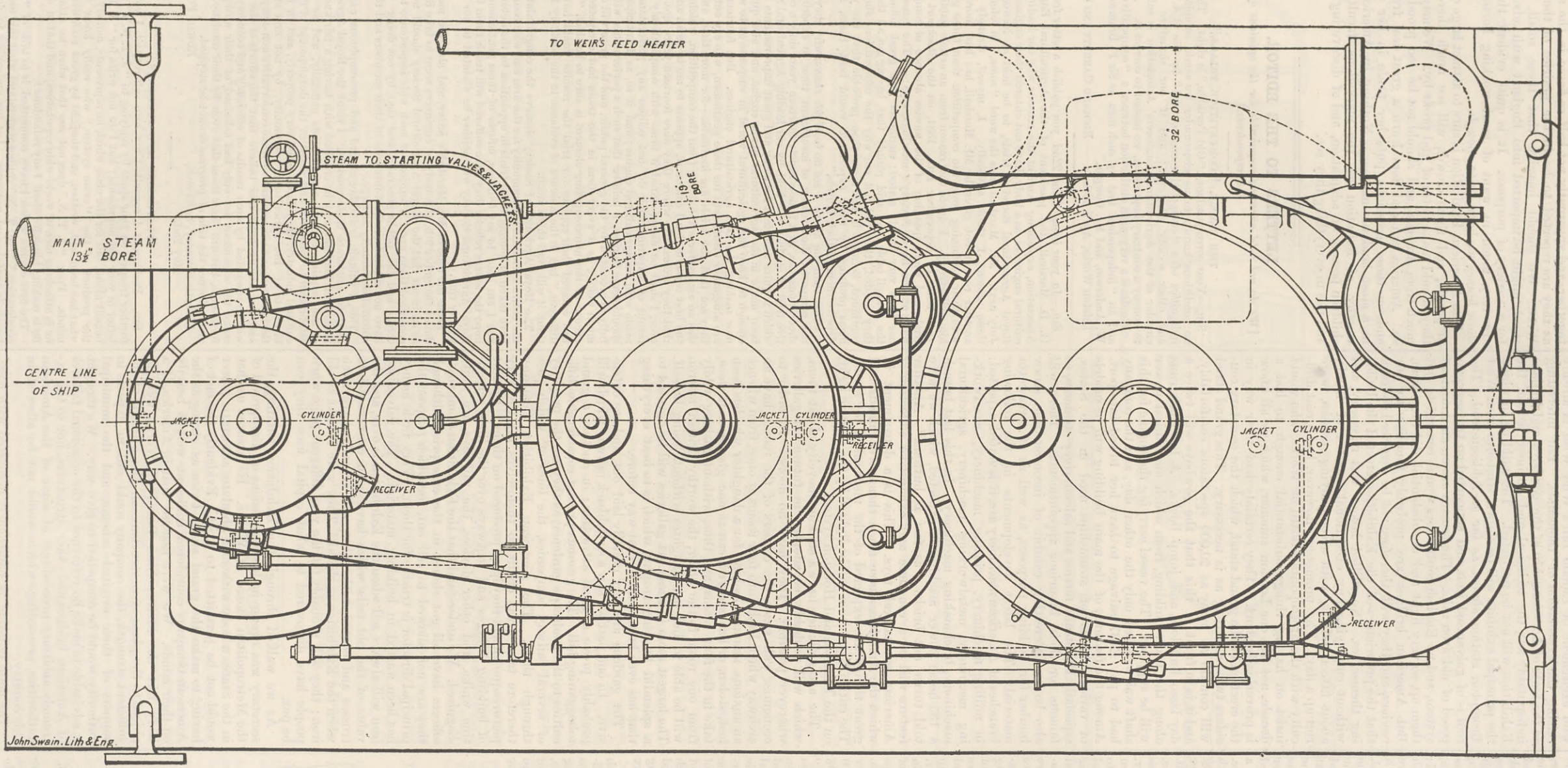
"On the other side of the present harbour is being formed the new seaside station, one of the chief features in the changes that are to be made. This station erected on a new extended quay, which will enable the largest packet boats to come alongside in all states of the tide, and which is specially sheltered by Cape Grisnez, will be of great benefit to travellers. The access will be easy, and the unloading of cargo very speedy. Travellers will have a comfortable refuge while this operation is going on, and thanks to the link line which the Northern Railway Company is constructing, and which will save the journey into Boulogne, they will reach Paris in five hours and twenty minutes after leaving Dover—that is to say, in seven hours and twenty minutes after leaving London, and even in seven hours, if the Sleeping-Car Company realises its scheme of organising trains which will Leave Paris and London at four in the afternoon, and arrive by eleven at night.

"Two towns are thus being formed into one, which will be the largest and best situated centre of population for commerce and traffic with England along the whole of the French coast. The harbour works comprise new wet docks, with a surface of twenty-seven acres, and with a depth which will enable the largest ships to enter and obtain all they require. One of the finest refitting docks which exist has just been completed.

"The outer harbour, which is as large as the wet dock, has a minimum depth of 7½ metres, The dry dock, which will accommodate men-of-war or merchantmen of the largest size, can be filled or emptied with great rapidity, an engine of 900-horse power emptying it in less than two hours. The foundations now being laid for the machine would be taken at first sight for a fort. More than 70,000,000f. will be laid out on them, the expense being shared by the State, the department, the town, and the French and the English railway companies."

TRIPLE EXPANSION ENGINES OF THE OROYA.—PLAN.

THE BARROW SHIPBUILDING COMPANY, BARROW-IN-FURNESS, ENGINEERS.



STEAMSHIP OROYA.

In our impression for March 25th we published the first of a series of engravings of the Pacific Steam Navigation Company's Royal Mail steamer Oroya. This week we publish engravings of her machinery. The Oroya is the second vessel of her kind which the Pacific Steam Navigation Company has recently added to its large and magnificent fleet, and is intended to ply between London and South Australian ports in conjunction with the steamers of the Orient Steam Navigation Company. The sister vessel, Orizaba, has completed her first voyage with remarkable success, and is again on her way out to the antipodes. The Oroya, which started for her first voyage on the 17th March, reached Adelaide after a rapid and most successful run.

Both these steamers have been constructed at Barrow by the Barrow Shipbuilding Company, which has turned out a large number of very successful vessels of that class. These vessels are undoubtedly the finest of the Pacific Steam Navigation Company's fleet, and may be fairly entitled to rank among the best examples of modern naval design. The remarkable success which these ships have achieved, both upon the official steam trials and at sea, cannot fail to add to the reputation of the builders.

The Oroya is 460ft. in length, 49ft. in breadth, and 35ft. 6in. depth of hold, and has a gross register tonnage of 6200 tons. She is fitted for the reception of 126 first-class and 154 second-class passengers in the state-rooms, which extend along nearly the whole range of the main deck, and has also accommodation for over 400 emigrants in the 'tween decks below. Forward of the machinery compartments is situated the first-class saloon and a spacious apartment 32ft. long communicating by a handsome staircase with an elegant drawing-room and a comfortable smoking-room in a broad deck-house overhead. The second-class saloon, which is aft, is about 28ft. long, and, like that of the first class, extends the whole breadth of the vessel. There is a handsome smoking room above, and in point of comfort and fulfilment of the wants of intending voyagers no pains have been spared to make this after cabin, no less than the forward one, as desirable a place of abode as life on the ocean will admit of. The first and second-class passengers are berthed in two-berth, three-berth, and four-berth family state-rooms in the vicinity of their respective saloons, and are provided with every possible convenience and luxury. The saloon state-rooms and passages are well lighted and ventilated by handsome sky-lights, deck-lights, and large side-lights, and by means of T. C. Green's patent system of artificial ventilation, which is applied to the whole of the cabin accommodation, a current of cool air may be set up at will. At night the vessel will be lighted by electricity by means of 400 incandescent lamps, the effect of which adds to the comfort and appearance of the already handsome saloons. The arrangement of the pantries and bars and other conveniences for the cooking departments and stewards is of the best description, and a complete system of pneumatic bells runs through the ship. Around the machinery casings on the upper deck are berths for the officers, engineers, and other officials of the ship, as also for the firemen and servants, the crew being berthed below the main deck right forward. At the after end, and covered by a long turtle back, are the after wheel-house, a hospital, and the wash-houses and other conveniences for the emigrants, a stairway for the latter leading to the quarters below. Abreast of the machinery openings, and beyond them to the end of the first-class drawing-room, the top of the deck-house is carried out to the side of the vessel, forming a magnificent promenade 178ft. long with sheltered walk below.

The after end of the vessel is covered by a turtle back, which is carried forward to the after-hatches, and forms a promenade for the second-class passengers scarcely inferior to that of their fellow-voyagers forward. The fore-end of the ship is finished by a turtle back for working the anchors similar to that aft, and having store-rooms, wash-houses, &c., below it. The hatchways, of which there are two forward and two aft, are arranged as stairways for the use of the emigrants who are berthed on the lower deck. Above the promenade deck, forward of the funnels, is the captain's house with flying bridge above, and in wake of the foremast is arranged a second look-out bridge for use in foggy weather, having the side-lamps fitted in small towers at each end. The vessel's rig is that of a two-masted fore and aft schooner. For the convenient working of the ship steam has been called into use wherever possible; steam windlass, steam steering gear, with connections and telegraphs to poop deck, promenade deck amidships, and flying look-out bridges with the hand steering gear, all form prominent features in the general design. The steam winches are of very heavy construction.

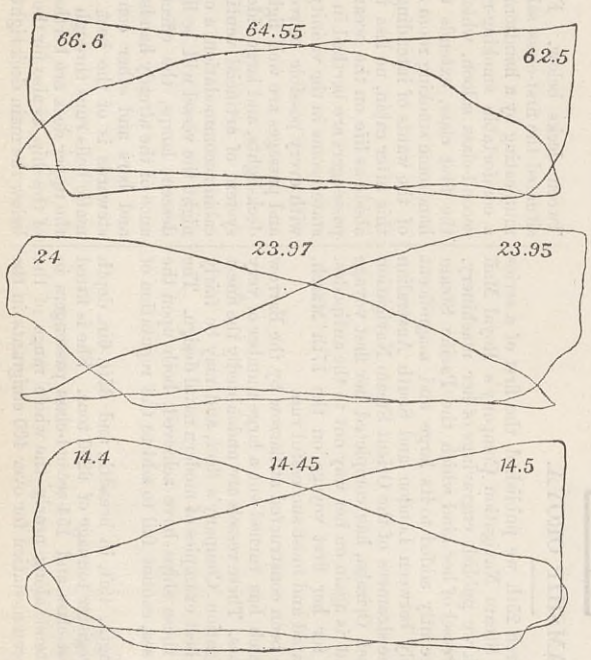
In addition to the luxurious manner in which the vessel is fitted up for passengers, she also carries over 1000 tons of cargo; and in view of the increasing trade in meat from the antipodes to this country, there is provided on the orlop deck aft freezing machinery of the most modern and approved description.

The Oroya has been built under the special survey of Lloyd's and the Liverpool Underwriters' Registries, and has received the highest classification.

The engines are of the triple expansion type, with three inverted cylinders working on three cranks. The high-pressure cylinder is 40in. diameter, the intermediate pressure 66in., and the low-pressure cylinder 100in. diameter, with a stroke of 72in. Each cylinder is fitted with a hard close-grained cast iron liner, 1⅛in. thick, secured to the bottom of the cylinder by countersunk screws, and fitted with an expansion joint at top. The space, which is 1in. wide, between the liner and the body of the cylinder, is used as a steam jacket. Steam at boiler pressure is admitted to the high-pressure jacket, and, at pressures of 100 lb. and 30 lb. respectively, to the intermediate and low-pressure jackets. All the cylinders are fitted with the usual manholes, escape valves, drains, and indicator cocks, and the intermediate and low-pressure receivers with safety valves. The jackets drain to water traps, with pipes to the condenser. Auxiliary starting valves are fitted to the intermediate and low-pressure cylinders. The cylinder covers are hollow and well ribbed, and after casting were thoroughly annealed. The pistons, which were also annealed, are fitted with MacLaine's rings and springs. All the cylinders are fitted with piston valves, the high-pressure valve being 22in. diameter, the intermediate-pressure cylinder having two valves, 22in. diameter, the low-pressure cylinder

valves being Thom's patent, 32in. diameter, and all the valves are balanced by pistons attached to the top ends of the valve spindles. Hughes' metallic packing is used in all the stuffing boxes of the piston and valve rods. The top halves of the excentric pulleys are made of cast iron, the bottom halves being wrought iron, the excentric straps are lined with brass rings, secured by countersunk pins. The reversing engine is on the direct-acting "push" principle, with oil cylinder and pump fittings for working by hand. The crank shaft, built of mild steel, was made by Vickers, Sons, and Co., the bearings being 21in. diameter and 23in. long, the crank pins 22in. diameter and 20in. long. The shaft is made in three pieces, reversible and interchangeable, and bolted together with solid couplings, 5½in. thick by 39in. diameter, the coupling bolts, nine in number, in each coupling being 4¾in. diameter. The tunnel shafts, 20in. diameter, and the thrust and propeller shafts, 21in. diameter, were also made by Vickers, Sons and Co., of steel; the propeller shaft is cased with brass for the whole length of the stern tube; the rings were slipped on in sections, and are lap jointed with burnt V joints. The thrust block is fitted with horse-shoe rings of cast steel, faced with Kingston's white metal, all the rings being separately adjustable; the bottom of the block is used for circulating water for cooling purposes. The tunnel-bearing blocks, two to each length, are of cast iron, lined with Kingston's white metal. The shafting is so arranged that the propeller shaft can be withdrawn readily and easily, the after length of tunnel shaft being short for this purpose. The piston-rods, which are carried up through the top cylinder covers, are 9½in. diameter, and made of best mild steel, are fitted into each piston with a cone, having a collar below and a nut above, and all the piston-rods are interchangeable. The connecting-rods are forged from mild steel, with double bearings at the top ends, the lower ends being bushed with gun-metal lined with white metal. The diameter of the top end of the rod is 8½in., and the lower end 10in. The condenser, which forms part of the structure of the engine, is made of cast iron in three pieces, bolted together; the columns for supporting the cylinders are also bolted to the condenser. The tubes, which are in two lengths, are 10ft. 6in. long between tube plates, the condenser being divided in the middle into what is practically two condensers. The tubes, ¾in. external diameter, No. 18 b.w.g. thick, 5604 in number, have a cooling surface of 11,546 square feet. The condenser may also be worked by jet injection. The air pumps, two in number, are 30in. diameter by 33in. stroke, worked from the low and high-pressure crossheads by levers and links. The barrels, buckets, and seats are made of brass, the valves being india-rubber; the rod of manganese bronze is attached to the crosshead, and guided by strong brackets bolted to the cover. The feed and bilge pumps, two of each, are worked from the air-pump crossheads, with plungers 7in. diameter, and made entirely of brass. The valve-chests and valves, of large size, are made of brass; and to each air-pump crosshead is also attached a sanitary pump with 4½in. plunger. The circulating pumps are of the centrifugal type, two in number, each capable of supplying the requisite quantity of water when the engines are worked full power. These pumps are driven by independent compound engines, with cylinders 8in. and 16in. diameter, and 10in. stroke. Weir's feed heater and engine is fitted on board for feeding the boilers. An auxiliary donkey pump of large size is also supplied for pumping from sea and bilge to boilers and overboard, and along with two fire engines, specially provided for fire purposes, may be used as a fire engine and for washing decks. In addition to these engines, a No. 7 pulsometer is fitted to draw from the sea, bilge, and ballast tanks, and discharge on deck and overboard. A special centrifugal pump driven by an independent engine, and capable of discharging 200 tons per hour, is also fitted for ballast purposes. The connections to the auxiliary engines are of the most complete description. The boilers, six in number, are of the ordinary marine multitubular type, constructed entirely of steel, for a working-pressure of 160 lb. per square inch. Each boiler is 13ft. 6in. diameter and 18ft. long, with six corrugated furnaces, having a mean diameter of 3ft. 1in. The total heating surface in all the boilers is 17,640 square feet, and the bars are 6ft. long, giving a bar surface of 627 square feet.

During the very successful twelve hours' trial in the Irish Sea on January 21st and 22nd of this year, the highest indicated horse-power developed was 6751, with 64·5 revolutions and a steam pressure in the boilers of 160 lb., the vacuum being 26in. The mean speed of the twelve hours' run was 16·5 knots, the mean displacement being 8840 tons, on a mean draught of 22ft. 7in. The mean indicated horse-power for the whole run was about 6500, with 64 revolutions, and this without the



HIGH, LOW, AND INTERMEDIATE PRESSURE DIAGRAMS, S.S. OROYA.

slightest sign of heating in any of the bearings. The accompanying diagrams speak for themselves. Steam 160 lb.; vacuum, forward, 26in., aft, 25½in.; revolutions, 64; horse-power, high-pressure cylinder, 1888; intermediate, 1908; low-pressure, 2649; total, 6445.

The propeller, with loose blades of manganese bronze, securely bolted to a cast steel boss, made by Vickers, Sons, and Co., is 22ft. diameter, with a pitch of 28ft. 6in. The pitch may be varied from 27ft. to 30ft., the flat area of all the blades being 149·6 square feet.

THE AMERICAN EXHIBITION.

This Exhibition, which will be opened on May 9th, will probably be in some respects one of the most interesting show places accessible to the ordinary Londoner. The wild excitement of Buffalo Bill's Wild West is already raising the expectation of thousands. But interesting as the feats of horsemanship of the cowboys and Indians indisputably are, the technical and business part of the Exhibition will not be neglected. The building in which the principal exhibits will be shown stretches from West Brompton station almost as far as Addison-road. The roof is of galvanised iron, and supported on trusses composed of old iron rails. The trusses are on an American system, and no English contractors would consent to put them up, so very light and unsubstantial did they seem. But American bridges are probably familiar to our readers, and they will therefore not be surprised to learn that the proprietors of the Exhibition erected the building themselves. No skilled labour was necessary, and without employing any exceptional number of hands, about fifteen pillars, with accompanying trusses, were run up a day. The promoters, however, had great difficulty with the Metropolitan Board of Works, who would insist on having things substantial enough to last a decade, not just one London summer, which we all know is proverbially short. They certainly had their way in the erection of the grand stand, which the secretary considers twice as strong as is necessary. This grand stand will contain as many as 20,000 spectators comfortably, and it is in front of this that the cowboys will twice a day lasso buffaloes, and jump bucks. A lay shaft runs along the main building, from which mechanical power will be supplied. The vessel carrying the engine for this shaft was wrecked only the other day, and the company had to pay £137 salvage to have her towed into port. Among the features of the main building will be models of various kinds of steamships used in the States, especially the steam ferries and saloon river steamers, so famous for their luxurious appointments. There will also be an interesting exhibit of incombustible straw lumber for building purposes, as well as of terra-cotta material. The latest developments in the following branches of American machinery are, it is stated, expected: in milling machinery, printing machinery, woodworking machinery, metalworking machinery, agricultural machinery, brickmaking machinery. In this last branch a 135-horse power machine is expected, which we were told turns out bricks "as fast as buttons." Another feature will be a complete and exhaustive collection of American mechanical toys. This is a department in which the Americans have made themselves famous, and great things are expected of the mechanical toy stand. The entire Exhibition will be lighted by the electric light, on the Thomson and Houston system.

The art galleries have a striking novelty about them, which will probably be adopted in future art galleries wherever possible. They have no doors. In order to economise wall space, the corners of the rooms have an archway which leads into four rooms at once, from whence an anxious mamma looking for a daughter who has been lost, stolen, or has strayed, can at one glance, as it were, take in the four rooms, and thus, without rushing wildly from one room to the other, the worthy British matron will be able to find her daughter without losing herself. The largest room in these art galleries will be devoted to a splendid hunting trophy, which is to beat everything that has ever been done in that way before.

The gardens are very prettily laid out, and are extensive. In one part we saw a switchback railway which will probably prove a great attraction; in another a grand tobogganing hill. The grounds present considerable difficulties to the landscape gardener, as they are the property of several railway companies, the lines of which pass through them. The American Exhibition Company therefore take great credit to themselves for the very picturesque effects they have produced on them. By dint of building bridges and footways over the lines, serpentine walks, and other devices, the railways are quite disguised. We understand that the Exhibition Company's officers have all got shares in the enterprise, although they are not allowed to sell out, for which purpose the principal director is trustee for them. Very little money has been wasted in building materials. The galvanised iron will always sell when the Exhibition is over, and the value of the old rails which have been converted into trusses and coated with paint, will actually have risen when the Exhibition is closed. They were bought as old iron; they will probably fetch a very different price when people have discovered to what capital uses they can be put.

As we walked through the Exhibition building, the secretary was strong in his expressions of disapproval of the Metropolitan Board of Works. He assured us that in the States a body with such absolute autocratic power would not be permitted to exist. Evidently the fact of having to make the grand stand twice as strong as the American Company considered sufficient weighs heavily on their minds. We were assured that in America, if a body like the Metropolitan Board of Works were to object to the plans of a structure on the grounds of insufficient strength, the company could call in experts in support of their original scheme, and the municipal authority would be compelled to give way. We thought it advisable to make no reference to the occasional failures of American bridges and other structures, nor to the extremely arbitrary proceedings of some of the American authorities, proceedings which would not be allowed in this country.

The main building is handsomely decorated with flags, workmen are busy running up stands, and everything has an appearance of activity and bustle. Things seem well advanced, and there is every reason to believe the Exhibition will be ready for opening on the 9th inst.

The encampment of "Buffalo Bill," or Colonel the Honourable W. F. Cody, as his real name is, presents many features of interest. The stables are of galvanised iron, and will, we fear, be found very hot in the summer. The tents are the pictures of neatness, and some are even luxurious in their furniture, carpets, &c. We were very much struck by the workmanlike appearance of the small, wiry horses, clever-looking animals, well put together, and apparently not half so fierce in the stables as they are reported to be in the prairies of the Wild West. We should imagine that these small, hardy steeds might be imported into England with advantage for a variety of purposes. It is quite evident that we are very much in want of good working horses. Of show horses we have quite enough.

The American Exhibition is sure to attract large crowds of people, and these crowds will see much there that they should make notes of and profit by. We may learn much from America, and should not be too proud to do so. America can and does learn a great deal from us, and on those occasions puts her pride in her pocket in a most laudable manner. Nothing in America is so worthy of imitation as the marvellous faculty her children possess of adaptation, and of discovering profit and use in everything they see.

LETTERS TO THE EDITOR.

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

THE R.A.S.E. "COMPETITIVE TRIALS."

Sir,—Your correspondent, "Old Portable," is right. There are no conditions known to us whereunder we would submit to the indignities of a "competitive engine trial" by the R.A.S.E. or any other society whatever; and if our signature to the circular of the Agricultural Engineers' Association is calculated to convey a contrary impression, we hasten to correct it.

We draw a very wide distinction between a "competitive trial" and an "independent test by such men as Sir F. Bramwell, Mr. W. Anderson, and Mr. Cowper."

