## HIGH SPEED LOCOMOTIVES.

### No. II.

WE explained last week that a locomotive constructed to run a distance of 120 miles in 120 minutes must be competent to attain a velocity of at least 75 miles an hour for a portion of the time, unless the line traversed was a dead level; and we added, that for such speed a single pair of drivers 9ft. in diameter would probably be found necessary. We also showed that the centre line of the boiler need not be unduly raised, as a height of 7ft. 6in. would be found sufficient. We have now to consider the work which the engine would have to perform, and the means to be adopted in order to obtain the requisite power.

We have fixed the gross load at 175 tons. Our reason for doing this is, that with the narrow gauge it will be found impossible to use a boiler capable of developing much over 1200-horse power. Indeed, as will be seen further on, it is questionable whether sufficient boiler power can be obtained at all. A train to weigh 100 tons might consist of nine vehicles, namely, seven passenger coaches and two brake vans, one at the front, the other at the rear of the train. Each coach would seat forty passengers, weighing about 3 tons. If the train were filled it would carry, say, 21 tons of passengers and 4 tons of luggage, or in all 25 tons. The net weight of the nine vehicles must therefore not exceed 75 tons, or 8 tons 6 cwt. 2 qrs. each. This is very light, but we have no doubt that by the free use of steel specially designed coaches could be produced of this weight. The total number of passengers carried would be 280. Extra fares could of course be charged, but at 3d. per mile the total sum received would be £420 for a run of 120 miles, which would pay very well indeed. The train would of course be strictly "limited."

We have said that the resistance would not in our opinion exceed 40 per ton on a level at 70 miles an hour. But, as we have shown, the speed if the whole line was free from inclines would be but 65 miles an hour. Allowing 40 lb. to the ton at this speed—which is well within the mark—we should have a gross tractive resistance of $175 \times 40 = 7000$ lb. Now, 65 miles an hour equals 95·3ft. per second, or 5718ft. per minute, and $\frac{5720 \times 7000}{33{,}000} = 1213$ indicated horse-power. These figures show that if we cannot reckon on getting more than 1200 indicated horse-power out of our boiler the weight of the train must be kept down to about 175 tons, as we have said. But our line is not level. We assume that there will be gradients of as much as 1 in 264 to overcome. It is a noteworthy fact that the higher the speed the less will gradients affect the work to be done by the engine. A gradient of 1 in 264 will represent a resistance of 8·5 lb. per ton nearly. This would be about the resistance of a train at 25 to 30 miles an hour. Such a gradient would, therefore, double the work to be done by the engine of a slow, heavy train, but will augment the resistance of our fast express by little more than one-fifth; that is to say, an addition of about 225-horse power would suffice to overcome it at 65 miles an hour, and by dropping the speed to 60 miles an hour, it is possible that the incline would be surmounted with 1200-horse power only. Indeed, curves will be found on the whole more serious impediments to high speeds than reasonable inclines. In any case, we believe that for such a line as the London and North-Western from Chalk Farm to Crewe, 1200-horse power would suffice to give an average velocity of 65 miles an hour.

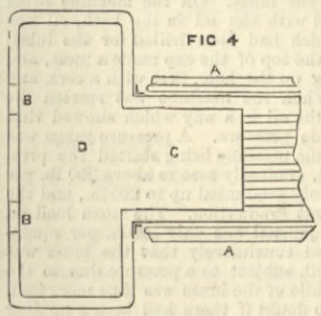
The question of adhesion now presents itself. It is of course useless to provide boiler and cylinder power unless we also provide means for utilising it. The tractive effort to be calculated on is, as we have seen, 7000 lb., and it will not be safe to count on a coefficient of adhesion greater than one-sixth. Thus we have $6 \times 7000$ lb. = 42,000 lb. = 18·75 tons as the load to be carried by the driving wheels. This may appear a tremendous weight, but it is not too much for an 84 lb. bullhead steel rail. Mr. Pearson's engines on the Bristol and Exeter line, already referred to, carried over 19 tons on their 9ft. drivers; and we believe that Mr. Stirling's single engines, with 8ft. drivers, on the Great Northern Railway, carry quite 18·5 tons. We see, therefore, that adhesion can be had; but we also see that the weight of our train will not admit of being augmented. Any addition to its weight would render it necessary either to increase the load on the drivers, which we dare not do, or else to couple two pairs of 9ft. wheels, which is quite out of the question, if for no other reason then because of the excessive length of coupling rods required.

A very brief calculation will suffice to show that the cylinders of our high-speed engine must be 20in. in diameter, with a stroke of 28in. An average pressure of 1 lb. in a cylinder of this size will give 103 lb. tractive effort, and $\frac{7000}{103} = 68$ lb., in round numbers, as the average effective pressure which must be maintained in the cylinders. This may be taken as standing for a boiler pressure of 150 lb. per square inch, and we may assume an initial cylinder pressure of 140 lb. above the atmosphere, or 165 lb. absolute. Steam of this pressure cut off at one-fifth of the stroke would give an average effective pressure of about 70 lb. in theory, or nearly what is actually wanted in practice, and this represents a fair amount of economy. A properly designed engine running under these conditions ought not to burn more than 3 lb. of coal per horse per hour, or for 1200 indicated horse-power 3600 lb., or for a run of 120 miles 7200 lb., or 60 lb. per mile. No doubt this will appear at first sight an enormous consumption, but the work to be done is enormous. The advantage gained by running down inclines is as small in proportion as the loss caused by ascending them, and steam must be kept full on from start to finish. In a word, we have the case presented of an engine which has to be run as fast as it can possibly go without any regard for economy of fuel. The cost of the coal burned is here a matter not worth a second thought. Economy in its use is only to be sought because the greater the work that can be got out of it the better is the prospect that the speed demanded will be obtained. We may add, however, that we believe that 60 lb. per mile is in excess of the weight that would actually be needed; but we must provide for the worst, and it must be borne in mind that our engine cannot run into the terminus with an empty fire-box. The pressure will have to be maintained to the very last.

We now come to the most important consideration of all—the design of the boiler. As the driving wheels will rise above the middle of the boiler, its diameter must be kept down sufficiently to admit it between them. The maximum diameter outside cannot exceed 51in., and to get this the lagging must be suppressed in the wake of the wheels. Without unduly adding to the length of the tubes, it will be impossible to get more than 1000 square feet of tube surface into such a barrel. Under these circumstances we shall have to rely on the fire-box for the production of steam to a much greater extent than usual. We have to burn 7200 lb. of coal in two hours, or 3600 lb. per hour; and even if we burn 100 lb. per square foot per hour, we would need 36ft. of grate to do this. But the grate cannot be more than 3ft. 6in. wide, and $\frac{36}{3{\cdot}5} = 10{\cdot}3$ as its length. Such a box could not be properly fired by any stoker, and unless a tremendous draught were maintained by a contracted exhaust, which would entail many evils, 100 lb. could not be burned per square foot of grate per hour. It would be necessary, we apprehend, to enlarge the fire-box on the Wooton system by spreading it behind the driving wheels over the trailing wheels; but this would entail the construction of a very complicated fire-box, or the placing of the wheels very far forward.* As an alternative scheme, Crampton's type of engine might be adopted. The great obstacle standing in the way of this would be the difficulty of distributing the weight, and the only advantage gained would be an addition to the diameter of the boiler barrel. So great, indeed, are the difficulties which stand in the way and bar our progress that we are forced reluctantly to the conclusion that it is impossible to design a narrow gauge engine which shall develope 1200 indicated horse-power steadily for an hour and yet shall be of anything like the ordinary type. If this be the case, then, it is not easy to see how runs of 60 miles can be accomplished in 60 minutes.

One way out of the difficulty that suggests itself to us is the adoption of a fire box shaped in plan as in the accompanying diagram. Virtually, we would have in the part C an ordinary fire-box with about 18 square feet of surface. The remaining portion D, a species of addition tacked on, so to speak, might be 7ft. by 4ft. Thus we should have a total grate surface of about 46 square feet. In order to get in sufficient tube area it would be necessary to use an oval boiler barrel. In this there is nothing novel, as such barrels have been used for years on the Continent. The driving wheels are shown at A A, while B B are two fire doors. On such a grate the requisite weight of coal could be consumed at the rate of about 78 lb. per square foot per hour, which is quite feasible.

FIG 4




We have not gone into details of design, nor is it necessary that we should. Our object has been to put the nature of the problem to be solved before our readers rather than attempt its solution ourselves; and, doubtless, many of our readers will take sufficient interest in this most attractive subject to say something to the purpose in our correspondence columns. We have based all that we had to say on the assumption that at exceedingly high speeds such as those we contemplate, the resistance is 40 lb. per ton. We have also, however, expressed the belief that it is not nearly so much. If it were we do not see how the present rate of speed could be maintained on the Midland, Great Northern, and other narrow gauge lines. In the chance that it is very much less lies the possibility that extremely high velocities may yet be attained on English railways. The discouraging fact is that on no railway in the world is 60 miles run in 60 minutes.

It is a noteworthy fact that this subject has not hitherto met with the full discussion it deserves. In the mind of the general public there appears to be an idea that railway trains could be run much faster than they are if railway companies pleased. The truth is, however, that the quickest trains on our great lines are run as fast as they can possibly go. They are timed so close to their capabilities, indeed, that nothing is left to contingencies, and a small mistake with fire or water will suffice to render them several minutes late. Nothing, indeed, but consummate judgment on the part of driver and stoker can secure that clockwork regularity for which some of our northern lines are famous. It is to be regretted that the magnitude of the difficulty to be contended with is not fully realised. If we have done something to open the subject up we shall not have written in vain. Men who ought to know better make enormous mistakes concerning it. For example, Mr. Barnet Le Van, a well-known Philadelphian engineer, read last year, before so eminent a body as the Franklin Institute, an elaborate paper to prove that 60 miles could easily be run in 60 minutes, wherein we find the following passage. He is dealing with the horse-power required:—"The estimated maximum resistance at 60 miles an hour is about 40 lb. per ton, or, say, for a train of 150 tons, 6000 lb. On the Pennsylvania or Bound Brook railroads, at the above-named speed, this would correspond to about 300 indicated horse-power. This amount of power would be obtained at 60 miles an hour by 19 lb. mean cylinder pressure with two 18in. cylinders and 24in. stroke, making 264 revolutions per minute, corresponding to a piston speed of 1056ft. per minute; driving wheels 78in. diameter. The dead weight and load would require 25 lb. additional, or 44 lb. per square inch on the pistons, to overcome the resistance and load combined at 60 miles an hour between Philadelphia and New York, and would be as follows:—H.P. = $\frac{251 \times 10{\cdot}56 \times 44}{33{,}000} \times 2 = 710{\cdot}70$-horse power." We confess we have not the least idea what Mr. Le Van means by "the resistance and load combined," but instead of 300-horse power as given above for the resistance, the true figures are $\frac{88 \times 60 \times 600}{33{,}000} = 960$-horse power. We need scarcely add that Mr. Le Van in no way concerns himself about the boiler required to supply the necessary volume of steam.

We do not think it is impossible to build a locomotive which would continually develope 1000 or 1200-horse power, but we are very certain that it cannot be done unless a more or less wide departure be made from existing types. Thus, a boiler on Fairlie's system might be easily designed which would give both grate surface and tube surface enough; or a combined engine with two foot-plates together, so to speak, might be employed; but we do not quite see how the weight is to be kept down, in such a case, to reasonable limits. Other schemes suggest themselves, but they are all so widely removed from existing methods of construction that it would probably be useless to suggest them.

In conclusion it may be well once more to point out that if long runs can be maintained, the chances in favour of 60 miles an hour are greatly increased. Thus with a run of 200 miles without a stop, the average speed need very little exceed 60 miles an hour, provided a pushing engine was used at the start to get up speed very quickly.

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* Mr. Wooton uses in some of his fast engines fire-boxes 9ft. long by 8ft. wide, and about 68 square feet of grate bar, for burning anthracite waste at the rate of about 50 lb. a mile. It is said that an engine of this type has run with a light train down an incline of about 1 in 1000 at the rate of 13 miles in 11½ minutes.

## THE MANCHESTER SHIP CANAL.

THE Select Committee of the House of Lords appointed to consider the scheme for constructing a canal from the upper Mersey to Manchester for ocean-going steamers have now held seven sittings under the chairmanship of the Duke of Richmond, but they have not made very much real progress. Happily their lordships do not seem to be in any particular hurry, and as only this one Bill has been referred to them, instead of the group generally handed over to a Committee, it is assumed that this inquiry will last over some weeks. The Committee follow the proceedings very closely, and the noble chairman displays remarkable acuteness and appreciation of the points involved. His well known interest in the cattle question cropped up on one occasion in a curious incidental manner. One of the witnesses having alluded to the importation of cattle, as it might be affected by this canal, his grace immediately put a number of questions to the witness as to this subject. Thus far the evidence has been almost entirely confined to the trade aspect of the scheme, a large number of Lancashire merchants, cotton spinners, and manufacturers having been called to show the effect the canal would have on transit rates and on the general trade of that part of the country. All are agreed that the charges by rail from Liverpool to Manchester, and the town and dock dues at Liverpool, are excessive, not only in regard to the bad state of trade, but in themselves; and that, indeed, these imposts have had a great deal to do in reducing trade to its present condition. Their argument is that as Liverpool is the natural, if not the only, outlet for their goods to foreign countries, heavy rates to that port necessitate their putting prices on their manufactures higher than those of foreign manufacturers producing the same articles. For example, one witness showed that Bombay was producing goods similar to Lancashire products, by having the cotton on the spot, at such prices that Lancashire had little chance of competing; and they traced this to the excessive cost of getting their consignments out to India. In the same way it has been given in evidence that the continental competition is doing much to ruin the Lancashire trade; and upon this point some extraordinary statistics have been given, especially in regard to Bombay products.

On the question of savings, a representative of Messrs. John Rylands and Son, of Manchester, predicted a saving of half the present transit charges through the canal, and to show what that must mean, he stated that such a saving would amount to no less than £3000 a year to his firm. Representing a firm employing over 11,000 hands, and owning 200,000 spindles and 5000 looms, this witness's support of the canal project must carry considerable weight by itself, but it has been confirmed by a dozen other manufacturers doing business on a large scale. Among these was a member of the famous firm of John Crossley and Sons, Halifax—a firm doing business to the extent of a million a year—who explained that in consequence of the heavy charges at Liverpool his firm had been driven from there to Hull, and other east coast ports, for exporting their goods. The belief of course is, that the canal once made, the largest vessels, steam and sailing, will go right up to Manchester, and through that the merchants will save not only dock and town dues at Liverpool, but the loss through damage of breaking bulk and frequent handlings, commission to agents to superintend the shipment—by being able to do it themselves in Manchester—and the cost of a selling broker. All this being realised, the amount saved would be something enormous; but the other side has still to be heard.

It is too soon to attempt to conjecture the leaning of the Committee, but in one or two instances the promoters have been somewhat injudicious, and there is a feeling that they have not put the case nearly so well this year as they did last session. Mr. Adamson, the chairman of the Provisional Committee, and therefore a most influential and representative witness, admitted to an opposing counsel that at a large meeting respecting this scheme, held in the autumn, he had made these remarks: "The great, renowned, big, infallible Lancashire Pope might mistake the figures and misrepresent the facts, but he would never be able to alter the fact that the main enterprise was one of the best paying that had ever been placed before the country, and when he had pricked the great canal bubble, the contents would overwhelm him like an avalanche, and nothing would be visible of him save the dishonoured wig of a Queen's Counsel and twenty stone of bones and corruption." He also confessed to having said that he had never known a more fractious, disturbing, interrupting chairman than Sir Joseph Bayley, who presided over the Commons' Committee last year. Of course he had an explanation of this strong language ready, but such observations are hardly likely to win the favour of any Committee.

One point the opposition might bring out is that the enthusiasm in Lancashire for this canal is dying out, and that money is not so readily forthcoming; but on this question those best qualified to know have emphatically declared that

subscriptions to the preliminary expenses have come in this year almost as well as they did last year; no less than £26,000 or £27,000 have been received this year. Last year over £65,000 were received; but then less money has been required for this second application. With regard to one question, they have asserted also that the leading merchants and capitalists in Manchester and Lancashire are coming forward to support the project much more than they previously did; it is certainly a significant fact that the Corporation and the Chamber of Commerce of Manchester, and the Corporation of Salford, have directly sent up members to give evidence on their behalf in favour of the Bill. Besides the reducing of railway charges, several curious reasons have been given for constructing the canal, one witness urging that it would be a great benefit to Lancashire if vessels could take direct to Manchester the agricultural products of the South and West of England. Another witness predicted that if Australian ships could get straight up to Manchester with their wool cargoes, Manchester would become the wool market of the country, as it ought to be considering the position of the woollen goods' towns. In a few days the engineering part of the scheme will probably be taken up.

## THE SALTERHEBBLE VIADUCT.

The supplement which we give this week is a perspective view of the Salterhebble Viaduct, by which it is proposed to carry a portion of the Huddersfield and Halifax extension of the Hull, Barnsley, and West Riding Junction Railway, of which Mr. W. Shelford, M.I.C.E., is engineer-in-chief, over the Salterhebble valley. The site of the viaduct lies about a mile south of the great manufacturing town of Halifax, near which, as perhaps our readers may be aware, are to be found some of the best of the Yorkshire building stones.

This fact might suggest the propriety of constructing this important work entirely of masonry, were it not that the spans prescribed by Parliament for the various roads, canals, and railways which it crosses, and the acuteness of their angles, are too great to allow of this being done. These circumstances, coupled with the great height of the viaduct and the exposed situation of this part of the valley, render almost obvious the adoption of wrought iron girders, supported on massive masonry piers, as best meeting the requirements of the case, and the somewhat bold and novel form in which these have been designed is, in our opinion, well adapted to the work they will have to perform, the form of the pier also lending itself readily to the sharp skews of the various openings required.

A very fair idea of the extremely fine effect which will be produced may be obtained from the perspective view which forms our supplement, and which has been reproduced from a drawing by Mr. Leonard Stokes.

The total length of the proposed viaduct, which runs nearly due north and south, is 1342ft., consisting of a south abutment having an arch 40ft. span over a road, nine spans 130ft. between centres, and a north abutment with a plate girder bridge of usual construction over another road. The greatest height from rails to the surface of the ground is 142ft. The general shape and design of the masonry piers and abutments will readily be seen from our engravings on page 220. The form of pier adopted is well calculated to resist the stresses it will have to sustain. The foundations being good, no difficulty is anticipated in obtaining a solid base for the piers and abutments. The main girders, which, it will be seen, are of the simple Warren type, of 126ft. span between centres of bearings, and placed 23ft. 8in. apart between centres, are arranged especially to meet the present requirements of the Board of Trade, and the method adopted of suspending the cross girders immediately below the top booms of the main girders will at once commend itself to our readers, both as economical and as providing a substantial parapet in the event of a train leaving the rails, which it could do without any danger to lattice bars or other vital parts of the structure. A wind fence is further provided, which greatly reduces the likelihood of a carriage mounting the metals in a high wind, such as caused the unfortunate Tay Bridge disaster. The flooring, which has to be maintained watertight over many of the spans, is of flat wrought iron plates, which, in addition, gives the platforms and main girders great lateral stiffness. The drawings we have now given of the viaduct show so completely every part of the structure that further description is not necessary.

It is to be hoped that the construction of so fine a piece of work will not long be delayed, and that the extension of the Hull and Barnsley Railway to Huddersfield and Halifax will shortly be put in hand, for the railway when finished will provide a much needed and long wished for additional route from the West Riding to the port of Hull and to the Midland Counties, and will also form the most important link in a new north and south line, *vid* the Midland Railway, through Huddersfield and Halifax to Scotland. The design has been worked out in all its details in Mr. Shelford's office by Mr. Wilfrid Stokes.

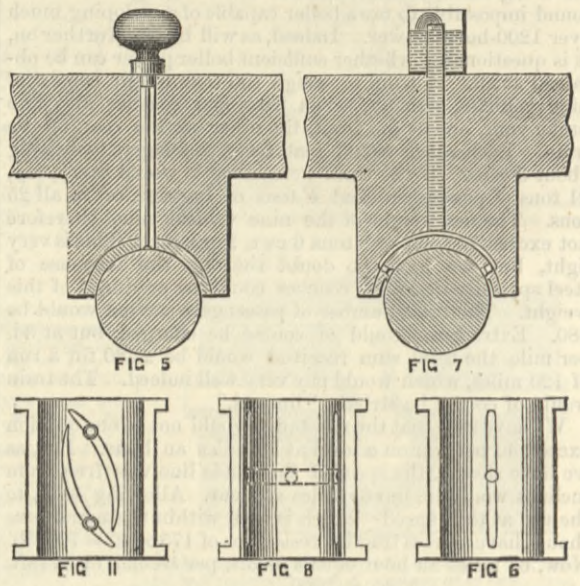
International Health Exhibition. — The great interest manifested in the Exhibition is shown by the fact that application has been made, by British exhibitors alone, for space five times as great as that actually at the disposal of the Executive Council. Information has recently been received that the French Government has appointed a Commission; and Italy—owing in a great measure to the individual exertions of a member of the Executive Council—will, it is hoped, take an active part. A portion of the Educational section of the Exhibition will be located in the Central Institute of the City of London Technical Guilds, the handsome building in course of erection in the Exhibition-road, which has been kindly placed at the disposal of the Executive Council. The Royal Albert Hall, with its musical attractions, will now form an integral part of the Exhibition; and the Aquarium, a popular feature of the late Fisheries Exhibition, will continue as an important part of the Health Exhibition. In the Dress Section, the most popular exhibit will probably prove to be a series, which is being prepared, illustrative of English dress of all ranks of life, from the time of the Conquest to George IV. While the main objects of the Exhibition—which are to impart instruction on the principal sections of the undertaking—have received the fullest attention from the Executive Council, the amusement of the visitors has not been overlooked. The Band of the Grenadier Guards, under the able conductorship of Mr. Dan Godfrey, will, as last year, perform each day: and, actuated by the success which attended the visit of the Thuringian Regimental Band to the Fisheries Exhibition, the Executive Council have taken such steps as may, it is hoped, lead to the visit of representative foreign military bands this summer. It is also intended that concerts shall from time to time be given in the Albert Hall. An International Congress on Education will be held, and conferences and lectures will conduce to the elucidation of the subjects of the Exhibition. It is also proposed to have a Library and Reading-room in connection with the Exhibition, which will be open to all visitors, under proper regulations, while the Exhibition is open. The Library will consist of books on various subjects comprised in the classification of the Exhibition, both English and foreign. Application has been addressed to foreign and colonial Governments, asking for reports and statistics on sanitary and educational matters, and to authors and publishers for works of a similar character.

## FRICTION OF LUBRICATED BEARINGS.

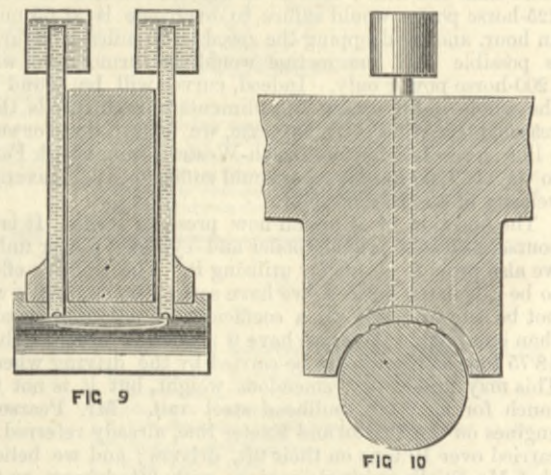
(*Concluded from page* 181.)

The results given in tables V., VI., VII., VIII., which will be found below, were obtained in this manner. Experiment showed that the friction varied considerably with temperature—see Table IX. All the oil-bath experiments were therefore taken at a nearly uniform temperature of 90 deg.; the variation above or below this temperature was never allowed to be more than 1½ deg.

(3) *Results of experiments.*—In the experiments shown in tables I., II., and III., care was taken not to load the bearing up to seizing, in order that the condition of the brass might not be disturbed. In Table IV. the bearing seized unintentionally. In tables V., VI., VII., and VIII., the bearing was intentionally loaded up to seizing. The experiments shown in tables V. and VI. were specially made for the purpose of ascertaining the greatest load which could be carried with rape and mineral oil in the oil bath. The greatest load carried with the rape oil was 573 lb. per square inch, and the greatest load carried with the mineral oil was 625 lb. In both of these cases the experiment was repeated after the brass had been taken out and scraped, but with no better result. The general results of the oil-bath experiments may be described as follows:—The absolute friction, that is the actual tangential force per square inch of bearing, required to resist the tendency of the brass to go round with the journal, is nearly a constant under all loads, within ordinary working limits. Most certainly it does not increase in direct proportion to the load, as it should do according to the ordinary theory of solid friction. The ordinary theory of solid friction is that it varies in direct proportion to the load; that it is independent of the extent of surface; and that it tends to diminish with an increase of velocity beyond a certain limit. The theory of liquid friction, on the other hand, is that it is independent of the pressure per unit of surface, is directly independent on the extent of surface, and increases as the square of the velocity. The results of these experiments seem to show that the friction of a perfectly lubricated journal follows the laws of liquid friction much more closely than those of solid friction. They show that under these circumstances the friction is nearly independent of the pressure per square inch, and that it increases with the velocity, though at a rate not nearly so rapid as the square of the velocity. The experiments on friction at different temperatures, shown in Table IX., indicate a very great diminution in the friction as the temperature rises. Thus, in the case of lard oil, taking a speed of 450 revolutions per minute, the coefficient of friction at a temperature of 120 deg. is only one-third of what it was at a temperature of 60 deg. A very interesting discovery was made when the oil-bath experiments were on the point of completion. The experiments being carried on were those on mineral oil; and the bearing having seized with 625 lb. per square inch, the brass was taken out and examined, and the experiments repeated. While the brass was out, the opportunity was taken to drill a ⅛in. hole for an ordinary lubricator through the cast iron cap and the brass. On the machine being put together again and started with the oil in the bath, oil was observed to rise in the hole which had been drilled for the lubricator. The oil flowing over the top of the cap made a mess, and an attempt was made to plug up the hole, first with a cork and then with a wooden plug. When the machine was started the plug was slowly forced out by the oil in a way which showed that it was acted on by a considerable pressure. A pressure gauge was screwed into the hole, and on the machine being started the pressure, as indicated by the gauge, gradually rose to above 200 lb. per square inch. The gauge was only graduated up to 200 lb., and the pointer went beyond the highest graduation. The mean load on the horizontal section of the journal was only 100 lb. per square inch. This experiment showed conclusively that the brass was actually floating on a film of oil, subject to a pressure due to the load. The pressure in the middle of the brass was thus more than double the mean pressure. No doubt if there had been a number of pressure gauges connected to various parts of the brass, they would have shown that the pressure was highest in the middle, and diminished to nothing towards the edges of the brass. The experiments with ordinary lubrication were begun with a needle lubricator, the hole from which penetrated to the centre of the brass. A groove in the middle of the brass, and parallel to the axis of the journal, extended nearly to the ends of the bearing for distributing the oil—see Figs. 5 and 6. It was found that with this arrangement the bearing would not run cool when loaded with only 100 lb. per square inch; and that not a drop of oil would go down even when the needle lubricator was removed and the hole filled completely with oil, thus giving a head of 7in. of oil to force it into the brass. It appeared as though the hole and groove, being in the centre of pressure of the brass, allowed the supporting oil-film to escape. This view was confirmed by the following experiment. The oil-hole being filled up to the top, the weight was eased off the journal for an instant. This allowed the oil to sink down in the hole and lubricate the journal; but immediately the load was again allowed to press on the journal the oil rose in the hole to its former level, and the journal became dry, thus showing that this arrangement of hole and groove, instead of being a means of lubricating the journal, was a most effectual one for collecting and removing all oil from it. It should be mentioned that care was taken to chamfer the edges of the groove, so as to prevent any scraping action between them and the journal. As the centre of the brass was obviously the wrong place to introduce the oil, it was resolved to try to introduce it at the sides. Accordingly the centre hole and groove were filled up, and two grooves were made. These grooves were parallel to the axis of the journal, extending nearly to the ends of the brass, and were placed at equal distances on either side of the centre; they formed boundaries to an arc of contact, the chord of which was 3½in.—see Figs. 7 and 8. With this arrangement of groove the lubrication appeared to be satisfactory, the oil going down into the journal and the bearing running cool. The results of the experiments with this arrangement of brass are given in Table VII. The bearing nevertheless seized with an actual load of only 380 lb. per square inch. The arrangement of grooves was then altered to that usual in locomotive axle-boxes—see Figs. 9-11. The oil was introduced through two holes, one near each end of the brass, and each connected to a curved groove, the two curved grooves nearly enclosing an oval-shaped space in the centre of the brass. At the same time the arc of contact was reduced till its chord was only 2½in. This brass refused to take its oil or run cool. It would sometimes run for a short time with an actual load of 178 lb. per square inch, but rapidly heated on the slightest increase of the load. The brass having been a good deal cut about by altering and filling up grooves, it was considered desirable to have a new brass, and one was accordingly obtained. The grooves being made exactly the same as in the last experiment with the old one, this brass seized with an actual load of only about 200 lb. per square inch. The oil-box was completely cut away so as to allow a freer current of air round the bearing, and the lubricator pipes were soldered into the brass. The wicks were taken out of the lubricators and the lubricators filled full of oil, by which means oil was supplied to the brass under a full head of 9in.; and yet the oil refused to go down, and the underside of the journal felt perfectly dry to the hand, and speedily heated with a load of only 200 lb. per square inch. The fact that this arrangement of grooves, which is found to answer in the axles of railway vehicles, was found to be perfectly useless in this apparatus, can only be accounted for by the fact that a railway axle has a continual end play while running, which prevents the brass from becoming the perfect oil-tight fit which it became in this apparatus. The attempts to make this arrangement of lubrication answer were not abandoned until after repeated trials. It now became clear that there was no use in trying to introduce the oil directly to the part of the brass against which the pressure acted, and that the only way to proceed was to oil the lower side of the journal, and trust to the oil being carried round by the journal to the seat of the pressure. The grooves and holes in the brass were accordingly filled up, and an oily pad, contained in a tin box full of rape oil, was placed under the journal, so that the journal rubbed against it in turning. The pad was only supplied with oil by capillary attraction from the oil in the box, and the supply of oil to the journal was thus very small; the oiliness, in fact, was only just perceptible to the touch, but it was evenly and uniformly distributed over the whole journal, The results are given in Table VIII. The bearing fairly carried 551 lb. per square inch, and three observations were obtained with 582 lb., but the bearing was on the point of seizing and did seize after running a few minutes with this load. It will be observed that in this instance the bearing seized with very nearly the same load as it did in the oil bath experiment with rape oil. These experiments with the oily pad show a nearer approach to the ordinarily received laws of solid friction than any of the others. The coefficient is approximately constant, and may be stated as about $\frac{1}{170}$ on an average. There does not in this case appear to be any well-defined variation of friction with variations of speed, according to any regular law. The results of the experiments with rape oil, fed by a syphon lubricator to side grooves—Table VII.—follow nearly the same law




as the results obtained from the oil bath experiments, as far as the approximate constancy of the moment of friction is concerned; but the amount of the friction is about four times the amount in the oil bath. It should be stated that though only these two tables are given as the results of the experiments on what is called ordinary lubrication, that is, lubrication by means other than that of the oil bath, they represent only a small part of the experiments or attempts at experiments which were made on this subject. But they are the only experiments the results of which were sufficiently regular to make them worthy of record. Indeed the results, generally speaking, were so uncertain and irregular that they may be summed up in a few words. The friction depends on the quantity and uniformity of distribution of the oil, and may be anything between the oil bath results and seizing, according to the perfection or imperfection of the lubrication. The lubrication may be very small, giving a coefficient of $\frac{1}{170}$; but it appeared as though it could not be diminished and the friction increased much beyond




this point without imminent risk of heating and seizing. The oil bath probably represents the most perfect lubrication possible, and the limit beyond which friction cannot be reduced by lubrication; and the experiments show that with speeds of from 100ft. to 200ft. per minute, by properly proportioning the bearing surface to the load, it is possible to reduce the coefficient of friction as low as $\frac{1}{1000}$. A coefficient of $\frac{1}{300}$ is easily attainable, and probably is frequently attained, in ordinary engine-bearings in which the direction of the force is rapidly alternating and the oil given an opportunity to get between the surfaces, while the duration of the force in one direction is not sufficient to allow time for the oil film to be squeezed out. The extent to which the friction depends on the quantity of the lubrication is shown in a remarkable manner in Table X.; which proves that the lubrication can be so diminished that the friction is seven times greater than it was in the oil bath, and yet that the bearing will run without seizing. Observations on the behaviour of the apparatus gave reason to believe that with perfect lubrication the speed of minimum friction was from 100ft. to 150ft. per minute; and that this speed of minimum friction tended to be higher with an increase of load, and also with less perfect lubrication. By the speed of minimum friction is meant that speed in approaching which, from rest, the friction di minishes and above which the friction increases.

Table V.

*Bath of Rape Oil. Temperature 90 deg. F. 4in. Journal, 6in. long. Chord of Arc of Contact of Brass = 3·92in.*

| Nominal load lbs. per sq. in. | Coefficients of friction for speeds as below. | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 100 rev. 105ft. per min. | 150 rev. 157ft. per min. | 200 rev. 209ft. per min. | 250 rev. 262ft. per min. | 300 rev. 314ft. per min. | 350 rev. 366ft. per min. | 400 rev. 419ft. per min. | 450 rev. 471ft. per min. |
| lbs. | | | | | | | | |
| 573 | — | ·00102 | ·00108 | ·00118 | ·00126 | ·00132 | ·00139 | — |
| 520 | — | ·000955 | ·00105 | ·00115 | ·00125 | ·00133 | ·00142 | ·00148 |
| 415 | — | ·00093 | ·00107 | ·00119 | ·0013 | ·00140 | ·00149 | ·00158 |
| 363 | — | ·00084 | ·0096 | ·0011 | ·00122 | ·00134 | ·00147 | ·00155 |
| 258 | ·00107 | ·00139 | ·00162 | ·00178 | ·00195 | ·00213 | ·00227 | ·00243 |
| 153 | ·00162 | ·0020 | ·00239 | ·00267 | ·003 | ·00334 | ·00367 | ·00396 |
| 100 | ·00277 | ·00357 | ·00423 | ·00503 | ·00576 | ·00619 | ·00663 | ·00714 |

The above coefficients × the nominal load = nominal frictional resistance per square inch of bearing.

| Nominal load lbs. per sq. in. | Nominal frictional resistance per square inch of bearing. 100 rev. 105ft. per min. | 150 rev. 157ft. per min. | 200 rev. 209ft. per min. | 250 rev. 262ft. per min. | 300 rev. 314ft. per min. | 350 rev. 366ft. per min. | 400 rev. 419ft. per min. | 450 rev. 471ft. per min. |
|---|---|---|---|---|---|---|---|---|
| lbs. | lb. | lb. | lb. | lb. | lb. | lb. | lb. | lb. |
| 573 | — | ·583 | ·62 | ·678 | ·721 | ·758 | ·794 | — |
| 520 | — | ·496 | ·546 | ·597 | ·648 | ·691 | ·735 | ·771 |
| 415 | — | ·386 | ·445 | ·495 | ·539 | ·582 | ·619 | ·655 |
| 363 | — | ·306 | ·35 | ·401 | ·444 | ·488 | ·532 | ·561 |
| 258 | ·277 | ·357 | ·416 | ·459 | ·503 | ·547 | ·583 | ·626 |
| 153 | ·248 | ·306 | ·364 | ·408 | ·459 | ·510 | ·561 | ·605 |
| 100 | ·277 | ·357 | ·423 | ·503 | ·575 | ·619 | ·663 | ·714 |

N.B.—The bearing seized on reversing with 573 lb. per square inch. The experiment was repeated, but the bearing refused to carry more weight. These quantities were obtained by a direct load on the lever, so that in these the coefficient is calculated from the force of the lever, instead of the force on the lever being calculated from the coefficient, as was the case in the former experiments.

TABLE VI.

