THE INSTITUTION OF NAVAL ARCHITECTS.

On assembling after luncheon, on Thursday, the 15th inst., a paper was read by Mr. A. F. Yarrow,

ON SOME EXPERIMENTS TO TEST THE RESISTANCE OF A FIRST-CLASS TORPEDO BOAT,

which, as it supplies data not previously given, we produce almost *in extenso*.

The object of the paper was to give a brief description of some experiments which were recently tried to ascertain in a first-class torpedo boat, propelled at various speeds, the indicated power of the engines, and the thrust on the shaft when steaming in the usual way; also the power required to tow the boat. The boat upon which the experiments were tried was 100ft. in length, by 12ft. 6in. beam, having a displacement of 40 tons, and for the purpose of towing it at as high a speed as possible another torpedo boat was used, somewhat larger, of about 50 tons' displacement. The first set of experiments were to ascertain the indicated power for various speeds. The indicators used were of Mr. Darke's latest pattern. The engines were of the ordinary direct-acting inverted surface-condensing type, having cylinders $12\frac{1}{2}$in. and $21\frac{1}{2}$in. by 16in. stroke, capable of making—at 120 lb. per square inch—480 revolutions per minute, giving a speed of twenty-two and a-half knots. The curve obtained is shown by the line A on the diagram, Fig. 4, which has been arrived at by numerous observations. How far diagrams obtained in the usual way with exceptionally high-speed engines may be relied on to represent exactly what passes in the cylinders is no doubt a matter for consideration. The next set of experiments was to ascertain the thrust on the shaft at various speeds. For this purpose he designed a dynamometer, which is simply a modification of Mr. Duckham's weighing machine. There are two hydraulic rams of a diameter giving collectively exactly six square inches area. The two ram cylinders were securely bolted to the bed-plate of the engine, Fig. 3, one on each side of the aftermost main bearing, and the rams were secured to the thrust block, which is generally bolted down to a bearer in the boat, but which in this instance was left quite loose, and allowed to move freely in a forward and aft direction. It was prevented from revolving by means of two stays about 7ft. long, secured at their upper ends to the deck, Fig. 1. It will be clearly seen that, with this arrangement, immediately there is a thrust on the shaft the thrust block would move bodily forward, pressing the rams into the cylinders. Copper pipes were led from these cylinders to pumps and to pressure gauges fixed in the after cabin, where they could be conveniently observed. As the rams were exactly six square inches in area, and as the exact pressure per square inch could be read off on the gauges, it was a very simple matter to arrive at the total amount of the thrust. There were three pressure gauges, for the sake of comparison, and three pumps, two of them being ordinary vertical reciprocating hand pumps, and the other a ram worked by means of a screw. The vertical hand pumps answered the purpose very well for pumping the ram cylinders full of oil in the first instance, but owing to their intermittent action they were unsuitable for use while any records were being taken. The pump having its ram worked by a screw was found by its steady and uniform motion to answer well, giving the utmost pressure required without difficulty. On first testing the apparatus the pressure gauges vibrated very considerably, too much so for a correct reading to be obtained, which it is believed was due to the unequal strains on the shaft during each revolution. To obviate this, a large air vessel was placed on the pipe uniting the rams with the pressure gauges. The greatest thrust on the shaft obtained was 4080 lb. at 15·735 knots. The coupling between the thrust shaft and the crank shaft was of the usual type, steel bolts being secured in the one coupling, passing loosely through holes bored out in the other. Consequently, when the thrust came on the shaft and it moved forward, the amount of pressure registered on the rams would be equal to the thrust on the shaft, minus the friction due to these bolts sliding through the holes and the friction of the rams themselves. Then by working the pump and forcing the stern shaft in a sternward direction the pressure obtained on the rams would be equal to the thrust plus the friction on the bolts and the rams. The mean between these were taken as representing the thrust, and to be as accurate as possible several pairs of these observations were made at each speed, and the mean of them taken as a fair estimate of the actual thrust. The corresponding horse-powers obtained multiplying the thrust into the speed of the boat divided by 33,000 gives the curve B. The shaft not being quite horizontal, the thrust obtained in this way clearly does not correctly represent the horizontal pressure. Resolving the inclined thrust in a vertical and horizontal direction, the difference between the total pressure in the direction of the shaft and the horizontal pressure is found, *i.e.*, for purposes of propulsion the loss due to the inclination, as represented by a quarter to three-eighths per cent. only for speeds within the limits under consideration. The boat upon which these experiments were tried was then towed by another boat, as explained. For this purpose the same dynamometer was used, modified to suit, and the same system of obtaining the pull was adopted as previously used in obtaining the thrust, so that any errors due to the dynamometer itself would be common to both sets of experiments. The dynamometer was secured on the deck of the hauled boat, the rope passing direct from it over a pulley at the bow to the towing boat, Fig. 2. The towing experiments were limited to 14·97 knots, which was the utmost speed that could be maintained continuously. The length of the tow line varied, the mean length being 450ft., which was believed to be sufficient to avoid the sternward column of water produced by the screw of the towing boat from being perceptibly felt by the towed boat. At first great difficulty was found in getting anything reliable, as the wave due to the towing boat materially influenced the result. To meet this a number of experiments were tried at as nearly as possible the same speed, varying the lengths of tow line, so that in some cases the waves formed should retard, and in others help the boat, taking the mean of them to represent fairly the correct result, which is shown by curve C. In these last experiments the screw of the towed boat was removed. The author said that, through the courtesy of Mr. Barnaby, some model experiments were carried out by Mr. Froude upon a very similar boat, having the same displacement as the one upon which he made the foregoing trials. These experiments extended from speeds corresponding to 11·7 up to 23·5 knots. Although he did not presume that his experiments were conducted with the same care and accuracy as done by Mr. Froude, still it is interesting to note that at those speeds common to both Mr. Froude's trials and his, Mr. Froude's resistances were less than his by about 3 per cent.

In the discussion, Mr. Froude made reference to the Admiralty experiments which he was now conducting at Torquay, and remarked on the very close agreement between the results obtained with a model, and those with an actual vessel, especially in the case of the Greyhound. He thought the resistance to a model would generally be found proportionately greater than with a full-sized ship. Mr. White said he had seen Mr. Yarrow's dynamometric apparatus in working order, and considered it excellent in every respect, and the results might therefore be taken as trustworthy. This was only the second large scale experiment that had been made, and it was an extremely valuable one, as, by comparing the curves on the diagram, it was visible at a glance what the screw was doing, the difference between curves B and C showing the augmentation of resistance due to it. It was also interesting as giving the ratio between indicated and actual horse-power.

Mr. J. Wigham Richardson then read a paper

ON THE MODES OF ESTIMATING THE STRAINS TO WHICH STEAMERS ARE SUBJECT,

the chief object of which was to put forward the view that the scantlings should be determined by a consideration of leverage strains as in a girder. The most obvious way of regarding the ultimate girder stress on a steamer is to suppose her loaded and supported on the crest of a bank, and not in any way water-borne. The stress in this position will manifestly depend upon the weight of the fore and after bodies respectively, and upon the distance of their respective centres of gravity from the point of suspension. This method, and the finding of the neutral axis, are very fully gone into in the work on shipbuilding written by the late Sir William Fairbairn; but it is a stress to which it is usually considered a ship ought never to be subjected. It is contended, and perhaps with reason, that a steamer is built to float, and not to be stranded. Still, this way of regarding girder strains has so much to recommend it, that whenever the author's firm builds a steamer without a classification certificate, they always adopt this method. Such instances have usually been paddle steamers intended to carry little or no cargo beyond bunker coal; but it is worthy of remark that these steamers, which were calculated to bear this stress, and which in more than one instance have borne it successfully, should have been considered inadmissible by the registries. So long as the load-line remains an open question, this is, perhaps, inevitable. It is usual to speak of hogging, sagging, wracking, and torsonal strains, but all of these are derived primarily from the weight of the steamer and of her cargo—in other words, from the displacement—and from the length. It would be foreign to the purpose of this paper to consider minor or local strains; it is sufficient to show that in fixing the scantlings of the midship section, the principal stress will always depend on the displacement and the length. This, no doubt, will be accepted by all who have paid any attention to the subject. The various rules for scantlings, as given by the Veritas Society, the Underwriters' and Lloyd's Registry, were then criticised at some length, the conclusion arrived at being that the classification societies, forming their rules tentatively, have preferred, not perhaps unnaturally, to make out tables and prescribe rules, both based largely on practice, rather than to enunciate principles, or simply to prescribe a limit, as the Board of Trade do in the case of bridges. It is not therefore easy,

FIG. 1

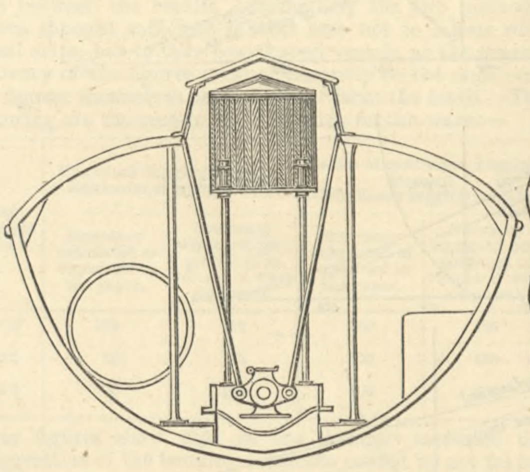


FIG. 2

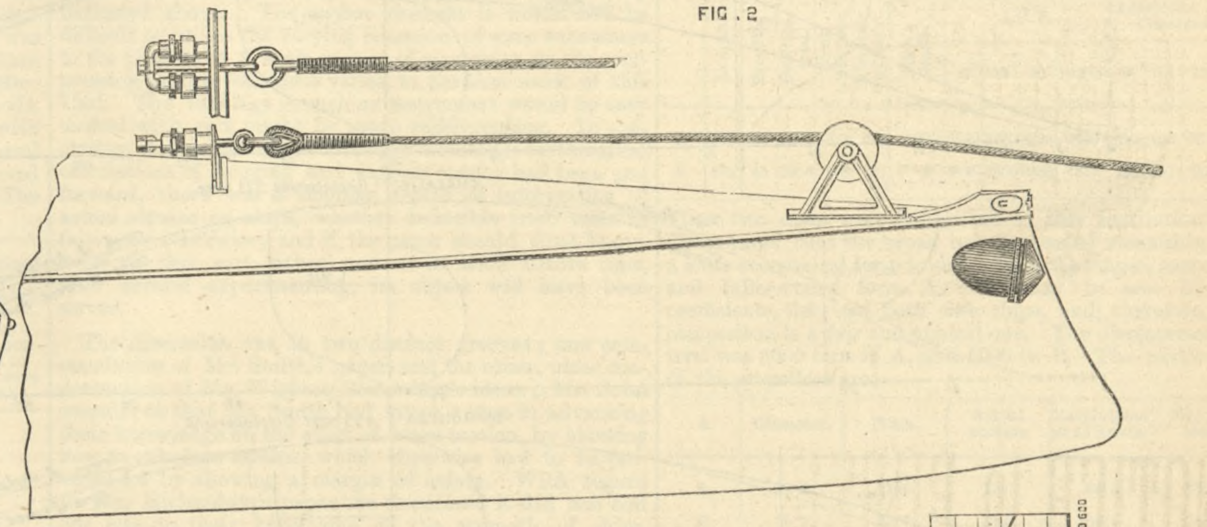


FIG. 3

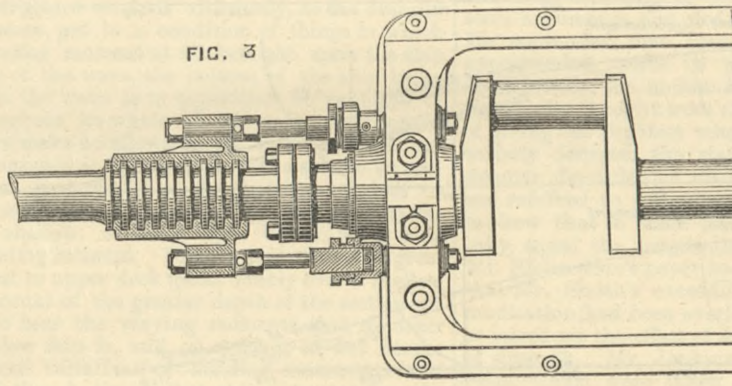
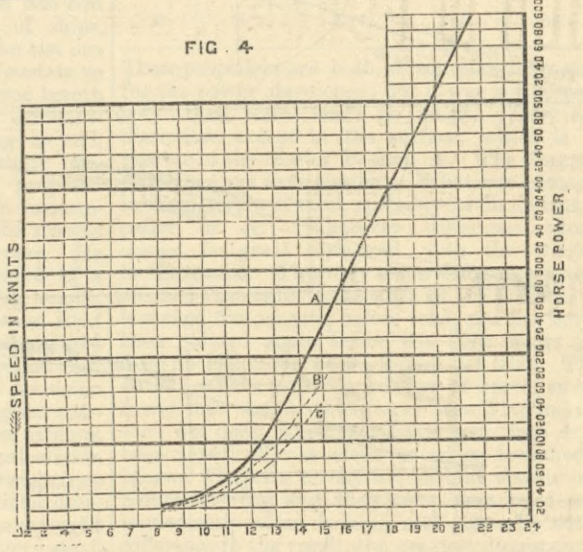


FIG. 4



APPARATUS FOR TESTING THE RESISTANCE OF TORPEDO BOATS.

or even possible, to say how far any of them recognise the depth of the girder as an element of strength. In view of this the author thought that it is probable that changes will ere long be made in the rules of one or all the classification societies. Many shipbuilders are far from satisfied, and it is in every way undesirable that the builders, who are the designers and constructors, should not be content with the regulations of those who in so many respects assist and aid them, and to whose funds they are the principal contributors.

The following paper, by Mr. W. E. Smith,

On Hogging and Sagging Strains in a Seaway as Influenced by Wave Structure,

was then taken, in order that it might be discussed with that of Mr. Richardson. The author thought that the rapidly growing numbers of very long ships—ships ranging from 450ft. to 550ft. in length, and whose scantlings necessarily increase in a more rapid ratio than their dimensions—afforded some excuse for drawing diagrams these pressures are marked p_1, p_2, p_3, &c. The ship is then placed in the wave, and the buoyancy at each section is estimated graphically as shown in Fig. 7. $W^1 L^1$ is the height of the wave at the section chosen. At the points 3, 4, 5, &c., on the immersed part of the section, the pressures are p_3, p_4, p_5. . . Vertical lines of lengths p_3, p_4, p_5 being set up from the points 3, 4, 5 . . . and a fair curve $w^1 l^1$ passed through their tops, we get the amount of buoyancy at the cross section chosen. The section shown in the figure is at the wave crest. The area of the section below $W^1 L^1$ marks the displacement, and the area below $w^1 l^1$ marks the buoyancy at this section, the shaded part representing the difference between the two; W L is the line at which the ship floats in still water. The excess of buoyancy amidships at the wave crest over the buoyancy in still water is the area between $w^1 l^1$ and W L, and this, as will be seen, is not nearly so much as the area between $w^1 l^1$ and $W^1 L^1$. The converse holds good at the wave trough, the buoyancy there being greater than the weight of water displaced. The buoyancy at each transverse section was obtained in a the keel is cut up very much at each end of the ship, so that the buoyancy is very much concentrated amidships. The mean draught is 18ft. In this example, calling the maximum hogging moment + the maximum sagging moment 100 as calculated by one method, it is 145, as calculated by the other—nearly half as much again. The difference between the maximum hogging moments obtained by the two methods is not very great, but the sagging moment, not allowing for wave structure, is practically double that obtained after making due allowance for wave structure. This difference is important as regards the tendency to produce buckling in the upper works of the ship. In this example the actual distribution of the weight of the ship has been taken as the basis of the numerical work. A different distribution of weight would alter the proportion in which the hogging moments and the sagging moments were separately affected, but would still leave the same difference of 45 per cent. between the sum of the two. For the purpose of investigating the influence of form of vessel in affecting the difference between the two modes of calculating, the author had

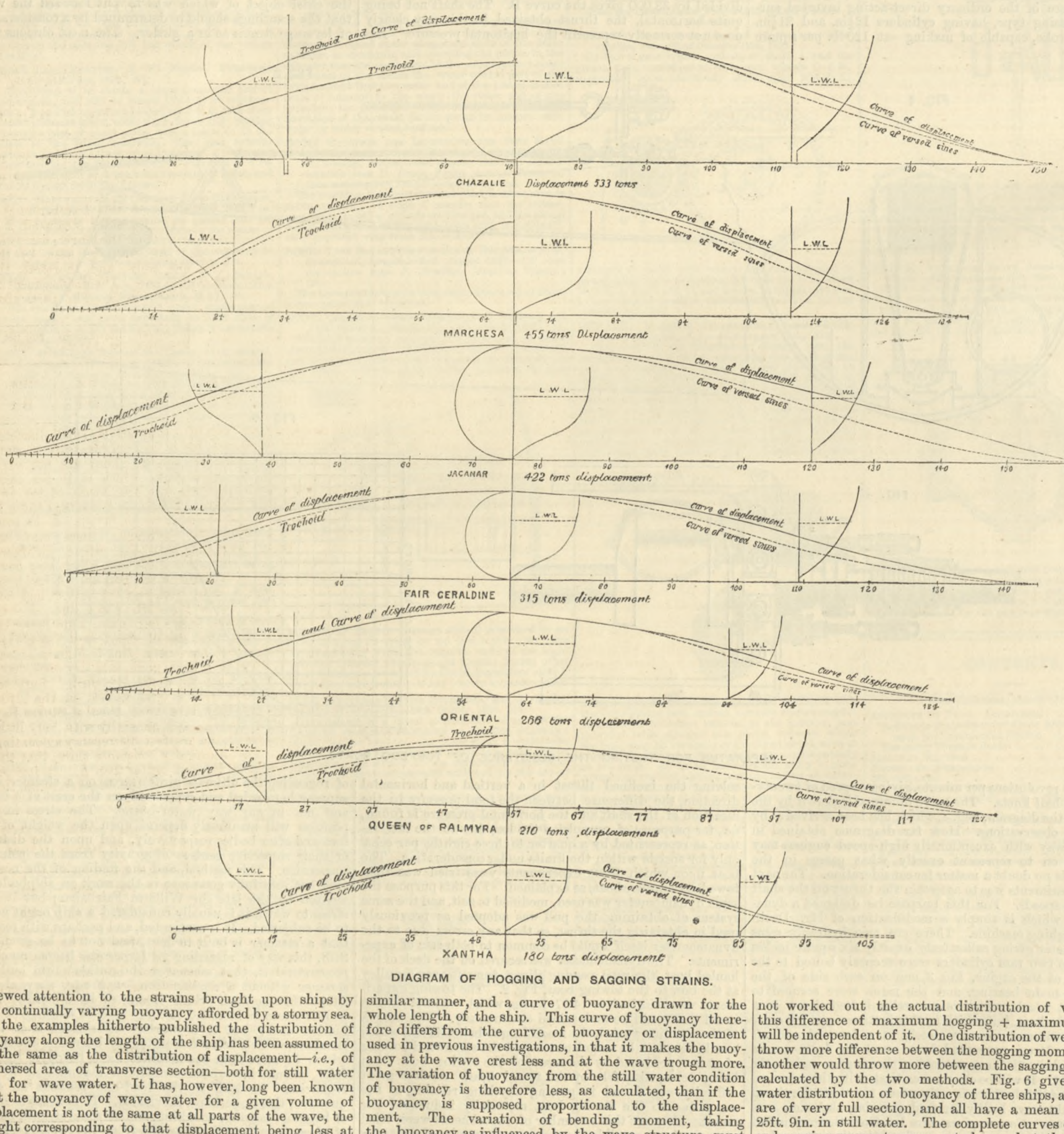


DIAGRAM OF HOGGING AND SAGGING STRAINS.

renewed attention to the strains brought upon ships by the continually varying buoyancy afforded by a stormy sea. In the examples hitherto published the distribution of buoyancy along the length of the ship has been assumed to be the same as the distribution of displacement—*i.e.*, of immersed area of transverse section—both for still water and for wave water. It has, however, long been known that the buoyancy of wave water for a given volume of displacement is not the same at all parts of the wave, the weight corresponding to that displacement being less at the crest of the wave and more at the trough of the wave than the weight due to the volume displaced. The great numerical importance of this feature of wave water was first pointed out some years ago by Mr. W. H. White, and although for some purposes it may be safely neglected, he showed in his paper on the rolling of sailing ships that for others its practical influence is very large. The author had recently been extending the application of this feature of wave water to the calculation of the longitudinal bending moments in ships in a seaway, so far as they are produced by variations of buoyancy, and he thought the results obtained could not fail to be of interest to the meeting. The method adopted in performing the work was as follows:—A diagram similar to Fig. 4 was constructed on a large scale, showing accurately the internal structure of the wave. Each wave line represents a surface of equal pressure, the numerical value of which was calculated. In the similar manner, and a curve of buoyancy drawn for the whole length of the ship. This curve of buoyancy therefore differs from the curve of buoyancy or displacement used in previous investigations, in that it makes the buoyancy at the wave crest less and at the wave trough more. The variation of buoyancy from the still water condition of buoyancy is therefore less, as calculated, than if the buoyancy is supposed proportional to the displacement. The variation of bending moment, taking the buoyancy as influenced by the wave structure, must in like manner also be less than if taken as being measured by the area displaced at each transverse section. The object of the paper was to place on record the relation between the bending moments calculated in the two hypotheses. The difference between the two results depends, as will be seen by the following examples, upon the form and the draught of water of the ship, and in some cases reaches a considerable amount. To avoid complication and crowding in the figures accompanying the paper, only the resulting curves of bending moments was given, the dotted lines showing the moments obtained after allowing for the influence of wave structure, and the solid lines the bending moments not allowing for this influence. In all the examples the length of ship is 315ft., and the height of wave 20ft. Fig. 5 gives the results for a vessel of very fine form, both as regards water-lines and also as regards rise of floor. To ensure great manœuvring power, not worked out the actual distribution of weights, as this difference of maximum hogging + maximum sagging will be independent of it. One distribution of weight would throw more difference between the hogging moments, while another would throw more between the sagging moments, calculated by the two methods. Fig. 6 gives the still water distribution of buoyancy of three ships, all of which are of very full section, and all have a mean draught of 25ft. 9in. in still water. The complete curves of hogging and sagging moments were not drawn, but the following table represents the results:—

Reference number of ship.	Ratios of maximum hogging moment. + Maximum sagging moment.		
	Buoyancy calculated as explained in the paper.	÷	Buoyancy supposed proportional to volume of wave displaced.
1	100	÷	170
2	100	÷	165
3	100	÷	155

The differences here are of considerable amount, and, provided the method explained in the paper is not largely in error, show us how enormously on the safe side we have been in the habit of computing these moments. Though implied by the title of the paper, the author thought it necessary to state explicitly that he was not attempting to take all the circumstances that affect the strain on the ship into account. For reasons stated at length farther on, this course appears to be impracticable. He was simply following to a conclusion a certain reasonable assumption as to the buoyancy afforded by waves supporting the ship. The effect of the up-and-down motion of the vessel in altering her virtual weight, for instance, has been altogether omitted. This, however, from rough estimates that were made, can never be very great, as regards longitudinal strains in the case of a ship steaming at right angles to the wave ridges. If the vessel were broached to in the trough of the sea, the alteration of virtual weight might be considerable, and would have an important influence both on the transverse and longitudinal strains. The longitudinal strains, under these circumstances, would be simply the still water strains increased or diminished approximately in the same ratio that the virtual weight exceeded or fell short of the actual weight of the ship, and these strains are not nearly so great as the strains brought about by the vessel steaming head to sea. When the vessel is steaming head to sea there is much less variation in her virtual weight than when steaming on a course parallel to the wave ridges, and this is especially so in the case of full ships, *i.e.*, of ships experiencing the greatest changes of hogging and sagging strains when in a sea-way. On account of the smallness of this feature, when the longitudinal bending moments are at their greatest, it was altogether neglected. Figs. 1, 2, and 3 show the influence of variations of draught of water in affecting the difference between the results obtained by the two methods. It was thought sufficient in this case not to labour with actual ships, but to take box-shaped vessels, as the general tendency of the figures must of necessity be the same, and the figures themselves cannot be far from the truth. The following are the results when floating on the wave:—

Mean draught of box.	Maximum hogging moment. + Maximum sagging moment.		Ratios of maximum hogging moment. + Maximum sagging moment.	
	Buoyancy calculated as explained in the paper.	Buoyancy supposed proportional to volume of wave displaced.	Buoyancy calculated as explained in the paper.	Buoyancy supposed proportional to volume of wave displaced.
10′·6″	100	125	100	125
20·6	83	125	100	150
25·9	75	125	100	165

These figures show that as the draught increases the exaggeration of the bending moments caused by not taking the wave structure into account rapidly increases also, and a little reflection will suffice to show that if we duly allow for the wave structure we shall ultimately, as the draught of water increases, get to a condition of things in which there is no bending moment at all brought upon the ship by the passage of the wave, the bottom of the ship being so far down in the wave as to experience no variation of pressure throughout its whole length as the wave passes along it. If we make no allowance for wave structure, but suppose the buoyancy at each section of the ship to be proportional to the displacement at that section, we shall be supposing the same bending moment to exist as when the draught was shallow, whereas there would be a total absence of bending moment. In this way a vessel of great depth from keel to upper deck gains doubly over a shallow vessel. On account of the greater depth of the section she is more able to bear the varying moments that do occur than the shallow ship is, and, on account of her deeper immersion, those variations of bending moments are of less magnitude than in the shallow ship. As the draught diminishes to nothing, the two methods of calculation lead to identical results, and it is therefore immaterial which is adopted. It was then pointed out that the principle of calculation adopted in the paper was certainly open to some question, because it supposes the wave structure uninfluenced by the intrusion of the ship, and for a ship as broad in proportion to her length as the Inflexible is there may possibly be a considerable error in the assumption, but for ships such as recent merchant ships, which are narrow in proportion to their length, and therefore narrow in proportion to the length of wave on which they would be supposed floating when calculating the hogging and sagging moments, this source of error probably would not be so great. There are other objections of a minor nature that need not be specified. Enough, however, has been brought forward to show that very different results may be obtained by looking at the question from different standpoints, and also that part of the difficulty we have all experienced in understanding how a ship has borne so well and without signs of distress the strain per square inch of material that was said to be imposed on it, may be due to the strain not having been there at all. This strain, at any part of a ship's section, depends upon the bending moment and other forces acting at that section, and also upon the nature of the elasticity possessed by the materials forming the section as a whole, viewed in the light of what is usually called the "equivalent girder." There are difficulties in this part of the subject foreign to this paper, but there is little doubt that at the best the ordinary method of assuming perfect elasticity can only give a coarse approximation to the distribution of the strain across the material forming the ship's section, even if we knew the exact value of the bending moment operating at the section. The method of estimating the bending moment on any section, as explained in the paper, omits many considerations, and the method adopted up to the present is still more imperfect, and under this double uncertainty—uncertainty as to the bending moment and uncertainty as to the distribution of that bending moment across the ship's section—it is impracticable to predict, by mere calculation, the actual strain on a given part of the ship's structure, even under known conditions of sea and load. What is required is careful watching of ships, especially those that are weak longitudinally. In the Admiralty service we have no chance of gaining this knowledge, on account of war ships having so much material in them for purposes other than those of structural strength. In the merchant service this knowledge, even when obtained, is not available to the profession at large, on account of the natural desire of builders and others not to publish details of failure. There is this further difficulty—a difficulty which is perhaps peculiar to questions of strength—that unless the structure breaks down, we only know that it is strong enough, and not how much strain is on the material. If the structure breaks down, we only know that it was too weak, and not by how much. In other questions, such as propulsion, for instance, if there is a failure, we have a numerical value of the failure, and this accurate knowledge of the shortcoming is available for guidance in future work. At present we have no such knowledge with respect to the strength of ships. To supply this knowledge we must have instrumental observation of the strain and variation of strain that goes on in the different parts of the ship's structure. Such instrumental means, perhaps, may never be obtainable. A small machine, however, was placed in the market some time ago, and known as Stromeyer's strain indicator, that bade fair to accomplish this kind of work. The principle of the machine depended on the creation of Newton's rings, and for some work the delicacy of the machine is marvellous. Some of the members present may have had experience of the machine on shipboard in a sea-way, and be able to say how far it is applicable to the work indicated above. The author thought it would not be difficult to utilise the varying resistance of some substances to the passage of a weak current of electricity, as the compression on the substance varies, to perform work of this kind. The readings in such an instrument would be easy to deal with, and might be made self-recording. In conclusion, it was stated that although numerous arithmetical calculations of hogging and sagging strains had been put forward, there was a singular dearth of information of actual strains on ships, whether deducible from cases of failure or otherwise; and if the paper should elicit knowledge of this sort, either now or at some future time, after careful experimenting, its object will have been served.

The discussion ran in two distinct grooves; one commendation of Mr. Smith's paper, and the other, utter condemnation of Mr. Wigham Richardson's ideas. Mr. John considered that Mr. Smith had taken a step in advancing their knowledge on the effect of wave motion, by showing how to calculate strains, which otherwise had to be provided for by allowing a margin of safety. With regard to Mr. Richardson's paper, he considered it did not add one iota to their knowledge of the strength of ships, though he would confess it was an advance on the last one read by the same author, inasmuch as it did not contain so many fallacies. Mr. Martell, who spoke at some length and with considerable emphasis, ridiculed Mr. Richardson's arguments and deductions from beginning to end. He contended that Lloyd's rules had been totally misapprehended, while in putting forward his proposed amendments, the author had merely made such assumptions as he thought were right, without taking the trouble of giving the slightest reasoning to support his case. He entirely disputed the statement that the strength of a steamer depended on displacement multiplied by length, and referred to the paper by Messrs. Jenkins and Reid to show that in some cases the transverse strains might fully equal the longitudinal. Mr. White thought that Mr. Richardson's paper had so much monopolised attention that Mr. Smith's exceedingly valuable and original communication had been overlooked. It was the first attempt to introduce the effect of a wave directly into a calculation of strength. Mr. Jenkins pointed out that Fairbairn's rules, which were taken as a basis by Mr. Richardson, were really intended to apply to such structures as wrought iron girders, in which the section of web was very small in proportion to the material collected in the top and bottom flanges. This, however, was not the case in an iron vessel, and he ventured to dispute the conclusions arrived at in the paper.

Mr. Richardson briefly replied, stating that as he thought Mr. Martell's remarks had been intended for their amusement, he would take no notice of them, a statement which afforded the meeting no small degree of amusement. Mr. Smith, in conclusion, made a few remarks as to the practicability of applying a strain measurer to the different parts of the structure of a vessel, so as to actually ascertain the extent of the stresses. He thought that the difficulty lay rather in the construction of the instrument itself than in the application, but hoped that whatever difficulty did exist might soon be got over, as the results obtained would be so exceedingly valuable.

The last paper was by Mr. J. H. Biles,

ON THE ADVANTAGES OF INCREASED PROPORTION OF BEAM TO LENGTH IN STEAMSHIPS.

The object of this paper was to give some of the advantages which have actually been obtained by adopting increased proportions of beam to length in some steamers which have been built recently by Messrs. J. and G. Thomson, of Glasgow. This firm have for some time past made it a rule, in tendering for any ship of large size or high speed, to suggest an alternative design to that proposed by the shipowner, and the modification has invariably taken the form of increased proportion of beam to length. In some cases the proposed modifications have been adopted, and the actual results of some of these ships are now laid before the Institution. It will be remembered that it was the late Mr. Froude, in his paper on "Comparative Resistances of some Long Merchant Ships," who first brought prominently into notice the fact that it was possible by increasing the beam and by fining the ends to get a form which at high speeds would have considerably less resistance than the ordinary merchant ship form with ten beams in the length. The alternatives which he gave were, however, exceedingly fine-ended, and did not appear to possess very much advantage at moderate speeds. Consequently they have not been much adopted, but since the reading of that paper there has been less tendency to look upon an increase of beam as likely to reduce speed though there has not been much notice taken of the fact that this increase should be associated with an increase of fineness in the ends. It is necessary to note, therefore, in all that follows, that whenever an increase in the proportion of beam to length is spoken of, it is assumed that it is accompanied by an increase of fineness in the form. Increased proportion of beam to length gives increased speed. It is very difficult to deduce really reliable information as to the relative merits of different forms of ships from the results of their steam trials. The efficiency of the means of propulsion is a large element in the gross result, and it is not possible in the present state of our knowledge to take a proper account of this efficiency. The only possible method of comparison is to choose ships somewhat similar in size, speed, and elements of propeller, and from the results of their steam trials deduce the relative efficiencies of the form by means of the Admiralty formula, or some similar one, which we know for small variations cannot be very far wrong. The comparative results cannot, however, be considered as accurate, but will give some rough guide to the relative merits of different forms. The following are the particulars of two vessels, built by Messrs. J. and G. Thomson. They are mail steamers carrying cargo of such a nature that internal capacity is of more importance than the weight-carrying:

	Length.	Breadth.	Draft on trial.	Block coefficient.	Prismatic coefficient.	Kirk's angle.	I.H.P.				Admiralty Dispt. Constants.			
							15	14	13	12kts.	15	14	13	12
A	390	42	18·2	·646	·694	9° 20′	5130	3390	2280	1660	216	256	301	324
B	375	45	20·3	·598	·651	9° 5′	3940	2860	2280	1810	280	311	315	316

These two cases were submitted to this Institution as a direct proof that the broad but fine-ended steamship B is a more economical form to drive than the longer, narrower, and fuller-ended form A. As may be seen by the coefficients, they are both fine ships, and, therefore, the comparison is a fair and typical one. The displacement on trial was 5500 tons in A, and 5900 in B. The particulars of the propellers are:—

A.	Diameter.	Pitch.	Actual surface.	Revolutions at 15 knots.	Slip per cent.
A	18·6	28·6	102	63·6	15·8
B	18·0	28·0	112	63·4	14·5

These propellers are both of comparatively small diameter for the power developed, but it was not necessary to state why they were made so small. They are not very dissimilar, except in the surface, which is 10 per cent. greater in the case of B than A. The forms of the two propellers are very similar. Whatever advantage there is in diameter, will most probably be in favour of the propeller of A. Whatever difference there may be, cannot be great compared with the whole difference in the results. The only other difference which may have affected the result is the state of the bottom. A had been launched five months before trial, and her bottom had not been painted again below the 10ft. water line. B had been docked three weeks before her trial. This, however, could not have caused much loss of speed, as it was always found that vessels which have been lying in Messrs. Thomson's wet dock, when they have gone into dry dock, have been practically as clean as when launched. Further, Messrs. Thomson have tried several vessels on the Clyde before docking, and they have been tried at Stokes Bay immediately after docking, and generally with very little difference in the result, the greatest discrepancy amounting to 6½ per cent. The Admiralty constants show that the vessel B was nearly 30 per cent. better than A. In further confirmation of the superiority of the broader ships, the following two cases are given:—

	Length.	Breadth.	Moulded draught.	Block co-efficient.	Prismatic co-efficient.	Kirk's angle.	I.H.P. at 14 knots	Admiralty constant at 14 knots.
C	365	43	17·1	·588	·656	8·37	2910	257
D	365	45½	17·4	·513	·624	8·41	2740	282

These are two steamers built by Messrs. Thomson. In these cases there is a differerence of 10 per cent. in favour of the broader ship. These vessels had lain about the same time in the water after launching, and had not been docked previous to their trials. Their propellers are very similar, being as follows:—

	Diameter.	Pitch.	Actual surface.	Revolutions at 14 knots.
C	17·6	25·6	95	61·8
D	17·6	25·6	90	61·5

Though there may be some reason for doubting the whole of the advantage in the case of A and B, there appears to be quite sufficient to warrant one in saying that increased proportion of beam to length gives greater speed when it is combined with finer ends. The displacement of A and B at 24ft. moulded draught are 7690 tons and 7240 tons respectively. Assuming that the total weight of hull and machinery are the same in the two cases, it will be necessary to increase the dimensions of B to length 386, and the breadth to 46·4 in order that the two ships may carry the same total dead weight of coals and cargo on commencing a voyage. From data obtained from ships built to Lloyd's three-deck rules, it appears that the vessel B enlarged would not exceed A in the weight of hull more than 1 per cent., the depth being the same. The difference in first cost in the two vessels, A and B, as enlarged, would not be more than 5 per cent., but the difference in horse-power, and therefore in coal consumption, for the same speed would be at least 10 per cent. Assuming that a vessel of this class costs £90,000, and that the machinery costs about £40,000, the extra first cost on the vessel will be about £4500, and the decreased first cost on the machinery about £4000, or a total increased first cost of £500 for a decreased consumption of fuel of 10 per cent., which is equal to at least £1000 per annum. This is assuming that the same total weight of coals and cargo be carried as in A, but obviously a decreased coal consumption means an increased cargo-carrying on the same draught. The actual dimensions which would give the same cargo-carrying in the two types, after providing sufficient coal for the voyage, must depend upon the length of the voyage, so that each case must be decided according to its special circumstances. Increased proportion of beam to length allows of increased depth for the same amount of initial stability. The advantages due to this extra depth are: Increased strength due to the increase in the depth of the virtual girder which the ship forms; increased finite stability, on account of greater freeboard; increased surplus buoyancy, on account of greater freeboard; increased internal capacity for cargo. If the cargoes are generally dead weight, this increased capacity will be useless for cargo purposes, and will be costly for maintenance, on account of the extra tonnage dues which must be paid. If, on the other hand, the cargoes are light in density, the extra capacity will be of value, and if the increase of proportion of beams to length be made with the increase of depth, a point must be reached where limitation of amount of cargo which can be carried will be the same as in a dead weight trade, viz., draught of water and freeboard, and in that way all cargoes may be reduced to the same basis as a dead weight one. One consequence of this will be, that the saving of weight which follows the adoption of steel will be as remunerative in a ship carrying light as in one carrying heavy goods. It may be remarked, however, that generally an increase of depth is not a necessity of increased proportion of beam to length, as few ships have too much initial stability. Increased proportion of beam to length gives of itself increased strength to the ship longitudinally by: (1) Generally reducing the absolute length of the ship, and thus reducing the straining action due to length. (2) Increasing the breadth of the decks and the bottom amidships, where the ship receives the greatest straining action. This is most increased in the decks, as the openings in the deck are not increased with the beam, and consequently the increased breadth is put in where the structure is not cut.