Leiston Works, April 30th. Richard Garrett and Sons.

Sir,—In your issue of the 22nd you publish a letter from Mr. H. D. Marshall, the president of the Agricultural Engineers' Association, explaining some of the reasons why our leading agricultural engineers, as a body, have not entered their engines in the Royal Agricultural Society's trials, to be held at Newcastle in July next. Mr. Marshall uses the word "some," in reference to these reasons, I think advisedly. I, myself, strongly believe another reason, not given by Mr. Marshall, has had more to do with their abstaining from the competition than those given by him collectively. I quote this reason from an article published in your issue of September 19th, 1884, on the Stockport engine trials, and when speaking of the unwise absence of competitive trials at the Royal Society's meetings, says:—"The reason why has been very plainly stated; engineers with great influence at the council table have said plainly that, having got all the prizes they needed, they did not see why the competitions should be continued, because it was more than probable that the younger firms profiting by their experience would beat them, and so deprive them of their laurels."

Other than the above I see no *bonâ fide* reason why they should not compete; their reason of insufficient time to experiment is sheer nonsense, as it is now nearly fourteen years since a competitive trial of engines was held by our leading Agricultural Society, which is quite sufficient for many and great improvements to have been made in the agricultural steam engine, and also quite long enough to keep the agricultural world in suspense as to who are now making the best agricultural engines. But fourteen years are altogether insufficient for these gentlemen, who cry out—when they see that the trials are inevitable—for more time, and make this an excuse for withholding from the competition, which, to put the best construction I can on it, appears to me to be an admission that they are exactly where they were fourteen years ago. However, I shall be disappointed if firms with comparatively limited means of experimenting do not eclipse any performance ever made with an agricultural engine; and if so, as I anticipate, this should come to pass, I believe that such a performance will be as fully appreciated by the general public, and the prize will carry as much weight as if every firm in the trade had competed. The excuse of the non-competing element is sure to be that, "If they had entered their engines for trial the results would have been different," but in the absence of evidence to the contrary I do not think it will avail them much.

The Royal Agricultural Society deserve the congratulations of the entire agricultural community for the firm and wise course they have taken in holding these trials in opposition to the determined, but I am glad to say fruitless, efforts of these gentlemen, and I hope the severe rebuke they have suffered will teach them that the Royal Agricultural Society will neither be dictated to nor coerced by any ring.

From the tone of Mr. Marshall's letter, and also the memorial, dated December 9th, this body of engineers seem to take it almost as an insult that the Royal Agricultural Society should not have consulted them upon a subject of such wide importance to themselves and the public generally, and that by not doing so they have not studied the best interests of their members and the agricultural community at large.

This, I submit, is another absurd and presumptuous excuse set forth to exonerate their conduct. I think the Royal Agricultural Society of England may be credited with having a fair knowledge of the requirements of agriculturists generally, and as a body established to promote and assist in the development of the agricultural industry, they have acted very properly, and in the best interests of the agricultural community, by not first studying the interests and convenience of these conservative non-competitors, and I sincerely hope and believe that the efforts of the Society will be rewarded by such results of efficiency and economy as will make the absentees not only feel ashamed of their antique performances, but will show them that even by their combined power and influence the tide of progress cannot be stopped.

Elworth Foundry, Sandbach, May 2nd. Edwin Foden.

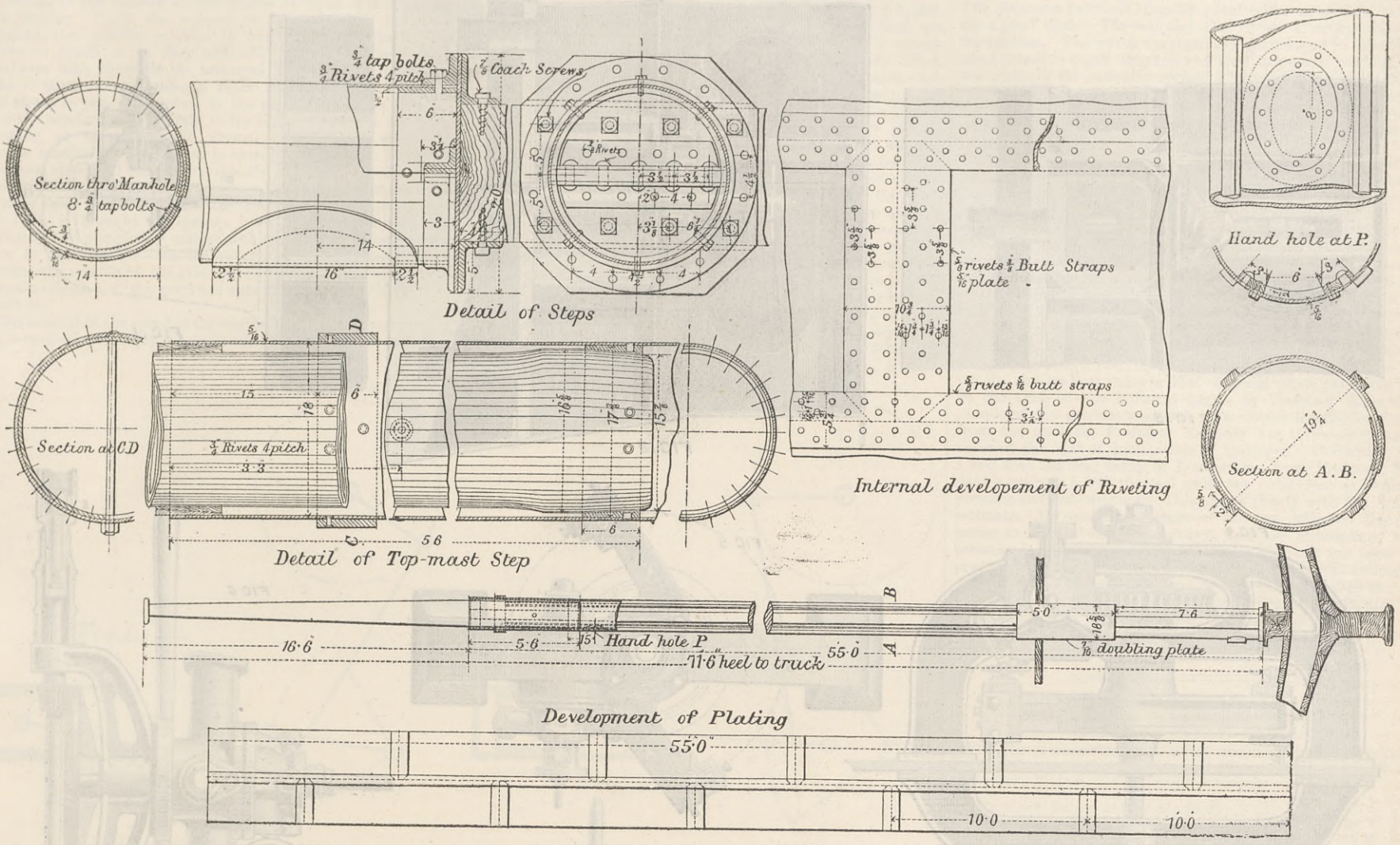
PROFESSORS AND STUDENTS.

Sir,—Perhaps if I consulted my own self-respect I would not further trespass on your space by replying to "J. T. N.'s" flippant letter in your last impression; but I do not write for "J. T. N.'s" benefit alone, but for the class which he represents, namely, a class the product of the "cram system," who really know little of what has been said, written, and thought by great men with great minds. Poor "J. T. N." does not see that when he attacks me he is attacking men of world-wide reputation, and that in doing so he is making himself—shall I say ridiculous?

The first offence which I have committed is to talk of "rate of acceleration." "J. T. N." cannot understand what this means; to him it is tautological nonsense. Let me endeavour to enlighten him. If a body A has an accelerated velocity of 2ft. per second, per second, while B has an accelerated velocity of 4ft. per second, per second, then it is said that the rate of acceleration of B is double that of A. That is one meaning of the words.

Now as to my authority for using it. If "J. T. N." will turn to Rankine on "The Steam Engine and other Prime Movers," a book of which he may have heard, he will

CONTRACTS OPEN.—STEEL MASTS FOR FLOATING LIGHTS.



find on page 19 the following passage:—"If the *acceleration be at any different rate per second*, the force necessary to produce that acceleration, being the resistance on the driving body due to the acceleration of the driven body, bears the same proportion to the driven body's weight which *the actual rate of acceleration* bears to the *rate of acceleration produced by gravity* acting freely." Further down we have, "Let *f denote the rate of acceleration.*" On page 20, "If the *rate of acceleration* is not constant but variable," and again, "The work performed in accelerating a body is the product of the resistance due to the *rate of acceleration* into the distance moved through by the driven body while the acceleration is going on."

Perhaps your correspondent will now withdraw his implication that I am an ignorant blunderer, and will admit that one of the most eminent mathematicians and the cleverest thinkers that Great Britain has produced has given me authority for using the words, "rate of acceleration." But perhaps "J. T. N." knows all about it, much better than Rankine did, and does not agree with Rankine?

I do not feel called upon to answer your uncourteous correspondent at any length, and he has himself said that he will be satisfied if I deal with one of the three points he has raised. He has had his answer concerning No. 1. Concerning No. 2 I can only regret that he is so obtuse that he cannot discover my meaning. It seems to me clear enough. As to No. 3, it appears that I have hurt his susceptibilities by saying that "as far as physics are concerned, the great thing we have to deal with is energy." "J. T. N." is angry because I have relegated matter to a second place. Will "J. T. N." kindly tell me what he knows about this matter of which he talks so glibly, apart from motion? If he can prove that he knows anything whatever, that any evidence of any kind concerning it or its existence has ever reached his brain, without the direct or indirect operation of motion, then I promise to admit that "J. T. N." knows more than any other man on earth; that he has really seen, not the picture of a thing on his retina, but the thing itself; that he has handled and examined matter at a temperature of — 461·8 Fah., and that he is blessed with powers of perception akin to the supernatural. Only, before he sets about his proofs I would ask him to read a little paper by Professor Crookes, "Matter Dead;" also let me quote Faraday for him: "What do we know of an atom apart from its force? You imagine a nucleus which may be called *a* and surround it by forces which may be called *m*; to my mind the substance consists of the powers *m*, and indeed what notion can we form of the nucleus independent of its powers? What thought remains on which to hang the imagination of an *a* independent of the acknowledged forces?"

But perhaps "J. T. N." knows more about these things than either Faraday, or Ampère, or a great many others.

Finally, to answer one more question. Energy *is* motion, and as nothing but motion can cause motion—or else the law of the conservation of energy is untrue—therefore energy in variety is not only motion, but is due to motion.

Perhaps "J. T. N." will favour your readers with facts and illustrations proving the contrary. Before attempting this, however, let him read, say, for six months. Let him turn to text-books and learn what professors have to say about the kinetic nature of energy. Let him learn something concerning chemical dynamics and kinetics. Let him, in a word, endeavour to teach himself something of what is going on in the world of science outside the narrow limits of the class-room.

As I have said before, I do not write for "J. T. N." alone, but for a class of young men, the results of whose education is a standing proof of the accuracy of my criticisms on the modern system of teaching.

J.

London, May 2nd.

SIR,—Your correspondent, "J. T. N." is confusing Matter with Mass. Dynamics and kinetics take no cognisance of Matter. They take cognisance of Mass. I am surprised that so rigid a stickler for minute accuracy should fall into the vulgar errror of confounding Matter with Mass.

W. SHAIRP.

Glasgow, May 4th.

COLOUR BLINDNESS AND ENGINE-DRIVERS' EYESIGHT.

SIR,—As Mr. Stretton has answered my letter of 16th inst., and asks for a few explanations, I shall, by your permission be most happy to answer his questions.

I do not desire to say much about the distance tests, but in passing, may say I have seen men tested for distance, by better means than the dot system. The main point of my letter was intended to be the colour tests. Mr. Stretton says, "a man may be perfectly able to see spots on a card, and sort various colours of wool, and yet be unsafe upon an engine." If this is the case, as Mr. Stretton states, I am sure the error will be in the distance and not in the colour. I said in my letter of 16th that "there is more in the question than he—Mr. Stretton—seems to think," and this gentleman wishes for an explanation, which I give readily. Your correspondent says in his letter of 15th that "Mem. Inst. M.E. . . . . states that he has known several instances of colour blindness," and goes on to say, "my—Mr. Stretton's—experience is quite contrary." I then point out how the Belgian State Railways, made a most thorough test of their men, and how the German Railway Union found ·72 per cent. of their drivers and firemen colour-blind; thus showing how some large railway undertakings found colour blindness to exist among their servants to a considerable extent, against Mr. Stretton's one man in twenty years.

The naming of the colours is quite unnecessary—from an ignorant man such a requirement would be unjust; but by all means let him arrange the shades according to intensity as Prof. Holmgren prescribes. To trust only to flags and lanterns is very dangerous, as it is perfectly possible for a man whose vision is abnormal, to indicate the colours rightly in such tests, as is most extensively pointed out in works on colour blindness; and it is this point I wish to lay stress upon, and to which I would draw Mr. Stretton's most particular attention, as it is in such a matter that theory steps in to help practice.

JOHN PLACE.

May 3rd.

SIR,—It is very satisfactory to find that a number of engine drivers and firemen on the North-Eastern Railway who failed in the recent "dot and wool tests," and to whom you referred in your issue of 18th March, were on Sunday, 24th April, re-examined, the test applied being those suggested by the men themselves, namely, the practical test of ability to see signals at the required distances. And the result was that drivers who had been removed from engines because they failed to pass the dot and wool test proved that they could see signals at 1000, 750, and 500 yards. It is satisfactory that a practical test has thus been admitted to be the most reliable and fair, and doubtless justice will now be done to the men by their being replaced in their former positions.

CLEMENT E. STRETTON,
Consulting Engineer Amalgamated Society of Railway Servants.

St. Pancras Hotel, London, N., May 2nd.

CONTRACTS OPEN.

STEEL MASTS FOR FLOATING LIGHTS.

THE work included in this contract consists in the construction and supply of six steel masts for floating lights for the Trinity House. Tenders are to be delivered at the Trinity House, London, E.C., on or before Thursday, May 12th inst., addressed to the secretary of the Corporation of Trinity House, and marked on the outside "Tender for Steel Masts."

The specification describes the masts and provides for the finding of all material and labour in the construction of six steel masts for light vessels, and delivering the same at the Trinity Buoy Wharf, Blackwall, Yarmouth, or Neyland, in accordance with the drawing, No. 6049, from which our engraving is prepared.

The masts, which are to be wholly of steel, are to be completed on the contractor's premises, and weighed in the presence of the superintendent. Due notice is to be given to the Corporation when ready for inspection, and after the same have been approved by the engineer-in-chief to the Corporation, the whole of the work is to be thoroughly cleansed from rust and then painted with three good coats in pure red and white lead paint. Samples of the steel to be submitted for test and approval, to be of the best quality of Siemens-Landore steel, and to bear a mean tensile strain of 30 tons per square inch of original area, with a mean contraction of not less than 50 per cent. at the point of fracture. The rivets throughout to be of steel, to be a good fit in the rivet-holes, and rivetted as hereinafter specified. The masts are to measure 55ft. in length by 18in. external diameter, to be made in two plates circumferentially and six plates in height as shown, and to be perfectly cylindrical, parallel, and true. The plates are to be $\frac{5}{16}$in. thick, double rivetted vertically on double butt straps with $\frac{5}{8}$in. rivets spaced $3\frac{1}{4}$in. apart, the butt straps to be $\frac{5}{16}$in. thick. The horizontal joints are to be treble rivetted on single butt straps, $\frac{5}{8}$in. thick, with $\frac{5}{8}$in. rivets spaced $3\frac{3}{8}$in. apart, as shown. The edges of all plates are to be truly planed and close butted before being rivetted. The rivet-holes are all to be punched and afterwards made perfectly true and fair by riming, and to be countersunk on the outside. At a distance of 7ft. 6in. from the heel the masts are to be doubled for a depth of 5ft., with $\frac{7}{16}$in. plate as shown for taking the wedging at the level of the main deck. Four lantern guide bars of the form and dimensions shown on the drawing, planed on the front and two sides, are to be attached to the masts with $\frac{3}{4}$in. rivets spaced about $4\frac{1}{2}$in. apart. The rivets are to be countersunk and flush rivetted on the outside. The two front corners to be rounded as shown. The greatest care must be taken that the guides are fixed perfectly true and parallel to the centre line of the masts for their whole length. These are intended for lantern guides; therefore perfect accuracy is indispensable. The heels of the masts are to be strengthened with an internal welded hoop as shown, double rivetted to the masts with $\frac{3}{4}$in. rivets spaced 4in. apart, countersunk and rivetted flush on the outside. The upper portion of the masts is to be strengthened with a welded band as shown, double rivetted to the masts with $\frac{3}{4}$in. rivets spaced about 4in. apart, countersunk and flush rivetted inside and out. A wrought iron step is also to be fitted to the inside of the masts for carrying the topmast as shown, which is to be rivetted to the masts with $\frac{3}{4}$in. rivets spaced 4in. apart, countersunk and rivetted flush inside and out. The topmast, which is of wood, is not included in this specification. A manhole, with cover, is to be provided at the foot of the masts, as shown, and a hand-hole in the upper part, as also shown. The mast steps are to be made to the form and dimensions shown, and to be a good close fit to the masts. The necessary bolts, nuts, and other fastenings, as shown, are to be supplied.

THE LATE GENERAL GORDON AND BERTHON BOATS.

A MELANCHOLY interest attaches to two letters written by General Gordon and in the possession of Mr. E. L. Berthon, secretary to the Berthon Boat Company, Romsey. The copies of these letters, which we give here, explain themselves:—

Kartoum, 6th May, 1877.

My dear Sir,—Your boats are well known to me, but I know no details of them. I send to England Mr. Geigler, care of Miss Gordon, 5, Rockstone-place, Southampton, to buy me four or six or eight of your boats, largest size; the number depends on the price.

I want them quickly. I believe you supply a large-sized boat to H.M. Navy. Mr. Geigler will go into details as to masts, stores, &c. &c. Perhaps if you are making boats for H.M. Navy, it may be arranged to let me have them, and the Navy might wait.

My brothers—one at Woolwich Arsenal, the other a colonel, R.A.—have interest with Admiralty, and might manage it. Economy and quick dispatch is what I want.

Yours sincerely,

C. E. GORDON.

Geigler will be England (D.V.) in July.

Massowah, 17th May, 1878.

My dear Sir,—(1) The eight boats, with all you sent with them, have been burnt at Lardo.

(2) I see by enclosed letters their price was £15 each, making a total of £120; but I expect there were some extras that you sent which would increase the expense. Please make me out a fresh lot of eight boats and a fresh lot of the extra stores. Please send them to Suakim *viâ* Canal. There are boats from England which trade through the Canal to Jeddah. Simla is *vis-à-vis* to Suakim. I think the line is British India.

Please send bill for boats, for extras, and for freight to my sister, who will pay the amount.

Believe me, dear Sir, yours sincerely,

C. E. GORDON.

A TELEGRAM from Washington reports that the Nicaragua Congress has ratified the Menscal contract for the construction of the Nicaragua Canal.

FONTAINE'S HYDRAULIC DRILLING MACHINERY.