*Bath of Mineral Oil. Temperature 90 deg. F. 4in. Journal, 6in. long. Chord of Arc of Contact of Brass=3·92in.*

| Nominal load lbs. per sq. in. | Coefficients of friction for speeds as below. 100 rev. 105ft. per min. | 150 rev. 157ft. per min. | 200 rev. 209ft. per min. | 250 rev. 262ft. per min. | 300 rev. 314ft. per min. | 350 rev. 366ft. per min. | 400 rev. 419ft. per min. |
|---|---|---|---|---|---|---|---|
| lbs. | | | | | | | |
| 625 | — | ·0013 | ·00139 | ·00147 | ·00157 | ·00165 | — |
| 520 | — | ·00123 | ·00139 | ·0015 | ·00161 | ·0017 | ·00178 |
| 415 | — | ·00123 | ·00143 | ·0016 | ·00176 | ·0019 | ·002 |
| 310 | — | ·00142 | ·0016 | ·00184 | ·00207 | ·00225 | ·00241 |
| 205 | ·00178 | ·00205 | ·00235 | ·00269 | ·00298 | ·00328 | ·0035 |
| 100 | ·00334 | ·00415 | ·00494 | ·00557 | ·0062 | ·00676 | ·0073 |

The above coefficients × the nominal load = nominal frictional resistance per square inch of bearing.

| Nominal load lbs. per sq. in. | Nominal frictional resistance per square inch of bearing. 100 rev. 105ft. per min. | 150 rev. 157ft. per min. | 200 rev. 209ft. per min. | 250 rev. 262ft. per min. | 300 rev. 314ft. per min. | 350 rev. 366ft. per min. | 400 rev. 419ft. per min. |
|---|---|---|---|---|---|---|---|
| lbs. | lb. | lb. | lb. | lb. | lb. | lb. | lb. |
| 625 | — | ·81 | ·865 | ·92 | ·98 | 1·03 | — |
| 520 | — | ·64 | ·72 | ·782 | ·84 | ·886 | ·924 |
| 415 | — | ·51 | ·594 | ·664 | ·73 | ·785 | ·83 |
| 310 | — | ·44 | ·494 | ·57 | ·64 | ·695 | ·745 |
| 205 | ·364 | ·419 | ·48 | ·55 | ·61 | ·67 | ·716 |
| 100 | ·334 | ·415 | ·494 | ·557 | ·62 | ·676 | ·73 |

N.B.—The bearing carried the 625 lb. per square inch running both ways, but seized on the weight being increased. These quantities were obtained by a direct load on the lever, as in Table V.

This was a thinner sample of mineral oil than that used in the previous experiments; it was fluid at 50 deg., while the oil previously used could only be described as grease at 50 deg. This will account for these experiments showing less friction than the former, except with the highest load, at which, the thin oil being overloaded and on the point of seizing, the friction is greater than with the thick oil.

TABLE VII.

*Rape Oil, fed by Syphon Lubricator. 4in. Journal, 6in. long. Chord of Arc, 3¼in.*

| Nominal load lbs. per sq. in. | Actual load lbs. per sq. in. | Coefficients of friction, for speeds as below. 100 rev. 105ft. per min. | 150 rev. 157ft. per min. | 200 rev. 209ft. per min. | 250 rev. 262ft. per min. | 300 rev. 314ft. per min. | 350 rev. 366ft. per min. | 400 rev. 419ft. per min. |
|---|---|---|---|---|---|---|---|---|
| lbs. | lbs. | | | | | | | |
| 258 | 317 | — | ·0056 | ·0057 | ·0063 | ·0068 | — | — |
| 205 | 252 | ·0132 | ·0098 | ·007 | ·0077 | ·0082 | ·0087 | — |
| 100 | 123 | ·0144 | ·0125 | ·0146 | ·0152 | ·0163 | ·0171 | ·0178 |

The above coefficients × the nominal load = nominal frictional resistance per sq. inch of bearing.

| Nominal load lbs. per sq. in. | Actual load lbs. per sq. in. | Nominal frictional resistance per sq. inch of bearing. 100 rev. 105ft. per min. | 150 rev. 157ft. per min. | 200 rev. 209ft. per min. | 250 rev. 262ft. per min. | 300 rev. 314ft. per min. | 350 rev. 366ft. per min. | 400 rev. 419ft. per min. |
|---|---|---|---|---|---|---|---|---|
| lbs. | lbs. | lb. | lb. | lb. | lb. | lb. | lb. | lb. |
| 258 | 317 | — | 1·43 | 1·46 | 1·61 | 1·76 | — | — |
| 205 | 252 | 2·71 | 2·01 | 1·43 | 1·57 | 1·68 | 1·79 | — |
| 100 | 123 | 1·44 | 1·25 | 1·46 | 1·52 | 1·63 | 1·71 | 1·78 |

The chord of the arc of contact of the brass=3¼in.
The nominal load per sq. in. is the total load divided by 4×6.
The actual load per sq. in. is the total load divided by 3¼×6.
The bearing seized on attempting to run with an actual load of 380 lb. per sq. in.
With nominal load of 258 lb. per sq. in. the temperature of the bearing was 90 deg.
With nominal load of 205 lb. per sq. in. the temperature of the bearing was 85 deg.
With nominal load of 100 lb. per sq. in. the temperature of the bearing was 80 deg.

TABLE VIII.

*Rape Oil, Pad under Journal. 4in. Journal, 6in. long. Chord of Arc of Contact of Brass = 2¼in.*

| Nominal load lbs. per sq. in. | Actual load lbs. per sq. in. | Temperature. Fah. | Coefficients of friction, for speeds as below. 100 rev. 105ft. per min. | 150 rev. 157ft. per min. | 200 rev. 209ft. per min. | 250 rev. 262ft. per min. | 300 rev. 314ft. per min. | 350 rev. 366ft. per min. | 400 rev. 419ft. per min. |
|---|---|---|---|---|---|---|---|---|---|
| | | deg | | | | | | | |
| 328 | 582 | 90 | — | — | ·0107 | ·0102 | ·0098 | — | — |
| 310 | 551 | 82 | — | ·0099 | ·0099 | ·0092 | ·0099 | — | — |
| 293 | 520 | 76 | — | ·0105 | ·0105 | ·0097 | ·0097 | — | — |
| 275 | 498 | 77 | — | ·9091 | ·0091 | ·0095 | ·0103 | — | — |
| 258 | 458 | 78 | — | ·0112 | ·0095 | ·0088 | ·0084 | ·0082 | ·0083 |
| 205 | 364 | 82 | — | ·0105 | ·0087 | ·0085 | ·0078 | ·0085 | ·01 |
| 153 | 272 | 74 | ·0102 | ·009 | ·0096 | ·0102 | ·0105 | ·0119 | ·0125 |
| 100 | 178 | 75 | ·0105 | ·0099 | ·0109 | ·0122 | ·0133 | ·0144 | ·0154 |

The above coefficients × the nominal load = nominal frictional resistance per sq. inch of bearing.

| Nominal load lbs. per sq. in. | Actual load lbs. per sq. in. | Temperature. Fah. | Nominal frictional resistance per sq. in. of bearing. 100 rev. 105ft. per min. | 150 rev. 157ft. per min. | 200 rev. 209ft. per min. | 250 rev. 262ft. per min. | 300 rev. 314ft. per min. | 350 rev. 366ft. per min. | 400 rev. 419ft. per min. |
|---|---|---|---|---|---|---|---|---|---|
| | | deg | lb. | lb. | lb. | lb, | lb. | lb, | lb. |
| 328 | 582 | 90 | — | — | 3·5 | 3·35 | 3·21 | — | — |
| 310 | 551 | 82 | — | 3·06 | 3·06 | 2·84 | 3·06 | — | — |
| 293 | 520 | 76 | — | 3·06 | 3·06 | 2·84 | 2·84 | — | — |
| 275 | 498 | 77 | — | 2·49 | 2·49 | 2·62 | 2·84 | — | — |
| 258 | 458 | 78 | — | 2·89 | 2·44 | 2·28 | 2·17 | 2·1 | 2·13 |
| 205 | 364 | 82 | — | 2·145 | 1·78 | 1·735 | 1·605 | 1·75 | 2·04 |
| 153 | 272 | 74 | 1·56 | 1·37 | 1·473 | 1·56 | 1·605 | 1·81 | 1·89 |
| 100 | 178 | 75 | 1·0 | 0·992 | 1·093 | 1·225 | 1·33 | 1·44 | 1·54 |

The chord of the arc of contact of the brass=2¼in.
The nominal load per sq. in. is the total load divided by 4×6.
The actual load per sq. in. is the total load divided by 2¼×6.
The results with the actual load of 582 lb. per sq. in. were obtained with difficulty, and the bearing seized with that load after running for a short time.
The pad consisted of a piece of felt pressing against the journal, and resting on worsted immersed in a tin box full of oil.

TABLE IX.

*Bath of Lard Oil. Variation of Friction with Temperature. Nominal Load, 100 lb. per sq. in.*

| Temperature. Fah. | Coefficients of friction, for speeds as below. 100 rev. 105ft. per min. | 150 rev. 157ft. per min. | 200 rev. 209ft. per min. | 250 rev. 262ft. per min. | 300 rev. 314ft. per min. | 350 rev. 366ft. per min. | 400 rev. 419ft. per min. | 450 rev. 471ft. per min. |
|---|---|---|---|---|---|---|---|---|
| deg. | | | | | | | | |
| 120 | ·0024 | ·0029 | ·0035 | ·004 | ·0044 | ·0047 | ·0051 | ·0054 |
| 110 | ·0026 | ·0032 | ·0039 | ·0044 | ·005 | ·0055 | ·0059 | ·0064 |
| 110 | ·0029 | ·0037 | ·0045 | ·0051 | ·0058 | ·0065 | ·0071 | ·0077 |
| 90 | ·0034 | ·0043 | ·0052 | ·006 | ·0069 | ·0077 | ·0085 | ·0093 |
| 80 | ·004 | ·0052 | ·0063 | ·0073 | ·0083 | ·0093 | ·0102 | ·0112 |
| 70 | ·0048 | ·0065 | ·008 | ·0092 | ·0103 | ·0115 | ·0124 | ·0133 |
| 60 | ·0059 | ·0084 | ·0163 | ·0119 | ·013 | ·014 | ·0148 | ·0156 |

TABLE X.

*Comparison of the Friction with the Different Methods of Lubrication, under as nearly as possible the same circumstances. Lubricant, Rape Oil; Speed, 150 revolutions per min.*

| | Actual load lbs. per sq. in. | Coefficient of friction. | Comparative friction. |
|---|---|---|---|
| Oil bath .. .. .. .. .. .. .. | 263 | ·00139 | 1 |
| Syphon lubricator .. .. .. .. | 252 | ·00980 | 7·06 |
| Pad under journal .. .. .. .. | 272 | ·00900 | 6·48 |

TABLE XI.

*Comparison of Friction with the various Lubricants tried, under as nearly as possible the same circumstances. Temperature, 90 deg.; Lubrication by Bath Oil.*

| Lubricant. | Mean resistance. | Per cent. |
|---|---|---|
| | lb. | |
| Sperm oil .. .. .. .. .. .. .. | 0·484 | 100 |
| Rape oil .. .. .. .. .. .. .. | 0·512 | 106 |
| Mineral oil .. .. .. .. .. .. | 0·623 | 129 |
| Lard oil .. .. .. .. .. .. .. | 0·652 | 135 |
| Olive oil .. .. .. .. .. .. .. | 0·654 | 135 |
| Mineral grease .. .. .. .. .. | 1·048 | 217 |

N.B.—The above figures—calculated from Tables I.-VI.—are the means of the actual frictional resistances at the surface of the journal per sq. in. of bearing, at a speed of 300 revs. per min., with all nominal loads from 100 lb. per sq. in. up to 310 lb. per sq. in.

They also represent the relative thickness or body of the various oils, and also in their order, though perhaps not exactly in their numerical proportions, their relative weight-carrying power. Thus sperm oil, which has the highest lubricating power, has the least weight-carrying power; and though the best oil for loads, would be inferior to the thicker oils if heavy pressures or high temperatures were to be encountered.

Of the discussion which took place on this paper when read at Birmingham in November last we gave an account in our impression of 9th November last. The short renewed discussion of Friday added nothing of importance.

## THE INSTITUTION OF CIVIL ENGINEERS.

### HYDRAULIC PROPULSION.

AT the ordinary meeting on Tuesday, the 26th of February, Sir J. W. Bazalgette, C.B., president, in the chair, the paper read was on "Hydraulic Propulsion," by Mr. Sydney Walker Barnaby, Assoc. M. Inst. C.E.

The idea of propelling ships, by forcing water through the bottom or sides by means of pumps, was suggested in 1661, which was the date of the first patent upon the subject. The Nautilus and the Waterwitch, built in 1866, attracted a good deal of public attention. The latter was an armoured gunboat built for the Admiralty at the Thames Ironworks, the machinery having been designed by Mr. Ruthven. This gunboat was driven by two water-jets discharged from nozzles at the sides level with the water, the diameter of each of which was 24in. The jets were supplied by a centrifugal pump, 14ft. in diameter. The quantity of water discharged per second was 5·2 tons at a velocity of 29ft. per second. When the engines were developing 760 indicated horse-power the vessel, which was of 1161 tons displacement, attained a speed of 9·3 knots. The Viper, a similar vessel, but driven by a screw propeller, with a displacement of 1180 tons, attained a speed of 9·58 knots, with 696 indicated horse-power. Although this pointed to a considerable waste of power by the hydraulic system, many people thought it had not received a fair trial; and Lord Dufferin's Committee on Designs of Ships of War in 1871, recommended that in view of its suitability for draughts of water so small as to preclude the use of screws, it should receive a more thorough trial. In 1878 a hydraulic torpedo vessel was built in Sweden for competition with a similar vessel propelled by twin screws. The vessels were 58ft. in length, with 10ft. 9in. beam, and of 20 and 21 tons displacement. The screws with 90 indicated horse-power drove the boat at a speed of 10 knots, while the turbine, with 78 indicated horse-power, gave a speed of 8·12 knots per hour. The displacement coefficients were 82 with the screw, 52·5 with the turbine. The Fleischer Hydromotor, built in Germany in 1879, also failed to compete with the screw in point of economy. In this vessel there was no centrifugal pump. The steam acted directly upon the water, forcing it out of vertical cylinders through nozzles in the bottom of the vessel, which could be turned in any direction. The motion was unpleasant owing to the intermittent action of the jets, and the speed obtained was small.

The advantages which the hydraulic system of propulsion presented might be enumerated as follows:—No impediment to speed under sail; no racing of the engines; power of reversing motion in the hands of the officer on deck; full engine-power for manœuvring; vessel capable of being made double-ended, and power of ramming much increased. The propeller was not liable to receive damage from running aground, and could not be fouled by floating obstructions; it was favourable for light draught, and the large pumping-power was available for keeping down leaks. The disadvantages were mainly these:—The difficulty of utilising the full energy of the water entering the propeller; every particle of water acted upon must be carried in the ship; loss by friction of the water in the passages and by bends in the pipe.

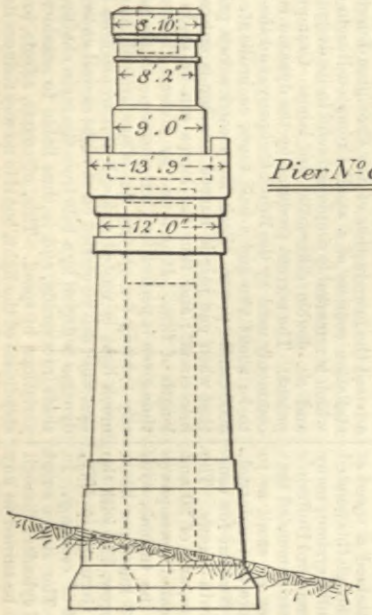
In 1882 Messrs. Thornycroft were building at Chiswick twenty second-class torpedo boats for the Admiralty, and they were commissioned by their Lordships to fit one of them with a Ruthven propeller in competition with the screw. As the machinery was necessarily heavier, the hydraulic boat was given a little extra length. The dimensions of the screw boats were:—Length 63ft., beam 7ft. 6in., draught 3ft. 8½in., displacement 12·89 tons. In the hydraulic boat the length was increased to 66ft. 4in., the beam was 7ft. 6in., draught 2ft. 6in., and displacement 14·4 tons. The engines, which were compound and surface-condensing, had cylinders 8½in. and 14½in. in diameter, with 12in. length of stroke. They drove a turbine 2ft. 6in. in diameter at 428 revolutions per minute. The inlet to the pump was at the bottom of the vessel about amidships, and the discharges, 9in. in diameter, were at the sides just above the water. In all previous hydraulic boats the water had been taken in through a hole in the bottom, in such a way that all its velocity relative to the ship was destroyed before it entered the pump. This velocity had to be restored by the pump, which involved a large waste of power. In the Thornycroft boat the bottom had been formed in such a manner that a large hole was presented to the water at right angles to the keel. The water flowed with unchecked velocity through the pump, and if the vessel was towed along the water was scooped up, flowed of its own accord through the pump, and fell out at the nozzles. The nozzles could be worked from the conning-tower, and made to discharge the water ahead, astern, or athwartships, thus driving the boat in either direction or stopping her. On trial the pump discharged one ton of water per second, at a velocity of 37½ft. per second. The horse-power developed by the engines was 167. The speed obtained by the boat was 12·6 knots per hour. The engines in the screw-boat were considerably lighter. The cylinders were 8½in. and 13½in. in diameter, with 8in. length of stroke. They developed 170 indicated horse-power, with 636 revolutions. The speed obtained was 17·3 knots per hour. The method adopted for measuring the quantity of water discharged from the nozzles in the hydraulic boat was considerably more accurate than any hitherto employed. On the Waterwitch, very imperfect measurements of the velocity of discharge were taken with a patent log placed in the jet. Measurements were made by the author on the new boat by a thin plate $1\frac{5}{16}$in. square, attached to the end of a lever, and placed in the jet just where it left the nozzle. The pressure on the plate was recorded by a dynamometer. The apparatus was so arranged that the pressure could be measured at every part of the jet, and not in the centre only. The pressure varied greatly in different parts of the jet, the mean being nine-tenths of the pressure in the centre. From this the velocity of the water was estimated, and also the quantity discharged. The efficiency of the jet was found to be 0·71, and of the pump 0·46. In the Waterwitch the efficiency of the jet was 0·5, and of the pump 0·47. In the Swedish hydraulic boat the efficiency of the jet was 0·5, and of the pump 0·55. The total efficiency or ratio of useful work in the jet to the actual work expended in producing it was—in the Waterwitch, 0·18; in the Swedish boat 0·214; and in the Thornycroft boat 0·254. The displacement co-efficients at the maximum speeds were, in the Thornycroft screw-boat, 169; in the Thornycroft hydraulic boat, 72. The only fair comparison, however, between these two boats was at the same speed of 12·6 knots; the co-efficient of the screw was then 140—still nearly double that of the other boat. It must also be remembered that no comparison could fairly be drawn between the co-efficients of the Thornycroft hydraulic boat at 12·6 knots and the coefficient of the Waterwitch at 9·3 knots, which was 116. The speed of 9·3 knots was an easy one for a vessel 162ft. long, while 12·6 knots was a speed difficult of attainment by a boat only 66ft. long. If the latter had been designed to run at 8½ knots, its most economical speed, the co-efficient would have been 140 against 116 of the Waterwitch. In conclusion, it was worthy of note that one of the greatest obstacles to the success of the jet propeller, namely, the loss of energy of the water entering the propeller, had been overcome. It had been clearly foreseen by Mr. Thornycroft; and by adapting the bottom of the boat to meet it in the manner described, the efficiency of the jet had been raised from 0·5 to 0·71. Unfortunately this obstacle did not stand alone. What efficiency it was possible to get with a centrifugal pump delivering one ton of water per second, with a lift of 21½ft. and of limited weight and dimensions, the author could not say; 46 per cent. seemed very low; had it reached 70 per cent. the total efficiency would have been 0·38 and the speed upwards of 15 knots. Perhaps this amount of success might yet be achieved for the hydraulic propeller, but it was not likely to be exceeded. The case at present stood somewhat thus:—In the screw-boat the efficiencies were—engine, 0·77; screw propeller, 0·65; total, 0·5. In the hydraulic boat—engine, 0·77; jet propeller, 0·71; pump, 0·46; total, 0·254. The jet, as a propeller, might be taken as a little better than a screw, but the loss in the pump was a dead loss, and represented about half the power. In other words, before a hydraulic-propelled boat could be made to compare favourably with and driven by a screw, the pump producing the jet must work without loss.

THE ELECTRIC LIGHT IN FOUNDRIES.—Messrs. Thwaites Bros., of Bradford, are now using the electric light very successfully. At present the light has only been adopted in the erecting shop, a large building some 40ft. high, of about the same width, and, perhaps, 60ft. in length, without any floors. The difficulty of lighting a large room such as this, in which the centre must be kept clear of all fixtures, so as to allow of the manipulation of large castings by an overhead travelling crane, is one which presents features of peculiar difficulty. With gas it was practically impossible to light the place at all adequately, and after dusk it was not considered safe to go on with work which involved the constant moving of heavy castings, so that during the winter months, and especially on dull and foggy days, work was frequently brought almost to a standstill. These difficulties led Messrs. Thwaites Bros. to consult Mr. Wilson Hartnell, engineer, of Leeds, who advised the introduction of the Crompton-Burgin light. The installation consists of a small Crompton-Burgin dynamo machine, which is remarkably simple and solid in its design and construction, and six double differential arc lamps—Crompton and Crabbe's patent. The current produced by the dynamo is just double that commonly used by the Brush Company, and the light is estimated to be about two and a-half times as brilliant, or from 2000 to 3000-candle power. Each lamp carries two pairs of carbons, so that when one pair is burned another is automatically switched into circuit; and thus the lamps can be made to burn for any length of time. It is found by Messrs. Thwaites that the light thus given is perfect for their purpose. Although from the necessity existing for placing the lamps around the sides of the room much light is wasted, yet still the whole area is so well lighted that work can be carried on at night as well as in the daytime. The dynamo is driven by a belt from the main shafting, with a countershaft intervening, and is thus liable to considerable and frequent variations in speed. This, of course, affects to some extent the steadiness of the light, but it in no way reduces its value. The consumption of power is comparatively slight, and, in the case of Messrs. Thwaites Bros.' installation, is not an appreciable consideration.

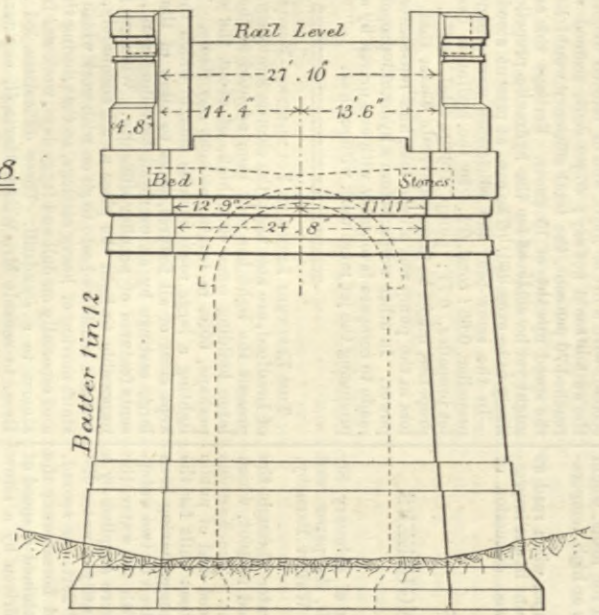
# SALTERHEBBLE VIADUCT, HULL AND BARNSLEY RAILWAY, HUDDERSFIELD AND HALIFAX EXTENSION.

MR. W. SHELFORD, M.I.C.E. ENGINEER-IN-CHIEF

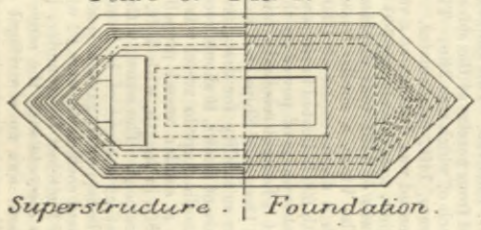
(For description see page 218.)




Pier N° 8.




Plan of Pier N° 7.

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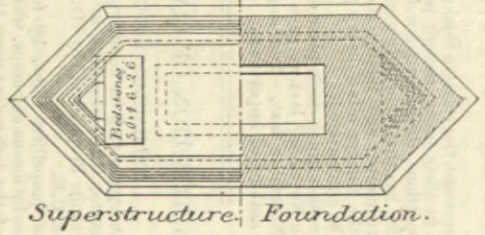


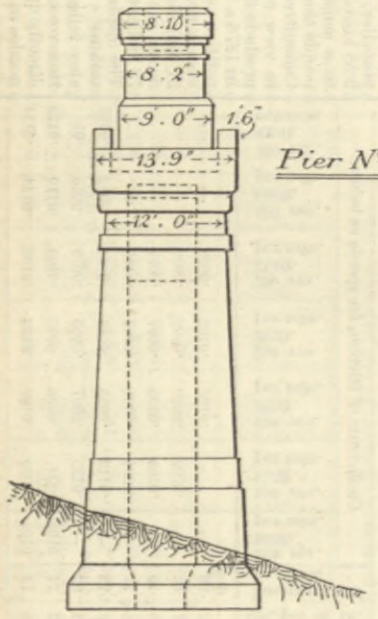


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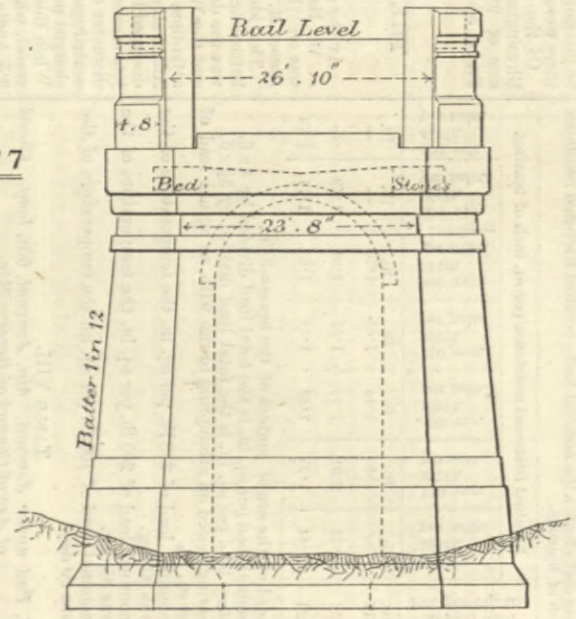
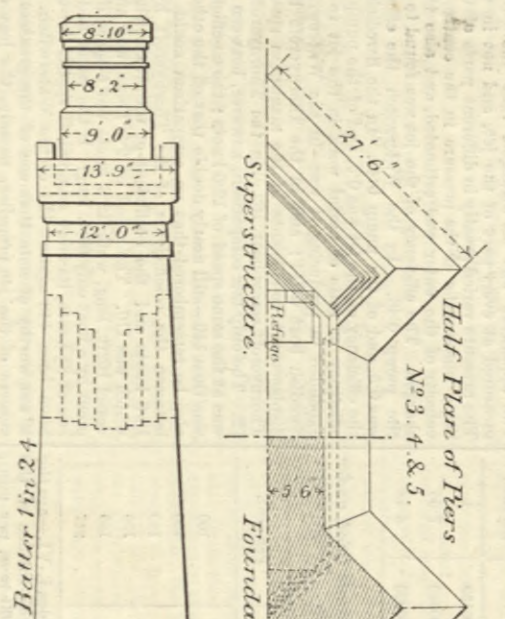
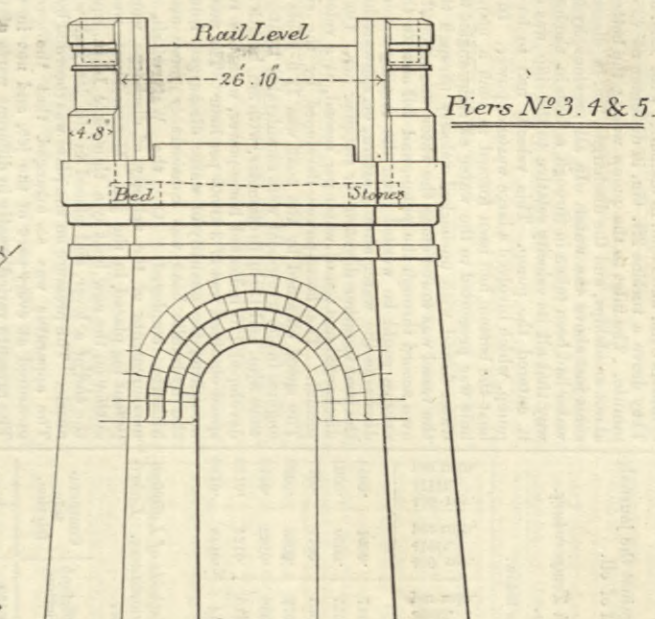
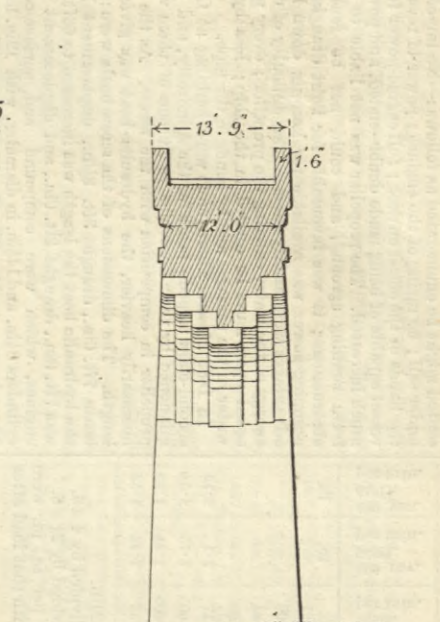


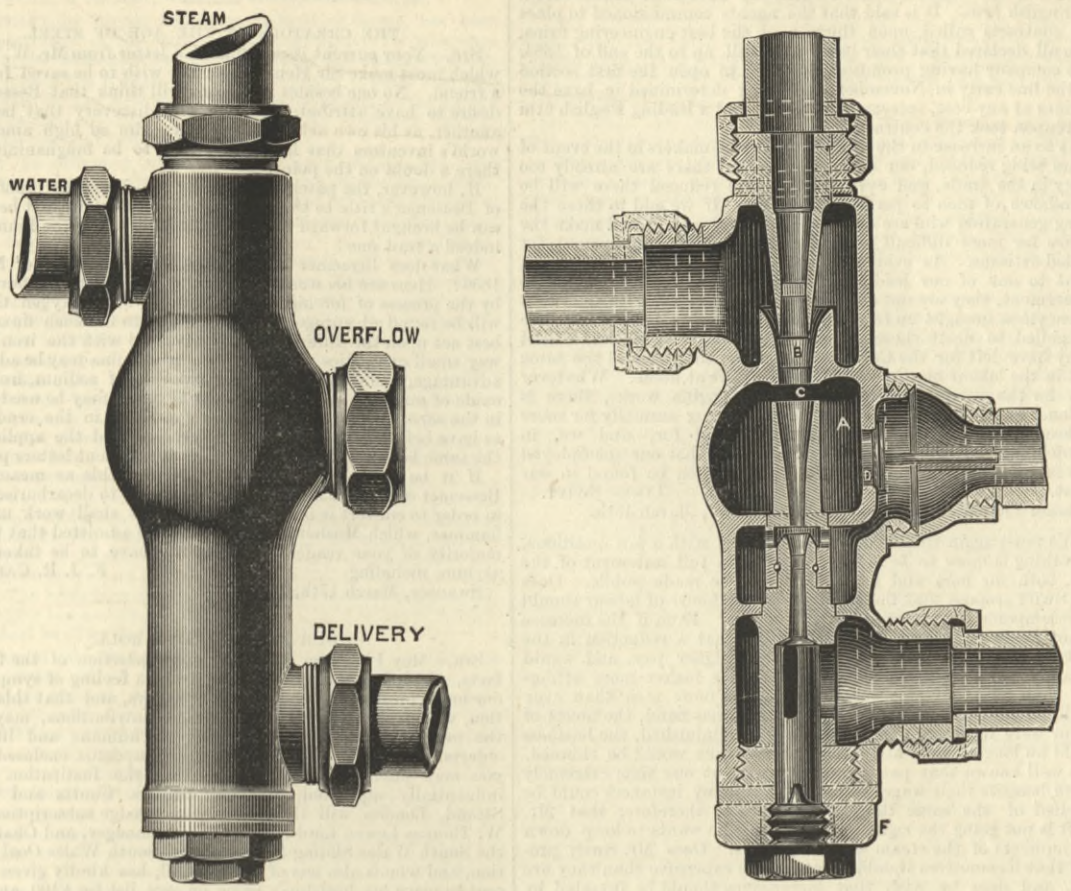






## THE INFLUX INJECTOR.




Messrs. Holden and Brooke, of Simon-street, Salford, are now introducing an injector—Brooke, Holden, and White's patent—which they have named the "Influx," and which we illustrate by the accompanying engravings. The injector acts as a "lifter" or "non-lifter" as may be required, and in either capacity starts, we understand, with unfailing promptness, and should its action be accidentally interrupted—as by the jolting of a traction engine or locomotive, or by the rolling of a ship—it re-starts automatically without any attention on the part of the man in charge. In design it has the advantage of being without split or hinged nozzles, lifting spindles, or levers, and is consequently without glands or packings. It is set to work by merely opening the ordinary boiler steam cock, and on account of this and its capacity for re-starting itself, may be trusted in unskilled hands and under conditions where ordinary injectors have failed. The ordinary type will lift water from 12ft., but a special type is made of similar action which will draw water, we understand, from a depth of 20ft.

## BAILEY'S TESTING APPARATUS.

Messrs. W. H. Bailey and Co. have devoted considerable attention to the manufacture of testing machinery. Fig. 1 is a new pattern of a dynamometer or power tester. This has been designed for testing the different machines employed in a cotton spinning and weaving mill in Spain. The base plate is mounted on wheels, and the holding-down plates are arranged so that it may be bolted to the floor in a convenient place opposite the machine to be tested. The value of a minute of speed is indicated by the number of revolutions on the index. Each weight on the end of the lever represents 132 foot-pounds per revolution. This dynamometer is for testing machines to 4 or 5-horse power, although it is strong enough to test higher powers, of course dependent upon the speed at which the machines are run. With ten weights on the lever, as shown, and the speed at 100 revolutions per minute, the power indicated would be 4-horse. To prevent violent agitation of the lever when at work, the rod is coupled up to a dashpot, in which is a piston working in oil or glycerine. Fig. 2 is a new pattern of Professor Thurston's oil tester; the oil is tested on this comparatively well-known invention by placing the oil on the bearings, which are compressed by means of a spiral spring in the pendulous lever. The number of revolutions required to raise the temperature of the bearing to 200 deg. Fah., indicated by thermometer fixed in the top step, giving the value as of the co-efficient of friction, and thus by this simple process being repeated with another oil, the difference in value as a lubricant between one oil and another is indicated.

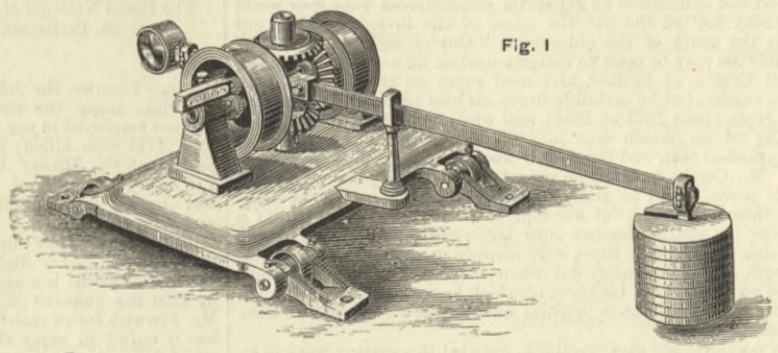


Fig. 1

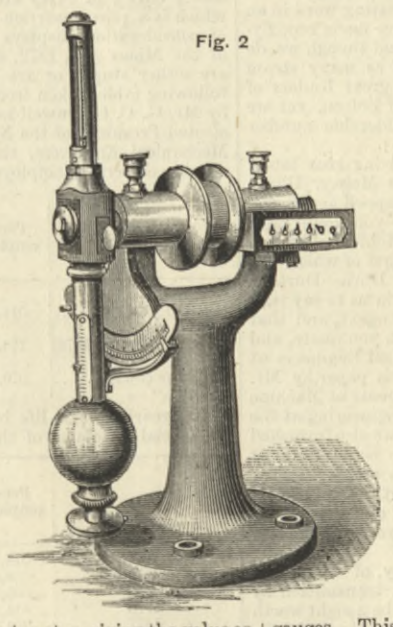


Fig. 2

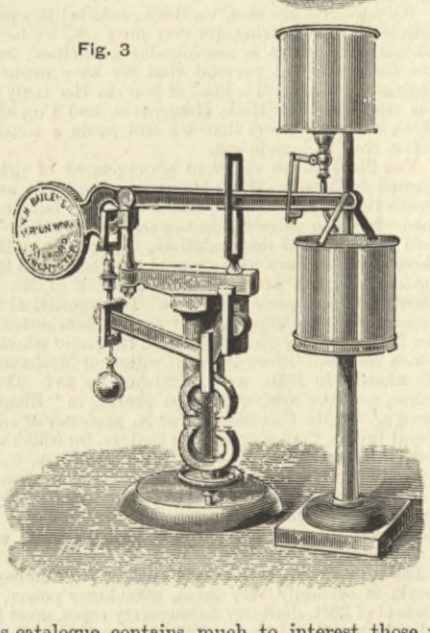


Fig. 3

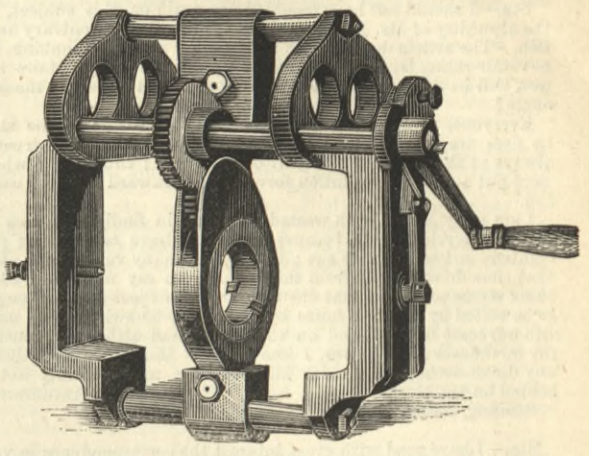
Fig. 3 is a view of Messrs. W. H. Bailey and Co.'s modification of the German method of testing Portland cement. This is called the table pattern tester, the stress being placed on the briquette, which in its weakest section is 1in. by 1in., by means of the sparrow shot, which slowly descends into the can at the end of the lever, and by an ingenious arrangement the supply of shot is automatically stopped when the briquette breaks. By weighing the shot and multiplying by fifty, the value of the force exerted to break the briquette is at once ascertained.