In the discussion on this paper, Mr. Inglis quite agreed with Mr. Biles in thinking that an increase in beam would in many cases be attended with improved results; but he thought the tables distinctly showed that the greatest benefit would be gained in the fast ocean-going steamers—of which so many had been built by Messrs. Thomson—rather than in slower cargo-carrying vessels. The explanation of this was that at low speeds the skin friction formed a much larger proportion of the total resistance than at high speeds; a remark which was also confirmed by Mr. Froude, who further pointed out that by fining the ends and concentrating the weight towards the centre, pitching would be much increased, and therefore the performance of these vessels would probably be not nearly so good when at sea as when on the measured mile. Mr. John said that it was worth consideration whether the slight difference in the propellers mentioned in the paper did not account for a great deal of the difference in speed, and instanced some experiments in which half a knot was gained by merely lessening the immersion of the propeller. He thought the tendency at present was certainly in the direction of increase of beam, and he feared this would go on till we had ships far too stiff and which would roll quite heavily; then a backward movement would set in and the beam would be cut down until the other extreme was reached.

Mr. Biles, in reply, said he had fully appreciated the differences that might be produced in slight variations in propellers, and had been fully alive to the fact when preparing his paper. This brought the day's meeting to a close, the attendance having been fairly good throughout, though it would add much to the comfort of many if members would make a point of being in their places at the time appointed, instead of dribbling in for an hour or more after the commencement. Considering the Naval Architects meet only once every year, this surely would not be a great tax upon the time of the members.

THE TRANSPORT OF MEAT.

It seems the time has arrived when British engineers and inventors may advisedly turn their attention at once to the carrying of animal food as still practised in this country. With the present increased value of beef and mutton, any improved system of conveying meat from the producer to the consumer will be a public advantage, and it cannot fail to be profitable to any ingenious and enterprising men of business by whom it may be established.

Everything is now appearing in favour of the importance of a carcase trade being substituted for live animal traffic. A number of Americans have practically shown this by the way they have built some refrigerating cars, and are rapidly increasing the number of them, for conveying meat through the hot Western States to Chicago, and hundreds of miles further, viz., to New York and such more southern towns as Philadelphia, Washington, Charlestown, and so on. This is being done on purely commercial principles, that is, because it is found to be cheaper to carry 100 quarters of beef or sheep hung up in a car than it is to "run" ten live beasts or a corresponding number of sheep squeezed into a truck. The carcases improve in the cool air which is circulated among them during the two or three days they are on the way, while the live animals, which are necessarily about double the time on the road, get so bruised and jaded from want of regular feeding and rest, that cattle waste from 8 lb. to 10 lb. per head a day, and sheep at an equal or greater rate according to their size.

About the economy of the carcase trade, and the superior quality of the meat over that from animals which have been carried long distances alive, it will be as well to relate here some of the adverse experience of the promoters of the carcase trade. In the first place, soon after the refrigerating trucks had been started it was found by the managers of the railways that as so much more animal food could be carried in a carcase car than in a live-stock truck at the ordinary rate for space, the receipts of the railway companies would be considerably reduced if this carcase trade came to be greatly extended. After what is apparently the usual practice of railway companies all the world over, the authorities threw every obstacle in the way of the progress and development of this new traffic. The owners of stock-yards, too, at Chicago, New York, and elsewhere, joined the railway managers in their opposition, as also, as a matter of course, did the commission agents for the sale of live stock; for if animals arrived at New York and other centres of population in the carcase, their occupation would plainly be gone. Butchers, too, were influenced, either through their own prejudices, or by the pressure put on them by the salesmen who gave them credit.

This is the point where the economy of the traffic in carcases, and the quality and flavour of the meat so carried, were brought into close connection. Everything that could be invented was done to prejudice consumers against refrigerated meat. Railway managers and shareholders, stock-yard and slaughter-house owners, salesmen and butchers, vied with each other in condemning refrigerated meat. The butchers would not have it on their stalls. But Americans, when they think they have got hold of something that is worth carrying out, are not to be easily frightened out of their intentions. So the promoters of the refrigerating car system opened stores of their own, and began by offering joints at such low prices that needy folks could not resist buying them. This point having been accomplished, and the refrigerated meat pronounced to be excellent, there was soon a run upon the stores where the meat that was brought in the carcase was sold. Consumers in the towns where this has been going on now prefer the carcase meat to that which has been brought long distances alive. This is not to be wondered at, for our own experience at home is that Aberdeen cattle, if killed before they are started for London, arrive in a bright condition—a "blooming" condition, as the butchers term it—while on the carcases being cut into joints they are found to be "sappy," or full of gravy. But if the same character of beasts be sent to London alive, and killed after arrival, they are found to yield joints of a greatly deteriorated quality. In fact, they have wasted a stone of 8 lb. a day while in the market whence they started, while in the trucks on the railway, and while they were in the lairs and stalls of the live stock market. In a word, that which remains as gravy and flavour in the carcase is pumped out of the animals by sweating and quickened breathing from the excitement and punishment and fatigue which they necessarily have to undergo.

The opposition that will be made to any general change in our present great work of distributing animal food at home will, no doubt, be various, and in some instances of a severe character. It is worth while, therefore, to give some consideration to this point before we come to an outline of the machinery required for the carcase trade, so far as it is possible to carry it out at home. Vested interests die hard, whatever may be their errors, and however contemptible their claims may appear to be when looked back upon after they have been overcome and set aside. Master chimney-sweeps, not so very long since, reckoned they had a vested interest in the boys they used to send up flues and chimneys to clean them. But fortunately for the benevolent opponents of his practice, master chimney-sweeps were not men with large capital to get up an agitation on what they thought was their own right, and, from a business point of view, in their own favour. They thought they were to be hardly treated, however. But when they saw the Legislature was in earnest they resorted to additional and mechanical contrivances that did their work better than the barbarous practice of employing boys.

As an example, however, of what capitalists, whether as private persons or companies, will resort to for defending what the look upon as their vested interests or "rights," the discussions which took place last year in the New York papers which attend to agricultural questions may be briefly summarised. As intimated above, a ring of railway chairmen, directors, stock-yard owners, salesmen, and butchers was formed to obstruct, and, if possible, to swamp the capitalists who had started a carcase trade by employing refrigerating cars. The well-known Mr. Vanderbilt was the leader of this ring. Mr. Vanderbilt is reputed to be the owner of property and cash amounting to many million dollars. Threats, however, are often more easily made than what they imply is accomplished. The carcase trade promoters went on increasing their cars and running them over the railways from the Western to the Eastern States. Whereupon Mr. Vanderbilt and his supporters issued further threats, which were to the effect that they would establish a carcase trade on their own account, and through Mr. Vanderbilt's influence with the railway companies, get a running contract on such favourable terms that they would be able to ruin the original promoters of the carcase trade system. The ring also threatened, as a preliminary notion, to buy cattle in the West and ship them in such numbers to the West that they could "undersell the refrigerating people, and thereby break them down in every market to which they have access." One writer on these threats said:—"This must mean ruin and utter destruction to one party or the other." The New York butchers acknowledged at this time that they lost 10 dols. a head on live beasts they bought in competing with the "refrigerator people." The points to be extracted for British advantages from this current commercial contest or fight in America—of which the above extracts of evidence are a mere trifle—are simply these:—(1) It is proved in America that animal food can be carried cheaper in the carcase than it can be in the form of living animals, be they cattle, sheep, or pigs; and (2) it is proved in America that animal food so carried is far better in quality—which includes flavour—than the meat which is the product of animals that have been tortured by railway journeys and standing for sale in more than one market.

Now let us see how advantageously a carcase trade may be adopted in this country. We do this on commercial grounds, apart from the fact that such a system of distribution, if established, would reduce the spread or dissemination of diseases to a minimum. We have far greater advantages in favour of a carcase trade in Great Britain and Ireland than exist in America, where the system is being carried out with increasing success. Our climate is in a general way much cooler. It is only in very hot weather, such as occurs in June, July, and August, that anything like a refrigerating process would be necessary. It is true that much meat goes bad, that is, is reduced greatly in value, if not rendered unfit for human food, in such muggy weather as often occurs in the autumn, winter, and spring months; but this can be obviated by the simplest well-known appliances, and at a very trifling cost. At every large centre for assembling animals—and as we say, where they ought to be slaughtered, instead of being sent to London or elsewhere alive—refrigerating rooms should be established, so that the animal heat may be speedily dissipated from carcases, and the fat and flesh thereby firmly "set." This is done in Chicago and other great centres of slaughtering in America. It is done by Messrs. Harris and Co., of Calne, Wilts, the great bacon curers, who kill from 200 to 400 pigs every day in the year. The pigs that are killed between 4 a.m. and 6 a.m. are put into an ice house at 9 a.m., and the temperature of the sides is reduced in a few hours from between 70 deg. and 80 deg. Fah., to between 45 deg. and 50 deg. Fah.

But cool cars for conveying carcases long and short distances in Great Britain and from Ireland are the main points of importance before us. As a rule, in nine months of the year nothing but properly-constructed cars can be required for carrying animal food in the best possible condition. The best place on land for a warm carcase of meat is a well-ventilated railway car that is travelling from twenty to thirty miles an hour. All the dissipating heat may be at once driven away by the current produced by rapid motion. If tubes with large bell mouths facing the engine be inserted in the top of the car, and proper provision is made for excluding dust, the whole thing is done. In hot weather a truck of ice might precede the cars containing the carcases, and the bell-mouthed tubes might be carried over that, and the iced air communicated to the cars containing the meat by connecting tubes, a small escape-pipe being arranged in the hindermost car to allow any vapour from the meat that will be dissipated to escape.

All this may be so easily accomplished, and the whole traffic in animal food may be carried out with so much increased economy and profit, that it seems difficult to understand how it is that the primitive barbarity of migrating live animals, and the wastefulness of carrying carcases or parts of carcases, should be continued in this age. Animal food may be brought from Aberdeen, Norwich, Exeter, Lincoln, and other centres with perfect safety and at about half the cost at which live animals are now carried, while the waste of a stone of 8 lb. per day, while the live animals are *in transitu* in markets and on the way will be saved, the exquisite flavour of animals just from their pastures or fatting stalls being at the same time retained. We have mentioned a travelling railway car as the best place on land for preserving animal food. But the best place *in the world*—excepting an artificially-fitted refrigerating chamber—for reducing carcases to the best temperature and state of external dryness for keeping, is the hold of a steamship on the North Sea or German Ocean. There is no excuse whatever for continuing a live stock trade, therefore, from the continent of Europe, whereby the diseases that are known to be imported periodically arrive to decimate our home stock, as foot-and-mouth disease has again been doing, owing to a cargo of French cattle, for more than two years. It is time this question was thoroughly understood, to promote which engineers and inventors appear to have before them a profitable opportunity. W. W. G.

RED-SHORTNESS OF COPPER DUE TO ADMIXTURE OF TELLURIUM.

A paper on this subject was recently read by Dr. T. Egleston, of New York City, at the Harrisburg meeting of the American Institute of Mining Engineers. Some months before samples of black copper oxide and of pig copper from Colorado were sent to him to examine for arsenic and antimony. He examined them both by the blowpipe and in the wet way, and found none present. A quantity of this material was purchased by a large metallurgical works, and when they attempted to refine it, they pronounced it to be full of arsenic and antimony; so much so, that their furnaces were, as they said, "poisoned," and rendered unfit for refining. He then re-examined the samples, and at the same time some of the material which had "poisoned" the furnaces, and found no traces of arsenic or antimony when the usual amounts for analysis were used; but on taking very large amounts he found traces merely in some parts of the sample, but not in all. As it was a matter of interest to ascertain what the white substance that "poisoned" the furnace was, he sent to the works making the black copper and obtained some of the matte from which the black copper was made. He then found the impurity to be tellurium, a substance not heretofore known as occurring in copper. He gives in this paper one analysis of the matte, two of the black, and one of the refined copper.

	Matte.	Black copper.		Refined copper.
Copper	55·02	97 120	98·090	99·705
Gold	0·06	—	—	—
Silver	0·40	0·132	0·128	0·135
Lead	17·87	0·777	0·757	none.
Zinc and nickel	2·22	0·070	0·100	0·024
Iron	4·18	0·130	0 080	0·031
Sulphur	20·02	0·236	†	trace.
Tellurium	0·12	0·093	0·097	0·083
Arsenic	†	0·006	†	0·091
Slag, &c.	—	1·270	0·192	—
	99·89	99·834	99·444	100·069

The mattes and the black copper are results of the treatment of copper ores with the tellurium ores of Colorado. In the laboratory no traces of white fumes were shown on charcoal; but when the metal in the furnace was subjected to the process of "dry roasting," as was unintentionally done, very dense white fumes were given off. When refined and cast into cake, it had the ordinary appearance of cake copper. At the first pass in the rolls very fine cracks showed themselves, which opened in succeeding passes. At a thickness of about 0·03 metre the cracks on each side nearly penetrated the cake, and at about 0·008 metre it began to fall to pieces. It was heated and rolled at different temperatures, but always with the same result. When cold the metal is tough and malleable. Although the cakes in the moulds showed no coating, when they were heated repeatedly and allowed to cool in the air they became covered with a white powder which proved to be oxide of tellurium. The copper, as it comes from the cake mould has every appearance of being good copper. This is the first time, so far as Dr. Egleston knew, that the presence of tellurium has been detected in commercial copper. But very little of it is removed in the treatment, as the four analyses show. It is surprising how very small a quantity renders the copper red-short, and consequently worthless for rolling.

ENGINES FOR THE CAPE RAILWAYS.

We publish this week a supplement representing the standard type of goods locomotive adopted by the Cape Government for their railways, on the advice of their engineer, Mr. Charles Hutton Gregory. They were built by Messrs. Neilson and Co., of Glasgow, the first being under the supervision of Mr. Hawthorn Thornton, the chief locomotive superintendent to the Cape Government. The passenger engines are of similar type, but have only four wheels coupled, but most of the details are all duplicates, including the valve gear. There are over sixty ordered, of which nearly half are complete. These engines are fitted with Joy's valve gear, the theory of which is now being considered in our columns by Mr. Graham. The cylinders are 15in. diameter, the stroke 20in.; the wheels are 3ft. 4in. diameter, and the gauge 3ft. 6in.

† No traces were found with the blowpipe.

RAILWAY MATTERS.

MR. PLIMSOLL is leading an agitation in favour of the ventilators along the District Railway, because they are, he says, of advantage to the 90,000 passengers who daily make use of the line.

THE tunnel known as the Weehawken tunnel on the New York, West Shore, and Buffalo Railway, New York, has been completed. It is nearly 4000ft. in length, and leads to a riverside terminus of 440 acres in extent, where it is joined by the New York, Ontario, and Western Railways.

WE are requested by Messrs. Wilkinson and Co. to state that Messrs. Beyer, Peacock, and Co., of Gorton Foundry, Manchester, have received an order from the North Staffordshire Tramways Company for twenty-one Wilkinson tramway locomotives, the company having decided to substitute them for the Merryweather engines hitherto in use on this line.

IN writing upon the District Railway ventilating shafts a leading evening paper said: "The true means of keeping the air pure in a tunnel must be sought in the substitution of a suitable motor for the obsolete locomotive." The *Pall Mall Gazette* might say what it considers a "suitable motor" and what it means by "obsolete" when applied to locomotives in universal employment.

A HANDY method of finding the speed of a locomotive when the size of the drivers and the number of revolutions are known has been given by Professor Frederick Steiner, of the High Polytechnical School, Prague. He takes $\frac{2}{11}$ of the locomotive wheel diameter in inches, and the result is a number which represents in seconds the period during which the revolutions of the wheel equal in number the speed of the train in miles per hour; $\frac{2}{11} = 0{\cdot}179$, so that with a locomotive having wheels 55in. in diameter, if it is observed that in $\frac{2}{11} \times 55 = 10$ seconds, it makes twenty-four revolutions, the speed of the train is twenty-four miles an hour.

THE half-yearly report of the directors of the Great North of Scotland Railway Company shows that the maintenance of way and works cost 9·16d. per train mile or 15·04 per cent. of traffic receipts, locomotive power cost 6·86d. per train mile, or 11·25 per cent. of the traffic receipts; carriage and wagon repairs, 2·95d. or 4·84 per cent.; traffic expenses, 8·10d., or 13·29 per cent.; general charges, 1·37d., or 2·26 per cent.; law charges, 0·01d., or 0·02 per cent.; compensation, personal and goods, 0·29d., or 0·47 per cent.; the total working expenses being 28·74d. per train mile, or 47·12 per cent., while the total expenses came to 32·95d. per train mile, or 54·09 per cent. of receipts.

WE have been officially informed by the Austrian-Hungarian Railway Administrations that they have concluded to grant reductions of freight on all objects sent to the Electric Exhibition to Vienna, which, according to the different tariffs on piece goods, will amount to a reduction of from 70 to 80 per cent. This much reduced tariff is relating to the transport of goods to and from Vienna. Besides, the insurance of the full value on the objects destined for the International Electric Exhibition will be allowed, and a simple certificate issued by the Commission, and added to the bill of lading, will suffice to give all these benefits to the exhibitors. With railway companies abroad negotiations have begun which will, we have no doubt, lead to favourable results.

OUR Sheffield correspondent writes:—A provisional committee, including the Hon. H. W. Fitzwilliam, Colonel W. S. Stanhope, and Mr. A. A. Jowitt, the Master Cutler, has been appointed to direct a movement in opposition to the Bill of the Hull and Lincoln Railway, which proposes to erect a bridge across the river Humber. The length of the proposed bridge is 5270 yards, in one span of 600ft., leaving a clear waterway in the centre of 90ft. high, two spans of 250ft. each, varying from 89ft. to 86ft. 6in. in height, and thirty-two spans of 150ft. each, varying from 86ft. to 46ft. It is urged that the bridge would hinder water communication in towns which now have a free access to the sea; that it would seriously jeopardise the trading interests of the West Riding by blocking up its great waterway; and that if vessels had to discharge and receive their cargoes at Hull instead of Goole, which now received a very large tonnage annually of foreign produce for the Humber to be transhipped to the inland towns, the manufacturers would have to pay a somewhat serious item extra in carriage overland.

THE whole of that part of the United States which is east of the Mississippi and north of the Potomac and Ohio has a population of 26,973,250, and had at the beginning of the present year 49,598 miles of road. This ratio gives 544 persons to the mile, and yet it supports its railroad system far better than the Southern States, which have a population of 740 to every mile of road in operation. The reason for this is to be found in the great diversity of industry, in the development of mines and manufactures, and in the concentration of foreign trade at Northern seaports, which causes the produce of the Far West and South to be moved largely over the Northern roads. The Southern States east of the Mississippi have 436,370 square miles to 16,108 miles of road, or 27·1 to one, while the Northern States east of the Mississippi have 418,495 square miles to 45,598 miles of road, or 8·4 to one. Notwithstanding, more railways are not yet demanded for the South with anything approaching the eagerness shown in adding to the mileage of the Northern States. In the North many more railways are in progress, while railway construction in the South is insignificant in amount.

IN a report on the collision which occurred on the 4th January, at Cowlairs west junction, on the North British Railway, when the 7.10 p.m. express train from Edinburgh to Glasgow, due at Cowlairs at 8.10 p.m., ran into the 9.10 a.m. goods train from Berwick to Sighthill, due at Cowlairs at 7.40 p.m., Major-General Hutchinson says:—"Until the engine of the express train was being turned into the Sighthill branch not fifty yards from the van of the goods train, no danger was anticipated by the driver, when there was time to do nothing more than apply the Westinghouse brake, which was fitted to nine out of the eleven vehicles composing the train, but not to the engine or tender. The guard of the express train noticed the west junction home-signal standing at danger after passing the east junction, but he did nothing in consequence to stop the train, though he, no doubt, might have done good service by applying the Westinghouse brake, of which he had control. The violence of this collision would doubtless have been much lessened had the driver been able by one and the same operation to apply a continuous brake to the whole of his train, whereas the brakes having to be applied by three operations, viz., by steam to the engine wheels, by hand to the tender wheels, and by the Westinghouse brake to the train, there was time to use only the last of these."

SOME interesting statistics have been published relating to recent railway extension in India. At the end of the year 1882-3 there were open for traffic 10,251 miles of railway, and in course of construction 2332 miles. There has been during the year an addition of 290 miles of completed line, and an increase of the railways sanctioned or actually begun of 1030 miles. This increase indicates vast benefits conferred on India. In the year 1860 the Indian railways carried under 4 millions of passengers; in 1881 they carried over 52 millions. In 1860 the merchandise carried was 632,613 tons; in 1881 it had risen to 11,637,000 tons. The traffic receipts in the earlier year were £586,000; in the later they were £13,726,000. These figures, says the *Times*, are remarkable in themselves, but their full significance may very easily be missed, unless we take the trouble to picture to ourselves what was the condition of India in respect of intercommunication before English capital and enterprise provided railways. In India there were practically no means of intercommunication, except in the vicinity of navigable rivers, until we provided them. No Roman conqueror had bequeathed to his abandoned provinces his all but imperishable roads, nor had any vigorous and progressive race constructed highways for itself. Thus, it happens that 10,000 miles of railway in India have a significance which no conceivable mileage could have in England. More lines are, of course, required, since each new one that is opened actually creates a demand for more.

NOTES AND MEMORANDA.

AN oil for belting is recommended, which consists of nine parts of linseed oil and four parts of litharge ground in water; these boiled to a plastic consistency, and then liquefied by an addition of turpentine, furnishes an oil which possesses, it is said, many admirable qualities.

IN a paper recently read before the Manchester Philosophical Society, Dr. Joule recommends a vessel about 1ft. in diameter, containing a layer of slaked lime of 4in. or 5in. in depth, suspended about 6in. above a gas burner, as more effective than the zinc he previously proposed for removing the acid vapours from the products of combustion of coal gas as described last week.

A CHEAP durable belt for elevators, designed for carrying such material as flour, middlings, &c., may be made, the *American Miller* says, of ordinary ticking. The ticking should be folded so as to have four thicknesses, and then be firmly sewed on a machine. The cups can be fastened to the belt by using ordinary blunt screws, the head running from the belt into the cup. A piece of tin can be used between the head of the screw and the belt, and the screw fastened on the inside of the cup by a leather washer. Belt bolts are much better, however.

THE highest bridge in the world is the railway viaduct of Garabit, in France, now being erected over a river in the department of Cantal. This bridge is designed by MM. Banby and Boyer, and constructed by M. Eiffel and Co., the builders of the Douro Bridge, has a total length of 564 metres—say, 1880ft.—and near the middle of the great centre arch—which is the most remarkable feature—the height from the bed of the river to the rail is 124 metres, or 413ft. The viaduct was begun in 1881, and it is to be completed next year. It is estimated to cost about £120,000.

IT is stated that the distinction of making the deepest sounding in the Atlantic ever yet recorded has been achieved by the officers of the Coast and Geodetic Survey steamer Blake, recently returned to New York from a two months' survey. The deepest sounding ever before reported was 3862 fathoms, which was made by the Challenger, sent out by the Royal Society. The depth reached by the Blake was 4561 fathoms. The place of sounding was 75 miles north of San Juan, Porto Rico, and not far from the point at which the Challenger sunk her deepest lead.

A NEW use for yeast has been suggested. The *St. James's Gazette* says:—"A German brewer in Nevada, having heard of the lime process for mining coal, proposes to use yeast as an agent for rending rocks. He has in his experiments blown strongly hooped casks to pieces, and forced out one end of his brewery. He desires to make experiments in the Comstock mines, the heat of which will set up fermentation the moment the yeast charge is damped, which will soon become so active as to overcome every resistance." The growth of the yeast fungus is apparently not much affected by a squeeze.

THE report of the British Iron Trade Association, just issued, shows that the total output of coal in the United Kingdom in 1882 amounted to 156,499,977 tons, being an increase of 2,315,677 tons on the output of 1881, and an increase of 9,530,568 tons on the production of 1880. South Durham stands first on the list, with an output of 21,780,808 tons, an increase of 249,895 tons over 1881. North Durham turned out 7,458,006 tons, an increase of 471,076 tons. Yorkshire turned out 18,530,331 tons, an increase of 236,154 tons. Scotland turned out 20,515,134 tons, a decrease of 307,921 tons, and Ireland, 127,777 tons, an increase of 192. Lancashire turned out 19,780,645, an increase of 1,280,835 tons, or more than half the whole increase for the year of the whole kingdom.

THE Registrar-General's return for the week ending March 17th shows that the annual rate of mortality in twenty-eight large towns of England and Wales averaged 26 per 1000 of their aggregate population, which is estimated at 8,620,975 persons in the middle of this year. The places in which the rate of mortality was the lowest were Portsmouth, Salford, Derby, Brighton, Huddersfield, and Bradford. In London 2771 births and 1854 deaths were registered, or an average of 16·5 births and 11·04 deaths every hour. Allowing for increase of population, the births were 62 below, whereas the deaths exceeded by 74, the average numbers in the corresponding weeks of the last ten years. The annual rate of mortality from all causes, which had been equal to 20·5, 21, and 21·7 per 1000 in the three preceding weeks, rose to 24·5.

ACCORDING to published analyses, perfectly dry maize contains 67½ per cent. of starch, and 4 per cent. of intermediate carbohydrates, or a total of 71½ per cent. of sugar-producing constituents; but dry rice contains 89 per cent. of starch and 1 per cent. of intermediate bodies, making a total of 90 per cent. Taking maize at 6s. 6d. per cental, and rice at 7s. 6d. per cwt., excluding the moisture, maize now costs 7s. 4d. per 100 lb., and rice 8s. 5d. per cwt., or 7s. 6d. per 100 lb.; at these rates every pound of available saccharine extract from maize costs 1·23 of a penny, or about 1¼d., whilst a pound of available extract from rice costs one penny, that is, about 20 per cent. less. The cost of working the two materials is as nearly as possible the same, for the expense of separating the fatty and albuminous constituents of maize is just about covered by the value of these constituents for other purposes.

THE addition of a small quantity of sodium to potassium yields an alloy fluid at ordinary temperatures, although the more fusible of the two metals, potassium, requires a temperature of 60 deg. Cent. to melt it. A mixture of sodium and potassium carbonates fuses considerably below the fusing point of either of the carbonates separately. Several other salts of the alkali metals exhibit a similar phenomenon, and amongst organic compounds there are many such instances, notably in the case of the fatty acids, mixtures of which usually exhibit a much lower melting point than any of the constituents separately. But the most striking effects of this kind are to be observed amongst the alloys of bismuth and of cadmium. Lead melts at 335 deg. Cent., bismuth at 268 deg., and tin at 268 deg., but an alloy of the three metals in certain proportions melts in boiling water, and by adding cadmium, which has almost as high a melting point as lead, an alloy is obtained which is fluid at about 60 deg. Cent. These phenomena have not been sufficiently investigated, and they cannot at present be satisfactorily explained. To the enterprising student there is here a most promising field for research.

IN an article on the use of new iron, and the effect on it of the use of scrap for founding car wheels, the *Railroad Gazette* says:—"The diminution of the silicon increases the amount of combined carbon, and consequently, up to a certain point, if the iron had considerable silicon to start with—*i.e.*, before repeated cupola meltings—increases the strength of the metal. At the same time the increase in the amount of foreign substances, such as slag and oxides, continually weakens the metal by interfering with its continuity. The phenomena resulting from successive remeltings of the same iron can be almost entirely explained in this way. Starting with an iron pretty high in silicon, and consequently low combined carbon and not much strength, the first remelting diminishes the silicon, increasing thereby the combined carbon, and consequently the strength, the increase of foreign substances, slag and oxides not being sufficient to counterbalance the increase in strength due to increase in combined carbon. Each successive remelting does the same thing, until finally the amount of silicon has become so small and of the foreign substances so large that the metal has reached its maximum of strength, and each subsequent remelting diminishes this valuable property. It is possible that the amount of slag and oxides may reach a maximum before the maximum of strength is obtained, since, if at each melting the metal is allowed to stand quiet in the molten condition for a period of time before casting, a portion at least of these foreign substances rises to the top and is removed. In this case, the ultimate diminution in strength arises from the diminution of the silicon, as has already been explained. In the case of car wheels, the number of remeltings that the metal can endure without too great injury is undoubtedly small—perhaps none at all."

MISCELLANEA.

THE Consul-General for Denmark calls attention to the Exhibition and competitive trial of cream separators, which will take place at the fifteenth Danish agricultural meeting, at Aalborg, in June next. Applications for space, and for information as to prizes to be awarded, should be made before the 15th April, to Mr. J. Hoegh-Guldberge, barrister, Store Torv, No. 5, Aarhus.

THE American *Woodworker* says:—"French band saw blades, of which great numbers have been sold in this country, are gradually giving way to home-made blades. Our saw-makers can now produce as good blades as can be found in the world." English woodworkers are still large users of French saws, and there are, it has often been noticed, several "sole" agents for Perrin's band saws in England.

A SYSTEM of ventilation by means of a current of air of large volume, induced by means of a small quantity of compressed air from an air-pump in a convenient place for the supply of one or of several buildings, is to be seen in operation at 147, Queen Victoria-street. The compressed air is permitted to escape from a nozzle into a large pipe, and thus induce a current, as does a Körting's steam ejector.

A SHIP CANAL is projected in the North of Florida, from a point in the river Suwanee, flowing into the Gulf of Mexico, to Jacksonville in the St. John's river, flowing into the Atlantic. The distance is about sixty miles, and the estimated cost £4,000,000. The New York Chamber of Commerce calculates the probable traffic at three times that through the Suez Canal, while the great loss of shipping that now occurs will be avoided.

A NEW twin-screw dredger, named the Crocodile, of 800 tons, built and engined by Messrs. William Simons and Co., was launched on the 27th inst., complete, from their works at Renfrew. This vessel will dredge to over 30ft. depth, and raise 400 tons per hour. It is fitted with compound engines of 100-horse power, two steel boilers, and steam appliances throughout. This vessel is the property of the Melbourne Harbour Commissioners, and is the second dredger this firm have constructed for them.

ON the 24th inst. Messrs. Raylton Dixon and Co. launched from their shipyard a screw steamer, the Machin, built entirely of steel, to the order of Spanish owners. Her dimensions are: Length over all, 270ft.; breadth, extreme, 38ft.; depth, moulded, 20ft. 3in.; and she will carry about 2600 tons, is built with water-ballast throughout, on the cellular system, and has steel decks, with cabin amidship. Her engines, of 200-horse power, will be fitted by Messrs. Blair and Co., of Stockton.

IT appears that for the fiscal year ending July 1st, 1882, the exports to Mexico from the United States reached the sum of 13,333,500 dols. In this were included the following items:—Horses, sheep, cattle, &c., 182,432 dols.; carriages, carts, &c., 173,015 dols.; railroad cars, 579,421 dols.; locomotives, 647,117 dols.; boots and shoes, &c., 85,327 dols. The value of saddlery and harness was 34,497 dols., and of all other manufactures of leather, 31,020 dols. The imports from Mexico to the United States for the year amounted to 15,093,837 dols., about half of which was specie. The value of hides and skins imported from Mexico was 1,525,107 dols.

THE advertisement, recently quoted in these columns from the *Chemiker Zeitung*, asking for the services of an "academically educated chemist, fully acquainted with the manufacture of sugar, who can undertake in summer the coppersmith's work, or the oversight of the teams of draught oxen," as well as the one with which it is compared, about the American ironmaster who wanted a chemist capable of keeping a watch on the phosphorus and teaching the cornet, for labourer's wages, these two advertisements were eclipsed by one in the *Chemical News*, about fifteen years ago, according to which the services of a chemical assistant were required, who was to be well acquainted with the various branches of analysis, and "must be prepared to wait at table when called upon to do so."

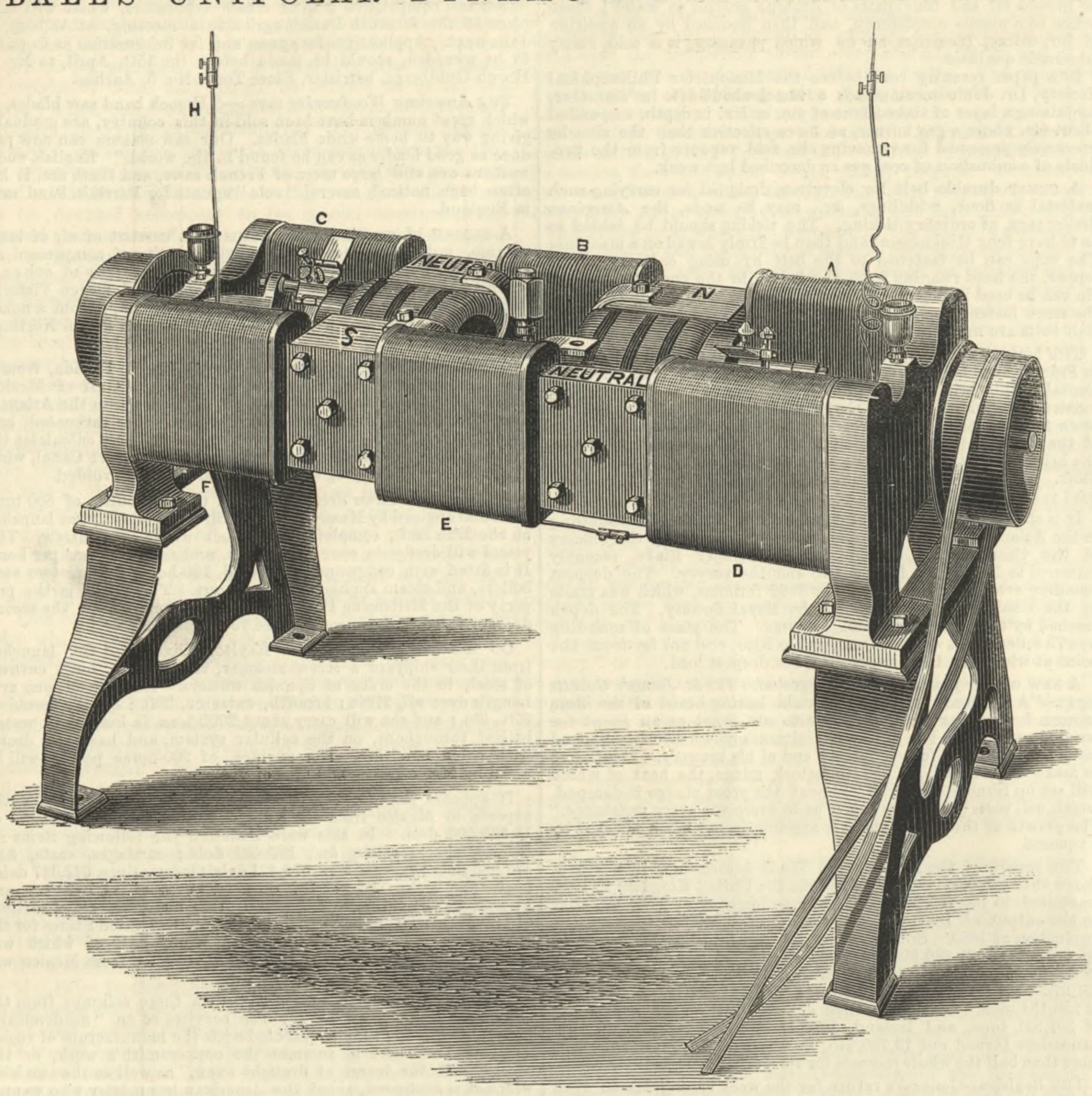
NAVAL reorganisation projects in Spain include the improvement of the armaments, the purchase of Nordenfelt guns, mitrailleuses, and torpedoes for the colonies; also the reorganisation of the recruiting system, so as to increase the present force of 7000 sailors and 4500 marines, extensive fortifications of the arsenals and ports, and the provision of other coast defences, mounting of heavy guns, of 40 and 80 tons, at Ceuta, Tarifa, and Algesiras, and in positions commanding the Straits of Gibraltar. These points have lately been inspected by three general officers, the commandants of Cadiz, Algesiras, and Ceuta, and the artillery commandant of Andalusia, who reported on the defences of the Strait. The Minister's plans would require an outlay of at least 16 millions sterling, spread over several years. The outlay will be obtained from the sale of the State lands and forests, without a fresh loan or issue of stock.

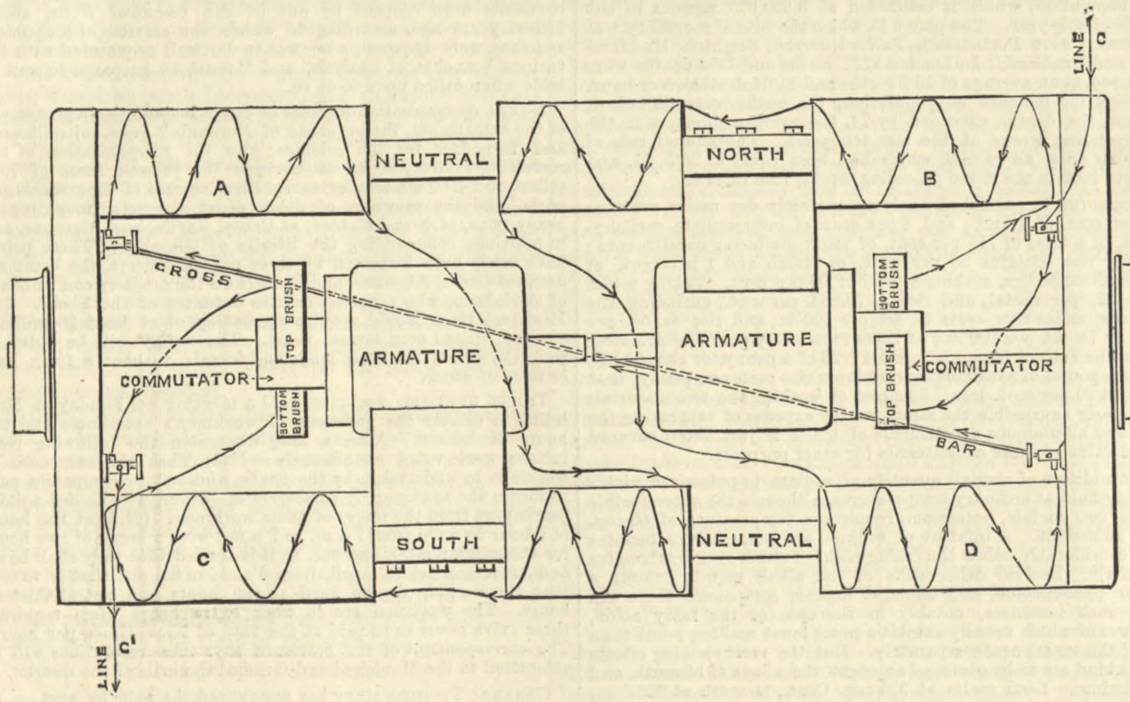
THREE HUNDRED workmen held a meeting on Sunday at Marseilles to discuss the questions of workmen's assurances and the hours of labour. After a long discussion the following resolutions were voted unanimously:—"(1) That the assurance of workmen be undertaken by the State, and not by companies paid to insure the workmen by employers of labour, who deduct a daily percentage from the wages of their workmen. (2) That the hours of labour be fixed from 7 a.m. to 7 p.m., with a break of two hours for the midday meal, and not, as it is settled that they shall be on and after the 1st of April, from 6 a.m. to 8 p.m.; that is to say, that the working day be fixed at ten hours, and not at thirteen hours. The workmen are to work extra hours when required, these extra hours to be paid at the rate of 75 centimes per hour." The correspondent of the *Standard* says these resolutions will be submitted to the Municipal and General Councils of the district.