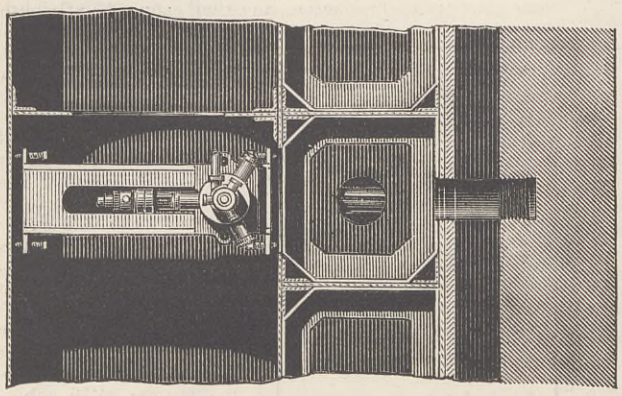


FIG. 3

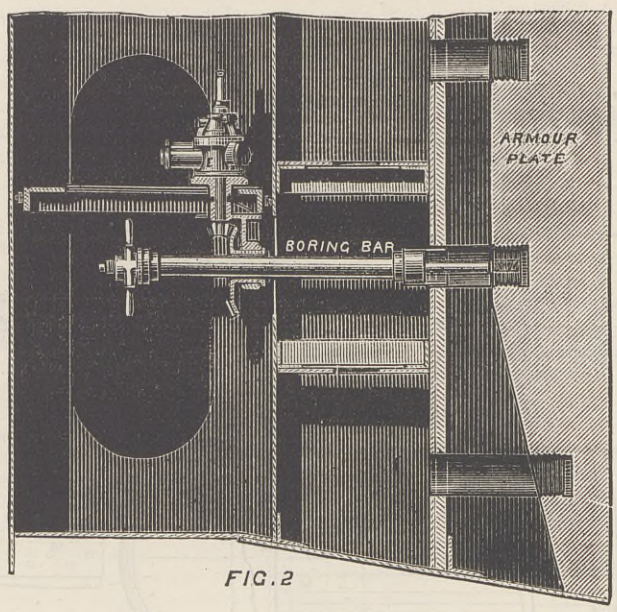


FIG. 2

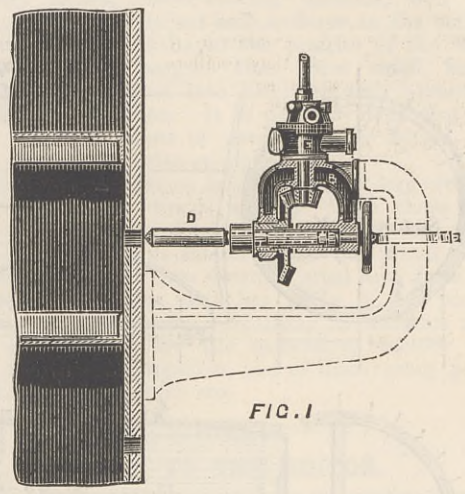


FIG. 1

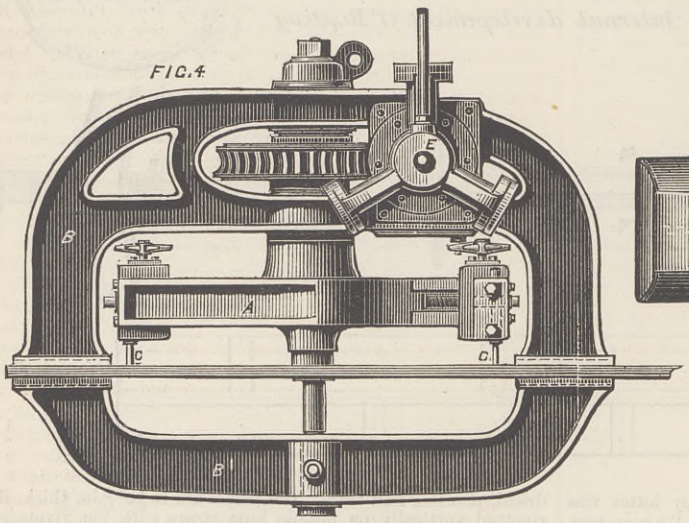


FIG. 4

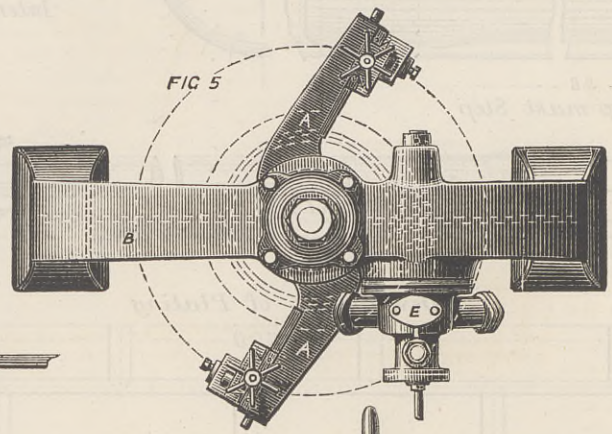


FIG 5

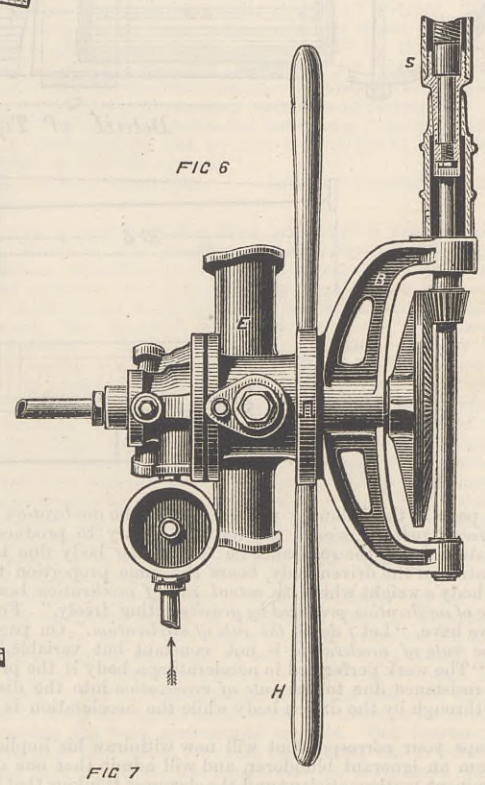


FIG 6

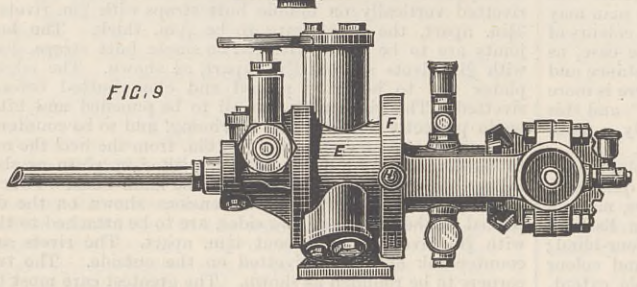


FIG. 9

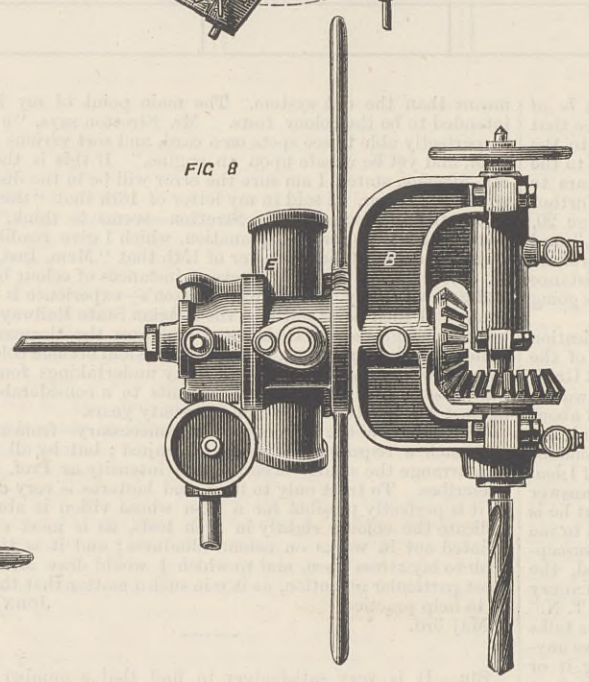


FIG 8

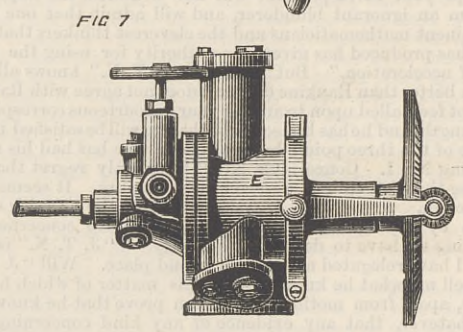


FIG 7

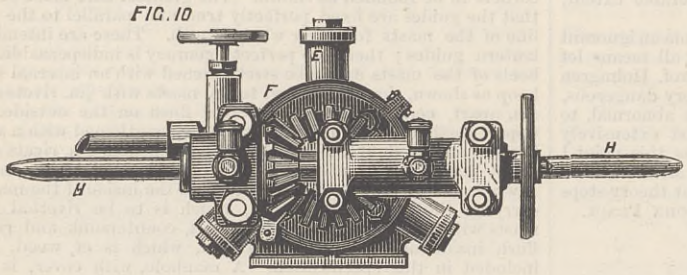


FIG. 10

HYDRAULIC DRILLING APPARATUS.

The machinery which we illustrate is made under the patent of M. Marc Berrier-Fontaine, whose name has for many years been known in this country in connection with his successful application at the Arsenal at Toulon of hydraulic rivetting by the aid of Tweddell's system of machinery. In addition to doing all the punching, shearing, forging, rivetting work, &c., a great deal of the lifting and transport of material is there done by hydraulic power, and amongst other machinery comprised in this plant are several Brotherhood three-cylinder hydraulic capstans; and it is this engine which Mr. Berrier-Fontaine has adapted in a very ingenious manner to the driving of drilling, tapping, and boring tools. The question of utilising the Brotherhood or other engine for the direct driving of stationary rotary machine tools had already been proposed by Mr. Tweddell in a paper read by him before the Institution of Mechanical Engineers in 1874. Of the machines from which our illustrations are taken, and which have been made by the Hydraulic Engineering Company, Chester, under Mr. Tweddell's instructions. Fig. 1 shows the three-cylinder engine E, attached to a frame B, and by means of suitable gearing, driving the drill D, a suitable feed motion is provided, and in dotted lines is shown the holding-up bracket. Figs. 2 and 3 show a special application of the same engine to boring out the holes to receive armour-plate bolts. As will be seen from the illustrations, the space in which the machine can work is very confined, but notwithstanding this the work was done nine times as fast as by hand. Figs. 1, 2, and 3 relate to machines employed on H.M.S. Victoria recently launched from the Elswick Company's yard at Newcastle-on-Tyne; and Figs. 4 and 5 show a design for cutting out the manholes, side-lights, &c., on ships or other iron structures when erected, a 1in. or 1½in. hole having been drilled in the centre of the proposed opening, a holding-bolt is passed through to connect the frames B B. The three-cylinder engine E, by means of suitable gearing clearly shown in the illustration, drives the arms A, carrying at either end cutting tools C. This not only makes an absolutely true and finished opening, but can do any hole from 15in. to 30in. diameter, and by well-known modifications can cut them oval with equal ease. In the case of Figs. 6 and 7, the drill is driven by a Stow flexible shaft; in this case, the shaft has to be speeded up to run about five times as fast as the drill itself. The gearing for this purpose is shown in the framework B, the flexible shaft being connected at S. The other end of the Stow shaft is fitted with the usual gearing to reduce the speed again. This arrangement is convenient, since it allows of the hydraulic engine being placed on the shop floor or ship's deck, while the drill is applied at any point within the range of the flexible shaft. Messrs. Doxford and Sons, of Sunderland, have one of these in their boiler-shop, and have found it very convenient. They have continued extending its applications.

Fig. 8 shows to a larger scale the engine applied to its work in Fig. 1, but with gearing for smaller holes; while Figs. 9 and 10 show side and end elevation of another arrangement of direct-acting drill. With the exception of those illustrated by Figs. 1, 2, and 3, which work at 750 lb. on the square inch, all the machines in this country work at 1500 lb. on the square inch; but there is very little practical difference in the weights of the apparatus for either pressure.

The engines are as a rule made in two sizes, viz., of either 1-horse or of ½-horse power, and weigh approximately 2½ cwt. and 1½ cwt. respectively, with all gearing complete. Generally it may be said from the experience gained—hitherto chiefly by M. Berrier Fontaine himself—that when these machines are used, 25 per cent. more holes can be drilled in the same time *in situ* than can be done when plates have to be marked off there, and taken to and fro to a stationary drilling machine in the shop.

Compared with ratchet brace and hand work, the work turned out is at least seven to eight times greater. This has been also amply confirmed in this country apart from the question of manual speed of turn out. In one instance the cost per dozen of drilling some holes in boiler work was reduced from 1s. 4d. per dozen by hand to 4d. by the machine. Mr. Tweddell has also introduced many other applications, and as there are but few works of any magnitude which are not now fitted up with hydraulic pressure on his system, there seems a promising field for the use of M. Berrier Fontaine's very neat invention.

The War-office authorities are experimenting with a polycycle machine which carries twelve riders in Indian file, and carries them easily at ten miles an hour, and hauls in addition a light wagon or ammunition cart.

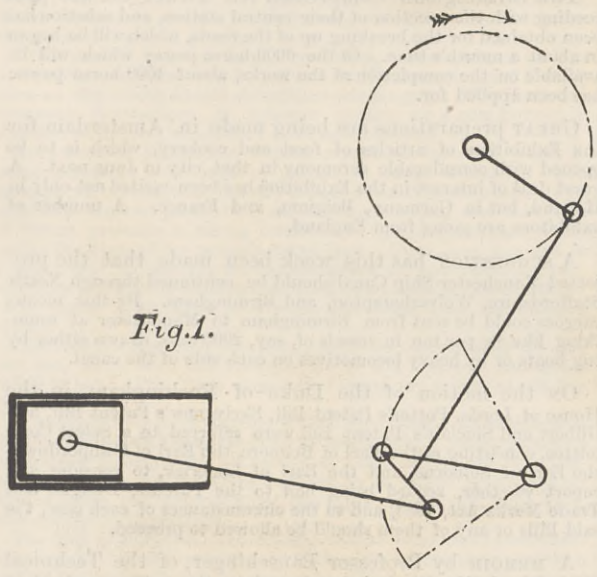
ROLLING MILL ENGINE WITH VARIABLE EXPANSION.

The rolling mill engine illustrated on pages 349 and 352 was constructed in 1885 to replace a smaller one of the ordinary Lancashire type at the works of Messrs. Fox, Head, and Co., of Middlesbrough. Being confined to the position of the old one, variation in size and in details was admissible, but not in general form. The mills to be driven were one clutch-reversing plate mill, with rolls 26in. in diameter by 7ft. 6in. long, and one three-high mill, with rolls 24in. and 18in. in diameter by 6ft. 2in. long. Upon the middle of the engine crank shaft is a fly-wheel 25ft. in diameter, and weighing 35 tons, and at the far end is a steel pinion 4ft. 8in. in diameter by 1ft. 8in. broad. Through this pinion the whole power of the engine is transmitted to the mills. The pressure of the steam supplied is 60 lb. per square inch above the atmosphere, and the normal number of revolutions is fifty-five per minute. The main cylinder is 48in. in diameter, and the stroke 54in. Both body and covers of the cylinder are steam-jacketted. The slide is of the kind known as the Trick valve, the steam passages being double and the exhaust single-ported. The engine frames are hollow, but exceedingly strong and massive. They are brought direct from the front of the cylinder to the main bearings, which are placed at an angle of 45 deg., thus ensuring the resistance being in the line of the principal stresses. The main crank consists of a cast iron disc containing a double crank, of which the end out of use acts as a balance weight. It is, however, also bored out to receive a crank pin, in case of the other pin getting loose and wearing its socket oval, which sometimes happens. The crank disc is hooped externally with wrought iron, and is perforated at intervals to facilitate rotation when required without steam.

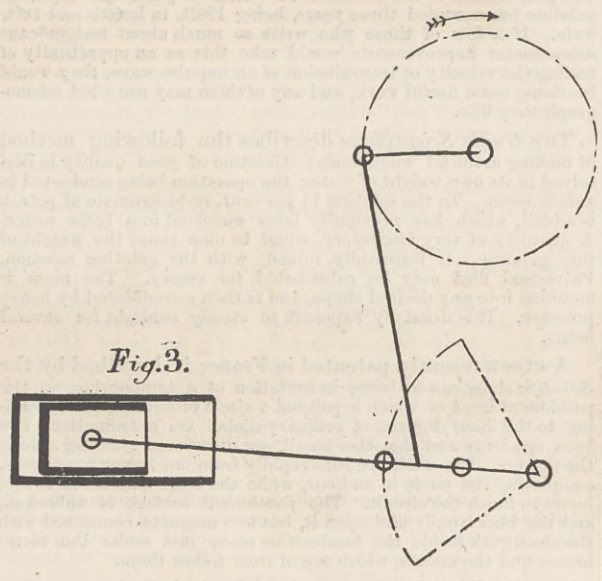
The engine is fitted with Schaeffer and Budenburg's variable expansion gear. To the slide rod, outside the slide chest, a stanchion is rigidly fixed, which transmits its motion through an adjustable rod to a hanging lever pivotted upon the spindle of a cylindrical grid valve. This is placed horizontally above the slide chest, and forms part of the steam inlet connections. The hanging lever is prolonged beyond the valve spindle, so as to carry a pair of curved horns, which are jointed to it. When in the position shown in the engraving they are united

to the valve spindle by hardened steel catches and suitable springs, and they and the grid valve rock to-and-fro with the hanging lever without interfering in any way with the passage of the steam. Between the horns, however, protrudes another spindle, one end of which is hinged to a fixed double eye and the other end is movable in a vertical plane by the governor, according to the number of revolutions at which it is driven by the engine. Until the normal or desired pitch has been reached, the spindle remains in too high a position for the horns to touch it as they oscillate. The grid valve, which oscillates with them, is so arranged in respect to its casing that it then opens passages right and left, which permits the steam to pass unimpeded to the main slide. The distribution is therefore left entirely to the latter when the engine is running at or below the normal speed. But when the proper number of revolutions is exceeded by ever so little, the governor rises, and causes the spindle to fall, the horns begin then to touch it alternately, and are lifted clear of the catches uniting them to the spindle of the grid valve. The latter, being set free, is brought by springs to a vertical position, and instantly and completely cuts off the steam. This event occurs once in each stroke. On the return stroke the released horn catches the spindle of the grid valve again, and holds it until it is again released, if the governor spindle remains low enough to touch it.

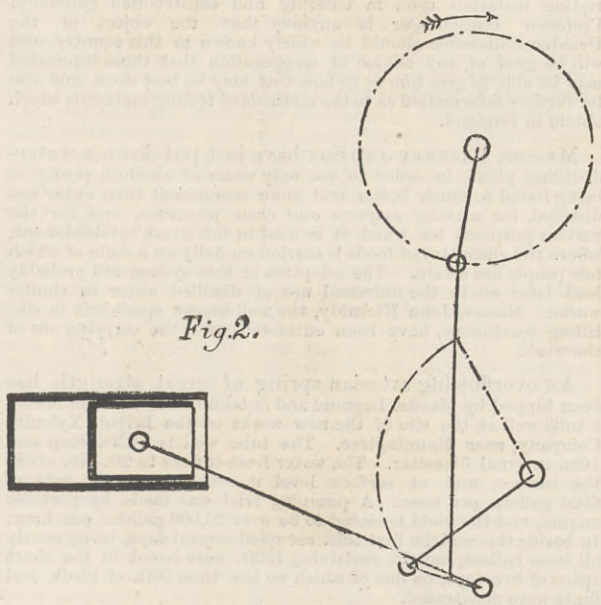
The control of the speed of the engine by this system of governing is perfect, even with the great variation in resistance which is inseparable from rolling mills. The diagrams, taken when the speed has exceeded the normal, show a good clean cut-off, which in view of the circumstance that it is done outside the slide chest, is more than might have been anticipated. For manipulating the slide valve during the operation of starting, or whenever it may be necessary to reverse for a few revolutions, an auxiliary cylinder is placed vertically near the middle of the outer frame. The excentric rod, which is formed with a gab end, is lifted clear of the slide-rod crosshead by depressing the innermost of the two horizontal catch levers. By means of the outermost one another rod is made to connect the same crosshead with the auxiliary cylinder, and the engineman can then move the slide backwards or forwards throughout its whole stroke at pleasure. The caps of the main and trailing shaft bearings are of cast steel and the principal brasses are of phosphor bronze. The latter are octagonal in form, with a midfeather to keep them in place instead of side flanges, and they are so arranged that they can be worn in four different positions before being cast aside.



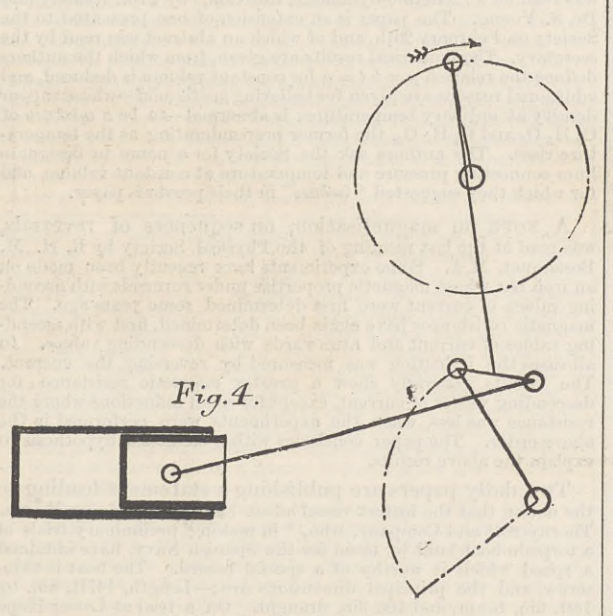
POSITION AT END OF EXHAUST STROKE.



COMPRESSION COMPLETED—IGNITION.



END OF SUCTION STROKE.



END OF WORKING STROKE.

DIAGRAMS SHOWING ACTION OF ATKINSON'S GAS ENGINE.

ATKINSON'S NEW GAS ENGINE.

OUR readers will be interested in the following information, which we take from a report by Professor Unwin, M.I.C.E., F.R.S., on a trial of a new gas engine, invented by Mr. James Atkinson, at the works of the makers, the British Gas Engine Company, Gospel Oak.

The engine is quite new, and is only less remarkable mechanically than it is for the great stride it makes in reducing the quantity of gas used per actual horse-power. The cycle explained below will be readily understood from the above diagrams, showing the chief positions of the parts.

The Engine.—The engine is a nominal 4-horse power engine, with a single cylinder serving both for compression and explosion. By a very ingenious arrangement of linkwork, the plunger makes two double strokes of unequal length for each revolution of the crank shaft. The plunger makes a short forward stroke, during which it draws in the charge of gas and air; a somewhat shorter back stroke, during which the charge is compressed; ignition then takes place, and the engine makes a long forward expansion stroke, followed by a long back stroke, which expels the products of combustion. The complete cycle is performed in a single revolution of the crank shaft and in a single cylinder. In the Otto engine two revolutions of the crank shaft are necessary for a complete cycle, and the charging and expansion strokes are necessarily of equal lengths. In the Clerk engine a complete cycle is performed in one revolution, but then a separate cylinder for compression is required, The advantages of Mr. Atkinson's arrangement are obvious, supposing that it can be carried out in a mechanically perfect way. (1) The engine in normal working receives an impulse during each revolution which tends to regularity of speed, and to a reduction of the weight of the engine for a given power. (2) The control of the engine by the governor can be much more perfectly effected than in an engine having only an ignition in normal working every second revolution. (3) The inequality of the charging and expansion strokes permits of a greater range of expansion to be utilised. (4) As the cycle is completed in half the time required for that purpose in the Otto engine, the loss through the cylinder walls is diminished, and more heat retained in the gases. This renders the longer expansion valuable. In fact, but for this action the longer expansion would add but little to the useful work done. During the trial the engine was kept continuously at work from 10.40 till 1.0, and from 2.0 till 4.35, without the slightest hitch. Under extremely different conditions of work it maintained, without any interference, a practically uniform speed, except only in the last trial, in which probably the taking of indicator diagrams interfered a little with the action of the engine. If it is considered that this is the first engine of the kind constructed, that some improvements in the proportioning can no doubt be effected in a new engine, and that the workmanship of the linkwork was not as accurate as in ordinary practice it would be made, it may be taken as demonstrated that there is no mechanical defect in the action of the engine likely to interfere with the realisation of those advantages of the mode of accomplishing the thermo-dynamic cycle in the cylinder which have already been described.

The mode of carrying out the trials.—I arranged to have a trial at normal full power, at about two-thirds full power, and at about one-third full power. Also a trial with the engine running without load. Subsequently a short trial was made with the largest load on the brake with which the engine would run. This last trial was not perfectly satisfactory, as the engine twice began to slow down, and the brake-weight had to be lifted for a few seconds to let the engine get away again. I suspect that in taking indicator diagrams we just interfered with the action of the engine enough to cause the slowing, and that if no diagrams had been taken the engine would have run steadily with this load. I allowed Mr. Atkinson to start the engine for each trial, and to adjust the gas valve for the trial. Subsequently every observation during the trial was made and recorded by myself, or by four of my students who assisted me. An indicator diagram was taken every five minutes, and simultaneously observations were made of the load on the brake, the counter, the weight and temperature of the jacket-water, and the gas consumption. The indicator diagram was taken and the observations made by signal, and the numbers given in the detailed tables appended show how regularly the engine was working throughout the trials.

The indicator diagams.—I intended to use a tested Crosby indicator of my own, but unfortunately the lever warped from the heat of the gases escaping round the small piston-rod. I therefore used a Crosby indicator of Mr. Atkinson's with a 100 lb. to the inch spring, which appeared to be in perfect order. The diagrams are perfectly easy to read, though the high speed and excessive fluctuation of pressure are trying to the indicator. The diagrams have one singular peculiarity, which has puzzled me a good deal. The exhaust line shows a strong wave-like fluctuation. The waves are regularly reproduced in exactly the same places in every diagram, and they cannot be attributed to the action of the indicator spring. I have come to the conclusion that these fluctuations of pressure in the discharging stroke are due to vibration of the exhaust valve. Probably in future engines this action will be eliminated, with a slight gain of efficiency to the engine.

The brake.—The brake was a leather strap on the fly-wheel, with a weight at one end and a spring balance at the other. The arrangement was quite satisfactory. The vertical circumference of the brake was 16·03ft.