We understand that Messrs. Bailey and Co. make larger machines on a similar principle to test 1½in. by 1½in. briquettes up to 200 lb. of stress, but instead of shot, water is used, slowly descending from one vessel to another, after the manner of the Clepsydra or water clocks of the Greeks, mentioned in the tragedies of Æschylus, who flourished 500 years B.C.

We will mention before we leave this subject that we have just seen a copy of the new sectional catalogue published by Messrs. Bailey and Co., which deals with the subject of testing, and Bailey's recorders, tell-tales, nocturnographs, and tide gauges. This catalogue contains much to interest those who wish to take automatic records of the speed of engines or pressure in steam boilers, the behaviour of watchmen, the height of reservoirs and of the tide, depth of wells, the punctuality of workmen, the duty of pumping engines, and a host of other graphic records, which may be useful to our engineering friends who study workshop economical statistics.

## CROSS-HEAD PIN TURNING MACHINE.

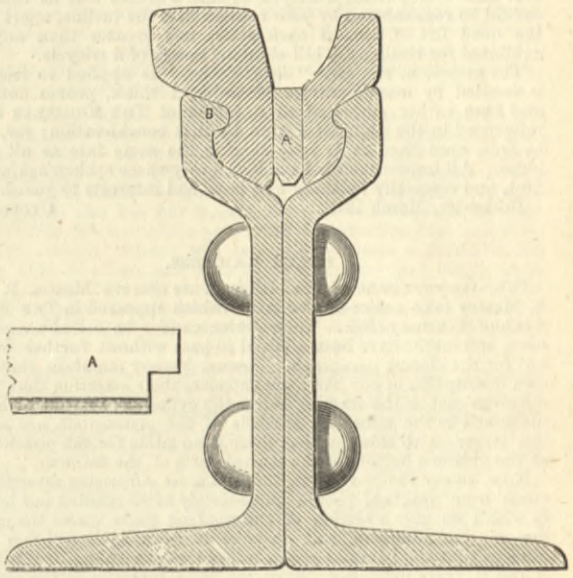
The turning off of what the *National Car Builder*, from which we take the following, calls wrist pins when cast or forged solid in locomotive crossheads is a laborious and expensive process, and to get them perfectly round and in line a very difficult operation. This work can be accomplished in a very expeditious and correct manner with the portable tool shown in the engraving. The operation of the machine is easily understood. First lay out centre-marks on outside of crosshead exactly opposite where the centre of the pin is wanted. In these centre-marks screw the centres of the machine, when the tool will be in position for work, the driving mechanism and cutter holding all parts in the centre, and as firm and strong as though they were solid. After being placed on the crosshead for work, the cutters are so arranged that the whole length of the pin can be turned from end to end, and as true and smooth as though turned in a lathe. The advantages of having a true crosshead pin, the work being done in a very short time, make the tool,



it is claimed, one of the best labour-saving devices in the market. It is made of several sizes—the standard size being adapted to a greater range of locomotive crossheads—by the L. B. Flanders Machine Works, Philadelphia, Pa.

## NEW TRAMWAY RAIL.

The accompanying engraving illustrates a form of rail designed and patented by Mr. G. F. L. Meakin, Kingston-on-Thames. The engraving explains the invention; the object being to provide a rail renewable in the wearing part without removing the paving setts. This is accomplished; the only objection which presents itself to the form is that the rail may gradually become




loose, and thus require a fresh set of the keys A, though if these are put in at first rather tight, so that there is initially a spring grip on the rail, looseness may not arise. The ends of the wedge strips A are notched, so as to be readily prised out of place when required. It would probably be found in practice better to make the upper face B of the angle iron parts of the permanent way more nearly horizontal. The sleepers are laid to break joint, so that no fishing is required.

A Triple Railroad Crossing.—Three heavy steam railroads crossing one overhead of the other at the same spot will be one of the curious freaks of railroad construction in Pittsburgh. This coincidence, as it might be termed, says the *Railroad Gazette*, is formed by the lines of the Pennsylvania Railroad, the Junction Railroad, and the East End Railroad all coming together in the narrowest part of a narrow valley. It is just a short distance, perhaps a few hundred yards, west of the Millville station in the Sixteenth Ward. The Junction road will emerge from the hill at that point, and a tunnel will be extended under the road-bed of the Pennsylvania Railroad in order to continue the route to Lawrenceville. At the same spot a handsome iron bridge for the East End line will span the Pennsylvania tracks, enabling the new company to cross from the top of one hill to the summit of the other. This bridge will be 70ft. above the Pennsylvania tracks and 90ft. above the Junction line. Thus, while a through passenger train may be flying eastward on the Pennsylvania road, a heavy freight train may be thundering immediately under it towards the north, and at the same moment a way accommodation train passing south in mid-air above. The bridge to span the valley will be the handsomest and most important on the route of the East End road. It will be a substantial iron truss, 750ft. long, and having a 120ft. span over the Pennsylvania Railroad. All the other bridges on the line, crossing streets, will be of the plate girder class.

Trial Trip.—On Thursday the 13th inst., the steel screw steamer Bulli, built to the order of Messrs. B. S. Lloyd and Co., London, for the Bulli Colliery Company, of Sydney, by Messrs. Napier, Shanks, and Bell, Glasgow, went down the Firth of Clyde for her official trial trip. Specially designed for the Australian coal trade, the Bulli is of the following dimensions:—164ft. in length, 25ft. moulded breadth, 13¾ft. depth of hold, the gross register tonnage being 450·77, net register, 277·15 tons. She is constructed of steel, to class 90 A1 at Lloyd's. The decks and deck fittings are East India teak, and the style of finish throughout is of a character not usually seen in colliers, and does credit to the builders. The engines, constructed by Messrs. Ross and Duncan, Govan, are of the nominal power of 95 horses, the cylinders being 23in. and 44in. diameter, length of stroke 33in. The boiler is of steel, with Fox's corrugated furnaces, and the working pressure of steam is 80 lb. to the inch. The engines are fitted with steam starting gear, and she has a Dunlop's patent pneumatic and steam combination governor, Duncan's patent propeller, and all recent improvements. The steam windlass made by Napier Bros. is a very compact and effective combination of windlass and winch, in addition to which she has three quick acting coal whipping winches, with frictional gear. On her trial, which was made in boisterous weather, she was loaded with 400 tons coal, and was under steam for nine hours. The engines developed a power of 350 horses, the mean speed of four to-and-fro runs at Skelmorlie being 9·89 knots, which was considered very satisfactory. The Bulli has been built under the superintendence of Mr. J. H. Ritchie, naval architect, London.

## LETTERS TO THE EDITOR.

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

### CLIMBING TRICYCLES.

Sir,—I should not have troubled you again on this subject, but the absurdity of Mr. Lawson's challenge demands a contrary assertion. The article dealing with this subject was hill climbing, and not stair-riding tricks. If Mr. Lawson adheres to the stairs as a test, will he undertake to ride up ordinary steps placed at the same angle?

Everyone, perhaps, did not notice that the treads of the stairs he uses are so arranged that the wheels meet the obstruction always at the most effective part of the crank; thus, if the wheels were put a quarter revolution forward or backward the test would fail.

I am sorry Mr. Lawson wasted so much in finding an idea for driving tricycles direct, because he might have tested that plan eighteen or twenty years ago; there being many velocipedes about that time driven direct from the crank. To my mind the whole thing seems so absurd that one may as well expect a steam engine to be tested by gas, or a horse by his ability to swim. The test I still advocate is uphill and on the level; and although I consider my modification the better, I know the "Merlin" will challenge any direct-acting tricycle for hill climbing, and certainly not be behind on the level. H. Aldridge.

Reading, March 17th.

Sir,—I have read with great interest the correspondence in your paper upon "Hill Climbing Tricycles," and must confess to having had my convictions deepened in favour of "direct-action." Your correspondent of the 14th has evidently been judging of the merits of the "National Royal direct-action" tricycle by the old pattern that was made by the National Company, instead of by the new and much-improved pattern of the National Cycle Works, Limited. This machine has perfect double-driving and free pedals, accompanied by a means for back-pedalling. Moreover, it is made wider, and the weight of the rider is so well distributed that it is now one of the safest and most comfortable machines to ride. With regard to its marvellous hill-climbing power, I think, Sir, that the fact of its being ridden up a flight of stairs unmistakeably demonstrates its superiority in this respect. This must be obvious to most of your readers, and I utterly fail to understand how your correspondent can see any analogy between testing a balloon in a coal mine and putting a tricycle to such a severe test as this. It should be remembered by your readers that the incline, apart from the dead lift of 8in. at each stair, was greater than any yet exhibited for testing the hill-climbing power of a tricycle.

The assertion, too, that "direct-action" as applied to tricycles is assailed by manufacturers generally, I think, proves nothing, and I am rather surprised at a reader of The Engineer being influenced in the slightest degree by that consideration; for, if it be true, even then it is only sharing the same fate as all good ideas. All improvements have been everywhere spoken against at first, and especially by those who have had interests to guard.

Rochester, March 19th. Cyclist.

### STEAM HAMMERS.

Sir,—In your issue of the 14th inst. we observe Messrs. B. and S. Massey take notice of our letter which appeared in The Engineer of February 29th. Their letter cannot be called a reply to ours, and might have been allowed to pass without further notice but for the closing paragraph. Messrs. Massey maintain that our own description of our hammers supports their assertion that "the openings cast in the framing below the cylinders, instead of being machined to the sizes and sections of the piston-rods, are about ⅛in. larger on all sides, so that there is no guide for the piston-rods at the extreme bottom of the central parts of the framing."

Now, to say the least of it, this is a most surprising assertion to come from practical people immediately after reading our letter, in which we give a section of the working parts under the cylinder of our hammers, and describe it as follows:—"You will observe that the hammer piston works through guides or glands at A and B, truly machined out of the solid metal to fit the section of the piston-rod. Those guides are situated at the extreme top and bottom of centre piece, and are therefore in the very best possible position for the purpose."

Messrs. Massey's opening statement, that "hammers of this type have been made for a generation," is perfectly correct. It is exactly thirty years since Rigby's patent was taken out for hammers of that type. About the same time R. Morrison took out a patent for a hammer of somewhat similar design, but guided through the top of cylinder. During the currency of these patents we were the sole makers of Rigby's patent, and R. Morrison and Co., Newcastle, worked the Morrison patent.

Glen and Ross.

Greenhead Engine Works, Glasgow, March 17th.

### LABOUR AND MACHINERY.

Sir,—Had it not been for your editorial note appended to my letter of last week—which you were kind enough to print in full—I should not have ventured to trouble you further with my individual opinions, but have contented myself with the one expression, unless some new proof had been adduced that the position we had taken up in our Report was untenable. As to the importation of locomotives in 1865, my former letter did not say they could not be obtained in England, but what I did say, was that they—the English builders—had so much work on hand that they did not feel the evil effects of the small order that then went to France. The real cause of the fifteen locomotives being made in France was the price, as tenders were solicited for eighty locomotives of different kinds, and, as a result, thirteen English firms, one Belgian, and MM. Schneider sent in a list of prices, the highest tender being £3350, the Belgian £2890—four English firms being under the latter tender—and MM. Schneider £2491. This statement will show the tender to have been accepted on account of the lower price; but as they would not build others at the same rate we can only assume that they were not remunerative, and no more were built in France.

As a proof of the country's capacity for building locomotives, in 1867 it was estimated that the works then in existence were capable of making 1500 locomotives annually, which were far in excess of those required on our own railways; and as these firms have been fairly employed, we may assume that large numbers have been sent abroad in the interval.

The three questions, or queries, in your addenda travel beyond the point we have taken up, as they open up matters that could only be settled as circumstances arose in the future. To say, "at what point a contraction in the working day must stop in order that the risk of foreign competition may not be incurred," is to solicit an opinion that would be based entirely upon supposition. To arrive at such a conclusion would require the fullest details as to the rates of wages, profits, and taxation of the countries who would be our competitors, and as we do not anticipate the hours' question being debated or settled on such a basis, it had better be left on one side until such times that we have real proof that the foreigner is coming on our own soil to undersell us. If, however, we take the case quoted in my last letter as a criterion, where the German firm asked £1400 for work that was completed by an English firm for £850, or if we take into account the wages paid to artisan engineers in America being about double to those in England, then, I think, they would allow a great margin for reducing hours before we should need to fear the loss of trade to the benefit of either of the countries named.

As evidence in support of these views I will quote a case that will at the same time, I think, answer your third query, the extract being taken from the *Buenos Ayres Standard* about twelve months ago, and if I mistake not was reported in your valuable paper as well:—"The locomotives for the Rosario and Candelaria section of the Western Santo Fe Railway have been ordered from an English firm. It is said that the agents commissioned to place the contracts called upon thirteen of the best engineering firms, who all declared that their books were full up to the end of 1884. The company having promised, however, to open the first section of the line early in November, and being determined to have the engines at any cost, increased its terms, and a leading English firm thereupon took the contract."

As to an increase in the number of engine-makers in the event of hours being reduced, our contention is that there are already too many in the trade, and even if hours are reduced there will be abundance of men to perform the work. If we add to these the rising generation who are now learning the trade, it will make the future far more difficult than the past to find employment for skilled artisans. As evidence in support of this opinion, we can point to one of our leading railways, where, in the locomotive department, they are not only supplying themselves with their own journeymen brought up from boyhood, but we, in self defence, are compelled to draft these young men to other localities, whilst many have left for the Colonies to find on their arrival the same glut in the labour market that they had left at home. Whatever may be the productive capacity of our engine works, there is evidence on all hands that they are producing annually far more tradesmen than employment can be found for, and we, in self-defence, say—reduce the working hours that our unemployed lists may be less, and as a result, less privation be found in our midst. James Swift.

Steam Engine Maker's Society, Manchester, March 18th.

[We must again trouble our correspondent with a few questions, as nothing is more to be desired than that a full statement of the case, both for men and masters, should be made public. Does Mr. Swift propose that the reduction in the hours of labour should be accompanied by increased wages or not? Even if the increase is not made in money, it would appear that a reduction in the working hours would be tantamount to higher pay, and would certainly make the trade of a steam engine maker more attractive than now. If this was the case, then more men than ever would be found in its ranks. If, on the other hand, the hours of labour were increased and the rate of pay diminished, the business would no longer prove attractive and its ranks would be thinned. It is well known that pattern makers were at one time extremely scarce because their wages were low, and many instances could be supplied of the same thing. It appears, therefore, that Mr. Swift is not going the right way to work if he wants to keep down the numbers of the steam engine makers. Does Mr. Swift propose that locomotives should become more expensive than they are now, and does he wish that larger sums should be invested by capitalists in putting down plant for their production? We assume that he does not wish English locomotive builders to refuse work. Yet it is clear that if they are as full of orders now as they can be, they must either refuse to take more or else put down more plant if they are to keep their works open for a smaller number of hours per week than they are now open. We believe that benefit would result from a clear enunciation of Mr. Swift's views on these points, and we venture to hope that he will not be reticent.—Ed. E.]

### ROPE DRIVING GEAR.

Sir,—By some unaccountable neglect we did not notice your article of the 11th January on "Rope Driving Gear" till this morning, or we should have asked space for a few words on it earlier. That so good and exhaustive an article on steam-driven rope gear could have been written and yet the name of the inventor be left out shows the truth of the old saying, "Out of sight out of mind." Possibly we may be open to correction when we assert that the late James Combe, of Belfast, first used ropes on the fly-wheel of a steam engine, but he certainly drove his own place, Falls Foundry, with ropes about 1863 or 1864; and when he first mentioned rope gearing to us, which was in 1865, he spoke of it as quite an accomplished fact, and one which was likely to revolutionise gearing. Mr. Combe took out no patent for grooved wheels by which steam power could be transmitted by ropes. Whether he could have done so we do not attempt to decide, but he did patent a machine for plaiting leather rope for working in the grooves, and we think that if hemp ropes were already in use and were answering well, as they certainly did when they were tried, Mr. Combe would not have spent his time, of which he was a great economist, inventing a dear thing to perform an operation already well done by a cheap one.

We ourselves are also, we think, entitled to a passing word in an article on rope gearing, for ever since 1865 we have made rope fly-wheels and pulleys in considerable quantities; and though we do not for a moment pretend that we have made as many steam engines fitted with this kind of gear as the truly great leaders of our trade, Messrs. Hick, Hargreaves, and Co., of Bolton, yet we think we might assert that we had made a considerable number before they had made one.

You illustrate an excellent arrangement of driving gear lately erected by Messrs. Hick, Hargreaves, and Co. at Messrs. Illingworth Brothers, Bradford, but if you had but stepped across the road—for their gates are just opposite each other—you would have seen at the mill of their relatives, Messrs. Isaac Holden and Sons, three steam engines with grooved fly-wheels, the first of which was made by us ten years ago. You speak of Mr. Duril—Durie it should be—and quote his words. Is it egotistical in us to say that these words were ours, for he was our Manchester agent, and that the facts so nicely given by him in the paper which you quote, and which was read before the Institution of Mechanical Engineers at Manchester in 1876, were furnished by us? This paper by Mr. Durie, and the article on rope gearing in "Elements of Machine Design," by Mr. Cawthorne Unwin, professor of engineering at the Royal Indian Civil Engineering College, for which we also furnished the data—see page 8—of preface, constitutes, we believe, almost the only printed information we have in English on the subject. You refer to the construction of wheels and pulleys of thin steel; this was a very favourite scheme of Mr. Durie's; and though his ideas were never finally patented, yet the affair was provisionally protected many years ago.

The size of the cotton mill engines for Bombay, of which you speak, is certainly very great, 4000-horse power, transmitted by a wheel of 30ft. diameter having sixty ropes, must be a sight worth going to the East to see. 2000-horse power with a wheel of 30ft. and thirty ropes is our greatest achievement; this drives a jute mill in Calcutta. Pearce Brothers, Engineers.

Dundee, March 8th.

### GAS ENGINE ECONOMY.

Sir,—Your last number contains an extract from a paper lately read before the Institution of Civil Engineers on the mechanical duty obtained by the explosion of gas in engines, and it is therein stated that in Crossley's and Clark engines it requires 20 cubic feet of gas per hour to obtain 1-horse indicated power, and that the old original Lenoir engine required four times that amount. Now this statement, so far as the Lenoir engine is concerned, is utterly incorrect. As the manager of the works where these engines were first made, I had ample opportunities during the construction of many hundreds to test the consumption of gas as it was passed through an ordinary meter, and I found the consumption for a 1-horse engine never exceeded 50 cubic feet per hour. The power was measured by the dynamometer, so that the useful effect was obtained—a very different thing to the indicated horse-power, as stated above. It is well known that in small engines the power absorbed by friction is proportionally much greater than in larger engines, so that if allowance be made for that, I think the Lenoir engine would not show so bad a result—something like 50 cubic feet to Otto's 30 cubic feet, and not four times as stated. John Pinchbeck.

9, Victoria-chambers, Victoria-street, S.W.,
March 11th.

### THE CREATORS OF THE AGE OF STEEL.

Sir,—Your current issue contains a letter from Mr. W. T. Jeans, which must make Sir Henry Bessemer wish to be saved from such a friend. No one besides Mr. Jeans will think that Bessemer can desire to have attributed to him any discovery that belongs to another, as his own achievements place him so high amongst the world's inventors that he could afford to be magnanimous were there a doubt on the point.

If, however, the patent adduced by Mr. Jeans as proof positive of Bessemer's title to the discovery claimed by Mushet be all that can be brought forward to rest such a title upon, the foundation is indeed a frail one!

What does Bessemer himself say, in this patent of May 31st, 1856? Here are his words:—"In the treatment of different irons by the process of forcing atmospheric or other oxygen therein, it will be found advantageous in some cases to use such fluxes as will best act upon the different bases associated with the iron; in this way small quantities of lime, silica, or alumina may be added with advantage, and so in like manner chloride of sodium, iron scales, oxide of manganese, and other salts or fluxes may be used to assist in the separation of the impurities contained in the crude metal, as have before been used for like purposes, and the application of the same is not claimed by me under the present letters patent."

If it be a proof of sanity to interpret this as meaning that Bessemer claims the addition of spiegeleisen to decarburised metal, in order to convert it into a material that shall work under the hammer, which Mushet claims, it must be admitted that the great majority of your readers will speedily have to be taken to the asylum, including F. J. R. Carulla.

Swansea, March 17th, 1884.

### OUR MINERS' DEATH ROLL.

Sir,—May I beg the favour of your insertion of the following facts, which I hope may arouse as strong a feeling of sympathy for our brave miners as is shown for our sailors, and that this Institution, which is supported by voluntary contributions, may receive the necessary £ s. d. to carry out its humane and life-saving objects. You will observe from the prospectus enclosed—which you may publish if you choose—that the Institution is most influentially supported, and that Messrs. Coutts and Co., 59, Strand, London, will thankfully acknowledge subscriptions. Mr. W. Thomas Lewis, Lord Bute's general manager, and Chairman of the South Wales Sliding Scale and the South Wales Coal Association, and who is also one of our Council, has kindly given us consent to place his lordship's name on our list for £100, and I hope the colliery owners and other mineowners throughout the country will at once respond to this appeal.

There are 500,000 persons employed in our coal mines, and of these in 1878 not less than 1413 were killed; and within the last ten years, since the passing of the Mines Act, the average yearly loss of life has been 1129. But in addition is the fact that there are many other accidents in mines not officially recorded, and it is believed the total lives lost in our mines of every kind is 2500 every year—forty-eight every week, or eight every day. Will the British public, but especially our colliery owners and the owners of every other mine and your readers generally, help to reduce this terrible death roll by supporting this Institution, and thus saving many homes sorrow and sadness? We await the practical response of every class. Messrs. Coutts and Co. are the bankers.

Thomas Fenwick, Secretary.

The Royal National Miners' Life-saving Institution,
36, Parliament-street, S.W., London, March 12th.

Sir,—I notice the following paragraph, signed by Mr. Thos. Fenwick, going the round of the press:—"There are 500,000 persons employed in our coal mines, and of these in 1878 not less than 1413 were killed; and within the last ten years, since the passing of the Miners' Act, the yearly average has been 1200, or 1 in every 38 employed, as compared with 1 in 75 of our sailors lost at sea. But in addition is the fact that there are many other accidents in mines not officially recorded, and it is believed the total lives lost in our mines is 2500 every year, 48 every week, or 8 every day." A very slight attention to these figures will show that the first assertion is a most palpable error, for if 500,000 be divided by 1200 the quotient is 416, instead of 38, so that, according to Mr. Fenwick's own statement, when his blunder is corrected, the loss is only 1 in every 416. The second portion of his remarks, which is a pure assertion uncorroborated by any evidence worthy of consideration, displays great ignorance of the coroners' clause of the Mines' Act, 1872, and supposes that the mines inspectors are either stupid or are wilfully suppressing information. The following table, taken from the Board of Trade returns, and given by Mr. G. C. Greenwell in an address on the occasion of his being elected President of the North of England Institute of Mining and Mechanical Engineers, shows the accidents compared with the number of persons employed in various occupations:—

| Employed in | Persons employed. | Deaths by accident. | Ratio of persons employed to each death. | Death rate per 1000 persons employed. |
|---|---|---|---|---|
| Mines (1876) .. .. .. | 514,532 | 933 | 551 | 1·8 |
| Merchant Service (1876) | 198,638 | 2270 | 87 | 11·4 |
| Railways (1874) .. .. | 270,000 | 1000 | 270 | 3·7 |

The yearly loss of life in mines for ten years, ascertained from the official statement of the mines inspectors, is as follows:

| | Persons employed. | Deaths by accident. | Ratio of persons employed to each death. | Death rate per 1000 persons employed. |
|---|---|---|---|---|
| 1873 | 514,149 | 1069 | 480 | 2·079 |
| 1874 | 538,829 | 1056 | 510 | 1·959 |
| 1875 | 535,845 | 1244 | 430 | 2·321 |
| 1876 | 514,532 | 933 | 551 | 1·813 |
| 1877 | 494,391 | 1208 | 409 | 2·443 |
| 1878 | 475,329 | 1413 | 336 | 2·972 |
| 1879 | 476,810 | 973 | 490 | 2·040 |
| 1880 | 484,933 | 1318 | 368 | 2·718 |
| 1881 | 495,477 | 954 | 519 | 1·925 |
| 1882 | 503,987 | 1126 | 447 | 2·234 |
| Average of 10 years .. | 503,428 | 1129 | 445 | 2·243 |

Mr. Fenwick, who, without any previous knowledge of the question, has only just given his attention to the subject, should hesitate before he makes such sweeping assertions, and should, at all events, be sure that the figures are correct before he casts aspersions on the conduct of men who have devoted a life-time to their profession, and whose reputation is unsullied.

Theo. Wood Bunning,
Secretary to the Northumberland and Durham Coal Trade.
Coal Trade Offices, Newcastle-upon-Tyne,
March 19th.

(*For continuation of Letters see page* 228.)

Mr. J. Evelyn Williams, C.E., has reported on the improvement of Steeping river outfall into Wainfleet Haven, and recommends the enlargement of the sea sluice and the straightening of the river, at a cost of £19,425.

## RAILWAY MATTERS.

ACCORDING to Tiflis papers, the Persians have made application for permission to connect the Caucasus Railway system with Resht, a project which, if realised, would be an important matter.

A PAMPHLET, by Signor Salvatore Raineri, of Rome, has been sent us descriptive of the wire rope haulage system for tramways as in use in San Francisco and Chicago, under the Hallidie system.

THE tender of the Hudson Brothers Company, a local firm, has been accepted by the New South Wales Government for the supply of the brake-vans required for the Eastern and Southern Railway lines during the next five years.

ONE of an ordnance survey party, Edwin Wales, has been killed by a passenger train near Gainsborough on the Manchester, Sheffield, and Lincolnshire railway. Seeing a train advancing he became confused, ran in front of the engine, and was cut to pieces.

AT a meeting convened by the Mayor at the Guildhall, Canterbury, to consider the rival schemes of the London, Chatham, and Dover and the South-Eastern Railway Companies for opening up a direct route to Folkestone, the former by way of Kearsney and the latter *vid* the Elham Valley, a resolution in favour of the Chatham and Dover project was carried.

THE report of the directors of the North British Railway Company gives the miles worked by its engines 1138·75 miles, and the passenger train mileage 2,627,901, goods and mineral trains 3,273,276 miles, or a total of 5,901,177 miles. The total cost of the locomotive power was £154,782 8s. 10d., which is equal to—but we're just going to press and must not wait to work it out—say sixpence per mile.

PLANS have been lodged for seventy-six tramway and light railway schemes in Ireland, viz.:—Ulster, 13; Munster, 24; Leinster, 16; Connaught, 23; total, 76; representing 1390 miles in length, with a capital of £5,000,000. The Government guarantee interest on £2,000,000 only upon projects recommended by the Lord-Lieutenant. The Irish farmers and landowners, however, quite rightly refuse to give the necessary support to these light railways, most of which would be of no use whatever.

THE record of United States train accidents in January contains notes of 49 collisions, in which 32 persons were killed and 65 injured; 86 derailments, in which 21 persons were killed and 146 injured, and 12 other accidents, in which three persons were killed and 29 injured, a total of 147 accidents, in which 56 persons were killed and 240 hurt. As compared with January, 1883, there was a decrease of 21 accidents, but an increase of 1 in the number killed and of 41 in that of persons injured.

IN reporting on the accident which occurred on the 4th December, near Fordham station, on the Ely and Newmarket branch of the Great Eastern Railway, when a passenger train from Ipswich for Ely ran into a herd of cattle about half a mile after leaving Fordham station, and killed eight out of the twenty beasts of which the herd was composed, the engine and tender being thrown off the rails, though all the vehicles composing the train kept on the line, Major-General C. S. Hutchinson says: "The prompt application of the Westinghouse brake, with which the train was fitted throughout, was no doubt the means of having prevented this accident being followed by more serious consequences than was happily the case."

THE American railway accidents during January are classed as to their nature and causes as follows, by the *Railroad Gazette*:—Collisions: Rear, 31; butting, 14; crossing, 4; total, 49. Derailments: Broken rail, 18; broken frog, 1; broken switch-rod, 5; broken bridge, 3; spreading of rails, 7; broken wheel, 4; broken axle, 1; broken truck, 2; accidental obstruction, 5; land-slide, 2; snow, 2; cattle, 1; rail accidentally misplaced, 1; misplaced switch, 6; unexplained, 28; total, 86. Other accidents: Broken connecting-rod, 6; broken axle not causing derailment, 2; broken wheel not causing derailment, 1; cars burned while running through oil, 3; total, 12; grand total, 147. Five collisions were caused by fog, three by the derailment of preceding trains, two by trains breaking in two, two by misplaced switches, one each by snow and by a mistake in orders.

THE passage through the Dominion Parliament of the resolution of the Bill granting a loan of 22½ million dollars to the Canadian Pacific Railway is already giving an impetus to the completion of the building of that line. This is more especially the case in the division north of Lake Superior. The track has been laid from Port Arthur, the western Lake Superior port of the system, for a distance eastward over the north of the lake of nearly 100 miles. The road will, it is anticipated, be constructed as far as Mackay's Harbour by the spring. The work of construction is to be resumed in the Rocky Mountains in the beginning of April, and the track laid from the summit of the Kicking Horse Pass, which was the point reached last season, westward to British Columbia. Activity is also being shown in the preparations for the furtherance of railway facilities in Manitoba by the construction of branch lines.

THE baggage traffic on the Belgian railways in 1882 yielded about £37,400, and the express traffic £293,080, the latter being 6⅛ per cent. of the total earnings. The freight earnings were 57½ per cent. of the total earnings and 4½ per cent. more than in the previous year. The average receipt per ton—of 2000 lb.—was only 56 cents; noticing this an American contemporary says:—"The average receipt per ton per mile we are not able now to give, for lack of a statement of tonnage mileage, but it is much greater than on many American roads, the average haul being very short. At the same time it is probably much less for so short a haul than on most American roads. The mileage of corporation roads in Belgium in 1882 was 914, and they earned about 7,925,000 dols. gross and 3,686,000 dols. net, or 8670 dols. and 4033 dols. per mile. One corporation road, 23½ miles long, was added to the state system during the year, which now includes 67·4 per cent. of the whole Belgian system of 2800 miles."

A GENERAL classification of the railway accidents in January in the United States is given as follows by the *Railroad Gazette*:—

| | Collisions. | Derailments. | Other. | Total. |
|---|---|---|---|---|
| Defects of road | — | 34 | — | 34 |
| Defects of equipment | 2 | 7 | 9 | 18 |
| Negligence in operating | 38 | 6 | — | 44 |
| Unforeseen obstructions | 9 | 11 | 3 | 23 |
| Maliciously caused | — | — | — | - |
| Unexplained | — | 28 | — | 28 |
| Total | 49 | 86 | 12 | 147 |

Negligence in operating thus includes a larger proportion—30 per cent.—of the whole number of accidents than any other class of causes. A division according to classes of trains and accidents is as follows:—

| Accidents. | Collisions. | Derailments. | Other. | Total |
|---|---|---|---|---|
| To passenger trains | 8 | 40 | 10 | 58 |
| To a pass and a freight | 19 | — | — | 19 |
| To freight trains | 22 | 46 | 2 | 70 |
| Total | 49 | 86 | 12 | 147 |

THE exports of rails from Great Britain to America in January last were smaller than in any other month since July, 1879, and not 30 per cent. of the January exports or the monthly average last year—enough for but 19 miles of track laid with 56 lb. rails—that is, they were entirely insignificant for a country which has 120,000 miles of railroad in operation. Throughout 1883 the British exports to countries other than the United States were extraordinarily large, averaging 58,456 tons per month, against 48,898 in 1882, and 35,499 in 1881. In January of this year, however, they were only 37,663 tons, which is 42 per cent. less than last year, and even 7½ per cent. less than in 1882. No exports to Canada are reported in January last, but 25·7 of the whole went to India, and 21·3 to Australia, and 25·3 to South American countries. For the first time Mexico is reported separately, taking out 177 tons this year in January, against 4331 last year, and 2935 in 1882. These reports are coming when railroad construction in Mexico seems to be drawing to a close for the present.

## NOTES AND MEMORANDA.

FOR the week ending February 23rd, 1884, in thirty cities of the United States, having an aggregate population of 7,103,600, there died 2770 persons, which is equivalent to an annual death rate of 20·3 per 1000—a slight diminution from the rate of the preceding week. For the North Atlantic cities the rate was 20·0; for the Eastern cities, 21·4; for the Lake cities, 15·8; for the River cities, 18·9; and in the Southern cities, for the whites, 19·4, and for the coloured, 37·9 per 1000.

THE Bilbao iron mines did not export so much ore in 1883 as in 1882. The following figures show the export to different countries. To Great Britain, 2,312,210 tons; Holland, chiefly transit to Germany, 454,463 tons; France, 461,943 tons; Belgium, 141,918 tons; Corsica, 1476 tons; United States, 6224: total, 3,378,234. This shows a falling off, as compared with the shipments of the year 1882, of 314,308 tons. In Great Britain, Wales took 1,269,316 tons, the Cleveland district 680,146 tons, and Scotland 347,756 tons.

THE deaths registered in twenty-eight great towns of England and Wales for the week ending March 15th corresponded to an annual rate of 22·6 per 1000 of their aggregate population, which is estimated at 8,762,354 persons in the middle of this year. In London 2761 births and 1660 deaths were registered. Allowing for increase of population, the births were 100 and the deaths 158 below the average numbers in the corresponding weeks of the last ten years. The annual death rate from all causes, which has been 19·3 and 21·3 per 1000 in the two preceding weeks, rose last week to 21·6. The death of a retired watchmaker, whose age was stated to be 101 years, was recorded.

M. CAILLETET, so well known in connection with the liquefaction of gases, has constructed an apparatus for the continuous production of intense cold, which consists of a closed steel cylinder containing a coil of copper pipe which projects from each end of the cylinder. Two copper tubes are also screwed into the cylinder, and one of these communicates with the mercurial piston pump already used by Cailletet, while the other receives the ethylene which has been compressed by the pump and cooled by methyl chloride. By this arrangement he forms a circuit in which the same quantity of condensed ethylene is repeatedly evaporated in the copper coil, producing intense cold, and then compressed again by the pump being sufficiently cooled with methyl chloride and ready for evaporation again. This process goes on as long as the sucking and compressing pumps are working.

FOR cementing brass on glass, M. Pusher recommends a resin soap, made by boiling 1 part caustic soda, 3 parts of colophonium—resin—in 5 parts of water, and kneading into it half the quantity of plaster of Paris. This cement, the *Scientific American* quoting a German source says, is useful for fastening the brass top on glass lamps, as it is very strong, is not acted upon by petroleum, bears heat very well, and hardens in one-half or three-quarters of an hour. By substituting zinc white, white lead, or air-slaked lime for plaster of Paris, it hardens more slowly. Water only attacks the surface of this cement. Wiederhold recommends for the same purpose a fusible metal, composed of 4 parts lead, 2 parts tin, and 2½ parts bismuth, which melts at 212 deg. Fah. The melted metal is poured into the capsule, the glass pressed into it, and then allowed to cool slowly in a warm place.