GENERAL TECHERNAIEFF has announced the sale by auction, at Tashkend, of four springs of naphtha, discovered in Central Asia, one near the city of Namangan; another in the district of Tchangyr Tash, 35 versts to the east of Andiane, near the river Oakara Daria; the third near the village of Karin Douvan, 30 vests south-west of the city of Khokand, where there are also sulphur mines; and the fourth 6 vests from the village of Kani Bodam, south-west of Khokand, and 70 vests east of Khojend. The *Moscow Gazette* calls attention to these and other petroleum springs in Ferghana, which bid fair to compete seriously with those of Salu and the Transcaspian. The quality of the product is said to be in no way inferior to that produced in the last-mentioned regions. With modern means of production, a flourishing industry is looked forward to in Ferghana by the new Governor-General; but the absence of means of transport to any part of the empire where the naphtha can be made use of in any large quantity will probably be a serious impediment for some considerable time to come.

THE anthracite coal trade statistics of Pennsylvania show that the output for 1882 was twenty-nine and a-half million tons, being an increase of one million tons over the previous year. The output for 1881 was five million tons greater than in 1880, so that the rate of increase showed a great falling off. No fewer than twelve lines of railroad and a canal unite to transport the output of hard coal collieries, upwards of 300 in number, while 75,000 men find employment in getting out the fuel, which is found in eight counties of the State. The river coal trade of Western Pennsylvania comprises but a small area as compared with that of the harder coal; but two counties, Westmoreland and Alleghany, furnish the main coal basins reached by the Monongahela pools. The river pits are seventy-four in number, and employ in round numbers 5000 miners, working in a vein usually but half as thick as that of the anthracite deposit. Although the outlet for all this coal is chiefly by a single river, hampered by narrow and slow working locks, during 1882 this limited field sent out more than four million tons of coal, and the figures of the last ten years show a steady increase of 100 per cent.

BALL'S UNIPOLAR DYNAMO-ELECTRIC MACHINE.





THE peculiar machine which we illustrate above is to be seen at 41, Kirby-street, Hatton-garden, where it is driven through the medium of a transmission dynamometer, and has in circuit six arc lamps, and five incandescent of different resistances. The machine has been running some time in London, and has been tested by Mr. Robert Sabine, the results of whose tests have been embodied in a report from which we take the following :—This machine consists of a long rectangular frame of soft iron, coiled so as to form the field magnets, and which longitudinally supports the axes carrying two bobbins of the Pacinotti type. The main peculiarity of the machine is that each bobbin is rotated in the presence of only one magnetic pole, the opposite side of the bobbin facing a neutral point of the field. Hence the name "Unipolar," by which the inventor designates his dynamo. The effect of this so-called unipolar arrangement, in so far as the field is concerned, appears to be that the rectangular soft iron frame is converted into two long electro-magnets with two poles, only one being presented to each of the rotating bobbins, instead of four shorter and proportionally weaker electro-magnets having four poles as in the ordinary way, by which two opposite poles would be presented to each of the bobbins.

When I tested the system the dynamo was run with six arc lamps, also said to be of Mr. Ball's invention, the dynamo being worked on the "series" system, that is to say, field magnets, armatures, and lamps all joined up in series. The speed of the machine was not so regular as could have been desired, and the Morin dynamometer by which the power given to the dynamo was measured, would have worked steadier had it been driven quicker or with a heavier load. The following are the mean results which I found :—

Current in circuit = c = 15·0 ampères.

Potential difference between terminals = E = 195 volts.
Resistance of dynamo = r = 4·5 ohms.
Speed of dynamo, 1650 to 1715 revolutions per minute.
Speed of dynamometer = s = 332 revolutions per minute.
Indicated pull on dynamometer, less pull when circuit open = k = 52 kilos.

From these values :—

(1) Given to dynamo for electrical work,

$$\frac{1{\cdot}5\ k\,s}{60 \times 76} = 5{\cdot}68\text{-horse power.}$$

(2) Accounted for in outer circuit,

$$\frac{\text{E C}}{746} = 3{\cdot}92\text{-H.P.}$$

(3) Accounted for in inner circuit,

$$\frac{\text{C}^2\,r}{746} = 1{\cdot}35\text{-H.P.}$$

The proportion accounted for electrically, therefore,

$$\frac{5{\cdot}27}{5{\cdot}68} = 0{\cdot}92,$$

of which $\frac{3{\cdot}92}{5{\cdot}68} = 0{\cdot}69$ was accounted for in the lamps. This would leave only 8 per cent. for the so-called Foucault currents. Photometric measurements were made with one of the lamps, placed apart from the others in a dark recess, the light of the five remaining lamps not being measured. The following mean results were obtained during the observations :—Current in lamp, 13·9 ampères; potential difference, 40·1 volts.

Accounted for in lamps,

$$\frac{13{\cdot}9 \times 40{\cdot}1}{746} = 0{\cdot}75\text{-H.P.}$$

The illuminating effects were as follows :—

Position of arc with regard to photometer.	Illuminating power. Observed.	Per I.H.P. accounted for in the lamp.
	Standard candles.	Standard candles.
22 deg. below.	602	802
11 deg. do.	626	835
Horizontal.	887	1183
11 deg. above.	1213	1617
22 deg. do.	1831	2441
31 deg. do.	1859	2479
35 deg. do.	1690	2253

To the particulars given in this report by Mr. Sabine we may add a few supplied by Mr. C. W. Raymond, who represents the inventor at the address already given :—

The machine has, as before stated, two armatures, and yet the machine is simple in construction. The armatures are 8in. diameter, revolving in opposite directions.

	lb.
Weight of No. 14 (Am. gauge) copper wire on two armatures (about)	38
Weight of No. 8 (Am. gauge) copper wire on field magnets (about)	130
Total copper on machine	168

Each armature contains 60 sections; the commutator also contains 60 sections.

Periphery speed at 1650 revs. per min. = 3450ft , gives 6 arc lights.
„ „ 1800 „ „ = 3700ft., „ 7 „
Magnet bars, 7in. × $1\frac{1}{8}$in.

The above machine is of the earliest pattern, and is nearly 35 per cent. more in weight than the latest pattern, both in copper and iron, the weight being about 750 lb.

The following figures relating to a 15-light machine, now in New York city, are of some interest :—

	lb.
Two armatures, 12in. dia. No. 14 (Am. gauge) copper wire (about) 3000ft.	80
Six magnet bars, each 2in. × 2in. (3 on top, 3 on bottom) No. 8 (Am. gauge) wire 4444ft.	200·5
Total copper	280·5
Total weight of iron	661
Copper in two commutators	30
Bearings (composition)	26
Total weight of 15-light machine ..	997

Weight of machine per lamp about 66 lb.
Internal resistance, about 7 ohms.

It has two commutators and two armatures on one shaft, revolving in same direction, with connections coupled as to give the same effect as in the case of the 6-light machine above described, and with but one soft iron pole piece to each armature—

With a periphery speed 3600ft. per min. = 1146 revs., gives 15 arc lights
„ „ „ 4000ft. „ = 1274 „ „ 18 „

A more recently finished machine for five lights, by advice from New York, has the following description :—Total weight of copper on field and armatures (about) 88 lb.; total weight of machine (about) 350 lb.; weight of machine per lamp (about) 70 lb. Revolutions, 1190 per minute, gives five arc lights of the same candle power as those referred to by Mr. Sabine. Two armatures, with but one pole piece to each armature, and but one commutator mounted on one shaft, revolving in same direction, with one belt. The commutator has 120 sections, the armatures have 60 sections each. The "sparking" is *nil*, and the commutator wears to a polish. Resistance of machine $2\frac{8}{10}$ ohms.

The machine at Kirby-street has been running in New York City and in London for a greater part of the time during the past twelve months, and has, we are informed, had no repairs, and has been taken apart but once, and then for the purpose of cleaning and painting previous to its shipment from New York to London. This freedom from repairs is due to the simplicity of construction and the light strain on the straps by which it is driven.

It will be noticed that our engraving shows very narrow driving straps. Those used are as narrow as shown, namely, from about $\frac{1}{2}$in. to $\frac{3}{4}$in. in width and about $\frac{1}{4}$in. in thickness, running on pulleys 8in. in diameter. The strain on the straps when the machine is running at 1700 revolutions per minute, and absorbing 5·68-horse power, is not very great, and taking the circumference at 2ft., the strain would be $\frac{5{\cdot}68 \times 33000}{2 \times 2 \times 1700} = 27{\cdot}5$, and allowing as tightness for adhesion and extra pull of, say 7·5 lb., we have a total of 35 lb. as the strain, which, though small, would probably soon destroy a strap, say, 0·6in. by 0·25in.

The diagram in the next column shows the peculiar way in which the winding is connected through the commutators and across the machine. Taking the negative or return wire C and following it, it will be found that the circuit is through the right-hand commutator round bobbin B, thence to central bobbin, thence back to bobbin D, then along cross bar below the armatures to bobbin A, across to central bobbin next the south pole, and from this to bobbin C through left-hand commutator, and on to the positive terminal carrying the lead C.

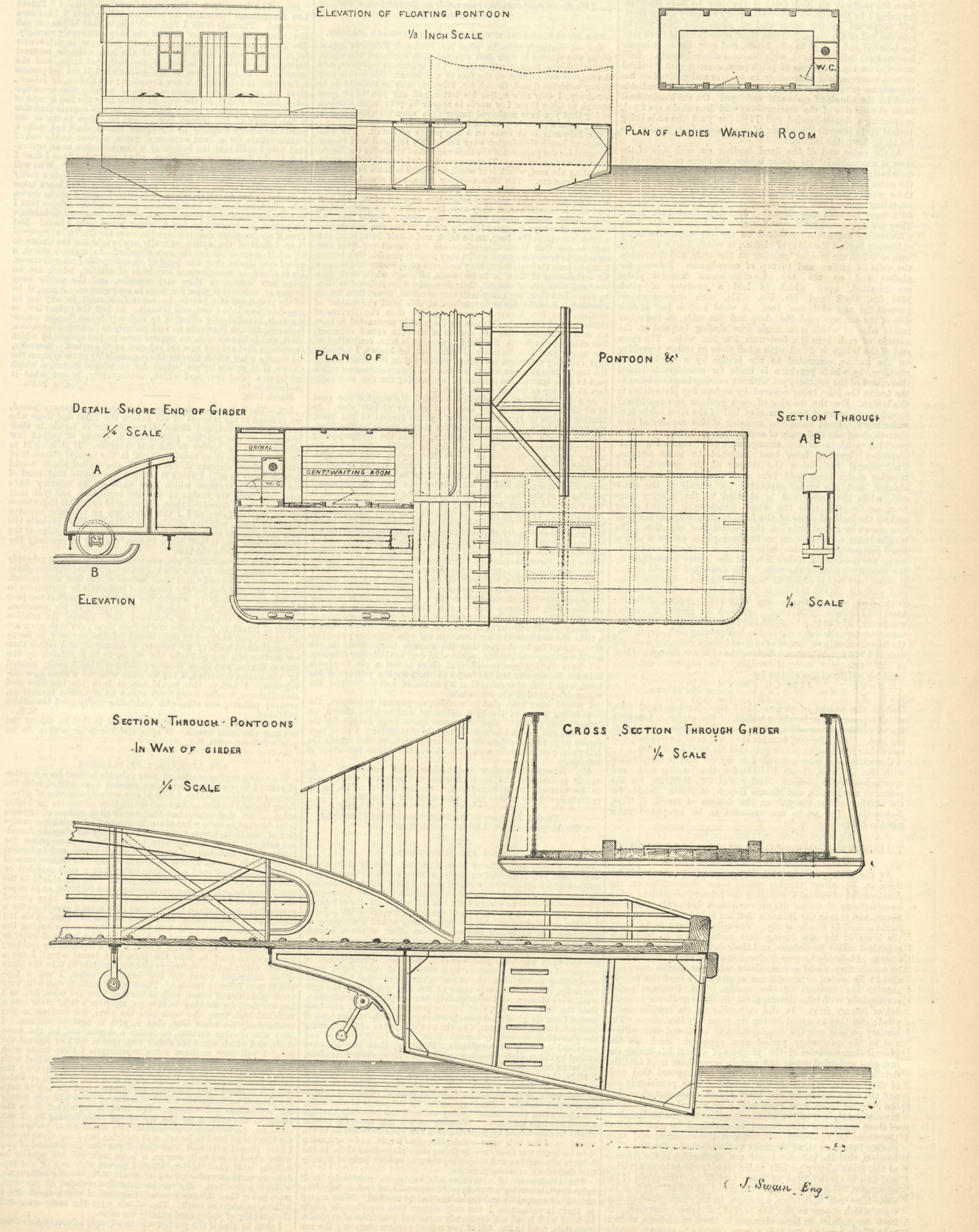
DEATH OF MR. FRANK HATTON.

A TELEGRAM has been received by the directors of the British North Borneo Company in London, announcing the death of their scientific explorer, Mr. Frank Hatton, only son of Mr. Joseph Hatton, the well-known author and journalist. Sir Walter Medhurst, at Hong Kong, telegraphs that Mr. Hatton was out elephant hunting when his rifle caught in the bushes. He was accidently shot through the lungs and died instantly, an inquest being afterwards held at Elopuran. This brings to a too early close a career of something more than promise. Although he had not yet completed his twenty-second year, his name was already associated with some good work. He had successfully endured the hardships of travel in North Borneo, exploring the greater part of the company's territory. He had conducted his various expeditions with great tact, courage, and discretion, and was arranging to return to England for a well-earned vacation, when the company were thus deprived of his services. An only son, in whose success lay his father's chief ambition, he had already distinguished himself in scientific research, and in other directions. A few weeks ago Professor Frankland publicly expressed his indebtedness to him for some original ideas employed in carrying out the filtration of water at Brussels. He was made a Fellow of the Chemical Society at nineteen, and in the same year was admitted an Associate of the Institute of Chemistry, for his investigations into the influence of gases on the life of bacteria. He was recently nominated to a fellowship of the Asiatic Society at Singapore, and was preparing a Dusun dictionary for the use of the Bishop of Singapore. He spoke both Malay and Dusun, and was especially happy in his power of establishing the warmest relations between the native chiefs and himself, having more than once been referred to in the Governor's despatches. He was to have returned in the autumn to prepare his diary and notes for publication.

HORSE AND CART FERRY LANDING STAGE AT JARROW

MR. C. J. TATE, C.E., ENGINEER.

(*For description see page 246.*)



HORSE AND CART FERRY, JARROW.

THE Jarrow Corporation having obtained powers by the Jarrow Improvement Act, 1878, to establish a ferry to ply between Jarrow and the opposite bank of the river Tyne, have now put in operation that power by commencing to lay foundations for landing stages, the contracts having been entered into for the due completion of the work. The ferry, which we illustrate on pages 245 and 248, is approached from the roadway on both sides of the river by fixed landings, inclining 1 in 10 towards low-water mark ordinary spring tides, and supported at the outer end on pitch pine piles driven into the bed of the river. Above, these cross-beams of pitch pine are tenoned and bolted to pile heads, and over the cross-beams longitudinal balks are fixed, with diagonal struts beneath. Laid crosswise on top are planks of pitch pine, covered with Portland cement concrete, laid alternately in squares and grooved on the top side to provide a secure foothold for horses and a suitable road for the wheels of carts and carriages. On the longitudinal balks at each side of the carriage-way cast iron chairs are fixed, supporting a double-headed rail 75 lb. per yard, the ends being turned up to prevent the wheels of the girders from moving too far up or down the incline.

At the outer end of the fixed landing on each side of the river is a movable lattice girder bridge, the shore end supported on wheels running on the before-mentioned double-headed rails, the outer ends being attached to a pontoon built of iron, having three water-tight compartments, on which are waiting rooms providing convenience for passengers. The lattice girders are 60ft. long between the supports, 6ft. deep, and 12ft. apart. They are connected on the under side by bulb iron 8in. deep, with double angle irons rivetted on the top edge, alternately extending beyond the sides of girders, to which double stiffening bars of T-iron are welded together at the ends, and rivetted to the sides of girders and to top of cross-beams. Between the girders and on the top of cross-beams diagonal plates are rivetted, upon which is laid a roadway of pitch pine 5in. thick and 5ft. 6in. wide, with cross-pieces to prevent the slip of horses' feet. A wood kerb is laid at each side of the carriage road 9in. deep and 6in. wide, on the upper inside edge of which is an angle iron chafing bar, and at the outside of each kerb is a foot-walk 2ft. 9in. wide. The shore end of the bridge is fitted with a tail piece on rollers travelling on the incline, connected to the bridge by a special chain coupling, by which provision is made for considerable lateral movement of the pontoon, yet without causing inconvenience to the traffic, the joint being covered by an iron flap plate fitted to the bridge. For the mooring of each pontoon two mushroom moorings are screwed into the clay bed of the river below low-water mark. From these the mooring chains are carried over sheaves along the underside of each girder, and the inner end is provided with a screw arrangement for regulating their respective lengths, from bars attached to stone anchors, fixed several feet below the surface of the ground. The mooring chains being held firm at both ends and hung over sheaves, and the girder supported on wheels at the shore end, while the outer end is rivetted to the floating pontoon, as the tide rises the whole structure is moved along and up the inclined plane of the fixed landing stage to the position shown by ticked lines on the section and elevation. The weight being on wheels on an inclined plane, causes a downward movement as the tide falls, which is continued until the water has reached its lowest level, or the bridge is checked by the turned-up ends of the rails. The estimated weight of one pontoon and bridge complete being as follows:—Plating knees and packing, 20,840 lb.; angle bars and rivets, 9098 lb.; woodwork, deck, and waiting-rooms, 12,980 lb.; cement, 9880 lb.; total, 52,778 lb. = 23·56 tons. Ironwork in girder, 25,119 lb.; woodwork, 13,093 lb.; total, 38,112 lb. = 17·46 tons. The distance between the supports of the bridge being 60ft., depth 6ft., the lower flanges have, exclusive of rivet holes, a collective sectional area of 13·56 square inches. Taking the ultimate strength of iron at 20 tons per inch of section, the engineer estimates breaking weight of the girders by

$$\frac{a\,d\,k}{l} \times 4 = \frac{13{\cdot}56 \times 6 \times 20 \times 4}{60} = 104{\cdot}48 \text{ tons.}$$

Deduct the weight of girders, 17·46 tons, leaving 91·02 tons, which represents the breaking weight of the girder. Assuming the safe load to be one-fifth, 18 tons may be taken as a safe working load. This, however, is more than will ever be applied, and more than the floating power provided for by the pontoons.

Contracts have been entered into by the Jarrow Corporation with Mr. J. Lane, South Shields, for the landing stage and approaches, Messrs. Sproat, Marley, and Co., Hebburn, for the pontoons and girders, and Messrs. Hepple, of North Shields, for the building of the ferry, from the designs of Mr. C. J. Tate, Newcastle. The works are expected to be completed three months hence.

THE DEVELOPMENT OF ANIMAL LIFE DURING THE PRIMARY FORMATIONS.

AT the sitting, on the 12th February, of the Académie des Sciences, M. Albert Gaudry made some observations on the development of animal life during the primary formations. We know nothing of animal life on our planet before the Cambrian Epoch, and it is in the Silurian that are found the most ancient forms accessible to our study. The trilobites and cephalopods, the kings of the sea during that period, seem to have been organised rather for defence and their own preservation than for attack. Their organs were inclosed in strong cases; the windows by which they could communicate with the outside were provided with covers, or constrictor appliances, a condition favourable to the increase of the species. The Devonian period corresponds with the development of the vertebrate animals, fish of strange form. In the carboniferous era reptiles multiplied; and they swarmed during the secondary formations. The tertiary periods saw the development of birds and mammifers; and in the quartenary period man appeared. Such are the general characteristics of the progress of animal life during the immense geological ages; but certain errors have crept into the details of this progress. It must not be supposed that each of these classes of animals was developed with precision in one and the same epoch, for the most recent researches show that the different types were continued over several epochs. There are also great inequalities in the duration and the prolongation of these types, and they cannot be explained by what is called the strife for existence. Sometimes the strongest and most perfect have been those destined to the shortest existence. The truth is, that the palœontologist can distinguish in the *ensemble* of this great history periods which seem to characterise a species, and he will speak of one of these periods as "the epoch of the ammonite," just as one says "the age of Pericles." It is at the same time true that there are some forms which perish or continue which appear to play the part of permanent reservoirs. In these inequalities, in these changes, in these oscillations, there is marvellous beauty; but it is a great mistake to suppose that the principle of the strife for existence, which resolves itself into the destruction of the weak, is the general law of this progress. If this were the case there would have been on the surface of the globe, for a long time past, nothing but devourers vainly seeking whom they might devour; and the harmony between the species would be destroyed.

LETTERS TO THE EDITOR.

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

THE SMOKE ABATEMENT COMMITTEE'S OFFICIAL REPORT.

SIR,—I certainly thought, when Mr. Frederick Edwards' letter, which was quoted in your last number, first appeared elsewhere, that it did not require any notice. The argument was poor, and the animus was evident on the face of the letter. He makes very strong assertions, and though Mr. Edwards may be thought to be somebody, I only now notice his letter, and ask you to be good enough to allow these few words to appear in your next number, seeing that you have conferred importance upon his utterances by giving them a place in your influential journal.

Mr. Edwards is in error on a few points of detail. The test-houses at South Kensington were thoroughly repaired and re-constructed for the purposes of the tests conducted by me for the Smoke Abatement Committee. They are constructed entirely of concrete, excepting the roof, which is of wood, and there is not a brick in the whole structure. The chimneys, or flues, are round, $8\frac{3}{4}$in. in diameter, and are surmounted by a few feet of 6in. zinc pipe; and Mr. Edwards does not attempt to produce an atom of proof in support of his assertion that they were too small for properly testing coal-burning grates, except by implication when he states that "all ordinary chimneys measure 14in. by 9in." When one reflects that a brick measures 9in. long, and a brick and a-half 14in. long, it is easy to see that these dimensions are convenient for flues constructed in brickwork; and whilst they make it possible for a human being to pass through them, they no doubt compensate in a manner for tortuosities of flues in house walls, although when such flues are lined with $\frac{1}{2}$in. of cement, their dimensions are reduced to 13in. by 8in. But there are many instances of round, house flues 9in. in diameter. Such things as dimensions of this kind are matter of routine, and Mr. Edwards must be aware that the throats of chimneys and the vents of grates are frequently contracted to have an area much less than the section of an $8\frac{3}{4}$in. round chimney. The chimneys at South Kensington were, it is true, contracted at the upper part to a diameter of 6in. But, he knows, I suppose, that ordinary chimneys are often contracted in the same way at the top by pots or pipes, and it is a mark of disingenuousness on his part to have ignored the practice of contracting the flue thoroughfare at the top as well as at the bottom.

As a matter of fact, the draught at South Kensington was good at all times, even during the stormiest weather of last year. As another matter of fact, corroborated by the results of the tests, the draught in the rooms employed for testing grates at the Manchester Smoke Abatement Exhibition, where the comparatively tortuous chimneys were 14in. by 14in. in section, was not a bit better than the draught at South Kensington, with the $8\frac{3}{4}$in. straight chimneys. By reference to the official report it will be seen that in the grates, which happened to have been tested both at South Kensington and at Manchester, the fuel was consumed practically at the same rates per hour; taking averages, indeed, it was consumed rather more freely at South Kensington than at Manchester. It can be proved in another way that the draughts were equally good. The grates that were tested at both places had an average velocity of upward draught at the rate of 411ft. per minute at South Kensington in the $8\frac{3}{4}$in. straight chimney, and an average upward velocity of only 130ft. per minute at Manchester in the 14in. tortuous chimney. These velocities of draught, singular to say, are almost precisely in the inverse ratio of the sectional areas of the chimneys, which are 60 square inches and 196 square inches respectively; and the volumes of draught per minute are respectively:—$8\frac{3}{4}$in chimney ($60 \div 144 \times 411$) = 171 cubic feet per minute; 14in. chimney ($196 \div 144 \times 130$) = 177 cubic feet per minute. Here, it is seen, that the volumes of draught are almost precisely equal with the $8\frac{3}{4}$in. and 14in. chimneys. The volume is a trifle the less—about 3 per cent.—in the $8\frac{3}{4}$in. chimney; and this is accounted for by the fact that the average temperature in the smaller chimey was 210 deg., against 223 deg. in the larger chimney.

I have thus demonstrated that there is not a pin to choose between the smaller and the larger chimney for the purpose of the tests, and I am of opinion that my ounce of fact outweighs Mr. Edwards's pound of rhodomontade.

I would have been glad to consider, on general principles, the ventilating power of the $8\frac{3}{4}$in. chimneys, and to have shown, on independent grounds, that they were quite large enough for the purpose; but I feared to extend unduly this letter. I have been forced to go thus far into detail in order to meet and expose the fallacious generalities in which Mr. Edwards has been permitted to indulge.

Mr. Edwards's baseless insinuations with respect to individual members of the Smoke Abatement Committee needed only to be uttered to be repudiated. I may add that he, as an exhibitor, did not receive any award from the committee.

D. K. CLARK,
Testing Engineer to the Smoke Abatement Committee.
8, Buckingham-street, Adelphi, March 27th.

GLASS AND GUNPOWDER.

SIR,—I know but little of plate-glass and scarcely more about explosions, yet, after reading the interesting notice on the two-fold subject which appeared in a recent issue of your paper, it occurred to me very forcibly that an explanation of the plate-glass phenomenon must be sought rather in the nature of the substance acted upon than in peculiarities of the acting force. With nothing but the description of the oblong regularly scored glass slabs to guide me, and surmising backwards from effect to cause, I reach the preliminary conclusions, subject to confirmation, modification, or refutation by the tests of inquiry and experiment, First, that the bed upon which the glass was cast was either strengthened or supported at certain distances by a network of more rapid heat-conducting power than the main substance of the bed itself. Secondly, that at intervals some of the ribs composing the network were thicker, and consequently more rapid heat-conductors, than the rest. Thirdly, that in the process of cooling the heat passed from the glass most quickly where it found the largest mass of heat-conducting substance, *i.e.*, the two categories of ribs, leaving the glass-plate apparently homogeneous, but in reality crossed and recrossed by lines of brittleness. Fourthly, that the air-wave caused by the explosion pressing equally upon the surface of the plate, the latter began yielding along all the lines of brittleness. And, Fifthly, that the lines of greatest brittleness, where the ribs had been most massy, breaking first, left the air-wave without a basis of resistance for further action upon the lines of secondary brittleness, which therefore closed up again, by the power of elasticity, the glass along their course having suffered fracture only through a portion of its thickness. Whether or not this theory is correct might be ascertained by inquiring of a few glass founders as to the structure of the beds upon which plate glass is cast, and—supposing it to be borne out thus far—by fixing some plate-glass slabs to the bottom of receivers, and subjecting them to sudden jerks of equally distributed air or water pressure.

The attainment of approximately analagous results by such means, while solving a curious problem, would, of course, leave the subject of explosives and explosions barely touched. With regard to their investigation I can only suggest that experiments might be tried with small and accurately measured quantities of explosive materials, fired in the *foci* of two sets of *cameræ obscuræ*; the one set provided with fixed plates, the other set with rapidly revolving plates and converging lenses. By these means one would at least learn something concerning the characteristic shapes, dimensions, durations, and morphic phases of explosion flames, and perhaps light upon some unhoped-for vein of interesting or useful discovery. The Tom Tiddler's ground of science is rich in unsuspected treasure.

CHAS. ED. MARR.
Finborough-road, South Kensington, March 27th.

PATENT LAW.

SIR,—The letter from "Millwright" on the subject of "Patent Law Amendment" contains the most sensible opinion I have seen expressed. The only fault I find with him is, that he has not put the ordinary manufacturers' side of the case sufficiently strongly. The granting of letters patent, or exclusive privileges, to an inventor for a limited period, is, in the eye of the law, a simple contract between the Crown, on behalf of the nation at large, and the inventor. The latter gives to the public what it did not possess before—the full details of a new invention; the Crown, in return, gives the inventor the exclusive right of working that invention for a limited period, at the end of which time the full benefit of the discovery reverts to the public. No one will dispute that this is the theory of the patent law. Now, Sir, when as one of the public the Crown bargains on my behalf that I shall not make a certain article for a fixed number of years, because at the end of that time I shall reap the benefit of a new invention as an equivalent to the temporary prohibition, what guarantee have I that I am not defrauded? Am I not, in nine cases out of ten? Who will venture to say that more than one patent in ten protects a really new invention? Again, Sir, if I am an inventor, the Crown takes my money; but does it fulfil its obligations? May I not be drawn into a tortuous lawsuit by a previous patentee, who alleges that I infringe his patent, and ruined—not, perhaps, because I do infringe his patent, but because he has a longer purse than I have? But even if my invention does infringe his, since the Crown has received it on behalf of the nation as really new, ought not the Crown to be solely responsible for its own blunder? As matters stand, a sword ever hangs over the head of an enterprising manufacturer. He is afraid to manufacture hundreds of articles, which are no more new inventions than clay marbles, and the public have to pay an exorbitant price for them in consequence. Again, if he be the proprietor of a patent, he never feels safe; for any day he may be drawn into a tortuous lawsuit. In fact the patent law, as it stands, is sufficiently effective to seriously harass honest manufacturers, though it affords no real security to deserving inventors. First, and before all else, we require some perfect system by which inventions that are not new are rejected at the outset. Secondly, we require a law which throws the responsibility entirely upon the Crown, if it grants letters patent for an alleged invention which infringes a prior one, and which, consequently, is not what it professes to be.

CUI BONO.
March 15th.

SIR,—The Patent Law, as it now exists, and the new one proposed, are opposed to the interest of all except the State and those who profit by inventions, and although patents are so fertile in their creation, no one yet has propounded a system of patent law calculated to do justice to the real inventor. If it is right to patent inventions there must be a law in the natural elements of political science discovered, understood, and applied which would operate justly to all. I think it will not be disputed that most of the valuable inventions which have enriched the country have emanated from the brains of working mechanics, and yet they have never been consulted upon a measure of such vital importance as the Patent Law; and I can safely say no measure, however artfully framed, will give satisfaction unless the State protects the poor inventor the same as the rich; and so far as I can judge of the proposed new law, it will leave him in the end in precisely the same position as the old law.

It is only the capitalists who can secure to themselves a monoply of inventions. Now I maintain the State and the capitalist ought to occupy the second and third place instead of the first and second. If it is right and just for the State and capitalists to participate in an invention, surely it is right the State should protect the poor man's relative right and interest in the property of his invention. American and Continental statesmen have learned the relative rights of inventors, and foster and protect them; our statesmen are all figures, and have yet to learn sound political economy, so far as the mechanical trade of the country is concerned, and rather than see another Bill brought into the House to be mutilated by the men of figures, who know little or nothing of what is really wanted by those most deserving, I say do away with the Patent Law alltogether. I believe this would benefit both the inventor and manufacturer, besides doing away with a lot of useless inventions, prevent pilfering and otherwise mutilating really good inventions published.

S. S.

[Our correspondent ought to say what it is that he thinks the working mechanic wants. Vague statements or wishes do no good whatever.—ED. E.]

THE EFFICIENCY OF TURBINES.

SIR,—As a regular reader of your valuable journal for a number of years, I have of late been more amused than edified with the letters on turbines, which I take to be a second-hand way of advertising the said turbine or turbines which their advocates so highly extol. I am also astonished that no English makers of turbines come forward to state what their turbines will do, with the exception of Mr. Hett, whose turbines I have heard are after the American pattern. Now, having been accustomed to water-power for thirty years, and having erected overshot, breast, and undershot water wheels, as well as turbines—not of my own make—some of the latter of which used a lot more water than a good overshot or backshot wheel to give out the same power. Finding this to be the case I have for years been experimenting with turbines, so as to get the best effect due to the various heads of water, and have proved conclusively that a given turbine may give a good result under a high head of water, but under a low head was nowhere. This led me to experiment as to the best forms of turbines for taking the places of the old style of water wheels. For high heads of water to take the place of an overshot wheel, I use a top-delivery turbine; for a medium head to take the place of a breast wheel, I use a turbine with a bottom delivery; and for a turbine to take the place of an undershot wheel for low heads of water, I use a top- and bottom delivery turbine. These can be made to deal with very large quantities of water, such as working from the tides, &c., as I can use them for working both ways, say from a tidal river into a tank and back from the tank into the river, the turbine to run continuously the same way, that is, with or against the sun. I have also another turbine, or rather a double one, on the same shaft, and which will work either way, that is, with or against the sun. I will now mention some experiments I have made with models. The turbine to take the place of an overshot wheel with 10in. of head will run at about 1500 revolutions per minute; the one to take the place of a breast wheel with 6in. of head of water will run at about 850 revolutions per minute; and the one to take the place of an undershot wheel with 2in. of head will run nearly 300 revolutions per minute. The head is calculated from the centre of the turbine to the top of the water driving it. I can show any party these experiments. No doubt some parties will say there is no heed to be taken of models; but I say there is, and I have proved over and over that if you can get a model of any water wheel to act well, one on a large scale will act equally as well, in most cases better, which I proved with one of the top-delivery turbines under a head of about 20ft., driving millstones, which is a good test. My turbine actually developed 25 per cent. more power than the one I tested it against, of which there are, I believe, numbers at work. The wheels were the same size, and the quantity of water used exactly the same.

I shall be glad if the parties who so strongly advocate American turbines will inform your readers if they can govern their turbines to the nicety required for electric lighting purposes—this I very much doubt. Then again, how would they work one of their turbines, say from a tidal river into a tank or tanks and back again through the same turbine, the said turbine to continue running all the time the same way; and how can they make a turbine that will run at the same speed with a head of water varying from 8ft. down to 4ft? I am happy to say that an English turbine can be made that will do all that I have stated above. As my time at present is fully occupied, I shall not be able to do much letter writing, but I have enclosed my address and shall be happy to show the models at work to any parties who take an interest in water power, especially "Aquarius," whose sensible letter appeared in your issue of March 9th.

I may say that my turbines are patented, and will, most likely, be introduced to the public before long. UNIQUE.

London, March 20th.

TRIAL OF THE CAPELL DOUBLE POWER BLAST FAN.

SIR,—The following particulars of a trial of one of my fans may interest your readers:—This 20in. fan was made for a special purpose, viz., to give draught to the furnaces of a steam yacht. It was stipulated that the speed of the fan was not to exceed 1400 revolutions per minute, and the discharge to be 4000 cubic feet per minute. To obtain these results, the fan was made with large inlets, and a large discharge port. The principal dimensions were, diameter, 20in.; inlets, area, 226in.; ports in fan cylinder, 156in. area; width of fan, 9in.; discharge port, 144in. area. The fan was made for volume, not for intensity of blast. The inlets would have been modified if intensity had been the object. In working out the speeds decimals of inches have been omitted. In this fan the air speeds are reduced by the case, which I find absorbs from 800ft. to 1000ft. of the blade tip velocity, where the outlet is of large size. By reducing the area of outlet to that of an ordinary fan, the air speed at once rises from 1000ft. to 1800ft. above the blade tip speed, by compression in the case.

The results of the trials of the 20in. fan were as follows:—(1) Revolutions, 1200; blade tip speed, 6200; cubic feet discharged same as speed of meter, 5030ft per minute; water pressure, 6·25in. (2) Revolutions, 1460; blade tip, 7540ft.; air speed by meter, 6730ft. = cubic feet of discharge. (3) Revolutions, 980; blade tip, 5063ft.; air speed by meter, 3680ft. = cubic feet of discharge. (4) Revolutions, 1140; air speed, 4620ft. = cubic feet discharged; blade tip, 5890ft. per minute. (5) Discharge port contracted to equal 10in. diameter outlet; revolutions, 1060; blade tip, 5476ft.; air speed by meter, 6430ft.; meter used, Casella's Counter Harding's. Trials of a regular pressure blast fan will follow these.

The results I set before you agree in a singular manner with those from the 6in. fan tried at the office of THE ENGINEER, and described on February 16th. A 3ft. diameter exhaust fan will be ready for trial in a week. Professors Ayrton and Perry's electromotor will be on a bracket cast on the fan cheek. The exhaust will probably reach one million cubic feet per hour. It will be carefully tested for discharge, and power required to effect the discharge. G. M. CAPELL.

Passenham, March 27th.

THE ELECTRIC LIGHT INSTALLATION AT WATERLOO STATION.