The gas used.—The gas was taken from the Gas Light and Coke Company's mains, and the gas measured did not include the small quantity required for the igniting flame. As no analysis of the gas was made, it is necessary to form an estimate of its probable heat value. The most accurate estimate of the heat value of London gas I have found is one based on thirteen analyses, and given by Dr. Adams—"Proc. Inst. Civil Engineers," vol. lxix. p. 299. According to this, the average London gas, at ordinary pressure and temperature, occupies 34·10 cubic feet per lb., and its heat value is 628·7 thermal units per cubic foot. In the trial of the Rollason engine by Professor Kennedy a sample of the gas was analysed. In computing the heat value from the analysis, Professor Kennedy has taken an erroneous value of the heat of combustion of hydrogen. Correcting this, I find that the heat value of London gas from Professor Kennedy's analysis is 627 thermal units per cubic foot at ordinary pressure and temperature. This agrees closely with Dr. Adams' estimate. I found the pressure of the gas delivered from the meter to be 29·86in. of mercury, and the atmospheric temperature in the workshop was 55 deg., so that the gas used was practically at normal temperature and pressure. The estimate of the heating power of the gas is important, because the calculation of the efficiency of the engine depends on it, and different samples of gas vary a good deal in heat value. In this respect London gas does not rank high.

(To be continued.)

TENDERS.

LEICESTER PUBLIC BATHS.

FOR the construction of a ladies' swimming bath at the Public Baths, Leicester. Quantities, specification, and drawings by Mr. J. Gordon, M. Inst. C.E., borough surveyor:—

	£	s.	d.
Hy. Black, Barrow-on-Soar (accepted)	840	0	0
S. and E. Bentley, London	848	8	2
W. Gimson and Sons, Leicester	858	16	2
T. and H. Herbert, Leicester	920	0	0
J. O. Jewsbury, Leicester	930	0	0
Geo. Hewitt, Leicester	985	0	0
J. Marston, Leicester	989	0	0
H. Hilton and Son, Birmingham	1230	4	10

ROYAL NATIONAL LIFEBOAT INSTITUTION.—The committee of this Institution have decided to offer a gold and a silver medal for drawings or models of a mechanically propelled lifeboat best adapted to meet the conditions under which lifeboats are called upon to perform their work. Also a gold and silver medal for models or drawings of a propelling power suitable for the boats of the Institution. All the models and drawings must be forwarded to the Institution not later than October 1st next, under cypher, accompanied by the fullest detailed explanations, and a sealed cover containing the name and address of the competitor, not to be opened until after a decision has been arrived at. The models and drawings will be examined by three judges, appointed by the committee, who reserve to themselves the right of withholding ail or any of the medals. All communications should be addressed to the secretary, Mr. Charles Dibdin, 14, John-street, Adelphi, London, W.C.

SCIENCE AND THE JUBILEE.—An instructive and interesting lecture was delivered on this subject by Mr. Eric Bruce on Thursday the 28th ult., at Princes Hall. Mr. Bruce opened his lecture by speaking of the tremendous strides made by science during the last fifty years. He dwelt first on the subject of steam, the progress of which he divided into two periods, its application, from 1837 to 1850, and its development, from 1850 to the present time. He went on to speak of the invention of Nasmyth's steam hammer, and the consequent improvement in all branches of industry, connected with steel and iron manufactures, the struggle for supremacy between the paddle and the screw, the victory of the latter, and its advantages as an economiser of power and space; the dwarfing of the "Woolwich Infant" of twenty years ago, by its gigantic successor. The lecturer then explained briefly the construction of the telephone and microphone, speaking hopefully of their future development. Mr. Bruce devoted the second half of his lecture to electricity as applied to telegraphy, as a future motor power, and as the successor of gas. Mr. Bruce wound up his lecture by showing his own latest application of electricity, his electric war balloon for night signalling This is an ordinary captive gas balloon, in which is placed an incandescent lamp, connected with a battery. By a pre-arranged code of flashes, armies are thus enabled to communicate with each other, independently of the physical features of the countries in which they may find themselves.

THE LATE MR. WILLIAM HUSBAND.—Mr. William Husband, inventor of Husband's oscillating cylinder stamps—mining—whose death was announced a few days ago, was born at Mylor, near Falmouth, on October 12th, 1823. Declining when a boy to be either a sailor or a shipbuilder, as his father required, he set out on horseback, unknown to him, for Hayle Foundry, where, after earnestly soliciting Mr. Henry Harvey, the head of the firm, to help him in his determination to be an engineer, he was received as an apprentice. The first erecting work intrusted to him by the firm was in Holland, in 1844. Messrs. Harvey had to supply the pumping-engines to drain Haarlem Lake; they chose young Husband for their representative, and as he quickly taught himself Dutch, the Dutch Commissioners at once saw his peculiar fitness to carry the drainage works all through, and they prevailed on Messrs. Harvey to let his services be transferred to their Government. Seven years sufficed to complete this great engineering work; and when, in 1851, Mr. Husband returned to England, he resumed his connection with the Hayle Foundry. He eventually became a partner in it, and was intimately associated with all its undertakings till his death at Clifton, after a short but painful illness. Besides the ore-stamping machine so well known in foreign and home mining districts, Mr. Husband's inventions included the balance-valve for water-works purposes, the four-beat pump valve, a safety plug for the prevention of accidents, &c., and only on the night of his fatal seizure he was explaining to his son a further improvement in the Cornish pumping-engines he was intending to patent, and a new method of ventilating mines, by which he hoped to benefit the miners. He was twice president of the Mining Association and Institute of Cornwall; president of the Hayle Industrial Exhibition, 1884; a member of the Polytechnic Society; the originator and captain of the Artillery Corps, &c. He was married, and leaves a widow and four children.

RAILWAY MATTERS.

The Manitoba Railway expects to build 670 miles of its extension to Montana, in the United States, before 23rd November next.

An extension of the Dakka State Railway to Chittagong, in India, has been sanctioned. This is one of the new lines which Sir Theodore Hope wishes to see placed in a fair way for commencement before he leaves office.

The Alnwick and Cornhill branch of the North-Eastern Railway, which runs through the centre of Northumberland for thirty-five miles, and has been constructed at a cost of £304,400, was opened for goods traffic on Monday.

In reply to a question in the House of Lords on the Quetta Railways, Viscount Cross said: "There are two railways to Quetta, both starting from Sibi, on the North-Western Frontier system. The Bolan route is now quite completed, and traffic is working on it throughout. On the Sind-Pishin route the rails have already been linked through, but the line is not yet opened for traffic."

It is stated that the Dutch Government contemplates the construction of a railway on the island of Sumatra from Mocara Kalaban to the Bay of Brandewyns on the west coast, passing through Fort de Hock, the seat of the Dutch Government, for the purpose of utilising the coal fields situate along the river Umbili, which were discovered about twenty years ago. The coal is stated to be superior in quality to the best English coal, and the yield is estimated at 200,000,000 tons. The work on the railway is to extend over six years, and the cost will be about 16,000,000fl. It is believed that the working of the coalfields will yield an annual profit of 600,000fl., and render Dutch India independent as regards the supply of coal.

In the House of Commons this week Mr. Sheil asked the Surveyor-General of the Ordnance, in reference to the cost and distribution of the plant of the Suakin-Berber Railway, whether the "storing" of a large portion of this plant at Woolwich consisted in leaving rails, engines, carriages, and trucks to rot and decay in the open air in a lonely spot on the Plumpstead Marshes. Mr. Northcote: Of this railway plant the rails are properly stacked in the open, as is usual. The engines are under cover, and, having been thoroughly overhauled and repaired, are in better condition than when they left Suakin. The carriages and trucks are standing on rails in the open; they are kept in good order ready for use. Mr. Conybeare asked what was to be done with this railway plant. Mr. Northcote said that he had answered a question on the subject already. Some of the rails were to be used in the construction of a military railway and some were to be sold.

The *South Australian Register* of March 21st says:—"A report upon the tenders for bridge iron for the Strangways Springs and Peake Railway has been received by the Commissioner of Public Works from the Commissioners of Audit. It concluded as follows:—Percentage of difference in cost of local tender and imported ironwork. There are two ways in which the extra cost of the local work can be compared with the imported, namely, the percentage which it bears (1) to the net total cost of the imported work, and (2) to the amount which might have been retained for expenditure here. The figures already stated show that the net cost of the imported work would be £8288 4s. 6d., and the local manufacture £12,567 5s.; excess, £4279 0s. 6d., or 51⅝ per cent. By sending to England for the raw material instead of the manufactured article the preceding figures show that more than three-fifths would still have to be sent out of the colony, and only £3217 7s. 3d.—at the outside—would be available for expenditure here. The extra cost incurred in doing so would be £4279 0s. 6d., or 133 per cent. more than the amount retained for expenditure in the colony."

Among the results of the measure of local self-government in Bengal has been the stimulus given to the development of tramways. The Bengal Tramway Act—iii. of 1883—provides that no project of this kind shall be authorised by the Local Government without the previous consent of the district board concerned. Full advantage has been taken of this provision by promoters to enlist local sympathy in favour of their projects. One of the latest contemplates a steam tramway connecting Suri, the capital of the Birbhoom district, with Ahmadpur, a station on the East Indian Railway. The proposed line would be laid on the side of an existing district road, thirteen miles in length, but a few diversions would be necessary, owing to the steepness of the present gradients. The promoters stipulate for the use of the road free of rent, the gift of the land required for stations and diversions, and a guaranteed contribution to a minimum dividend of 5 per cent. These proposals were recently acceded to by the district board, with the proviso that the arrangement should be subject to revision after the expiry of five years, and the tariff for goods and passengers should be framed with the approval of the board.

Writing to the *Times* on the Post-office contracts for foreign letter service, Mr. Henniker Heaton says:—"We at present pay admittedly extortionate rates, and now that it is understood we have arranged to put our mails on board at Brindisi or Naples, the companies owning the railways to those ports can charge us what they like. To illustrate what I mean it is sufficient to say that for the transport of mails from New York to San Francisco, a distance of 3300 miles, *en route* to Australia, we pay ½d. per letter. On the other hand, for their transport from London to Brindisi, 1200 miles, we pay the French and Italian railway companies 1½d. per letter, or three times the price for nearly one-third the distance. The character of the latter bargain is further shown by the facts I elicited from the Postmaster-General in the House of Commons on Friday week. He said that the arrangement commenced in 1879, and in that year we paid the railway companies of France and Italy £67,224. In 1886 the payments had risen to £97,884, showing in the seven years a total increase of £30,600, although the expense to France and Italy had practically remained the same all through. Taking the mails and passengers together, I find that the companies benefit even more than appears from the above official figures. They make in the year 104 journeys of 1200 miles each, for which they receive for passengers and mails not less than £126,000, or more than £1800 per journey and exceeding £1 per train mile run."

The traffic over the great Brooklyn bridge has grown to such great proportions that the proprietors are unable to cope with it. The *American Engineering News* says:—"It is claimed, with good reason, that almost the last step possible to increase its capacity under the present system of operation has been taken this week, in substituting four-car for three-car trains. At ten miles per hour—15ft. per second—and ninety seconds headway, there is only 1350ft. between trains. Allowing forty-five seconds for unloading—and no less is reasonably possible—the next approaching train is within little more than 600ft. when the previous one is switched away from the platform. To increase the speed to fifteen miles per hour would diminish the headway to sixty seconds, and bring one train almost upon another before it could be unloaded, for to the speed of unloading, when the cases of invalids, children, and clumsy people are included, there is a positive limit. Therefore the trains can never be run on much less than a minute headway for this reason alone, and such short headway would not now be safe." The same paper makes the following curious suggestion:—"By the use of some special form of hydraulic interlocking apparatus, however, which would introduce some form of protecting hydraulic buffer behind a discharging train, of sufficient strength to receive and resist without undue shock the moderate impact of a train approaching at ten miles per hour, such headway might be permitted."

NOTES AND MEMORANDA.

The deaths registered during the week ending April 30th, in twenty-eight great towns of England and Wales, corresponded to an annual rate of 20·6 per 1000 of their aggregate population, which is estimated at 9,245,099 persons in the middle of this year. The six healthiest places were Derby, Brighton, Leicester, Portsmouth, Plymouth, and London.

In London last week 2516 births and 1481 deaths were registered. Allowance being made for increase of population, the births were 329 and the deaths 238 below the average numbers in the corresponding weeks of the last ten years. The annual death-rate per 1000 from all causes was 18·3. In Greater London, 3290 births and 1826 deaths were registered last week, corresponding to annual rates of 31·7 and 17·6 per 1000 of the population.

The most interesting alloy of aluminium with zinc contains 3 per cent. of aluminium. It is harder than either metal, and the brightest of all the alloys used. Ninety-seven per cent. of gold and 3 per cent. of aluminium give a more beautiful colour to the gold, and yet the latter metal does not lose in ductility or malleability. The introduction of small quantities of foreign metals into aluminium improves its brilliancy and hardness without very greatly injuring its other properties; while the properties of other metals are almost invariably improved by the addition of small amounts of aluminium.

Arrangements are almost completed at Llanberis slate quarries, Carnarvon, for the biggest blast yet known in the principality, nearly 100,000 tons of bad rock between the upper and lower working of the quarries being about to be removed. The preparation of the chamber in which to place the explosive gelatine has occupied three years, being 180ft. in length and 18ft. wide. If a few of those who write so much about insignificant seismometer improvements would take this as an opportunity of testing the velocity of transmission of an impulse wave, they would be doing some useful work, and any of them may use what seismograph they like.

The *Guide Scientifique* describes the following method of making artificial whetstones:—Gelatine of good quality is dissolved in its own weight of water, the operation being conducted in a dark room. To the solution 1½ per cent. of bichromate of potash is added, which has previously been dissolved in a little water. A quantity of very fine emery, equal to nine times the weight of the gelatine, is intimately mixed with the gelatine solution. Pulverised flint may be substituted for emery. The mass is moulded into any desired shape, and is then consolidated by heavy pressure. It is dried by exposure to strong sunlight for several hours.

A clock recently patented in France is described by the *Scientific American* as being in imitation of a tambourine, on the parchment head of which is painted a circle of flowers, corresponding to the hour figures of ordinary dials. On examination, two bees, one large and the other small, are discovered crawling among the flowers. The small bee runs rapidly from one flower to another, completing the circle in an hour, while the large one takes twelve hours to finish the circuit. The parchment surface is unbroken, and the bees simply laid upon it, but two magnets connected with the clockwork inside the tambourine move just under the membrane, and the insects, which are of iron, follow them.

At the last meeting of the Physical Society a paper was read on a "Thermo-dynamical Relation," by Prof. Ramsay and Dr. S. Young. The paper is an extension of one presented to the Society on February 26th, and of which an abstract was read by the secretary. The numerical results are given, from which the authors deduce the relation $p = b\ t = a$ for constant volume is deduced, and additional reasons are given for believing acetic acid—whose vapour density at ordinary temperatures is abnormal—to be a mixture of $C_2\ H_4\ O_2$ and $C_4\ H_8\ O_4$, the former preponderating as the temperature rises. The authors ask the Society for a name to designate lines connecting pressure and temperature at constant volume, and for which they suggested "*isobars*" in their previous paper.

A note on magnetisation, on sequences of reversals, was read at the last meeting of the Physical Society by R. H. M. Bosanquet, M.A. Some experiments have recently been made on an iron bar whose magnetic properties under reversals with ascending values of current were first determined some years ago. The magnetic resistances have again been determined, first with ascending values of current and afterwards with descending values. In all cases the induction was measured by reversing the current. The results generally show a greater magnetic resistance for descending values of current, except for small inductions where the resistance was less, when the experiments were performed in the above order. The paper concludes with a molecular hypothesis to explain the above results.

The daily papers are publishing a statement leading to the notion that the fastest vessel afloat has been made by Messrs. Thornycroft and Company, who, "in making preliminary trials of a torpedo-boat built by them for the Spanish Navy, have obtained a speed which is worthy of a special record. The boat is twin-screw, and the principal dimensions are:—Length, 147ft. 6in. by 14ft. 6in. beam, and 4ft. 9in. draught. On a trial at Lower Hope on the 27th ult. the remarkable mean speed of 26·11 knots was obtained, being equal to a speed of 30·06 miles an hour, which is the highest speed yet attained by any vessel afloat." If our readers will turn to our last impression, they will see that Messrs. Yarrow and Co. have attained as a maximum with a similar boat a speed of 27·277 knots, or 31·44 miles per hour.

A "Report of the Wind Force Committee," drawn up by Mr. G. Chatterton, M.A., C.E., was read at the last meeting of the Meteorological Society. In this report, which is a preliminary one, the committee have dealt mainly with that portion of the investigation relating to Beaufort's Scale of Wind Force and the equivalent velocity in miles per hour. The committee have compared the velocities as recorded by the anemographs at Holyhead, Falmouth, and Yarmouth, with the entries of Beaufort's Scale in the logs of the neighbouring light-ships and lighthouses for the year 1881, and they give the results in a table. After a careful consideration of the whole of the results of this investigation, the committee are of opinion that the velocities shown by the Yarmouth anemograph, corresponding to Beaufort's Scale as recorded on board the light-ships, are too high, and that the velocities shown by the Falmouth anemograph are probably too low.

Mr. Brechstein, of Strasburg, recommends the following plan as the best means of steelifying wrought iron, *i.e.*, producing a hard steel crust whilst the core remains soft, which can then be used for taps, spindles, and other like purposes. An ounce and a half of prussiate of potassium, half an ounce of borax, half an ounce of saltpetre, and one-third of sugar of lead are all to be well pounded and mixed together. The iron to be hardened is made well red-hot, taken out of the fire, and covered well over with the powder, then with the powder on it is again brought into the fire, and when it has assumed the necessary degree of hardness, it is to be cooled in cold rain water. Steel hardened in this manner has, through the more intimate combination of the hard skin with the soft core, far greater toughness than steel of the kind produced in any other of the old-fashioned ways. For taps the temper should be light yellow, or what is generally called straw colour. In order to prove the strength and toughness of steel thus treated, a square bar of 6in. to 8in. long may be taken, which has only been hardened for half its length, and fixed with the glass-hard end in a vice. Then with a spanner on the soft end it may be screwed round as in the operation of cutting a screw-thread. It will then be seen that the soft upper half can be completely twisted off the lower hard one, which will remain unbroken and unaffected.

MISCELLANEA.

The old-established woodworking machinery business of Messrs. Samuel Worssam and Co. has been purchased by Mr. S. H. Nelson, who will carry it on with the co-operation of Messrs. Samuel and F. Worssam.

The Scottish Miners' Federation has adopted a resolution for the purpose of improving the condition of the ironstone miners, which calls upon the men to federate their unions, and to limit the output by strict adherence to ten days' work a fortnight and eight hours a day.

The 68,200 lb. anvil block, recently cast by the Otis Iron and Steel Co., of Cleveland, for the Morgan Engineering Works, is said to be the largest single steel casting ever turned out in the United States. The block is 8ft. square by 3ft. 10in. high; 78,525 lb. of steel were melted, and this was poured in 4 min. 20 sec.

During April sixteen vessels of an aggregate of 9643 tons were launched from the Clyde shipyards, as compared with nineteen vessels of 22,754 tons in April, 1886. In the past four months of the year forty-eight vessels of 55,413 tons have been built, compared with forty-one of 51,312 in the corresponding period of last year.

The partnership hitherto existing between Mr. George Heaton Daglish and Mr. Harry Bolton Daglish, and Mr. Robert Shaw Daglish, has been dissolved by mutual consent, and the business will for the future be carried on under the name of Robert Daglish and Co., by Mr. Harry Bolton Daglish and Mr. Robert Shaw Daglish.

The Birmingham Compressed Air Power Co. are proceeding with the erection of their central station, and sanction has been obtained for the breaking up of the roads, which will be begun in about a month's time. Of the 6000-horse power which will be available on the completion of the works, about 4000-horse power has been applied for.

Great preparations are being made in Amsterdam for the Exhibition of articles of food and cookery, which is to be opened with considerable ceremony in that city in June next. A great deal of interest in the Exhibition has been excited not only in Holland, but in Germany, Belgium, and France. A number of exhibitors are going from England.

A suggestion has this week been made that the projected Manchester Ship Canal should be continued through North Staffordshire, Wolverhampton, and Birmingham. By this means cargoes could be sent from Birmingham to Manchester at something like 4s. per ton in vessels of, say, 2000 tons, drawn either by tug boats or by heavy locomotives on each side of the canal.

On the motion of the Duke of Buckingham, in the House of Lords, Potter's Patent Bill, Skrivanow's Patent Bill, and Gilbert and Sinclair's Patent Bill were referred to a Select Committee, consisting of the Earl of Belmore, the Earl of Camperdown, the Earl of Selborne, and the Earl of Limerick, to consider and report whether, regard being had to the Patents, Designs, and Trade Marks Act, 1883, and to the circumstances of each case, the said Bills or any of them should be allowed to proceed.

A memoir by Professor Bauschinger, of the Technical High School, Munich, is being issued by the conference held at Dresden for obtaining information as to the various methods of testing materials used in building and construction generally. Professor Bauschinger is anxious that the object of the Dresden conference should be widely known in this country, and will be glad of any advice or co-operation that those interested may be able to give him as to how this may be best done, and also for further information as to the methods of testing materials which obtain in England.

Messrs. Lazenby and Son have just put down a water-distilling plant, in order to use only water of absolute purity, it being found so much better and more economical than water not distilled, for making extracts and clear preserves, and for the various purposes for which it is used in this great establishment, where the chemistry of foods is carried on daily on a scale of which few people are aware. The adoption of this system will probably lead later on to the universal use of distilled water in similar works. Messrs. John Kirkaldy, the well-known specialists in distilling machinery, have been entrusted with the carrying out of the work.

An overflowing artesian spring of great strength has been tapped by Messrs. Legrand and Sutcliffe, of London, in boring a tube well at the site of the new works of the British Xylonite Company, near Manningtree. The tube well is 162ft. deep and 10in. internal diameter. The water from it rises to 2ft. 6in. above the surface, and at surface level it overflows at the rate of 6000 gallons per hour. A pumping trial was made by portable engine, and the yield is stated to be over 20,000 gallons per hour. In boring this well the first 30ft. occupied several days, being nearly all loose ballast, but the remaining 132ft. were bored in the short space of five days, on one of which no less than 50ft. of chalk and flints were penetrated.

Five persons were injured last week by an explosion of dynamite eight miles from Sheffield. A workman had one dynamite cartridge, and what is known as a "primer," or half-cartridge. Finding the dynamite too hard, the workman placed the cartridge under some hot shale, which lay near a fire. The heat softened the explosive material to such an extent that turning the shale over in order to seek the cartridge, was sufficient to cause the friction necessary for its ignition. A blinding flash was seen by other workmen, who, hurrying to the spot, found five persons injured, two of them dangerously. It is feared that in each instance the sight will be affected, the eyes in all the cases having sustained the main force of the explosion.