OF American patents granted last year, New York State received the largest number, 4359, Massachusetts following with 2173, and Pennsylvania with 2168; then come Illinois with 1792; Ohio, 1604; Connecticut, 883; Michigan, 727; Indiana, 712; Missouri, 625; California, 596; Iowa, 445; Wisconsin, 394; Rhode Island, 327; and Minnesota, 310. The United States Army is credited with 6 and the Navy with 3 patents. According to population, the District of Columbia received one patent on the average for 318 inhabitants, Massachusetts one for 320, Connecticut one for 705, and Rhode Island one for 845, the fewest patents in proportion to population being issued to Mississippi, which received one for an average of 22,188. The patents issued to citizens of foreign countries numbered 1259, or 124 more than were so issued in 1882. England takes the lead with 435, followed by Canada with 251; Germany, 235; France, 179; Austria, 33; Switzerland, 22; and Belgium 20.

TO file glass, take a 12in. mill file, single cut, and wet it with turpentine saturated with camphor, and the work can be shaped as easily and, the *Scientific American* says, almost as fast as if the material were brass. To turn glass in a lathe put a file in the tool stock, and wet with turpentine and camphor as before. To square up glass tube put them on a hard wood mandril, made by driving iron rod with centres through a block of cherry, chestnut, or soft maple, and use the flat of a single-cut file in the tool post, wet as before. Run slowly. Large holes may be rapidly cut by a tube-shaped steel tool cut like a file on the angular surface, or with fine teeth, after the manner of a rose bit, great care being necessary, of course, to back up the glass fairly with lead plates or otherwise, to prevent breakage from unequal pressure. This tool does not require an extremely fast motion. Lubricated as before, neat jobs of boring and fitting glass may be made by these simple means. The whole secret is in good high steel worked low, tempered high, and wet with turpentine standing on camphor.

INVESTIGATIONS reported in the *Metallarbeiter*, and quoted in the *Builder*, have demonstrated the character of the appearances which are noticeable when a lead pipe has been for five years in a layer of Portland cement. A red coating was noticed $\frac{1}{32}$in. to $\frac{1}{16}$in. in thickness, the appearance of which corresponded with that of oxide of lead as it is usually delivered in commerce. This coating was carefully removed, and the particles of lead removed along with it were separated by means of a magnifying glass. The specific gravity of this powder—carefully defined at 59 deg. Fah. and reduced for a vacuum—varied between 8·002 and 9·670. This variation is explained by the presence of metallic lead mixed in the oxide of lead and of carbonate of lead. Qualitative analysis demonstrated that this powder contained oxide of lead, lead, carbonic acid, water, and traces of calcium. The composition of the powder was as follows:—Oxide of lead, 84·89; lead, 12·33; water, 0·99; carbonic acid, 1·53; lime, traces; insoluble in nitric acid, 0·16. This coating on the lead pipe appears to have been formed by the action of the oxygen in the air in union with that of the lime contained in the mortar. It is remarked that the action of lime-water on lead has also been noticed by Besnon.

AT a recent meeting of the Engineers' Club, of Philadelphia, Mr. Wilfred Lewis read a paper upon the "Resilience of Steel," reviewing some of the means employed for the storage of energy, and showing the place occupied by steel among them. Compressed air, hot water, and the secondary battery were cited, from Prof. Osborne Reynolds, as being about equal in value, and as giving out about 6500 foot-pounds of work per pound of material employed. Steel springs, according to the same writer were said to yield about 18 foot-pounds per pound. Several experiments were made by Mr. Lewis upon tempered specimens, both for tension and flexure. Contrary to expectation, the highest results were shown by the flexure of a small spiral clock spring weighing 2040 grains, which gave out, when wound up, about 45 foot-pounds of energy, or, in other words, 154 foot-pounds per pound. The transverse strength of this steel within the elastic limit was found to be about 300,000 lb. per square inch, and its modulus of elasticity about 30,000,000 lb. Such extraordinary strength, with such a low modulus, was so far beyond conjecture that it seemed to give a new hope for the success of the project referred to; but after making the necessary allowances for weight of car and efficiency of driving mechanism, it was found that not more than about 20 foot-pounds per pound of car would be available for locomotion. It was, therefore, improbable that such a car could ascend a hill over 20ft. high. It was also a matter of doubt whether large springs could be made to show results which would even approach these figures, and on this account the experiments about to be tried might be looked for with some interest.

## MISCELLANEA.

THE production of the Lake Superior copper mines for 1883 was sixty million pounds of copper.

AGRICULTURAL readers will be interested in the fact that the appointment by the Swedish Government of an entomologist to assist farmers has been found of so much value that it has been decided to continue it.

MESSRS. HAYWARD TYLER AND CO. have received at the Calcutta Exhibition, in addition to a gold medal for aërated water machines, medals and certificates for brasswork, and steam and ordinary pumps of all kinds made by the firm, thus taking in all one gold medal, three silver medals, and two bronze medals.

THE first enterprising Londoner who introduced conduit water to his premises was—the *Builder* says—a tradesman of Fleet-street. In a record of 1478 it is mentioned that "a wex-chandler in Fletestrete had by crafte perced a pipe of the condit withynne the ground, and so conveied the water into his selar; wherefore he was judged to ride through the citie with a condit uppon his hedde," and the City Crier was to walk before him proclaiming his offence.

IT is announced from the Imperial and Royal Austro-Hungarian Consulate-General that an international exhibition of motors and implements for the small industries will be opened at Vienna, on the 24th of July next, and will close at the latest by the 12th of October. Applications should be addressed not later than the 1st of April, 1884—"An den Niederoesterreichischen Gewerbeverein I. Eschenbachgasse 11, Wien, Austria," on forms obtainable at the Austrian Consulate.

THE Chinese have begun to adopt the Western chemical science, and a factory has recently been erected for the manufacture of sulphuric acid on a large scale. Two well-known chemical text-books, Malgutti's "Elementary Chemistry" and Fresenius's "Chemical Analysis," have also been translated into Chinese with the help of a great number of new characters, and adopted into the Imperial colleges. His Excellency, Tong Kin Sing, First Minister, and a director of the Tung Wen Huan, has taken the work under his immediate patronage, and written a preface for the first of these books.

AT the Calcutta International Exhibition, Messrs. Ransomes, Head, and Jefferies have been awarded a first-class certificate and gold medal for Ansell's patent tea sorting and winnowing machine. Messrs. Priestman Brothers have also been awarded a first certificate of merit, together with gold medal, for their dredgers. Messrs. Hunt and Mitton have been awarded a first-class certificate and silver medal for superiority of workmanship and design in engine and boiler fittings, hose couplings, and fire brigade fittings. Messrs. Griffiths, Berdoe, and Co., have been awarded a gold medal for their Griffith's patent white, Griffith's enamels, silicate distempers, and other similar exhibits.

ON Monday, March 15th, Messrs. James Bremner and Co., of Hull, launched from their yard the s.s. Cutch, a fast iron passenger steamer, built for the Eastern Pilgrim trade of Messrs. Jumahoy Laljee, of Bombay. The Cutch is in length 180ft.; breadth, 23ft.; depth of hold, 11ft. 6in.; net register, 199 tons. The engines, also built by Messrs. Bremner and Co., will be very powerful for the size of the vessel, having cylinders 25in. and 48in. by 36in. stroke. Steam will be supplied from a double-ended boiler, 15ft. 6in. long and 10ft. 8½in. diameter, and 100 lb. pressure, calculated to develope 600-indicated horse power. The vessel is guaranteed to obtain 14 knots mean speed on trial, and has been built under the superindence of Messrs. Flannery and Baggallay.

AS illustrating the value of the growing cotton mill industries abroad, it is noted that the Cologne Cotton Spinning and Weaving Company has recently declared a dividend of 9 per cent. for the past financial year, against 7 per cent. for 1882 and 6 per cent. for 1881. The gross profits for last year amounted to £20,182, from which a sum of £4962 has been written off to the depreciation and suspense accounts, and £1523 has been added to the reserve fund. The Leipsic Worsted Yarn Spinning Company also declared a dividend of 14 per cent. for the past year, the production of the company having increased 10 per cent. during 1883 against 1882. The total amount of the profits was £25,909, against £24,599 in 1882. The margin of profit was therefore narrower last year on the increased production than in 1882.

ON the 1st inst. Messrs. Harland and Wolff launched from the Queen's Island the fourth steamer for the Ulster Steamship Company, forming an important addition to the Head Line. She is named the Horn Head, and the dimensions are:—Length, 320ft.; breadth, 37ft.; depth, 25ft.; gross tonnage, 2600. The engines have also been constructed by Messrs. Harland and Wolff. The cylinders are 34in. and 68in. diameter, with 45in. stroke, and 90 lb. working steam pressure, and about 250 nominal horse-power. The crank shaft is of Vickers' steel, and the propeller shaft and blades are also of steel. The pistons are fitted with MacLaine's patent rings and springs. The boilers are steel of large dimensions, hydraulic rivetted, and are fitted with Fox's corrugated furnaces, which have been tested to a pressure of 180 lb. to the square inch. The other vessels of the line are the White Head, the Teelin Head, the Black Head, and the Fair Head, together with the Bickley Head, and at present a sister ship to the Horn Head is being built by Messrs. A. and J. Inglis, of Glasgow.

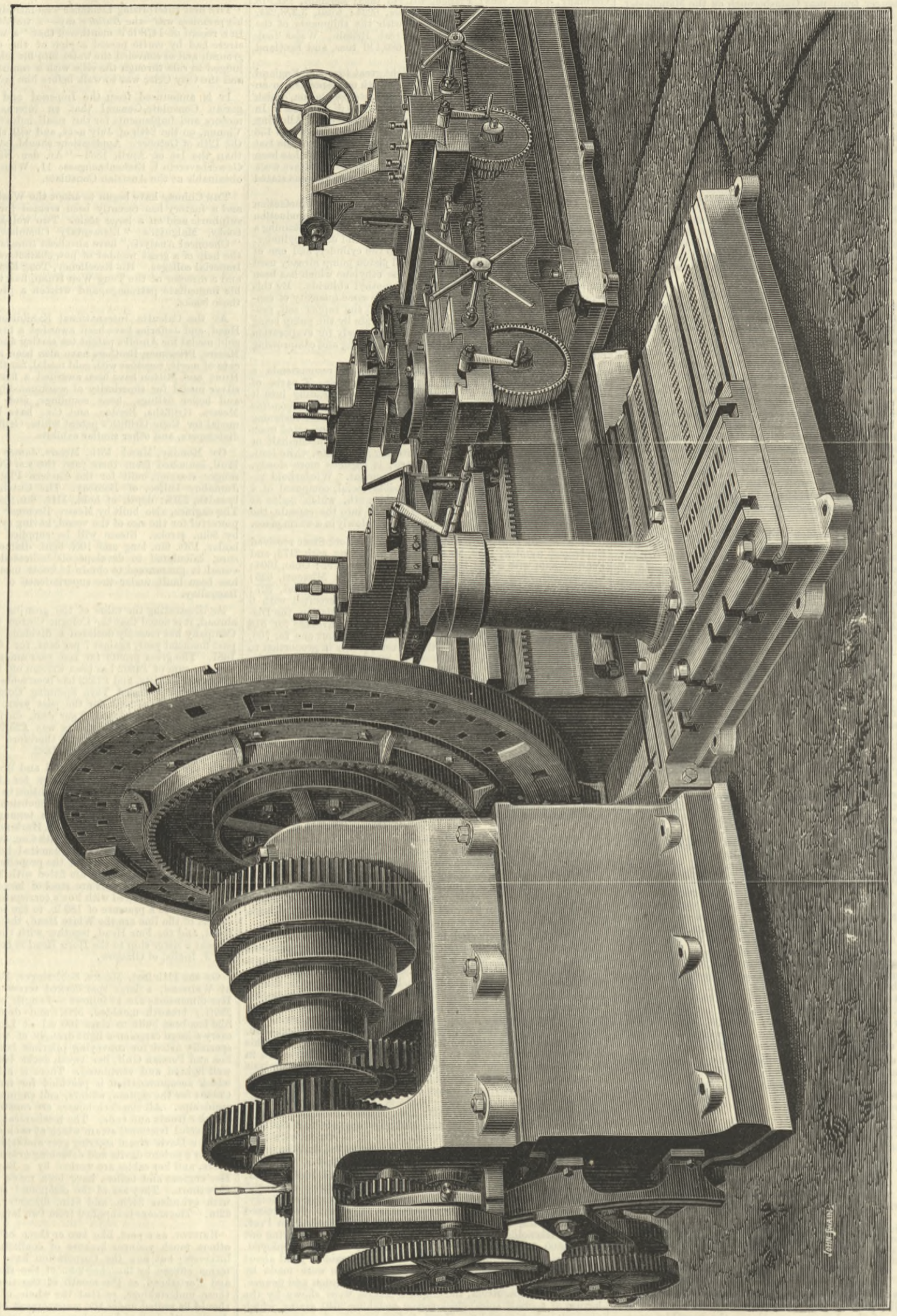
ON the 11th inst. Messrs. Schlesinger, Davis, and Co. launched, at Wallsend, a large spar-decked screw steamer named Obock. Her dimensions are as follows:—Length between perpendiculars, 290ft.; breadth moulded, 37ft.; and depth moulded, 28ft. 6in. She has been built to class 100 A1 at Lloyd's. The Obock will carry a large cargo on a light draught of water, and she has been specially fitted for conveying pilgrims between ports in the Red Sea and Persian Gulf, her 'tween decks being unusually lofty and well lighted and ventilated. There is a large deckhouse aft, in which accommodation is provided for ten first-class passengers. Cabins for the captain, officers, and engineers are in a deck-house amidships. All the deck-houses are constructed of iron, and have circular fronts and ends. The mechanical appliances on board are a powerful frictional steam winch at each of the four cargo hatchways, a Davis' steam steering gear amidships, and a screw gear aft. Broker's patent davits and detaching gear are fitted to some of the boats, and her cables are worked by a Baxter's vertical windlass. Her engines and boilers have been made by Messrs. R. and W. Hawthorn. They are of the compound surface condensing type, with cylinders 34½in. and 64in. diameter, and a piston stroke of 42in. The steam is supplied from two large steel boilers.

BRISTOL as a port, like two or three others, has lagged behind others much younger because of conflicting and clogging vested interests; but now the Corporation have resolved to accept the terms offered by the chairman of the rival docks at Avonmouth and Portishead, at the mouth of the river, for the purchase of those undertakings, so that the whole of the docks of the port should be united under the management of the Corporation. The Avonmouth dock and warehouses cost originally £780,000, and the price to be paid by the city is £550,000. The Portishead dock and warehouses, which cost between £370,000 and £380,000, are offered at £250,000, making a total purchase money of £800,000. At a meeting of the Council, the Mayor, who had carried out the negotiations, said the interest on the amount that would have to be paid by the city for the two undertakings would be £23,550 per annum; but with £18,000 receipts from the two docks and warehouses, the loss would only be £5500 per annum, and certain re-adjustments of rates, without exercising any deterrent effect upon trade, would reduce this to £800 or £900 a year. But they would have to create a sinking fund, which would cost, perhaps, £2500 per annum. The Council unanimously resolved to promote a Bill at present in Parliament for the purchase of the two undertakings.

## TREBLE-GEARED GAP LATHE

MR. W. ASQUITH, HALIFAX, ENGINEER.

(For description see page 227.



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Y. M. (Wilmington).—*There is no better treatise on Glasgow Harbour Works than that by Mr. James Deas, the engineer of the works.*

C. H.—*We cannot tell what is the power lost in a thrust block, nor can any one else, because it is impossible to measure it distinct from other resistances, but the efficiency of the whole propelling apparatus, that is to say, of engine and screw, seldom rises above 50 per cent. That is to say, when an engine indicates* 1000-*horse power, about* 500-*horse power are expended in driving the ship; the remainder is wasted in various ways.*

### FOX'S METAL.

(*To the Editor of The Engineer.*)

SIR,—Can any reader kindly inform us who are the makers of Fox's patent metal for fixing bolts in stone? WM. R. AND CO.
London, March 18th.

### RIVET-MAKING MACHINES.

(*To the Editor of the Engineer.*)

SIR,—I shall be obliged to any readers who will give me the names and addresses of makers of small rivet making and rivetting machines, for rivets up to half-inch diameter, to be worked by belts. M. C.
Manchester, March 18th.

### HYDRAULIC CUP LEATHERS.

(*To the Editor of The Engineer.*)

SIR,—Would any reader kindly give me the best information at his disposal in regard to the making of hydraulic cup leathers for an hydraulic plant? The thickness of leather will be about $\frac{3}{8}$in. and 9in. diameter, and 3in. to 3$\frac{1}{2}$in. deep when finished. W. H. G.
W.-Hampton, March 18th.

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## MEETINGS NEXT WEEK.

THE INSTITUTION OF CIVIL ENGINEERS.—Tuesday, March 25th, at 8 p.m.: Ordinary meeting. Paper to be discussed, "Wire-gun Construction," by Mr. Jas. A. Longridge, M. Inst. C.E.

SOCIETY OF TELEGRAPH ENGINEERS AND ELECTRICIANS.—Thursday, March 27th, the following papers will be read:—"On the Proportion which Ought to Subsist between the Size of Conductors and the Strength of Currents," by Professor George Forbes, F.R.S.E., Member. "On the Relation which should Subsist between a Current of Electricity and the Conductor Employed to Convey it," by Thos. H. Blakesley, M.A., Assoc. M. Inst. C.E.

SOCIETY OF ARTS.—Monday, March 24th, at 8 p.m.: Cantor Lectures, "The Alloys Used for Coinage," by Professor W. Chandler Roberts. F.R.S., Chemist to the Royal Mint. Lecture II. Gradual development of the processes of coining. The compositions and "standards of fineness" of the alloys used for coinage in ancient and modern times. Wednesday, March 26th, at 8 p.m.: Sixteenth ordinary meeting. "Vital Steps in Sanitary Progress," by Mr. B. W. Richardson, M.D., F.R.S. Sir Robert Rawlinson, C.B., will preside. Friday, March 28th, at 8 p.m.: Indian section. "Trade Routes in Afghanistan," by Mr. Griffin W. Vyse. Lord Aberdare, F.R.S, will preside.

## DEATH.

On the 15th inst, at Glen Caladh, Kyles of Bute, in her 63rd year, JANE, the beloved wife of GEORGE ROBT. STEPHENSON, C.E., of Glen Caladh, and Albemarle Lodge, Wimbledon Park, Surrey. Friends will kindly accept this intimation.

# THE ENGINEER.

*MARCH* 21, 1884.

### THE BREAKAGE OF SCREW SHAFTS.

NOTWITHSTANDING the adoption of steel as a material for screw and crank shafts, both break as frequently as in the days when iron alone was used. It will be urged that the powers transmitted are much greater now than they used to be—so much greater, indeed, that iron could not have dealt with them. Ten thousand horse-power, transmitted at the rate of 65 revolutions per minute, represents a tremendous strain; and it may, perhaps, be taken for granted that an iron shaft could not be made which would bear it. The fact remains, however, that ship after ship is disabled, and that all the resources of the steel maker and the engineer appear to be exerted in vain to avoid the recurrence of very dangerous casualties. The whole subject has been discussed and re-discussed, but the discussion has borne no fruit. Are we to assume that nothing can be done, and that we are as powerless to prevent the screw shaft of a great Atlantic liner from breaking as we are to avert a summer thunderstorm? We hope not; but it appears to be certain that so long as we continue to combat, by sheer brute strength, the forces tending to fracture a shaft so long will we be beaten. That which cannot be overcome must be eluded. How to elude it is the question. A correspondent calls attention to the fact that no information is available as to the manner in which a shaft gives way. The world learns through the daily press that such and such a large steamer has broken her shaft; but it is usually impossible to obtain any particulars concerning the precise locality of the fracture, its exact nature, or the presumed cause. There are reasons for this reticence, but they have too much force attached to them. The makers of the defective shaft do not like its failure to be talked about. The engineers of the ship see no advantage in publishing the precise details of a disaster for which they may be held responsible, and so silence is observed all round. But unfortunately the breakage of shafts in steamships is now a thing of almost daily occurrence, and it has ceased to be a matter concerning which anyone need feel shame. If only all the facts were made public causes might be suggested and devices might be hit on to avoid such casualties in future. At all events, whether this is so or not, nothing can be gained by silence.

It has been shown almost conclusively that shafts are broken because the bearings are not in line. The result is that at every revolution the shaft is bent twice through a small angle. Ultimately it becomes fatigued. Its molecular arrangement is disorganised; and finally it gives way. A screw shaft a little out of line will undergo about 1,500,000 bendings on a single voyage across the Atlantic. In the course of a year, allowing that the steamer makes but six voyages each way, we shall find that the shaft will be bent not fewer than 18,000,000 of times. Is it remarkable that it should give way? We think not. The only thing remarkable is that shafts should be found which last for many years. The degree of bending to which the shaft is subjected varies continually as the ship strains in a seaway, and as the bearings wear more or less. The obvious way out of the difficulty is to prevent the shaft from bending. The question is, How is this to be effected? Let us suppose that we have a screw shaft 80ft. long, between the stern tube in-board end and the crank shaft. We shall assume that there are in the tunnel four bearings, which gives five lengths of shafting, each 16ft. long. Now if these bearings are so disposed that every alternate length of shafting has two bearings, one at each end, while the remaining lengths have no bearings, being carried by the pins in the coupling cheeses, then it is certain that, provided the couplings are not set up dead tight, no bending due to the straining of the ship, or want of level in the bearings, can affect the shaft; and, furthermore, the shaft being in comparatively short lengths, these will not be much bent by their own weight. Of course, if the couplings are set up tight, the existing evil will be perpetuated. Arrived thus far, it is easy to see that the next step must be to devise a coupling which shall be flexible. It is by no means easy, however, to do this, and yet prevent back lash and secure sufficient strength within the circumscribed limits of a screw-shaft tunnel; but it seems that in this way, and in this way only, can the fracture of shafts be prevented. One great obstacle standing in the way is that the coupling must be of such a nature that the engine can be reversed without dragging it open. A simple clutch arrangement might be made to answer every purpose were it not for this. Again, the strains are exceedingly variable, depending, as they do, on the crank moments, the piston pressures, and the *vis viva* of the masses put in motion. We have, too, to provide for racing. It is easy to see that the couplings must be sorely tried; but we do not for a moment believe that the difficulty is insurmountable. Thus in the French navy an ordinary universal joint has been employed for many years to couple the crank and screw shaft, and we think we may say with the best results. In the Winans' cigar ship—still lying off Southampton—there are three engines of the steeple type driving the crank shaft, and this shaft is made up in three lengths, united to each other by a very simple and ingenious yielding coupling. Mr. Brotherhood, of Lambeth, has recently patented an extremely ingenious flexible coupling, which he applies between the crank shaft of his three-cylinder engine and that of the dynamo which it drives. To one of the shafts is secured a species of cup, with its concavity turned towards the next shaft. Over the mouth of the cup is stretched a disc of leather. To the centre of this disc is secured the shaft to be driven by a suitable circular clamp. It will be seen that we have here a perfectly flexible coupling of the most beautiful type. The leather coupling has been used with perfect success to transmit as much as 100 indicated horse-power. Is it not possible that something of the same kind might be adopted at sea, flexible discs of steel being substituted for the leather suitable for smaller powers? The discs might be corrugated, and two or even more put to work in each coupling. The thrust would still be transmitted by slightly rounding the ends of the shafts, and letting them abut on each other after passing through the disc or discs. We throw out the suggestion; others may, if they think it worth while, work out details.

In the absence of flexibility other than that provided by the springing of the shaft itself, we shall continue to have breakages. We suggest here an expedient which we suggested years ago, intended to minimise the results of fractures. The idea is borrowed from rolling mill practice. In order to save the rolls and gearing from the effect of undue strains, what is known as a "breaking spindle" is always put between the driving wheel and the roll trains. It is simply a short length of shafting of smaller section than the rolls or roll necks. If something must give way, it will be the weak breaking spindle, which, being of cast iron, can be replaced, for a few shillings, and with not more than a few minutes' delay. Why should not screw shafts have one short length in each with a strength of, say, 75 per cent. of the rest of the shaft? Two or three spare lengths might be carried. If the shaft breaks at all it will be here, and the broken bit can be taken out and replaced by another in a couple of hours. We have heard it objected that to put in a weak length is to court destruction; but nothing can be more fallacious in the way of argument. Let us suppose that a screw steamer has a propeller shaft 11in. in diameter now, and that it breaks. Let it be replaced by an 11$\frac{1}{2}$in. shaft, one short length of 11in. being retained. It cannot be said that in this case the ship is worse off than before, while it is tolerably certain that it is the 11in. length which will fail next time the shaft gives way, and this can be replaced at once. A great deal of mystery is supposed to shroud the failure of marine engine shafts, but it is at all events clear that the existing state of affairs does not reflect any credit on modern engineers, and that improvements are imperatively demanded in the way in which such shafts are put to work. As for the material, that is now so excellent that we do not think there is much chance that it can be made better.

### ENGINEERS AND CONTRACTORS.

A PARAGRAPH in our Birmingham correspondent's letter of March 7th deserves some notice from us. We refer to his statement that civil engineers are now much more than heretofore insisting on the literal carrying out of their specifications. In a recent impression we touched upon this subject; but the relations between engineers and contractors are so unsatisfactory that it will bear further discussion. Contractors frequently complain of the difficulties they experience in getting value for work to be executed. Virtually the question of profit or loss on a contract depends upon the character of the engineer under whom the work has to be carried out. Sound workmanship can be done at a certain cost; but the amount of finish demanded has a great influence upon the expense involved. Many portions of a bridge or roof are unseen, and therefore do not require the same amount of finish as the visible portions. For example, the ends of ties may be simply left in the rough, and rivets need not be snapped up perfectly free from hammer marks. The rivetted work need not be cleaned over with a chisel to remove the fraising; and of sundry other portions, such as packing pieces, the same remark holds good. In like manner, the bolts and joints of ties in king and queen rods may be left black, instead of being machined all over. Details of finish are seldom defined in specifications, nor, indeed, could they well be; and things of this sort are therefore settled during the progress of the work. We ourselves have known instances where dissension has arisen between engineer and contractor during the execution of work, as to what was and was not a reasonable amount of finish. A point like this can only be arranged in either of two ways, namely, by the engineer referring the contractor to some similar piece of work already executed, and demanding in his specification that the new work shall be in all respects equal to it; or else by a personal interview in the first instance between the engineer and contractor, a shorthand writer being present to record all that is said on both sides, which notes being then read aloud to them should be signed by both parties, and kept as a record for future reference in case of dispute. Occasionally engineers of eminence do insert a finish clause; but it is greatly to be feared that they do not insist upon its observance. So far as engineers are concerned no improvement can take place in the relationship between contracting parties until engineers uniformly as a body take care to draw reasonable and practical specifications, and invariably insist on their exact fulfilment. If engineers complain that they experience difficulty in getting work done to please them, they have only themselves in some respects, or some of their brethren in the profession, to thank, because of the habit of relaxing apparently legitimate demands. When a contractor gets a relaxation in one clause, he not unnaturally regards it as a precedent, and expects to get relaxations in other clauses equally admitting of them; and finding in the course of his business that such concessions are granted in, it may be, nine cases, he not unreasonably anticipates that he may almost demand them as a right in the tenth. He sends in his tender at a price based on this assumption; but finds when the work is being executed that no concession will be allowed him, and in the case of poor firms the temptation becomes very great indeed to grant themselves these concessions. We can illustrate our remarks by a case which came under our own notice in a certain bridge contract. The rivets were specified to be made of iron of the very best quality, but when the rivets were tested they were found far below the standard, and the contractor being asked why this was so, after a little pressing, said that the rivets were made of good ordinary rivet iron; and when censured for not adhering to the specification, replied he knew what was in the specification, but that engineers specified for certain things, but they never insisted upon their literal fulfilment. If this was generally true it would denote the existence of a great evil; and we are glad to think that a sounder and more dignified practice is at last beginning to prevail among engineers.

As regards finished workmanship, it may be pointed out that engineers are not unanimous. We ourselves have known cases where very honourable and upright contractors would never have tendered had they anticipated that extreme excellence of workmanship and finish would have

been demanded; or, if they had tendered, their price would have been proportionately high. But contractors, as we remarked in a former article, in many cases of bad bargains have only their own negligence to thank if they do not attentively study all the stipulations of a contract on which they propose to tender. We can give an instance of this in our own experience. An iron company while constructing a bridge disputed certain instructions given by the resident engineer. The managing director was told by him that he could not contest the matter, inasmuch as under the specification, in the event of any dispute arising during the progress of the work, the decision of the engineer was final and could not be appealed against; thereupon the managing director denied that the specification contained any such clause. On referring to it, however, the clause was found; when he replied that he had not seen it before; that had he done so "he would not have signed the contract."

Another point which is a fruitful source of discussion is the question of extras. We are of opinion that if specifications are properly drawn up first, there ought to be scarcely any extras whatever; because the introduction of any alterations in any piece of work, not the first of its kind, indicates an infirmity of purpose on the part of either the engineer or his client. In fact, it might be said of a contract, in the execution of which a great many extras were introduced, that the man for whom the work was being done did not know what he wanted; and by nothing is the ability of an engineer more conspicuously displayed than by the absence of extras. One reason why extras are so constantly a source of disagreement is the difficulty of estimating their real cost. They stand in this respect on a different footing from that of the main work. Many engineers when compelled by the instructions of their clients to introduce extras, know by their own practical acquaintance with work what such extras should cost; and the proportion of such engineers in the profession thus well-informed is, we are happy to think, increasing every year, mere theory being no longer allowed to exclude thorough practical training; but it is not so in all cases, and very heavy lawsuits have been entailed, the whole point in dispute being not so much what was and was not an extra, as the price to be paid for it. As an example of what we mean about the trouble and expense involved in extras, we may refer to such a point as that wherein an engineer may decide that certain additional pieces of iron are to be introduced, or certain pieces of different sections, into a bridge during its progress; it may be a matter of only a few tons, or, possibly, only a few hundredweights of iron. Now this may appear simple to the inexperienced; but all who are conversant with such matters know very well that it is much easier to obtain 200 or 300 tons of iron of a given section than five or six. Ironmasters seldom keep just the iron wanted in stock; and, besides this, a contractor for a piece of work usually obtains his iron under a sub-contract with a particular mill, and did he go elsewhere he would, of course, have to pay a much higher price for a small quantity, especially if he wanted it in a hurry; and the delays and hindrances to the general progress of the work, and the prolonged exposure of his plant to storm and flood, standing idle while waiting for the extra, altogether involve expense far in excess of what is apparent to a superficial observer. Another source of expense which attends on the introduction of extras is that they can seldom or never be introduced without entailing alterations—and often considerable alterations—in other parts of the work. Every competent draughtsman is well aware of this, as he knows by experience that when his chief or manager makes an alteration in a design, such an alteration necessitates an extensive re-arrangement of other parts in order to make everything fit. A contractor, on the other hand, during the progress of a piece of work will suggest the omission of certain items as being unnecessary, but fails to see the justice of any deduction being made from his money if the things are omitted. Contractors who act thus are unreasonable, because if they have just claim to payment for extras, they cannot fairly claim payment for work they have not performed.

Some engineers unnecessarily add to the difficulties of contractors by insisting on materials being obtained from particular sources, and upon the work being performed by a certain method. In respect to the first point, they restrict the contractor's power of getting materials in the cheapest market; and in the second place obstruct him in executing the work. All that an engineer requires are results. So long, therefore, as the materials are of the requisite quality it need matter nothing to him where they are obtained; and so long as the workmanship is sufficiently good, that ought to suffice for him. Another point of grievance with contractors is the incapacity displayed on different occasions by inspectors employed by engineers to superintend the execution of work. Contractors complain that they have had mere apprentices sent to their yard as supervisors of work; men possessing no experience of matters involved in the exercise of duties generally of great delicacy, and having no knowledge of men. Such inspectors, we have been informed, occasionally make demands and ask questions only deserving the ridicule which they receive. A dispute is easily raised by such men, and the matter has to be referred to the high contracting parties, and much exacerbation of temper ensues. Engineers therefore cannot be too careful in selecting their inspectors. As a rule, inspectors are not sufficiently paid, and consequently the best men are not obtained. In some instances men are employed at this work who are not altogether above a bribe, though we believe that cases where they are offered or received are few and far between.

An impression seems to prevail that contractors when dealing with corporate bodies are more hardly dealt with than when doing business with individual engineers, it being argued that corporations, usually having men in trade on their committees, such members must be pleased as well as the engineer. This is a fallacy. As a rule, traders and contractors have a sympathy amongst themselves as against outsiders; and knowing what they have to do in their own business, have a fellow feeling for their contractors' difficulties. Another erroneous impression is that it is useless for a contractor to assert his rights in a law court against a corporation. This fallacy has been repeatedly proved. We know an instance ourselves in connection with a contract, in which the engineer to a corporation refused to pass certain work, and, after a great deal of wrangling, the contractor sent a legal notice to the council, which at once took fright, backed out of the affair, overruling their engineer, and compelling him to compromise the matter. In fact, private traders have no reason to complain of the results of litigation with corporations. A remarkable example of this took place a couple of years ago in a large provincial city between a firm of carpet dealers and the corporation about the bursting of a sewer. This was a case where carpets were warehoused in a cellar close to a large sewer. The owners of the warehouse had excavated the cellar to such a depth that they very materially weakened the sewer, by removing a portion of its arch—giving no notice to the corporation officials; and not only this, but they also introduced certain obstructions into the sewer itself, in connection with business purposes of their own. A flood came soon after and burst the sewer. The water got into the cellar, and damaged the carpets stored there to the extent of some hundreds of pounds. The owners sued the corporation for the damage done. The corporation pleaded in defence that the plaintiffs suffered this damage in consequence of their own interference with the sewer, as above described. Nevertheless, judgment was given against the corporation, it being held that they were bound to satisfy themselves at all times that their sewers were in an efficient state. Instances such as these serve to show that contractors are by no means at the mercy of corporations to the extent that is sometimes supposed.

The principle of accepting the lowest tender should be exercised with more judgment than is usually bestowed on it, because it does not suffice merely to accept a tender. Inquiry, in the first place, should be made, and a personal visit paid to the works of any strange firm, in order that the engineer may satisfy himself that the firm tendering has the appliances and plant necessary to the proper fulfilment of the contract. Small but respectable firms often feel tempted to seek after jobs so much beyond their own powers of execution that they are compelled—if they get them—to sublet portions of them; and no system can be more pernicious or defective than this, the greatest evil being the subdivision of responsibility created. It is to be hoped that the new order of things, as indicated by our correspondent, will extend to the whole profession, and that an amicable execution of contracts will become universal.

### THE SUNDERLAND ENGINEERS' STRIKE.

It seems probable that an attempt will be made to bring to an end the strike of the Sunderland engineers. It is stated that the employers in the North believe that the time has come for a general reduction of the rate of wages, and in the attempt that is being made to amicably affect this there is the opportunity for some efforts to bring the long strike of the engineers on the Wear to a close. It is, of course, well known that the employers long ago obtained a large number of workmen, and that the bulk of these are still at work, whilst it is as well known that there has been a considerable decline in the amount of work in the hands of the employers, so that the latter are now practically masters of the situation. The strike began in June, the men making demands in regard to the rate of wages, the number of apprentices, and one or two allied questions, and it has been maintained ever since. It is clear now that, instead of receiving any advance in wages, the workmen must expect, in the present state of trade, to suffer a reduction, and it is probable that the apprentice question will be settled, because the lesser earnings of the men and the worse prospect of the trade will decrease the number, so that the two grave points in the causes of the strike have settled themselves. It seems therefore the time, if the wages' question of the employers in the North is to be revised, that there should be a conclusion to a strike that has hurt the employers, the men, and the general trade of the Wear, and that is still exercising a baneful influence, even though most of the employers have their shops fairly filled.

## LITERATURE.

*The Gaillet and Huet Process for Softening and Purifying Water.* Andrew Howatson, C.E., 11, Queen Victoria-street, London. Extract from the work *Etude sur les Eaux Industrielles et leur Epuration*, by Gaillet and Huet. London: T. Pettit and Co., Soho-square. 1884.

The above is the title on the wrapper of this pamphlet; but on the first page we have a fresh heading: "The Purification of Water." In fact, according to the Index we have three chapters headed respectively: "The Inconveniences of Impurities in Water;" "Chief Means that are Adopted for Remedying the Inconveniences of Impurities in Water;" and "Chemical Purification, Gaillet and Huet's Process."