SIR,—We notice in your account of the Edison electric light installation at Waterloo station that you state the power of the Field boiler, made by us for this installation, to be 20-horse power. We shall be glad if you will correct this in your next impression, as that boiler is only a 12-horse power—in other words, it is calculated to economically evaporate twelve cubic feet of water per hour at 80 lb. In point of fact, this boiler, which is 8ft. 2in. high by 4ft. diameter, supplies steam for the Armington engine, driving one 150 and one 60 light Edison dynamo, representing about 35-I.H.P., or 1400 lb. of water evaporated per hour, since, in a rough test, the Armington engine used 40 lb. of water per I.H.P. per hour. We consider this a very high duty for so small a boiler. We have not made any economy tests at present, but we may say that in recent tests made with boilers of this type, built by us for Messrs. Sales, Pollard, Lloyd, and Co., of Farringdon-road, an evaporative efficiency was obtained, on a two days' trial, of 10·83 lb. of water per pound of ordinary Welsh coal, from and at 212 deg., and the boilers worked up to their full duty for which they were designed. At the Richmond Waterworks also, with Field boilers seven years old, recent trials have given the very gratifying result of 10·93 lb. of water per pound of good Welsh coal, from and at 212 deg.

It was the knowledge of the economy of these boilers which induced us, as consulting engineers to the Edison Company, to recommend one for this installation. We may further remark that the water at Waterloo station is so bad that ordinary portable boilers there require cleaning every week, and from experience we find that the Field boiler only requires to be cleaned once in five weeks. LEWIS OLRICK AND CO.

27, Leadenhall-street, London,
March 21st.

THE PRINCIPLES OF MODERN PHYSICS.

SIR,—On the subject of conservation of energy I note "Student's" curious letter in your issue of the 16th. Surely "Student" does not seriously suppose that by burning 50 lb. of coal at the top of a 50ft. building he has succeeded in destroying the energy stored up in raising 50 lb. 50ft. high? He must be aware that when the coal was raised up 50ft. the centre of gravity of the earth was proportionately shifted, and, as Mr. Groves has it, the length of the day was altered; and whether the coal be allowed to remain as a solid or be changed into carbon dioxide, and water, makes no difference to the above fact. If, when burnt, the resultant gases again find their way to the earth's surface the former position of the earth's centre of gravity will be restored, and the energy spent in raising the coal 50ft. will be given out by the fall of the resultant gases. "Student" must give something different from this if he is to prove the fallacy of conservation. His spring idea is better, apparently, but as I take it "equally morer;" on that example I would ask him why a railway bar lasts better when in use than when idle? When in use it is constantly in vibration and not so readily oxidised. A spring when wound up is in a state of molecular vibration, and I do not doubt would require a different amount of time to dissolve, or would generate more heat in the process. WILLIAM HY. BOOTH.

Manchester.

STEAM POWER ON TRAMWAYS.

SIR,—Referring to a letter from Mr. Hughes in your last issue, we notice one sentence which requires contradiction at our hands. We therefore beg to say we have not "copied Mr. Hughes' water condenser, and made use of Messrs. Kitson's air condenser." Our water condenser is totally different in construction to any we have seen described of Mr. Hughes', and was specially designed to obtain the best possible condensing effect with a limited supply of water. Our air condenser, although somewhat resembling that of Messrs. Kitson's and others in mere outside appearance, is constructed in a different, and, as far as we know, novel manner, while the means taken to bring the steam into contact with the cooling surfaces are the result of experiments extending over several years.

With regard to superheating the exhaust steam, from the results of our early experiments our opinion has long been that this arrangement is quite unsuitable for heavy work. We consider that it increases rather than diminishes the nuisance from the chimney of the locomotive. The reports of recent trials of this system appear to support us in this opinion.

MERRYWEATHER AND SON.

Greenwich-road, London, March 27th.

SIR,—Since reading the letter signed "Aston," and also that from Messrs. Marple and Co., which appeared in your issue of 16th inst., we have made careful inquiries as to the statements with respect to our engines therein contained.

When the Birmingham and Aston Tramway was first opened, we saw our engines on several occasions take two heavily loaded cars up the long incline from Aston with the greatest ease, and at the time with less than 150 lb. steam pressure in the boiler. We may add that the safety-valves are loaded to 150 lb., and the pressure cannot exceed this amount. We are also informed by several witnesses that the engines we have supplied to the company perform their work with much greater ease than those from Messrs. Wilkinson.

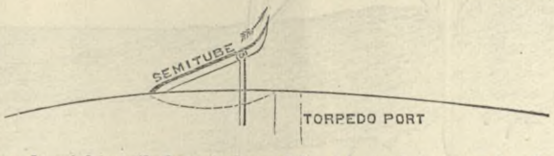
We are not acquainted with Messrs. Marple and Co., and are also ignorant as to the source of their information—which they publish with the ostensible object of damaging the reputation of our engines. We can only hear of one instance when one of our engines failed to mount the long incline at Aston. During the heavy fall of snow about three weeks ago, the manager sent one of our engines, with a car attached, thinking that it would be best able to force its way up the incline, and clear the line for traffic. After mounting for a considerable distance it came to a stand-still, owing to the heavy accumulation of snow in front of it. One of Messrs. Wilkinson's, which happened to be the engine to run the next trip, having a clean rail came up behind, and assisted the first engine to mount to the top of the incline. We shall not comment upon the above statement, but leave the matter in the hands of your readers to decide in favour of which engine the above facts "speak volumes."

In conclusion we may say that we can fully confirm the statement contained in Mr. J. S. Batchelor's letter with reference to the fuel consumption necessary to render the exhaust steam invisible, as our first engines were constructed practically on this principle, and, like other manufacturers, we have long since abandoned it. KITSON AND CO.

Airedale Foundry, Leeds, March 28th.

THE POLYPHEMUS.

SIR,—In your impression for the 9th ult. appeared an article upon the Polyphemus, and it struck me upon reading it that the difficulty experienced in getting the long torpedoes clear of the ship was one most easy to overcome. I particularly refer to those desired to be delivered from the broadside. All that appears to me to be required is to hinge to the side of the ship, say, some six yards in advance of the ports through which the torpedo is to be discharged, a bent plate forming half a tube, or possibly a little less than half, and having the end nearest the port or torpedo tube curved outwards. A rod passing through a stuffing-box near this curved end could be made to carry out this bent plate or semi-tube just before a torpedo was to be liberated, and behind this the



torpedo might easily be got clear of the ship, and the curved end of the semi-tube would give to the water flowing from it a direction far less unfavourable to the course of the torpedo than would be the case even though it were possible to get the torpedo clear of the ship as it was first intended.

That the direction of the torpedo would be affected to some extent under the most favourable conditions is certain, but an intelligent estimate of the distance of the object, coupled with the speed of the ship, and an allowance based upon such estimate being made, I think would be sufficient to meet the requirements of the case; that is, the torpedo would have to be slipped when the ship was at a greater or less distance in advance of the object aimed at, this distance being governed by the speed of the ship and its distance from the object desired to be struck by the torpedo. The side of the ship might be so made where this semi-tube was required, that when not in requisition it might stand flush with the surrounding parts, and so not affect its speed in any way.

Worcester, March 27th. J. C. D.

GUIDE-BLADE PROPELLERS.

SIR,—Having read the letter in your last issue from Mr. Arthur Rigg, I feel that an answer is necessary from me, as Mr. Rigg seems to think that I am anxious to call his guide-blade propeller by my name. This, however, is not the case, and I have no doubt Mr. Rigg will find, on carefully comparing the two, that my propeller contains a principle which is not contained in his. The propeller of Mr. Rigg, like the ordinary screw propeller, acts on the stream of water which it has previously accelerated, and maintains no considerable difference of velocity between the water entering and that leaving his propeller, for even in those propellers where Mr. Rigg uses a large boss he does not make provision for maintaining the contraction of the stream which he has provided; and, as stated in his letter, he does not see the use of the conical projection to my propeller, which is the means I employ for maintaining the contraction, which is an important feature, and necessary to ensure success. The propeller of the Hon. Richard Parsons is a great advance on the guide-blade propeller as previously described by Mr. Rigg; and the screw and guide bladesin his propeller are so curved as to be well adapted to act smoothly and uniformly on the stream of water flowing through the instrument, but this propeller, like that of Mr. Rigg's, does not provide a gradual contraction of the stream maintained to the point of discharge; but the increasing pitch of the screw and guides is so far like my propeller that it seemed necessary to make mention of this in the paper I read at the Institution of Naval Architects. Had I written a history of the guide-blade propeller I certainly should have mentioned the name of Mr. A. Rigg. Before proceeding far with my propeller I examined all the papers by Mr. A. Rigg that I could obtain, as I was anxious to know all that had been done on the subject. I also wrote personally to him, asking for any further information he would give me on the subject of guide-blade propellers, but my gain by this last venture was of a negative character.

I believe Professor Rankine, Mr. Napier, and Mr. Griffiths also made experiments with guide blades, but I have been unable to find that anyone has anticipated me in forming a propeller as described in my paper read at the recent meeting of the Institute of Naval Architects; I therefore think I have a right to call the propeller my own, but do not wish in any way to detract from the merit of Mr. Rigg's invention. To further illustrate the value of the gradual acceleration of the water within the field of operation of the propelling instrument, I may mention that in the year 1851 Sir F. Bramwell patented an arrangement for carrying out this principle in the paddle-wheel when used as a propeller. In this arrangement the paddle floats gradually separated from each other during their operation on the water. In this way they had an accelerating velocity, which would increase the efficiency of their action. This mode of action was described to me by the late Mr. Froude, who explained how this gradual acceleration, starting from the initial velocity of the stream to the intended discharge velocity, constituted the most perfect idea of propeller for the paddle, and he said he would see if this could not be done for the screw. It is to be regretted that death prevented Mr. Froude from carrying further many valuable investigations, among them the application of this principle, which he so clearly explained to me, to the screw. Having this principle so forcibly brought to my mind, the propeller I have described in my paper seems to be the best solution of the problem. JOHN THORNYCROFT.

Torquay, March 27th.

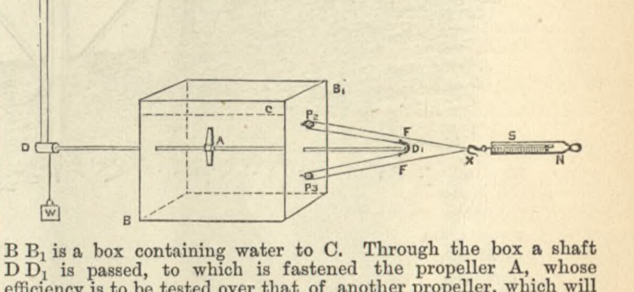
SIR,—I am glad to see that Mr. J. I. Thornycroft has published some more facts relative to the action of screw propellers fitted with guide blades. Some four years ago I devoted considerable attention to this subject, and by the assistance of Messrs. Easton and Anderson I was enabled to carry out some experiments on a tolerably large scale, the results of which were embodied in a paper read before the Institute of Mechanical Engineers in October, 1879. The form of the blades I experimented upon differed in one most important respect from those used by Mr. Rigg many years ago, viz., in their having a very rapidly-increasing pitch. The object of this is fully explained in the paper above referred to, and I believe that this form of blade is essential in order to derive any benefit whatever by the addition of guide blades. It is unnecessary here to recapitulate what was fully treated in the paper above referred to, but I may add that I believe that with a carefully designed propeller with the addition of guide blades, a higher efficiency may be attained than with an ordinary one. Mr. Thornycroft's experiments, although on a small scale, go far to corroborate the above statement, and I hope this important question may receive more attention than it has done from those interested in shipping. There are other advantages besides increase of efficiency which may be derived by the use of a circular casing surrounding the propeller and the addition of guide blades. The vessel is rendered far more manageable, and is capable of being turned in smaller circle. The commotion produced at the stern of the vessel by the ordinary propeller is entirely obviated and the propulsive force considerably increased, both of which peculiarities should be of great advantage to those who employ steam canal boats. The most important advantage, however, appears to be that with a considerably smaller propeller and the addition of guide blades a larger horse-power can be utilised, which in these days of high speeds is one of the limits towards which we are rapidly approaching.

In conclusion, I would add that Mr. Thornycroft is not quite correct in saying that his propeller differs from the one I used by its having a large boss. If he will refer to the paper above-mentioned he will observe that I was fully aware of the necessity of a large boss, and that all my propellers were constructed with one.

Airedale Foundry, Leeds, March 29th. R. C. PARSONS.

TESTING SCREW PROPELLERS.

SIR,—I have read Mr. Froude's "Description of a Method of Investigation of Screw Propeller Efficiency" in your last issue. Having invented a propeller, I offer to give you a description, for the benefit of your readers, of how I tested its efficiency over that of the present style of propellers. I will omit all description of the propeller, and confine myself to the method of testing them.

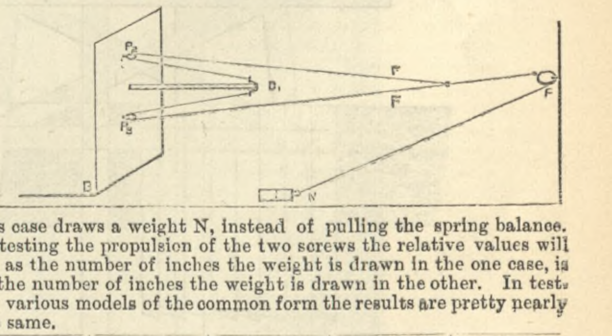


B B_1 is a box containing water to C. Through the box a shaft D D_1 is passed, to which is fastened the propeller A, whose efficiency is to be tested over that of another propeller, which will be done in the same way and under the same circumstances. At D is the driving pulley, to which is fastened a cord E passing over a pulley P_1, and suspending a weight W. At the other end of the shaft D_1 is a cap which fits so as to give little resistance to the revolution of the shaft. It carries two cords F F which pass round two pulleys P_2 P_3—fastened to the box—and attached to a spring balance S at the loop X. The spring balance is firmly fastened and kept horizontal. When the indicator moves it takes a very small weight along with it N. The cord E is wound round the driving pulley D until the weight W is as close as possible to the pulley P_1. The shaft is then placed so close to the cap D_1 that the cords F F may just keep the indicator at 0 lb., but so that the least pressure of the shaft will give an indication. All this time the weight is kept still, but when all is ready the weight is allowed to fall to the ground, and so gives the shaft and propeller a rotary motion. The propeller presses forward against the cap at D_1 and gives an indication on the spring balance of the approximate pressure or propulsion forward. When the indicator is moved it takes a very small brass weight along with it, and on the stoppage of the propeller when the weight comes to the ground the indicator moves back, leaving the weight N, which shows the force exerted on the balance by the propeller. The other propeller to be tested against it is placed on the shaft and the same experiment is gone through. The great point in these experiments is to get the weight to fall in the same time in each case, so that their relative efficiency may be shown. The efficiency of one propeller over that of another is shown by the pressure, and is—as the pressure, in lbs., in the one case is to pressure, in lbs., of the other.

I have tried various models of the common propeller, and obtained, with few exceptions, the same results. The following table will show the result of the common propeller as compared with my spiral propeller, the conditions in either case being the same:—

Propeller.	Diam. of prop	Diameter of driving pulley.	Weight.	Distance it falls.	Time.	Pressure.
Common	—	3in.	1½ lb.	10ft.	5 sec.	1 lb.
Spiral	—	3in.	1½ lb.	10ft.	5 sec.	1½ lb.

Another way of testing propellers will be seen from the sketch below, the letters in both cases being the same. The propeller in



this case draws a weight N, instead of pulling the spring balance. In testing the propulsion of the two screws the relative values will be, as the number of inches the weight is drawn in the one case, is to the number of inches the weight is drawn in the other. In testing various models of the common form the results are pretty nearly the same.

Propeller.	Propelling weight.	Distance weight falls.	Diameter of propeller.	Distance the weight is drawn.
Common	1½ lb.	3ft.	6¾in.	4½in.
Spiral	1½ lb	3ft.	6¾in.	6in.

I have found that 1 lb. of the propelling weight is lost in drawing the shaft through the bearings. I tested the speed of the propellers in the following manner:—The cap is taken from the shaft, which is then drawn towards the left—first sketch—and the distance of the end D_1 is then measured from the side of the box. The weight is wound up till it is 3ft. from the ground and allowed to fall. The distance is again measured, and the former measurement subtracted, which gives the relative speed or distance travelled. Common propeller travelled 10in., and the spiral 13in. From this simple way of testing accurate results are obtained.

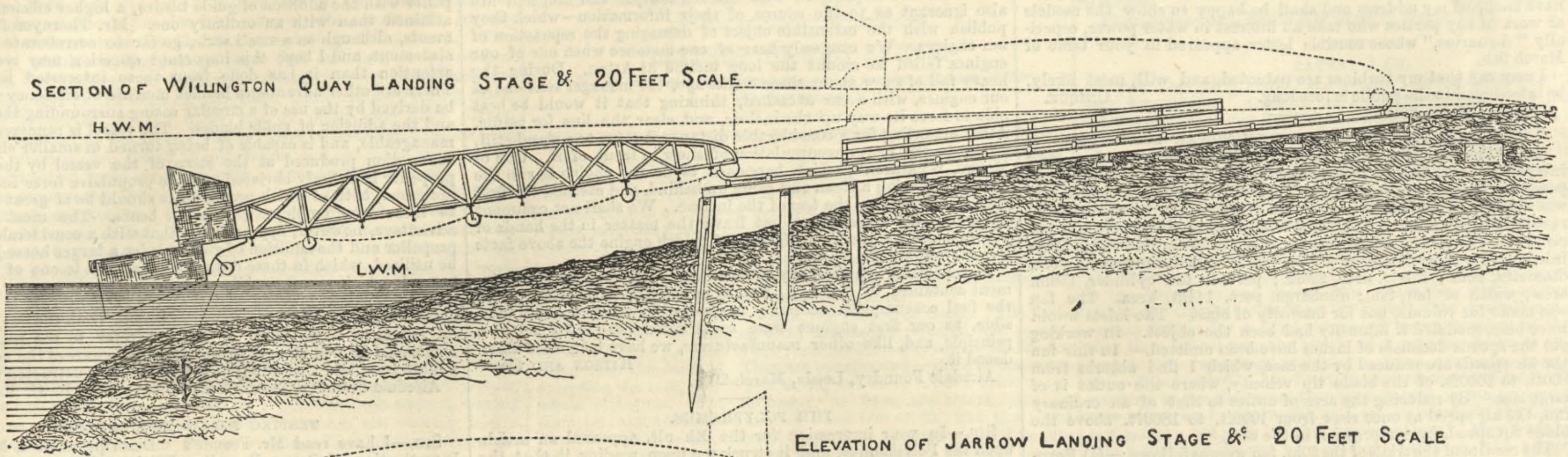
37, St. Martin's Cottages, Silvester-street, ROBERT GIBB.
Liverpool, March 26th.

HORSE AND CART FERRY LANDING STAGE AT JARROW.

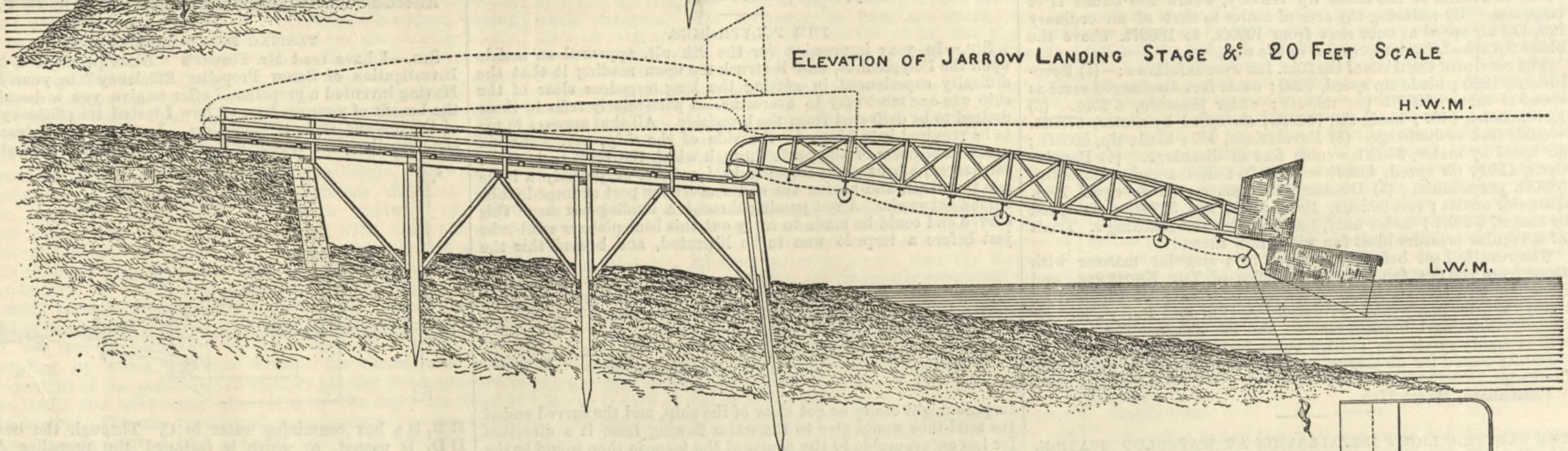
MR. C. J. TATE, C.E., ENGINEER.

(*For description see page 246.*)

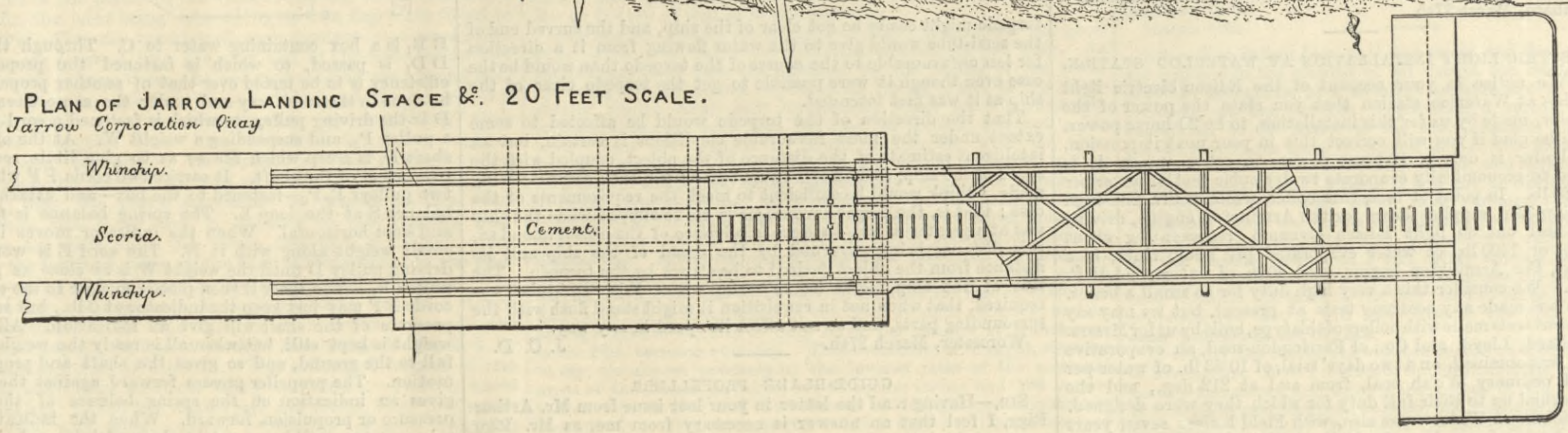
SECTION OF WILLINGTON QUAY LANDING STAGE &c 20 FEET SCALE.



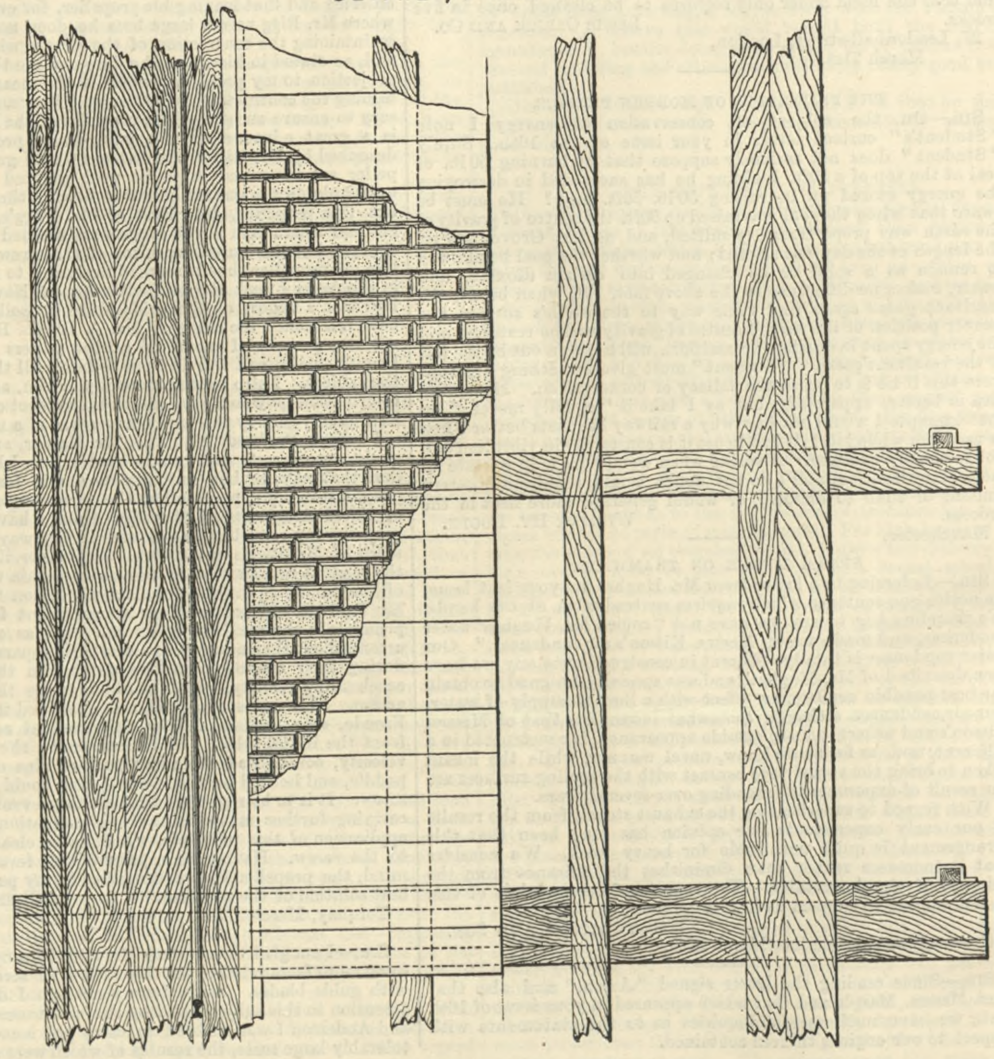
ELEVATION OF JARROW LANDING STAGE &c 20 FEET SCALE



PLAN OF JARROW LANDING STAGE &c. 20 FEET SCALE.

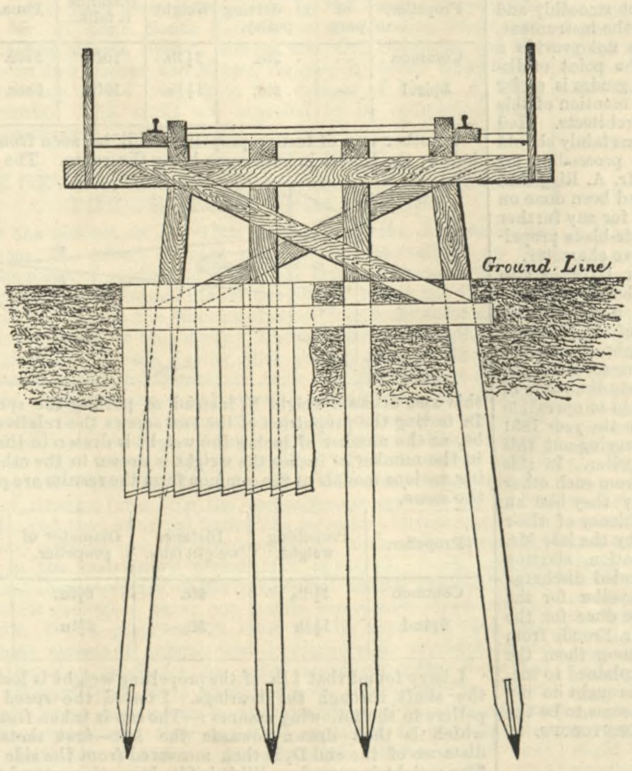


DETAIL 1/4 INCH SCALE

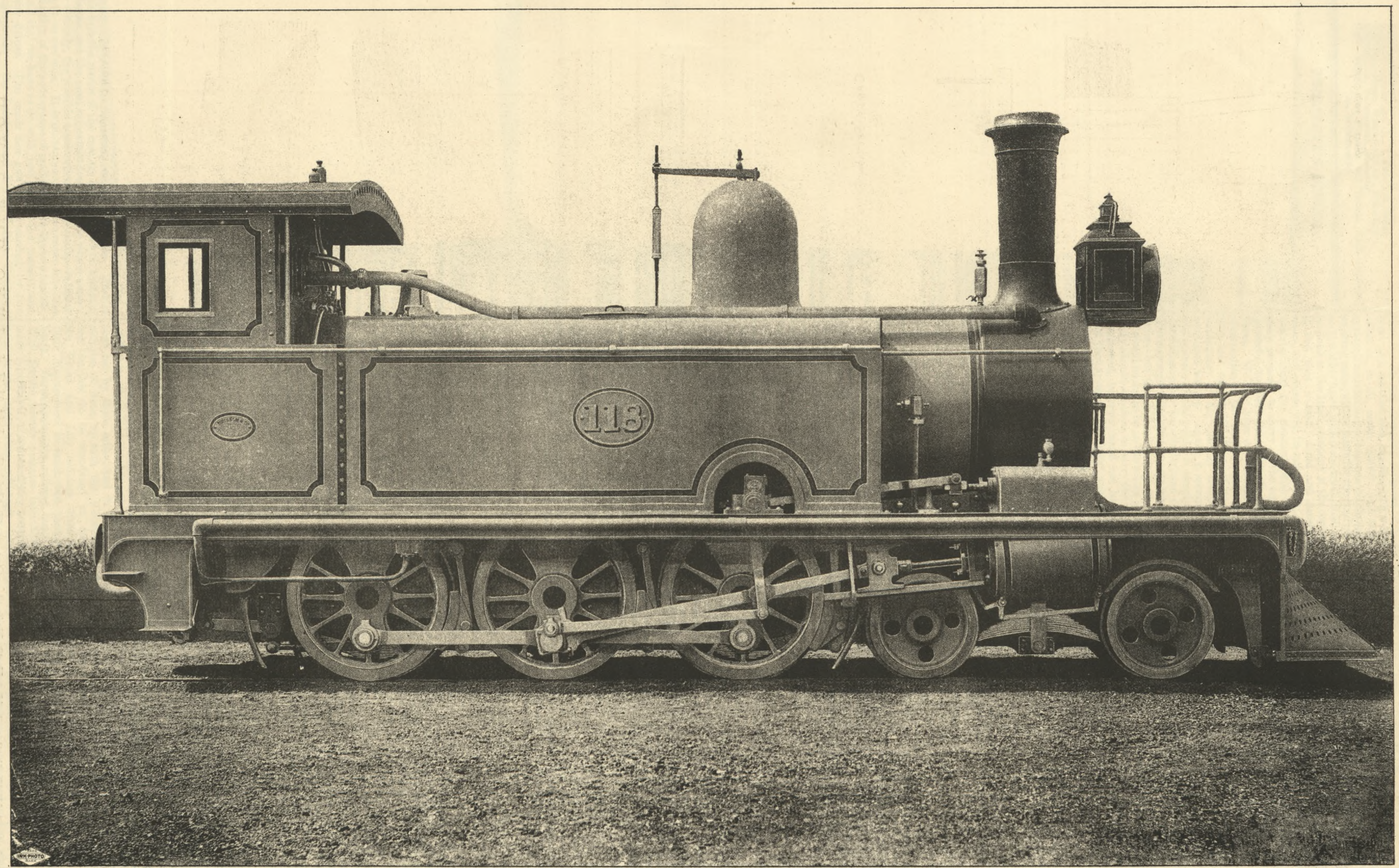


CROSS SECTION THROUGH LANDING STAGE

1/8 INCH SCALE.



J Swain. Eng.



LOCOMOTIVE GOODS ENGINE FOR THE CAPE GOVERNMENT RAILWAYS.

FITTED WITH D. JOY'S VALVE GEAR.

BUILT BY MESSRS. NEILSON & Co. GLASGOW.

PUBLISHER'S NOTICE.

*** *With this week's number is issued as a Supplement, a Locomotive Goods Engine for the Cape Government Railways, fitted with D. Joy's Valve Gear. Every copy as issued by the Publisher contains this Supplement, and subscribers are requested to notify the fact should they not receive it.*

TO CORRESPONDENTS.

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

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

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

H. G. D.—*We do not remember the engine by the name you give. Do you not know the name of the patentee?*

T. K. (Leeds).—*Brewtnall's electrolier fittings are patented. You can obtain them from Messrs. Faraday and Sons, Berners-street, Oxford-street.*

CH. D'ALBERT.—*You cannot get the "Ingenieurs Taschenbuch" in English. The nearest approach to it in English is "Molesworth's Pocket-book of Engineering Formulæ," published by Messrs. E. and F. N. Spon.*

A. R.—*The electro-motive force does not depend on the number of inches of copper and zinc, and the current depends on other quantities than the size of plates, as, for instance, on the internal and external resistance of battery and circuit. You must get a text-book on the subject—say Ferguson's "Electricity and Magnetism."*

ERRATA.—*In our article on "The Vienna Street Railway," on p. 212, March 16th, in the sixteenth line of second paragraph, for* "proprietor *of a city railway" read* "projector *of a city railway." In the last line but two of same paragraph, for "building* sand" *read "building* land."

TAR PAVING.

(*To the Editor of The Engineer.*)

SIR,—Will any reader kindly say how best to convert ashes, tar, and sand into a durable and cheap asphalte for village street paths?

RURAL SURVEYOR.

MEETINGS NEXT WEEK.

THE INSTITUTION OF CIVIL ENGINEERS.—Tuesday, April 3rd, at 8 p.m. Ordinary meeting. Paper to be read with a view to discussion, "Summit-level Tunnel on the Bettws and Festiniog Railway," by Mr. William Smith, M. Inst. C.E. Thursday, April 5th, at 8 p.m. Special meeting. Fourth lecture "On the Applications of Electricity"—"Some Points in Electric Lighting," by Dr. J. Hopkinson, F.R.S., M. Inst. C.E.

SOCIETY OF ENGINEERS.—Monday, April 2nd, at 7.30 p.m., a paper will be read "On the Feasibility and Construction of Deep-sea Lighthouses," by Mr. Chris Anderson, the leading features of which are as follows:—A light tower of sufficient dimensions, and suitably provided with apparatus, is floated by a mass of unsinkable material, and is maintained in vertical position by a counterpoise of sufficient depth and weight for that purpose. Protected steel wire cables are to be used for mooring purposes, secured to anchor blocks formed of a mass of concrete to be floated into position in iron cases, which are to be sunk by admission of water to the same when over their respective positions.

CHEMICAL SOCIETY.—Thursday, April 5th, at 8 p.m.: Paper to be read, "On the Estimation of Hydrogen Sulphide and Carbonic Anhydride in Coal Gas," by Mr. Lewis Wright.

THE ENGINEER.

MARCH 30, 1883.

THE IRISH MAIL CONTRACT.

THE proposal recently made to put the whole work of carrying the mails between England and Ireland into the hands of the London and North-Western Railway Company, has evoked a somewhat curious discussion. That is to say, the merits of the case are being argued on abstract issues, and the most important feature of the whole matter—namely, the possible acceleration of the mails—is being put on one side. It is quite unnecessary to enter into the history of the conveyance of mails between the two islands. All that we have to do with just now is the present and the future. The mails are now being carried by two companies—the London and North-Western Company providing the land, and the City of Dublin Steam Packet Company the sea service. It is understood—though the terms of the proposed contract are not yet fully known—that the railway company proposes to do the whole of the work at a reduced rate, representing a saving to the Post-office of, in all, about £5000; but that, if the present system is maintained, an augmented charge, as compared with existing rates, will be made for the land service. It is urged, on the other hand, with some truth, that a great injustice will be done to the Irish company if the contract be taken from it, and that a staff of old and deserving officers, engineers, and others will be cast adrift; and it is furthermore asserted that the steamers with which the railway company proposes to carry on the service are not sufficiently powerful to meet the demands which will be made on them. We hear little or nothing, however, concerning the acceleration of the mails; and it seems to be lost sight of that not one word of proof has been adduced of the inadequacy of the railway companies' steamers for the proposed service. Again, it seems to be lost sight of that the concern of the public is simply that the mails shall be carried as safely, punctually, and expeditiously as possible. We may regret that old servants would find their occupations gone—but this difficulty could no doubt be got over—and it would no doubt be on the whole better that the Irish company should continue to carry the mails across the channel. Sentiment, however, must not be permitted to interfere, and that system of transport ought to be adopted which is most efficient, no matter by whom supplied. Up to the present time the mail service between this country and Ireland has not been as good as it ought to be, and we have no hesitation in saying that if the Dublin company should now lose the contract it will have itself in some measure to blame, because it has not done the most that could be done with its four steamers. Let us see what the facts are. The distance from London to Holyhead is 268 miles, from Holyhead to Kingstown the distance is sixty-four miles, and from Kingstown to Dublin six miles; the total distance is, therefore, 338 miles. The average speed of the London and North-Western mail trains is forty miles an hour, including stops. The mail boats take about four hours in making the passage, and a little over half-an-hour is expended in transferring the mails from the boat to the train, and carrying them to Dublin. Taking the night mail as an example, we find that the mails leave Euston at 8.25 p.m., and reach Dublin at 7.35 a.m., according to the time-tables. This is 11 hours 10 min., and gives an average velocity of little more than 25·5 miles an hour. The train reaches Holyhead at 3.5 a.m., so its running time is 6 hours 25 min., or, as we have said, forty miles an hour, including three stops. The steamer starts as soon after the arrival of the train as the mails and passengers can be got on board. Thus, according to the time tables, she has but 3·5 hours to make the run; but in practice it is never made in that time, which would, indeed, imply a speed of nearly nineteen miles an hour, or not far short of half that made by the trains. The steamers used for the purpose are the Ulster, Leinster, Munster, and Connaught. They are all nearly alike in dimensions, and power of engines; but two of them have four funnels and the others two funnels each. If we describe one we virtually describe all, though there are some small differences between the Ulster and Munster and the Leinster and Connaught. The Ulster, then, is 328ft. long, 35ft. beam, 21ft. deep, and measures about 2000 tons builders' measurement. She was built in 1860, and is propelled by engines, by Messrs. Boulton and Watt, indicating on the measured mile 4100-horse power, at 23 revolutions per minute; the speed being close on twenty statute miles per hour. The engines are oscillating, with jet condensers; the cylinders are 96in. diameter, and the stroke is 7ft.; the safety valves are loaded to 25 lb. on the square inch. There are eight boilers with 18,400 square feet of surface, and forty-eight furnaces, with 840 square feet of fire-bar; the weight of the engines is 220 tons; of the paddle wheels, 110 tons; of the boilers, 230 tons; and of the water in the boilers, 170 tons; and the draught of the ship ready for sea, with 75 tons of coal on board, is 13ft. The wheels are 29ft. in diameter, and have fourteen floats. The average number of revolutions at sea is 18, and for a considerable time before Holyhead or Kingstown is reached the fires are permitted to burn down, so that as we have seen over and over again, should the order for full speed coming into harbour be given, it means 9 revolutions. The object in view is, of course, to save fuel, but it will be readily understood that in this way a great deal of time is lost on a run of but four hours' duration. It is well known, indeed, that the mail boats are never run nearly so fast as they might be run, and this is a factor which must be taken into account in dealing with the proposed supercession of the Irish company. That company has no doubt fulfilled to the letter the terms of its contract, but it has never manifested the smallest desire to do more.