In the House of Commons on Monday, on the motion of Baron H. De Worms, a Committee was appointed to inquire into the existing laws and regulations regarding boats, life-buoys, and other life-saving gear required to be carried by British merchant ships, and to report what, if any, amendments are required therein, and that the Committee do consist of seventeen members—Lord Charles Beresford, Mr. Macdonald, Sir Edward Birkbeck, Mr. Hoare, Mr. Howard Vincent, Mr. Donkin, Captain Price, Sir James Corry, Sir Charles Palmer, Viscount Kilcoursie, Mr. Bruce, Sir William Plowden, Mr. Menzies, Mr. Thomas Sutherland, Mr. Taylor, Mr. Richard Power, and Mr. Thomas Gill—power to send for persons, papers, and records; five to be the quorum.

Messrs. John Yates and Co., Birmingham, are making an oar in which the blade is made from the best sheet steel, highly tempered. It is put forward as being much stronger than the ordinary wooden one, and cannot be broken without undue violence. The handle fits into a socket running nearly the whole length of the blade, and forming a backbone of great strength. The oar being much thinner in the blade than the wooden one, enters and leaves the water cleaner. The handles are made separately of the ordinary spruce or ash, and if broken can be readily replaced. The leathers for these oars are laced and shrunk on in six different ways, all of which strengthen the loom, and this is an advantage over the present method, as no nails or rivets are required for fixing. The ordinary button is fastened by long nails, which very much weaken the handle or loom in a part where strength is required. The new leathers can also be moved to suit any width of boat, and they present several points of recommendation, but where a slight increase in the weight of the blades of oars or sculls is of importance the new ones may not be so much liked.

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

(*From our own Correspondent.*)

THE demand for finished iron is not improving, whether as to best or common sorts. The quietude which characterises the quarterly meetings seems to be becoming more pronounced. Ironmasters' order books present little business ahead, and current demand will not allow of full time in scarcely any direction. Orders are kept down to the satisfaction of buyers' early necessities, and export as well as home inquiries are much below the average. Buyers are standing off the market, in the expectation that prices will further weaken.

Prices of marked iron are unaltered at £7 to £7 12s. 6d., and there is no prospect of a change. Medium qualities range from £6 down to £5 10s., and common qualities from £5 5s. down to £4 17s. 6d.

Sheets, singles, are £5 17s. 6d. for galvanising qualities; doubles, £6 to £6 5s.; and lattens an average of £7. Plates continue dull at £6 10s. for tank sorts, and £7 10s. to £8 10s. for boiler qualities. For hoops and strips prices vary from £5 to £5 5s.

The amalgamation is announced of the Albion Iron Co., Batman's Hill, Bilston, with Messrs Tupper and Co., galvanisers, Birmingham.

The position of the pig iron trade has not improved upon the week. Prices continue to ease, and consumers are consequently persuaded to stand off the market.

Northampton pigs are quoted about 30s. per ton, delivered to consumers' works hereabouts; Derbyshires, 37s. 6d. to 38s.; and Lincolnshires, 39s. to 40s. Native pigs are 50s. to 52s. 6d. for all mines; 37s. 6d. to 40s. for part mines; and 30s. for common. Welsh hematites are 52s. 6d. delivered, and West Coast sorts are about 52s. 6d. to 55s. nominal.

If the present quietude in pigs continues, it is considered certain that further furnaces will be put out in Northampton and Derbyshire—a step which should strengthen prices again. The Bestwood Company, Nottingham, is however putting up a new furnace in addition to the two which they have now blowing.

An increased demand is finding expression for steel, which is being preferred over iron by buyers in many directions. The tonnage of blooms and billetts rolled down in Staffordshire iron mills into finished products is steadily augmenting, and this state of things presents a strong contrast to the sluggishness which marks the demand for manufactured iron. Steel bars, too, are in a larger sale, so much so that steelmasters are now becoming considerably indifferent to orders for steel in a partially manufactured form, upon which their profits are less than upon the finished article.

Steel blooms imported into this district are commanding £4 10s. per ton, while bars are realising £5 to £6. Hoops and strips rolled in local works from imported blooms are selling at £6 10s. per ton.

A somewhat singular feature of the steel trade at the present time is that notwithstanding that in Staffordshire we manufacture basic steel, considerable quantities of basic billets are being imported into this district from Scotland to be rolled into strips for welded tubes, the material itself being the softest and most weldable quality in the market.

The only explanation forthcoming is that local basic steelworks have not yet found it much worth their while to turn their attention to this particular branch of the trade. They are so well engaged in the larger departments that they do not at present recognise the necessity for such a course.

Steel strip of exceptional quality is being rolled at the present time at the Earl of Dudley's Round Oak Works. It is pronounced by tube makers to be particularly good, a feature which, it is explained, is due to the fact that the blooms are heated in Mr. Smith Casson's patent gas furnaces. The operation of this patent furnace protects the steel from the ordinary oxidising influences almost inevitable when heating in grate furnaces. This advantage results from the circumstances that any pressure can be put on the gas so as to fill the furnace perfectly full of flame, and the flame is peculiarly clean. An increased quantity of steel bars is also being rolled at his lordship's works.

In marked iron orders are being received for shoe iron from Australia, and for general merchant iron from South America. The manufacture of charcoal iron bars has lately been added to the other qualities of iron turned out. Formerly the Earl of Dudley was accustomed to execute United States orders for axe, hatchet, and shoe and tire iron, shipments being made to Boston and other ports, but of late years the trade has got down to *nil*. His lordship's treble best crystalline iron is in increased call for engineering purposes. A 2in. round tested by the Admiralty gives a tensile strain of 25 tons per square inch, with an elongation of 30 per cent., and the Admiralty have admitted this iron to equal competitive privileges with those conceded to the celebrated Lowmoor iron.

The North Staffordshire finished iron trade is affected by a weak demand, and weaker rates. Vendors consequently are suffering from precarious values, which generally forbid the transaction of remunerative business. This state of things is not observable in the home trade alone, but is conspicuous likewise in foreign inquiries. The American spring demand, which usually at this time provides abundant work for the mills and forges, is very dull. Prices nominally rule at £5 for Crown bars, £5 10s. for best, £6 5s. for ship plates, and £6 12s. 6d. for boiler qualities, all delivered Liverpool or equal.

The present prices of Messrs. Robert Heath and Sons, of the Biddulph Valley Ironworks, Stoke-on-Trent, and the Ravensdale Ironworks, Tunstall, are as follows:—Flats from 1in. by ¼in. to 6in. by 1in., rounds and squares ¼in. to 3in., £5 5s.; best ditto, £5 15s.; double best, £6 5s.; best bevelled from 1in. by ¼in. £6 15s.; best grooved horseshoe iron from 1in., best turning to 3in. diameter, Staffordshire angle iron from 1 by 1 by ¼ united inches, all £5 15s.; best Staffordshire angle iron, £6 5s.; double best, £6 15s.; tee iron to 8 united inches, £5 15s.; best ditto, £6 5s.; best angle and channel, £7 15s.; bridge or tank plates, £6 5s.; best boiler, £6 15s.' double best, £7 5s.; treble best, £9 5s.; annealed tank plates or sheets, not thinner than 13 w.g. or over 4ft. wide, £6 5s.; "Ravensdale" best hoops 1in. to 5in. ordinary gauges, £6 2s. 6d.; "Ravensdale" best waved hoops 1⅛in. to 16 w.g., £6 7s. 6d. Best half-round and convex, best ovals, best cantop, ⅝in., and 1in., all £5 15s.; bridge and tram rails, £5 10s.; wheel spoke and grate bars, £5 5s.; best rivet iron from $\frac{5}{16}$in., £7 15s.; fencing wire, 0 to 4 w.g., £7 5s.; best boat head iron, £5 15s.; all delivered Liverpool or equal.

The pipefounders are anticipating that numerous orders will follow on the inquiries which are now being made. Among the orders now on the market is one for 1700 lineal yards of iron pipes required for Swansea; and another for about 25 miles of pipes, together with other cast iron work, in connection with the Heston and Isleworth Sewerage Works. The Barry and Cadoxton Gas and Water Company is seeking tenders for a large supply of 9in. to 2in. cast iron pipes; and at Tipton inquiries are being made for about 130 tons of 30in., 24in., and 9in. cast iron socket pipes, together with other work.

NOTES FROM LANCASHIRE.

From our own Correspondent.)

Manchester.—The past week has partaken so much of a holiday character, and the Royal visit and the opening of the Manchester Exhibition have so much occupied attention, that business has practically received little or no attention. The usual Tuesday's iron market had, of course, to be suspended, and nominally it was held on Monday; but there was little or nothing doing. So far as there is any opportunity of forming an opinion as to the actual condition of trade, makers of pig iron would seem to be holding with, if any, rather more firmness to their prices, but they do not meet with any support from buyers, who are only disposed to give out orders where they can place them at very low figures; and there is iron offering in the market at prices far below what makers are asking. In one or two cases excessively low prices have been taken for large quantities, but these are exceptional transactions; and just at present, in the absence of any business of importance, it is difficult to say what prices really are. For Lancashire pig iron 38s. to 39s., less 2½, for forge and foundry qualities delivered equal to Manchester, are the nominal quoted prices, but at these figures local makers are quite out of the market. For district brands Lincolnshire makers are in some instances prepared to take about 36s. 6d. to 37s. 6d., less 2½, delivered equal to Manchester, but even these figures do not meet the views of buyers; and in outside brands there is a good deal of underselling going on. For hematites prices are being cut excessively low, and merchants are prepared to book orders at figures far below what makers are asking. For manufactured iron the demand is very slow, and in most cases makers are in want of work to keep their forges going. The basis of quoted prices remains at about £5 per ton for bars delivered into the Manchester district, and for forward delivery good qualities could not perhaps be got at much under this figure; but for prompt specification there is a disposition in many cases to take less money.

So far as the engineering branches of industry are concerned, the inquiries I am in a position to make through reliable sources still show trade generally to be in a very unsatisfactory condition, and I hear of very little new work of any weight coming forward. Locomotive builders are working on the orders which were got a month or so back, but these are not being followed by further orders. The same may be said with regard to boilermakers, who are still kept fairly well employed with work in hand, but are getting very little new business. In heavy engineering work there is but little doing; machine tool makers are moderately well employed, and some of the machinists are in the same position, but none of them speak very hopefully as to the future, and in any branch of the engineering trade it is only very exceptional where there is really any activity. On the other hand, the returns received through the trades union organisations from the various district branches are in most cases more hopeful in tone, and show a continued reduction in the number of members out of employment.

As considerable interest is taken in this district in the Rating of Machinery Bill now before the Select Committee of the House of Commons, and as perhaps the most important evidence in support of the position taken up by the leading engineering firms with regard to the matter is being contributed from this immediate neighbourhood, it will not be out of place to give a few particulars with regard to the question as it now stands. The Bill, it may be stated, is a simple defining measure fixing the liability of machinery to be rated by adopting the hitherto received theory that only that which goes with the freehold, such as engines, boilers, shafting, steam hammers, and other similar heavy fixed plant, is thus liable. In the inquiry now proceeding the Select Committee would seem to be going on these lines. Mr. Lings, of Manchester, was the first witness called, and he showed that the decision in the Tyneside Boiler Works case made all machinery liable, and stated he knew that in Lancashire and Yorkshire the assessment committees and officers would in future rate textile machines, such as looms, spindles, &c. Other witnesses have followed in the same tenour, and Mr. Marshall notified to the committee that he should now complete his valuation of the Crewe locomotive works, and that he should include all light machines. This week Mr. W. A. Edgill, clerk to the Chorlton Local Board, is before the committee, and Mr. MacPherson, who made the valuation of the machines at the works of Sir Joseph Whitworth and Co., is to be called. It was upon this gentleman's valuation that the dispute arose in which the engineers of Manchester made common cause with Messrs. Whitworth and Co., and opposed the assessment of the light machinery in question. This case was eventually settled under the judgment given in the Tyneside Boiler Works case, but it is not unlikely that the matter may be re-opened again before the select committee, as an illustration of the principle upon which such valuations are made for the purposes of assessment.

Amongst minor engineering matter, I may notice an improved lawn mower, constructed upon quite a different principle to the ordinary run of horticultural implements of this class, that is being introduced by Messrs, Follows and Bate, of Manchester. This is styled the "Silent Gorton" machine, and it is driven by rolling frictional gear instead of toothed wheels. In fire extinguishing appliances, Messrs. Rose and Co., of Manchester, are also introducing some improvements. One of these is a four-way jet—Knott's patent—by means of which the stream of water from a hose pipe can be contracted or expanded as desired from ½in. to 1¼in. in varying degrees out of four different jets by simply turning a revolving plate carrying the different sizes of jets, and one important—perhaps the most important—feature is that in changing from one sized jet to another the flow of water is never absolutely checked, and there is thus no sudden shock brought upon the hose pipe, which is so often the cause of bursting. Another improvement is a locking clip for fire ladders; in the usual construction, when an extra length of ladder is put on, it is simply dropped into a loose clip, but in this new clip, which is Hunt and King's patent, there is a spring lock which firmly holds the extra length of ladder as soon as it is dropped into the slot, and it can be liberated by simply pressing down a small button acting on the spring from the outside.

The demand for shipment has quieted down, and delivered at the high level, Liverpool, or the Garston Docks steam coal does not average more than about 7s. per ton.

With the reduction of the price of coal in the Manchester district, the wages of the colliers and day men are being reduced about 10 per cent. The question of a reduction of wages at the collieries of the South-West Lancashire district has also been under consideration, but so far nothing definite has been decided upon.

Barrow.—There is a better tone in the hematite pig iron trade this week, and a fuller inquiry is experienced alike for Bessemer and ordinary hematite qualities of iron, but buyers are wanting to place large contracts for forward delivery at the low rates which have been ruling the market lately so far as speculative sales are concerned. These have been done at 42s. 6d. per ton, net; makers, who for the most part are very busily employed all round, are asking from 43s. 6d. to 46s. 6d. per ton net, f.o.b., and are not negotiating any orders which are offered at lower rates, knowing that the orders they have on hand will furnish them with work for fully four or six months to come, irrespective of new work. Stocks remain large, although those in the hands of speculators or second-hand dealers have been considerably reduced, and now that the market shows itself to be a trifle firmer, holders of these stocks are asking increased prices as well as makers. The demand for steel shows an improvement, and rails are in especially brisk request, both from home and foreign buyers. The Americans have again begun to enquire for terms of delivery, and it is noted that their wants are considerable, notwithstanding the fact that the American manufacturers can supply themselves with such a very heavy proportion of what they actually require; but English makers, when they get favourable terms of freight, can compete successfully with American producers, notwithstanding the heavy import duties charged. Rails are firm, and ordinary heavy sections are quoted at £4 per ton. There is a good demand for blooms, bars, and billets, and some especially heavy contracts are offering. There is a steadier tone in the shipbuilding trade, and some contracts which are being tendered for are likely to come into the hands of local builders. There is a fuller inquiry for shipbuilding material in steel, which in itself is a gratifying proof that orders are in the market for shipping. It is probable that at Barrow increased activity will be shown in this branch of the steel trade. Shipbuilding at Barrow has been exceedingly dull for some time, and it is now hoped that a revival is setting in, and that the large yards in the place which are now practically at a standstill will soon be in full work. Engineers, ironfounders, and boilermakers are doing a quiet trade. Iron ore is firmer in tone, and there is a good inquiry for good ordinary qualities, for which the quotation ranges from 9s. 3d. to 11s. per ton, there being poorer qualities at lower and better qualities at higher figures than these. Coal and coke is steady in tone at unchanged prices. There is not much doing in the shipping trade, but prospects are very good all round.

THE SHEFFIELD DISTRICT.

(*From our own Correspondent.*)

THE defective cutlasses and sword bayonets involved an expenditure to replace them of £26,430. It was recommended by the committee that if the triangular bayonet would fit the Martini-Henry rifle in use in the navy, the requisite number should at once be issued; otherwise, that the Enfield-Martini sword bayonet should be issued to replace the converted cutlass sword bayonet, which they recommended should be withdrawn. Hence the order for 150,000 sword bayonets, which for the moment excited so much interest in the Sheffield district. I am afraid the work will not be taken here after all. In the first place, the sword bayonets were offered to the leading Birmingham firm of swordmakers, who did not see their way, being already full of orders, to deliver 30,000 within a year and the remainder at the discretion of the Secretary of State for War, unless upon conditions which the authorities were not likely to grant. A large addition would have been required to their powers of production, and when once the special occasion had passed, what guarantee was there for the new machinery being kept fully employed? This was also the difficulty of the Sheffield firms. That they could make the blades was not disputed—any grinder who had been accustomed to carvers could grind sword blades. But to turn out the sword-bayonets needed at least £5000 would have been required for new machinery, and men would have to be specially set apart for the work. When the present heavy deficiency caused by the discovery of untrustworthy weapons had been met, what would the machinery and men have to rely upon? The orders would drop again to 2000 or so per year. Not only were there the blades to make, but they had to be fitted to the rifles. This was an engineering matter, and Sheffield cutlery firms do not like complicated matters of engineering. They would supply any quantity of blades, of proper material and thorough workmanship, but there their responsibility, they felt, should end. Another alternative has been suggested. The Government officials have shown a desire to engage in manufacturing enterprises. Why not turn some of the enterprise and capital they have longed to embark in heavy castings and forgings into small arms? No Sheffield firm will undertake the 150,000 sword bayonets without some guarantee against loss in the future—a guarantee which they do not for a moment expect the Government will give. Why should not the Government themselves become their own manufacturers? If they do, they should leave Enfield, and establish works at the seat of the steel manufacture. There they would find abundance of skilled labour ready to their hand. They would have no difficulty then in the delicate operations of hardening and tempering steel, on which the success or non-success of weapons for warfare mainly depends. If they only knew one half of what is said by Sheffield steel makers—employers and employed alike—who see how steel is tempered and hardened in some Government establishments, they would cease the effort.

Last week I gave you some idea of what Sheffield was doing at Manchester Exhibition. Newcastle will have an equally interesting, though a smaller show. Messrs. Vickers, Sons, and Co., show steel crank shafting made by them to the designs of Messrs. R. W. Hawthorne, Leslie, and Co., for the starboard engine of the royal Italian twin screw armour-clad Sardegna, of 25,000 indicated horse power. Each propeller is driven by two sets of triple expansion engines. At lower power, the after set of engines only are used, the crank shaft of the forward sets being disengaged by the connecting bolts being simultaneously withdrawn from the forward coupling. Each of the six portions of the shaft is forged solid from an ingot of Messrs. Vickers' special mild steel. The weight of the shafts finished is 66 tons. Messrs. John Brown and Co., the Atlas Works, have a noble exhibit. It includes a fine piece of work in a huge marine boiler furnace front plate, with four large furnace holes. This plate has been flanged in one heat in one of their large hydraulic presses. Close at hand is a superheater and plate, of unusual shape and size, flanged on the inside and outside, and a pan 9ft. 3½in. and 28in. deep, dished out of a flat plate 10ft. 8in. diameter, in one piece. This is used for chemical furnaces. In this front Messrs. Brown show one of their latest specialities, a Purves patent ribbed flue, which has already received the full sanction of Lloyd's, and is expected to pass the Board of Trade during the next three months, when the series of experiments for the Board, now in progress, have been completed. Messrs. Brown and Co. also show four pieces of armour plate which have been tested. These illustrate the progress of armour since its beginning. Among steel castings is a large propeller blade, weighing 85 cwt., which is a duplicate of those the company have made for the Atlantic liner America recently sold to the Italian Government.

It was recently stated in a London paper that out of fifty patent "Wallace" intrenching tools served out to a regiment last Easter Monday manœuvres, thirty-two proved failures. I am informed, on the authority of the exclusive makers, Messrs. Lucas and Son, of Dronfield, near here, that the tools which broke down were not Wallace tools at all, but were of an obsolete type, which the Government have had in stock for a considerable time. Messrs. Lucas are at present engaged upon an order for 7250 of the "Wallace" tools for the British Government. This firm have just brought out a new spanner, known as Parry's registered spanner, which is adapted for universal use; it has already taken a firm hold on the market.

Messrs. John Brown and Co. are putting down extensive plant for the manufacture of the new ribbed flues to which reference was made sometime ago. They have received very gratifying orders for these flues of late.

The cutlery and plated trades are again very quiet. Railway material is ordered as freely as ever.

THE NORTH OF ENGLAND.

(*From our own Correspondent.*)

A FAIR amount of business was done in Cleveland pig iron last week, and No. 3 g.m.b., which was quoted at 33s. 6d. on the 26th ult., advanced 6d. per ton before the end of the week. But at the market held at Middlesbrough on Tuesday last the tone was again flat; buyers held off, and prices were easier. Makers seem more than ever determined not to part with their iron at present prices. They believe that there will be a substantial improvement when the extent to which stocks are reduced is appreciated; and as the quantity of iron in second hands cannot be very great, buyers will, in their opinion, be soon compelled to go to them. Merchants are unwilling to commit themselves. Most of them refuse to accept less than 34s. for prompt delivery; but nevertheless on Tuesday some small lots were sold at 33s. 10½d. per ton.

Stevenson, Jaques and Co.'s current quotations are:—"Acklam hematite," mixed Nos., 45s. per ton; "Acklam Yorkshire" (Cleveland), No. 3, 36s. per ton; "Acklam basic," 36s. per ton; refined iron, 48s. to 63s. per ton.

Warrants have lately fluctuated considerably more than has makers' iron. The price advanced from 34s. to 34s. 9d. per ton last week, but by Tuesday last it had again fallen to 33s. 10½d., at which figure sales were reported from Glasgow.

The stock of pig iron in Messrs. Connal and Co.'s Middlesbrough stores was, on the 30th ult., 329,173, being an increase of 5250 ton for the month. At Glasgow on the same date, 866,725 tons were in stock, being an increase of 9759 tons.

The shipments of pig iron from Middlesbrough were last month exceedingly good, and, indeed, far above the average. Only twice have they been exceeded during the last two years. The total quantity which left the river was 78,209 tons, of which 31,835 tons went to Scotland, 11,696 tons to Germany, 7780 tons to Russia, 5896 tons to the United States, and 5712 tons to Holland. The manufactured iron and steel exports were also excellent, the total weight sent away having been 46,875 tons, or about 11,000 tons more than during February and March. India was, as usual, by far the best customer, 21,340 tons having been sent thither.

In the finished iron trade there is no improvement; orders are exceedingly scarce, and consumers can place them almost on their own terms. Ship plates and common bars can be bought for £4 10s. per ton, and angles for £4 5s., free on trucks at makers' works, less 2½ per cent. discount.

The accountants to the Durham Coalowners' and Miners' Association have just issued their certificate for the three months ending March 31st last. The net average selling price of coal appears to have been 4s. 5·65d. per ton, which involves no change in the prevailing rate of wages.