In the opening chapter the authors deal with the principal impurities which are met with in water, and they are classified as follows: Carbonate of lime, sulphate of lime, chloride of calcium, carbonate of magnesia, sulphate of manganese, salts of potash and soda, alumina and iron, silicic acid and silicates, and organic matter. Then they treat of steam boilers, and the fluids employed to prevent their loss of heat and danger of explosion; the washing of wool; bleaching; the manufacture of sugar; distilleries, and similar industries; tanning, leather dressing, and dye works. In the second chapter, which deals with the chief means that are adopted for remedying the inconveniences of impurities in water, we have much elementary advice that is to be found in many books devoted to the subject of the purification of water; and we then proceed to the chemical purification, which is, in fact, the important part of the pamphlet.

The chemical purification and the preparation of the reagent, which is a mixture of solution of caustic lime and caustic soda, is now considered. It should be mentioned here that the use of milk of lime is imperfect and often even dangerous. In fact, the quantity of lime to be added to a given water to purify it should be exactly determined. When too little is used the purification is imperfect, an excess of lime is even more objectionable. The caustic soda is then mixed with it, and it is converted into carbonate of soda when it is added to the water to be purified, and this carbonate of soda then reacts upon the sulphates and chlorides of calcium and magnesia. After this treatment, all that remains in the purified water is sulphate of soda and chloride of calcium—harmless products, which in no case can do any mischief, either in the feeding of steam boilers or in any use to which the purified water can be put. There still remains the consideration of the elimination of organic matter. It is generally enough to add to the water during the purification process a small quantity of some salt of iron, or alumina. Such a salt yields through the action of the water a very voluminous precipitate of sesquioxide of iron or alumina, which falls down, easily catching up at the same time any organic matter present, and thus brings about a rapid clarification of the water. Certain precautions, rendered necessary by reason of the solubility of the hydrate of protoxide of iron in an alkaline solution, are referred to.

The proportion of the reagent requires special attention, because the apparatus, contrived for rendering the water clear, is automatic and continuous. The tanks in which it is to be prepared should either be large enough to contain such a quantity of the reagent as will suffice for the work of a considerable time—for twelve hours, for example; or, on the other hand, an automatic apparatus may be employed which prepares the reagent continuously as it is wanted, and only requires to be charged with the constituent materials at wide intervals of time—as every twelve hours, for example.

The translation from the French is queerly rendered in some places:—"In such installations," "these last cocks," and other expressions that are quite difficult to understand. For instance, "The decantation of water holding an access of lime in solution is very easy and rapid." Here, doubtless, "access" stands for "excess," but even in that case the excess of lime is not in solution, but in suspension—a state of things directly in contrast to solution.

The mode of removing the precipitated lime carbonate and all the other insoluble salts is by passing the water up and down over inclined iron plates arranged in a low tower, and the insoluble bodies are said to deposit at the bottom of the inclination, and are so easily separated. But there are many questions which suggest themselves: At what rate is the precipitate deposited in certain cases? What influence has temperature on the rate of its deposition? We should like to know somewhat on these all-weighty points; but not a word on this subject is vouchsafed to us. The precipitation takes place *in the cold*, which greatly retards the settling down of insoluble products.

*The Principles of Mechanics.* By T. M. Goodeve, M.A. New edition. Re-written and enlarged. London: Longmans and Co. 1883.

This book was good in its first edition, but it has been much improved, both in arrangement and in the exactness with which the principles involved are dealt with, and in the numerical examples which are given of the application of mechanical principles in practice. One is almost inclined to agree with Sir W. Thomson in his addition of a sense of force to the usual five senses, for a proper comprehension of uniform and variable forces and their measure, requires a sense which is distinct from touch, although, as Mr. Goodeve remarks, our ideas of matter and force exist together. A mode of measuring force, whatever the ideas as to its nature, is an essential in mechanics, and hence this and the reasons which have led to two different methods of measuring or expressing force, *i.e.*, in gravitation units and absolute units. We must not, however, follow our author in this subject, or in his treatment of the laws of motion, energy, inertia, and so on, but must notice that in exemplification of these he very properly refers, as examples, to practical applications of these laws. This is particularly noticeable throughout this book, and must appeal to the student in such a way as to make his comprehension of the laws much more easy, at the same time that a concrete example is conveyed. The properties of fluids and laws relating to their movements are dealt with in the same happy way, and the style of treatment of every subject in the book renders it interesting, so that the reader does not wish to put it down as though a piece of work taken up only perforce. In the graphic solution of problems in framework, the author very briefly explains the use of reciprocal figures, the origin of which he attributes to Prof. Culmann, of Zurich, and deals with the principle of the arch; but here he does not enter sufficiently fully into the demonstration of the residence of the resultant pressures. The book concludes with some apt illustrations of the application of the mechanical principles explained, including the centrifugal pump, injector, dynamometer, and Watt, chronometric, and loaded high-speed governors.

It is unnecessary for us to do more than call attention to this new edition of a well-accepted book—one which has every claim to a place amongst the works a student must have; but in another edition the absence of an index will not be excusable.

*The Science of Building. An Elementary Treatise on the Principles of Construction, especially adapted to the requirements of Architectural Students.* By E. Wyndham Tarn, M.A. Second edition, revised and enlarged. London: Crosby Lockwood and Co. 1884.

The first chapter of this book is on mechanical principles, chiefly as related to stresses in beams. The second, a short one, is on retaining walls; the third is on arches, cupolas, and spires. Here the graphic method with reciprocal figures has been introduced, and examples of the use of the formulæ are given for finding the stability of arches and abutments or piers for semicircular, segmental, and Gothic arches. Iron domes are cut off with about a page of generalities. The fourth chapter is on building

stones, and the fifth on timber and the strength of beams and pillars, roof timbers, and centreing. Chapter VI. is on iron, and here space is wasted in descriptions of how cast iron, wrought iron, and steel are made, and in what they differ—descriptions too incomplete to be of any use to anyone needing metallurgical knowledge, and not required by those for whom the book is written. What is said on steel is especially useless from a building point of view. The method of treating the stresses in girders and beams is not that calculated to encourage young architects. They want to be shown how to arrive at the stresses in iron beams and girders, and then how to apportion the sectional areas, not only as regards a mere black board diagram girder, but a real one made up with plates and rivets. In Chapter VII., on "Fluids at Rest and in Motion," the pressure of water in tanks and reservoirs is dealt with, and amongst other things the author wanders off to the method of finding the specific gravity of alloys. He does, however, get back to water in motion, and deals with friction of water in pipes by the aid of Weisbach and others. The part dealing with wind pressures needs modification, and the eighth chapter, which is on lightning conductors and the nature of lightning, is very poor and out of place. As a book on "The Science of Building," it is disappointing.

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*A Royal Road: Being a History of the London and South-Western Railway from* 1825 *to the Present Time* (1883). By SAM FAY. Kingston-on-Thames: W. Drewett. 139 pp.

THIS little book begins with a reference to the want experienced early in this century of communication between the South of England and London, and the proposal to construct the London and Spithead ship canal at a cost of £4,000,000; the failure of this proposal; the opening of the Stockton and Darlington Railway in 1825, and the issue on the 6th April, 1832, of the prospectus of the "Southampton, London, and Branch Railway and Dock Company," with a capital of £1,500,000 in shares of £25 each. The basis on which the hopes of the promoters were founded are set forth, and then the history of the successes, failures, difficulties, and victories of the South-Western Company, and the history reminds one very much of the histories of other railways. A good deal of information descriptive of features of the line, its branches, tunnels, and future extensions, is followed by a glance at the locomotive history of the line. We do not notice any special reference to the date of construction of the very old rolling stock still in use for conveying passengers on the South-Western line, so it is to be presumed that this was lost in the early days when the confusion of the first operations of opening the new line in 1839 made this seem a trivial matter. Since the year of opening the South-Western has always paid a dividend of over 4 per cent. per annum except in 1850, when it was but 3·5 per cent. In 1845 and 1846 it was 8 per cent.

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*Economy of Coal in House Fires; or How to Convert an Ordinary Fire-grate into a Slow Combustion Stove at a Small Cost.* By T. PRIDGIN TEALE, M.A. London: J. and A. Churchill. 1883. 47 pp.

IT is hardly necessary to give more than the title of this little book to enable our readers to know what it is about; but we may say that after some sensible and not wildly enthusiastic remarks about economy and waste of fuel in house fires, slow combustion, construction of the fireplace and economiser dampers, lighting "economised" fires, diminution of smoke, and so on, the economiser is described as consisting of a shutter to place in front of the space under the grate of any ordinary existing fireplaces, and a damper for closing more or less of the lower part of the front when a small fire is required. Slow combustion stoves with air chambers and baffle plates are also described.

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## *BOOKS RECEIVED.*

*The Practical Dictionary of Mechanics; a Description of Tools, Instruments, Machines, Processes, and Engineering; General Technological Vocabulary, and Digest of Mechanical Appliances in Science and the Arts.* By Edmund H. Knight. Vol. IV. Supplementary volume. London: Cassell and Company. 1884.

*Personal Reminiscences of General Skobeleff.* By V. J. Nemorovitch-Dantchenko. Translated from the Russian by E. A. Brayley Hodgetts. London: W. H. Allen and Co. 1884.

*A B C Paper Mill Guide for Great Britain and Europe.* 1884. London: W. John Stonhill, Ludgate-circus, E.C.

*Mediæval Military Architecture in England.* By G. T. Clark, London: Wyman and Sons. 1884. Two vols.

*The History of a Lump of Iron, from the Mine to the Magnet.* By A. Watt. London: A. Johnston. 1s.

*Moxon's Guide to the Use of Belting.* Upperthorpe, Sheffield: J. Moxon. 1884.

*Fortunes Made in Business; a Series of Original Sketches, Biographical and Anecdotic, from the Recent History and Industry and Commerce by various Writers.* London: Sampson Low, Marston, Searle, and Rivingtons. 1884.

*Die Stollenanlagen. Leitfaden fuer Bergleute and Tunnelbauer.* Von Geo. Haupt. Berlin: Julius Springer. 1884.

*Journal of the Society of Telegraph Engineers.* No. 50. London: E. and F. N. Spon. 1884.

## TENDERS.

### WILDERSPOOL.—ADDITIONS TO THE BREWERY.

MESSRS. DAVISON, INSKIPP, AND MACKENZIE, architects and consulting engineers, 62, Leadenhall-street, London. Quantities for No. 1 contract by Messrs. Curtis and Son.

CONTRACT No. 1.—BOILER AND ENGINE-HOUSE.

| | £ | s. | d. |
|---|---|---|---|
| J. Gibson, Warrington | 2659 | 0 | 0 |
| Neil and Son, Manchester | 2610 | 0 | 0 |
| W. Harrison, St. Helens | 2496 | 3 | 9 |
| Treasure and Son, Shrewsbury | 2455 | 0 | 0 |
| R. Beckett, Hartford—accepted | 2387 | 0 | 0 |

CONTRACT No. 2.—BOILERS.

| | | | |
|---|---|---|---|
| The Pearson and Knowles Company | 850 | 0 | 0 |
| Daglish and Co. | 800 | 0 | 0 |
| Galloway | 775 | 0 | 0 |
| W. Jones and Son | 745 | 0 | 0 |
| Thornewill and Warham | 730 | 0 | 0 |
| J. Watt and Co.—accepted | 695 | 0 | 0 |

CONTRACT No. 3.—ENGINES.

| | | | |
|---|---|---|---|
| Daglish and Co. | 1420 | 0 | 0 |
| J. Watt and Co. | 1395 | 0 | 0 |
| The Pearson and Knowles Company | 1256 | 0 | 0 |
| H. Woods | 992 | 6 | 0 |
| Thornewill and Warham—accepted | 930 | 0 | 0 |

## PRIVATE BILLS IN PARLIAMENT.

THE Select Committee of the House of Lords proceeded with the consideration of the Manchester Ship Canal Bill, as will be seen on page 217.

Group 5.—On Wednesday the Select Committee of the House of Commons met under the presidency of Mr. Bourke to consider a group of six Bills relating to the North-east district of England. Four Bills were placed on the list for the day. At the sitting of the Committee, however, it appeared that there was no business ready for consideration. The Corporation of Sunderland and Messrs. Bolckow, Vaughan, and Co. had withdrawn the petitions which they had presented against the North-Eastern Railway Bill. The promoters of the Halifax High-level and North and South Junction Railways Bill had concluded a satisfactory arrangement with W. H. E. Rhodes and Messrs. John Crossley and Sons, and the opposition to the Scarborough and East Riding Railway Bill disappeared with the withdrawal of the North-Eastern Company's petition. There was also no appearance on behalf of the petitioners against the Cleveland Extension Mineral Railway Bill. Under these circumstances the Committee adjourned till Monday next.

Group 9.—The Committee on this group, Admiral Egerton presiding, passed the Denbighshire and Shropshire Junction Railway Bill, of which the object is to incorporate a company for making a railway from the authorised Wrexham, Mold, and Connah's Quay Railway at Wrexham to the Cambrian Railway, near Wolverhampton. The Committee then proceeded to the consideration of the Manchester, Sheffield, and Lincolnshire Railway Bill. By this Bill the Sheffield Company is authorised to make a line from its railway at Chester to Connah's Quay, where a junction will be formed with the Wrexham, Mold, and Connah's Quay, over which running powers are taken. Mr. Littler, Q.C., on behalf of the promoters, put before the Committee the objects of the Bill. Connah's Quay, he said, was situated in a district with extensive mineral, brick, lime, and chemical works. Until 1861 the district was dependent for railway accommodation upon the London and North-Western Railway Company; but since that time the Connah's Quay Company had come into existence. The Bill was opposed by the London and North-Western Railway Company and by the Corporation of Chester, and others, on the ground of the interference with the navigation of the Dee by reason of the swing bridge which it is proposed by the promoters to place over the Dee at a point in the lower part of the river. Evidence was given by gentlemen representing the various collieries in the district, who spoke of the very great advantages which would result from the carrying out of the scheme. These witnesses were followed by representatives of the salt and chemical works, who also expressed their approval of the Bill.

Group 10.—The Committee in this group sat on Tuesday, the Right Hon. James Lowther in the chair. The four cases set down for their consideration were matters in dispute between the Great Western Railway Company on the one part and the Swindon and Cheltenham, Swindon, Marlborough, and Andover Companies on the other part. The Committee were informed, however, that the parties had settled the questions of difference between them, and in consequence the Swindon and Cheltenham Railway Bill, the Great Western Railway Bill, the Swindon and Cheltenham, and the Swindon, Andover and Marlborough Railway Bill, and the Swindon and Cheltenham Railway Bill would be unopposed, while the Swindon, Marlborough, and Andover Railway Bill would not be proceeded with.

Group 13.—The Hardcastle Committee resumed their consideration of the Barmill and Kilwinning Railway Bill, which provides for an extension of the company's system to Ardrossan Harbour, and changes the name of the company to "Lanarkshire and Ardrossan Direct Railway Company." The case for the promoters was further gone into, and Mr. Bolton, the chairman of the Caledonian Company, gave evidence in support of the Bill. He stated that although the Caledonian had originally had no connection with this company, it had now been arranged that the line should be worked by the larger company. He considered that the Lanarkshire coal would receive great benefits from the scheme. Mr. W. J. Wainwright, manager of the Glasgow and South-Western, and Mr. Henry Oakley, manager of the Great Northern, gave evidence in support of the allegations of the former company against the Bill. Eventually the Committee passed the Bill, with a condition that if the railways were carried out, certain improvements in Ardrossan Harbour should be executed by Lord Eglinton, the owner of the harbour. The Committee then took up the Caledonian Railway (No. 1) Bill and the Glasgow and South-Western Railway Bill, each of which proposes an extension from Greenock to the port of Garnock. The matter will be severely contested by the two companies, and it is thought probable that the case will last for a week.

## DEATH OF SIGNOR QUINTINO SELLA.

DURING the last few days the death of one of the most illustrious of the statesmen and scientific men of Italy has been recorded, and it is noticeable how his earlier fame has been eclipsed in the later, so that the daily papers hardly mention the fact of his being known for his scientific work. He was Professor of Geometry and Director of the Mineralogical Museum of the Royal Technical Institute of Turin, and was Member of the Academy of Sciences there. One of his first papers was on some of the forms of the red silvers, quartz, and calcite; on the crystalline forms of certain salts of platinum and adamantine boron; and on the forms of certain salts derived from ammonia. Most of them appeared in the *Nuovo Cimento*, and were occasionally reprinted in *Poggendorff's Annalen*. In 1864, during the later period he delivered the discourse at the opening Congress of Naturalists at Milan in September; then we have "An Ascent of Monte Viso," and "Geometrical Principles of Drawing, especially on Axonometry;" and in 1868, "Pyrites of Piedmont and Elba," and "The New Metals Castor and Pollux," evidently suggested by the caesium of Bunsen; and, in 1871, one on the Metallic Veins of Sardinia. He died last Friday at Biella, in Piedmont, close to the spot where he was born, at Mosso, near Biella, on July 7th, 1827. He was Minister of Finance in the Ratazzi Cabinet in 1862, in the Marmora Cabinet of 1864, and again in the Lanza Cabinet from 1869 to 1873. During this latter period he rendered two memorable services to Italy. By most unpopular but salutary fiscal measures he saved the State from bankruptcy, and after Sedan he forced on the Italian Government the occupation of Rome. During the last two years, although only 58 years of age, he had almost entirely withdrawn from active politics, devoting himself to the care of his woollen manufactories at Biella. Still he was regarded by all parties as one of the strongest, and he was one of the most highly-esteemed, of Italian statesmen, and any national emergency must have brought him again to the front. The King telegraphed to his widow expressing the warmest sympathy.

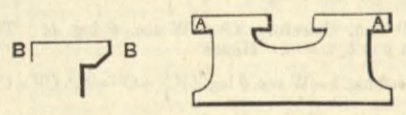
On Saturday last the Chamber of Deputies occupied its entire sitting in commemorating its lost colleague. Nearly every Minister and nearly all the leading members of the Chamber spoke in his praise. Perhaps the most remarkable speech was that of Signor Bonghi, who read extracts from a speech by Sella in 1870, predicting that decline of parliamentary life which we are witnessing. The Chamber will suspend its sittings for three days, and its members will go into mourning for fifteen days. The bust of Signor Sella will be placed in the Parliament House. The Chamber also, on the proposition of the Foreign Minister, determined to vote funds for a monument to him in Rome; but a somewhat acrid debate took place as to the locality for it. If it were to be placed in the Academy of Science all parties of the Chamber would agree; but if placed in front of the Ministry of Finance, as was agreed to by the House, thus honouring not merely the man of science, but the Statesman, the Left would oppose it. Having, however, been outvoted they left the House before the second voting which is necessary to complete the measure, so to prevent a legal quorum, and by this device they prevented the vote for the moment being taken. This manifestation of party rancour has much disgusted the public conscience. The interment of the deceased statesman took place on Saturday in the family burying-place at Oropa, near Biella. The obsequies were strictly private, but the procession of friends following the coffin was more than half a mile long. It is proposed to give the name Sella to the street in Rome now called Volturno. The House was adjourned until the 19th ult., and at the suggestion of the President of the Chamber of Deputies, a crown is to be placed on his tomb at the expense of the Chamber.

Il Commendatore Quintino Sella was elected a foreign member of the Geological Society of London in the year 1881, and about the same time was chosen a corresponding member of the Mineralogical Society.

Sellaite is the name given to an interesting mineral found in Italy some years ago; a singularly rare mineral, but one which one would look to have been found long ago. Strüver, in about 1872, published a paper in the *Atti della R. Accad.* di Torino, on a colourless transparent mineral occurring with anhydrite at Geibroula, in Piedmont, and crystallising in the quadritic system. Small fragments of the mineral melt in the flame of a candle; it is insoluble in water and acids, with the exception of sulphuric acid, which causes the evolution of hydrogen fluoride. The sulphuric acid solution contained 39·64 per cent. of magnesia, and the chemical and physical characters of the mineral led Strüver to consider it a magnesium fluoride analogous to fluorspar in composition. It has since been formed artificially by Cossa, of Turin.

## A LARGE LATHE.

ON page 224 we illustrate a very large lathe made by Mr. W. Asquith, High-road Well Works, Halifax. This is a 30in. centres treble-geared, self-acting, sliding, surfacing, and screw-cutting break lathe, which will turn an object 10ft. in diameter and 6ft. wide, in the break, and admit 41ft. between centres when the break is open 6ft. Finished weight, about 45 tons. The lathe is very powerful, steel gearing being largely used in its construction. It is calculated to execute the heaviest class of work that can be put to a general tool, and is arranged so that a traverse of four cuts for sliding, and six for surfacing, can be obtained from the back traverse shaft. The level or sliding bed is 40ft. in length, and arranged to move in or out 6ft. by hand or power. Upon the bed are two self-acting sliding, surfacing, and screw-cutting carriages, which can be used independently or simultaneously. The sliding and surfacing portions are driven by a back traverse shaft. The screw for screw cutting is the full length of the bed, placed inside, and supported by intermediate fixed bearings. Each carriage is arranged for screw cutting with a nut in two parts, which can be disengaged instantly.




The edges of the bed are made at right angles as at A A instead of the ordinary form B B, the die in carriages being adjustable in both directions, making the same very firm, moving with less friction, and putting less strain upon the bed.

The back end of the fast head is very strong and substantial for receiving thrust, and is arranged so that any size of change wheel can be geared up for coarse pitch screws. The reversing motion wheels are all steel, and of a lage size, and can be reversed instantly for either sliding or screw cutting in either direction. The standard is arranged to receive one of the compound slide rests for turning large diameters, and is arranged for self-acting feed by a ratchet lever. The standard is arranged to move transversely or longitudinally, and is always parallel with the object operated upon.

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BERLY'S UNIVERSAL ELECTRICAL DIRECTORY AND ADVERTISER.—The third edition of this Directory, published by W. Dawson and Sons, has now been published, and it is well got up, conveniently arranged for quick reference to home, American, and continental names and manufactures. The Directory is prefaced by a short account of the prominent work of the past year, and with formulæ and wire tables. Its completeness as a directory may, however, be questioned, when we find amongst the list of British electrical publications mention of some absurdly useless, while the most valuable of all these periodicals, such as the *Electrician*, are not mentioned. Names we should expect to see are not in it, and prominence is given to some for reasons which are not at all obvious. Advertisements are also intruded amongst the text.

THE TWIN-SCREW TUG-BOAT CLIVE.—The increasing size of the vessels frequenting the Hooghly has necessitated a revolution in the tug-boats used on the historical river on which Calcutta is situated, and the trial trip on the Clyde the other day of the new twin-screw tug-boat Clive built expressly for the Hooghly river, marks the commencement of a new departure. Externally the Clive has the appearance of a smart Government despatch-boat. She has two masts, two raking funnels, and as her length is 192ft., with a beam of 30ft., and a depth of hold of 14ft., her gross tonnage is 572 tons, and as she boasts a most symmetrical hull turned out in first-class Clyde-built fashion, she presents a very effective ship. Her engines were made by the well-known firm of Messrs. Rankin and Blackmore, of Greenock. They consist of two pairs compound surface condensing, with cylinders of 27in. and 52in. diameter, and a stroke of 33in. There are two large double-ended steel boilers, from which steam is supplied at a pressure of 80 lb. pressure, and capable of indicating 1450-horse power. On the measured mile, with a mean draught of 9ft., the engines made 82 revolutions. The Clive attained a speed of 15½ miles per hour. She has accommodation for 600 tons of coal, and her consumption, working at full speed, is only one ton per hour. A marked feature in the equipment the Clive is the powerful patent steam windlass and capstan supplied by Messrs. M'Onie, engineers, Greenock. Her builders are Messrs. R. Duncan and Company, of Port Glasgow, from designs furnished them by Mr. James Ash, of London; her owners are Messrs. Jas. Wylie and Company, of London and Calcutta.

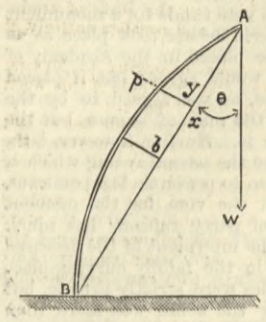
## LETTERS TO THE EDITOR.

[*Continued from page* 222.]

### INVESTIGATIONS OF A PARTICULAR CASE OF AN ARCHED RIB.

Sir,—I have thought the following investigation of a particular case of an arched rib might be of interest to your readers:—

Suppose we have a curved iron bar A B fixed at B, as in the diagram, and it is required to find an expression for the largest admissible force W acting endwise on the bar.




Let $\theta$ be the angle between chord A B and the line of action of W: Then resolving W along A B, we have W sec. $\theta$. The angular momentum round $\rho$ tending to bend the bar to the right is W sec. $\theta \times y$—the centre of the chord A B is taken for the origin of $x$. The angular momentum in the opposite direction is inversely as the radius or directly proportional to the radius of curvature $\rho$, and to a constant C, depending upon nature of material used and the unit of measurement employed, or to $\rho \times$ C.

Therefore it follows that W sec. $\theta \times y$ must equal—

$$\frac{\left[1+\left(\frac{d^2y}{dx^2}\right)\right]^{\frac{3}{2}}}{\frac{d^2y}{dx^2}} \times C,$$

using the well-known expression for the radius of curvature.

Put $p\,dy$ for $dx$ and $dp\,dy$ for $d^2y$, then this equation becomes

$$y \text{ W sec. } \theta = \frac{(1+p^2)^{\frac{3}{2}}}{dp}\,dy\,C,$$

or,

$$\frac{dy}{y \text{ W sec. } \theta} = C\,\frac{dp}{(1+p^2)^{\frac{3}{2}}}$$

Integrating with respect to $y$, we have—

$$\text{W sec. } \theta \log. y + C_{11} = C\frac{p}{(1+p^2)^{\frac{1}{2}}} \quad \ldots\ldots\ldots \quad (1)$$

$$\text{Therefore } p = \frac{\text{W sec. } \theta \log. y + C^1}{C\sqrt{\left\{1-(\text{W sec. } \theta \log. y + C^1)^2\right\}}}, \text{ and}$$

$$x = \int p\,dy + C^{11} = \frac{1}{C}\int \frac{(\text{W sec. } \theta \log. y + C^1)\,dy}{\sqrt{\left\{1-(\text{W sec. } \theta \log. y + C^1)^2\right\}}} + C^{11} \quad (2)$$

$$\text{Therefore, } x = -\frac{1}{C}\sqrt{\left\{1-(\text{W sec. } \theta \log. y + C^1)^2\right\}} + C^{11}.$$

To determine the values of the constants $C^1$ and $C^{11}$,

In equation (1), when $y = b$, $x = o$, $\therefore \frac{dy}{dx} = o$, $\therefore p = o$.

Hence we have—

$$\frac{\text{W sec. } \theta \log. b + C^1}{C\sqrt{\left\{1-(\text{W sec. } \theta \log. b + C^1)^2\right\}}} = o, \text{ or}$$

W sec. $\theta \log. b + C^1 = o$, therefore $C^1 = \text{W sec. } \theta \log. b$. To determine $C^{11}$, when $y = b$, $x = o$. Hence

$$-\frac{1}{C}\sqrt{\left\{1-(\text{W sec. } \theta \log. b - \text{W sec. } \theta \log. b)^2\right\}} + C^{11} = o. \therefore C^{11} = C.$$

The full value of equation (2) therefore is—

$$x = -\frac{1}{C}\sqrt{\left\{1-(\text{W sec. } \theta \log. y - \text{W sec. } \theta \log. b)^2 + C\right\}} \quad . \quad (3)$$

From which we obtain—

$$y = e^{\frac{-\sqrt{(C^2x^2 + C + 1)} + \text{W sec. } \theta \log. b}{\text{W sec. } \theta}} \quad \ldots\ldots \quad (4)$$

and—

$$\text{W} = \frac{\sqrt{(C^2x^2 + 1 + C^2)}}{\log. b - \log. y} \quad \ldots\ldots\ldots\ldots \quad (5)$$

This gives an expression for the limiting value of the weight which the curved bar can sustain without "buckling."*

It will be observed that we have neglected the weight of the bar in our investigation—W representing an external force applied. Should we desire to introduce this factor in our computation, we have only to deduct the weight from the result obtained above, and the remainder will be the permissible force for action on the top of the bar.

Charles H. Romanes.

London, Feb. 29th.

### THE BREAKAGE OF SCREW SHAFTS.

Sir,—The letters of your correspondents on propeller shafting encourages me to write to say that I think you would be performing an act of great public utility and interest if you would collect and publish accounts of fractures of propeller shafts.

We have read that quite recently two of the largest Atlantic liners have been disabled from steaming, and compelled to finish their voyages under sail, consequent on breaking their screw shafts, but no details of the nature and position of the fractures, or explanations of the reasons why it was impossible to repair them at sea, have yet been published. We may, however, infer that the fractures must have taken place either in the stern tube, or else in the crank shaft—both places almost impossible to repair, as a fracture in the intermediate portion of the shaft could easily be rectified by taking out the broken part, and replacing it with a spare length.

When I was crossing the Atlantic, about four years ago, in the Cunard s.s. Samaria, we picked up the disabled Danish steamer Thingvalla, and towed her, after a week, into Boston. She was incapacitated from steaming by the key of the propeller having fallen out, leaving the propeller loose on the shaft, and hammering the hull and rudder post alternately as the ship pitched. The captain seized the opportunity of the first calm day to remove a length of the shaft, thus letting the propeller fall to the bottom of the sea. His vessel then travelled much easier, and could take care of herself under sail if the sea had become rough and the towing hawser had parted.

Last April I read a paper before the Institution of Mechanical Engineers on the "Strength and Stability of Shafting," advocating, as your correspondents do, greater independence of the elasticities of the shaft and the hull, and recommending that this should be attained by the use of a smaller number of bearings for the intermediate part of the screw shafting. Whether this is practically feasible experience only can show, but recent events have proved the importance of considering the elastic yielding of screw shafts. In the discussion on the paper Professor Unwin mentioned that the plan proposed by your correspondent "Log Chip," of having intermediate couplings on universal joints, was formerly in use in the French navy, particularly with wood vessels, where the elastic yielding of the hull would be very much greater than in iron or steel vessels.

The discussion of the nature and causes of these recent breakdowns would be of so much interest and utility that the responsible engineers who can furnish the details would be performing an act of great public advantage in sending them to you for publication, and I venture to hope that you will prevail upon them to do so.

R.A. Institution, Woolwich, March 17th. A. G. Greenhill.

### FUEL AND WATER.

Sir,—May I be allowed to draw your readers' attention to a decimal point which, by a most unfortunate printer's error, has slipped into the formula quoted in your review for the thickness of boiler shells—"Fuel and Water," p. 136—and has only now been detected. The true form of this formula, of course, is $t = \frac{d\,p}{4480\,s}$ where $t$ and $d$ are thickness of plate and diameter of shell in inches, $p$ is the pressure in pounds per square inch, and $s$ the working stress in tons per square inch.

W. R. Browne.

9, Victoria-chambers, Westminster, March 17th.

## PROGRESS IN THE SIZE OF TELESCOPES.

Many years ago, Herschell gave a very great impulse to physical astronomy. His amazing manual dexterity, his activity, his patience, led to the great works which made of him one of the greatest minds that England ever possessed. Guinand and Fraunhofer led to the realisation of large objectives by the progress they instituted in the manufacture of optical glass, while a mechanism of clockwork compelled the glasses and telescopes to follow the diurnal movement of the stars. All modern instruments are mounted in this manner. The tendency is toward enlargement, so that telescopes have reached such a size that some possess mirrors of 1·20 m. in diameter—Paris and Melbourne—with refractors 0·65 m. aperture—Washington—of 0·75 m. and even 1 m. in diameter. Is this mania for enlargement justified? Arago, when he asked from the Chamber the credit necessary for the construction of an objective of 0·38 m., believed that, by raising the enlargement of the glasses to 6000 times, objects upon the moon 20 m. in length or 2 m. in width should be seen, the causeway of a railroad, fortifications, and monuments. The single difficulty in the way of realising this hope lies in the deficient luminosity of the images. Yet it is impossible to determine to what extent the increase of the optical power of a lens or a telescope is more than compensated by the increase of special aberration, the difficulty of manipulation, the instability, the deficiency of light.

To give a more exact conception of the fineness of details that are attained in a good instrument, we may recall that Schiaparelli, in his observations upon Mars, made at Milan with a lens of Merz, of 0·218m. aperture—Mars being distant 14 million leagues during the opposition of 1877—could distinguish a round spot 137 kilos. wide. From Mars an island such as Sicily, a lake of the size of Lake Ladoga or Tshad, could have been seen, a zone of 70 kilos. would have been visible, and Jutland, Cuba, or Panama would have been seen. The lens of Washington, of 0·65m., would show details but one-third the size, that is 44 kilos. to 24 kilos.; upon the moon the lowest dimensions would be 315m. in size, upon the sun 177 kilos., upon Venus 36 kilos., upon Jupiter 555 kilos. Experience proves that the most useful aperture is from 0·38m. to 0·40m. The following is a table of instruments of which the greatest diameter is 0·92m. The number of lenses whose diameter is greater than 0·245m. does not exceed 62.

| Observatory. | Aperture in centimetres. | Builder. |
|---|---|---|
| Lick, in Cal. .. .. .. .. | 91·5 | A. Clark and Son. |
| Pulkowa .. .. .. .. .. | 76·0 | A. Clark and Son. |
| Nice .. .. .. .. .. .. | 76·0 | Henry Bros., of Paris. |
| Paris .. .. .. .. .. .. | 73·5 | Martin, of Paris. |
| Vienna .. .. .. .. .. | 68·5 | Grubb, Dublin, 1881. |
| Washington .. .. .. .. | 66·0 | Clark, 1873. |
| McCormick, Chicago .. .. | 66·0 | Clark, 1879. |
| Newall, Gateshead .. .. .. | 63·5 | F. Cook & Son, York, 1868. |
| Princeton, New Jersey .. .. | 58·5 | Clark, 1881. |
| Strassburg .. .. .. .. | 48·5 | Merz, 1879. |
| Milan .. .. .. .. .. .. | 48·5 | Merz, 1881. |
| Dearborn, Chicago .. .. .. | 47·0 | Clark, 1863. |
| Van der Zee, Buffalo, N.Y. .. | 46·0 | Fitz. |
| Rochester .. .. .. .. .. | 40·5 | Clark, 1880. |
| Madison .. .. .. .. .. | 39·5 | Clark, 1879. |
| Lord Lindsay, Aberdeen .. | 39·5 | Grubb, 1875. |

—*Revue Scientifique.*

Street Improvement.—The widening of Gray's-inn-road, from Holborn Bars to Clerkenwell-road to 60ft. by the Metropolitan Board of Works, has been completed. The Holborn Board of Works has resolved to plant trees on each side of the thoroughfare.

Lighting Mines.—The Manchester Geological Society, which has become practically an association of mining engineers, held a meeting at Wigan on Friday last, and the whole proceedings were devoted to the discussion of questions affecting the lighting of mines and blasting operations in the getting of coal, upon which papers were read by Mr. H. Hall and Dr. C. Le Neve Foster, both of whom are Government inspectors of mines. Mr. Hall dealt chiefly with what it was probable the Royal Commission would report as to lighting and blasting in mines. The experience of the last four years had, he said, established beyond the possibility of contradiction that any unprotected gauze lamp was unsafe in an explosive atmosphere moving at even a moderate velocity. As it was altogether out of the question that the difficulty would be met by slowing the ventilating currents passing through the mines, they were compelled to fall back upon an improved lamp which ought to meet the following conditions:—That it must be self-extinguishing in an explosive mixture; that it must be impervious to draught; that if glass were used in the construction, it must be so arranged that the light would be extinguished before it could impinge on the glass when canted sideways, and that it must be strong and simple in construction. The lamp which, in his opinion, fulfilled these conditions the nearest was the Muesler; but it did not meet the last condition, and anyone who could simplify its construction would confer a great boon upon the mining community. With regard to blasting operations, there appeared to be a strong case for further restriction as to the use of gunpowder, and it was not improbable that the Commissioners would, whilst admitting that the use of explosives could not be dispensed with altogether, suggest that the adoption of the long wall system of working would in most seams render the use of explosives unnecessary for getting the coal itself; that blasting under its most favourable aspect was attended with substantial danger, but when the charge blew out, as it not unfrequently did, then there was imminent risk of a serious explosion if the mine were fiery, and that as far as possible blasting should be altogether dispensed with, but in no case should it proceed in mines subject to fire-damp while a large number of persons were underground. Dr. Foster, in his paper, gave a description of an arrangement introduced by Herr Wolff into his safety lamps for re-lighting them without removing the gauze. The apparatus for re-lighting closely resembles Shadwell's patent lighter for ordinary gas jets, and the lamp is re-lit by means of a flash from a detonating composition ignited by a hammer and spring operated from the outside of the lamp, which carries charges for re-lighting seventy-five times if required. The apparatus is, however, applicable only to lamps in which mineral volatile oils are used, and in the discussion it was questioned whether it might not prove a source of danger, as in the event of a lamp becoming injured so as to be unsafe, the miner would still have the means of re-lighting it.