The boats proposed to take the place of these vessels are the Rose, Shamrock, Violet, and Lily. They are in many respects alike, but the Violet and Lily are faster than the other two. It has been loudly asserted that these boats are not as good as the existing mail boats. It is as well that facts should be known. It is true that the Irish boats are larger than the railway companies' boats; but it must be borne in mind that they were built more than twenty years ago, and that remarkable improvements have been since effected in marine engineering and shipbuilding. The Rose and the Shamrock are as fast as the present mail boats, but the Lily and the Violet are much faster. A trial was arranged between the Violet and one of the City of Dublin Company's boats, and in one hour the Violet beat her by three miles, and it took the mail boat ten minutes to come up with the Violet after she stopped. Nor is this to be wondered at, for the engines of the Violet and Lily indicate 3200-horse power, and their displacement is much less than that of the mail boats. Furthermore, the railway boats leave the North Wall, Dublin, twenty minutes later than the mail boats leave Kingstown; but the railway boats can arrive at Holyhead at the same time, although handicapped by six miles and twenty minutes. The Violet on one occasion, with everything in her favour save the tide, which was dead against her, made the run from Poolbeg Light to Holyhead, a distance one mile greater than the mail boats have to run, in 3 hours 5 min., which is the shortest passage on record. The boats have a tonnage of 1400 tons, so that it will be seen they are by no means the cockleshells some persons would persuade the world, and they draw only 2ft. less than the mail boats. As regards the accommodation for passengers, we may say that the railway boats are better than the mail boats. They are passed by the Board of Trade to carry more passengers; and excellent second-class accommodation is provided on board them, while there is next to none on board the mail boats. There is besides a splendid promenade provided by the flush spar deck, which runs right fore and aft. We do not desire to underrate the Leinster and her sisters, but they do not, so far as we can see, possess any advantage over their rivals, and it is a suggestive fact that the opponents of the railway company have adduced no figures of any kind in support of the case they try to make out against these steamers. It is evident that an important mail service conducted in the present day at an average speed of a little over twenty-five miles an hour is an anachronism, and it is easy to see that no mechanical difficulty stands in the way of accelerating the service. The dimensions of the trains are strictly limited, and the weight seldom exceeds about 80 tons without the engine. Under the circumstances a velocity of fifty miles an hour could easily be maintained. The road is good, and heavy tenders are not needed, thanks to Ramsbottom's water troughs. Stops might be made at Rugby, Crewe, and Chester, of five minutes each—occupying a quarter of an hour. Slowing down and getting up speed, entering and leaving these stations, will make another quarter. At a continuous fifty miles an hour, the run to Holyhead would be made in five hours and twenty minutes. Deducting forty minutes for stops and slowing and taking tickets at Holyhead, we have six hours as the time between Euston and the steamer; and thus a train leaving Euston at 9 p.m. would reach Holyhead at 3. A saving of about half an hour would thus be effected in the land portion of the route. Again, there would be no difficulty in driving suitable vessels across the Irish Channel in all but the heaviest weather in three hours and twenty minutes. The little Banshee did this more than thirty years ago, when carrying the mails for the Admiralty under the old contract. Allowing ten minutes for putting the mails and passengers on board—and this would amply suffice under a proper system—Kingstown ought to be reached at 6.30, English time, with certainty. The whole time, then, required for the transport of the mails from Euston to Dublin would be but ten hours, instead of, as now, eleven hours ten minutes. We understand that the railway company has promised to accelerate the service by half an hour, but this is less than half what may easily be done, and Parliament ought not to be satisfied with half.

LOCOMOTIVES FOR UNDERGROUND RAILWAYS.

IT is by no means certain that the effort now being made to prevent the construction of ventilators in Westminster and the City by the Metropolitan District Railway Company will not be successful. It is worthy of notice that the supporters of the company are few in number, and that the arguments they advance are very feeble. Sifted down, these amount to a statement that the line must be ventilated for the benefit of passengers, and that the company cannot possibly find any expedient for purifying the air in the tunnels, except making holes in the streets. We have already explained that the ventilators between the Temple and the Mansion-house are not being put in to promote the comfort of passengers, but to enable the engine drivers to see the signals, which they cannot now do because of the clouds of steam which hang in the tunnel. We have shown that this steam is a result of the unsuitability of the locomotives for their work, and of the penuriousness of the company which will not pay for condensing water. It is worth while to insist on the first point, and the best method of putting the facts in a clear light is to show what the rolling stock is and what it might be.

The Metropolitan Railway as first laid out was a broad gauge line, worked by the Great Western Railway Company, with outside cylinder tank engines. The line began at Paddington and ended at Farringdon-road, and its total length was about three miles. There were at first in 1862 but four trains each way every hour, but the number rapidly increased. At that time there was no inconvenience experienced from want of ventilation. After a time the Great Western Company ceased to work the line, and a contest arose between the owners of the railway and the Great Western Company, and for a time it seemed as though traffic must be suspended. The Great Northern Railway Company came to the rescue, and Mr. Sturrock, then locomotive superintendent of the line, hastily fitted up some tender engines with pipes to lead the exhaust steam into the tenders. On the whole the service was tolerably well carried on by these engines. But extensions were in progress, and it became evident that something must be done to provide for augmented traffic. Mr. Burnett was appointed locomotive superintendent, and Mr. John Fowler designed a complete set of rolling stock. It has always been difficult to understand what Mr. Fowler had in his mind when he prepared his designs; instead of securing as much room for passengers as possible with a minimum of weight, he designed the heaviest rolling stock known on an English railway up to that time. The passenger coaches, hung on a bogie at each end, weighed 16 tons each, and the locomotives 42 tons full. The proportion of dead weight to live load, taking the train as a whole, is enormous. No doubt the stock is strong, and the expenses for repairs to it moderate, but it is heavy stock on the road, as the permanent way accounts of the company prove. After a time, the Metropolitan District Railway was opened, and the engineers of the company determined to avoid the mistake made by the Metropolitan Company, and instead of the great 16-ton bogie coaches, they ordered much smaller carriages, supported on four wheels, and weighing much less per passenger. But no change was made in the type of locomotive, and the whole of the Metropolitan traffic was worked for some time with engines identical in pattern. Some years ago Mr. Armstrong, locomotive superintendent of the Great Western Railway, designed tank engines for working his metropolitan traffic, which engines have been illustrated in THE ENGINEER, and they do their work in the most satisfactory manner, although they weigh nearly nine tons less than the Metropolitan engines proper. The perpetuation of the Fowler type of locomotive has been a great mistake. Indeed, the defective nature of the rolling stock of the line has heavily handicapped the venture, and done much to keep down dividends. Nor is it to be supposed that we are alone in saying this. Mr. Webb, of Crewe, who will be admitted to be an authority, has stated at the Institution of Civil Engineers that the work could be done with engines weighing 27 tons, with 16in. cylinder, 20in. stroke, and carrying 700 gallons of condensing water. The 5ft. 9in. driving wheels of Mr. Fowler's engines he held to be too large, and would use a 4ft. wheel instead, and by this means and using light coaches, more than one and a-half million of tons of transport would be saved per year. Mr. Tomlinson, who supported Mr. Fowler's views, admitted that the engines might be made $4\frac{1}{2}$ tons lighter, and other speakers followed suit. We have given the merest sketch of the history of the line. Our readers may easily fill in the details, in some respects, if they like; but much of it has yet to be written, and most probably never will be made public. Now let us see what the rolling stock ought to have been.

The maximum number of passengers to be provided for is about 400 per train. In the mornings and evenings the carriages are crowded until there is no standing room; but 400 is a sufficient basis to go upon. This number could be readily provided for in eight coaches, the total weight of which need not exceed 48 tons. This is an ample allowance. The coaches would be close-coupled with centre buffers, and care would be taken to keep down weight in every possible way. The maximum velocity at which the trains now run is twenty miles an hour, and it is important that the trains should get away as quickly as possible. This result may be readily obtained by either of two expedients, namely, the use of large cylinders or the use of small driving wheels. There is this important difference in the result, that a resort to the first expedient augments the cost and weight of the whole engine, while the use of small driving wheels has precisely the contrary effect. Unfortunately, Mr. Fowler chose the former alternative, and his engines have 17in. cylinders, 24in. stroke, 5ft. 9in. driving wheels, and carry 130 lb. pressure. The maximum tractive force these engines can exert is 100 lb. per one pound of average pressure in the cylinder. If, now, the driving wheels had been made 4ft. in diameter, the cylinder might have been reduced to 15in. in diameter, and the stroke to 22in., and the tractive power of the engine would then be over 103 lb. per pound of cylinder pressure. Under the circumstances it would be possible to make an engine which would weigh with its tanks empty, but otherwise in running order, but 20 tons, and we should thus have a gross weight of train of 68 tons. To this we must add say 30 tons of passengers, or in all 98 tons. If we add 2 tons for coal in the engine bunkers and sundries, we have a total train weight of 100 tons. The resistance of this train at twenty miles an hour on a level would be about 1200 lb., while on an incline of 1 in 100 it would amount in round numbers to 3440 lb., and our locomotive with 4ft. driving wheels would need an average cylinder pressure of only 34 lb. to overcome this resistance, and assuming the co-efficient of friction to be only one-eighth, a load on the driving wheels of 12·25 tons would suffice, or for four-coupled wheels, a little over 3 tons per wheel, as against 7·5 tons on each driving wheel of the existing engines. We have said nothing as yet concerning the provisions to be made for condensing steam. To be quite satisfactory the engines ought to be able to make a run of ten miles without needing more condensing water, and to secure a satisfactory result the water ought not to be allowed to exceed a temperature of about 180 deg. We may assume that it will be taken in at 60 deg., and we shall have therefore a range of 120 deg. through which it may be elevated in temperature. Each pound of steam condensed will be nearly at atmospheric pressure when discharged into the tank, and will represent 1146 units per pound from 32 deg.; from 60 deg. it will represent 1118 units, and from 180 deg. it will represent 998 units. Taking a mean between the last two figures, we find that each pound of steam delivered into the tank will represent 1058 units. But each pound of water in the tank will be able to absorb 180 of these units; and dividing 1058 by 180, we have, in round numbers, 6—that is to say, if the tank holds six times as much water as is evaporated in any given run, all the steam will be condensed, and none will be given out to fill the tunnels with vapour. Now, the consumption of fuel per running mile will not at the most exceed about 18 lb., and supposing that each pound of coal evaporates 10 lb. of water, we have 180 lb. of steam per mile, and six times this gives us 1080 lb. as the weight of condensing water which will be needed per mile; and multiplying this by 10, we have 10,800 lb., or, in round numbers, let us say, 5 tons, or 1080 gallons. The addition of this will bring up the total weight of the locomotive full to 25 tons, and something must be added for the tanks. The total weight may be taken then at 28 tons, but this will but little modify the figures we have given. It will, perhaps, be objected that the figures we have given are too favourable, and that such an engine as we speak of could not work the traffic of the Metropolitan Railway. Our reply is, that it certainly could not if the existing rolling stock were retained; for example, it could not satisfactorily deal with a train the coaches of which alone weigh 113 tons, instead of 48. It will be seen that the quantity of condensing water which the existing engines must carry is very much larger than that indicated by the weight of the coaches alone. They actually carry but 4 tons, which is about 2 tons too little. The moment weight is augmented in one place in rolling stock, it is increased all round. Thus, the total weight of a Metropolitan Railway train is now, including passengers, 42 + 113 + 30 = 185 tons, instead of 100 tons. But there is no reason to doubt that the whole traffic could be worked with much less expense than it is worked now by using lighter stock, and it is quite certain that the stock could be had. We have drawn no fancy picture; engines and trains of the kind we have in our mind may be seen daily at London-bridge and Victoria-stations of the London, Brighton, and South Coast Railway.

It is hardly necessary to point out that the reduction in weight, being accompanied by a reduction in the consumption of fuel, the air in the tunnel would be so much the purer. Indeed, years ago Mr. Burnett, before he gave place to Mr. Tomlinson as engineer of the line, endeavoured to reduce weight by introducing double or twin carriages. We never found out exactly what these twin carriages weigh. That an advantage was to be had by improving on Mr. Fowler's designs is shown by the action taken by Mr. Armstrong and perpetuated by Mr. Dean. Mr. Fowler's stock would have given little trouble, as far as polluting the air was concerned, if only the traffic had not increased far beyond what was anticipated. His idea was, we have heard, to produce engines and trains that would never break down; and to do this he used much more weight than was needed. In one respect this has been satisfactory; in the other respect it has created the existing demand for ventilators on the Embankment and in Queen Victoria-street. We presume that the existing rolling stock will not last for ever, and we recommend to the directors of all the companies using the District Railway that a new departure should be taken, and that, as new stock is required, a change should be made. There would be no difficulty in the existing type of train and engine taking their turn with the new type until the old was entirely extinct. No doubt the company would suffer some loss by making the change, but we believe the whole outlay would soon be repaid by the reduction in fuel and permanent-way accounts.

CARGO STEAMERS.

THE Institution of Naval Architects is to be congratulated on the very practical character of many of the papers read recently in the Hall of the Society of Arts. What was written and said concerning cargo steamers was specially worthy of attention, two papers in particular claiming notice. The first was by Mr. James Dunn "On Bulkheads," and the second by Mr. Hamilton "On the Speed and Form of Steamships considered in Relation to Length of Voyage." The part played in promoting the prosperity of this country by the modern cargo steamer cannot be exceeded in importance. We have in our own hands nearly the whole ocean-carrying trade of the world, and a very large proportion of the work is done by cargo steamers. The construction of these craft keeps our shipyards and engine builders busy from one end of the year to the other; while thousands of hands are employed in producing the materials of which they are built. They are costly craft in the sense that each of them represents a large capital. The economy with which their engines work is quite unsurpassed; and there is apparently much about them in which all concerned may be congratulated; but when we come to look into matters a little, we find, we regret to say, much to condemn, and many things which ought to be changed for the better. The loss of life in the cargo steamer fleet is dreadful; and these ships are lost at sea in such numbers, that great as the annual production of them is, it does not in the winter season more than keep pace with the demand. If the loss of ships and lives and cargoes was unavoidable, we might deplore it and submit; but there is a universal consensus of opinion among dispassionate and competent authorities that a little care exercised in the building and management of these craft would have the happiest results. A great deal of plain speaking was heard during the recent meeting of the Institution of Naval Architects, and we believe that we should hardly fulfil our duty did we keep silence with such an example before us of the outspoken expression of opinions.

The modern cargo steamer of the normal type is an iron vessel, capable of stowing from 2000 to 3000 tons of grain. She is propelled by compound engines, usually indicating from 500 to 700-horse power, and driving the ship at from eight to nine knots as an average velocity. Her bunkers will stow about 400 tons of coal, and such ships have usually about five bulkheads nominally serviceable. These ships are contracted for and built at a low price under the supervision of Lloyd's or the Liverpool Underwriters' Association. They are owned sometimes by single firms, but more frequently, although sailing under the house flag of some firm or company, they really belong to many individuals, who have no further interest in them than to get as large a return as possible out of them. What the return will be depends largely on the captain, and may reach as much as 14 to 15 per cent. net per annum. When it falls below 4 or 5 per cent. the ship is a bad speculation. She is kept carefully insured; and if she is wrecked or founders the owners lose nothing; and inasmuch as the underwriters divide losses and risks and profits among themselves, they have very little individual interest in seeing that steamers insured with them do not sink or upset. The result of all this is that it is nobody's business to take much trouble to secure safety; and so cargo steamers and their crews have a bad time of it, especially in winter. There are two bodies, however, which might be supposed to be capable of securing good work at all events, namely, Lloyd's and the Liverpool Association. We have no desire to write of the officers of these bodies in any save the highest terms; but speaking plainly, we say that much has recently been said, and many facts have come to light which tend to show that they are by no means so particular as they ought to be. We do not refer to the engineer surveyors, but to the ship surveyors. In certain cases the duties are combined in the one individual, but it would appear that the practice of the surveyor is not uniform, and that he will permit things to be done with the hull which he would not tolerate with the engines. Take, for example, the following passage from Mr. Dunn's paper:—"Bulkheads," he said, "are useless when found as we have found them, with stiffeners cut, with rivets omitted, with caulking neglected, with plates removed, with large holes cut in them for small pipes to pass through, with sluice holes and no covers, with doors and worthless securities, or with open doors rusted and unmanageable." Lloyd's surveyors are not answerable for all these things, but they are answerable for a good many of them. The charges urged against that body by Mr. Samuda were perhaps too severe and too sweeping; but Mr. Martell's defence of Lloyd's action was weak and violent, and lacking in logic, and it left the impression on the minds of those present that there was something in the charges made by Mr. Samuda. Nor are these charges confined to this country. We regret to say that in the United States the British cargo steamer is becoming a byword and a reproach. As an instance we quote the following from the *New York Times*:—"It may almost be said that no steamer without a spar deck can safely cross the North Atlantic in winter. Such a vessel is always liable to ship a sea that may put out her fires, crush in her hatches, and sink her more suddenly and surely than would a collision with another vessel. That this is the way in which dozens of missing steamers have been lost there can be little doubt. Such disasters would not have happened had the unfortunate vessels been designed for the rough weather of an Atlantic winter. Of course, overloading adds to the original sources of danger, and that steamers constantly leave this port overloaded is notorious. It is an every-day matter for freight steamers and tramps to leave our harbour in winter so heavily loaded that the water is within a few inches of the main deck. The profit made by two or three successive trips is sufficient to reconcile the owners to the loss of the vessel, when that by no means unexpected event happens; and as the owners are not responsible pecuniarily for the lives of the ship's company, they do not grieve to any great extent over the men whose death they have virtually procured. Much could be done to prevent the employment of open-waisted ships in the Atlantic trade by the reduction of the heavy taxes which are imposed upon tonnage entering our harbour. The system at present in force places a premium upon unseaworthy vessels and perpetuates a system of building which is totally unsuited to the Atlantic trade. As to overloading, that is surely a matter which we have a right to forbid. Congress can pass a law forbidding any vessel to leave an American port without a certain amount of freeboard; and it is a disgrace that no such law exists, or, at any rate, is enforced. There is scarcely a week from October to April when steamers do not leave New York in a condition unfit to meet the usual winter Atlantic weather. We cannot very well compel foreigners to build vessels after any one particular pattern, but we can forbid overloading, and we can take off the premium that is now offered to owners of open-waisted ships." We earnestly deprecate Government interference in this matter, but the appalling fact that, as stated by Mr. Samuda, no fewer than 550 vessels were lost last year from preventible causes, cannot be repeated in succeeding years without eliciting a Parliamentary inquiry which may have very unpleasant results.

The most prominent defect in the cargo steamer herself is the want of efficient bulkheads. The most prominent defect in her management is overloading her. It is asserted that plenty of bulkheads would so much interfere with the stowage of a steamer that she would be put out of the trade; and Mr. Martell, indeed, in replying to Mr. Samuda's strictures, had no better defence than this for a shortcoming the existence of which he did not deny. We are by no means ready to say that a cargo steamer ought to be fitted with as many bulkheads as a passenger steamer, nor do we assert that commercial loss ought to be incurred that ample margins of safety may be secured; but we do assert that everything that can be done within reasonable limits ought to be done to make a cargo steamer safe. For example, although it may not be possible to fit her with as large a number of bulkheads as may be desirable, is that any reason why the bulkheads with which she is fitted should be worthless? The first principle we contend for is that every bulkhead in a steamer should be efficient; that is to say, that it should be staunch, strong, and kept in good order as regards all fittings, such as doors, attached to it. It is impossible to read Lloyd's Rules on the subject of bulkheads and not perceive that they are inadequate to secure the desired end. Some time ago the Admiralty decided that it would be well to prepare a list of steamships complying with certain conditions in the matter of structural details, which ships would probably be of service in time of war. Vessels on this list enjoy some privileges. Thus, for example, when Government wishes to charter a ship for any purpose, one of those on the Admiralty list is selected. Under the circumstances it will surprise no one to learn that the Admiralty were offered a great many ships. Mr. Dunn told his hearers that out of 3640 only 157 were found to comply with the very reasonable demands of the Government, and that during the last six years the average rate of loss of the ships which did not comply with the stated conditions was 1 in 25, while of those which did comply only 1 in 86 was lost. But something more may be done than seeing that a few sound and serviceable bulkheads are put into every cargo steamer. These may be carried up high enough and put in the proper place. Nothing which we could say in this connection would be half as suggestive and impressive as the diagrams which will be found in our last impression on page 201. It was worth notice that in the discussion which followed the reading of Mr. Dunn's paper, although there were many shipowners present, not one had anything to say against the introduction of more and better bulkheads than are now in use. It was argued, not by a shipowner, that certain classes of cargo, as, for example, 40ft. rails, could not be stowed if ships had compartments close together. But Mr. Biles, who knows as much about a ship as most men, explained that not only was there no difficulty in so fitting bulkheads that this particular kind of cargo could be loaded, but that ships were actually being so built. The truth is that nothing is wanted in this matter but the will, and the way will soon follow. If Lloyd's made the fitting of proper bulkheads compulsory to-morrow, we feel certain they would be fitted. But it seems that the directors of the body lack courage, and fear to do that which might give offence to their clients. In no other way can we explain the laxity of the body on this important point.

Concerning the influence of load line on the safety of cargo steamers much might be said; a great deal was said when Mr. West had concluded his paper. The subject is far too large to handle fully here. There is every reason, however, to believe that in dealing with this question Lloyd's have acted with the utmost prudence and good sense. The aggravating thing about Lloyd's Registry is that it can do some things so thoroughly well, that its neglect and incompetence in other respects are shown up in a very broad light. Its officers have prepared with immense pains and judgment a set of tables setting forth the proper load line for almost every conceivable class of ship, and they recommend, but do not attempt to enforce, the adoption of this line on their clients. We can find space for the consideration of but one more point connected with cargo steamers, namely, speed. Mr. Hamilton showed on Friday week that in voyages extending over 5000 miles, eight knots was the maximum paying speed. He entirely neglected to take into his calculations the effect of want of sufficient power on the life of a steamer. There cannot be the least doubt but that many steamers are lost in gales entirely because they lack sufficient engine power. It would, however, be too much to expect that shipowners should take this point into serious consideration; all the same, it would have been well if the Institution of Naval Architects had said something about it.

THE GROCERS' COMPANY'S ENDOWMENT OF RESEARCH IN SANITARY SCIENCE.

THE endowment of research, for which great schemes were in the air some years ago, and respecting which the astronomers especially fought so keenly, has now been actually realised for one department of science by the Grocers' Company. In most of the daily papers appears a detailed advertisement of the liberal offer of the City company and of the objects it has in view. It is going to endow research in the most magnificent way, and will shortly employ three seekers after truth in matters sanitary at £250 a year each, while every four years it intends to give £1000 to some sanitary Pasteur who has made a startling discovery in this very necessary science. What will Sir George Biddell Airy, the late Astronomer Royal, say to this? It may, of course, happen that before the four years are over the Grocers' Company may find its money devoted by a ruthless municipality to other purposes, including, perhaps, the practice and not the theory of sanitation. Still it must be given credit for the best intentions. Cynics may indeed say that the proceeding reminds them of the unjust steward, who became excessively liberal shortly before his retirement, and that they fail to trace the connection between grocery and sanitation. But cynics will always say disagreeable things, and the Grocers' Company may pass into oblivion without it being said of it that it is an association which has disposed of a good many thousands of pounds without saying a good thing or doing a good action. It has done a good action, and, we believe, it may be placed on record that the Grocers' Company collectively made a joke. So far as the administration of the scheme will involve scientific considerations, the Court of the company propose to act with the advice of a committee of scientific men, and the following gentlemen have kindly consented to form the first committee:—Mr. John Simon, Dr. Tyndall, Dr. J. Burdon Sanderson, and Dr. Buchanan. With a view to encouraging the making of exact researches into the causes of important diseases, and into the means by which they may be prevented or obviated, the company offers three scholarships, tenable for one year, with eligibility for re-appointment. The appointments are to be made in May next, and persons who may wish to offer themselves at that time are invited to make their applications not later than the last day of April. The scholarships are open only to British subjects under the age of thirty-five. Under the same scheme, and with the same object in view, the company also proposes to offer for competition, once in every four years, a discovery-prize of the value of £1000. The prize is to be open to universal competition, British or foreign. In the month of May next the company will announce the subject proposed for the first competition, which is to terminate at the end of 1886; and at the time of announcing the subject they will announce the full conditions of the competition. Meanwhile, such of the conditions as are hitherto settled will be communicated by the clerk of the company.

LITERATURE.

New Valve Diagrams. Der Practischer Machinen-Constructeur, Neue Schieberdiagramme. Von C. Falkenburg. 1882.

THE title of "New Valve Gear Diagrams," which Herr Falkenburg has thought fit to bestow upon the papers we are about to review, is a misnomer calculated to mislead. A close perusal of them has convinced us that they contain nothing new, as far as valve gear diagrams are concerned. In other parts, however, where the author treats of the clearances, port dimensions, and piston velocities, we find a certain amount of matter which, if not precisely new in substance, is at least new in form. The form of valve diagram attributed by Herr Falkenburg to Müller is simply an inferior reproduction of the "great circle valve diagram" of John F. Gray. It is a well-known fact that the imaginary straight line, joining the end of the crank to the end of the excentric arm, when projected on the same plane surface, is constant in length for any position of the piston and at any part of the stroke. By the aid of this principle the position of the valve excentric arm can be found corresponding to any given position of the crank. French writers make great use of this method, and have given it a far more elegant form and development than that claimed by Herr Falkenburg as new and original.

Judging only from the evidence of these papers, it would seem that Herr Falkenburg has not much faith in indicator diagrams. The indicator, he tells us, yields no definite information concerning the amounts of clearance, and the conditions of temperature and moisture, all of which exercise an important influence upon the action of steam in a cylinder. Until, therefore, the instrument has been fitted with apparatus to define not only the conditions of temperature, moisture, and clearance, but also the electrical state of the steam, all its indications are equivalent only to scientific guess (*wissenschaftliches Rathen*). Electricity, it is stated, is freed during each partial condensation of steam in the cylinder; in other words, it accompanies a free development of latent heat. And again, electricity is made prisoner during the whole time of evaporation. Therefore, Herr Falkenburg would like to know what influence is to be attributed to these changes in the electrical conditions of steam; and until indicator diagrams can satisfy his curiosity, he withholds his acceptance of the mechanical theory of heat. Now the influence of electricity on the work done by steam is very small; in fact, steam under the most favourable conditions, as in the Armstrong apparatus, furnishes only an insignificant quantity of high-tension electricity, representing no appreciable amount of work or loss of work. Hence, Herr Falkenburg is not justified in rejecting the whole mechanical theory of heat, merely because he does not understand the influence of the small amount of electricity possibly generated by steam friction.

In another part of these papers we find steam jackets condemned in terms almost as emphatic as those quoted in reference to indicators; and why? Because the superficial area which steam jackets offer to the cooling medium, air, is larger than the corresponding surface of the cylinder which they enclose. Hence, according to Herr Falkenburg, the cooling effect of the air upon steam jackets must be greater than upon the cylinders which they are meant to protect. This reasoning is all very specious, but it is, nevertheless, perniciously false. The writer seems to forget that the cooling effect of the external air upon a volume of steam enclosed in cylinders of equal length, but varying diameters, is expressed by the general ratio,

$$\frac{2\,\pi\,r}{\pi\,r^2} = \frac{2}{r};$$

in which r = radius of the cylindrical cross-section. It follows, therefore, that the cooling effect varies inversely as the radius of the steam envelope. Moreover, Herr Falkenburg has attributed to the steam jacket an improper function. Its chief office is to protect the metal surface of the steam cylinder, and to counteract the cooling influence of the condenser.

So far we have taken the liberty of pointing out some of the errors which disfigure the papers under review. It is now our duty to indicate a few of their good features—which, however, are not new. A certain amount of instructive writing is to be found in the parts relating to the clearance spaces, port dimensions, and the varying velocities of the piston. The clearance spaces are defined as embracing: (1) the volumes of the two steam channels leading to the ends of the cylinder; (2) the spaces left between the cylinder-covers and the piston, when the latter is at the ends of the stroke. The first part forms a constant quantity, but the two components of the second part—viz., the spaces between piston and cylinder-covers—are variable, or at least have a tendency to vary. According to the author it is not rare to find the course of the piston, looked upon as a whole, gradually displaced towards one or other of the cylinder ends; and he further adds that cases have often occurred where this displacement has led to a succession of bumps of the piston against one of the covers. The cause of this irregular action is assigned to the fact that the maker has not taken care to provide that the wear of the crosshead pin, the crank pin, and its brass should be compensated by a corresponding wear of the crank shaft and its bearings. Now the frictional wear of the crosshead pin is produced by the oscillation of the connecting rod. Taking the latter as five times the length of the crank, the limiting angle θ of its oscillation above and below the centre line of the piston-rod produced can be determined by the equation—

$$\tan.\ \theta = \tfrac{1}{5},$$

whence, $\theta = 11°\ 18'\ 35''$.

This angle is described by the connecting rod four times during each revolution of the fly-wheel. Hence, the sum total of its angular movement will be represented by 45° 14′ 20″. But during the same time the crank pin makes a complete revolution of 360 deg., or nearly eight times the angular movement of the crosshead pin. Therefore, if it be assumed that the pressures conveyed by the piston to the crank pin and crosshead bolt are approximately equal, and that the coefficient and area of friction are the same in both cases, it follows that the wear of the crank pin will be eight times that of the crosshead pin. If, however, the length and diameter of the crank pin be made double the same dimensions of the crosshead pin, the relative wear will be reduced to one-fourth of its original value, because the friction area of the crank pin is now four times that of the crosshead bolt. In other terms, the reduced wear of the crank pin will be now only twice, instead of eight times that of the crosshead bolt. If the engine has been in use some considerable time this relative wear will show itself, and the cotters must be tightened up in such a way as to drive the centre points of the crank and crosshead bolt in one and the same direction, say towards the cylinder. When this has been done the length of the connecting rod will be effectively shortened by the difference in wear of the pin and bolt; or, since one has sustained double the wear of the other, by the linear wear of the crosshead bolt. Consequently the course of the piston, looked upon as a whole, will be displaced towards the front cylinder cover. To provide against this displacement, the journal of the driving axle should have double the friction area of the crank pin, so that keeping the same ratio of diameter to length of wearing surface for the crank pin, crosshead bolt, and axle journal, the diameters of these three parts should be in the proportion of $1 : 2 :: 2\sqrt{2}$, in order that their friction-areas, which are as the squares of their diameters, may be as $1 : 4 :: 8$.

Under these conditions the linear wear of the journal will be half that of the crank pin, or, in other terms, equal to that of the crosshead; and the centre of the crank shaft can be driven back by the same amount that the course of the piston has been displaced forward. In this way the relative wear is neutralised, and the resultant displacement of the piston course is *nil*.

The object of this minute calculation is to minimise the clearance spaces, which Herr Falkenburg considers to be one of the greatest evils of working by steam in a cylinder. He holds that compression is only a partial remedy for the baneful effects of these spaces, which richly deserve the name given them in German, *die schädlichen Räume*. Hence, it becomes a matter of the highest interest and economy to reduce the volume of these spaces by every legitimate means.

But it seems to us that Herr Falkenburg has exaggerated the evil influences of the clearance spaces. By aid of the principles just explained, he says the clearances at each end of the cylinder can be reduced in length to $\frac{1}{100}$th; and in the case of large machines, to $\frac{1}{300}$th of the piston stroke. But if Herr Falkenburg and his engineering friends are in the habit of allowing such small clearances as this statement would lead us to suppose, we are not surprised to learn that the piston occasionally takes a fancy to bump up against the cylinder covers. We do not quarrel with the soundness of the theory advanced; it is not new, but it is put into good form. Still, every machine, no matter how well made, has a tendency to work loose in time; and, if the limits of clearance were reduced to a theoretical minimum, there can be no doubt that the greatest care and attention would fail to keep the piston from suffering displacement sufficient to bring it, at the end of the stroke, close up to one of the cylinder covers.

Herr Falkenburg next discusses the problem of finding the proper dimensions of the steam ports. In old times, German engineers prescribed that the steam port should be $\frac{1}{30}$th the cylinder cross section. Professor Radinger prefers the formula $\frac{O\,c}{30}$; where O is the cylinder cross section, and c the mean velocity of the piston. The Hütte gives the rule, $\frac{O\,c}{40}$; and Professor Hràbak the formula, $\frac{O\,c}{15\sqrt{p}}$; where p is the absolute pressure of steam during admission. But, according to Herr Falkenburg, the formulæ just cited are not generally applicable. They take no account of the difference of the pressures in the valve box and cylinder, and, for exhaust, of the difference between the pressures in the cylinder and the outer air or condenser. In addition, these formulæ neglect the relative densities of steam. It is stated that, looking only at the volume of steam to be exhausted during a given time, an engine working at a great ratio of expansion does not require so large a port as one working with full admission. Hence, the dimensions of the port involve as functions the pressures in the boiler, the cylinder, and the exhausting medium. Therefore, it is only when the difference of the pressure in the valve box and cylinder during admission is equal to the difference between the pressures of release and of the exhausting medium that, rigorously speaking, the same port can perform the double service of admission and exhaust. But, if these differences are very marked, it is necessary to use separate ports for these functions. Taking the admission port as a known quantity, Herr Falkenburg informs us that the cross section of the exhaust port will bear a certain proportion to the cross section of the admission port, expressed by the square root of the quotient of the two differences in pressure mentioned in the last paragraph. For example, let the boiler pressure be 6 atmospheres, the pressure in the valve box $5\frac{3}{4}$ atmospheres, and that registered by the indicator during admission $5\frac{1}{2}$ atmospheres. Moreover, let the pressure of expanded steam at the moment of release equal $1\frac{1}{2}$ atmospheres, then, supposing steam to be exhausted into the open air, we shall have by the foregoing rule:—

$$\text{Cross section of exhaust port} = \sqrt{\frac{1\frac{1}{2} - 1}{5\frac{3}{4} - 5\frac{1}{2}}}\ .\ \text{Steam port.}$$
$$= 1{\cdot}41.\ \text{Steam port.}$$

And in the case of condensing engines:—

$$\text{Exhaust port} = \sqrt{\frac{1\frac{1}{2} - 0{\cdot}055}{5\frac{3}{4} - 5\frac{1}{2}}}\ .\ \text{Steam port.}$$
$$= 2.\ \ \text{Steam port (nearly).}$$

This rule supposes the section of the steam port to be a known quantity. Herr Falkenburg makes it equal to $\frac{O\,w}{50}$, where w equals the piston velocity at the point of cut of, expressed in metres per second, and O the effective piston area. For all grades of expansion which lie beyond the point of maximum piston velocity the maximum value of w must be retained as a factor. It is doubtful whether this formula is elastic enough to meet all cases. It would, however, seem to give approximate results for express engines going at maximum speeds. Take, for example, a locomotive travelling at the rate due to a piston velocity of 22ft. per second. Reducing feet to metres, and substituting in the given formula, we find a cross section for the steam port of $\frac{6{\cdot}7^{m}}{50}$ O; or ·134 of the effective piston area.

Taken as a whole, the papers of Herr Falkenburg betray evidence of careless thought and writing. The formulæ given do not always tally with ordinary practice, and the style of the author, making every allowance for the characteristic profundity of German writers, is heavy and laborious. But, as the special papers we have criticised form part of a work on practical mechanics, it would be unfair for our readers to form an unfavourable opinion of the rest of the work from the judgment which we are compelled to pass upon this particular part.

ON RADIAL VALVE GEARS.

By Robert Hudson Graham, C.E.

No. II.

The Crewe gear treated by geometric method.—In the present paper, the principles expounded in the first part will be applied to a methodical construction of the gear, which has been recently applied to a goods locomotive by Mr. Webb, of Crewe. The usual data will be taken for granted, viz., the course of the piston, ditto of slide valve, the lap and the lead, the lengths of the valve-rod, and valve link, &c. It is a generally admitted principle in locomotive engineering that the travel of the valve in mid gear action is equal to twice the sum of the lap and lead. Now, whether we consider the excentric link or the radial slot, each is vertically placed at mid-gear, so that the part of the full gear travel of the valve depending on the inclination of link or slot is entirely eliminated in this position. From the fact of the elimination in mid gear of that part of the full gear travel depending on the inclination of the link or the slot, a useful and important principle is deduced; for if the travel in full gear be divided into two parts, one part representing the travel in mid gear action, the other expressing the difference between the travel in full, and that in mid gear, this second part will constitute the amount of travel derived from the inclination of the link or slot. Consequently the first part must be induced by some cause independent of the inclination of the link or slot, seeing that this part of the travel exists at mid gear, when the inclination of the link or slot has ceased to exist. In the particular form of gear under consideration this mid element of travel, as it may be fittingly called, is due to the advance and retreat of the point E—see Fig. 1. Moreover, if the extent of mid gear valve motion be attentively regarded, it will be clear that the slide valve is at one extremity of its travel when the piston is at the commencement of the stroke, because at that moment the steam port must be open to the extent of the lead, which in mid gear action represents the maximum admission of steam. In like manner the slide valve will be at the other end of its mid gear travel when the piston has finished the stroke. Now, it has been proved above that the mid gear travel is derived—in Joy's gear—from the to-and-fro movement of the lever-extreme E, so that during the time of the stroke the point E must have travelled over the same distance, in a horizontal sense, as the slide valve in mid gear action, from which it follows that the horizontal distance between the two positions of E, corresponding to the ends of the piston stroke, must be equal to the travel of the valve at mid gear, or, Fig. 5—

$$E_2 E_0 = 2\ (\text{lap} + \text{lead})$$
$$= 2\ (L + l)$$
$$= 2\tfrac{3}{8}\text{in. (Crewe engine).}$$

The above determination of the horizontal distance between the relative positions of E, at the ends of the stroke, when the gear is set for the mid travel of the valve, is the foundation stone, so to speak, on which the whole construction can be built up.