The balance-sheet of the Northumberland Miners' Association, for the first quarter of the present year, has been issued. Only one copy was forwarded to each colliery, in the hope that the contents thereof would not get into the newspapers. However, the principal items soon became known. It appears that since the strike began £29,458 9s. 10d. has been paid out to members on strike. Deputations to kindred associations have cost £197 13s. 9d. The expenses of the special committee, and of deputations to the coalowners, £28 2s. 7d. Delegate meetings have cost £79 19s. £52 17s. 6d. has been paid for executive committee meetings, and £22 18s. 5d. for deputations to collieries. £4676 14s. 2d. has been received from the public, in the form of subscriptions in aid of those on strike. The receipts from other sources are £2053 8s. 2d., and £1446 17s. 7d. is the balance in hand. The total number of members of the Miners' Association is 13,245, besides which there are 1128 half-members.

The demand for pig iron in Russia is just now very brisk, as buyers in that country are apprehensive that the import duty will shortly be raised still higher. The Baltic ports being now open, it is not unlikely that larger shipments will take place as the season advances. It is said by some who are engaged in the Russian trade, and who profess to understand the policy of the Russian Government, that the duty will be increased more and more, until English pig iron is totally barred from access to the Russian market.

The Newcastle Chemical Company, whose works are at Gateshead, has determined to put down a bore hole for water by what is called the American process. It is somewhat strange that in South Durham and North Yorkshire, where so many bore holes have been made to obtain access to the great salt deposits, that we should be dependent on our transatlantic cousins for the best method of developing our own resources. It appears, however, that the large amount of attention given to boring, and the experience gained in the States in seeking for petroleum oil, has enabled the Americans to know how to operate more quickly and cheaply than we do on this side of the Atlantic. One is immediately struck, when inspecting a sinking on their system, with the extreme simplicity of the apparatus they use. The engine is a good one, though small, having usually only a 12in. cylinder, and it is afterwards retained for working the brine pump. The boring rod, which is some 50ft. or 60ft. long, in jointed sections, is also well made. All the rest of the machinery is as cheap and crude as it is possible to magine, but it works well enough, and to make it more expensively would be quite unnecessary. There is only one man and one lad employed on each shift. These do the whole of the work. One shift starts at noon and the other at midnight. Boring by the diamond drill does not seem to be able to compete at all with the American system, either as regards rapidity or cheapness. One of the chief characteristics of the latter is that when the hole is complete, and the salt is reached, almost all the appliances are retained in their original position, as, in case of a breakage of the pumping tube, they may be required again at any time. There seems little doubt but that since boring can be done so cheaply and so expeditiously, it may be usefully employed for many other purposes connected with mining and other branches of engineering.

NOTES FROM SCOTLAND.

(*From our own Correspondent.*)

A substantial advance took place in the prices of pig iron warrants towards the close of last week, in consequence of the reception of some fresh orders from the United States. Summerlee iron was advanced 1s. per ton, and a number of the other brands were raised 6d. But when the market re-opened after the holiday on Tuesday, the tone was very flat, and the quotations began to fall rapidly back towards the old level.

The past week's shipments were fairly good, amounting to 9709 tons, as compared with 10,285 in the corresponding week of 1886. And backward as the pig iron trade continues to be, it is gratifying to state that the exports are nearly 11,000 tons greater than they were at this date last year. The stock of pig iron in Messrs. Connal and Co.'s Glasgow stores continues to increase by about 2000 tons per week. An additional furnace has been put in blast at Gartsherrie, the total now blowing in Scotland being 80, against 95 at the corresponding date last year.

The current values of makers' pig iron are:—Gartsherrie, f.o.b. at Glasgow, No. 1, 47s. 6d., No. 3, 44s.; Coltness, 54s. and 44s. 6d.; Langloan, 50s. 6d. and 46s.; Summerlee, 52s. and 43s.; Calder, 50s. and 42s.; Carnbroe, 44s. and 40s. 6d.; Clyde, 47s. and 42s.; Monkland, 42s. 9d. and 39s.; Govan, at Broomielaw, 42s. 9d. and 39s.; Shotts, at Leith, 48s. 6d. and 45s. 6d.; Carron, at Grangemouth, 52s. and 44s. 6d.; Glengarnock, at Ardrossan, 47s. 6d. and 41s.; Eglinton, 42s. 6d. and 38s. 6d.; Dalmellington, 44s. 6d. and 40s. 6d.

The reduction of 5s. a ton in the prices of shipbuilding steel, which has been made by the Steel Company of Scotland, brings angles to £5 15s., ship plates to £6 15s, and boiler plates to £7.

Merchants state that they have been quoting prices as low as these for some time.

The iron and steel manufactured goods shipped from Glasgow in the past week, embraced £3100 worth of engine parts for Bombay, £4281, machinery; £3696, sewing machines; £12,630, steel goods; the greater part of which went to the United States, and £21,700, general iron manufactures, including £10,430 worth of pipes, plates, and tubes for Canada.

The coal trade is active, a large business being done, but the prices of all sorts except steam coals are easier. There was shipped from Glasgow in the past week, 33,437 tons; Greenock, 134; Ayr, 9080; Irvine, 3160; Troon, 6158; Burntisland, 13,000; Leith, 7055; Grangemouth, 12,672; Bo'ness, 6669; Granton, 4140; and Port Glasgow, 1100—total, 96,605 tons, as compared with 93,031 in the same week of 1886.

At a conference of masters and colliers delegates held in Glasgow, as representing the districts of Airdrie, Slamannan, and Bathgate, to consider the question of the adoption of a sliding scale of wages, it was reported that the whole of the districts were not agreed as to its acceptance. The matter was therefore postponed in the meantime, but it was resolved that before any change should be made either in wages or the terms of employment, a fortnight's notice should be given by either party.

WALES AND ADJOINING COUNTIES.

(*From our own Correspondent.*)

I noticed last week a capital rail made at Cyfarthfa some time ago, now being placed on the Rhymney line. Unfortunately steel rails, however good and cheap, are not in demand. Cyfarthfa has not made a rail this year, certainly, but other works are turning out a few, principally for renewals. These may be expected to increase as the spring advances. The chief make at most works are steel and iron bars. Cyfarthfa turns out 1000 tons a week. An interesting consignment has just left these works in the form of a box of exhibits for Newcastle, principally steel plates, &c. It shows the perfection to which scientific appliances have been brought when I state that 1100 sheets only measure 1in. in thickness. This character of steel make is used for coating buttons. Steel, like tin, is evidently to figure in more varied uses even than at present. This is good for the ironmasters, who are working at rails as no longer the leading article. Speaking with one this week he said, "We won't make rails at the price offered, and only wish every maker did the same. Present quotations are no good either to master or man."

A few consignments, foreign, are reported. Puerto Cabello took 298 tons; Lisbon, 140; and Colombo, who is becoming a good customer, 500 tons, iron shipments this week.

For the ordinary cokes, Bessemer, and Siemens, the demand is fairly well sustained, and as regards quantity there is not much ground for complaint. The real grievance is price. Take Swansea for instance. Last week was one of the busiest, especially in tin plates. The quantity exported was 51,443 boxes, and as only a little over 24,000 came from Wales, there was a rush upon the stocks. Three large steamers are now loading plates for the States, so that a good total may be expected this week again.

Prices remain unaltered. Buyers cannot force down below 12s. 6d. as a rule, and from this to 13s. have been the ruling figures. Good Bessemers are in demand for as much as 13s. 3d. Siemens' range to 13s. 10½d. Charcoal sheets are in slight request, and may be had for as little as 13s. 10½d. Best will fetch 15s. 6d., but for these sales are small. Coke wasters are still in demand, and sell freely for from 12s. 3d. to 12s. 6d.

The favourite plate on the market is Bessemer steel, with coke tinning, and for these, special, as much as 13s. 6d. has been asked, and obtained.

Abercarne Works, Mr. Whitehouse, are in good form again, and Monmouthshire make will soon prove a serious consideration.

But the element of discontent is the one which makers fear more than the question of demand. Organisation is going on apace, and Unionism is to be supported with a capital of £20,000. There have been several meetings of late at Swansea, and Llanelly, and a subscription of 1s. per week per man is to be carried out.

I would suggest a good representative meeting of masters and men, and a sliding scale adopted similar to that which has been found so useful in the coal trade.

Another spurt seems to be taking place in the steam coal trade. On Saturday and Monday ten consignments of over 2000 tons each, best steam, left Cardiff for foreign destinations. The total last week from that port was nearly 160,000 tons, and Swansea showed a total of nearly 33,000 tons. Newport coasting, total, 23,790 tons.

Small steam again suffers by the increased output of large, and at 4s. 3d. it is going a-begging. Large stocks are accumulating.

Prices of steam coal remain stagnant, from 8s. 3d. to 8s. 6d. f.o.b., being the ruling figures. Monmouthshire coal 1s. cheaper; Rhondda No. 3 in poor demand, prices quoted 8s. 3d. Coke dull, 14s. 6d. furnace, 16s. foundry, patent fuel better, and shipments increasing. Swansea sent away over 7000 tons last week. Penarth Dock cleared 70,044 tons coal last week, the largest clearance which has yet been made there. The average is about 10,000 tons daily.

Plymouth colliers returned to work on Wednesday after a little difference about the check weighers. Rhondda and other colliers' meetings are moving in the matter of the Mines Regulation Bill.

NOTES FROM GERMANY.

(*From our own Correspondent.*)

The iron market in Silesia is in an especially hopeful condition just now, for not only are all stocks of pig iron both at works and in dealers' hand sold, but the forges and rolling mills, steel works, and foundries are at the same time exceptionally well off for orders, and have contracted for their output for the current quarter, the price for bars being at M. 120 p.t. as base price, so there can, under these circumstances, be no question but prices will keep up for some time, if they do not indeed rise, that is, till the production, which has been increased by relighting fresh blast furnaces, has overtaken the consumption, and stocks have begun to accumulate again. The reasons for this better state of things are the purchase of so much pig iron to go to Russia before the duty is raised, and the firm position of the Wrought Iron Convention, now strengthened by the accession of the largest firms, which has brought consumers and merchants into the market, fearing now, perhaps, higher prices in the future. The neighbouring market of Austria is also able firmly to maintain its quotations, and this more particularly because after the 1st of July it is proposed to raise the import duty on iron.

The Belgian iron market remains firm and unchanged from last week. The blast furnaces have contracted for nearly all their output, and both pig and wrought iron of all descriptions are in excellent request. The prices of crude iron are now very firm, as the cause of any former weakness has ceased, since there has been no more over production to produce it. Steel is also firm. Three Belgian and Lorraine firms have just divided an order for 900 wagons between them for the Italian Mediterranean Railway. The coal trade is not so favourably situated at home, but the export has greatly increased since the beginning of the year, which compensates in great part for this.

The French market is showing more hopeful signs, for until lately in Paris prices had a continued downward tendency, whilst all over the country the reverse was the case, but now prices are beginning to look up in Paris itself. Girders are at 130f., and merchant bars, 140 p.t. The Aciéres de France have got an order for 1400 t. of steel rails for Corsica, at 130f. p.t. There is no uncommon demand for iron at the several works, but sufficient orders came to book to keep them regularly going, and prices pretty firm. The Wrought Iron Convention has been prolonged to the 30th of November next. The work for the Eiffel Tower and the Exhibition building is being pushed forward regularly. Of the coal trade there is nothing worthy to remark.

The Rhenish-Westphalian iron and steel market does not show up quite so well as its neighbours before alluded to. There is little change to note, demand has certainly slackened, but prices in general have been upheld. Ores, as last reported, are still less sought after this week again, red hematites having the call. The Spanish market, on the other hand, is brisker with a slight upward tendency. Most kinds of pig iron have held their places, and Spiegel, high in Mn., is in much better demand again, large batches having been disposed of and contracts for the whole production for the current quarter having been closed. In other sorts concessions on the base prices are obtainable, which is remarkable, for there are no stocks at the furnaces and very little stored, and the demand is greater than the supply. This only applies to the Siegerland. The prices at the Westphalian works have all been moderately well maintained. In the month of March in all 315,713 t. of pig iron were produced. For wrought iron neither the demand nor the prices have changed much, the base price having again been fixed by the Rhenish-Westphalian Convention on the 23rd ult. at M. 110 p.t. A delegate from the Silesian Convention attended this meeting, the result of which will probably be a coalition of the two. This would bring the buyers, who have been hanging back so long, into the market, as further waiting would be of no avail, when the present complaint of the slowness with which specifications come into the works would cease. These conventions are so far of interest that it better enables the works to compete against England in neutral markets, for the reason that it is possible for them to charge a lower figure for exported iron than for domestic consumption, the home consumer being saddled with the difference. Boiler plates have been a little better called for, but the price obtained does not pay, so it is expected the Western Convention will shortly raise it in face of the firmly-held prices of pig iron. In March, 7775 t. of plates were produced by the west group of works. Thin gauges of sheets in the Siegerland are in less request, but a further fall in prices has not been made known. In railway material there is little to note. It appears the native works had anticipated foreign competition at Bromberg, noted last week, so they reduced their tenders accordingly, which were M. 111 and 112 p.t. as the lowest, but this is an advance of M. 5 to 6 p.t. in the prices there tendered last October. At the Italian tenderings last month for the Mediterranean Railway, the Bochum Company took 77,000f. of locomotive and tender axles, while the native works, Terni, took 158,000f. of Bessemer and Martin steel tires. The position of the machine and other construction works remains almost unchanged, but Henschel and Son, of Cassel, have received an order for twenty locomotives from the Italian railways, and the Germania Company of Kiel has just taken a contract for ten torpedo boats for the Turkish Government.

It may be useful to parties doing, or about to do business in Italy, to be informed that A. Miazzon and Co., in Milan, *vià* Carmine No. 5, are now publishing every Thursday, under the title "I fallimenti monitores del commercio," a list of firms for the whole of Italy who have suspended payment, and a supplement which gives particulars of all protested bills. The price for the two is 25 lire yearly; for the first alone, 8 lire.

The third sea-going cargo steamer of 850 tons and 450 horse-power, built and engined by Sir W. G. Armstrong and Co., to run between Cologne and London direct, has just arrived at the former city to begin her regular passages. She is fitted throughout with electric lamps. It is not improbable that these vessels may be the precursors of a collier fleet to carry coals from Westphalia to the North and Baltic Sea ports, in rivalry with the English.

The new explosive compound, "Roburite," is coming to the front, and a factory to produce at first about two tons per week is now being built near Witten, in Westphalia, to manufacture it. From exhaustive experiments in actual practice, it appears that it has the following advantages, amongst others, above dynamite:—It is perfectly harmless to handle, and water destroys its efficacy; it i much more powerful, weight for weight, and after explosion the gases are neither dangerous nor even annoying, and used in coal mines it does not pulverise the coal like dynamite, but acts more like gunpowder, without its dangerous igniting flash. The inventor is Dr. Roth. It is stated that it is a compound of petroleum and chlorine with nitrate of potash, but I do not vouch for the accuracy of this statement.

The foundation stone of the Schwartzkopf branch torpedo works, at Milan, was laid on 25th ult. It appears that the German Government has for some time past had technical attachés (engineers) added to their embassies at London, Paris, Rome, St. Petersburg, and Washington, to which architects are now being joined, and the arrangement has been useful, and given satisfaction. It is to be hoped the English Government will follow suit, if it has not already done so.

Agricultural Engineers' Association.—The annual meeting of the Association was held in the Memorial Hall, Farringdon-street, E.C., on Tuesday last, Mr. Henry D. Marshall—Marshall, Sons, and Co.—the president, in the chair. The annual report of the council, together with the treasurer's statement, was adopted. Mr. Marshall was unanimously re-elected president for the ensuing year, and Mr. J. E. Ransome, of Ipswich, and Mr. A G. E. Morton, of Chelmsford, were likewise unanimously elected vice-presidents. A vote of thanks was awarded to Mr. Marshall for his able services as president during the past year

The London Association of Foremen Engineer and Draughtsmen.—At the thirty-fourth anniversary dinner, held on Saturday last, Lord Thurlow presided. The great hall of the Cannon-street Hotel was the scene of the celebration, and the chairman was supported by Admiral Mayne, C.B., M.P.; Colonel E. Hughes, M.P.; the Hon. and Rev. Canon Fremantle, Sir Frederick Abel, Mr. Joseph Newton, C.E., and others, whilst the room was well filled by members of the Association and their friends. It was remarked, however, that scarcely a single employer of note in the engineering community was present—a marked contrast to similar gatherings in former years. The speeches—especially those of the noble chairman, Admiral Mayne, and Mr. Powrie, president of the Association—were fairly up to the average, and the contributions to the benevolent funds, including one of twenty guineas by Lord Thurlow, amount to about £100. The deputy chairman on this occasion was Mr. William Beardmore.

The Sportsman's Exhibition.—The Exhibition which closed on Saturday last contained a good deal that was of interest to our readers from an engineering or a mechanical point of view, as well as with a view to recreation. Besides a small quantity of machinery not legitimately belonging to the Exhibition, there was a very large quantity of mechanical work of the best kind in the numerous bicycles and tricycles, in the guns and rifles of various kinds, and in the display of canoes, rowing and sailing boats, model and full-size river launches, and everything necessary to outdoor recreation. The development of the bicycle has now reached an interesting stage, and has returned as to form to the old dandy-horse with two wheels of equal size. Most of the makers are producing machines of this form, and there seems to be very much to recommend it. The Coventry Machinist Company, amongst others, showed some very nice machines of this and other classes. Messrs. Forrestt exhibited some fine boats for river and shore use, well made, and at moderate prices.

Society of Engineers.—At a meeting of this Society held on the 2nd of May, at the Westminster Town Hall, Professor Henry Robinson, President, in the chair, a paper was read on "Refrigerating Machinery on board Ship," by Mr. T. B. Lightfoot, M. Inst. C.E. After mentioning early applications of refrigerating machines, the author pointed out that at the present time the only machinery in use on board ship for refrigerating purposes was that in which heat is eliminated by the successive compression, cooling when under compression, and subsequent expansion of ordinary atmospheric air. Though apparatus on this principle was at work as early as the year 1845, it is only since 1870 that it has received much attention. The theory of air refrigerating machines was briefly explained, showing, first, how a perfect gas behaves during compression, cooling, and expansion; and, secondly, the effect of aqueous vapour mixed with such gas. These principles were then applied, and the construction of cold air machines described, after which a short historical *résumé* was given, commencing with Dr. Gorrie's machine, which was at work in New Orleans in 1845 and in London in 1856, and referring to Siemens' invention of the interchanger, Windhausen's and Nehrlich's improvements, Giffard's separate exhaust valve for the expansion cylinder, and Bell-Coleman's duplicate machine with interchanger. The author's machines for use on board ship, as manufactured by Messrs. Siebe, Gorman, and Co., were described at length by the aid of diagrams. These machines have no interchanger, and the reason for this was given. The largest sizes generally have compound surface condensing steam engines, but sometimes the condenser is made separate, as in the case of the installation for the s.s. Fifeshire, now being specially built for the New Zealand meat trade by Messrs. Turnbull, Martin, and Co., of Glasgow. The smaller machines are combined with ordinary steam engines, and are made both of the horizontal and vertical type, the latter, however, being specially suited for ship work on account of the small space occupied. In addition to the dead meat trade, the author's machines are extensively used in passenger vessels for making ice, preserving provisions, fruit vegetables, &c., and for cooling water; also on board steam trawlers and carriers for the preservation of fish, especially in hot climates. They have also been applied in cattle-carrying steamers for ventilating and cooling the holds. A recent application of a very small vertical machine on board Mr. G. Gordon-Bennett's steam yacht Namouna was illustrated.

AMERICAN NOTES.

(*From our own Correspondent.*)

NEW YORK, April 22nd.

THE metals have been unusually quiet for a week or two. Comparatively little copper has been exported this year, as compared to last, and the trade conditions seem to be opposed to rapid increase for some time to come. The copper producers are determined to control the production and preserve prices.

The iron market has developed very little strength, and the unsold capacity of American mills is estimated at about 350,000 tons this week. The apprehensions that have been entertained regarding the continuance of projected railway work, have been dissipated by the recent resolutions of syndicates having railway building in charge. At present the indications are that all of the projected mileage will be constructed, and the estimates of this mileage vary from 9000 to 13,000 miles of main track for this year. The estimated capacity of the rail mills is put at from 1,950,000 to 2,000,000 tons. The new works and the extended old works will have capacity available for early winter, and if the present favourable conditions continue, the railmakers will enter next year with a million tons of rail contracts on their books. A great deal of machinery is now in request for mining operations in the far west and south-west. Very extensive mining operations are projected; besides this large tracts of land are being bought up for agricultural and mineral purposes. 500,000 acres of land have just been purchased lying in the States of Coahuila, Durango, and Chichuhua, in Northern Mexico. The tract is traversed by the Mexican Central Railroad, and also by the International Road, which C. P. Huntingdon is building from Eagle Pass to Laredo. Of this tract 1,000,000 acres is the finest cotton land in the famous Laguna district. A company composed chiefly of Hartford, Conn., capitalists has bought 500,000 acres in Senora and Chihuahua, all grazing and agricultural land. A purchase of 235,000 acres has been made in the western part of Chihuahua by Utah men.

Prices of iron and steel remain firm. The demand is temporarily restricted under the lack of confidence as to what the freight rates may be next week or next month. Steel rail contracts could be placed at mill at 31 dols. for early winter delivery. Old rails are selling at 23 dols. to 23·50 dols. at Atlantic ports. Consumers of billets, slabs, and Bessemer pig are waiting for further developments. There is a very heavy business in all kinds of lumber.

Foreign iron is selling at 18 dols. at furnaces, equal to about 19 dols. at mill, and foundry iron is selling at 19 dols. to 20 dols. at furnace, and the heavy production is all absorbed. Nails have dropped to 2·35 per keg. Wrought iron pipes are in heavy demand for natural gas and other purposes, and the makers of cast pipe are sold from three to four months ahead all the way to the Allegheny.

NEW COMPANIES.

THE following companies have just been registered:—

Climax Foundry Company, Limited.

This is the conversion to a company of the businesses of malleable and soft iron and brass-founders, and manufacturers of patent boot protectors, carried on at the Globe Works, Stourbridge, Worcester, by Messrs. Benjamin Bloomer and Andrew Knowles, under the style of the Climax Patent Boot Protector Company. It was registered on the 31st inst., with a capital of 10,000, in £1 shares, with the following as first subscribers:—

	Shares.
*T. Bantock, Wolverhampton, railway and general contractor	1
T. H. Gough, Dudley, chartered accountant	1
*H. A. Wassell, Stourbridge	1
*B. Bloomer, Stourbridge, ironfounder	1
T. S. Hatton, Wolverhampton, accountant	1
R. Muras, Wolverhampton, chartered accountant	1
H. S. Johnson, Wolverhampton, solicitor	1

The number of directors is not to be less than three, nor more than seven, the first being the subscribers denoted by an asterisk, and Messrs. W. Jones and A. Knowles; qualification, £250 in shares or stock, or £500 in debentures; remuneration, £150 per annum.

Crown Point Gold Mine, Limited.