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

(*From our own Correspondent.*)

Upon 'Change in Birmingham this—Thursday—afternoon, and in Wolverhampton yesterday, sheet manufacturers announced that they were stopping their mills rather than accept many of the orders offered them. This action does not arise from the associated project which was proposed, but is voluntary at individual works. If it should continue, as there seems every probability it will, there will be less necessity for pursuing the associated scheme.

Manufacturers are doing their best to keep up prices, and they are altogether wise. To follow the market to a profitless level can lead to no good result. If there were more firms who could afford to lie idle half of the week it would be decidedly to the benefit of trade. Prices of galvanising doubles are this week £7 12s. 6d., and lattens, £8 12s. 6d. Common export singles are to be had at £7.

Woodford sheets were quoted this afternoon at £9 for 20 B.G.; £10 10s. for 21 to 24 B.G.; £12 for 25 and 26 g.; and £12 10s. for 28 g. Woodford Crown, close annealed sheets, were £10 for 20 g.; £11 10s. for 21 to 24 g.; £13 for 25 and 26 g.; and £13 10s. for 28 g. Woodford best were £1 additional per ton, and double best a further 30s. extra per ton. Treble best were quoted £14 10s., £16, £17 10s., and £18 according to gauge. Woodford charcoal were named as £16, £17 10s., £19, and £19 10s. respectively. Mild steel close annealed sheets were £13 for 20 g., £14 10s. for 21 to 24 g., £16 for 25 and 26 g., and £16 10s. for 28 g.

The galvanisers are—some of them—pressing specifications for immediate execution upon sheet-makers. A few of them have in consequence as many orders as they can possibly get through in the next fortnight. It may, however, be that this influx of specifications is no more than a spurt. Galvanisers quote about £12 5s. for 24 b.g. delivered in Liverpool.

Plates are in slow sale, whether tank, girder, or boiler qualities. Tank sorts are quoted £7 10s., boiler descriptions £8 10s., and superior qualities £9 to £9 10s. The competition from other districts keeps severe. Particularly is this so as to girder and bridge sorts from the North of England.

A moderate call is expressed for bars, hoops, strips, and other merchant sections. Marked bars are £8 2s. 6d. to £7 10s.; medium quality, £6 15s. to £6 10s.; and common, £6 5s. to £6. Hoops are £6 10s. to £7, and gas strip £6 2s. 6d. to £6 5s.

Additional evidences of the progress of the steel industry hereabouts are steadily forthcoming. The old-established and celebrated Lilleshall Iron Company, Shropshire, has now completed its steelworks, upon the erection of which it has been engaged for some time past. All the necessary materials for the manufacture are now being bought, and it is expected that the converters will be blown in very shortly. When a start is actually made I shall have more to say about the new plant. I shall also by-and-bye give particulars concerning the plants which are being laid down in this district for the manufacture of steel upon the Clapp and Griffiths' patent. The best sheet firms are receiving the process with most favour, since the product is particularly adaptable for soft sheet rolling. The economy of the process is most conspicuous. The Staffordshire firms have been induced to adopt it in much part because of its success in South Wales; and the competition of the Welsh sheet firms with those of this district is steadily increasing.

Messrs. Nettlefold's, Birmingham, and Messrs. Hatton, Sons, and Co., Bilston, are two of the leading firms here who are entering upon the Clapp and Griffiths' method. At the latter works the new plant is in a very forward state, but a few weeks may pass before a start is made. The firm advise me that it is their intention to produce only soft metal of the highest quality, which will be rolled into sheets, plates, and other forms.

The notice which the ironmasters have just given for a reconsideration of the wages question will come before the Arbitration Board in two or three weeks' time. Before the Board meets it is hoped that the arbitrator in the North of England will have given his decision upon the reduction claimed by the masters there. That decision must necessarily largely regulate the result of the proceedings in this part of the kingdom.

The strike in the Shropshire wire drawing trade is still going on, but I hear that the masters are gradually getting in other hands to fill up the places of the strikers.

Pig iron does not show much revival this week. Still some vendors of Derbyshire sorts reported good sales, but low prices have to be accepted. Sellers of hematites here and there reported good contracts in prospect if principals will allow them to meet buyers half way in the matter of price. Northampton pigs were quoted 44s., Derbyshires 45s., and Lincolnshires 47s. For the Thorncliffe—South Yorkshire—brand 57s. 6d. is demanded, but without sales. Hematites are quoted 57s. 6d. to 58s. 6d.; native all-mines are 80s. for cold blast, and 60s. for hot blast; part-mines are 47s. 6d. to 45s., and cinder sorts 40s. to 38s. 6d.; North Staffordshire pottery mine is scarce and firm at 17s. 6d. to 18s. delivered. Northampton ironstone of good quality was to-day quoted 6s. per ton delivered, but new sales are restricted.

South Wales blast furnace coke is 15s. delivered into this district; Glamorgan foundry coke, 19s. to 20s., and Durham ditto, 19s. to 21s. Coal is difficult to get off at from 5s. up to 6s. 6d. for forge sorts, according to the locality where it is mined. Mill coal is 7s., and furnace coal 9s. to 10s.

Some wrought iron girder work is being inquired for by the Midland Railway Company, for erection on the northern division of its line, but the work is very small.

The annual report of the Chillington Iron Company, Wolverhampton, shows the large turn over of £354,213; but there has been a loss of £5449. The directors state that prices have ruled low in all departments. Finished iron has fallen 20s. per ton, while there has been only a slight fall in the price of pig iron and other raw materials. The directors propose to exercise the borrowing powers of the company in order to raise the sums necessary to repay the temporary loans included in the £87,117 credited in the balance sheet to "accounts due by the company." The loans have been borrowed to provide cash capital.

The Institute of Iron and Steel Works' Managers resumed at Dudley, on Monday, the discussion upon Mr. J. E. Stead's paper on "The Chemistry of Iron Purification."

The better cable news from New South Wales is encouraging. Increased strength in iron and hardware at Sydney is matter of much importance if it is maintained. The Cape demand for tools and hardwares does not improve, and manufacturers who had anticipated revived buying are disappointed. Some of the South American and Indian markets are ordering plantation tools and implements freely, but the profits resulting are very fine. For such orders competition was never more severe than now. The orders for picks, hammers, crowbars, spades, and other mining tools for South Africa, Australia, South America, Spain, and elsewhere, are happily rather more profitable. Horseshoes are in fair call from Australia and home. The agricultural implement trade is in some degree an improvement on March last year. Old accounts the farmers are discharging rather better.

The Council of the Birmingham Chamber of Commerce do not favourably regard the state of trade. In their annual report they state that they cannot congratulate the Chamber on the present position or prospects so far as the immediate future is concerned, though with regard to some, at least, of the important staple trades of the Midland district, the volume of business has been, and is still, important; but owing to home and foreign competition the resulting profits have no doubt been below the average. The Council is strongly of opinion that relief to the prevailing depression may be greatly aided by an equitable adjustment of the railway rates of the district, and of considerable concessions in the rates generally. This would not only conduce to the material prosperity of the commercial community, but would also be of ultimate advantage to the railway shareholders.

* See Sir G. B. Airy's Theory of Buckling (*Nature*, vol. xxvi. p. 600).

Mr. John Brotherton, of the Imperial Tube Works, Wolverhampton, has been awarded a first-class certificate and gold medal at the Calcutta Exhibition, for iron tubes and fittings for gas, water, and steam.

The employers in the Wolverhampton plate lock trade having mostly refused an advance of 10 per cent. in wages to their operatives, these have come out on strike. The strike, however, cannot last very long.

The spike-makers employed at Messrs. W. M. Warden's works at Handsworth have come out on strike against a reduction of 10 per cent. in wages. The men admit that trade is bad, but urge that the employers ought to have served a notice upon the Association, that they might take action upon the subject. The Nut and Bolt Makers' Association support the men, and are allowing them strike pay.

The Birmingham gunmakers, dissatisfied with the charges made by the Guardians of the Gun-barrel Proof House, have appointed a deputation to wait upon the Guardians to ask for a reduction of rates. They claim that the profit during the past few years has been about £34,000. Some of them, indeed, go so far as to advocate that the gun trade should be placed on an equal footing with that of Belgium, to whose members the Belgian Proof House returns annually a bonus of 38 per cent.

The report of the West Bromwich borough engineer shows that £53,100 will be needed to carry out the Corporation sewerage scheme. Of this sum £24,864 will be expended in putting down the intercepting sewer from Rydding-lane to Roebuck-lane, and £24,500 for the subsidiary and branch sewers, contingencies, &c. The subsidiary sewers will drain sixteen small areas. There are 204 manholes, 115 ventilators, eighty-four flushing chambers, and in a few cases special means of flushing. The total daily sewage that would have to be dealt with is estimated at 879,450 gallons.

Hopes are entertained this week in North Staffordshire of a slight revival in trade. The depression shows signs of having reached the lowest point. The orders on foreign and colonial account are here and there a little better. The heavy section mills are the best employed. Some of them are running full time. The merchant mills, however, are only making three turns a week. Crown bars are quoted at £6 to £6 7s. 6d., and common sorts at £5 15s. upwards per ton. Business in hoops appears to have fallen away somewhat. Still prices are on the basis of £6 5s. to £6 10s. per ton. The plate trade is better. Several good orders have come in, and the mills are rather more active. Tank and girder sorts are quoted at £7 10s. to £7 15s. Quietude characterises the pig iron branch. Quotations range from 40s. to 45s.

At a large and influential meeting of the South Staffordshire and East Worcestershire Coal Masters' Association held at Birmingham, Mr. J. B. Cocherane, the president, in the chair, it was resolved to call a joint meeting of the Wages' Board to consider the question of miners' wages, and it is considered that the state of trade does not warrant the present rate of wages.

## NOTES FROM LANCASHIRE.

*(From our own Correspondent.)*

*Manchester.*—The actually new business coming forward in the iron market here continues extremely small. So far as local and district pig iron makers are concerned they have still a sufficient weight of iron to deliver against old contracts to keep them going, and they show no disposition to press sales on the present basis of prices, whilst buyers are quite indifferent about giving out orders except such as they require for immediate wants. Occasional offers are put forward in the market for moderately large quantities, but in most cases they are at prices so much under those that makers are asking that sellers decline to entertain them. Indeed there is very little giving way at all in pig iron, and for the small orders that buyers have to give out they find it very difficult to place them at much below current rates. Finished iron makers, however, have not been able to maintain so firm a position, and prices, where orders have been taken, have recently been gradually receding from the nominal list rates. Generally throughout the iron trade there is a continued absence of any weight of new work in prospect to give any real strength to the market, and buyers, who can see nothing to be gained by giving out orders just now, prefer to run out their contracts before entering into further engagements.

There was but a very quiet market at Manchester on Tuesday, with only a small inquiry for either pig or manufactured iron. Lancashire makers of pig iron report little or nothing doing; they have had moderate offers at about 1s. and 1s. 6d. per ton under their quoted prices; but these they have declined to entertain; and although it is possible they would be prepared to give way a little for good orders, nominally they remain firm at 44s. 6d. less 2½ for forge and foundry qualities delivered equal to Manchester. For district brands delivered into this district quotations are on the basis of about 43s. 10d. for forge and 44s. 4d. to 44s. 10d. less 2½ for foundry Lincolnshire, and at a little under these figures there are offers in the market. The blowing-out of furnaces in the North of England has not, so far as this market is concerned, given that increased firmness to Middlesbrough iron that was anticipated, and there are still sellers open to book orders for good foundry brands at about 45s. net cash delivered equal to Manchester. The stronger tone reported in Scotch iron last week has been maintained, and there is less underselling; but the weight of business doing here continues very small.

The hematite trade shows no improvement. The business doing continues extremely small, with 56s., less 2½, still about the average figure for good foundry brands delivered into this district.

The finished iron trade also continues in a depressed condition, and to secure orders local and North Staffordshire makers have had to give way upon their nominal list rates of £6 per ton for bars delivered into the Manchester district, £5 12s. 6d. being now about the average figure, with Middlesbrough bars and plates offering freely at £5 12s. 6d. per ton, and in some cases even less than this is being taken for good specifications.

The condition of the engineering trades, as set forth in the last reports sent in from the various districts throughout the country connected with the trades union societies specially identified with the above branch of industry, would, so far as employment is concerned, appear to be practically stationary. The returns issued by the Amalgamated Society of Engineers show an average of about 3½ per cent. of the members in receipt of out-of-work support, which is about the same average as shown in the returns for the previous month. An exception to the general rule is, however, to be found in the Manchester and Salford district, where the returns show a decrease of about ½ per cent. in the number of out-of-work members; the cotton machine making trades appear to have slightly improved, and some of the large firms have been putting on an additional number of hands; the large engineering works and tool makers are also kept fairly employed, and locomotive builders are still pretty full of work. Taking, however, the trade generally of Lancashire, it cannot be said that the reports show any real improvement, but in most cases it is returned as fairly steady, and with the exception of the shipbuilding branches, this is pretty much the tenour of the reports from the leading industrial districts throughout the country. The report issued by the Steam Engine Makers' Society states that the number of unemployed is pretty much the same as last month, but the majority of the branch reports are very despondent in tone as to the condition of trade itself. The reports from the various marine engine districts are all of a depressed nature, and threatened reductions of wages or the discharge of men seemed to be the general rule, whilst in some districts there was also a tendency to increase the number of working hours.

It may be of interest to add that the reports received from the Colonial and American districts connected with the engineering trades union societies are all of a very discouraging character. Trade continues bad, with no sign of improvement, and all branches of industry, especially in the United States, are reported to be over-stocked with labour.

The slight improvement in the coal trade reported last week is being fairly maintained, and so far there has been a decidedly better business done this month than during either of the two preceding months of the year. The condition of the coal trade is, however, still anything but good; and it is only in exceptional cases that pits are able to work more than four days a week without putting into stock. House fire coals have been moving off moderately well, but the common round coals still meet with only a slow sale for iron making and steam purposes, and the demand for engine fuel is only moderate, although supplies of slack are scarce, owing to the small quantity of round coal now being screened. Quoted prices are without material change, but for quantities or for forward delivery low prices are taken for all classes of round coal, and coal from the Yorkshire district is competing here at very low figures. At the pit mouth best coal averages 9s. to 9s. 6d. per ton; seconds, 7s. to 7s. 6d.; common house coal, 6s. to 6s. 6d.; steam and forge coal, 5s. 6d. to 6s.; burgy, 4s. 6d. to 5s.; best slack, 4s. to 4s. 3d.; and good ordinary qualities, 3s. 3d. to 3s. 6d. per ton.

For shipment there has been more inquiry, and in the coasting trade there has been a fair business doing, but the prices taken to secure orders continue very low, Lancashire steam coal delivered at the high level, Liverpool, or the Garston Docks, averaging 7s. 3d. to 7s. 6d. per ton.

There is every prospect of a protracted dispute in the wire-drawing trade at Warrington, where the employers are enforcing a reduction varying from 15 to 25 per cent. On Tuesday a meeting of the representatives of the various firms and of the men now on strike was held at Manchester, for the purpose of coming to some arrangement. The men's delegates presented a list which the masters' representatives would not accept, and, on the other hand, the men declined to discuss the masters' list, so that a settlement is as far off as ever.

*Barrow-in-Furness.*—The hematite pig iron market of this district shows considerable depression, and has not improved since last week. The slight improvement which occurred a few months ago has entirely died away, and the trade is now in a worse position than it has been for some time past. Consumers appear to be anything but willing to come forward, and there is little disposition to place orders. Makers on the whole are anxious to sell, but forced sales are only effected at less money. The contracts to hand on both home, foreign, American, and continental accounts, are considerably restricted. The weight of shipments is inextensive, and as the present amount of deliveries does not by any means represent the output of metal in this district, stocks are daily increasing, and some time must elapse before they are cleared out. Prices have fallen rapidly, and quotations now are 1s. per ton less all round. Parcels of No. 1 Bessemer qualities are offered, but selling slowly, at 47s. per ton net at works, prompt delivery; No. 2, at 46s.; and No. 3, at 45s. per ton. The steel trade shows little change, but still remains in a low and unsatisfactory condition. Orders from all quarters are coming but slowly to hand. Rails are in limited request at unchanged prices, from £4 10s. to £5 being generally accepted, although large concessions are made at easier rates. Steel shipbuilders are but indifferently employed, and few contracts are being booked. The minor departments of the steel and iron trades are anything but briskly employed. Iron ore is quiet and prices are extremely low, orders being accepted at 8s. 6d. per ton net at mines. Stocks of ore now held are heavy. Coal and coke quiet, at easier prices. Shipping dull, as freights are low.

## THE SHEFFIELD DISTRICT.

*(From our own Correspondent.)*

THE Congo treaty is a subject which is exciting no little attention. It is contended that by the new tariff our interests will practically be placed under Portuguese rule. Sheffield, it is believed, will be affected to the extent of £200,000 per annum lost trade. British commerce on the Congo has hitherto been free and unfettered by any tariff, and the proposal in the treaty is to put a duty of from 30 to 100 per cent. on our manufactures. This proposal is sufficient, some of our manufacturers say, to ruin those engaged in the trade, and surprise is expressed that the Government should propose to abandon our interests to the mercy of what is called "the most protective nation in the world, one whose colonial policy has been of the most restrictive character, the consequence of which is seen in the stagnation and want of progress in all her colonies." The proposal to hand over the Congo district to the Portuguese is regarded as a direct invitation to other countries to receive from our Government the remainder of our interests in Western Africa.

Messrs. George Butler and Co., of the Trinity Works, have obtained a first-class certificate and silver medal for their exhibit at Calcutta; Messrs. Christopher Johnson and Co., second-class and bronze medal; Messrs. Rawson Brothers, second-class and bronze medal.

## THE NORTH OF ENGLAND.

*(From our own Correspondent.)*

THE Cleveland iron market held at Middlesbrough on Tuesday last was well attended, and a brisk business was done in pig iron at the advanced rates which have prevailed since the output was reduced. No. 3 g.m.b., for prompt delivery, cannot now be had from either merchants or makers for less than 37s. 3d. per ton; some of the latter ask 3d. to 9d. more. The minimum price of forge iron is 35s. 9d., but some makers demand and obtain 36s. per ton. The pig iron trade is now in a much firmer condition than it has long been.

There is still little inquiry for warrants, the price being nominally 37s. per ton.

The stocks in Messrs. Connal and Co.'s stores, both at Middlesbrough and Glasgow, have decreased during the past week. At Middlesbrough the quantity held on Monday last was 60,777 tons, being a reduction of 273 tons for the week; at Glasgow the stock amounted to 593,901 tons, being a reduction of 105 tons.

Exports from the Tees have been fully equal to expectation this month; large quantities have been sent to foreign ports, notably to those of Germany and Holland. The quantity of pig iron shipped to Monday night was 42,319 tons.

The manufactured iron trade continues in a dull and inanimate condition. Fresh contracts are still most difficult to obtain. Prices remain about the same, and are scarcely likely to be lower now that the price of pig iron has advanced. Ship plates are £5 2s. 6d. to £5 5s. per ton; shipbuilding angle iron, £4 15s. to £4 17s. 6d.; and common bars, £5 to £5 2s. 6d, all free on trucks at makers' works, cash 10th less 2½ per cent.

The shipsmiths' strike at Stockton terminated on the 12th inst., the men having agreed to a reduction of 5 per cent. on piecework for steamers. All the wages disputes in connection with the shipbuilding trade at Middlesbrough and Stockton have now been adjusted for the time being.

The Anderston Foundry Company, of Port Clarence, which manufactures large quantities of railway chairs, iron sleepers, and crossings, is exceedingly busy, and intends to enlarge its works. It already employs about 700 hands, and will require 400 more when the proposed extensions are made.

The Fighting Cocks Wire Works near Darlington are again at work. Mr. Dobbing, the plaintiff in the recent successful action against the proprietor, has sold his house to the owner of the neighbouring house property, whose income was suffering for want of his rents.

The North Brancepeth Coal Company have now given a fortnight's notice to most of the miners and cokemen employed at Littleburn Colliery, near Durham. They are about to stop forty coke ovens owing to the depression in trade.

A meeting of the Board of Arbitration was held at Darlington on Monday last, when the employers' notice for a reduction of 1s. per ton in puddling and 10 per cent. in other forge and mill wages was discussed. It was decided to refer the matter to an arbitrator, who will be asked to fix the rates for another three months. It was unanimously resolved to ask Dr. Spence Watson, of Newcastle, again to act as referee.

Messrs. Gray and Gladstone, who restarted the West Hartlepool Ironworks about two years since, have been compelled to cease operations for want of a sufficiency of orders. It is understood that they will work next week to finish up certain remaining specifications, and that then they will discharge all *employés*, except the manager and watchman, and will remain idle for two years, or until some considerable change takes place in the state of trade. Their output is about 900 tons per week, and consists entirely of ship-plates.

The Britannia Ironworks, Middlesbrough, belonging to Messrs. Dorman, Long, and Co., have been standing the whole of this week for similar reasons. Angle iron is there chiefly made.

The depressed state of the manufactured iron trade has at last compelled the employers to take into serious consideration the excessive earnings of plate rollers in charge of heavy mills. These workmen are still obtaining in many cases £11 to £12 per week, and in some cases even more. It is considered that such earnings as these, for any operative ironworkers, are absurd, when the state of trade is such that large numbers of their fellows have not the opportunity to earn anything whatever, and when employers are ceasing operations in all directions, because they can only continue by working at a loss.

## NOTES FROM SCOTLAND.

*(From our own Correspondent.)*

THE iron market has been quiet this week, and the quotations of warrants have not shown much fluctuation. It was anticipated that after the recent advance, which was attributed to speculative causes, there would be a considerable drop in prices; but hitherto there has been a rally following upon the decline. For shipment a fair quantity of pig iron is required. The shipments of the past week were 12,238 tons, compared with 11,876 in the corresponding week of last year. The home demand, on the other hand, is reported as slack, but the production is considerably smaller than it was twelve months ago, and there is at present no material addition to stocks. In fact, the aggregate in Messrs. Connal and Co.'s stores is 17 tons less than it was a week ago. There are 96 furnaces in blast, compared with 113 at the corresponding date in 1883, but it is expected that four additional furnaces that were put out at the Clyde Works by an accident to the blowing machinery will be in operation again in a few days.

Business was done in the warrant market on Friday last at 42s. 9½d. per ton cash. On Monday forenoon the market was flat, with transactions from 42s. 7½d. to 42s. 4½d. cash, there being an improvement in the afternoon to 42s. 7d. cash. Business was done on Tuesday forenoon at 42s. 6½d. to 42s. 7½d. cash, and in the afternoon at 42s. 8d. to 42s. 7d. cash. Business was done on Wednesday at 42s. 6½d. to 42s. 7d., and back to 42s. 6d. cash. To-day—Thursday—the tone was quiet at 42s. 5½d. to 42s. 5d. cash.

The market values of makers' iron are as follows:—Gartsherrie, f.o.b. at Glasgow, per ton, No. 1, 53s.; No. 3, 51s.; Coltness, 58s. 6d. and 51s.; Langloan, 54s. 6d. and 51s.; Summerlee, 52s. 6d. and 48s. 6d.; Calder, 53s. 6d. and 48s.; Carnbroe, 52s. 6d. and 48s. 6d.; Clyde, 48s. and 45s. 6d.; Monkland, 44s. 3d. and 41s. 6d.; Quarter, 43s. 9d. and 41s.; Govan, at Broomielaw, 44s. 3d. and 41s. 6d.; Shotts, at Leith, 53s. 6d. and 52s.; Carron, at Grangemouth, 48s. 6d. (specially selected, 54s.) and 47s. 6d.; Kinneil, at Bo'ness, 46s. and 45s. 6d.; Glengarnock, at Ardrossan, 52s. and 46s. 6d.; Elington, 46s. 3d. and 43s.; Dalmellington, 49s. and 45s.

Last Saturday a reduction of wages, the second within the past few months, was intimated at the malleable ironworks of Lanarkshire. It was to take effect in the course of the present week. The reduction follows upon a similar one awarded by the North of England Board of Arbitration, and amounts to 10 per cent. on the wages of millmen, forgemen, and shinglers, and 1s. per ton on puddlers. When the last reduction was made the men loudly protested against it. They have now an association of their own, and they do not wish to have their wages regulated any longer by what is done in the North of England. The employers, on the other hand, are acting in accordance with a long-established custom, the convenience of which is obvious, and the men themselves used to approve cordially of the practice, especially when the arbitration boards gave them a rise of wages. This last reduction will make their pay comparatively low, but the trade is at present in a very backward condition. The men have been idle several days this week, and are much dissatisfied with the position in which they are placed. The probability is, however, that they will offer no organised resistance worthy of the name, more particularly as several hundred men have lately been discharged owing to want of employment.

In the coal trade business is rather quiet.

## WALES AND ADJOINING COUNTIES.

*(From our own Correspondent.)*

THERE has been a slightly better tone imparted to trade from the character of the last American news, but it has had no practical result yet. In fact, the opinion is becoming general that we cannot become more depressed; the lowest condition has been reached; any change now must be an upward one. Cyfarthfa bar rolls keep moderately brisk, and the iron is appreciated. At present pig iron is bought from neighbouring works, but very shortly it will be made again on the spot. A temporary stoppage took place at some of the mills of the district on Monday, and I am afraid that in one or two cases the stoppage was a relief, for orders have been running short.

To tin-plate a little more life has been imparted, and prices are hardening.

I noticed lately that it had been decided upon the suggestion of the South Wales Institute to the Cardiff University College to appoint a professor of engineering. This came under the special committee this week, when it was arranged that the salary should be £300 a year and a share of the fees.

A colliery manager has asked me to state that he will willingly give £50 a year for three years for a series of lectures in colliery districts on chemistry and other scientific subjects.

Owners of best coal have nothing to complain about either as to inquiries or prices. They are all well booked. Some slight stoppages took place during the early part of the week, caused by an arrival of steamers; but this was soon overcome, and the rush at docks and at the various lines of rail is as much as ever. What it would be if house coal was in free demand it is hard to state. That branch of the coal trade is slack and prices low, and as winter is leaving us there is a poor lookout for recovery until next season.

A fine steamer left Cardiff this week, the Lilburn Tower, of the Tower Line, with a cargo of steam coal—4500 tons. She was principally coaled by the Lewis Merthyr and Dowlais coal, and sailed direct for Egypt.

The Elliot pit of the Powell Duffryn Company is being sunk in the Rhymney Valley and the new Tredegar Colliery opened out.

In the Merthyr parish a movement, initiated by Mr. Rhys, Llwydcoed, has been made to levy a rate of 7½ per cent. upon colliery proprietors.

GAS making by the various corporations in the Birmingham district appears to be a very profitable business. Tipton, which up to the last nine months has been losing money, has since made a profit of £2300; Walsall made a profit of £7964 last year; West Bromwich of £6276; and Smethwick of £3088.

# THE PATENT JOURNAL.

*Condensed from the Journal of the Commissioners of Patents.*

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

## Applications for Letters Patent.

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

11*th March*, 1884.

4666. Boiler Flues, G. W. Dyson, Bolton.
4667. Folding Tables, A. Barr, Glasgow.
4668. Dredging Machinery, H. C. Lobnitz, Renfrew.
4669. Making Rigid the Axles and Seats of Bicycles, J. H. Summers, Birmingham.
4670. Feeding Poultry, J. Bailey, Warrington.
4671. Making Moulds for Casting Baths, J. Shanks and W. Dennison, Barrhead.
4672. Toy, R. H. C. Cotton, Birmingham.
4673. Chimney Top, A. Swan, Greenock.
4674. Umbrellas, E. Cooke, Birmingham.
4675. Weaving Diapers, J. Irving, Barnsley.
4676. Permanent Designs upon Raised Pile Fabrics, T. Whitham, Leeds.
4677. Preparing and Dressing Leather, S. Haley, Bramley.
4678. Spinning Mules, W. Bamford and J. Kelly, Middleton.
4679. Extracting Grease from Soap Water, B. Davy, Keighley.
4680. Desiccating Eggs, L. J. Cadwell, Chicago.
4681. Spindle Flyers, R. Turpey, Manchester.
4682. Nut Locks, W. P. Thompson.—(*W. L. Moore, Rochester, U.S.*)
4683. Dynamo-electric Machines, W. H. Scott, Nottingham, and E. A. Paris, London.
4684. Untinning Tin-plate Refuse, &c., L. Poensgen, Düsseldorf.
4685. Driving Dynamo-electric Machines, W. P. Thompson.—(*J. B. Wayne and J. R. Markle, Detroit.*)
4686. Harvesting and Binding Grain, W. P. Thompson.—(*C. Young and D. M. Osborne, Auburn, U.S.*)
4687. Operating the Healds of Weaving Looms, G. H. Hodgson, Bradford.
4688. Operating the Healds of Weaving Looms, G. H, Hodgson, Bradford.
4689. Lock Nuts, J. Berry, Preston.
4690. Condensing and Cooling Apparatus, F. Hocking, Liverpool.
4691. Twist Lace Fabrics, B. Walker, Old Lenton.
4692. Steam Rock Drills, H. J. Allison.—(*F. A. Halsey, New York.*)
4693. Paper Wrappers, H. J. Allison.—(*D. Dick, New York, U.S.*)
4694. Pile Fabrics, H. H. Lake.—(*C. Coupland, U.S.*)
4695. Knife Attachment for Finger Rings, W. R. Comings, London.
4696. Electrical Meter, P. Jolin, Bristol, J. Parsons, London, and M. F. Purcell, Dublin.
4697. Ventilating Buildings, T. Arnold, London.
4698. Utilising the Waste Residues of Fuel, W. H. Spence.—(*F. W. C. Waldeck, The Hague.*)
4699. Preventing Down Draught in Chimneys, H. B. Dow, London.
4700. Cutting Wood, &c., C. Pape, Prussia.
4701. Toilet Soap Dishes, F. Simpson, London.
4702. Opera Glasses, J. C. Mewburn.—(*H. Suchsland, Dresden.*)
4703. Metal Plate Machinery, W. Phillips and G. Teideman, London.
4704. Manifold Folding Newspaper Rack, J. G. Lyle, London.
4705. Inflammable Gas, &c., L. A. V. Fellegrin.—(*E. Duchamps, Brussels.*)
4706. Gripping Device, T. Dugard.—(*W. H. Milliken, San Francisco.*)
4707. Bleaching, J. B. Thompson, London.
4708. Coke Ovens, A. M. Chambers, Thorncliffe, and T. Smith, Chapeltown.
4709. Roofing Tiles, F. I. Nibbs, London.
4710. Cleaning Steam Boilers, H. J. Haddan.—(*R. Stewart and F. Watts, Illinois.*)
4711. Combustible Gas, B. von Steinaecker, Prussia.
4712. Self-acting Mule Spinning Machinery, W. A. Barlow.—(*E. Grignard, Belgium.*)
4713. Railway Car Wheels, S. Pitt.—(*J. A. Hagan, St. Joseph, U.S.*)
4714. Metallic Fastenings for Buttons, S. Pitt.—(*G. W. Prentice and F. A. Smith, jun., Providence, U.S.*)
4715. Safety Couplings, S. Pitt.—(*J. Prince, Paris.*)
4716. Evaporating or Condensing Apparatus, A. W. L. Reddie.—(*E. Theisen, Germany.*)
4717. Wear Plates for Railroad Ties, A. W. L. Reddie.—(*D. Servis, New York.*)
4718. Furnaces, &c., W. Black and T. Larkin, South Shields.
4719. Incubator, J. Mayes, Thetford.
4720. Sharpening Saws, &c., S. P. Wilding.—(*W. Tucker and H. M. Tower, Brookfield, U.S.*)
4721. Dynamo-electric Machines, W. R. Lake.—(*C. Richter, New Jersey, U.S.*)
4722. Mechanical Toys, G. Beck and J. J. Perry, London.
4723. Exhibiting Advertisements, G. F. Redfern.—(*V. Hess, Vienna.*)
4724. Filing Schedules, L. A. Groth.—(*A. d'Attemps, Florence, Italy.*)
4725. Flushing, &c., Sewers, W. R. Lake.—(*P. Burke, Salt Lake City, U.S.*)
4726. Titration Apparatus, C. D. Abel.—(*B. Greiner, Germany.*)
4727. Shafts, Axles, and Bars, A. M. Clark.—(*S. B. Jerome and A. O. Jennings, U.S.*)
4728. Railway Wheels, &c., R. Elsdon, Brockley.
4729. Tricycles, J. Webb, London.
4730. Chains, &c., R. Elsdon, Brockley.
4731. Breech-loading Small-arms, E. James, Birmingham.
4732. Combined Pruning Knife and Walking Stick, R. W. Cowen, Dalston, near Carlisle.
4733. Candy Balls, &c., J. H. Wathew, Birmingham.
4734. Battery or Machine Guns, O. Edwards, London.
4735. Direction Labels, T. Stobie and J. Winfield, Aston.
4736. Petroleum Motors, F. Wirth.—(*J. Söhnlein, Schierstein, Germany.*)

12*th March*, 1884.

4737. Stoppering Bottles, W., E., and T. W. Hazlehurst and J. Wolstenholme, Oldham.
4738. Steam Engines, F. W. Webb, Crewe.
4739. Preparing and Spinning Cotton, &c., W. Sumner, Preston.
4740. Lace and Hosiery Needles, W. Harriman, sen., and W. Chester, Sheepshed.
4741. Blind Roller, F. A. Weston, Caerleon Village.
4742. Shuttles, J. Sellers, Preston.
4743. Joiners' Gauges, A. McL. Chalmers, Glasgow.
4744. Combination Mortising and Boring Machines, T. and R. Lees, near Manchester.
4745. Strainer for Teapot, W. Brandon, Ashted.
4746. Belt Hinge, E. Smith, San Francisco.
4747. Cutting Tin-plate Scraps, &c., W. P. Thompson.—(*M. L. Poensgen, Germany.*)
4748. Slicing Oranges, &c., F. Follows, Manchester.
4749. Cord Holdfasts, F. Taylor, Chippenham.
4750. Stopping Bottles, H. Arch and C. S. Wozencroft, Leeds.
4751. Calico Printing, A. Drew, Burnley.
4752. Chromatic Duet English Concertinas, J. H. Maccann, Plymouth.
4753. Preventing the Abstraction of Letters from Pillar-boxes, &c., A. E. W. Howe, Peterborough.
4754. Cleaning Steam Boiler Tubes Inside, R. and W. Robinson, Wolverhampton.
4755. Tramways, W. and W. R. Lester, Glasgow.
4756. Automatically Regulating the Drag in Spindle and Flyer Machines, J. Rostron, Bolton.
4757. Spinning Cotton, &c., J. Pendlebury and J. Wardle, near Bolton.
4758. Belt Fastener, J. B. Griffith.—(*C. Whiteside, Auburn, New York.*)
4759. Photograph Holders, T. Schmidt, Berlin.
4760. Velocipedes, J. Jackson, Coventry.
4761. Bicarbonate of Soda, W. Weldon, Burstow.
4762. Bicarbonate of Soda, W. Weldon.—(*A. R. Pechiney, Selindres, France.*)
4763. Flushing Drains, &c., G. Macfarlane, London.
4764. Holdfasts for Pipes, J. R. Johnson, Unstone, and W. Urton, Chesterfield.
4765. Holdfasts for Pipes, J. R. Johnson, Unstone, and W. Urton, Chesterfield.
4766. Iron Wheels, F. Garnier, France.
4767. Automatic Safety Pawl Catch, &c., E. P. Keevil, London.
4768. Metallic Roofings, E. Sherratt, Swansea.
4769. Stop Mechanism, T. Thorpe, New Basford.
4770. Frilling, M. and L. Moore, Nottingham.
4771. Mincing Sausage Meat, &c., T. Williams, jun., London.
4772. Ornamenting Walking-stick Handles, &c., J. Howell and J. W. Anderson, London.
4773. Malting Lentils, J. Keene and T. Welton, London.
4774. Moulds for Casting Nails, W. Giles, near Bristol.
4775. Electric Arc Lamps, W. Fairweather, Glasgow.
4776. Gas Engines, J. Spence, Harrogate.
4777. Gas Motor Engine, F. W. Crossley, Manchester.
4778. Preserving Artists' Moist Colours, H. F. Brousson.—(*G. Wagner, Hanover.*)
4779. Garden Implements, J. Lee, London.
4780. Connecting Links, G. Hughes, Wolverhampton.
4781. Electric Lamps, F. H. Varley, W. Beale, and R. H. Padbury, London.
4782. Secondary Batteries, S. Kalischer, Berlin.
4783. Friction Clutch, W. Bagshaw, Yorkshire.
4784. Wood Fibres, H. J. Haddan.—(*P. Holmes, U.S.*)
4785. Hydrogen, R. Lehmann, London, and J. Oettli, Switzerland.
4786. Fire-arms, &c., T. P. Wood, Bristol.
4787. Brakes, E. Patterson, Liverpool.
4788. Packing the Stuffing Boxes of Stop Valves, J. B. Price, Preston.
4789. Galvanometers, A. P. Chattock, Charlton.
4790. Radial Axle-boxes, W. M. Smith, Newcastle-upon-Tyne.
4791. Current Meters, Sir D. Salomons, Kent.
4792. Compound for Covering Boilers, &c., A. Southwell, Southampton.
4793. Ventilating the Stoke Holes of Steam Vessels, H. Barrett, Forest Gate.
4794. Measuring Currents of Electricity, R. E. B. Compton, London, and G. Kapp, Chelmsford.
4795. Sewing Machine Motors, A. Watkins and the Self-acting Sewing Machine Company, London.
4796. Priming Compositions, P. Layden and W. McLean, Jarrow-upon-Tyne.
4797. Glass Labels, C. Woodhead, Yorkshire.
4798. Drying Goods by Hot Air, A. W. L. Reddie. (*E. Theisen, Germany.*)

13*th March*, 1883.