Construction of the Crewe gear (Figs. 3, 4, and 5).—1. Make the continuation of the centre line of the piston-rod the horizontal centre line of the system.

2. On each side of this centre line lay off the centre lines of the valve link S L and lever rod M N at equal given perpendicular distances, 1ft. 3in. from the principal centre line O X.

3. Draw the vertical line through the edge of the slide valve in the position of lead. Make this line the base line of the system.

4. From this base line, along the centre line of valve link produced, set off a length equal to that part of the valve link—S L—external to the edge of the valve, added to the length of the valve rod, or equal to—Fig. 5—

$$S L + L E_2 = 5\text{ft. } 6\text{in.}$$

5. Call the end of this line E_2, which marks the position of the centre E when the piston is at the end of the stroke towards the crank shaft.

6. From E_2 lay off the length $E_2 E_0$ along the valve link centre line equal to

$$2\ (L + l) = 2\tfrac{3}{8}\text{in.}$$

7. Draw a mid vertical line, bisecting the line just drawn, $E_2 E_0$, and letter this line $H_0 O_2$.

8. The centre of the slot being symmetrically placed relatively to the points, E_2 and E_0 must be somewhere on this line.

9. From the mid vertical line $H_0 O_2$ and along the principal centre line, set off the distance $X T = 3\text{ft. } 5\text{in.}$ The point T will be the centre of the crank shaft.

10. About the centre T describe a circle, representing the crank motion, with a radius equal to half the course of the piston—12in.

11. Divide this circle into any convenient number of equal parts, marked as in the figure.

12. From each of these divisions, as a centre with the length of the connecting rod—between centres—equal to 5ft. 8in. as a radius, describe arcs of circles, cutting the principal centre line in points corresponding to the position of the crosshead centre for the selected phases of the crank motion.

13. Join the division points on the crank circle with those similarly marked on principal centre line.

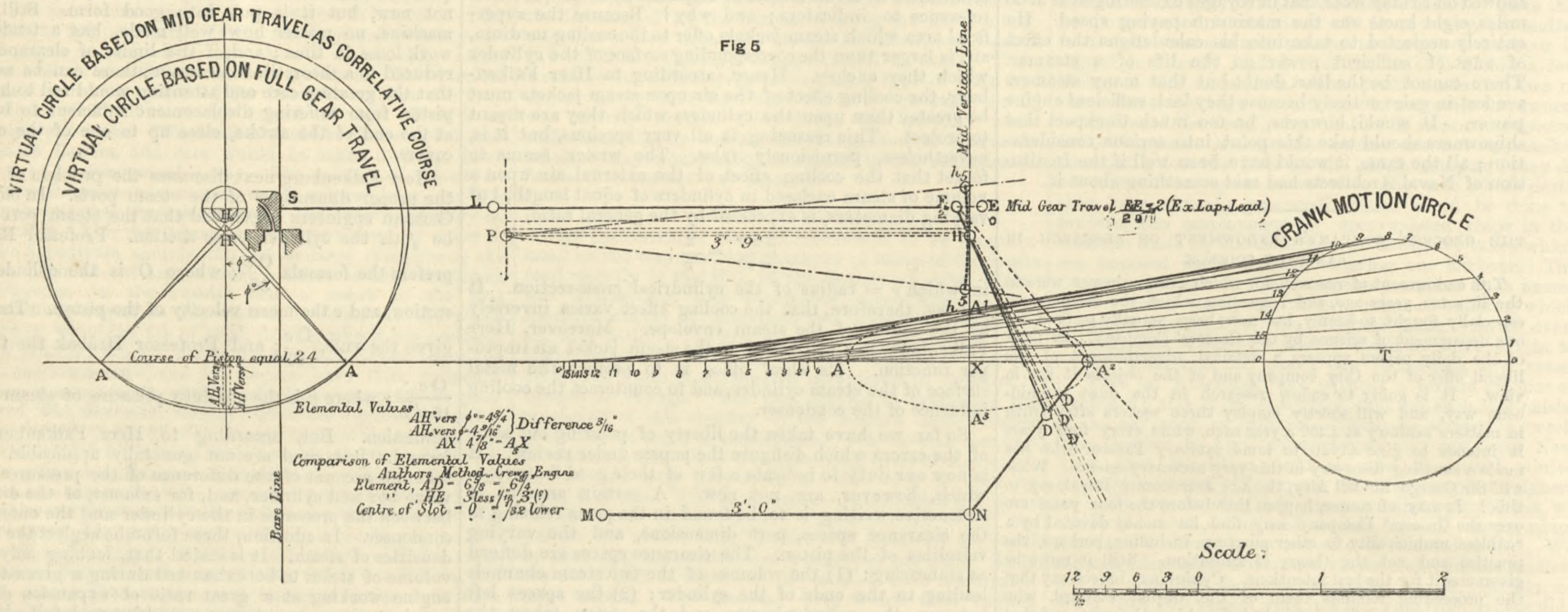
14. Set off from each of the divisions on the crank circle, along the line joining each division with its co-relative on the principal centre line, the distance of the point A from the crank end of the connecting rod, equal in the present instance to 3ft. 5in. The positions of the centre A so found will mark its varying movement for the different phases of the crank motion, and the curve drawn through them will constitute the ellipse path of A.

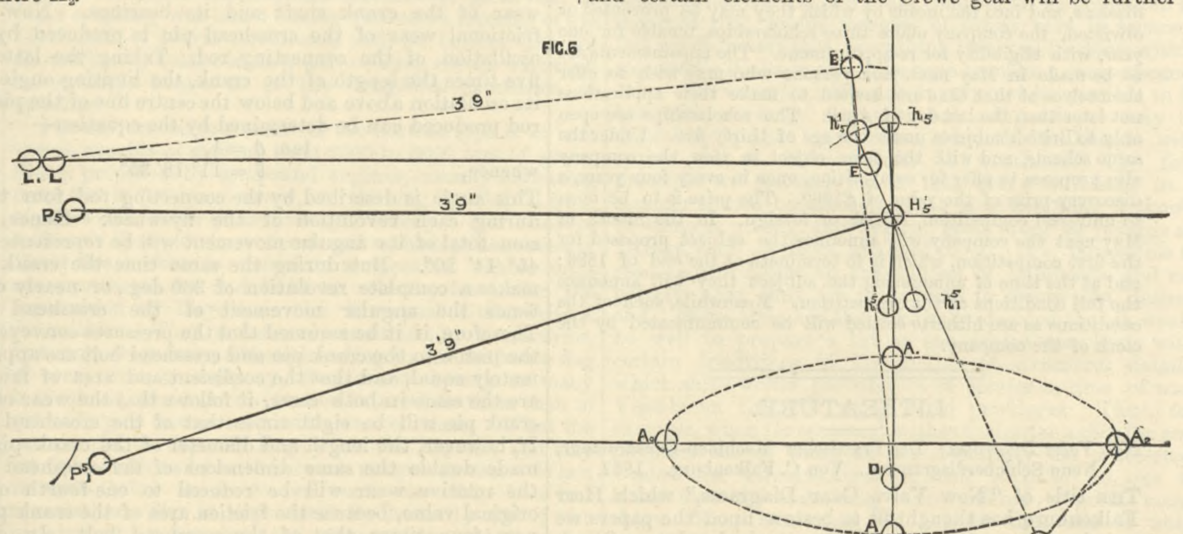
15. Let the rod M N be supposed horizontal, and equal in this case to 3ft.; and let the extreme N be found at the intersection of the mid vertical line $H_0 O_2$ with the centre line of the rod M N when the piston is at the end of the stroke towards the crank shaft.

16. Let A_2 be the position of the centre A when the piston is at the same end of the stroke.

17. Join the centres A_2 and N by the line $A_2 N$. The centre D will be found somewhere on this line.

18. Join the centres A_2 and E_2 by the line $E_2 A_2$, which will cut the mid vertical line $H_0 O_2$ in a point H_0, representing the centre of the slot when the rod D E is supposed in its initial position, the end D coinciding with the centre A_2.





19. But, as we have shown earlier in these pages, the point of attachment of the lever rod D E must be depressed along the rod $A_2 N$ by an amount equal to

$$A_2 D_1 = \frac{A_2 H_0 \text{ vers } \phi}{\cos \theta_2}$$

(see Fig. 5, in which these quantities are indicated)

$$= \frac{18{\cdot}125\text{in.} \times \text{vers } 41\tfrac{1}{2}^\circ}{\cos \theta_2};$$

since by the virtual circles—Fig. 3 and Fig. 5—

$$A_2 H_0 = 18\tfrac{1}{8}\text{in.}$$
$$\phi = 41\tfrac{1}{2}^\circ.$$

Wherefore the angle θ_2 being equal in this instance to nearly $2\tfrac{1}{2}$ deg.,

$$A_2 D_1 = \frac{18{\cdot}125\text{in.} \times \text{vers } 41\tfrac{1}{2}^\circ}{\cos \theta_2}$$
$$= \frac{18{\cdot}125 \times {\cdot}252}{\cos 2\tfrac{1}{2}^\circ}$$
$$= 4\tfrac{5}{8}\text{in., approximately.}$$

20. Lay off the value found for $A_2 D$ in the last article from A_2 to D_1, Fig. 5, and shift the lever rod from its initial position $E_2 A_2$ to its second position $E_2 D_1$.

21. From D_1 set off along the rod $A_2 N$ the correction required for the decentralisation of the slot (page 139, ante)

$$D_1 D_2 = H_0 H_1.$$

22. Again depress the centre D_2 to the position D_3, such that

$$D_2 D_3 = H_1 H_2$$

23. Apply the correction for the gradual lengthening of the lever rod, depressing D_3 into the position D_4, so that

$$D_3 D_4 = D_3 H_3 - A_2 H_0$$

(see page 139, ante).

24. Move the centre D_4 into its final position D_5, by the amount of decentralisation of the slot centre induced by this last change in position of the rod D E, or by the length

$$D_4 D_5 = H_{2,3} H_{4,5},$$

the symbols $H_{2,3}$ and $H_{4,5}$ implying that the position of the slot, corresponding respectively to the positions of ends of the lever rod D_2 and D_3, D_4 and D_5, are coincident.

25. The final position of the lever rod will be $E_2 D_5$, and the final centre of the slot H_5.

26. Through the centre of the slot H_5 draw the line $P_5 H_5$ parallel to the centre line of valve link, and equal in length to 3ft. 9in.

27. About P_5, as a centre with the length of the valve rod = 3ft. 9in. as a radius, describe the circular arc $h_5 H_5 h^5$; this will be the central curve of the slot.

28. About the centre of the slot H_5, with a radius equal to $A_1 X$, or half the minor axis of the ellipse path of A, describe a circle, cutting the central curve of the slot in the points $h_5 h^5$. These points mark the ends of travel of the fulcrum H in the radial slot.

The construction of the gear may be now considered implicitly complete, although the angle through which the slot must be turned, in order to change from mid gear to full gear working, has not been calculated. This angle, termed the "angle of cant," will be now determined, and certain elements of the Crewe gear will be further discussed, with special reference to their functions and the final object of their existence in the gear. In the next paper other forms of Joy's excellent gear will be reviewed, and shown to be dependent upon the same first principles which underlie the gear, the construction of which has just been given.

The angle of cant.—The angle, through which the radial slot or, as the case may be, the radial lever rod, must be turned, to change it from its mid gear or vertical position to its full gear or inclined position, is termed in these papers the angle of cant. This angle will be seen to depend upon the difference between the travel of the valve in full gear and its reduced travel, corresponding to mid gear action.

Let, T = full gear travel of the valve
L = the lap
l = the lead.

Then, if the difference above mentioned be represented by D,

$$D = T - 2\ (L + l)$$
$$= 4 - 2\ (1 + \tfrac{3}{16}). \text{ (Crewe gear}$$
$$= 1\tfrac{5}{8}\text{in.}$$

In order graphically to construct this forward position of the slot, it will be necessary to develope a few simple geometrical considerations. Taking the Crewe gear—Fig. 6—in its mid gear position, $L\,E\,H_5\,D\,A_2$, corresponding to the valve in the position of lead—see Fig. 5—it will be seen that, in order to work the engine in full gear, a further opening of the steam port to the extent of $\frac{D}{2}$ or $\frac{13}{16}$in. must be effected by means of an equal increment of travel given to the slide valve; or, if L—Fig. 6—be the position of the end of the valve link, when the steam port is uncovered to the extent of the lead, L must suffer a further horizontal displacement, $L\,L_1$ equal to $\frac{13}{16}$in., in order that the steam port may be fully opened for full gear action. Let us suppose that the steam port be opened by the action of the valve to its maximum extent, whilst the engine is going forward and the piston is on its stroke from the crank shaft. The end L of the valve link would then be situate at L_1, where $L\,L_1$ is equal to $\frac{13}{16}$in. Consequently, if a circle be described about the centre L_1, with the length of the valve rod L E as a radius, the other end E_1 of the valve rod must be situated on this circle. At the same time, since the valve has to travel a distance equal to $L\,L_1$ forward and back again to lead, whilst the point A is in motion from one extreme A_2 to the other A_0 of the major axis of its ellipse path, it follows that when the valve has moved forward by the amount $L\,L_1$, the centre A will occupy a position midway between A_2 and A_0, or in other terms, A will be placed somewhere in the vicinity of the end of the minor axis of its path. Let A_1 be the position of A corresponding to that L_1 of L; and let D_1 be the relative position of D. If about the centre D_1 an arc of a circle be described with a radius equal to the length of the lever rod D E, the other extreme E_1 of the lever rod must be found on this arc. But it has been previously shown that E_1 is also found on the circle already described about the centre L_1; therefore the position of E_1 is defined by the point of intersection of these two circular arcs. Join the determined points D_1 and E_1 by the line $D_1\,E_1$ —— the fulcrum H must be located on this line. But if the radial slot be made to revolve about the centre H_5, which is supposed immovable, the arc described by its upper extreme h_5—Fig. 6—will trace out the *locus* of the end of the *up travel* of the fulcrum H for all positions of the radial slot. Consequently since H is granted to be at the end of its travel in the slot, when A is at the end A_1 of the minor axis of its ellipse path, the position of H corresponding to A_1 and E_1 will be found somewhere on the arc $h_5\,h^1{}_5$—Fig. 6. Moreover, it has been previously shown that H must be somewhere on the line $D_1\,E_1$; therefore it will be at the point of intersection $h^1{}_5$ of the line $D_1\,E_1$, and the circular arc $h_5\,h^1{}_5$. If, therefore, with the length of the valve rod as radius, an arc of a circle be described, passing through the points $h^1{}_5$ and H_5, this arc $h^1{}_5\,H_5\,h^5{}_1$ will form the central curve of the slot for full forward gear, and the angle through which the slot must turn, to change from mid to full gear action, will be measured by $P_5\,H_5\,P^5{}_1$—Fig. 6. The above method is very nearly geometrically exact. It is, however, subject to certain imperfections. For example, owing to the different inclinations to the vertical of the rod A N, when A is passing the ends A_1 and A_3 of its ellipse path, the steam port will be opened a little more on the stroke towards than from the crank shaft; and in general the events taking place on the stroke towards the crank shaft would be somewhat accelerated relatively to the times of the same events on the stroke from the same centre of reference. On these accounts the angle of cant as found by the above method would be subject to a slight correction, if it were desirable to secure a mathematically equal port; but in general the induced error is so very small and unimportant that it is permissible to pass it over.

Discussion of certain elements of the Crewe gear.—The elemental centres E and A, being those first determined in the Crewe gear, may be called the primary centres, and the centres H and D, being derived from these primary centres, may be fitly named the secondary centres of motion. The centre M, being only an external point of support, and not intimately connected with the radial system, does not admit of strict geometrical determination, neither is there any strict geometrical limit to the length of the rod M N; but it will be observed that the most symmetrical position for the rod M N is horizontal, whilst the natural place for the point N is on the mid vertical line—Fig. 5. With regard to the length of the rod M N, there arise certain questions of an economical nature, which it may be well to mention. For example, if the point M were too distant from the centre of the radial system, an undue increase of length would be given to the rod M N, which, endowing it with greater freedom of action, might induce excessive tremour and nervous pulsation at high speeds; whereas, again, if M N were cut too short, the arc of its oscillation would be unduly increased, and the inclination of the rod A N to the vertical, when passing the lower extreme of the minor axis of its ellipse path, would be vastly more accentuated than when passing its higher extreme.

Functions of the element A D.—The element A D has for its sole object and cause of existence the versinal correction of the unequal vibration of the fulcrum-centre H in its motion through the radial slot. This fact is worthy of mention, because A D is liable, from its position in the gear, to be turned to a very illegal and abnormal use as an instrument *to vary the lead.* For example (Fig. 6), the centre H_5 may be approximately found by experimental trial and failure, and then by moving the centre D nearer to or farther from the centre N, the amount of lead may be decreased or increased as required. This statement will be confirmed by an inspection of the figure, for, by moving D nearer to the point N whilst the centre H_5 is kept fixed and constant, the extreme E_2 will be moved laterally nearer to the mid vertical line $H_5\,O_2$, and in consequence, the line $E_2\,E_0$ representing the mid gear travel, will be shortened, which will effect a proportionate decrease in the lead. But so to handle the element A D is to take a most unlawful and unwarrantable liberty, and the result will certainly be to disturb its proper functions, which—it is unnecessary to repeat it—are entirely comprised in the correction of the error induced by the unequal vibration of the fulcrum H. According to the methods employed in these papers, the variation of the lead is provided for prior to the determination of the element A D, and therefore, any subsequent handling of this element with a view to a change of lead is not only wrong in itself, but introduces an error into the vibration of the fulcrum H in the radial slot. It is nothing to the purpose to answer that this effect does not occur in the *act of shifting* the centre D nearer to or farther from the point N, because whilst the centre D is being thus varied in position, the rod D E is similarly varied in length, on account of the centre H_5 of the slot remaining fixed. But the influence of this change of position given to D makes itself felt during the action of the gear, and more especially at mid stroke, when the centre D having been brought to an abnormally high or low level, will lift up or drag down with it the fulcrum centre H. This error may be compensated for by some other modification in the gear; but it is none the less evident that such a system of construction depends on principles fundamentally wrong.

The element H E.—The element H E may vary in two ways and under two conditions. First, H E may vary with the element A D, the centre of the slot, H_5, remaining fixed. This may be done by causing E_2 and D to glide along the lines $E_2\,E_0$ and A N respectively; whilst the rod $E_2\,D$ may vary in length, but must always pass through H_5, the fixed centre of the slot. Secondly, H E may vary with the centre of the slot; or rather the centre of the slot may be made to depend on the amount of lap and lead required and represented in Fig. 6 by the element $E_2\,Y$. The first method of variation applied to the element H E is comprised in the principle already explained and condemned, that the lead can be varied by varying A D; or, in other terms, by changing the position of D along the rod A N. The arguments condemnatory of this unlawful practice need not be repeated. The second method contains the statement of the only true sense in which the element H E can be made to vary consistently with sound principles. It is abundantly clear that the position of the centre of the slot along the mid vertical line $N\,O_2$ depends upon two quantities:—(1) Upon the amount of lap and lead required to be given to the valve, and represented in Fig. 6 by the length $E_2\,Y$. (2) Upon the final position of D, on the rod A N, as geometrically determined in Paper I. of the series. Once the correct position of the slot-centre has been determined for any particular lap and lead, and any geometrically defined position of D, it is absolutely illegal to tamper with the rod D E in order to vary the lead of the slide valve. It would be equally illegitimate and against all true scientific principles to try to feel for the correct position of the slot-centre, corresponding to any particular lap and lead, by means of shifting the end D of the lever rod up and down the rod A N.

THE Huddersfield Fine Art and Industrial Exhibition promises to be very successful, and especially so in the machinery department. The applications for space have been so numerous and important that the committee have been compelled to provide more shed accommodation.

THE ISTHMUS OF CORINTH CANAL.—The Athens correspondent of the *Temps*, who has just paid a visit to the works which are in progress for cutting a canal through the Isthmus of Corinth, states that they will be finished in four years, at a total cost of rather less than a million sterling. The total length of the canal will be just under four miles, and it will be quite straight, and of the same dimensions as the Suez Canal—that is to say, 72ft. broad and 26ft. deep throughout. The correspondent of the *Temps* says that the work of cutting through the rocks, which will form a natural wall upon both sides, has not so far given rise to any difficulties, and that the quantity of rock and earth to be removed will be about 11,000,000 cubic yards. It has already been mentioned that this canal will shorten by 185 miles the passage from the Adriatic ports to Greece, Turkey, Asia Minor, and the Black Sea, while from the Mediterranean ports and Gibraltar the difference will be about 95 miles, thus effecting a great saving in time and coal, to say nothing of avoiding the dangerous coast around Cape Matapan, which is called by the Greeks "the great slayer of men."

LIVERPOOL ENGINEERING SOCIETY.—The fifth meeting of the session was held on Wednesday, the 14th of March, at the Royal Institution, Colquit-street, Mr. H. Bramall in the chair, when a paper, entitled "Wire-rope Traction on Tramways, as Practised in American Cities," was read by Mr. C. F. Findlay, M.A., Assoc. M. Inst. C.E. The author pointed out the reason why stationary engine systems had universally been disregarded for general railway purposes in favour of locomotives, and described the conditions under which alone the stationary system could successfully compete, the advantage in economy which resulted when the stationary system could be adopted, the difficulties in the way of its adoption, and how these difficulties had been met first in San Francisco, and then in Chicago, and other cities. The grip used on the Clay-street Hill-road, the first of the kind constructed in 1873, was described and a model of it exhibited. The author then went on to give a detailed account of the latest and more extensive appplication of the system to the tramway lines of the Chicago City Roads Company, which when the whole system is complete will embrace nearly fifty miles of tramway, all actuated from one engine house by ten long endless cables. Various plans of the works were shown, and the result of the experience of the system, so far twenty miles of cable being now at work, were described as being entirely satisfactory, and surpassing the expectations of its promoters; burning 630 lb. of coal per hour, they were doing work which would require 600 horses to be kept. The engine indicated 115-horse power when moving the cables of one street $4\frac{1}{2}$ miles in length at the busiest part of the day, there being 43 trains of two cars each on the cables, and 1900 passengers—estimated—on board. The line constructed by the Union Passenger Road Company, in Philadelphia, was described, and also the grip used on the rope tramway or railway over the East River Bridge, from New York to Brooklyn. Plans were also shown of the Highgate-hill tramway, now being built in London from the designs of Mr. James Cleminson, M. Inst. C.E. A visit of this Society was made to Mr. C. Wells' quarry, Bootle, on Friday afternoon, 2nd of March, on the invitation of Mr. Brunton, to see his "heading machine for tunnels" at work. The machine itself was entirely in the heading, so that only a few could get in at a time to see it at work. It is of a somewhat novel principle, as the cutting is done by circular discs set at an angle and revolving or rolling on the face of the rock in two groups of six working in sets of three alternately, a revolving motion being also given to the two groups of cutters, which are fixed to a cross-head revolved at its centre. It is capable of cutting two inches an hour, and has been constructed for some waterworks in Australia.

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

(*From our own Correspondent.*)

THOSE mills and forges which did not intend to remain idle all this week re-started, after the holidays, on Tuesday or Wednesday night. But, through lack of demand, the number of places where the whole week will be an idle one is unusually large.

Pending the quarterly meetings that are fixed for April 11th in Wolverhampton, and April 12th in Birmingham, merchants who have orders of much size for finished iron to give out are generally holding off. It is scarcely likely, however, that there will be any alteration in crucial prices.

Messrs. William Millington and Co., of the Summerhill Ironworks, Tipton, quote bars, rounds, and squares, $\frac{7}{16}$in. to $2\frac{1}{2}$in., and flats 1in. to $4\frac{1}{2}$in. wide to $1\frac{1}{4}$in. thick, £7 10s.; horseshoe and shutter bar iron, £7 10s.; small rounds and squares, $\frac{3}{8}$in., £8; ditto, $\frac{5}{16}$in., Nos. 1 and 2, £8 10s.; $\frac{1}{4}$in., Nos. 3 and 4, £9; No. 5, £9 10s.; $\frac{3}{16}$in. and No. 6, £10; No. 7, £11; No. 8, £12; No. 9, £13 10s.; No. 10, £15 10s.; No. 11, £17 10s. Best bars are quoted £8 10s.; double best, £9 10s.; treble best, £11 10s.; and treble best "L. M." bars, £13 10s. Plating bars, 1in. to $4\frac{1}{2}$in. wide, and $1\frac{1}{4}$in. thick, and cable iron, are £8; best ditto, £9; double best chain iron being £10. T-angle iron, $\frac{1}{2}$in. and $\frac{7}{16}$in., is £7 10s.; best, £8 10s.; and double best, £9 10s. Ordinary rivet iron is £8 10s.; best, £8 15s.; double best, £10 5s. Angle iron, $1\frac{1}{2}$in. to 3in., is £8 10s., £9, and £10, according to quality. Plates are quoted £9; best boiler plates, £9 10s.; double best, £10; and treble best, £12 10s. Treble best "L. M." plates are £15 10s. Sheets are £9 10s. to £10 10s., according to quality.

The bar prices of Messrs. E. T. Wright and Son, of the Monmoor Works, Wolverhampton, are:—"Monmoor" crown, $\frac{1}{2}$in. to 3in. round and square, or to 6in. flat, £7 5s.; best, £8 5s.; and double best, £9 5s. Monmoor best rivet iron of usual sizes is £9, and double best, £10. Angle bars, to eight united inches, £7 15s.; best, £8 15s.; and double best, £9 15s. T bars ranged from £8 5s. to £9 5s. and £10 5s., according to quality. The "Wright" qualities of the same firm are quoted 10s. per ton lower than the above prices.

Ordinary hoop and bar makers report this week a steady business not on home account alone, but likewise for Oporto, Australia, the Cape, India, and other export markets. £6 10s. to £6 12s. 6d. is quoted for hoops, and £6 upwards for common bars.

Sheet makers who supply the galvanisers still complain of a want of orders, and prices are easier at £7 15s., and on for "singles." Thin sheets are in inquiry on United States account, but the terms are not such as makers care much about.

The mail from Melbourne brings news of a fair inquiry for iron. Galvanised iron has been moving freely at from £20 to £21 10s. Three shipments of medium brands have been taken up at from £20 5s. to £20 10s. A fair parcel of Redcliffe has been disposed of at a full price, while for a shipment of Orb £22 was obtained. Bar and rod iron continue in good request at Melbourne at from £8 10s. to £9 10s. Black sheets have been moving quietly; for Nos. 8 to 18, £10 10s. has been paid; and for Nos. 20 to 26, £13. Plates were quoted, when the mail left, at £10 10s.; whilst hoops were worth £10.

The pig market keeps firm, notwithstanding the easier prices for finished iron. The selling price of Derbyshires is this week about 48s. 9d., though 50s. is quoted. Northamptons are quoted 47s. 6d.; for the Wellingborough brand 50s. is asked, but it cannot be got. Staffordshire all-mines are 65s. nominal, and second-class mine iron, 60s. to 55s.; part mines are 45s.; and cinder pigs, 40s.

Messrs. T. and I. Bradley Bros., of the Copperfield furnaces, Bilston, have just rented the Darlaston Coal and Iron Co.'s Nos. 2 and 3 furnaces. The plant is now being repaired, and will be set upon common iron.

The blast furnace operatives are accepting their 5 per cent. drop in wages with the best grace possible.

Next week the finished ironworkers will begin work at a reduction of 6d. per ton in puddlers' and 5 per cent. in millmen's wages. The investigation under the new sliding scale of the books of the twelve selected bar firms has shown that the average selling price obtained for bars during December, January, and February last, was only £6 19s. 6·79d. per ton. Puddlers' wages now become 7s. 9d. and millmen's wages in proportion. This wage will continue until the 30th of June next.

Steelmaking by the basic process continues at the works at Wednesbury of the Patent Shaft and Axletree Company, Limited, and the method is proving very successful, but the directors have not discontinued steelmaking by the Bessemer process.

The unequal working of the new American tariff appears in the action of the Roofing Company, of Wolverhampton, an American concern for the making of shingles of stamped sheet iron. Under the late tariff it paid it to remove its machinery to this side, and having made the shingles of British iron, import them into America, as well as export them to Central America, New Zealand, and other markets. Under the new tariff it will be to its advantage to remove back to the United States such machines as are needed to manufacture the shingles demanded in that country. By the 1st of July the company will have its machinery fixed up and running in the States again. The Central American and other customers will still be supplied from Wolverhampton.

Machinists and ironfounders find that the continued lack of vigour amongst the japanners, and the falling away of the trade of the galvanisers, is making against them, and they are eagerly looking after any new business.

The accountants' examination of the Cannock Chase coalmasters' books shows that the average selling price for the four weeks ending March 7th was 6s. 2·92d. The masters now claim a reduction in wages, but the men maintain that under the sliding scale no reduction can be made until the price drops to below 6s. 1d. The matter remains undecided, pending communication with South Wales, South Yorkshire, and the North of England.

At a meeting of the Iron Trade Wages Board in Birmingham this afternoon, resolutions were passed carrying out the proposals to increase the contributions of the Board from 3d. to 6d. per man per quarter, and to increase by one-half the salaries of the operatives and employers' secretaries. The chairman said the expenses of the Staffordshire Board were less than one-half those of Cleveland. A minority of the ironmasters in this district did not subscribe. It was urged that all masters who benefitted by the Board's decision ought to subscribe, and the hope was expressed that they would.

NOTES FROM LANCASHIRE.

(*From our own Correspondent.*)

Manchester.—The past week has been so much of a holiday character that it is difficult to form any accurate estimate as to the actual condition of trade. Works and collieries have, as a rule, been stopped for about three days, and business more or less interfered with; but apart from any effect the holidays may have had in interrupting the course of ordinary transactions, trade itself is dull, and so far as pig iron is concerned, there are scarcely any of the large buyers at present in the market. The contracts recently entered into appear for the most part to have covered current requirements, and as values show no upward tendency, there is no inducement to enter into speculative purchases. In fact, if orders had to be sought, it is doubtful whether present rates could be fully maintained; but as makers are not pressing sales, prices remain unchanged. In the finished iron trade buyers show no anxiety to place out orders even at the present comparatively low prices, and makers are not doing more than keeping themselves going from hand to mouth.

The Manchester market on Tuesday was characterised by the usual slow resumption of business after the holidays. There was less than an average attendance, and little or no inquiry of any description. For Lancashire pig iron makers were still quoting 47s. 6d. to 48s., less $2\frac{1}{2}$ for forge and foundry qualities delivered equal to Manchester, but as they are undersold by some of the district brands by quite 2s. per ton, they are practically out of the market. Local makers are, however, so fully sold over the next three months, and the whole of their output is at present going away in deliveries against contracts, that they are indifferent about booking further orders; and although they are not able to effect sales at their list rates, show no disposition to give way. For Lincolnshire brands quotations remain at 45s. 4d. for forge, to 46s. 10d. for foundry, less $2\frac{1}{2}$ delivered equal to Manchester; but only a very limited business is being done, and in some cases complaints are made that customers are not taking their deliveries of iron already bought. Derbyshire brands vary so much in price according as makers are well sold. But quotations are of little practical value; 48s. to 50s., less $2\frac{1}{2}$, appear to be about average figures for delivery into this district.

For finished iron very few orders have been given out, either for shipment or home requirements. Some of the South Staffordshire makers show a firmer tone, and for bars delivered into the Manchester district ask about £6 7s. 6d. per ton, but local makers are still open to book orders at £6 5s., and in a few exceptional cases there are odd sellers to be found at £6 2s. 6d. per ton.

Following the reduction of the finished ironworkers' wages in Staffordshire under the operation of the sliding scale, there will be a reduction of about 5 per cent. in the rate of wages paid at the Lancashire forges, which will come into operation with the commencement of next month.

Some time back I briefly referred in my "notes" to a couple of exceptionally large gun-boring machines which are being made for the Government by Messrs. Craven Brothers, of Manchester. As these machines are now in a fairly advanced state, a few additional particulars will be of interest. The main beds, which are completed, weigh in each case 76 tons, and the main driving headstocks, which are 6ft. high from the face of the beds to the centres, and are in a forward state, weigh, with the spindles and 12ft. face plate, 28 tons each; the steady rests for carrying the guns weigh 12 tons each; and the beds for forcing the boring bar, which are 54ft. long, weigh 16 tons each. The total weight of the machines when completed will be 180 tons each; they are constructed to bore 6ft. 6in. diameter and 50ft. long, and the main headstock is driven by a worm wheel 8ft. diameter and 4in. pitch. The motion is the same as in two similar though lighter machines made for the Government by Messrs. Craven several years back, and it has given results so satisfactory that it has induced the Government to adhere to this method of driving in the new machines. One great advantage in this means of driving, and especially in the class of machines to which it is being applied, is that there is none of the back-lash which would be unavoidable in a train of gearing for the same amount of power.

It will probably be remembered that the last great colliers' strike in Lancashire, which was in fact the most serious dispute that has ever taken place in the coal trade of this district, originated primarily on the question whether the men should contract themselves out of the Employers' Liability Act through the medium of the Lancashire and Cheshire Miners' Permanent Relief Society. The men were successful in carrying their point, but although the coalowners abandoned any attempt at insisting upon the miners contracting out of the Act, the suggestion that in case of accident they should obtain relief through the Society and not under the provisions of the Employers' Liability Act has since been practically carried into effect, and the Society now numbers upwards of 34,000 members. It seems, however, very doubtful whether the Lancashire and Cheshire Society, which has been the pioneer of other similar organisations in the leading coal mining districts, has not been started on too liberal a basis of allowance for relief in proportion to the subscriptions it receives from the colliery proprietors and the men. A report presented at the annual meeting by Mr. Neison, the actuary, presents a somewhat alarming financial prospect. Mr. Neison estimates the present liabilities, as represented by the value of the allowances to widows, children, and disabled members, at £58,773, whilst the total accumulated capital of the Society only amounts to £28,780, showing a deficiency of upwards of £30,000. One main source of weakness has been the large drain upon the income of the Society to meet claims for temporary disablement, and this is so abnormally large as to suggest that undue advantage is being taken of this class of benefit. In times of bad trade and low wages there is no doubt a strong temptation for men to avail themselves of any colourable pretext for going on the funds, but seeing that the large expenditure for temporary disablement is threatening the very existence of the society, it is incumbent on those who have the management to see that this risk is removed. It would be an irretrievable misfortune if failure ultimately to meet its liabilities should be the means of striking a fatal blow at a system of relief which has already proved of so inestimable a benefit in connection with a branch of industry so peculiarly liable to accident and unforeseen disaster as coal mining.

The coal trade throughout the district maintains a generally steady tone, and the month closes without any indication of a giving way in prices. The continued cold weather keeps up an active demand for house-fire coals, and other classes of fuel for iron making, steam, and general trade purposes, move off without difficulty. As regards slack there is quite a pressure for supplies, and for the better qualities slightly advanced prices are in many cases being obtained. The present output of the pits is all going away, and the holiday stoppages during the week have necessitated some filling up out of stocks to meet requirements. At the pit mouth prices average about as under:—Best coals, 9s. 6d. to 10s.; seconds, 7s. 6d. to 8s.; common house fire coals, 6s. 6d. to 7s.; steam and forge coals, 5s. 9d. to 6s. 3d.; burgy, 4s. 9d. to 5s.; good ordinary slack, 3s. 6d. to 4s., with some of the best qualities fetching 4s. 6d. per ton.

The shipping trade has been quiet. There is a continued scarcity of vessels, which is a serious obstacle to the transaction of business, but apart from this orders have not been at all plentiful, and there is a good deal of coal lying at the ports. Somewhat low prices are ruling, and Lancashire steam coal delivered at the high level, Liverpool, or the Garston Docks can be bought at about 7s. 6d. per ton, or delivered alongside at Liverpool on boats at about 8s. 6d. per ton.

Barrow.—The hematite pig iron market is still flat, and gives very slight evidence of any immediate animation. Sales are few, but as steel makers are largely sold forward, it is likely that some fair parcels of pig iron will be sold in order to enable steel producers to meet their engagements. Deliveries by sea and rail have decreased considerably within the past few weeks. The shipping season is, of course, closed at present, but in a short time the shipments of metal, especially rails, will be heavy. There is no diminution in the output, nor any signs of a decrease. Prices of pig iron are unchanged, although there is a slight increase in cheaper samples. No. 1 Bessemer is quoted at 53s.; No. 2, 52s.; and No. 3, 51s. net at works.

Iron shipbuilders are likely to be fairly well employed in a short time, as it is said a few good orders have been secured, and inquiries are being made. Iron ore is in fair request, but owing to heavy stocks at the mines, there is not much activity. The coal and coke trades are well employed.

THE SHEFFIELD DISTRICT

(*From Our Own Correspondent.*)

THIS has been a week of holiday making, and no change of consequence is to be noted in the position of the heavy trades. The miners have devoted most of their leisure to addressing meetings in various parts of the South and West Yorkshire and the North Derbyshire districts, counselling the men to join the Yorkshire Miners' Association, with the view of securing the restriction of the output. Mr. Benjamin Pickard, addressing the miners employed at Car House Colliery—Messrs. John Brown and Co., Limited—advocated a policy of restriction. He asked, if because one employer chose to send out 1000 or 1200 tons per day into the market at a lower price than at other pits, were the men to help him "to ruin the trade." Manvers Main, and Denaby Main, and other "mains" which he could mention were doing this, "and it simply meant selling or giving away the coal in order that the pit might not stand." This is a fair sample of the speeches which have been made in nearly all the South and West Yorkshire colliery districts during the holidays; but in Derbyshire there have been one or two exceptions to the general approval of limiting the output of coal. At a miners' meeting, held at New Whittington, though it was declared that miners' wages were at starvation point, restriction was held to be impracticable.