On the 23rd inst. this company was registered, with a capital of £160,000, in £1 shares, to acquire and work the Crown Point Gold Mine, Grass Valley, Neva County, California. The subscribers are:—

	Shares.
E. T. Read, 80, Lombard-street	1
F. E. Hamilton, 33, Fenchurch-street, clerk	1
W. J. Smith, 42, Lombard-street, clerk	1
Wm. Poole, 243, Commercial-road, Peckham, clerk	1
J. Yuill, 65, Alderbrook-road, Balham, clerk	1
J. T. Carrington, 2, Victoria-mansions, S.W., engineer	1
T. Larking, 5, Little Exeter-street, Chelsea, clerk	1

The number of directors is not to be less than three, nor more than seven; the first are Messrs. C. Clark, J. Hastings, D. F. Carmichael, J. E. Vesey Fitzgerald, E. H. Hindley, and G. P. Simpson; qualification, £500 in shares or stock; remuneration, 300 guineas per annum to the chairman, and 200 guineas per annum to each other director. The board will also be entitled to one-twentieth of the dividends paid over and above the first £10 per cent. made by the company.

East Lincolnshire Brick, Tile, Terra-cotta, and Coal Company, Limited.

This company was registered on the 20th inst., with a capital of £10,000, in £10 shares, to acquire certain brickfields in East Lincolnshire. The subscribers are:—

	Shares.
F. E. Friston, Mablethorpe, artist in terra-cotta	1
L. W. Pockett, Hogsthorpe, physician	1
J. W. Davis, Grimsby, merchant	1
J. F. Walker, Hull, artist	1
J. W. Strachey, Mablethorpe	1
W. Boulton, Hogsthorpe, surgeon	1
Hy. Hobson, Hogsthorpe, builder, &c.	1

Registered without special articles.

Gold Fields Prospecting Company, Limited.

This company was registered on the 25th inst., with a capital of £50,000, in £1 shares, to search for, prospect, and discover mining lodes, and mining rights of every description. The subscribers are:—

	Shares.
W. C. Freeman, 3, Cowley-road, Brixton, clerk	1
H. Gatsford, 184, Kingsland-road, clerk	1
A. B. Brotheridge, 9, Gairloch-road, Camberwell, clerk	1
J. W. Dewhurst, 473, Liverpool-road, book-keeper	1
J. Rudkin, Belvedere, Kent, manager of a banking company	1
S. Batsford, 89, Dalzell-road, Brixton, shorthand writer	1
G. Rawlings, 6, Lilac-villas, Upton Park, estate agent	1

The number of directors is not to be less than three, nor more than ten; qualification, 100 shares; the subscribers are to appoint the first. The company in general meeting will determine remuneration.

Governor Group, Limited.

This company was registered on the 25th inst., with a capital of £100,000, in £1 shares, to purchase the Governor Group of mines situate in Mount Sneffles, Ouray County, Colorado, upon terms of an agreement of the 20th inst., made with the Whitehead Mining and Smelting Company, Limited. The subscribers are:—

	Shares.
Lion Hertz, 19, Caufield-gardens, West Kensington, manager of a company	1
H. S. Foster, Glenhurst, West Dulwich, accountant	1
W. Kern, 44, Hereford-road, Bayswater	1
W. S. Nuler, 3, Belle Vue-villas, Woodgreen, N., secretary to a company	1
J. Wing, 17, Belgrave-street, King's-cross	1
A. Hill, King's Arms'-yard, auctioneer	1
F. Grant, 72, Bishopsgate-street Within, chartered accountant	1

Registered without special articles.

Hart Brothers, Limited.

This is the conversion to a company of the business of manufacturers of india-rubber and waterproof goods, carried on by Messrs. Hart Brothers at Failsworth and Manchester. It was registered on the 22nd inst., with a capital of £20,000, in £10 shares, with the following as first subscribers:—

	Shares.
H. Jonas, Whalley Range, Manchester, buyer	1
J. Besso, 15, Cross-street, Manchester, shipping and insurance broker	1
H. G. Nicholson, 100, King-street, Manchester, chartered accountant	1
*A. M. Hart, 33, Fountain-street, Manchester, india-rubber manufacturer	1
*M. Hart, 33, Fountain-street, Manchester, india-rubber manufacturer	1
*M. Eilenberg, 2, Hart-street, Wood-street, E.C., india-rubber garment manufacturer	1
S. Betts, 353, City-road, N., manufacturing jeweller	1

The number of directors is not to be less than three, nor more than seven, the first being the subscribers denoted by an asterisk, and Mr. Victor R. Levi, of Manchester; qualification, 10 shares. The vendors are appointed managing directors for five years.

Ilex Gold Mining Company, Limited.

This company proposes to acquire and work gold mining claims, situate in Calaveras County, California, U.S.A. It was registered on the 21st inst., with a capital of £100,000, in £1 shares. The purchase consideration is £16,000 cash, 16,000 fully-paid preferred shares, and 8000 fully-paid deferred shares. The subscribers are:—

	Shares.
*Count de Torre Diaz, 41, Moorgate-street, merchant	1
*Hon. A. H. Petre, 17, Tokenhouse-yard, stock broker	1
W. Thornton, 32, Mount Park-road, Ealing	1
*H. Weld Blundell, 5, Gracechurch-street, director of the Cumberland Gold Mining Company, Limited	1
J. F. C. Norman, 18, Laurence Pountney-hill, merchant	1
R. C. Wyatt, 88, Leadenhall-street, merchant	1
J. C. Mardel Ferreira, 62, Marquis-road, Camden-square, clerk	1

The number of directors is not to be less than three, nor more than six; qualification, 250 preferred shares; the first are Sir Samuel Canning, J. F. C. Norman, Esq., and the subscribers denoted by an asterisk; remuneration, £300 per annum multiplied by the number of directors for the time being, with the addition of the fixed sum of £200.

North of Italy Steam Tramways, Limited.

This company was registered on the 26th inst., with a capital of £100,000, in £5 shares, to acquire certain lines of steam road railway or tramway in Italy upon terms of an agreement of the 5th inst., entered into with Francesco Radice and Vincenzo Remotti. The subscribers are:—

	Shares.
F. W. Munk, 27, Clement's-lane, solicitor	1
H. M. Collins, 23, Bolina-road, S.E., shorthand writer	1
G. Webber, 15, Parkville-road, Fulham, surveyor	1
A. N. Humphrey, St. George's Club, Hanover-square, mining engineer	1
C. J. Chubb, C.E., 33, King-street, E.C.	1
Captain E. J. S. Norton, 45, Cambridge-street, Hyde Park	1
C. Holland-Haynes, 3, Cambridge-road, Teddington, secretary to a company	1

The number of directors is not to be less than three, nor more than eight; the subscribers are to appoint the first; qualification, 50 shares; remuneration, £200 per annum to the chairman and £150 per annum to each ordinary director.

Pahang Mining Company, Limited.

This company proposes to acquire mining and other properties in the territories of the Sultan of Pahang, or elsewhere in the Malay Peninsula or Archipelago, and particularly to purchase a concession or grant of land from the Sultan, upon terms of an agreement with Wm. Fraser. It was registered on the 27th inst., with a capital of £200,000, in £1 shares. The subscribers are:—

	Shares.
E. A. Pontifex, Farringdon Works, Shoe-lane, engineer	1
Nevil Story-Maskelyne, M.P., Swindon	1
Wm. Fraser, M.A., 2, Sergeants'-inn, Fleet-street	1
J. Ashton Bell, 86, Lancaster-gate, merchant	1
A. Barry Herrfeldz, 54, Nevern-square, merchant	1
F. Jones, Elstree, Herts, solicitor	1
C. J. F. Campbell, 5, Moreton-gardens, S.W., merchant	1

The number of directors is not to be less than three, nor more than seven; the subscribers are to appoint the first, and act *ad interim;* qualification, 500 shares; remuneration, £200 per annum to the chairman, and £150 per annum to each director.

Patent Hosiery Machine Company, Limited.

This company was registered on the 25th inst., with a capital of £10,000, in £5 shares, to acquire the business and assets of Messrs. John Dalby and G. W. Brand, including the patent No. 4745, A.D. 1887, for improvements in knitting machines. The subscribers are:—

	Shares.
*Wm. Lee, Nottingham, machine tool maker	1
*W. Hunt, Nottingham, machinist	1
*J. Dalby, Nottingham, machinist	1
*G. W. Brand, Nottingham, machinist	1
R. Hunt, Burton-on-Trent, baker	1
H. Oakes, Mansfield, schoolmaster	1
S. Baggaley, Nottingham, clothier	1

The number of directors is not to be less than three, nor more than five; qualification, 75 shares; the first are the subscribers denoted by an asterisk. The company in general meeting will determine remuneration.

Percy Ibotson and Sons, Limited.

This company was registered on the 27th inst., with a capital of £20,000, divided into 6000 preference and 14,000 deferred shares of £1 each, to purchase the business of paper and boards manufacturers, carried on by Hy. Percy Ibotson, at Poyle, Middlesex. The consideration is 6500 fully-paid deferred shares, £760 6s. 1d. in cash, and the discharge of the liabilities of the vendor in connection with such business. The subscribers are:—

	Shares.
*H. P. Ibotson, Poyle Mills, board manufacturer	1
*W. H. Makins, Poyle Mills, board manufacturer	1
Colonel W. T. Makins, M.P., 1, Lowther-gardens, S.W.	1
W. H. Simpson, 16, Kent-terrace, Regent's Park	1
M. Norsworthy, 71, Cornhill, chartered accountant	1
J. W. Smith, 52, Queen Victoria-street, accountant	1
H. I. Ward, 1, Walbrook, solicitor	1

The number of directors is not to be less than two, nor more than five; the first are the subscribers denoted by an asterisk; qualification, £500 in shares. Mr. Ibotson is appointed director for life, and Mr. W. H. Makins for fourteen years. Any executor or administrator or nominee of Mr. Ibotson may appoint a director so long as he shall hold 2000 shares. The company may advance money to the two directors at such times and in such manner as they may require, but not exceeding £600 per annum to Mr. Ibotson, and £750 per annum to Mr. W. H. Makins. Such sums may be paid out of capital, and the company shall not be bound to take security for the repayment thereof. Any sums so advanced may be taken by the two directors on account of the dividend on their shares, provided that if the profits of the first two years do not amount to £2700, the said directors are to repay within four years so much respectively of the said annual sums as shall during such period of two years have been paid out of the capital. If after the two years the profits do not amount to £1350, the said directors are to repay so much of such sums as shall in one year be paid to them out of the capital.

Rendle and Company, Limited.

This is the conversion to a company of the business of contractors, glaziers, builders, and engineers carried on under the styles of Wm. Edgecumbe Rendle and Co., and John Edgecumbe Rendle and Co. It was registered on the 27th inst., with a capital of £70,000, in 6000 ordinary and 8000 7 per cent. preference shares of £5 each. The subscribers are:—

	Shares.
*Captain J. W. Clarke, 16, Beaufort-gardens, S.W.	1
*G. E. Milner, Gresham House	1
T. Hepburn, 99, Vauxhall Bridge-road, clerk	1
J. Hobbs, 30, Union-street, Hackney-road, clerk	1
*T. W. Allen, 5, Wood-street, Westminster	1
F. W. Boer, 8, Copthall-court, clerk	1
A. G. Edwards, 15, Gilbert-road, Kennington, draughtsman	1

The number of directors is not to be less than three, nor more than five; the first are the subscribers denoted by an asterisk, and Mr. J. H. Andrews, of Arcade-chambers, Manchester; qualification, 20 shares; remuneration, £400 per annum.

Santander Harbour Company, Limited.

On the 23rd inst. this company was registered, with a capital of £300,000, in £20 shares, to acquire from the Compagnie de Santander pour l'agrandisement de la Ville, the benefit of a concession for the construction of a harbour and works, and the reclamation of land in Santander, Spain. 5000 of the shares are to be entitled to a cumulative preferential dividend of 7 per cent. per annum. The subscribers are:—

	Shares.
Ramon de Artola, 14, Austinfriars, banker	1
M. Clarke, 9, New Broad-street, railway contractor	1
R. Kalli, 3, Audley-street, W., proprietaire	1
J. Macalister, 14, Trebovir-road, Earl's Court	1
E. C. C. Smith, 54, The Chase, Clapham	1
F. H. Rapley, 66, Maury-road, Stoke Newington, engineer	1
F. Modet, 38, Bedford-place, W.C.	1

The number of directors is not to be less than three, nor more than nine; qualification, £500 of share capital; the subscribers are to appoint the first and act *ad interim;* the company in general meeting will determine remuneration.

THE PATENT JOURNAL.

Condensed from the Journal of the Commissioners of Patents.

Application for Letters Patent.

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

25th April, 1887.

6037. TREATING MATTERS having an OFFENSIVE SMELL, A. D. Hunter, London.
6038. CEMENT, G. H. Sharpe, F. W. Turner, and E. Mesnard, London.
6039. HEATING AIR, R. Haddan.—(*— Vaillant-Dubus, France.*)
6040. SETTING SCREWS, R. Macer, London.
6041. OPTICAL INSTRUMENT, J. Leiter, London.
6042. GALVANISING, H. H. Lake.—(*C. Swinscoe, United States.*)
6043. MAGAZINE or REPEATING FIRE-ARMS, A. Greenwood, London.
6044. FOLDING DESK, H. H. Lak.—(*J. D. Richardson, United States.*)
6045. TUBULAR PARTS of STEAM BOILERS, S. Fox, London.

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6046. HARVESTER REELS, H. J. Allison.—(*S. S. Stout and H. G. Underwood, United States.*)
6047. CHESSMEN, L. S. Schmitthenner, London.
6048. AFFIXING a KNOB of a DOOR HANDLE to the SPINDLE, A. Smith, Burslem.
6049. INVALID COUCHES, R. Harrison, Bradford.
6050. GAS HEARTHS for BOILING, &c., W. Towler, Leeds.
6051. KNITTED FABRICS, J. Booth, Halifax.
6052. TOY HOBBY HORSES, &c., G. Taylor, Hyde.
6053. LITHOGRAPHIC TRANSFER PAPER, J. and E. A. Ridgway, Stoke-on-Trent.
6054. CARBONISING FABRICS and FIBRES, E. Schorah, Halifax.
6055. AUTOMATIC RAILWAY COUPLING, H. L. Moody, Halifax.
6056. SELF-ACTING FASTENER and LOCK, E. Marston, Enderby.
6057. CASK, &c., TAPS, J. R. Hargrove, Birmingham.
6058. CASTING STEEL, B. H. Thwaite, Liverpool.
6059. BINDING DEVICES, A. G. Boookes.—(*J. F. Haskins, United States.*)
6060. VIOLINS, &c., A. Cooper, London.
6061. BURNING SUBSTITUTES for COAL, &c., J. Balbirnie Sheffield.
6062. DENTAL FLASKS, G. H. Salt, Middlesbrough.
6063. LOOSE VENETIAN BLIND LATH, W. Little, Preston.
6064. COKE OVENS, W. Hanson, Middlesbrough.
6065. METALLIC CASE, L. Meyers, Birmingham.
6066. BALLS for BEARINGS, &c., T. Dredge, Birmingham.
6067. PAPER BAG MACHINE, W. A. Lorenz and W. H. Honiss, London.
6068. PURIFICATION of SINK WATER, R. Nicholls, London.
6069. ENVELOPES, C. White, London.
6070. HORSESHOES, G. W. Heaton, London.
6071. FOG SIGNALS, F. D. Banister and W. Stroudley, London.
6072. APPLYING SAND to PREVENT WHEELS SLIPPING, J. Gresham, London.
6073. DRYING OVENS, R. E. Phillips.—(*C. P. N. Martin, Ceylon.*)
6074. TRICYCLES, W. E. Hurrell, London.
6075. WATER METERS, F. W. Tuerk, jun., and J. C. and J. Hunter, London.
6076. PHOTOGRAPHIC CAMERAS, W. Clark, London.
6077. PORTABLE TOOLS for FIRE-ARMS, A. J. Boult.—(*G. W. Morse, United States.*)
6078. EXTRACTING FERRULES from TUBES, H. W. Swift, Liverpool.
6079. BUTTON-HOLE SEWING MACHINES, F. Egge, London.
6080. WATER-CLOSETS, J. V. Eves, Manchester.
6081. ATTACHMENT HOLDER for SEWING MACHINES, F. Egge, London.
6082. CAMERA OBSCURA, S. and F. E. Andrews, Liverpool.
6083. BOX-NAILING MACHINES, T. B. De Forest, London.
6084. CABLE and other RAILWAYS, W. P. Thompson.—(*A. Shobe, United States.*)
6085. DISINFECTING POWDER, S. Hallsworth and R. Bailes, London.
6086. ELECTRO-DEPOSITION, S. P. Thompson, London.
6087. REDUCING the POINT in CARBON in STEEL, E. D. Wassell, London.
6088. MACRAMI LACE APPLIANCES, W. E. Bradbury, London.
6089. DRIVING GEAR for VELOCIPEDES, J. R. Hudson and J. W. Marshall, Sheffield.
6090. GAS STOVES, J. Galli, London.
6091. SECURING STEREO-PLATES on PRINTERS' BLOCKS, A. P. Sanson, Edinburgh.
6092. PASTING SHEETS of PAPER together, A. M. Clark.—(*E. T. Hazeltine, United States.*)
6093. WROUGHT METAL SLEEPERS, J. Edwards, London.
6094. STAVE-MAKING MACHINERY, C. L. Goehring, London.
6095. PLOUGHS for CUTTING DRAIN DITCHES, J. Harper, London.
6096. FOOD for ANIMALS, A. G. Wass, London.
6097. DREDGERS and EXCAVATORS, A. L. Blackman, London.
6098. RINGS for CURTAIN POLES, H. H. Lake.—(*W. P Hill, United States.*)
6099. RODS or POLES for SUPPORTING CURTAINS, H. H. Lake.—(*J. Cremer, United States.*)
6100. TREATMENT of DIASTASE, G. Epstein, London.
6101. TIRES of BICYCLES, J. Thom, London.
6102. DRIVING VELOCIPEDES, J. Glover, London.
6103. TIRES for VELOCIPEDES, J. K. Starley, London.
6104. ELECTRICAL MEASURING INSTRUMENTS, A. Le N. Foster and F. V. Andersen, London.
6105. OPENING, &c., BUNG HOLES, J. R. Dry, London.
6106. RIDING SHIRTS, E. Davies, London.
6107. SEPARATON of CARBONIC OXIDE from NITROGEN, &c., H. Gardner.—(*R. J. Henderson, United States.*)
6108. WINDOW SASHES, J. L. Shoebridge, London.
6109. MANUFACTURE of TIN-PLATES, &c., A. J. Mashrey and P. S. Phillips, London.
6110. ATTACHING BOWS to COLLARS, &c., J. Carter, London.
6111. SUPPLYING WATER to WATER-CLOSETS, A. Dawes, London.
6112. FRAMES of UMBRELLAS, H. Jeffery, London.
6113. STARTING TRAMWAY VEHICLES, A. Fendt, London.
6114. CLEANING STAIR-RODS, J. Jones, London.

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6115. FILTER TAPS, R. Gough, London.
6116. SOFTENING, &c., HIDES, J. Palmer, London.
6117. SMELTING CRUDE ANTIMONY, G. B. Williamson.—(*H. F. Logan, New Zealand.*)
6118. PROTECTING the OPEN ENDS of CIGARS, H. Wilson, Landport.
6119. PRINTING MACHINES, J. Bousfield, York.
6120. MINERS' SAFETY LAMPS, W. Patterson, Low Fell.
6121. MECHANICAL CLEANSING of COCOONS, E. W. Serrell, Paris.
6122. LOWERING CONCRETE under WATER, H. H. Wake, London.
6123. MECHANICALLY ILLUSTRATING INCLINATION of the EARTH'S AXIS, J. Corbridge, Halifax.
6124. FALLERS, J. C. Horsfall, Bradford.
6125. PEELING OSIERS, J. Rowlatt, Wigston.
6126. KNITTING MACHINERY, A. Hamer, T., W. R., and R. J. Walker, Leicester.
6127. BOWLS used in MANGLES, J. Oliver, Manchester.
6128. DYEING COTTON YARNS, F. A. Gatty, Manchester.
6129. WEAVER'S REED HOOKS, J. Clayton, Preston.
6130. SECURING CLOTHING to the BARS of CARD FLATS F. Law, Halifax.
6131. DYEING WARPS, A. U. Lewis, Bradford.

132. Apparatus for Receiving Coins or Checks, W. T. Kennedy, Dundee.
6133. Nicotine Trap for Tobacco Pipes, J. J. Allen, Halifax.
6134. Rugs for Perambulators, &c., R. and W. H Todd, Manchester.
6135. Packing for Steam Engine and Machine Glands, H. Field, Liverpool.
6136. Automatic Motion for Stopping Looms, E. Smith, Bradford.
6137. Open Fire-grates, S. Pickersgill, Derby.
6138. Life-boats, J. J. P. Shervell, Portsmouth.
6139. Securing the Metal Bands Surrounding Bales of Cotton, J. W. Warburton.—(*F. T. Warburton, United States.*)
6140. Carding, J. Platt, Stalybridge.
6141. Sewing Thimbles, A. Mitchell, Sheffield.
6142. Automatic Cartridge Extractors, C. H. Maleham, Sheffield.
6143. Sight Feed Lubricators, H. J. F. Beckwith, London.
6144. Steam Driers, G. G. Picking and W. Hopkins, London.
6145. Preventing the Fraudulent Opening of Safes, London.
6146. Damping Brushes, &c., A. C. Thomson, Glasgow.
6147. Washing Machines, A. Samson, London.
6148. Galleries and Globe Holders, F. M. Dixon and S. H. Dixon, London.
6149. Culinary Freezing and Steaming Apparatus, T. Fishburn, London.
6150. Weaving Wire Mattresses, P. J. Dowling and J. F. Dowling, London.
6151. Valve Gear for Steam Engines, F. Bosshardt.—(*J. R. Frikart, France.*)
6152. Portable Buildings, W. P. Thompson.—(*A. Defiers, France.*)
6153. Decanting Liquids, J. F. Moore, Liverpool.
6154. Locking Nuts, O. Jazenburg, Liverpool.
6155. Perambulators, J. Simpson and S. T. Fawcett, London.
6156. Saddle Bars, L. Rolleston, London.
6157. Armour-plating for Vessels of War, &c , T. E. Hussey, Northwold.
6158. Brake, G. Scholle, London.
6159. Ploughs, A. Simpson, W. Law, and D. Arnot, London.
6160. Electric Inductive Translators, W. Main, London.
6161. Metallic Hurdles and Gates, S. Bayliss, London.
6162. Shackles for the Springs of Carriages, J. A. Lamplugh, London.
6163. Penholders, T. Hooper and S. G. Moore, London.
6164. Supplying a Regulated Quantity of Scent or Perfume in Exchange for a Predetermined Payment, B. Hallett, London.
6165. Steel or Ingot Iron and Phosphate of Lime, R. S. Casson, London.
6166. Working and Interlocking Railway Points and Signals, W. Smith and J. P. O'Donnell, New Malden.
6167. Valves for Vacuum Brakes, J. Ruxton, London.
6168. Telephones for Checking Payment for the Use of Telephones, H. F. Jackson, London.
6169. Rolling Mills, P. Tafel, London.
6170. Cleaning and Preparing Lithographic Printing Surfaces, E. O. Schmiel, London.
6171. Valve Flaps for Air Pumps, &c., F. W. Larsen, London.
6172. Grinding Wheels, E. D. Barker, London.
6173. Steel, R. A. Hadfield, London.
6174. Engines and Machines for the Manufacture of Paper Pulp, F. Voith, London.
6175. Coal and other Similar Plates, H. J. Alexander, London.
6176. Automatically Adjusting the Pumping Load of a Cornish Pumping Engine, W. Husband, London.
6177. Adapting Electric Lamps to the Helmets of Divers, A. Marcilhacy, London.
6178. Utilising the Power Expended in the Thrust Bearings of Propeller Shafts, &c., T. Cooke and W. H. Boyens, London.
6179. Mountings for Heavy Ordnance, J. Vavasseur, London.
6180. Propelling and Steering Vessels, J. F. Green, London.
6181. Stockings and other Knitted Goods, W. Bown and H. W. Cooke, London.
6182. Securing Corks in Bottles without the Aid of Wire, L. Dove, London.