4799. Fire-escape, J. Imms, Aston.
4800. Boring Bar, E. Richards, Staffordshire.
4801. Improvements in Bicycles, J. Key, Ashted.
4802. Padding the Bottom of the Inside of Vessels for Containing Ink, &c., R. H. Berkeley, Aston.
4803. Brushes, S. Morley, Stockton-on-Tees.
4804. Jacks for Looms, J. Rebbla, Leeds.
4805. Window Boxes, &c., G. Sutton, Lancaster.
4806. Looms for Weaving, W. Warrington, Lancashire.
4807. Reaping Machine, J. Adams, Dawlish.
4808. Boiler Composition, T. Lowe, Radford.
4809. Propelling without Machinery, T. Griffiths, Pembrokeshire.
4810. Water-closets, W. H. Hindle, Blackburn.
4811. Chromates, &c., W. J. A. Donald, Glasgow.
4812. Attaching Buttons to Textile Fabrics, W. R. Mowbray, Cape of Good Hope.
4813. Down-cast Ventilator, R. Munn, Glasgow.
4814. Cutlery, J. Hulley and W. Griffith, Sheffield.
4815. Sheet Iron Tanks, J. G. Whyte, Liverpool.
4816. Cleansing Bottles, W. W. Horner, Wandsworth, and E. W. Lancaster, Dulwich.
4817. Air-tight Jars, E. Johnson, Longsight.
4818. Woven Wire Mattresses, I. Chorlton, Manchester, and A. Lawrie, Birmingham.
4819. Excavating Apparatus, J. H. McNee, U.S.
4820. Two-speed Gear for Velocipedes, A. B. W. Whatton, London.
4821. Bicycles, &c., F. Beauchamp, London.
4822. Band Brakes for Velocipedes, E. R. Settle, Coventry.
4823. Fixing Neckties in Position, A. Ash, London.
4824. Inking Pads, C. W. Crutsinger, United States.
4825. Gas, W. P. Wilson, Westminster.
4826. Treating Leather, W. J. Gale, Clifton.
4827. Boxes for Matches, H. de Schwabacher, Paris.
4828. Telegraph Posts, J. Oppenheimer, Manchester.
4829. Traps for Catching Rats, &c., J. H. Brodie.—(*A. S. Jackson, Cape Colony.*)
4830. Pants, H. Cooper and R. Steele, Nottingham.
4831. Elevators, W. H. Steel, London.
4832. Hurdles, G. Nisbet, Greenlaw.
4833. Insulated Conductors, &c., A. R. Bennett, Glasgow.
4834. Paper Bags, F. D. Bumsted, Hednesford.
4835. Rotary Fountain, F. H. F. Engel.—(*G. E. Wolff, Hamburg.*)
4836. Dispersing Oil upon Waves, W. Gardiner, Ealing.
4837. Railway Coupling, J. Hyde, Acton.
4838. Tobacco Pipes, &c., H. J. Haddan.—(*F. Bailac, Toulouse, France.*)
4839. Looms, F. Allen, Bradford-on-Avon.
4840. Lifeboats, H. Critten, Great Yarmouth.
4841. Fire Basket and Boiler, A. H. Hearington, London.
4842. Water-heater, A. H. Hearington, London.
4843. Heating Water, &c., A. H. Hearington, London.
4844. Making Hats, J. Goddard, Ashton-under-Lyne.
4845. Joint Fittings for Fishing Rods, F. J. Williams, London.
4846. Bottles, J. Booth, New Basford.
4847. Tricycles, &c., E. Hollands, London.
4848. Driving Belts, F. Walton, Twickenham.
4849. Slip-hook, L. K. Bell, Chatham.
4850. Preparation of Halogen Derivatives of Tetra-methyl-diamido-benzo-phenone and Analogous Ketone Bases, J. H. Johnson.—(*H. Caro, Ludwigshafen-on-the-Rhine, Germany.*)

14*th March*, 1884.

4851. Movable Ascension Pipes for Gas Retorts, J. Thomas, Bodmin.
4852. Steering Tricycles, E. Gilyard, Bradford.
4853. Stoves, J. Parker, Kilmarnock.
4854. Cylinder Printing Machines, R. Cundall, Thornton.
4855. Steam Valves, J. Longton, Brinscall.
4856. Ornamenting Bricks, &c., W. R. Cornell, Whitehall, Grays.
4857. Fixing Brackets to Mirrors, S. Krinks, Birmingham.
4858. Steam Engine Gland and Joint Packing, E. Whittles and G. Trickett, Haslingden.
4859. Self-acting Mules, J. Macqueen, Bury.
4860. Valve Motions for Automatic Steam Pumps, A. Gozzard, Sheffield.
4861. Nut or Bolt Locking Device, J. Glover, jun., Liverpool.
4862. Couplings for Railway Wagons, &c., W. J. Thomas, Redfield, and W. G. Doel, Bristol.
4863. Dealing in Receipts Representing Securities, A. Wimpfheimer, Liverpool.
4864. Inserting Races, &c., into Stereotype Pages of Newspapers Very Quickly, W. Curthoys, Wolverhampton.
4865. Amalgamating Free Gold, R. J. Atcherley, London.
4866. Safety Ventilating Sash Fastener, A. F. Garrood, London.
4867. Washing Clothes, &c., G. Cooper, Sheffield.
4868. Packs or Bags, S. J. V. Day.—(*P. S. Swan, Calcutta.*)
4869. Pack or Bag, S. J. V. Day.—(*P. S. Swan, Calcutta.*)
4870. Fenders for Boats, J. P. Wright, Redhill.
4871 Balancing Sliding Window Sashes, J. Telford and R. Philpott, Liverpool.
4872. Looms, J. W. Whittaker, Blackburn, and T. Taylor, Rishton.
4873. Boxes for Receiving Letters, H. J. Crossle, London.
4874. Electrically Actuated Clocks, E. G. Colton, —(*Kick Brothers, Amsterdam.*)
4875. Siren Fog-signal Apparatus, C. Ingrey, Fulham.
4876. Pressing Woven and other Fabrics, C. Scriven, Potternewton.
4877. Surfacing Wood Pavement, A. C. Bicknell, Sandycroft.
4878. Accumulator of Electricity, J. Mijers, Amsterdam.
4879. Preparing Cement, J. Watson, Greenhithe-on-Thames.
4880. Gas Motor Engines, &c., G. W. Weatherhogg, London.
4881. Musical Instrument, J. Wallis.—(*A. Gentner, Stuttgart, Würtemburg.*)
4882. Feed-water Heaters, P. Addison, Cumberland.
4883. Jars, &c., T. C. Blanchflower, jun., and J. C. Blanchflower, Great Yarmouth.
4884. Toys, G. Cole, London.
4885. Tricycle, H. Etheridge, London.
4886. Dobby Machines, J. Poole, Bradford.
4887. Generating Steam, A. Johnson, Bradford, and G. G. Rhodes, Liversedge.
4888. Cocks or Valves, J. R. McNeil, London.
4889. Library Steps and Easel, G. Hampton, London.
4890. Tricycles, &c., J. Davies, Wednesbury.
4891. Shirts, &c., J. McCheyne, Dundee.
4892. Turntables, &c., J. B. Eads, London.
4893. Lifting and Lowering Ships, &c., J. B. Eads, London.
4894. Cams of Knitting Machines, W. R. Alington, London.
4895. Sporting Guns, Sir R. Payne-Gallwey, Bedale.
4896. Electrical Switches, W. Lowrie, London, and A. B. Pickard, New Beckenham.
4897. Waterproof Felts, A. Davidson, Wimbledon.
4898. Bell, &c., G. Watts, London.
4899. Weaving, T. H. Brigg, Bradford.
4900. Ventilating, S. Chandler, jun., and J. Chandler, London.
4901. Couplings, J. Brockie, Brixton.
4902. Drying, &c., Steam, W. R. Lake.—(*L. Fouque, Paris.*)
4903. Glazed Shelter Wall, &c., J. Monro, New Barnet.
4904. Thread Separators, &c., A. M. Clark.—(*G. Jaquith, Kentucky, U.S.*)
4905. Locking Apparatus, A. Reinhard.—(*B. G. Kecker, Germany.*)
4906. Dark Slide for Photographic Cameras, A. F. Howman, Oxford.
4907. Yielding Couplings, R. H. Heenan and R. H. Froude, Manchester.
4908. Lubricated Bearings, R. H. Heenan and R. H. Froude, Manchester.
4909. Taps, &c., F. G. Fleury, London.
4910. Desk, Hat, &c., Rail, W. Pitt, Tottenham, and W. Morgan, Stratford.

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4911. Beds, J. Davison and J. Wilson, Sunderland.
4912. High-speed Motors, A. B. Brown, Edinburgh.
4913. Pull Opening Can, E. H. Cooke and H. T. Seymour, Cork.
4914. Looms for Weaving, J. Wild, Huddersfield.
4915. Pickers for Looms, H. Tetlow, Manchester.
4916. Mouse and Rat Traps, J. Baber, Liverpool.
4917. Rotary Engines, J. Sant, Newcastle-under-Lyme.
4918. Spinning, &c., Machinery, R. Wild, Littleborough, and H. Ledger and W. Gallimore, Leek.
4919. Markers for Sizing Yarn Machines, J. Butterworth and W. Dickinson, Burnley.
4920. Wool Combing, &c., Machinery, E. G. Hattersley and S. Hird, Haworth.
4921. Handle Attachment, &c., for Hand Bags, W. Hemingway, Rochampton.
4922. Tape Jointing, B. C. Tyzack, North Shields.
4923. Paper-cutting Machines, H. P. Trueman and J. G. New, Birmingham.
4924. Boilers, &c., W. Wright, Airdrie.
4925. Ventilating Silo, &c., J. M. Fletcher, Cheadle.
4926. Bicycle, &c., Wheels, T. Clark, Manchester.
4927. Attaching Tubs, &c., to Wire Ropes, J. E. Partridge, West Bromwich.
4928. Boots and Shoes, R. Gilliatt, Knutsford.
4929. Bichromate of Soda, C. S. Gorman, Irvine.
4930. Ginger Cakes, M. Chatfield, Horsham.
4931. Baggage Checks, C. C. Smith, Pennsylvania.
4932. Belt Fasteners, H. C. Hart, Connecticut, U.S.
4933. Lubricators, E. Hodge, Bristol.
4934. Sliding Window Sashes, R. Adams, London.
4935. Shooting Saloons, E. Handslip, South Shields.
4936. Furnaces for Melting Metals, J. Hodgkins, Wednesbury.
4937. Incandescent Lamps, J. S. Fairfax, London.
4938. Perambulators, J. L. Bramley and J. S. Conway, London.
4939. Heels for Boots and Shoes, W. H. Stevens, Leicester.
4940. Frames for Suspension Lamps, E. A. Rippingille, Aston.
4941. Lamps for Burning Mineral Oils, E. A. Rippingille, Aston.
4942. Metallic Labels, &c., B. Knight and J. Durant, Birmingham.
4943. Furnaces for Heating Iron, T. Milward, Kidderminster.
4944. Lathes, E. P. Alexander.—(*J. C. Eckhardt, Stuttgart, Germany.*)
4945. Mash Tuns, J. McFarlane, Edinburgh.
4946. Cigar Boxes, &c., J. F. Hickie, London.
4947. Phosphatic Salts, S. G. Thomas, London.
4948. Heating Water, C. Cooper, London.
4949. Siphons, E. de Pass.—(*A. Baloche and A. Krahnass, Paris.*)
4950. Earth Closets, J. D. Garrett, Southwold.
4951. Scouring Leather, J. Hallgarth, Exeter.
4952. Communicating Motion to any Shaft for the Transmission of Power, W. Ross, London.
4953. Multiplex Type, A. Rubinstein, London.
4954. Folding Machines, H. J. Haddan.—(*H. Stamm, Paris.*)
4955. Furnace for Reducing Zinc, G. W. von Nawrocki.—(*J. Quaglio, Frankfort-on-Main, and J. Pintsch and A. Lentz, Berlin.*)
4956. Spring for Corsets, &c., E. Edwards.—(*C. Thury and S. P. de Bassecourt, France.*)
4957. Administering Anæsthetics, L. Roussy, Geneva.
4958. Link Motion, A. D. Bryce-Douglas, Seafield.
4959. Yielding Coupling for Rotating Shafts, R. H. Heenan and R. H. Froude, Manchester.
4960. Yielding Coupling for Rotating Shafts, R. H. Heenan and R. H. Froude, Manchester.
4961. Producing Violet, &c., Colouring Matters, C. D. Abel.—(*Farbwerke vormals Meister, Lucius, and Brüning, Germany.*)
4962. Illuminating Light-houses, J. R. Wigham, Monkstown.
4963. Braces, F. J. Wollen, Walthamstow, and G. C. Reddick, London.
4964. Toasting and Broiling, G. W. Horne, London.
4965. Bench Drilling Machines, P. Winn, Birmingham.
4966. Lubricators, C. Hulseberg, London.
4967. Galvanic Batteries, J. A. W. Dollar, London.
4968. Music Machines, G. W. von Nawrocki.—(*H. Lorentz, Prussia.*)
4969. Regulating the Supply of Gas in Railway Trains by Electricity, W. E. Langdon, Derby.
4970. Extinguishing Railway Carriage Lamps, W. M. Trousdale, Harrogate.
4971. Smoke-preventing Furnaces for Bakers' Ovens, F. Smith, London.
4972. Steam Tramway Locomotives, D. McI. Reid, Tynemouth.
4973. Sawing Machinery, S. Skinner, Eastbourne.
4974. Actuating Mechanical Automaton Toy Workmen, &c., G. Cole, London.
4975. Combing Wool, &c., W. Fearnley and I. Davy, Bradford.
4976. Drawing, &c., upon Glass, E. S. Chatterton, London.—*January 26th*, 1884.

17*th March*, 1884.

4977. Linen Horse and Suspending Apparatus, G. F. Stidolph, Woodbridge.
4978. Spring Hinges for Doors, P. O'Connor, Wavertree.
4979. Metallic Packing Piston, R. Young, Leith.
4980. Direct Action Corkscrew, H. Perry, Brighton.
4981. Connecting Leather Picking Arms to Picking Sticks, T. Pickersgill, Huddersfield.
4982. Raising and Lowering Clothes-horses, J. Leach, Accrington.
4983. Motive-power Engines, W. Cooke, Nottingham, and S. Meekin, New Lenton.
4984. Rolling Metals, T. Keen and W. Beasley, Smethwick.
4985. Piston Steam Engine Indicators, G. M. Borns, London.
4986. Indicating Apparatus, A. Horne, Liverpool.
4987. Elastic Pencil Over-grainer, W. F. Pigott, Bywale, Ireland.
4988. Steam Boilers, W. Wright, Airdrie.
4989. Changing Sensitised Plates, J. Sturrock, Dundee.
4990. Flower-pots, &c., C. M. Hunter, Birmingham, and C. J. Mountford, Small Heath.
4991. Table Forks, &c., C. Ibbotson, Sheffield.
4992. Looms, T. Richmond, H. Haworth, and D. Whitehead, Burnley.
4993. Perpetual Cutting Machines, J. W. Taylor, P. Gledhill, and J. Liversedge, Huddersfield.
4994. Looms, E. Beach, near Leeds.
4995. Drawing Pins, &c., F. Brampton, Birmingham.
4996. Locking Velocipedes, B. Roberts, Birmingham.
4997. Ventilating Buildings, T. Clayton, Ashton-on-Mersey.
4998. Internal Gauges, W. Whittam, Salford.
4999. Giving Alarm in Febrile States of the Human Body, W. Fearnley, London.
5000. Vehicles, W. J. Brewer, London.
5001. Stocks and Dies, J. C. Bauer, Brockley.
5002. Giving Wooden Articles the Appearance of Metal, C. W. Rees, London.
5003. Floorcloth, J. C. Mewburn.—(*V. Réal, Paris.*)
5004. Splitting Osiers, C. J. Bremerkamp, London.
5005. Reversing Gear, J. Whitehead and J. Pollock, Belfast.
5006. Dredgers, W. Fleming & P. Ferguson, Paisley.
5007. Gas Engines, W. and J. H. Hill, York.
5008. Stone Breakers, W. H. Baxter, Leeds.
5009. Washing Machines, J. Roffey, Bromley.
5010. Clip or Holder for Tickets, &c., W. Potter jun., London.
5011. Insulating Plates for Galvanic Batteries, &c., D. Hammond, London.
5012. Electrical Accumulators, &c., D. Hammond, London.
5013. Preserve Tins, J. J. Burton and H. Harsant, London.
5014. Venetian Blinds, A. Boult.—(*J. Querre, France.*)
5015. Marking Lawn Tennis Courts, A. J. Boult.—(*D. D. Williamson, New Brunswick, U.S.*)
5016. Metallic Trunks, &c., R. Foster, Birmingham.
5017. Compressing Vegetable Substances, G. W. C. Catford, London.
5018. Life-buoys, &c., J. R. Hodgson, London.
5019. Trimming Mechanism for Sewing Machines, W. R. Lake.—(*T. C. Robinson, U.S.*)
5020. Telpherage, F. Jenkin, Edinburgh.
5021. Colouring Matters, F. Wirth.—(*E. Erlenmeyer, Frankfort-on-the-Main.*)
5022. Scissors, A. Reutershan, Germany.
5023. Pegs for Stringed Instruments, J. Wallis.—(*C. Engert and J. Glass, Germany.*)
5024. Mechanically Playing Pianofortes, &c., F. H. Wenham, London.
5025. Smelting Iron Ore, S. R. Smyth, London.
5026. Electric Arc Lamps, C. D. Abel.—(*T. Basilevsky, St. Petersburg.*)
5027. Clasps for Neckties, H. W. Aberlin, London.
5028. Pattern Chart, W. K. Hillyard, Newcastle-upon-Tyne, and G. Newnes, London.

# ABSTRACTS OF SPECIFICATIONS.

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

**730.** Furnaces for Burning Gaseous Fuel, &c., *J. H. Selwyn and R. Walker, London.—9th February*, 1883. 6*d*.

The combustion chamber is made of fire-clay, and is provided with a number of gas jets. Injectors send a spray of liquid hydrocarbon fuel impregnated with air or steam into the combustion chamber, where it impinges on a fire-clay block and is broken up and ignited.

**2544.** Manufacture of Gas, &c., *S. Pitt, Sutton.—22nd May*, 1883.—(*A communication from E. J. Jerzmanowski, New York.*)—(*Complete.*) 6*d*.

This relates to a process for the production of a large percentage of hydrogen by the action of hot lime, and it consists in bringing naphtha vapour and steam into contact with a highly heated body of lime, in cooling the product, and then causing the regulated constant stream, under uniform pressure, to flow through a chamber containing lime in a cooler condition.

**2546.** Hammocks, and in their Combination with a Tricycle and a Tent, *C. E. Hiester, Harrisburg, U.S.—22nd May*, 1883. 6*d*.

The hammock is formed so that it can be suspended from the wheels of tricycles, which can thus be converted into a sleeping compartment.

**3307.** Effervescing Drink, *A. Baumgarten, London. 4th July*, 1883.—(*Provisional protection not allowed.*) 2*d*.

Milk is reduced by evaporation, and the residue treated chemically to preserve it, and then mixed with strongly charged carbonated or effervescing water.

**3379.** Earthenware or Porcelain Tiles, *G. Max Broseley, Salop.—7th July*, 1883.—(*Provisional protection not allowed.*) 2*d*.

A pattern is impressed upon the surface of the tiles while in a plastic condition by moulds, dies, or engraved plates, and they are then burned.

**3526.** Marine Drags, *W. Clark, London.—17th July*, 1883.—(*A communication from A. J. Clarke, Brooklyn, U.S.*) 6*d*.

The object is to facilitate the heaving-to of vessels, and it consists in a marine drag constructed with a shank provided with a stationary collar and a runner, to which ribs and stretchers, whose outer ends are loosely connected together, are respectively hinged in combination with triangular plates hinged to each other and to the ribs, whereby the drag will be opened by the resistance of the water.

**3531.** Manufacture of Steel, *W. Naylor, Penistone, Yorks.—18th July*, 1883. 2*d*.

This relates to the manufacture of a soft weldable

steel, and it consists in running molten cast iron into a Bessemer or other converter or other suitable vessel having an acid or basic lining, where such impurities are removed as are possible or desirable by blowing or other convenient manner. To the molten metal is then added oxide of manganese, with a suitable proportion of spiegeleisen or ferro-manganese.

**3587.** APPARATUS FOR SPINNING AND DOUBLING COTTON, &c., *E. Dyson, near Bolton.*—21*st July*, 1883.—(*Not proceeded with.*) 2*d.*

This relates to throstle spinning and doubling frames, wherein the twisting of yarn is performed by flyers on the spindles or their equivalents, such as rings and travellers in ring frames. A loose tube projects to the top of the spindle. The flyer is of special construction, and is connected by improved means to the top of the spindle to facilitate "doffing," and giving greater stability to the flyer.

**3616.** MAGAZINE OR REPEATING FIRE-ARMS, *H. H. Lake, London.*—23*rd July*, 1883.—(*A communication from the Spencer Arms Company, Incorporated, New York.*) 8*d.*

This relates to machine guns in which the motion to actuate the re-loading apparatus is derived from a forked slide reciprocating in a line parallel with the axial line of the barrel, which slide is operated by one hand, while the other hand grasps the stock and holds it against the shoulder of the person using the gun. One feature consists in employing a breech lock fitted to turn upon a vertical axis in a plane across the top of the receiver, and in line with the barrel; and another feature consists in effecting the movements of the block in both directions by positive means.

**3624.** EXTRACTION OF SULPHUR COMPOUNDS FROM ALKALI WASTE, *J. Simpson, Liverpool.*—24*th July*, 1883.—(*Void.*) 2*d.*

This consists in subjecting alkali waste and a solution containing hyposulphite of lime or sulphurous acid to the direct action of steam pressure in a closed vessel, whereby the sulphur compounds in the waste are to a large extent converted into a soluble form, dissolving an hyposulphite or sulphurous acid solution. The solution is drawn off downward through the residue of the waste.

**3629.** METHOD OF ADVERTISING, *A. M. Clark, London.*—24*th July*, 1883.—(*A communication from C. F. Herbelot, Paris.*—(*Provisional protection not allowed.*) 2*d.*

This consists in distributing vouchers gratis, which have a certain value entitling the holder to a certain discount on goods purchased.

**3636.** WATCHES, *W. R. Lake, London.*—24*th July*, 1883.—(*A communication from F. Fitt, Switzerland.*) —(*Not proceeded with.*) 2*d.*

This relates to an escapement, which can be readily removed and replaced, the object being to facilitate the examination and repairing of the watch.

**3641.** MACHINES FOR POLISHING OR FINISHING TEXTILE FABRICS, *J. H. Johnson, London.*—24*th July*, 1883.—(*A communication from E. A. Ruizand, France.*—(*Not proceeded with.*) 2*d.*

This relates to a machine in which a series of rotary burnishers are mounted on independent axes arranged in a suitable supporting frame so as to rotate in planes perpendicular to the direction in which the fabric is caused to travel.

**3645.** HANSOM CABS, *L. Engel, London.*—25*th July*, 1883.—(*Not proceeded with.*) 2*d.*

The sliding window is replaced by a movable curtain or blind with top and sides.

**3651.** RECEPTACLES FOR THE CONVEYANCE OF VARIOUS SUBSTANCES AND FLUIDS, *F. Marsden. Sheffield.*—25*th July*, 1883.—(*Not proceeded with.*) 2*d.*

The receptacle is made in two parts, the edges of which can fit tightly together; and a bolt passing through the two parts secures them together.

**3653.** "DEVONSHIRE" OR OTHER CREAM, &c., *W. Horner, Cuddington, Chester.*—25*th July*, 1883.—(*Not proceeded with.*) 2*d.*

This consists in heating cream in vessels by steam so as to obtain a perfectly uniform heat.

**3656.** AUTOMATIC FLUSHING APPARATUS, *W. B. G. Bennett, Southampton.*—25*th July*, 1883.—(*Not proceeded with.*) 2*d.*

A tank is connected to the sewer or drain by a pipe, and at about the desired level of water in the tank is an elongated open float, pivotted at its sides to supports in such position that its normal position when the tank is empty tends to the vertical. The heavier end of the float acts as a counterpoise to a ball valve.

**3660.** MOTORS FOR TRAM-CARS, &c., *J. T. Dann, Brixton.*—26*th July*, 1883.—(*A communication from C. Brown, Switzerland.*)—(*Not proceeded with.*) 2*d.*

Upon one driving axle two driving wheels run loose, being compelled by differential gearing to revolve along with such axle, thus adapting themselves to any curve. Upon the frame supporting the axle is mounted a mechanical motor.

**3661.** STREET OR OTHER GRATINGS, *E. Jordan, Cardiff.*—26*th July*, 1883.—(*Not proceeded with.*) 2*d.*

The gully box is covered by a grating which is secured by a bolt which can be actuated by inserting a key in an opening in the grating.

**3666.** SHIPS OR OTHER VESSELS, *W. P. Thompson, London.*—26*th July*, 1883.—(*A communication from H. Le Roux, Paris.*) 6*d.*

The vessel is characterised by a belt of air spaces with water-tight compartments existing on the outside on its upper parts, and by the arrangement of a flat bottom extending the whole length of the vessel at its middle, and depressed or at a different level so as to form a kind of channel filled by relatively calm water, giving the effect of water ballast.

**3667.** TOOL FOR USE IN THE MANUFACTURE OF BOOTS AND SHOES, *A. J. Boult, London.*—26*th July*, 1883. —(*A communication from S. Fejes, Hungary.*)—(*Not proceeded with.*) 2*d.*

This relates to a tool for enabling the superfluous parts of the sole to be removed without danger of injuring the upper.

**3669.** PROPELLING AND STEERING SHIPS, *G. W. von Nawrocki, Berlin.*—26*th July*, 1883.—(*A communication from A. F. Barth, Germany.*)—(*Not proceeded with.*) 4*d.*

A cylindrical shell has two pipes branching in opposite directions and fitted water-tight on each side of the hull of the ship. Within the shell is a six-bladed screw propeller composed of three two-bladed screws with the blades at an angle of 60 deg. The shaft is rotated, so that the screw draws water into the pipes and forces it through the shell to the back of the blades. The rear part of each tube is provided with a flap valve.

**3672.** MILLINERY AND OTHER TRIMMINGS, *W. Askham, Nottingham.*—27*th July*, 1883.—(*Not proceeded with.*) 2*d.*

This relates to a machine provided with fluted rollers by means of which reversely fluted or pleated trimmings are produced.

**3675.** MATS OR FLOOR COVERINGS, *R. Martinez, New York.*—27*th July*, 1883. 2*d.*

This relates to slatted mats in which rods or slats of wood are jointed together so as to roll up, and it consists in encircling the rods at the junctions by means of rubber to form an elastic bearing on the floor. Other improvements are described.

**3676.** APPARATUS FOR ENABLING PERSONS TO REMAIN WITHOUT DANGER IN ROOMS OR SPACES FILLED WITH SMOKE, DUST, &c., *L. A. Groth, London.*—27*th July*, 1883.—(*A communication from B. Loeb, jun., Berlin.*) 8*d.*

A smoke cap is placed over the head and fastened to the body, elastic bands ensuring a close fit. To the cap is fitted an apparatus provided with suitable valves to enable the wearer to breathe properly, the entering air being filtered through suitable materials.

**3679.** SMELTING AND REFINING FURNACES, *N. Frère, Belgium.*—27*th July*, 1883. 4*d.*

This consists chiefly in adding to the furnace proper a purifying or refining tank, which receives the molten metal from the furnace for the purpose of separating the metal from its slags, the tank being heated by a part of the hot gases from the main furnace.

**3680.** REFRIGERATING APPARATUS FOR PRESERVING MILK, &c., *D. Chapman, Manchester.*—27*th July*, 1883.—(*Not proceeded with.*) 2*d.*

This consists in placing air-tight ice receptacles in vessels used to convey milk.

**3681.** SLIDING CHANDELIERS AND GASELIERS AND PENDANT LAMPS, &c., *J. Nadal, London.*—27*th July*, 1883. 6*d.*

The object is to dispense with the weights usually employed to support vertically sliding gas pendants, and it consists in substituting therefor spring barrels, to which one end of a metal ribbon is secured, the other end thereof being secured to the bottom of the fixed or supporting gas tube.

**3682.** APPARATUS FOR EMPTYING THE CONTENTS OF CENTRIFUGAL MACHINES, &c., *G. H. Bolton, Widnes.*—27*th July*, 1883.—(*Not proceeded with.*) 2*d.*

Upon the stationary framework of the centrifugal or other stationary base is fixed an adjustable spout, which has a chisel or gauge-shaped end, and can be made to dip down into the centrifugal cage with its edge facing the way the machine is rotating, whereby the machine can be emptied without stopping it.

**3683.** LIFE RAFTS, *A. H. Williams, London.*—27*th July*, 1883. 6*d.*

The raft is composed of two or more flat air-tight chambers jointed together and arranged to form a seat when folded, a folding contrivance or compartment being arranged between any or all of the flat chambers.

**3685.** FASTENINGS FOR SECURING FOLDING BOOK-CASE AND OTHER DOORS, &c., *W. A. Bonella, London.*—27*th July*, 1883. 6*d.*

This relates to means for ensuring the fastening of one of the doors by the action of closing the other, and it consists in causing the second door to come in contact with an arm pivotted to the casing and forcing it into a recess in the door which is first closed.

**3686.** MACHINERY FOR CUTTING OR BREAKING UP SUGAR CANE INTO LENGTHS, *J. Thornton, Cleckheaton.*—28*th July*, 1883.—(*Not proceeded with.*) 2*d.*

A rotary knife is arranged on a spindle, parallel to which is a cylinder with apertures at intervals, into which the canes are placed, the cylinder and knife running in opposite directions. An emery wheel or stone bears on the knife so as to keep it sharp and clean.

**3687.** CHAIRS, *F. C. Glaser, Berlin.*—28*th July*, 1883. —(*A communication from F. W. A. Erdmann and H. Ruperti, Germany.*) 8*d.*

This relates to chairs with adjustable seats, backs, and footboards or leg-rests, and it consists in constructing the seat so that it can slide backwards or forwards on the framing. The back is hinge-jointed to the seat, and is supported by the arm rests which are jointed to the framing, so that by adjusting the seat the angle of the back is also altered. To the front edge of the seat is hinged a footboard or leg-rest, which is adjustable to form any angle with the seat.

**3688.** APPARATUS FOR GUIDING CHAINS OR ROPES TO WINCH AND OTHER BARRELS, *R. J. Rudd, Croydon.*—28*th July*, 1883. 6*d.*

The object is to guide chains or ropes to barrels so that there is no tendency to irregularity in its convolutions thereon, and it consists in leading the rope or chain through an eye or over a guide pulley, and then over a second guide pulley arranged to travel in a parabolic curve of which the first eye is the focus, the axis of the barrel being parallel to the directrix.

**3689.** SPINNING AND ROVING MACHINERY, *T. E. Smith, Keighley.*—28*th July*, 1883. 6*d.*

This relates to ring spinning and roving machinery, the object being the better manipulation of short-stapled fibrous substances in such a manner that the production of the yarn or roving is greatly increased, contains less "twist," and therefore softer than when operated upon in the ordinary manner; and it consists in mounting on the rings travellers of less weight than ordinarily used, and in conjunction with such travellers using a rod on which is secured a number of brushes for the purpose of retarding the travellers, which would otherwise overrun the bobbins and cause the fibre to "snarl" when the machine is started.

**3692.** SYSTEM OF ELECTRICAL DISTRIBUTION, *St. G. L. Fox, London.*—28*th July*, 1883. 6*d.*

High tension currents are generated at any suitable spot where power may be cheaply obtained. These currents are employed to drive motors having coupled on their shafts generators, by which currents of the requisite tension are produced at the places where the light or power is required.

**3694.** MACHINERY FOR PREPARING AND SPINNING YARNS OF ALL FIBRES, &c., *W. Lancaster, Accrington.*—28*th July*, 1883. 6*d.*

This relates, First, to a holder for carrying improved flyers, travellers, or drag wires, such holders consisting of one or more plates, and being connected together in a novel manner to any angle lifting bar; Secondly, to the use of a spaced, or slotted, or grooved plate as a guide for the yarn between the delivery rollers and the spindles; Thirdly, in the use of a thin plate, presenting its edge to the yarn, to assist in propelling the twist ascending from and given by the motion of the spindles and drag wires to the delivery rollers; Fourthly, to a novel mode of putting into action and relieving a brake for the purpose of suddenly arresting the motion of continuous spinning machines when the strap is removed from the fast to the loose pulley.

**3696.** ASCERTAINING AND RECORDING SPEED OF VESSELS, *F. H. F. Engel, Hamburg.*—28*th July*, 1883.—(*A communication from O. Pezoldt, Hamburg.*) 6*d.*

This consists mainly of a small float-board wheel connected to a frame that can be lowered in guides of a vertical channel in the vessel, such channel being open at the bottom. The wheel, when lowered so as to project from the channel, is caused to revolve, and the motion is transmitted by gearing to a vertical shaft, the top end of which is in connection with a counter and dial.

**3697.** PANTOGRAPHS, *C. Pieper, Germany.*—28*th July*, 1883. 6*d.*

This relates to extension frames of apparatus for reducing or increasing the size of printing by means of a sheet of india-rubber, which is attached to the extension frame by cramps, such frame consisting of a number of bars connected together so as to form a kind of lazy tongs. A press is described for enabling the rubber sheet to receive the impression, or to transfer it to stone.

**3698.** STATION INDICATORS, *S. Ballin, Hamburg.*—28*th July*, 1883. 8*d.*

This relates to gearing connected to the vehicle to which the apparatus is applied for the purpose of actuating a band in such a manner as to indicate the station the vehicle has next to pass.

**3699.** APPLIANCE AND PROCESS FOR THE TREATMENT OF WASTE PRODUCTS, &c., *W. J. Brewer and A. Binns, London.*—28*th July*, 1883.—(*Not proceeded with.*) 2*d.*

The object is to extract grease or oil from waste products, and it consists in treating such products in a steaming vat having a perforated floor, under which is a coil of steam piping. After being steamed the waste products are subjected to pressure, and the grease extracted is treated to produce soap, or to render it available as a lubricant. The residue is utilised to form "briquettes" to be used as fuel, to form artificial leather, and for other purposes.

**3700.** CHAPLETS OR CORE SUPPORTS FOR MOULDS FOR CASTING, *T. Samson, Greenock.*—28*th July*, 1883.—(*Not proceeded with.*) 2*d.*

The chaplets consist of studs with flat heads or discs and shanks, which are supported with their discs uppermost, and the ends of the shanks just entered into holes in a piece of sheet iron.

**3701.** APPARATUS FOR INCREASING THE VENTILATION IN CHIMNEYS AND MINES, &c., *J. Davies, Llanfyllin.* 28*th July*, 1883.—(*Not proceeded with.*) 2*d.*

In the chimney or shaft a series of revolving fans are mounted, such fans consisting of three longitudinal vanes placed parallel with the axis, the breadth of the vane being less than half the depth of the chimney from front to back, and the length such as will almost fill the area of the chimney.

**3702.** DYNAMO-ELECTRIC MACHINES OR ELECTRIC GENERATORS, *S. Z. de Ferranti and A. Thompson, London.*—28*th July*, 1883. 1*s.* 4*d.*

It is proposed to obtain better insulation by enamelling the cores of electro-magnets. When the conductors are zig-zag metallic bars interposing rods of insulating material are used, the several conducting strips lying side by side, being insulated by studs of material carried in depressions in the sides of the strips. In place of forming the zig-zag armature conductor of patent 3419, of 1882, of one single bar, it is now formed of several strips overlying one another, and insulated from each other, so as to avoid Foucault currents. A generator is described so constructed that each of the strips shall be made to start and finish at different points of the armature's circumference. The invention further relates to a belt tightener, to means of collecting the current from contact rings on the axle, and to the construction of a continuous current generator.