The price of house coal continues firm owing to the spell of cold weather, and the demand for the London market as well as for the eastern counties continues to improve.

In the file trade arrangements have been made which point to the strike being of short duration. Messrs. Spencer Brothers, of Pea Croft, have arranged for their men to continue working at full statement prices. Messrs. Spear and Jackson are also continuing at the same rates, though their men are not formally engaged on these terms, and are liable to notice at any time. The file trade is not so profitable as it has been, but the men urge that is largely owing to firms "giving away" files with the view to secure other orders in the heavier branches.

The report of Mr. A. Morley, M.P., upon the Clay-cross explosion in November last, by which forty-five lives were lost, has been received. Mr. Morley finds that there were no such premonitory signs as would have enabled even the most perfect management to have averted the disaster. The manager of the colliery believes the explosion originated in a locality where there is no possible receptacle in which a gradual storage of gas could collect. Mr. Morley goes on to say: "If, however, the theory that the first explosion took place in No. 1 flat and the others were consequent upon it is the true one, it becomes important to see that every precaution was taken which might have led to the detection of an accumulation of gas, supposing such to have existed previous to the ignition." With reference to this point he thought the suggestion of the jury was of considerable value, namely, that examination of the working places should be made as late as possible previous to the men going to work early in the morning.

Messrs. Charles Cammell and Co.'s annual meeting took place on Wednesday, and Messrs. Wm. Jessop and Sons' on Thursday. At the former, Mr. George Wilson, the chairman, made the interesting statement that our ordnance authorities had at length decided to make the guns wholly of steel, and not of coiled wrought iron, as heretofore; and he also expressed his firm conviction that the result of the trials of armour-plates on the Continent would be the adoption by every European Power of the Sheffield compound plates. The action of the board in the purchase of the Dronfield Steel Works and the Derwent Company's blast furnaces, now being amalgamated at Workington for the steel rail trade, received the emphatic endorsement of the shareholders; and Mr. H. Munster, a director and large shareholder, who had taken up an attitude of hostility, particularly with regard to Dronfield, was not re-elected a director. Mr. Munster has announced his intention of applying for an injunction to prevent the directors paying the dividend of £4 per share recommended in the report.

THE NORTH OF ENGLAND.

(*From our own Correspondent.*)

OWING to the holidays the attendance at the Cleveland iron market, held at Middlesbrough on Tuesday last, was exceedingly small, and little business of any kind was transacted. The tone of the market was, however, more cheerful than it has been for the last two or three weeks, as the shipments for this month are very good, and there is every prospect that they will be better in April. Some few sales of No. 3 g.m.b. were made by merchants at 40s. 3d. per ton f.o.b. for prompt delivery. Some of the makers were willing to take 40s. 6d. per ton for No. 3, but the majority quoted 41s. and 41s. 6d., and were not disposed to take less. Warrants were but little pressed upon the market. Holders asked, and in some cases obtained, full makers' prices. Sales at 40s. 6d. per ton f.o.b. took place in Connal's No. 3 warrants.

The stock of Cleveland iron in Messrs. Connal's Middlesbrough store on Monday night was 82,646 tons, being exactly the same as on the previous Monday.

Shipments from the Tees have been satisfactory this month in spite of the stormy weather. Up to Monday night 57,340 tons of pig iron and 22,144 tons of manufactured iron and steel had left the port.

In the finished iron trade quietness prevails, most makers having booked as much as they care to take at present prices; the advanced rates are therefore being fully maintained. Ship plates are quoted at £6 5s. to £6 10s. per ton; angles for shipbuilding, £5 10s. to £5 15s.; and common bars, £5 15s. to £5 17s. 6d. f.o.t. at works; cash 10th, less $2\frac{1}{2}$ per cent. Puddled bars are still £3 15s. per ton net at makers' works. Most of the manufactured ironworks were closed on Easter Monday and Tuesday.

The Council of the Durham Miners' Association met at Durham on Thursday, the 22nd inst., to consider the question of restricting the output of coal throughout the county of Durham. After debating the subject for some hours, and no definite resolution having been come to, the meeting was adjourned until March 31st.

The Bishop Auckland Local Board have decided not to press further the legal proceedings which they instituted against the Ironworks Company. The case, therefore, will not again be gone into in court. Considering the works have now been closed some weeks, and the staff of foremen and workmen disbanded, this decision is almost amusing. It brings to mind the locked stable door with the horse at large.

The annual report of the Tee-side Iron and Engine Works Company, Limited, has been issued. It shows that during the past year the profit made was £13,243 14s. 7d. Adding an amount brought forward from the previous years the total is £13,266 4s. 7d. From this the balance of the suspense account, viz., £5890 3s. 10d., must first be written off, leaving £7376 0s. 9d. to be dealt with. Arrears of interest due to preference shareholders up to June 30th, 1881, will absorb £6630 2s., leaving £745 18s. 9d. to be carried forward. The blast furnaces have worked well during the year, but owing to the restrictive arrangements they have not produced the full quantity of pig iron they are capable of making. Prices for pig iron were fairly remunerative until near the end of the year, but at present very little profit is being made from smelting pig iron. The engineering and foundry department has not been fully at work, as sufficient orders were not obtainable at paying prices. The rolling mills were closed in January, as they could not be kept going except at a loss.

The first reference under the new Board of Arbitration rules will take place on Saturday next at Darlington. Mr. David Dale, the chosen referee to the Standing Committee, will then hear a case between the heaters employed by the Walker Iron and Steel Company and that company. The question has already been discussed at the Standing Committee, and it was found impossible to decide it, as all the employers voted one way and all the operatives the other. There is no doubt but that Mr. Dale will very quickly settle the matter.

NOTES FROM SCOTLAND.

(*From our own Correspondent.*)

THE iron market was closed from Thursday till Tuesday on account of the holidays, and so far the present week has likewise been a quiet one in the trade, although the tone of business is rather more cheerful than it was a week ago. The past week's shipments of Scotch pigs turned out very well, and the improved exports from Cleveland have also exerted a favourable influence here. It is hoped that presently our merchants will enjoy a better run of business with the Continent, and that the Canadian trade, which has just commenced, may prove satisfactory. The reduction in stocks in the warrant stores continues, and amounted in the past week to 2200 tons, the aggregate stocks now amounting to about 585,000 tons, or 41,000 tons less than at the same date last year. Since last week two furnaces producing hematite, one at Govan and one at Shotts, have been put out of blast, and there are now 111 in operation compared with 107 in the last week of March, 1882. The demand for hematite here is again rather limited, and the prices range from 51s. 6d. to 53s. for No. 1, 2, and 3 Bessemer, f.o.b. at Cumberland ports. Makers of Scotch pig find business at home steady, with very little alteration in values.

When the warrant market re-opened on Tuesday forenoon after the holidays, business was done at 47s. 6d. to 47s. $7\frac{1}{2}$d. cash, also 47s. $8\frac{1}{2}$d. to 47s. $9\frac{1}{2}$d. one month. The market was idle in the afternoon, with quotations at 47s. $9\frac{1}{2}$d. to 47s. 9d. one month, and 47s. 7d. cash. Business was done on Wednesday from 47s. 6d. to 47s. $4\frac{1}{2}$d. cash. To-day—Thursday—the market was flat, with business down to 47s. $1\frac{1}{2}$d. cash and 47s. $3\frac{1}{2}$d. one month.

The quotations of the principal makers' brands, which show little alteration, are as follow:—Gartsherrie, f.o.b., at Glasgow, per ton, No. 1, 62s. 6d.; No. 3, 55s.; Coltness, 64s. 9d. and 55s.; Langloan, 64s. 9d. and 55s.; Summerlee, 62s. and 52s.; Chapelhall, 61s. 6d. and 54s.; Calder, 62s. 6d. and 53s.; Carnbroe, 56s. and 50s. 6d.; Clyde, 52s. and 50s.; Monkland, 49s. 6d. and 47s. 6d.; Quarter, 49s. and 47s.; Govan, at Broomielaw, 49s. 6d. and 47s. 6d.; Shotts, at Leith, 65s. and 56s.; Carron, at Grangemouth, 53s.—specially selected, 58s. 6d.—and 48s. 6d.; Kinneil, at Bo'ness, 48s. 6d. and 47s. 6d.; Glengarnock, at Ardrossan, 55s. 6d. and 49s. 6d.; Eglinton, 50s. and 47s. 6d.; and Dalmellington, 50s. 6d. and 49s. 6d.

In the malleable iron department, the works are being kept well employed, although it is admitted that fresh orders are not coming to hand quite so freely as could be desired. Prices are without material alteration.

Owing to a want of vessels, resulting from stormy weather, the shipping trade in coals at some of the west coast ports was beginning to suffer; but ships are now coming freely into harbour, and shippers are likely to be very busy working up arrears. Complaints are again made of a short supply of railway wagons, by which the coal trade is so frequently hampered; and it is reported that some coalmasters are about to provide trucks for their own use. The domestic inquiry has been exceedingly brisk, as a consequence of the very cold weather which now prevails. In prices there is not much change. There has been rather more doing in the shipment of coals at Leith, notwithstanding the dispute which now exists in the mining trade of the Lothians. The storm of the previous week having detained steamers, a larger number than usual arrived at the same time for cargo; and hence the activity which has prevailed. Prices at that port are without change, but freights are somewhat firmer. Upwards of 2000 tons of coals were shipped at Bo'ness, which is a very good week's work for that port. The quantity despatched from Grangemouth was 2586 tons.

The whole of the eastern mining counties is at present agitated by the wages question. Whether they are right or wrong this is not the place to determine, but it is certain that the miners entertain a very strong impression that in the reductions lately made in their wages they have not been well treated by their employers. The men allege that since they obtained a rise of wages in autumn, the price of coals has advanced from 2s. to 3s. per ton, and that, therefore, it is unfair to reduce their pay. In Mid and East Lothian, where the reduction of wages amounts to 10 per cent., a considerable proportion of the miners have been on strike for nearly a fortnight, and some of the larger collieries are practically idle in consequence. The miners of Fife and Clackmannan resolved at a meeting held at Dunfermline on Monday, to restrict their labour to five days per week, as the best means of forcing the employers to withdraw the reduction. They agreed to commence the restriction in fourteen days.

Mr. James Gale, C.E., superintendent engineer of the Glasgow Corporation Waterworks, has read an interesting paper on the Loch Katrine Waterworks, from which the city of Glasgow is supplied, at a meeting of the local Institution of Engineers and Shipbuilders, Mr. James Reid, of the Hyde Park Locomotive Works, in the chair. The various additions made to the works from time to time were described, together with the extensions now in progress. Mr. Gale stated that the piping now in use in connection with the works was 360 miles in length, and that the outlay upon the works had been £1,454,000.

WALES AND ADJOINING COUNTIES

(*From our own Correspondent.*)

THE impression that the Valley of Aberdare is nearly worked out as regards its best coals has received a rather forcible contradiction lately in the action of the Powell Duffryn Company which has been sinking in a virgin track and making good headway. It is expected that nearly 500 acres of the best four-feet will be won.

There is no question but that a large cutting has been made into the stores of the best Aberdare coals, but it will be a long time before they are worked out. The Dare line is now one of the principal feeders to the London market, and the lower part of the valley is one of the best new coal takings in the county, the coal won there being second to none.

The coal trade is in excellent condition, but the holidays and adverse east winds have affected the output this week, though as regards prices and orders in hand there is no cause for complaint. It is true that coalowners would like to see coal run up a shilling in quotations, a possibility, considering the great competition existing, which is rather remote.

The statistics of output for last year are of the most satisfactory kind, and if the present year sees that maintained there will be little cause for complaint, though coalowners, I may add, are calculating upon a progressive increase for the next five years. In Glamorganshire the output of the year was 16,399,263 tons; in Carmarthenshire, 488,796 tons; Pembrokeshire, 71,615; and Breconshire, 143,753. Accidents show an increase of thirty-two fatalities compared with 1881. The number of colliers employed in Glamorgan is 53,845; Pembrokeshire, 597; Carmarthenshire, 2123; and Breconshire, 622. The difference between the number of colliers in North and South Wales is enormous. The total in North Wales during 1882 amounted to a little over 10,000.

Pitwood is again moving upwards; patent fuel is firm and in good demand at 11s. f.o.b.

Foreign trade is firm, and for some destinations coal prices are hardening. Business yet, prospectively, for the Baltic is dull, and may be expected to continue so a little while.

The iron trade is tolerably good; prices continue about the same, though in some parts of the district there is a tendency in steel rails to go up. The order booked by Dowlais for one of the Australian colonies will not be much short of 20,000 tons, including fish-plates, &c., and as the delivery will be extended, a tolerable year's work is secure.

An important movement is now before the public—the Bute Shipbuilding, Engineering, and Dry Dock Company. The company has been formed for the purpose of acquiring and carrying on foundries at Treherbert and Cardiff, shipbuilding yards, engine works, &c. Messrs. Morel, who are prominent in this undertaking, own about twenty steamships trading to and from Cardiff.

A good deal of excitement prevails in the Forest of Dean. A few colliers have been induced to work, and some of those on strike are in custody charged with intimidation. Money support has been received from Durham and South Wales, but I anticipate that the strike is coming to an end.

Deliveries this week will be scant as the Easter holidays have told at most of the coal pits, and shipping has suffered.

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.

17th March, 1883.

1415. Laying Out Lines of Railway, &c., A. Haman, San Francisco, U.S.
1416. Clocks for Advertising Purposes, F. W. Little, London.
1417. Ventilating Apparatus, R. H. Brandon.—(*J. P. d'Aragon, Paris.*)
1418. Machinery for Finishing Lace, &c., L. Lindley, Nottingham.
1419. Milk Cans, J. C. Mewburn.—(*M. Devriès, Paris.*)
1420. Cooling Air, G. H. Lloyd, Birmingham.
1421. Gas Stoves, W. T. Sugg, Westminster.
1422. Cure for Foot-and-mouth Disease, G. Jeanes, Burton Bradstock.
1423. Sorting and Screening Coal, &c., R. Silcock, Warrington.
1424. Knives and Forks, H. Walker, Sheffield.
1425. Elevating Apparatus, W. Blythe, Liverpool.
1426. Stoves and Furnaces, G. Gore, Balsall Heath.
1427. Sulphur Compounds, W. Ramsay, Bristol.
1428. Tune Bands or Music Sheets, A. Eli, London.
1429. Preserving Meat, &c., P. R. Conron.—(*S. Conron, Texas, U.S.*)

19th March, 1883.

1430. Galvanic Batteries, J. B. Hannay, Glasgow.
1431. Repeating Fire-arms and Cartridges, B. Burton, London.
1432. Rendering Paper, &c., Uninflammable, S. J. Blane, London.
1433. Ventilated Tap, T. Peacock, London, and J. S. Sworder, Loughton.
1434. Screw Propellers, G. E. Vaughan.—(*C. M. MacDonald, Paris.*)
1435. Spinning Machines, L. A. Groth.—(*J. Bourcart, Zurich, Switzerland.*)
1436. Preparing, &c., Fibrous Material, L. A. Groth.—(*C. A. Kraemer, Berlin.*)
1437. Ventilating and Exhaust Fans, E. Alexander.—(*L. G. Fischer, jun., Chicago, U.S.*)
1438. Cutting Vegetables, H. J. Haddan.—(*E. Barth and Spilger, Döbeln, Saxony.*)
1439. Applying Plugs to Casks, G. W. von Nawrocki.—(*E. Schlicht, Landsberg, Germany.*)
1440. Electric Safety Lamp, J. Imray.—(*G. Mangin and C. A. Royer, Paris.*)
1441. Musical Instruments, P. M. Justice.—(*J. Albert, Brussels.*)
1442. Bogies, J. Paterson, Workington.
1443. Pen-holders, &c., C. E. Orrell, Kidsgrove.
1444. Sectional Warping, H. Yates, Manchester.
1445. Picking Motion for Looms, H. Yates, Manchester.
1446. Locks, M. Wolfsky, London.
1447. Regenerative Gas Burners and Lamps, W. B. Wicken, London.
1448. Soldering Apparatus, H. H. Lake.—(*J. J. Johnston, Boston, U.S.*)
1449. Ironing Machine, B. Mills.—(*H. Schmidt, Berlin.*)
1450. Railway Carriage Lamps, J. H. Johnson.—(*J. Schulke, Paris.*)

20th March, 1883.

1451. Portland Cement, J. H. Johnson.—(*E. J. de Smedt, Washington, U.S.*)
1452. Electric Telephony, J. H. Johnson.—(*J. A. Maloney, Washington, U.S.*)
1453. Tobacco Pipes, C. Jackson, Nottingham.
1454. Roads for Tramways, C. Hinksmann, London.
1455. Safety Electric Switch, C. Wharton, London.
1456. Boots, H. Abbott, West Cross, and A. R. Molison, Swansea.
1457. Portable Conservatories, E. Harris, London.
1458. Measuring Liquids, G. A. Adams, Peel.
1459. Metallic Foot Warmers, T. Ash, Birmingham.
1460. Hydraulic Motors, W. P. Thompson.—(*E. B. Benham and H. B. Richardson, Amherst, and J. W. Currier, Boston.*)
1461. Fastening Paper Bags, J. Doherty, Dublin.
1462. Non-conducting Composition, G. F. Redfern.—(*H. C. Goodel, Atchison, U.S.*)
1463. Breech-loading Small-arms, T. W. Webley, Birmingham, G. Bouckley, Aston, and E. C. Hodges, London.
1464. Utilising Currents of Rivers for Motive-power, C. D. Abel.—(*N. Yagn, St. Petersburg.*)
1465. Railway Trucks, J. C. Mewburn.—(*E. Whiting and J. M. Smith, Brooklyn.*)
1466. Spinning Cotton, &c., A. Higgins, Salford.
1467. Tables for Yachts, A. Maudslay, Littlebourne.
1468. Lasting Machines, P. M. Justice, London.—(*J. E. Matzeliger, C. H. Delnow, M. S. Nichols, and G. S. Forbush, Lynn, U.S.*)
1469. Artificial Guano, M. Zingler, London.
1470. Pumps, A. Russell and F. Curtis, Newburyport.
1471. Drying Peat, J. A. London and J. Harbottle, Newcastle-upon-Tyne.
1472. Propelling Cars, P. R. Allen, London.

21st March, 1883.

1473. Last for Boots, H. Morris, Blackburn.
1474. Joining Whalebone, E. Rosenwald.—(*F. Robin, Paris.*)
1475. Voltaic Batteries, J. Gray, Gateshead-on-Tyne.
1476. Stopping Gear for Machinery, W. H. Beck.—(*W. Dawson, Paris.*)
1477. Nut Wrenches, &c., W. Morgan-Brown.—(*J. A. Dodge and G. R. Marble, U.S.*)
1478. Lawn-tennis Boots, W. H. Stevens, Leicester.
1479. Purifying Spent Lyes, T. Venables, Glasgow.
1480. Attaching Cuffs to Shirt Sleeves, F. S. Turner, London.
1481. Generating Electricity, &c., J. A. Kendall, Middlesbrough.
1482. Indicating Speed of Shafts, A. C. Campbell, Blythswood, and W. T. Goolden, London.
1483. Screw Augers, G. Heaton, Birmingham.
1484. Nut-locking Device, W. J. Brewer, London.
1485. Compressing Air, O. J. Ellis, Derby.
1486. "Lap" Forming Machines, J. Walker and T. G. Beaumont, Dewsbury Mill.
1487. Rolling Angular Wire, J. W. and J. Hirst and J. Bottomley, Brighouse.
1488. Stable Drains, A. Clark.—(*P. Basserie, Le Mans.*)
1489. Detecting Waste of Water, G. F. Deacon, Liverpool.
1490. Utilising Rope Driving, F. Holgate, Burnley.
1491. Caramel, E. R. Southby, London.
1492. Union Joints, J. T. Garratt, Camberwell.
1493. Garden Hose, J. Burbridge, R. C. Thorpe, and T. Oakley, Tottenham.
1494. Skiving Machines, W. R. Lake.—(*F. F. Raymond, Newton, U.S.*)
1495. Cutting Machine Screws, W. P. Thompson.—(*R. F. Hyde, Springfield, U.S.*)
1496. Tool-holding Chucks, W. P. Thompson.—(*R. F. Hyde, Springfield, U.S.*)
1497. Manufacturing Sugar from Cane, A. J. Boult.—(*C. Blandin, Guadeloupe.*)
1498. Valve Seatings, J. Teggin, Longton.

22nd March, 1883.

1499. Perambulators, A. W. J. Swindells, Manchester.
1500. Ring Spinning Frames, J. and W. Monks and W. J. Redman, Bacup.
1501. Storing Gas, R. M. Marchant and T. Wrigley, London.
1502. Ventilating, W. P. Buchan, Glasgow.
1503. Umbrellas, R. Brandon.—(*E. Blaguière, Paris.*)
1504. Generating Carbonic Acid Gas, J. McEwen, Manchester.
1505. Ventilators, F. L. Jeyes, London.
1506. Holding in Position Pivotted Windows, E. and J. M. Verity, Leeds.
1507. Cleaning Tobacco Pipes, S. Grafton, Birmingham.
1508. Stereotype Plates, A. Sauvée.—(*H. Marinoni and J. Michaud, Paris.*)
1509. Iron and Steel, T. Griffiths, Abergavenny.
1510. Ascertaining Temperature, H. Stopes and W. Crockford, London.
1511. Valves, B. W. Davis, Lambeth.
1512 Mechanical Musical Instruments, &c., H. J. Haddan.—(*O. Zabekow, Berlin.*)
1513. Pavements, R. M. Ordish, London.
1514. Warming Explosive Stores, W. Whittle, Whitehaven.
1515. Breech-loading Small-arms, H. Tolley, Birmingham.
1516. Coffee Roasters, G. H. Pfeifer, Freiberg.
1517. Pattern Multiplier, N. Walbrodt and W. Wolff, Nieder Schönweide.
1518. Electric Armatures, J. B. Rogers and H. O'Connor, London.
1519. Pulverising Diamondiferous Ore, &c., A. J. Struthers, Glasgow.
1520. Furnaces, S. Schuman, Glasgow.
1521. Steam Lubricators, P. Jensen.—(*J. Rudolph, Stockholm.*)
1522. Treating Sewage, J. H. Kidd, Wrexham, and T. J. Barnard, London.
1523. Setting Clocks, J. A. Lund, London.
1524. Attaching Shanks to Buttons, J. H. Johnson.—(*J. F. Bapterosses, Paris.*)
1525. Cartridge Boxes, G. Pitt.—(*G. Fosbery, Liège.*)

24th March, 1883.

1526. Checking Passengers' Fares, T. A. Silverwood, Brighton.
1527. Knitting Machinery, F. and S. Keywood, Nottingham.
1528. Flexible Wheel Bases, T. Slater and S. Owen.—(*E. Kiebitz, Berlin.*)
1529. Skates, W. P. Thompson.—(*E. H. Barney, U.S.*)
1530. Paper, &c., G. Johnston and J. Molony, Belfast.
1531. Jacquard Apparatus, J. Chapman, Nottingham.
1532. Automatic Flushing Apparatus, A. C. Boothby, Kirkcaldy.
1533. Trimming Grain, &c., H. Holt, Rawtenstall.
1534. Weaving Looms, J. Hodgson and S. Greenwood, Brearley.
1535. Window Frames, &c., J. Booth, Bolton.
1536. Looms, T. Taylor and J. Whittaker, Oldham.
1537. Vehicles, &c., G. Allix, London.
1538. Electrical Cables, H. H. Lake.—(*C. de Cazenave, Verviers.*)
1539. Direct-acting Steam Pumps, P. Dunlop, London.
1540. Ring-spinning Frames, A. M. Clark.—(*J. J. Bourcart, Zurich.*)

26th March, 1883.

1541. Electric Batteries, H. H. Lake.—(*H. A. and A. H. Radiguet, Paris.*)

Inventions Protected for Six Months on Deposit of Complete Specifications.

1448. Soldering Apparatus, H. H. Lake, London.—A communication from J. J. Johnston, Boston, U.S.—*19th March*, 1883.
1458. Measuring Liquids, G. A. Adams, Peel.—*20th March*, 1883.
1462. Non-conducting Compositions, G. F. Redfern, London.—A communication from H. C. Goodell, Atchison, U.S.—*20th March*, 1883.
1468. Lasting Machines, P. M. Justice, London.—A communication from J. E. Matzeliger, C. H. Delnow, M. S. Nichols, and G. S. Forbush, Lynn, U.S.—*20th March*, 1883.
1494. Leather Trimming Machines, W. R. Lake, London.—A communication from F. F. Raymond, Newton, U.S.—*21st March*, 1883.
1495. Cutting Machine Screws, W. P. Thompson, London.—A communication from H. H. Taylor, Detroit.—*21st March*, 1883.

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

1218. Sighting Ordnance, L. K. Scott, London.—*22nd March*, 1880.
1221. Breaking Coal, &c., J. West, Maidstone.—*22nd March*, 1880.
1269. House Sinks, &c., S. S. Hellyer, London.—*25th March*, 1880.
1236. Braid and Lace Machines, A. Büdenbänder, London.—*23rd March*, 1880.
1319. Dressing Flour, W. H. Williamson and S. Bruce, Wakefield, & G. Marsh, Scarscroft.—*31st March*, 1880.
1545. Gas Burners, W. T. Sugg, London.—*15th April*, 1880.
1568. Extracting Tannin, W. A. Barlow, London.—*16th April*, 1880.
1254. Bending Metal Plates, W. R. Lake, London.—*24th March*, 1880.
1260. Separating Liquid from Solid Matter, W. R. Lake, London.—*24th March*, 1880.
1268. Circular Knitting Machines, E. de Pass, London.—*25th March*, 1880.
1855. Steam Fire Engines, H. Merryweather and C. J. W. Jakeman, Greenwich.—*6th May*, 1880.
1227. Bicycle Bearings, W. Bown and J. H. Hughes, Birmingham.—*22nd March*, 1880.
1285. Projectiles, &c., C. Pieper, Berlin.—*27th March*, 1880.
1287. Explosive Matter, &c., C. Pieper, Berlin.—*27th March*, 1880.
1306. Stoppers for Bottles, W. R. Lake, London.—*30th March*, 1880.
1324. Manure, T. Croysdale, Whitley Bridge.—*31st March*, 1880.
1397. Electric Lamps, C. D. Abel, London.—*6th April*, 1880.
1710. Sewing Machines, A. Anderson, S. Mort, and J. Walker, Glasgow.—*26th April*, 1880.
1275. Cerium Compound, J. B. Mackey, London.—*25th March*, 1880.
1299. Cruet Frames, &c., G. C. Wildman, Wolverhampton.—*30th March*, 1880.
1478. Purifying Coal Gas, W. Mann, Gunnersbury, and W. T. Walker, Highgate.—*10th April*, 1880.

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

1194. Nickel, &c., W. R. Lake, London.—*20th March*, 1876.
1233. Spinning, &c., Yarn, T. Unsworth, Manchester.—*23rd March*, 1876.
1281. Tramways, &c., B. Barker, New Wortley.—*25th March*, 1876.
1297. Attachment for Pole Chains, P. Hooker and E. Wright, London.—*25th March*, 1876.
1339. Mariners' Compasses, W. Thomson, Glasgow.—*29th March*, 1882.

Notices of Intention to Proceed wtih Applications.

(*Last day for filing opposition, 10th April*, 1883.)

866. Hat-pressing Machines, H. C. Birley, London.—A communication from G. Yule.—*16th February*, 1883.
901. Printing Calico, C. Hindle, Rawstenstall, and J. H. Canavan, Salford.—*19th February*, 1883.
924. Electric Meter, A. S. Butler, St. Andrews, Fife.—*20th February*, 1883.
927. Secondary Batteries, O. J. Lodge and J. S. Pattinson, Liverpool.—*20th February*, 1883.
940. Electric Cables, A. M. Clark, London.—A com. from L. A. Fortin-Hermann.—*20th February*, 1883.
962. Mortising Wood, J. H. Johnson, London.—A com. from J. B. Alexandre.—*21st February*, 1883.
973. Dynamo-electric Machines, J. Hopkinson, London.—*22nd February*, 1883.
1313. Dynamo-electric Machines, H. H. Lake, London.—A com. from G. W. Fuller.—*12th March*, 1883.
1332. Smelting Furnaces, A. M. Clark, London.—A communication from G. H. and W. H. Nichols and J. B. F. Herreshoof.—*13th March*, 1883.
1347. Dynamo-electric Machines, H. H. Lake, London.—A com. from G. W. Fuller.—*13th March*, 1883.
1355. Compound of Sugar and Coffee, C. A. Allais, Paris.—A com. from F. V. Pillard.—*14th March*, 1883.
1375. Dynamo-electric Machines, H. H. Lake, London.—A com. from G. W. Fuller.—*12th March*, 1883.

(*Last day for filing opposition, 13th April*, 1883.)

5288. Refining Cast Iron, J. Wetter, New Wandsworth.—Com. from C. Lévêque.—*6th November*, 1882.
5469. Actions for Pianofortes, W. H. Squire, London.—*17th November*, 1882.
5508. Architectural Ornaments, L. A. Groth, London.—Com. from C. Mineur.—*20th November*, 1882.
5509. Magnesium, &c., L. A. Groth, London.—A com. from R. Gratzer.—*20th November*, 1882.
5510. Gas Motor Engines, J. Maynes, Manchester.—*20th November*, 1882.
5514. Cast Tubes of Gold, &c., T. Morgan, London.—Com. from E. I. Levavasseur.—*20th November*, 1882.
5515. Erasing Pencil Marks, &c., L. Wolff, London.—*20th November*, 1882.
5518. Distributing Electricty, C. D. Abel, London.—Com. from L. A. Brasseur.—*20th November*, 1882.
5519. Integrating Apparatus, J. Imray, London.—A communication from B. Abdank-Abakanowicz and C. Roosevelt.—*20th November*, 1882.
5532. Lithographic Presses, H. J. Haddan, London.—A com. from E. Lapeyre.—*21st November*, 1882.
5536. Purifying Town Sewage, P. Jensen, London.—A com. from H. Betche.—*21st November*, 1882.
5551. Washing the Human Head, A. G. Klugh, London.—*22nd November*, 1882.
5562. Lamps and Burners, H. Salsbury, London.—*22nd November*, 1882.
5582. Naves of Wheels, S. Andrews, Cardiff.—*23rd November*, 1882.
5594. Dynamo-electric Machines, C. D. Abel, London.—A communication from B. Abdank-Abakanowicz and C. Roosevelt.—*24th November*, 1882.
5642. Forks or Tongs, H. J. Allison, London.—A communication from R. Turner.—*28th November*, 1882.
5647. Shaping Clay, &c., W. Crawford, Glasgow.—*28th November*, 1882.
5657. Heel-paring Machines, F. Cutlan, Leicester.—*28th November*, 1882.
5692. Colouring Matters, I. Levinstein, Manchester.—*30th November*, 1882.
5902. Preventing Corrosion, J. B. Hannay, Glasgow.—*11th December*, 1882.
6108. Velocipedes, R. C. Fletcher, Preston.—*21st December*, 1882.
6131. Enamelled and Metallised Glass, &c., A. M. Clark, London.—A communication from J. Feix.—*22nd December*, 1882.
6240. Indicating the Pressure of Wind, &c., L. M. Cassela, Hampstead.—*30th December*, 1882.
6241. Toggle, A. M. Clark, London.—A communication from E. Dervaux-Ibled and G. N. Schoenberg.—*30th December*, 1882.
79. Colouring Matters, C. D. Abel, London.—A communication from Farbwerke vormals Meister, Lucius, and Brüning.—*5th January*, 1883.
242. Substitutes for Gutta-percha, &c., M. Zingler, London.—*15th January*, 1883.
664. Belt Fasteners, C. D. Abel, London.—A communication from P. Thatcher.—*6th February*, 1883.
706. Colouring Matters, I. Levinstein, Manchester.—*9th February*, 1883.
712. Fireplaces, &c., G. Ermen, Holcombe.—*9th February*, 1883.
953. Dense Metal Castings, C. M. Pielsticker, London.—Com. from F. Müller.—*21st February*, 1883.
1117. Alcohol and Food for Animals, W. R. Lake, London.—Com. from K. Trobach.—*1st March*, 1883.
1448. Soldering Apparatus, H. H. Lake, London.—A communication from J. Johnson.—*19th March*, 1883.
1458. Indicating the Quantity of Liquid Drawn from Casks, G. A. Adams, Peel.—*20th March*, 1883.
1462. Non-conducting Compositions, G. F. Redfern, London.—Com. from H. Goodell.—*20th March*, 1883.

(*Last day for filing opposition, 17th April*, 1883.)

5457. Hydraulic Pressure Valves, H. Berry, Gloucester.—*16th November*, 1882.
5529. Winding Apparatus, J. Farrar, Halifax.—*21st November*, 1882.
5548. Improving the Appearance of Inferior Precious Stones, J. C. Mewburn, London.—A communication from G. H. Durkés.—*22nd November*, 1882.
5555. Boiler Flues and Shells, G. W. Dyson, Bolton.—*22nd November*, 1882.
5558. Fountain Pen-holders, A. Osborn, Birmingham.—*22nd November*, 1882.
5571. Protecting Ships from the Effects of Collision, W. Beverley, Aberdeen, and G. MacLaverty, Glasgow.—*23rd November*, 1882.
5578. Bobbins and Spools, L. Heppenstall, jun., Milnsbridge.—*23rd November*, 1882.
5580. Carbons, Candles, &c., W. Cunliffe, Hornsey.—*23rd November*, 1882.
5585. Attaching Lamps to Carriages, R. Dobbs and F. Davies, Birmingham.—*23rd November*, 1882.
5593. Making Embossed Plates and Discs, &c., J. F. Smyth, Belfast.—*24th November*, 1882.
5595. Candle Moulding Machine, E. Cowles, Hounslow.—*24th November*, 1882.
5608. Looms for Weaving, G. Keighley, Burnley.—*25th November*, 1882.
5611. Regulating the Flow of Liquids, P. J. Catterall and E. Birch, Manchester.—*25th November*, 1882.
5628. Steam and Motive Power Engines, W. Hornsby and R. Edwards, Grantham.—*27th November*, 1882.
5638. Cultivating Land, W. Fisken, Stamfordham, and S. S. Robson, Sunderland.—*27th November*, 1882.
5641. Stays or Corsets, W. Rosenthal, London.—A com. from H. Rosenthal.—*27th November*, 1882.
5672. Regulating Apparatus for Steam Engines, A. Budenberg, Manchester.—A communication from C. Budenberg.—*29th November*, 1882.
5725. Tube Stoppers, D. J. Morgan, Cardiff.—*1st December*, 1882.
5749. Chains, Necklaces, &c., W. E. Gedge, London.—A com. from E. Armelin.—*2nd December*, 1882.
5822. Bottles and Stoppers, J. T. Creasy, London.—*6th December*, 1882.
5867. Ordnance, A. M. Clark, London.—A communication from A. Suel.—*8th December*, 1882.
5883. Spring Motors, A. M. Clark, London.—A communication from J. Baudouin, H. Mathieu, and A. Conshon.—*9th December*, 1882.
5899. Lighting, &c., by Electricity, P. R. Allen, Lambeth.—*9th December*, 1882.
5900. Spanner or Pipe-cutter, &c., W. Lake, London.—A com. from G. Duhayon.—*9th December*, 1882.
5917. Planing and Milling Machines, W. Smith and A. Coventry, Salford.—*12th December*, 1882.
5976. Keys or Wedges, J. H. Johnson, London.—A com. from E. Gallois.—*14th December*, 1882.
6228. Telephonic and Microphonic Transmitting Instruments, J. Imray, London.—A communication from J. Ochorowicz.—*30th December*, 1882.
574. Tricycles, A. Burdess, Coventry.—*2nd February*, 1883.
587. Bichromate of Soda, E. Potter and W. Higgin, Bolton.—*2nd February*, 1883.
588. Drills, A. A. Patterson, Nunhead.—*2nd February*, 1883.
599. Water-closets, &c., S. S. Hellyer, London.—*3rd February*, 1883.
724. Cartridges, W. Gardner, London.—*9th February*, 1883.
854. Screw Propellers, R. M. Steele, London.—*16th February*, 1883.
986. Pirn and Spool Winding Machines, P. Marriott and J. Hall, Stockport.—*23rd February*, 1883.
1037. Generating Electricity, A. M. Clark, London.—A com. from H. A. Archeau.—*26th February*, 1883.
1310. Printing Machines, W. R. Lake, London.—A communication from H. Feister.—*13th March*, 1883.
1345. Sewing Machines, W. R. Lake, London.—A communication from C. Tibbles.—*13th March*, 1883.
1494. Skiving and Trimming Machines, W. R. Lake, London.—A communication from F. F. Raymond.—*21st March*, 1880.

Patents Sealed.

(*List of Letters Patent which passed the Great Seal on the 20th March*, 1883.)

4583. Rotary Pumps, M. Benson, London.—*27th September*, 1882.
4584. Buckles for Belts, &c., J. B Brooks and R. Baker, Birmingham.—*27th September*, 1882.
4592. Ventilating Soil Pipes, H. Blair, Glasgow.—*27th September*, 1882.
4674. Steam Engines, T. J. Handford, London.—*2nd October*, 1882.
4714. Alkalies, E. W. Parnell, Widnes, and J. Simpson, Liverpool.—*4th October*, 1882.
4731. Connecting Spindles to Locks, &c., J. Drewitt, Peckham.—*4th October*, 1882.
4770. Cooling Liquids, C. Pieper, Berlin.—*7th October*, 1882.
4830. Fuzes for Projectiles, A. Noble, Newcastle-upon-Tyne.—*11th October*, 1882.
4884. Electrical Distribution, T. J. Handford, London.—*14th October*, 1882.
5184. Measuring Power, C. V. Boys, Wing.—*31st October*, 1882.
5417. Bolts and Nuts, R. Howarth, Wolverhampton.—*14th November*, 1882.
5753. Preparing Jute, D. R. Malcolm and G. Malcolm, jun., Dundee.—*2nd December*, 1882.
5925. Miners' Safety Lamps, W. Morgan, Pontypridd.—*12th December*, 1882.
5953. Purifying Coal Gas, J. F. G. Kromschröder, London.—*13th December*, 1882.
48. Safety Gear for Starting Engines, J. Musgrave and R. Gregory, jun., Bolton.—*3rd January*, 1883.