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6183. Solitaire, E. Trow and R. J. Lewis, Birmingham.
6184. Steering Steamships, F. S. Willoughby, Stockport.
6185. Pencils, &c., A. C. Durant, Bradford.
6186. Coupling and Uncoupling of Railway Wagons, &c., F. H. Simpkin, Sheffield.
6187. Step Ladders and Trestles, H. C. Longsdon, Halifax.
6188. Breech-loading Small-arms, T. Woodward, Birmingham.
6189. Protector for Gas-burners, B. Thompson, Great Yarmouth.
6190. Heating of Feed-water of Boilers, J. Weir and G. Weir, Glasgow.
6191. Fog Signalling on Railways, F. Rosebottom, Hyde.
6192. Colour Printing Machines, J. Pollard and C. Mather, Manchester.
6193. Lifting Bar Frames, J. Dixon, Great Ayton.
6194. Cigarette Wrapper, E. L. Sheldon, London.
6195. Cross-tube Fire-box, B. K. Noy, Colchester.
6196. Alternative to the Link Motion of Engines, W. R. Bigsby-Chamberlin, Eastbourne.
6197. Hearth-rug Making, W. Illingworth, Shipley.
6198. Reversing Valves, M. B. Mountain, Birmingham.
6199. Pickers for Looms, W. Atherton, Bradford.
6200. Tea Kettle, F. Payne, Birmingham.
6201. Electric Meters, R. Dick and R. Kennedy, Glasgow.
6202. Portable Pump, M. E. Faust, London.
6203. Spades, H. McC. Alexander, Cheltenham.
6204. Induction Coils and Transformers, W. J. Muller, London.
6205. Sewing Machine Attachments, E. H. Buck and W. Wadmore, London.
6206. Moulding Pipe and other Castings, K. Thien, Liverpool.
6207. Plant Sticks, J. de Paiva, Liverpool.
6208. Drying Cotton, J. D. Sutcliffe and B. T. O'Brien, Manchester.
6209. Combining Disinfectants with Soda Crystals, R. L. Hicks, London.
6210. Selling Publications, C. R. Heap, London.
6211. Button-hole Scissors, L. V. Rees and S. H. Levi, London.
6212. Antiseptic Pails and Commodes, R. Nicholls, London.
6213. Printing Patterns on Floor-cloths, M. B. Nairn, London.
6214. Driving-wheels of Locomotives, C. E. Swinerton, London.
6215. Marking Patterns upon Cloth, E. O'Donnell, London.
6216. Decoration for Metals, E. Haskell and G. Williams, London.
6217. Heating, Curling, &c., Hat Brims, J. Moores, London.
6218. Smoke Consuming Apparatus, J. W. Holden, London.
6219. Induction Apparatus, J. Swinburne, Chelmsford.
6220. Urinals, F. E. Mohr, London.
6221. Governing by Electric Chemical Action, A. Shippey and W. J. L. Hamilton, London.
6222. Rims of Bicycle, Tricycle, &c., Wheels, W. Bown, London.
6223. Escritoires, T. R. Scott and A. F. Graves, London.
6224. Metal Wheels, H. Devien, London.
6225. Ships' Riding Bitts, W. H. Harfield, London.
6226. Watches, F. Knoeferl, London.
6227. Safety Stirrup, E. Noirit, London.
6228. Bins for Wine Bottles, W. B. and J. S. Burrow, and T. Smith, London.
6229. Sad Irons, J. S. Brunt, London.
6230. Hurricane Match-box, H. C. Braun and A. F. Lloyd, London.
6231. Automatic Advertiser, H. C. Braun and A. F. Lloyd, London.
6232. Tin Boxes, G. F. Griffin, London.
6233. Cartridges for Fire-arms, J. P. Lee, London.
6234. Music Stools, J. T. Cänosa, London.
6235. Circular Latch Needle Knitting Machines, J. W. Watts, London.
6236. Furniture Castors, J. Vernon, London.
6237. Velocipedes, J. Ashbury, London.
6238. Piston Motor Engines, C. D. Abel.—(*J. C. Grâbner and C. Ruperti, Germany.*)
6239. Treatment of Incandescent Bodies, O. Imray.—(*C. A. V. Welsbach, Austria.*)
6240. Mowing Machines, W. M. Cranston.—(*The W. A. Wood Mowing and Reaping Machine Co., United States.*)
6241. Screw-stoppered Bottles, &c., W. J. Wheeler, Richmond.
6242. Soldering Irons, C. Clarke and F. Williams, London.
6243. Watering Cans, &c., C. Clarke and F. Williams, London.
6244. Flushing Water-closets, C. Clarke and F. Williams, London.
6245. Indexing Memoranda, H. A. Lee, London.

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6246. Snaffle-bit for Bridles, J. C. King, London.
6247. Cigarette Papers, J. F. Millington, London.
6248. Boot-cleaning Machine, A. Hiscoe, Harrogate.
6249. Metallic Stand for Photos, J. A. Richards, Birmingham.
6250. Syringes, E. and S. Stokes, Birmingham.
6251. Cutting Dovetails, H. Skerrit.—(*L. Fritz, France.*)
6252. Painting in Oil and Water Colours, T. and D. Lister, Halifax.
6253. Needle Case, E. R. S. Bartleet, Redditch.
6254. Drying Fabrics, G. Tolson, Halifax.
6255. Bolts, F. A. Harrison, Birmingham.
6256. Latches, W. Kneen, London.
6257. Raking Hay, T. Mosley, Huddersfield.
6258. Sheep Shears, H. Burgon, Sheffield.
6259. Pens, B. C. Fryer, Bradford.
6260. Looms for Weaving, J. Bennett and J. Bullon, Brimscall.
6261. Drying Sugar, J. Buchanan, Liverpool.
6262. Safety Apparatus for Hoists, J. and T. Barker, Manchester.
6263. Starting-gear for Tram-cars, W. M. Brittain, Kingston-upon-Hull.
6264. Raising the Hoods of Victorias, J. Cook, Birmingham.
6265. Safety Cleaning Sliding Window Sashes, T. Robson, Scarborough.
6266. Car Coupling, J. L. Shoenberger, Lowrenzville, U.S.
6267. Lock Switches, A. C. Cockburn and E. Thomas, London.
6268. Self-indicating Targets, J. Paterson, Glasgow.
6269. Needle Threaders, J. L. Corbett, Glasgow.
6270. Lifts, T. and D. Thomas, London.
6271. Harness Saddle, J. Saunders, London.
6272. Safety Envelope, W. Southall, London.
6273. Porous Plates, J. T. Armstrong, London.
6274. Generating Gas, &c., from Oil, W. Wakefield, London.
6275. Cornice Pole Brackets, F. W. Rees, London.
6276. Compasses, W. A. Murray, London.
6277. Stuff Buttons, F. Bocks, London.
6278. Steering Screw-steamers, G. H. Harrison, London.
6279. Fluid for Writing with Stylographic Pens, H. C. Glanville and W. O. Jennings, Paris.
6280. Clinometer, T. Dobie —(*J. G. Dobbie, India.*)
6281. Grinding Machinery, W. F. Goreham and M. Watson, London.
6282. Cans, H. Cogan, London.
6283. Bricks, A. Murray, London.
6284. Gas Burners, T. Gordon, London.
6285. Albumen-maltose Dietary Malt Powder, A. Leerbeck and J. Holm, London.
6286. Moulds, J. Colley, London.
6287. Radiating Gold Amalgamator, W. Bevitt, Romford.
6288. Adjusters for Car Brakes, A. J. Boult.—(*E. Corson, United States.*)
6289. Shelf Brackets, A. J. Boult.—(*J. Baines, United States.*)
6290. Steam Windlass for Ships, W. H. Harfield, London.
6291. Bronzes, J. H. Jackson, London.
6292. Delivery of Goods by the Action of a Coin, G. Jeffery, London.
6293. Oil-cake, A. Greenwood and H. Lambert, London.
6294. Electrolytic Treatment of Zinc, &c., A. Watt, London.
6295. Sewing Machines, E. Kohler and M. Lachman, London.
6296. Carding Engines, A. V. Newton.—(*W. Decker, Germany.*)
6297. Recording Tunes, J. Carpentier, London.
6298. Sewing, &c., Machinery, E. Rodriguez, London.
6299. Cut-off of Steam in Engine Cylinders, W. Wingfield, London.
6300. Packing employed for Stuffing-boxes, W. Bethell, London.
6301. Finishing the Soles of Boots and Shoes, W. H. Stevens, London.
6302. Beating Eggs, W. R. Lake.—(*D. H. Rice, United States.*)
6303. Hansom Cabs, P. Mackenzie, London.

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6304. Velocipedes, J. F. Haskins.—(*G. D. Davis, United States.*)
6305. Kettles, J. Stevens, Birmingham.
6306. Rack of Capstan Lathe, B. Barker and J. E. Leak, Hunslet.
6307. Water Tap, E. Zahn, London.
6308. Garment Stud Guard, W. E. Moser, Liverpool.
6309. Fittings for Baths, E. Marston, Newcastle.
6310. Sewing Machines, T. E. Bolton and E. Gilyard, Manchester.
6311. Stretching Vellums on Banjos, &c., S. I. Fünkenstein, Birkenhead.
6312. Shoes for Horses, C. J. Jutson and F. A. Poupard, London.
6313. Covering Jars, H. Faulder, Manchester.
6314. Signalling in Foggy Weather, A. Fleming, Manchester.
6315. Propelling Vessels, S. Douglas, Manchester.
6316. Joints for Securing Rails, J. E. B. Armytage, Stanningley.
6317. Cleansing, &c., Plaster, T. Simpson, Kendal.
6318. Furnace Bridges, T. Thompson, Seghill.
6319. Hand Brushes, J. Worthington, Blackpool.
6320. Safety Fastener for Carriage Lamps, C. T. W. Piper and W. Wright, Devonport.
6321. Jackson's Lawn-tennis Pole, J. Allen, Cheltenham.
6322. Navigation of Ships, W. B. Thompson, Dundee.
6323. Oil-lac, W. L. Wise.—(*R. Lehmann, Germany.*)
6324. Machinery for Forcing and Lifting, &c., H. J. Allison.—(*J. Richards, United States.*)
6325. Type Writers, A. J. Boult.—(*C. Spiro, United States.*)
6326. Grain Binders, W. P. Thompson.—(*C. H. McCormick, jun., United States.*)
6327. Fire Grates, W. P. V. Wallis, London.
6328. Brackets, F. F. Smart, London.
6329. Adjustable Pedestals for Shafts, W. Hargreaves and R. Harwood, London.
6330. Facilitating Piano Playing, F. Bosshardt.—(*G. Huard, France.*)
6331. Holding, &c., Sensitised Films, C. D. Durnford, Edinburgh.
6332. Lock Swing Bridge, F. O. Fisher, London.
6333. Holdfast for Tackle, Blinds, &c., C. Curdle, London.
6334. Increasing Power and Speed, J. A. Smith, London.
6335. Fire-arms, J. J. Speed, London.
6336. Separating Dust from Air, E. Kreiss, London.
6337. Synchronising Mechanism, W. S. Harrison, London.
6338. Brushing Animals, H. J Haddan.—(*N. Petersen and A. Fritze, Denmark.*)
6339. Preventing Vehicles from Leaving the Rails, I. Plou, London.
6340. Stringed Musical Instruments, G. O. Hagspiel, London.
6341. Bottles, &c., J. Hickisson, London.
6342. Coke Ovens, G. Downing.—(*T. Bauer, Germany.*)
6343. Propulsion of Small Craft, A. Biver, London.
6344. Harness for Oarsmen, F. F. Martin, London.
6345. Variable Nozzle, R. F. Derrick, London.
6346. Roofing and Wall Tiles, A. T. Morse, London.
6347. Anchors, J. A. Birch, London.
6348. Appliances to be Rendered Incandescent by Heat, B. Piffard, London.
6349. Regulating the Supply of Liquids, Sir J. C. Cowell, London.
6350. Velocipedes, C. Bach, E. Kraft, M. Neuburger, F. J. Miller, and C. Stiefet, London.
6351. Binding Mechanism of Harvesting Machines, W. M. Cranston.—(*The W. A. Wood Mowing and Reaping Machine Company, United States.*)
6352. Twisting Straws to Make Rope, W. M. Cranston.—(*The W. A. Wood Mowing and Reaping Machine Company, United States.*)
6353. Washing Photographic Prints and Plates, The Hon. W. Grimston, London.
6354. Rotary Steam Engine or Motor, P. Kirchoff, London.
6355. Wheels of Bicycles, &c., W. Bown, London.
6356. Wheels of Carriages, &c., W. Bown, London.
6357. Parallel Vices, E. Harris, London.
6358. Corking Bottles containing Beer, &c., A. Kempson, London.
6359. Mechanical Toys, G. F. Lutticke, London.
6360. Cartridges for Ordnance, G. Quick, London.
6361. Boots and Shoes, J. Thornhill, London.
6362. Cigarettes, W. Morris, London.
6363. Central Telephone Stations, G. F. Redfern.—(*G. Lagache, France.*)
6364. Harvesters, G. F. Redfern.—(*B. E. Huntley, United States.*)
6365. Boots, J. Gilling, London.

2*nd May*, 1887.

6366. Spades, H. W. Robinson, Northampton.
6367. Boring Holes in Coal Mines, C. Burnett, Hartlepool.
6368. Piercing Armour-plates, A. Reaney, Sheffield.
6369. Preventing Waste in the Retailing of Ale, W. T. Hardy, Middlesborough.
6370. Extracting Tin from Tinned Iron Scrap, S. Toussaint, Paris.
6371. Testing the Baking Properties of Flour, T. T. Vernon, Manchester.
6372. Injectors, W. J. Cooke, Manchester.
6373. Starch Boxes, T. Gregson, Halifax.
6374. Picking Band Chains, J. Qualter and E. Hall, Barnsley.
6375. Coupling for Pipes, J. Dainton, Newcastle-on-Tyne.
6376. Working Plates, S. A. Rosenthal, Berlin.
6377. Cylindrical Rulers, J. Shettle, Haverfordwest.
6378 Ostrich Feathers, L. Lee, London.
6379. Box Churns, A. Coulter, Donegal.
6380. Lathes, T. Baum, London.
6381. Clay Blocks, F. O. Ferguson, London.
6382. Serrated Wire, J. Wilson and S. Berry, London.
6383. Levels, F. Bosshardt.—(*A. F. Hahn, France.*)
6384. Grillers, G. Goldsmith, London.
6385. Fire-place Heads, C. Hunt, London.
6386. Valve Gear, H. H. Leigh.—(*J. F. Carpenter, Germany.*)
6387. Valve Gear, H. H. Leigh.—(*J. F. Carpenter, Germany.*)
6388. Rapid Formation of Ice, B. Manfroni, London.
6389. Punching Patterns in Jacquard Cards, W. and W. T. Martin, London.
6390. Stoppering Bottles, G. H. Jones, London.
6391. Abdominal Belt, J. Williams, Birmingham.
6392. Food Plate, E. W. Cleversley, London.
6393. Union Joints for Coupling Tubes, M. Schleifer, London.
6394. Suspender Attachments, A. E. Gosnell, London.
6395. Perpetual Motion, H. M. Thomas, London.
6396. Water-pressure Engine and Water Transmitter, W. H. Wells, Dorset.
6397. Measuring Water, &c., E. Edwards, London.
6398. Coating Surfaces of Glass, H. J. Burton, Hanwell.
6399. Ladies' Saddle-tree, F. W. Mayhew, London.
6400. Electro-magnetic Apparatus for Automatic Lighting and Extinguishing of Street Lamps, J. R. Schiller and C. Meyer, London.
6401. Preparing a Mixture of Tea, Coffee, &c., H. B. Thornton, London.
6402. Curtain Rings, W. J. Tanner, London.
6403. Vibrating Bearing for Carrying the Ends of Iron Girders, C. E. D. Waring and W. Boby, London.
6404. Decanters, &c., M. H. Lakin and E. St. L. Walker, London.
6405. Novel Device for the Protection of Venetian Blinds, H. J. Luff, London.
6406. Flush and Drop Handles, W. West, London.
6407. Billiard Balls, T. B. Sharp, Smethwick.
6408. Chronometer Movements, C. and R. Adam, London.
6409. Dynamo-electric Machine, R. E. Bell and W. A. Kyle, London.
6410. Lime Kilns, G. F. Redfern.—(*F. Martin, France.*)
6411. Permanent Way of Railways, T. W. Smith, London.
6412. Decorating Glass, J. B. Germeuil-Bonnaud, London.
6413. Motor Engines, H. W. Bradley and F. W. Crossley, London.
6414. Sewing Machines, B. Rudolph, London.
6415. Valve-gear for Steam Engines, R. Matthews, London.
6416. Boilers, W. Whitehead and A. Emley, London.
6417. Manufacture of Alkalies, J. Marx, London.
6418. Button-hole Mechanism for Sewing Machines, D. Mills, London.
6419. Improvements in Lubricators, R. T. Baines, London.
6420. Fore-sight Marker for Rifles, E. M. Richford, London.
6421. Artificial Fuel, J. Hall, London.

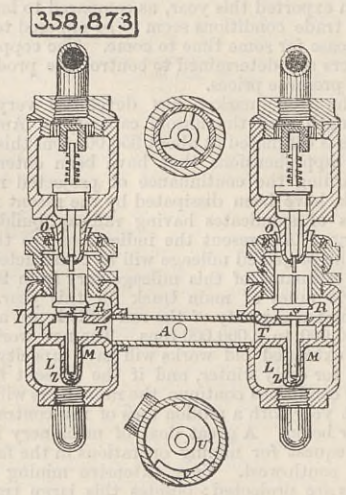
SELECTED AMERICAN PATENTS.

(*From the United States' Patent Office Official Gazette.*)

358,873. Fire Engine Heater Connection, *J. J. Meyreck, Louisville, Ky.—Filed July 29th*, 1886.

Claim.—(1) The chambers A A and nuts B B, pipes J and K, with valve stem guides C C, and water openings D D around them, substantially as herein described. (2) Combined with the chambers L L and A A, provided with extensions having openings I I and nuts B B, the valves G G having stems F F and spiral springs E E around them, with stems H H extending down through the ends of the chambers, to open the valve G when the engine is backed up against the stationary chambers L, as above described. (3) In heater connections for fire engines, the chambers L L

358,873

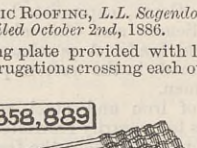


and supply openings T T, forming valve seats U U in the interior, with the water openings V V around them in combination with the pipe A′, by which the chambers are connected, substantially as described, and for the purpose set forth. (4) Combined with the chambers L L and supply openings T T, the winged valves R and S, having seats U and stems Y, with guides M and spiral springs Z, the nuts P P and N N, gum rings O O, and pipes W and X, substantially as described, and for the purpose set forth.

358,889. Metallic Roofing, *L.L. Sagendorph, Cincinnati, Ohio.—Filed October 2nd*, 1886.

Claim.—A roofing plate provided with longitudinal and transverse corrugations crossing each other at right

358,889

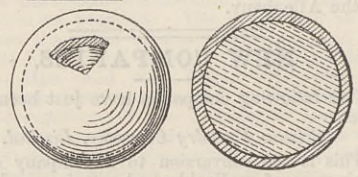


angles, one set of corrugations being curved and the other set V-shaped, substantially as and for the purpose specified.

359,032. Billiard Ball, *G. E. Phelan, New York, N.Y.—Filed August 3rd*, 1886.

Claim.—(1) As a new article of manufacture, an ivory billiard ball having a permanent protective covering. (2) As an improved article of manufacture, an ivory billiard ball having a permanent protective covering

359,032

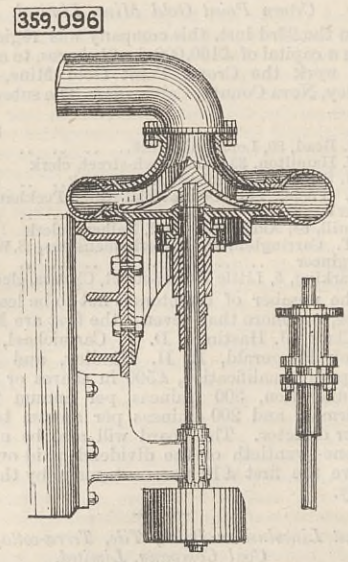


of fibrous composition. (3) As a new article of manufacture, a combined ivory and composition billiard ball. (4) The combination, in a billiard ball, of an inner ball of ivory and an outer shell or covering of fibrous composition, as set forth.

359,096. Centrifugal Pump, *J. Richards, San Francisco, Cal.—Filed April 27th*, 1886.

Claim.—(1) In a centrifugal pump, a wheel or runner having a curved or dished perforated body and a series of blades or vanes on each side thereof, substantially as set forth. (2) In a centrifugal pump, the combination of a wheel or runner having a perforated body and a series of blades or vanes on each of its sides and a casing having an inlet on one of its sides, substantially as set forth. (3) In a centrifugal pump, the combination of a wheel or runner having a perforated body and a series of blades or vanes on each of its sides, a casing having an inlet on one of its sides, and a discharge passage communicating with the casing on the inlet and the rear sides of the runner through passages of larger and smaller areas respectively, substantially as set forth. (4) In a centrifugal pump, the combination of a casing, having a suction pipe connected to one of its sides, a wheel or runner secured upon a shaft

359,096



passing through the opposite side of the casing, an external socket or chamber fixed upon the casing, a removable sleeve or socket connected to the outer end of the fixed socket,, and a main bearing surrounding the shaft and fitting within the removable socket, substantially as set forth. (5) In a centrifugal pump the combination of a casing, a suction pipe connected to one side thereof, an external socket or chamber fixed upon the opposite side thereof and composed of two sections connected by bolts, a main bearing fitting in said socket and connected adjustably to the outer section thereof by clamping bolts, and a wheel or runner fixed on a shaft passing through the casing and main bearing, substantially as set forth.