**3706.** STEAM STEERING APPARATUS, *J. Downton and E. Wimshurst, London.*—28*th July*, 1883. 6*d.*

The objects are to simplify the construction of steam steering gear, to render it direct-acting, to bring it under the complete control of the steersman, and to provide a cushioning when the rudder is acted on by a heavy seat. The apparatus being situate near the stern of the vessel, a horizontal double-acting trunk engine is provided, and the trunk connected with the tiller by a link rod. The cylinder being fitted with an ordinary slide valve will admit steam to either side of the piston, and open the exhaust passage to either side thereof, the valve being operated by a hand lever. An exhaust valve in the exhaust passage is controlled by a second lever. The steam on one side the piston forms a cushion.

**3707.** MANUFACTURE OF PLATES OR MOULDS FOR USE IN OBTAINING IMPRESSIONS OR FAC-SIMILES REPRESENTING LACE, MEDALLIONS, &c., *R. Lanham, London.*—28*th July*, 1883. 4*d.*

Heavy lace is immersed in a solution of alum and water, and when dry is sized on the back and laid on a piece of conducting paper, and used as a matrix to obtain a stereotype in the usual manner. For fine lace an impression of the lace is taken in wax, and from it the stereotype is produced.

**3708.** MANUFACTURE AND PURIFICATION OF ILLUMINATING AND OTHER GASES, &c., *A. G. Henderson and J. A. Kelman, London.*—30*th July*, 1883. 10*d.*

This relates, First, to a washer scrubber for the purification of gas from ammonia, tarry matters, and other well-known impurities; Secondly, to the condensation and partial purification of the gas preparatory to its passage to the scrubber; and, Thirdly, to the recovery from the liquid deposited in the hydraulic main of certain illuminating properties taken from the gas while passing through it, and restoring the same to the gas before passing to the condensers; and also to the partial purification of the gas so treated.

**3709.** MANUFACTURE OR PRODUCTION OF BACKGROUNDS FOR PHOTOGRAPHIC AND OTHER PICTURES, *F. A. Marra, London.*—30*th July*, 1883.—(*Not proceeded with.*) 2*d*

This consists in the use of a metal in a pulverised state, which is caused to adhere to the material on which the paper is produced by means of adhesive material so as to form the background.

**3710.** APPARATUS FOR CUTTING DOUBLE-WOVEN VELVETS AND OTHER SIMILAR FABRICS, *H. Springmann, Berlin.*—30*th July*, 1883.—(*A communication from E. Cohnitz, Germany.*)—(*Not proceeded with.*) 2*d.*

A circular knife is fixed by a central screw to a reciprocating carrier or slide, and the projecting edge moved in the plane in which the double fabric is to be divided.

**3711.** MACHINES FOR BREAKING OR REDUCING GRAIN, *H. Springmann, Berlin.*—30*th July*, 1883.—(*A communication from A. C. Nagel, R. H. Kaemp, and A. Linnenbrügge, Hamburg.*) 6*d.*

This relates to machines in which grain is reduced between discs having annular reducing surfaces, and it consists, First, in constructing the operating surfaces of the discs so that the grain is split lengthwise, for which purpose the surfaces at their inner parts diverge towards the centre of the discs, which are provided with throwing ledges, between which and the reducing surfaces there is a considerable space; Secondly, in arranging fan blades to draw air through the discs to ventilate same; Thirdly, in the means for fastening detachable rings bearing the reducing surfaces to the discs; and Fourthly, in means for regulating the distance between the reducing surfaces, and the degree of pressure which they exert on the grain.

**3712.** WICK HOLDERS FOR RAILWAY CARRIAGE AND OTHER LAMPS, *W. P. Thompson, London.*—30*th July*, 1883.—(*A communication from J. Scrafton, India.*) 4*d.*

This consists in providing the wick holder with a series of points which prevent the wick slipping or shaking down, one side of the holder being hinged to enable the wick to be taken off such pins when necessary.

**3715.** FASTENER FOR GLOVES, BOOTS, &c., *H. Pataky, Berlin.*—30*th July*, 1883.—(*A communication from C. Distel, Germany.*)—(*Not proceeded with.*) 2*d.*

The fastener consists of a tube which is passed through the button-hole, and has a slot on one side in which moves a pin ending in a knob inside the tube.

**3716.** ROOF COVERING, *H. Pataky, Berlin* —30*th July*, 1883.—(*A communication from C. Wildhagen, Germany.*)—(*Not proceeded with.*) 2*d.*

This relates to a material for covering roofs, and consisting of four parts vegetable filaments, two parts finely sifted pit coal, and one part coal tar, sufficient water being added to form a stiff mortar.

**3717.** REFINING PARAFFINE, *C. Crellin, Leytonstone.*—30*th July*, 1883.—(*Not proceeded with.*) 2*d.*

The paraffine is melted in a vessel and kept at a temperature of about 170 deg. Fah., 17 lb. of sulphuric acid is added and the whole agitated. After settling, the impurities are drawn off at the bottom, and the operation repeated. The temperature is allowed to fall to 160 deg. Fah. and 17 lb. sulphuric acid and 34 lb. water added, the impurities being again drawn off. The melted paraffine is then treated with Fuller's earth and the temperature raised to 180 deg. Fah., the impurities being removed, and the operation repeated, raising the temperature to about 220 deg. Fah.

**3718.** ASPHALTE APPARATUS, *B. D. Healey, Brighouse.* —30*th July*, 1883.—(*Not proceeded with.*) 2*d.*

This relates to improvements on patents No. 2733, A.D. 1876, No. 4297, A.D. 1881, and No. 3783, A.D. 1882, and consists in various alterations in the construction of pans used for melting pitch and producing hot bituminous compounds of tar and pitch.

**3720.** TREATMENT OF SOAP LIQUORS OR SUDS, &c., AFTER USE IN THE WASHING OF RAW SILK PREPARATORY TO ITS MANUFACTURE OR DYEING AND IN THE RECOVERY OF USEFUL PRODUCTS THEREFROM, *A. Crossley, near Bradford.*—30*th July*, 1883.—(*Not proceeded with.*) 2*d.*

This consists in recovering fatty acids and nitrogenous hydrocarbons from soap liquors or suds from the washing of raw silks, by treating them first with an acid and separating the fatty acids by filtration or skimming, and then evaporating the liquor with or without the addition of an alkali for the recovery of the nitrogenous hydrocarbons.

**3719.** SCREW HOOKS, SCREW PEGS, SCREW RINGS, AND PLATE RINGS, *S. W. and J. A. Richards, Birmingham.*—30*th July*, 1883. 6*d.*

A screw hook is formed by making a thread on one end of a length of iron wire and covering the other end with a brass tube. A washer is placed at the junction of the tube and the iron base, and secured by closing tools which cause it to enter depressions in the hook.

**3721.** INDICATING AND CHECKING RECEIPTS OF MONEY, *H. Lyon, London.*—30*th July*, 1883.—(*Not proceeded with.*) 2*d.*

This relates to improvements on patent No. 3134, A.D. 1880, and consists in the means for actuating the mechanism.

**3722.** STOP MOTIONS FOR LOOMS, *A. W. L. Reddie, London.*—30*th July*, 1883.—(*A communication from Messrs. Pruvot Bouy et Compagnie, Paris.*) 6*d.*

This relates to a novel arrangement of stop motion for looms, whereby on the shuttle failing to enter the shuttle box the motion of the batten will be gradually arrested without shock, the brake will be applied to the fly-wheel, and the driving belt shifted to a loose pulley.

**3723.** DOORS OF GAS RETORTS, *J. Bartle, London.*—30*th July*, 1883. 4*d.*

The object is to fit a door of a gas retort. so that a sliding rising action be given to it while being tightened up by the screw, and also that a sliding falling action be given to it to release it from contact with the face of the barrel, whereby the door is dislodged from the tar in an easy manner when being released for opening and ensures a close fit without the usual luting. The end of the tightening screw is conical and enters a recess in the door, and when turned raises the latter, which is hung loosely upon its hinges.

**3724.** APPARATUS FOR TRANSMITTING AND RECEIVING TELEPHONIC MESSAGES, &c., *G. F. Redfern, London.* —30*th July*, 1883.—(*A communication from C. Mildé fils et Cie and C. T. A. d'Argy, Paris, and C. F. Lund, Copenhagen.*)—(*Not proceeded with.*) 2*d.*

Relates to a microphone transmitter, a receiver, and a call bell.

**3725.** TREATMENT OF BITUMINOUS SHALES LARGELY IMPREGNATED WITH SULPHUR, &c., *C. M. Irvine, Blackwood, N.B., and R. Slater, Blackheath.*—30*th July*, 1883. 4*d.*

Shales containing large quantities of sulphur are distilled at a low heat, and the watery and oily distillates condensed. The gases are conducted from the retorts, and treated either to produce sulphuric acid or to eliminate the sulphur.

**3726.** ORGANS, *T. C. Lewis, London.*—30*th July*, 1883. 6*d.*

Organs operating upon the "pneumatic" principle are actuated by electricity by combining with them auxiliary "pneumatics" acted upon by electro-magnets.

**3729.** MACHINES FOR DRILLING OR PERFORATING ROCKS, &c., *A. Shedlock, New York.*—31*st July*, 1883. 6*d.*

The drill is adapted to be operated by one man, for whom a seat is provided, and who actuates two crank handles, fitted to a shaft mounted in the top of the frame, and which actuates by bevel wheels a vertical shaft. This shaft causes a cam to rotate and raise a tool holder. A spring is located between the bottom of the cam and the tool holder, to force the tool on to the rock when the holder is released. Projections are formed outside the holder, and bear against ribs on the cylindrical body to cause the tool to revolve.

**3731.** LOCKS OR DAMS, *W. P. Thompson, Liverpool.*—31*st July*, 1883.—(*A communication from J. Du Bois, Pennsylvania.*) 6*d.*

This relates to improvements in the flexible dams, composed of hinged leaves, controlled by the admission of water thereunder, described in patent No. 4453, A.D. 1881; and it consists in means for compelling such dams to rise and fall uniformly throughout its length, and also to allow the joints to have a limited sliding movement.

**3732.** APPARATUS FOR CARBONISING WOOD AND SIMILAR SUBSTANCES, *W. P. Thompson, Liverpool.*—31*st July*, 1883.—(*A communication from J. A. Mathieu, Detroit, U.S.*) 6*d.*

A main retort has at the bottom a neck descending into a large iron tank, and around it smaller inclined retorts, with covers at top, are arranged, and beneath them are combustion chambers, communicating with flues extending along the inner sides of the retorts. Pipes lead gas to the combustion chamber, and other pipes lead gas into the main retort, and are coiled in the flues under the small retorts. The small retorts are charged with wood, and the tank below the main retort is filled with pyroligneous acid. The fires are lighted in the combustion chambers, and the gases evolved pass down through the carbonising material, and through a condenser. Carbonisation in the main retort proceeds from the top downwards.

**3735.** ELECTRO-DYNAMIC MACHINES, *H. J. Allison, London.*—31*st July*, 1883.—(*A communication from R. N. King, Dayton, Ohio, U.S.*)—(*Not proceeded with.*) 4*d.*

Relates to the construction of a self-ventilating armature, to the construction of the commutator, to a duplex series of brushes, arranged so as to lessen the resistance due to the reversals of the coils, and to a serial circuit connection of the commutator and a series of brushes bearing thereon.

**3736.** HATS, CAPS, OR OTHER COVERINGS FOR THE HEAD, *W. R. Lake, London.*—31*st July*, 1883.—(*A communication from A. C. Couch, Boston, U.S.*) 6*d.*

This relates to the use of sheets of mica in head coverings.

**3738.** BARBED FENCING, *W. C. Johnson and S. E. Phillips, London.*—31*st July*, 1883.—(*Not proceeded with.*) 2*d.*

Holes are made in strips of iron, and the spikes of nails inserted therein, and secured by galvanising.

**3739.** PENCIL-CASES OR HOLDERS, ALSO APPLICABLE FOR PENS, CRAYONS, &c., *F. Haffner, London.*—31*st July*, 1883.—(*A communication from E. Mahla, Germany.*)—(*Not proceeded with.*) 2*d.*

The pen or pencil is propelled from the holder when pressure is applied to one end, and a knob enters a hole in the case to hold the pen in position, and acts on the knob when it is released from the hole, so as to force the pen back into the holder.

**3740.** APPARATUS CONNECTED WITH WATER-CLOSETS, *T. W. Helliwell, Brighouse.*—31*st July*, 1883. 6*d.*

This relates, First, in apparatus for preventing gases returning from the fall pipe into the closet basin, and consists of two hinged straps, one placed at the orifice of the outlet pipe, which empties into a box at the top of the main discharge pipe, the outlet of such box being fitted with a second hinged trap. A ventilator is arranged between the two traps. Secondly, in making the outlet or fall pipe in two parts lengthwise, the joints of which are packed and secured by bolts, so that the front half can easily be removed.

**3741.** STAYS OR CORSETS, *W. H. Symington, Market Harborough.*—31*st July*, 1883. 4*d.*

The object is to strengthen the seams, and also to provide means of ventilation and to ornament the stays; and it consists in arranging eyelets down the seams,

**3742.** REGENERATIVE GAS-LIGHTING APPARATUS, *A. S. Bower, St. Neots, and T. Thorp, Whitefield.*—31*st July*, 1883. 6*d.*

To a central gas supply pipe is attached a ring burner. The burner is of steatite or other suitable material. Around the supply pipe above the burner is a regenerator, consisting of vertical tubes, through which the products of combustion pass. To this regenerator a short tube is attached above the burner, and in this tube is a perforated plate. A perforated annular curved plate deflects the flame inwards, and between the deflector and the lower plate of the regenerator are a number of projections contained in a

chamber forming a secondary regenerator. A tube below the burner is perforated to admit air.

**3743.** Looms for Weaving, *W. Houghton and E. Knowles, Gomersal, and H. Bradbury, Leeds.*—31*st July*, 1883. 8*d.*

This relates to jacks for operating the healds. On the front top rail is fixed a bracket having a projecting slotted arm. On the front top rail is fixed a similar bracket; the two brackets carrying a grooved shaft on which the radial jacks are mounted. At one end of the shaft is a slotted lever for imparting partial radial or to-and-fro motion thereto, by a connecting rod driven from the crank shaft. Within each jack is fitted an L-shaped needle having a spiral spring thereon, the cranked end of the levers being acted upon by a peg, lag, or other card mechanism, and the point of each needle being forced into the groove in the shaft and forming a key for the jack, causing the latter to partially rotate with shaft. On the projecting arm of the top rail bracket is a holding and stop plate.

**3744.** Furnaces for Carbonising Woollen Rags, *W. Brierley, Halifax.*—31*st July*, 1883.—(*A communication from E. Rosskam, Germany.*) 6*d.*

The furnace comprises a series of steam-heating pipes for heating the sieves containing the material to be carbonised, together with a carriage for running the sieve in and out. The fire gases from two hearths heat plates carrying vessels filled with hydrochloric acid.

**3746.** Tobacco Pipes, Cigar and Cigarette Holders, *H. de M. Wellborne, London.*—31*st July*, 1883.—(*Not proceeded with.*) 2*d.*

A glass tube is placed in the mouthpiece, and one end has an enlargement in which cotton wool is placed to absorb the nicotine from the tobacco.

**3749.** Releasing Harnessed Cattle from Vehicles, *W. Corbould, London.*—31*st July*, 1883.—(*Not proceeded with.*) 2*d.*

This relates to a system of levers, rods, bolts, springs, and cords, to enable the drivers of vehicles to release cattle from vehicles.

**3750.** Springs to Assist in the "Dollying" or "Possing" of Clothes, &c., *J. Sample, Newcastle-upon-Tyne.*—31*st July*, 1883.—(*Not proceeded with.*) 2*d.*

The dolly or poss stick is suspended by a cord to an elastic spring above, so that when forced down into the tube the spring will be compressed and tend to raise the stick for the next down stroke.

**3751.** Pencils, Pencil-cases, Pen-holders, &c., *J. Hickisson and W. Lee, London.*—31*st July*, 1883.—(*Not proceeded with.*) 2*d.*

This relates to the combination with a pencil, penholder, penknife, or like article, of a cigar-cutter or nipper, and a tape measure or receptacle for postage stamps.

**3752.** Apparatus for Engraving or Cutting Glass, &c., *J. H. Johnson, London.*—31*st July*, 1883.—(*A communication from R. Josia, Florence.*)—(*Not proceeded with.*) 2*d.*

The apparatus consists of arms or pallets revolving in a case supplied with sand or emery, which is projected by centrifugal force against the surface to be engraved or cut, the parts not to be acted upon being covered with a protective covering.

**3753.** Tools and Apparatus for Cleaning the Interior of Steam Boilers and other Tubular Structures, *J. Jefferies, Gravesend, and C. Thomson, London.*—31*st July*, 1883.—(*Not proceeded with.*) 2*d.*

Tools with teeth are employed to clean the surfaces of the tube-plates between the tubes, and spring tools are used to clean between the tubes.

**3754.** Apparatus for Ventilating, Heating, Deodorising, or otherwise Treating the Atmosphere of Rooms, Houses, and Buildings, *C. M. Tate, London.*—31*st July*, 1883.—(*Not proceeded with.*) 2*d.*

A cylindrical vessel is provided with a screen and a chamber to receive a lamp, and also a pipe entering the lower part, and provided with a mouth-piece at its opposite end terminating at or near the upper part of the room.

**3757.** Mowing and Reaping Machines, *E. Pratt, Uxbridge.*—31*st July*, 1883. 2*d.*

This consists in forming projections on the driving wheels of mowing or reaping machines by casting them in chills, while the wheels themselves are cast in sand, the object being to prevent the wheels slipping when travelling over the ground.

**3760.** Automatic Flushing and Antiseptic Tank, *F. J. Austin, London.*—1*st August*, 1883. 6*d.*

Running up from the bottom and near the centre of a tank is an outflow pipe, over which, extending to near the bottom of the tank, is another pipe, closed at top. The water supply is regulated by a ball tap. Over the tank is a second tank, containing disinfecting fluid, and fitted with a ball valve, operated automatically simultaneously with the discharge of water into the cistern or first tank.

**3761.** Stair Pads, *T. Griffith, Manchester.*—1*st August*, 1883. 2*d.*

This consists in forming a pad to receive carpets of one thickness of felt and stitched around the edges.

**3763.** Electric Clocks, *G. M. Herotizky, Hamburg.*—1*st August*, 1883. 6*d.*

The "function" of the current is regulated by a vibrating pendulum which automatically receives an impulse every minute.

**3764.** Street Cleaners and Snow Removers, *B. J. B. Mills, London.*—1*st August*, 1883.—(*A communication from A. J. Reynolds, Chicago.*)—(*Not proceeded with.*) 2*d.*

This relates to a combined road sweeper and wagon, suitably actuated so as to automatically load the dirt or snow swept up by the sweeper into the wagon.

**3765.** Means for Supporting Trousers, *J. H. Topham, Manchester.*—1*st August*, 1883. 6*d.*

Two buttons are secured at each side of the trousers to receive loops or tabs formed at the opposite ends of an adjustable band, which passes round the back of the trousers.

**3766.** Apparatus for Damping, Separating, and Affixing, &c., Stamps, Tickets, Labels, and other Articles, *J. H. Topham, Manchester.*—1*st August*, 1883. 6*d.*

The stamps or tickets are passed in strips through rollers, which advance them a given distance each time a plunger is caused to descend. The lower roller dips in water or gum, and the top roller may be caused to print the ticket. The plunger in descending cuts off each ticket, and its further movement affixes it to the article to which it is to be applied.

**3770.** Gates, *R. Allen, Wolverhampton.*—1*st August*, 1883. 6*d.*

The uprights are of wood and the horizontal bars of iron, and a diagonal piece of wood is tenoned into the top of one and the bottom of the other upright. Two shorter diagonal pieces are tenoned one to the middle of each upright, and extend one above and the other below the main diagonal piece to near the middle of the gate. All the horizontal bars pass through the diagonals. The top bar is formed in one with the top hinge, and the other end receives a nut outside the upright. The bottom bar is also fitted with nuts outside each upright.

**3771.** Machines for Making Envelopes and similar Receptacles, &c., *J. C. Mewburn, London.*—1*st August*, 1883.—(*A communication from A. T. Howard, Brooklyn, U.S.*)—(*Not proceeded with.*) 2*d.*

A blank is taken by a pneumatic suction device from the top of the pile and delivered to an endless carrying belt, which carries it through the folders for the end flaps, which consist of folding blades over which the flaps are folded by narrow belts. Gum or paste is applied by a gumming roll. The bottom flap is folded by a tumbler mounted on axial pivots.

**3772.** Machinery for Cutting Metals, *W. W. Hulse, Manchester.*—1*st August*, 1883. 6*d.*

In drilling and boring machines the boring spindle is carried on a slide movable vertically in guides in a standard fixed at any desired part of a base plate. Stays carrying the cutting bar are fixed on the base plate and can be adjusted vertically with the boring spindle. The tables are secured to the base plate, and each is provided with a slide movable in guides, to which the work is secured. The invention further relates to machines for punching and shearing, and also for planing metals.

**3776.** Arrangements and Mechanism for Grinding, Glazing, and Polishing Articles of Metal, *R. Wallwork, Manchester.*—2*nd August*, 1883. 10*d.*

The principal feature consists in entering the article to be operated upon between a rotary grinding, glazing, or polishing surface, and an india-rubber roller which presses the article against the operating surface and prevents it moving except at the speed imparted to the india-rubber roller.

**3777.** Producing Golden Sulphuret of Antimony or Pentasulphide of Antimony, *A. G. Brooks, London.*—(*A communication from T. Sanders, Haverhill, U.S.*) 4*d.*

This consists in producing golden sulphuret of antimony by dissolving native sulphide of antimony and free sulphur separately in saturated solutions of caustic alkali, and afterwards adding the same together and heating the mixture with acid.

**3778.** Gongs for Bicycles, Tricycles, &c., *F. U. Bolton, Birmingham.*—2*nd August*, 1883. 6*d.*

The part of the handle of bicycles which is gripped by the hand can be revolved, so as to actuate the hammer of a bell or gong.

**3779.** Apparatus for the Regulation of the movement of the Carbons or Electrodes in Electric Lamps, *E. G. Brewer, London.*—2*nd August*, 1883.—(*A communication from La Société Anonyme des Ateliers de Construction Mecaniques et d'Appareils Electriques, Paris.*) 10*d.*

The descent of the upper carbon imparts a rotary motion to a vertical central screw. This screw is provided with two nuts, one of which regulates the movement of the screw, while the other, under the influence of a rising plate operated by electro-magnets, imparts either backward or forward motion to the screw. Various methods of applying this principle are described and illustrated.

**3781.** Razors and Razor Sheaths, *T. Clarke, Sheffield.*—2*nd August*, 1883. 4*d.*

The handle is made hollow, and forms a sheath or case, into which the blade can slide when not in use.

**3785.** Setting and Distribution of Type, &c., *W. R. Lake, London.*—2*nd August*, 1883.—(*A communication from B. P. y Albizu, Madrid.*) 8*d.*

A speaking tube is fitted into an aperture in a wheel, which is caused to rotate intermittently, and bring the tube successively in front of a series of tubes leading to the compositors, whereby each compositor hears a portion of the dictation of a single person extending over a fixed period. The compositor sets the type by depressing the keys of a composing apparatus.

**3787.** Plaiting Machines suitable for Making Candle Wicks, &c. *L. J. Pirie, Birkenhead, and H. Findlay, London.*—2*nd August*, 1883. 6*d.*

This consists in actuating the switches of plaiting machines independently of the bobbins and bobbin spindles or holders, by means of a crank or equivalent appliance.

**3790.** Automatic Brakes for Tramway Cars, &c., *E. B. Price, Antrim.*—2*nd August*, 1883. 6*d.*

This consists in the use of a centrifugal governor and of a friction clutch, to which the brake blocks are connected, the governor and clutch being arranged so that the brake blocks—which are held free of the wheels while the vehicle travels at the proper speed—will be automatically applied when an excessive speed is attained.

**3791.** Direct-acting Pumping Engines, *W. Clark, London.*—2*nd August*, 1883.—(*A communication from E. G. Shortt, Carthage, New York.*) 8*d.*

This relates to pumps in which the pump piston and steam piston are connected together, and work in unison in a case, one end of which forms the pump, and the other end the steam engine, and it consists in making the cylinder open at both ends, and surrounding its ends by independent chambers providing a plunger playing in the cylinder, a valve opening outward from one of the chambers, and a valve opening outward from one chamber and inward to the other chamber, whereby the pump is made on one stroke to expel water from one chamber and fill the other from the main supply; and on the other stroke is made to transfer the water from one end chamber to the other.

**3792.** Egg Decapitator, with Rotating Blade, *A. C. Henderson, London.*—3*rd August*, 1883.—(*A communication from L. Olivier Paris.*)—(*Not proceeded with.*) 2*d.*

A metal ring has at the bottom a spiral spring, and at top a rotating disc, with a central aperture to receive the egg. On the disc a cutting blade is mounted, and can be rotated by a handle.

**3793.** Manufacture of Devonshire or other Cream, &c., *W. Horner, Cuddington.*—3*rd August*, 1883. 6*d.*

This consists in heating cream or milk in vessels by steam, so as to obtain a perfectly uniform heat.

**3794.** Applying Printed Designs to Stoneware, &c., *J. Miller, Glasgow.*—3*rd August*, 1883. 4*d.*

The design on paper is transferred to the article, and the paper is then rubbed over the outside with a volatile liquid, such as turpentine or paraffine oil, when the paper can be removed, leaving the design behind. The volatile liquid causes the medium of the pigment to completely evaporate off the surface of the article.

**3795.** Lifeboats, *G. Skelton, London.*—3*rd August*, 1883. 6*d.*

This relates to the construction of metallic lifeboats with air chambers.

**3796.** Embroidering Frames, also Applicable to Curtain Stretching Apparatus, &c., *W. A. Brabner, Manchester.*—3*rd August*, 1883.—(*Not proceeded with.*) 2*d.*

This relates to a frame to hold fabrics for embroidering thereon, and consists in inserting the ends of the fabric into slots in the frame, and securing them therein by means of a bar provided with a series of needle points.

**3797.** Screw Nuts and Arrangements for Locking or Fastening the same, *J. Heap, Ashton-under-Lyne.*—3*rd August*, 1883. 6*d.*

One end of the nut is made conical and slits are cut in it, and the nut is used in connection with a washer on another nut formed with a conical recess to receive the conical end of the nut, so that when the latter is screwed home it is compressed and binds tightly on the screw.

**3798.** Mills with Vertical Runners for Grinding Paint, &c., *T. T. Crook, Bolton.*—3*rd August*, 1883. 6*d.*

This consists in driving edge runners by placing on the vertical pan shaft a bevel wheel gearing with bevel wheels secured to the bosses of the edge runners.

**3799.** Weighing Apparatus for Granulous, Pulverulent, and Liquid Materials, *H. J. Haddan, London.*—3*rd August*, 1883.—(*A communication from C. Munnen, Cologne.*) 8*d.*

For solid materials a receptacle is suspended from a scale beam, and contains a single compartment fitted with a valve at bottom. Two weights are mounted loose on a shaft provided with knife edges, the upper weight serving to open the inlet valves, but not until the discharge valve of the receptacle has been closed; while the lower weight serves to place the upper weight in such a position that it may fall freely to open the discharge valve. Auxiliary weights serve to put the balance through the first period of action, and to close the discharge valve. A pivotted vessel is provided for weighing liquids.

**3800.** Preparing and Painting Photographs, Prints, or Drawings to Resemble Oil Paintings on Canvas, *A. M. F. Caspar, London.*—3*rd August*, 1883.—(*Not proceeded with.*) 2*d.*

The paper on which is the photograph or print is rubbed thin on the back side, and then coated with gum, after which coarse canvas is pressed on it, and the picture, which will then be apparent on the canvas, is painted in transparent albumen colours mixed with water.

**3801.** Manufacture of Twisted Yarns or Threads, &c., *C. D. Abel, London.*—3*rd August*, 1883.—(*A communication from P. Olombel, jun., France.*)—(*Not proceeded with.*) 2*d.*

This consists in doubling on the card spinning machine two rovings or slivers, which are then formed into one doubled and twisted yarn by a spinning machine, such as the mule jenny.

**3802.** Dobbie Machines for Weaving, *P. Burns and R. McCrum, Milford, Ireland.*—3*rd August*, 1883. 6*d.*

This relates especially to dobbie machines having shifting needle plates, and it consists in shifting the plates at the proper time by using rising and falling needle plates carried in frames pivotted to the frame of the dobbie, so as to allow of their being rocked sufficiently to present the needles as required to the first, second, or other row of holes in the cards passing over the cylinders of the dobbie. A counting mechanism is described serving to stop the loom when any desired length of cloth has been woven.

**3803.** Packing-cases for Bottles, &c., *W. R. Lake, London.*—3*rd August*, 1883.—(*A communication from J. H. Livermore and C. L. H. de Hundermark, Paris.*)—(*Not proceeded with.*) 2*d.*

The case or box is provided with bars or brackets, some fixed and others sliding, and which by their shape and arrangement permit the bottles in the case to be firmly held in position.

**3806.** Apparatus for Printing from Engraved Plates, *J. H. Johnson, London.*—3*rd August*, 1883.—(*A communication from H. F. Marcilly and Utzschneider and Co., Paris.*) 6*d.*

This consists in the employment of an automatic inking and scraping or wiping apparatus in machines for printing from engraved plates.

**3807.** Railway Passenger Carriages, Cars, or Saloons, *T. Clapham, Keighley.*—3*rd August*, 1883.—(*A communication from W. H. Holmes, Chicago.*) 6*d.*

This relates to constructing railway carriages with interior side communication from end to end; also with washing accommodation and all modern conveniences, besides means for extinguishing fires, and for rescuing lives in case of fire.

**3808.** Machines for Winding Yarn or Thread, *W. Clark, London.*—3*rd August*, 1883.—(*A communication from La Société Ryo frères, France.*) 6*d.*

This relates to a machine for uniting two or more yarns or threads, so arranged that should one yarn or thread break, the winding of the yarns or threads from the bobbins of the same group is immediately arrested, and it consists in causing the threads to keep a lever in position, which, when released, falls and prevents the spool from revolving.

**3809.** Machines for Rivetting Umbrella Frames, &c., *W. Clark, London.*—3*rd August*, 1883.—(*A communication from D. M. Redmond, Philadelphia.*) 6*d.*

This consists in the combination of a plunger, feed rolls, knives, and other accessories operated by a lever mounted in a frame, the machine being intended especially for entering and cutting the rivets or pins used in making umbrella frames.

**3811.** Railway Chairs, &c., *S. Leadbeater, near Leeds.*—4*th August*, 1883. 6*d.*

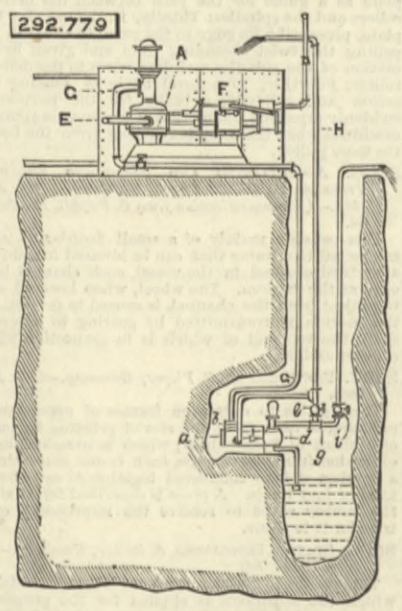
One side of the chair is formed to receive the rail, and the other is bevelled to receive a metallic key formed to fit against the other side of the rail. The inner end of the key is provided with a web to slide in a groove in the bevelled side of the chair, and a horizontal wedge or cotter is forced into a hole formed partly in the chair and partly in the key.

## SELECTED AMERICAN PATENTS.

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

**292,779.** Reciprocating Hydro-transmitter, *Wm. Baxter, Jersey City, N.J.*—*Filed March 20th*, 1883.

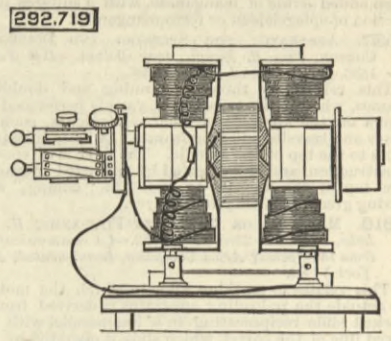
*Claim.*—(1) The combination of the direct-acting reciprocating steam pump A, with the pipe E, tank F, and reciprocating pump consisting of the cylinders *a* and *d*, the motor cylinder *a* being supplied with water by automatic valves contained in valve chest *b*, and the pump A being connected with said valve chest by a pipe G, and the motor *a* discharging its




spent water into the tank F by pipe H, as and for the purpose set forth. (2) The combination, with the discharge pipes H and *g* from the motor and drainage cylinders *a* and *d*, of the connecting cock *e* and stop-cock *i*, arranged and operated as and for the purpose set forth.

**292,719.** Electrical Generator or Motor, *Edward Weston, Newark, N.J.*—*Filed January 31st*, 1883.

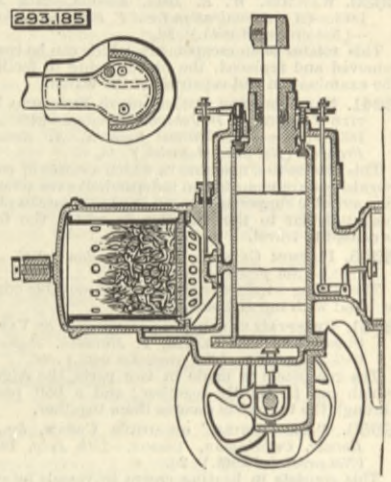
*Claim.*—(1) In a dynamo-electric machine or motor, an armature core in the form of a disc, as described, in combination with coils wound thereon in a direction parallel with the axis of rotation of the core, substantially as set forth. (2) In a dynamo-electric machine or motor, an armature core in the form of a disc, having peripheral recesses or grooves, in combination with coils wound thereon in a direction parallel to the axis of rotation, as set forth. (3) The combination, in a dynamo-electric machine or motor, with field magnets, substantially as described, of a flat or disc-shaped armature mounted between the said magnets in bearings formed or set in the cores of the same, as set forth. (4) In a dynamo-electric machine or motor, the combination, with parallel field-




magnets and pole pieces bridging the cores of the same, of a flat or disc-shaped armature mounted in bearings formed or set in the cores of the magnets, as and for the purpose set forth.

**293,185.** Hot Air or Gas Engine, *Hiram S. Maxim, Paris, France.*—*Filed January 31st*, 1883.

*Claim.*—(1) In an air or gas engine, the combination of a cylinder and piston, a flame or fire chamber, passages or chambers of communication from said flame or fire chamber to opposite ends of the cylinder, valves located at opposite ends of the cylinder, those at one end operating, in conjunction with the piston, as a compressor, and those at the other end for admitting and exhausting air to and from the working end of the cylinder, passages and a valve arranged to connect said passages of communication independently of the fire or flame chamber, and automatic means for operating said valve to shunt all or a portion of the air entirely from said flame or fire chamber in its route from the pumping to the working end of the cylinder, substantially as described. (2) In an air or gas engine having a fire chamber in communication with the opposite ends of its cylinder by means of suitable passages and valves, and suitable shunt pas-




sages arranged to connect the opposite ends of the cylinder independently of the fire chamber, a valve arranged to control the flow of air through said shunt passages, an air space or chamber connected with the pumping end of the cylinder, a flexible diaphragm, forming one of the walls of said space or chamber, and devices connecting said diaphragm with the valve controlling the shunt passages, and arranged to move said valve in proportion to the pressure on the diaphragm, substantially as and for the purpose set forth. (3) The method herein described of regulating the speed of an air or gas engine, which consists in shunting, through a route distinct from and independent of the fire chamber, a portion or the whole of the air or gas forced into the engine, as and for the purpose set forth. (4) The method herein described of increasing the efficiency of an air or gas engine, the same consisting in adding a small portion of cool air to the gases issuing from the fire on their way to the cylinder, essentially as set forth.

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With a Supplemental Perspective of Salterhebble Viaduct.

# Hull Barnsley and West Riding Junction Railway—

*Extensions to Huddersfield and Halifax*

## Proposed Salterhebble Viaduct

*W. Shelford Engineer in Chief*