(*List of Letters Patent which passed the Great Seal on the 22nd March*, 1883.)

3296. Preparing Sheet Lead Electrodes, A. Clark, London.—*11th July*, 1882.
3481. Printing Machinery, W. C. Kritch, Leeds.—*21st July*, 1882.
4024. Bottle Stoppers, I. Lippmann, Berlin.—*22nd August*, 1882.
4449. Combined Range and Register Grate, W. Y. Stevens, Bristol.—*19th September*, 1882.
4514. Forming Temporary Partitions, J. W. Cook, London.—*21st September*, 1882.
4560. Composing and Distributing Type, E. G. Brewer, London.—*25th September*, 1882.
4565. Bottles and Stoppers, A. Pullan, London.—*25th September*, 1882.
4575. Propellers, R. Gibb, Liverpool.—*26th September*, 1882.
4585. Aerial and Marine Navigation, B. Maughan and S. D. Waddy, London.—*27th September*, 1882.
4588. Steam and Water-gauge Taps, T. Allison, Milnsbridge.—*27th September*, 1882.
4593. Independent Car-wheels, &c., H. J. Allison, London.—*27th September*, 1882.
4597. Bicycles, &c., T. Warwick, Aston.—*27th September*, 1882.
4607. Obtaining Extract from Tanning Materials, J. Hutchings, Warrington.—*28th September*, 1882.
4608. Obtaining Artificial Light, J. Mayer, London.—*28th September*, 1882.
4618. Fire-grates or Stoves, E. Whillier, Stoke Newington.—*28th September*, 1882.
4649. Ornamental Frillings, C. Jackson, Nottingham.—*30th September*, 1882.
4657. Brakes or Drags, H. Downie, Corstorphine.—*30th September*, 1882.
4676. Incandescent Electric Lamps, J. F. Phillips, London.—*2nd October*, 1882.
4698. Tricycles, H. C. Bull, Liverpool.—*3rd October*, 1882.
4718. Electric Railways, J. Hopkinson, Westminster.—*4th October*, 1882.
4724. Elastic Fabrics, W. R. Lake, London.—*4th October*, 1882.
4729. Velocipedes, E. Brown, Birmingham.—*4th October*, 1882.
4730. Chiming Clocks, W. R. Lake, London.—*4th October*, 1882.
4734. Furnaces for Consuming Smoke, F. Brown, Luton.—*5th October*, 1882.
4737. Fountain Pen-holders, F. F. Benvenuti, Swansea.—*5th October*, 1882.
4762. Revolving Lamps, J. Trotter, London.—*6th October*, 1882.
4774. Boiler for Generating Steam, H. C. Bull, Liverpool.—*7th October*, 1882.
4776. Organs, T. Casson, Denbigh.—*7th October*, 1882.
4783. Window Sashes, G. Hurdle, Southampton.—*7th October*, 1882.
4787. Moulding Pipes, &c., J. H. Johnson, London.—*7th October*, 1882.
4838. Employing the Muscular Force of Man, B. J. B. Mills, London.—*11th October*, 1882.
4880. Electric Arc Lamps, A. M. Clark, London.—*13th October*, 1882.
4899 Machine Guns, T. Nordenfelt, Westminster.—*14th October*, 1882.
4951. Automatic Registering Apparatus for Closet Doors, J. M. Hart, London.—*18th October*, 1882.
5077. Pneumatic Elevators, A. W. L. Reddie, London.—*24th October*, 1882.
5080. Watches, &c., W. Clark, London.—*24th October*, 1882.
5278. Telegraph Cables, G. E. Vaughan, London.—*4th November*, 1882.
5300. Electro Plating, A. J. Boult, London.—*6th November*, 1882.
5909. Bedstead, A. J. Boult, London.—*11th December*, 1882.
6038. Winches, &c., W. Pitt, Bath.—*18th December*, 1882.
6050. Regenerative Hot-blast Stoves, E. A. and C. Cowper, Westminster.—*19th December*, 1882.
6103. Administering Medicine to Horses, &c., P. Fonnereaux and W. Fielding, London.—*21st December*, 1882.
130. Gas Motor Engines, F. J. Odling, Derby.—*9th January*, 1883.
160. Looms for Weaving, G. A. Shiers and A. Wright, Oldham.—*11th January*, 1883.
161. Corrugating, &c., Metallic Cartridge Cases, H. A. A. Thorn, London.—*11th January*, 1883.
205. Posts for Supporting Wires, C. E. J. May, Charlton.—*13th January*, 1883.
233. Distributing, &c., Powerful Lights, A. P Trotter, London.—*15th January*, 1883.
247. Treadle Mechanism, A. M. Clark, London.—*16th January*, 1883.
325. Wood Screw, H. H. Lake, London.—*19th January*, 1883.
487. Sewing Machines, R. H. Brandon, Paris.—*29th January*, 1883.
535. Electric Motors, &c., S. Pitt, Sutton.—*31st January*, 1883.

(*List of Letters Patent which passed the Great Seal on the 27th March*, 1883.)

4546. Extracting Moisture from Air, W. R. Lake, London.—*23rd September*, 1882.
4547. Dynamo-electric Machines, R. Barker, Seacombe.—*23rd September*, 1882.
4629. Tricyles, &c., A. Gibbs, Birmingham.—*29th September*, 1882.
4632. Furnaces, J. W. Couchman, Tottenham.—*29th September*, 1882.

4636. Bismuth Bronze, J. Webster, Solihull.—29th September, 1882.
4638. Steam Generators and Furnaces, W. Thompson, London.—29th September, 1882.
4644. Purifying Coal Gas, C. F. Claus, London.—29th September, 1882.
4645. Electric Meters, S. D. Mott, Pimlico.—29th September, 1882.
4646. Electric Meters, S. D. Mott, Pimlico.—29th September, 1882.
4650. Musical Instruments, T. Machell, Glasgow.—30th September, 1882.
4658. Purifying Alcohol, A. J. Boult, London.—30th September, 1882.
4667. Locks, J. Jackson, jun., and C. Sheekey, Westminster.—30th September, 1882.
4668. Velocipedes, S. Miller, London.—30th September, 1882.
4670. Imparting a Glossy Appearance to Boots, &c., E. and A. Wright, London.—2nd October, 1882.
4673. Railway Carriage Couplings, R. Stone, Bristol.—2nd October, 1882.
4687. Transmission of Power, &c., W. P. Thompson, London.—2nd October, 1882.
4803. Gearing for Bicycles, &c., W. Britain, jun., Hornsey Rise.—9th October, 1882.
4810. Dynamo-electric Machines, R. E. Crompton, London, & G. Kapp, Chelmsford.—10th October, 1882.
4814. Moulders' Nails and Chaplets, W. Motherwell, Glasgow.—10th October, 1882.
4843. Looms for Weaving, J. W. Holmes, Preston.—11th October, 1882.
5030. Anhydrous Alumina, H. A. Bonneville, London.—23rd October, 1882.
5124. Alarm Bells, &c., A. Reddie, London.—27th October, 1882.
5191. Combined Reaping and Sheaf Binding Machine, W. Cranston, London.—31st October, 1882.
6169. Silica Fire-bricks, &c., H. Edwards, Braich-y-Cymmer, and H. Harries, Glyn Neath.—27th December, 1882.
57. Lubricators, T. Duff. Upton.—4th January, 1883.
96. Sulphuric Acid, W. Weldon, Burstow.—8th January, 1883.
105. Regulating the Supply of Air and Gas to Gas Burners, J. Lewis, Brockley.—8th January, 1883.
243. Galvanic Batteries, H. H. Lake, London.—15th January, 1883.
281. Mechanical Musical Instruments, H. H. Lake, London.—17th January, 1883.
358. Ships' Sleeping Berths, H. H. Lake, London.—22nd January, 1883.
372. Braces, F. Hovenden, West Dulwich.—23rd January, 1883.
380. Printing and Bookbinding Machinery, W. R. Lake, London.—23rd January, 1883.
564. Brake Apparatus, W. R. Lake, London.—1st February, 1883.
621. Apparatus for Fining Malt Liquors, R. Dean, London.—5th February, 1883.

List of Specifications published during the week ending March 24th, 1883.

773, 6d.; 2728, 6d.; 3372, 6d.; 3400, 6d.; 3410, 6d.; 3427, 6d.; 3435, 6d.; 3474, 6d.; 3527, 6d.; 3540, 6d.; 3555, 6d.; 3593, 6d.; 3598, 2d.; 3603, 6d.; 3619, 6d.; 3621, 6d.; 3635, 6d.; 3652, 6d.; 3661, 6d.; 3664, 6d.; 3666, 6d.; 3678, 2d.; 3680, 2d.; 3683, 1s. 6d.; 3691, 6d.; 3693, 6d.; 3694, 8d.; 3696, 4d.; 3699, 6d.; 3705, 4d.; 3709, 2d.; 3712, 6d.; 3715, 6d.; 3727, 6d.; 3728, 6d.; 3729, 2d.; 3730, 6d.; 3733, 6d.; 3735, 6d.; 3738, 6d.; 3739, 6d.; 3740, 4d.; 3742, 6d.; 3745, 6d.; 3747, 4d.; 3748, 2d.; 3749, 4d.; 3750, 6d.; 3753, 6d.; 3755, 6d.; 3756, 6d.; 3757, 6d.; 3760, 6d.; 3763, 6d.; 3765, 6d.; 3766, 2d.; 3768, 6d.; 3769, 6d.; 3770, 4d.; 3771, 8d.; 3772, 8d.; 3773, 6d.; 3774, 6d.; 3775, 2d.; 3776, 6d.; 3777, 2d.; 3778, 6d.; 3781, 2d.; 3782, 6d.; 3785, 6d.; 3787, 6d.; 3788, 6d.; 3792, 4d.; 3794, 4d.; 3797, 2d.; 3799, 6d.; 3800, 6d.; 3801, 6d.; 3802, 4d.; 3803, 6d.; 3807, 6d.; 3808, 6d.; 3811, 6d.; 3815, 2d.; 3819, 6d.; 3820, 6d.; 3821, 4d.; 3822, 2d.; 3823, 6d.; 3826, 8d.; 3828, 6d.; 3830, 6d.; 3831, 4d.; 3834, 2d.; 3839, 6d.; 3844, 6d.; 3858, 2d.; 3863, 6d.; 3870, 6d.; 3879, 1s. 2d.; 3969, 6d.; 3972, 4d.; 4240, 6d.; 4850, 4d.; 5201, 6d.; 5654, 6d.; 5655, 6d.

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

ABSTRACTS OF SPECIFICATIONS.

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

773. Knitting Machines, *J. Poole, Bradford.—17th February*, 1882. 6*d*.
The object is to make knitted looped fabrics firmer and so that they will not stretch so much as at present. A carriage is mounted at the back of the knitting machine in front of the needles and warp guides, and is traversed on slides extending across the machine. It is actuated by a reciprocating lever, and it is fitted with a yarn carrier, through which the yarn passes, and is so arranged that when the carriage arrives at each end of the machine the carrier is actuated by an inclined plate and is moved towards the warp guides and needles, laying the yarn between the needles and the warp thread guides, so that it is embodied in the fabric by the looping together of the warp threads.

2728. Washing Houses, *M. Cockburn, Falkirk, N.B.—10th June*, 1882. 6*d*.
This relates to public washing houses having distinct compartments for the separate accommodation of several persons, and it consists in forming the compartment partly of unperforated plates and partly of wire netting, the doors being similarly formed. A hood with an adjustable lower part is placed over each boiler to lead the vapour away to a condensing apparatus. Heating pipes are arranged so as to cross under or over the drying frames, and heated air is caused to dry the clothes.

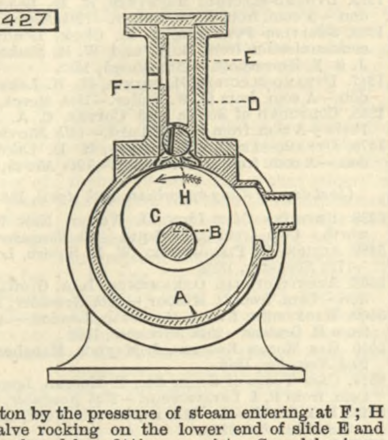
3372. Cocks or Valves, *J. W. Restler, Nunhead.—15th July*, 1882. 6*d*.
The object is to facilitate access to the interior of the valves while under pressure, the gland round the spindle being abolished. Means are provided to detect waste and prevent improper opening of the valve when desired to cut off the supply. The valve spindle carries two valves, one on each side of a partition, and one of which serves to close the valve in the usual manner, while the other, when forced against its seating, allows the valve to be opened when necessary to examine the interior.

3400. Perambulators, &c., *J. Aylward, Birmingham.—18th July*, 1882. 6*d*.
This relates, First, to reversible perambulators; and, Secondly, to the construction of wheels. The perambulator frame is mounted on a conical stud fixed to the under frame, a spring catch being employed to keep it in position, and which, when withdrawn, allows the perambulator to be reversed. The wheels have metal spokes, a hub bush being provided, and collars caused to bear against the rivetted heads of the spokes.

3410. Passenger Tickets, *J. A. Francis, Newington-butts, Surrey.—18th July*, 1882. 6*d*.
This relates to the cutting of slits in railway or other tickets so as to form projections or openings, by which they may be secured to the dress or to the finger of a passenger.

3427. Rotary Steam Engine, *J. Pinchbeck, Westminster.—19th July*, 1882. 6*d*.
The object is to obtain a steam-tight joint abutment valve of such a shape that a large surface is always in contact with the piston at any portion of its revolution, and to employ the various angles which the excentric piston makes as it revolves as a means for opening or shutting the admission ports, and without the use of a separate valve, the abutment valve being also the steam admission valve. A is an ordinary cylinder; B the centre shaft carrying piston C; D a slide box, in which the slide E is forced down on to

3427



the piston by the pressure of steam entering at F; H is a valve rocking on the lower end of slide E and having a broad face fitting on piston C, and having a passage which opens or shuts according to the angle it assumes.

3435. Gas Motor Engines, *C. D. Abel, London.—19th July*, 1882.—(*A communication from C. Beissel, near Cologne.*) 6*d*.
The object is to effectually remove the gaseous products of the combustion from the cylinders of gas engines before the introduction of the next charge. For this purpose the cylinder 1 is connected by passage 5, port 18, and passage 9, first with reservoir for compressed air through check valve 8 and passage 7,

3435 FIG. 1

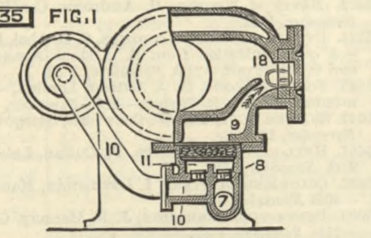
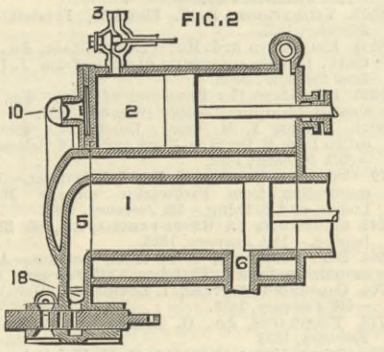


FIG. 2



and, secondly, with the compressing pump 2 for combustible mixture of gas and air through check valve 11 and passage 10. The pump draws in a charge of gas and air through valve 3, and discharges it through pipe 10, valve 11, and passages 9 and 5, into cylinder 1 while the piston is beginning its return stroke. The opening 6 is open and the incoming charge drives out the products of combustion. The pump will draw in a charge of air, which, when compressed, passes into cylinder and drives out the products of combustion.

3474. Couplings for Shafts, *H. Smith, Brixton, and C. Harrison, Blackfriars-road.—21st July*, 1882. 6*d*.
This relates principally to the employment of the upper cap of a coupling divided longitudinally in the rough state as cast without turning the bore, the object being to decrease the cost of the coupling and increase the grip on the ends of the shafts when the two halves are tightened up by suitable bolts. A projection or tongue on the upper cap enters suitable recesses formed in the shafts.

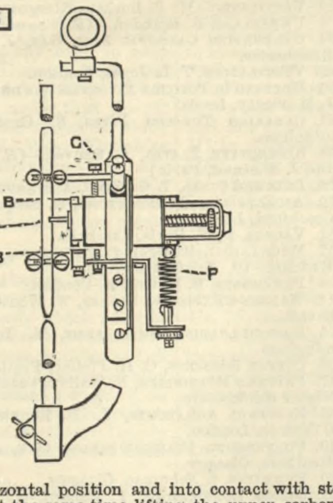
3527. Coupling Clutches, *E. J. Sterling, Brooklyn, U.S.—25th July*, 1882. 6*d*.
This relates to clutches that grasp the body to be rotated, and hold the same with a firmness of grasp proportional to the power exerted to rotate the body. As applied to connecting the ends of two shafts, a helix with an internal diameter corresponding to that of the shafts has its two ends connected, one to the end of each shaft. When applied to a pulley one end of the helix is connected to a friction ring, which can be pressed against the revolving surface by a lever.

3540. Thermo-dynamic Engines, *J. Hargreaves, Widnes.—26th July*, 1882. 6*d*.
This relates to internally-heated regenerative caloric engines in which solid, liquid, or gaseous fuel may be used. A working cylinder is provided, in which a piston is forced outwards by heated air and vapour. A pump compresses air and forces it into a reservoir, which may also be used as a saturating vessel, where the air is saturated with vapour from water heated by the heat rejected from the working fluid, the saturation being effected by causing sheets of wire gauze to be dipped into the water and then raised into the air to be saturated. Volatile hydrocarbons may be added to the water. The air then passes through a regenerator on its passage to the cylinder, the exhausted fluid also passing through the same. When using solid fuel the air is forced through the furnace. Means are provided to keep the neck of the cylinder cool and to render the abstracted heat available to produce motive power.

3555. Watchmen's Tell-tales, *C. R. F. Schloesser, Manchester.—27th July*, 1882.—(*A communication from Messrs. Kreutz and Bauer, Vienna.*) 6*d*.
This relates to clocks to indicate the times at which watchmen visit a certain part of their rounds. A spring ring carries a slip of paper and is revolved by the clock mechanism, while at the same time it is capable of transverse vibration to press the paper against the bit of a key which has a type projecting therefrom, the vibration being effected by a curved lever acted upon by a cam revolved by the key. A revolving inking apparatus is worked directly by the turning of the key.

3575. Electric Lamps, *J. G. Lorrain, Westminster.—27th July*, 1882. 6*d*.
The lamp which is the subject of this invention is shown in the accompanying illustration. Its action is as follows:—The carbons being apart, and the current switched on, the latter passes through the electro-magnet which is in a shunt circuit, draws in the core A and projection C (which embraces the upper carbon) against the pressure of the spring. The upper carbon then falls, and makes contact with the lower one. At the same time a mass of soft iron B is magnetised, and tends to attract a similar mass B^1, but as the latter is fixed, the electro-magnet is attracted towards it, and swings on its pivotted axis against the action of spring P. The whole of the current now passes through the carbons as they are in contact, and the electro-magnet is no longer energised, consequently the spring forces the core A out into contact with the upper carbon, while spring P pulls the electro-magnet

3575



into a horizontal position and into contact with stop screw G, at the same time lifting the upper carbon a short distance and striking the arc.

3593. Apparatus to be used in the Treatment of Grain and Flour, *A. W. L. Reddie, London.—28th July*, 1882.—(*A communication from H. F. S. Requier, Paris.*) 6*d*.
The object is to effect the several operations of sifting and cleaning grain, the ganging of the grains and meal of corn, and the bolling of flour with greater precision than hitherto. A long frame consisting of two end plates connected by horizontal bars of angle iron, which are held so as to prevent flexion by external rings of angle iron, is surrounded with wire or silk gauze, and inside the cylinder a number of helicoidal blades are arranged so as to form with the horizontal bars a series of pockets into which the material is raised as the apparatus rotates, to fall again at the proper time into the compartments formed by the next set of blades, by which means it is gradually worked along the whole length of the cylinder. The wire or silk is secured by laces passing over studs, and can be readily changed or tightened. There is no central shaft.

3598. Grabs for Dredging, &c., *J. T. Jones and J. H. Wild, Leeds.—29th July*, 1882.—(*Not proceeded with.*) 2*d*.
This consists in the application of a shrouding or hood which will cover and enclose the cage formed by the teeth of the grab as it leaves the ground, and will prevent the loss of small particles which could pass through the teeth.

3603. Buttons and Fasteners for the Same, *C. Daggett, London.—29th July*, 1882. 6*d*.
The top of the button can oscillate on the shank, through the lower end of which a horizontal hole is formed. The shank is passed through the material to which it is to be attached, and a disc with a central hole passed over the end and secured in position by inserting a pin through the hole in the shank.

3621. Uniting Small Pieces of Amber into a Large Block, *W. Morgan-Brown, London.—31st July*, 1882.—(*A communication from B. Borowsky, Germany.*) 6*d*.
This relates to the production of blocks of amber by melting small pieces in closed moulds, from which air is excluded and pressure applied. The moulds are formed in different parts and close perfectly tight.

3635. Machinery for Use in the Manufacture of Flour or Meal, *H. H. Lake, London.—31st July*, 1882.—(*A communication from R. R. Schmidt, Berlin.*) 6*d*.
This relates, First, to the method of fastening the bolting cloth to the drum of a flour bolting or dressing machine; and, Secondly, to the combination with such machine of an automatic elevator delivering the grist by means of a conveying worm into some centrifugal feed apparatus which may throw it into the grinding rollers as usual. The bolting cloth has a thick edge, which may be produced by enclosing a rope or cord therein, and which is passed into a longitudinal slot formed by bars, pipes, or rings fixed to the heads of the machine. An elevator formed with a number of buckets revolves with the head of the machine and at a less speed than the beater wheel in the cylinder. The grist is raised by the buckets and delivered to a conveyor.

3652. Driving Belt Fasteners, &c., *W. D. Chase, London.—1st August*, 1882. 6*d*.
This relates to fasteners for connecting the ends of machine bands, and consists preferably of a slightly flattened round wire, which is cut into lengths and bent with an oblong ring, each extremity of which is formed with an eye, the ends of the wire being bent down in contact with the centre, the butting ends nearly touching. The eyes pass through holes in the leather and a cross pin is inserted through them. A tool is described for slotting the leather so that the holes for the eyes of the ring are all at equal distances from the edges.

3663. Steam Traps, *H. Lancaster, Pendleton, Lancashire.—2nd August*, 1882. 6*d*.
A hollow screw spindle has a valve loosely mounted thereon, and is connected by a hollow arm to a float. The water of condensation issues from the outlet into a valve chamber, whence it escapes through ports in the hollow spindle into the float, the issue of steam raising the float by turning the spindle, and closing the valve.

3664. Fastening for Tarpaulins, &c., *T. Marlborough and J. Cunningham, Sunderland.—2nd August*, 1882. 6*d*.
This relates to fastenings specially adapted for securing tarpaulins over the hatches of ships, and it consists in placing over the edges of the same a bar pressed against the sides of the hatches by a bolt or pin, passing through a support secured to the hatches, and formed with a slot to receive a wedge-shaped key, which, when forced home, presses the bar firmly against the tarpaulin.

3668. Lubricating of Spinning and Preparing Machinery, *B. A. Dobson, Bollon.—2nd August*, 1882. 6*d*.
This consists, First, in applying a loose or removable oil reservoir to spindles mounted in rails of spinning machines; and Secondly, in an arrangement of a fly comb-motion box, whereby thorough lubrication and a perfectly even motion can be obtained, such box having an accurately-fitting cover secured by bolts, and with an oil channel running all round the four sides of the joint, with holes communicating with the working parts.

3669. Looms for Weaving, *J. Whittaker, Padiham, and R. Clayton, Rishton, Lancashire.—2nd August*, 1882.—(*Not proceeded with.*) 2*d*.
This relates to looms for weaving sateen and other fancy cloths, the object being to provide simple apparatus for lifting the healds, and to avoid risk of injury to the cloth by the dropping of oil from the tappets, and also to admit light freely to the shed. The tappets are placed under the loom and the jack below them, and connected to the top staves of the healds by cords.

3671. Combined Working of Railway Switches and Signals, *P. Prince, Derby.—2nd August*, 1882. 6*d*.
This consists in appliances connected with facing points and signals which will prevent a signal being lowered for a train to pass over the points unless the latter are absolutely in their proper position.

3672. Figured Cloth, *J. Kirkman, R. Smith, and P Entwistle, Bolton.—2nd August*, 1882. 4*d*.
The object is to obtain a raised or embossed figure on a twill or satin ground, the figure to be plain satin or twill, as desired.

3674. Preventing Accidents on Railways, *S. Williams, Newport, Monmouth.—2nd August*, 1882.—(*Not proceeded with.*) 4*d*.
A system of levers on the principal of lazy-tongs is connected at one end to the engine of the train, and at the other to a suitable frame or bogie truck, so that the latter will travel some distance in front of the train, and indicate, by the collapse of the jointed levers, the fact of anything being on the line.

3675. Cleaning Wool from Burrs, Thistles, &c., *W. P. Thompson, Liverpool.—2nd August*, 1882.—(*A communication from A. Fraysée, Belgium.*) 6*d*.
A travelling table feeds the wool to two toothed or grooved rolls, which deliver it to a large roll having needles, wires, or teeth, the delivery being assisted by a sheet of water caused to fall from a slit tube and force the wool in among the needles, and washes it, at the same time clearing it from thistles, which remain on the roll, and are removed into a trough by a roll provided with blades. The wool passes to other rolls, and is further subjected to the action of water.

3677. Balanced Slide Valves for Steam Engines, *A. M. Clark, London.—2nd August*, 1882.—(*A communication from J. J. De Lancey, Binghamton, U.S.*)—(*Not proceeded with.*) 4*d*.
This relates to slide valves fitted to work beneath the face-plate in the steam chests, and consists in making such valves hollow, of rectangular form, and with perpendicular faces on both its inner and outer sides. The face-plate fits the steam chest above the valve, and a slotted balance-plate upon the valve and beneath the face-plate. The upper edges are formed with grooves to receive packing bars connected at the corners by lap joints, and beneath them are springs pressing the packings outward. In the sides of the valves are apertures to admit steam beneath the packing bars.

3678. Apparatus for Softening and Clarifying Water, *L. A. Groth, London.—2nd August*, 1882.—(*A communication from F. Pichler and C. Sedldcek, Vienna.*)—(*Not proceeded with.*) 2*d*.
A vessel is so divided by walls into several spaces of increasingly larger section that the movement of the water through them is retarded and the deposit of the precipitate ensured.

3679. Railways, *L. A. Groth, London.—2nd August*, 1882.—(*A communication from F. Schauman, Sweden.*) 6*d*.
The object is to obtain a durable elastic and safe permanent way, and it consists in the employment of stone or concrete sleepers, with washer plates of compressed cork as an elastic medium between the rails and the sleepers, both the rails and washers being connected to the sleepers by bolts and nuts and spring clip plates.

3680. Finger Rings, &c., *R. J. la Grange, Philadelphia, U.S.—2nd August*, 1882.—(*Not proceeded with.*) 2*d*.
This relates to rings, the bow of which can be adjusted to suit different fingers by means of a pin mounted on the ring and engaging with teeth on the bow, the pinion being actuated by a suitable key.

3682. Grass Edge Clippers, *T. Green, Leeds.—2nd August*, 1882.—(*Not proceeded with.*) 2*d*.
This object is the cutting the overhanging grass on the edges of walks, &c., and it consists in the use of a revolving star or other shaped cutter acting in its rotary motion against a blade or shear fixed on the side of the machine.

3683. Locking Mechanism for Safes, Vaults, &c., *W. R. Lake, London.—2nd August*, 1882.—(*A communication from H. F. Newbury, Brooklyn, U.S.*) 1*s*. 6*d*.
The object is to prevent the locking being unseated or broken by the use of explosives placed against the door or wall of a safe or vault opposite the part where the lock is situated, and it consists principally in combining with the fastening bolts that secure the lock to the safe or vault, springs or other yielding and elastic connections.

3684. Fire-arm, *W. R. Lake, London.—2nd August*, 1882.—(*A communication from Count A. Coronini, Austria.*) 6*d*.
The object is to enable a number of bullets to be fired off at once, and it consists in the use of a number of rifled barrels fixed in a plate having two bolts. The breech block is hinged to the barrel plate, and when shut the bolts of the latter pass into slots in the block, and by turning their heads the block is secured. The block has as many firing pins as there are barrels, the whole of which are actuated simultaneously when the trigger is pulled.

3686. Exhaust Fans and Blowers, *F. M. Eden, Kettering.—2nd August*, 1882.—(*Not proceeded with.*) 2*d*.
The fan is in the form of a hollow annular narrow or edge vane wheel carried on the end of its driving shaft by an eye in the centre of a flat disc web forming the close end of the fan, which exhaust in through a large eye in the centre of an annular curvilinear disc forming the other side of the wheel, with a number of curvilinear radial vanes inside extending from the eye to the outer perimeter, where the fan discharges the air through the spaces between the vanes.

3687. Working Machinery by Manumotive Power, *J. T. M. Hircock, Birmingham.—2nd August*, 1882.—(*Not proceeded with.*) 2*d*.
A lever arm has connected to it a quadrant rack driving two pinions or ratchet boxes, on the spindle of one of which is a second pinion and cog wheel, while on that of the other is a driving wheel and a small toothed wheel gearing with another small wheel on the opposite spindle. The action upon the pinions from the lever is by springs and clutches in the ratchet boxes alternately in and out of gear, so that one of the spindles is always travelling in the right direction.

3688. Door Knobs, *W. Thomson, Shaw, Lancashire.—2nd August*, 1882. 6*d*.
This relates to knobs not secured directly on the spindle, but to washers attached to the door, and it consists in means for connecting them to such washers. The washer is formed with a shallow socket to receive the inner end of the knob, and from such socket a hollow spindle projects and enters a corresponding central hole in the knob, its outer end being screwed to receive a nut inserted through an opening in the front of the knob, which is preferably afterwards closed by a plug.

3690. Horseshoes, *J. R. Thomson, Buckden, Huntingdon.—2nd August*, 1882.—(*Not proceeded with.*) 2*d*.
The object is to prevent the injurious concussive effects of ordinary shoes upon horses' legs and to prevent their slipping on smooth surfaces, and it consists in the combination with the metal parts of the shoe of an india-rubber pad or cushion, formed and arranged so as to afford great elasticity of tread and a secure foothold.

3692. Winding on Motions for Tapeing Machinery, &c., *Y. Duxbury, jun., Over Darwen, Lancashire.—2nd August*, 1882. 6*d*.
This relates to a winding on motion of a tensional or frictional character, and it consists of a lever mounted on a fulcrum and preferably forked so as to span the driving shaft. On each fork leg is an anti-friction bowl capable of pressing on to a sliding friction plate, so as to bring it into contact with another friction plate connected to the driving wheel. The lever is connected by a link to a second lever mounted so as to have one arm in a horizontal position, and on which a

weight can slide so as to regulate the tension applied to the fabric or yarn being wound on to the beam.

3693. APPARATUS FOR EVAPORATING LIQUIDS, &c., *H. Gardner, London.—3rd August*, 1882.—(*A communication from F. B. Nichols and C. Thomson, Halifax, Canada.*) 6d.

The object is to expose a large surface of slowly moving liquid for the purpose of absorbing gases or vapours, and conversely for the purpose of driving off gases. The apparatus consists of a series of troughs, vessels, or cells provided with syphon slips or thin slips of solid material bent over their edges to maintain a continuous flow of liquid out of the vessel, and diffusing strips or broad strips of thin material, arranged to maintain a continuous flow of liquid over their surfaces, suitable means being provided for applying heat for evaporating purposes, and for supplying gas or vapour for the purpose of causing the liquid to absorb the same.

3694. WAGON FOR RAISING, CARRYING, AND DEPOSITING HEAVY WEIGHTS, *E. Hollingworth, Dobcross, Yorkshire.—3rd August*, 1882. 8d.

A platform carrying a turntable is mounted upon wheels, the front wheel being mounted on a swivelling disc. The platform is supported above the wheels by lugs on the underside connected by pins to links on the main shaft, and on the swivel mechanism of front wheel. Around the swivelling link carrying the front wheel is a stationary annular ring supporting one end of two arms, the other end of such arms supporting a cross-shaft carrying the back wheels, by which the turntable can be revolved without disturbing the position of back wheels. The table is supported upon three short-jointed arms or bulks capable of being set at an angle by raising a lever in connection with the front link.

3695. PRESERVING MILK AND CREAM, *H. W. L. O. von Roden, Hamburg.—3rd August*, 1882.—(*Not proceeded with.*) 2d.

The milk is placed in bottles or jars closed by stoppers, and over their mouths a piece of rubber is drawn so as to form a cup, the bottom of which is the stopper. Oil or other liquid is placed in the cup and the jars heated by steam or hot water, so as to expel all air and kill the germs of fermentation.

3696. PREVENTING NOISE IN WINDOW FRAMES, *W. Ney, Old Ford.—3rd August*, 1882.—(*Not proceeded with.*) 4d.

An elastic wheel is let into the window frame and bears on the sash, so as to keep it firmly in its place.

3699. BELLS FOR BICYCLES, &c., *J. Harrison, Birmingham.—3rd August*, 1882. 6d.

The clapper of the bell is in the form of a rod with a ball at its lower end, and another ball arranged at its upper end, so that a lever arm working upon a pivot upon the outside of the bell can be moved so as to clutch the top of the rod and hold the clapper rigid, so as to prevent the bell ringing.

3703. MAKING ICE, *T. Watts, Isle of Wight, and W. A. Gorman, Westminster Bridge-road.—3rd August*, 1882. 6d.

This relates to apparatus for agitating the water so as to obtain clear ice, and it consists in forming an agitator with pivotted hinged or loosely attached flaps so arranged that the agitation of the water will be greater when the agitator is moved in one direction than when it is moved in the other. The agitator moves inside the cells, and the flaps adjust themselves to the space left as the ice is formed, so that the agitation may be continued until the cells are nearly filled with ice.

3704. VACUUM BRAKE APPARATUS, *J. Gresham, Salford.—4th August*, 1882.—(*Not proceeded with.*) 2d.

This relates, First, to arrangements for packing or preventing leakage past the rods connected with the pistons or diaphragms of vacuum brake apparatus; Secondly, to improvements in the valve arrangements.

3706. COMBINING HARMONIUMS WITH PIANOS, *L. Küstner, Hamburg.—4th August*, 1882. 6d.

The object is to so combine a harmonium and piano that the finger-boards of the two instruments may be readily coupled and uncoupled, and also to facilitate the application of the piano's pedal while moving the pedal of the harmonium.

3709. SCREW OR OBLIQUE BLADED PROPELLERS, *W. G. Wrench, Glasgow, N.B.—4th August*, 1882.—(*Not proceeded with.*) 2d.

This consists principally in making the acting surface of the blade so that at each distance from the centre there is a diminishing pitch from the entering to the rear edge, whilst at the corresponding part of the back or non-acting surface the pitch is made uniform, or nearly so.

3711. BRIDGES OF THE FURNACES OF MARINE AND CORNISH BOILERS, *C. Hill, Blaydon-on-Tyne.—4th August*, 1882. 4d.

This consists in the construction of a hollow bridge for furnaces, such bridge having an opening for the admission of air to the hollow interior below the fire-bars, and also an opening above the fire-bars for the escape of air from the interior on to the fuel.

3714. SULPHUROUS ANHYDRIDE, *S. Pitt, Sutton.—4th August*, 1882.—(*A communication from the Compagnie Industrielle des procédés Raoul Pictet, Paris.*) 6d.

This consists in the dehydration of gaseous sulphurous acid, produced by known means, by means of liquified sulphurous acid, and by the employment of low temperatures obtained directly by the natural evaporation of this body, separating from the gas by crystallisation and condensation all the hydrates of sulphurous acid.

3715. PREPARING AND DRESSING WASTE SILK, &c., *S. Lister, Manningham, Yorkshire.—4th August*, 1882. 6d.

The silk waste, after being discharged from the gum or softened, is fed into a carding engine, and when properly carded and worked is delivered on to a doffer, so as to produce a continuous sliver or lap. The "licker-in" must be clothed with much coarser cards than those generally used, and the angle of the pins or teeth not so keen as is now the practice.

3716. CUBE FIRE-LIGHTERS, *T. V. Trew, Plaistow.—4th August*, 1882.—(*Not proceeded with.*) 2d.

This invention consists in boring and cutting off in one operation from lengths of wood certain blocks called cube fire-lighters.

3719. FOLDING SEATS FOR COUNTER, DESK, &c., *W. H. Avis, Polegate, Sussex.—4th August*, 1882. 6d.

The seat is rigidly supported by one end of a horizontal arm, the other end of which is pivotted to the counter or desk, and to the under side of the seat a strut or support is pivotted, its upper end being formed with a stop upon which the seat bears, while its other end works in a slot formed in a frame secured to the desk below the pivot of the horizontal arm. By turning the latter the seat is caused to occupy a vertical position close to the counter, the strut or support moving with it.

3720. SOLITAIRES, LINKS, AND SHIRT STUDS, *A. B. Furlong, London.—4th August*, 1882.—(*Not proceeded with.*) 2d.

This relates to solitaires, &c., provided with coiled springs.

3721. APPARATUS FOR BOILING WATER, BEER, &c., *A. Barraclough, Heakmondwike, Yorks.— 4th August*, 1882.—(*Not proceeded with.*) 2d.

The invention consists when boiling water in placing outside the boiling cistern a heater composed of a chamber containing pipes either vertical, horizontal, or coiled. This heater is connected by pipes to the boiling cistern, the inlet pipe from the cistern being connected to the lower part of the heater, and the return pipe being connected from the top part of the heater to the said cistern.

3722. MECHANICAL BUTTON, *A. Combault, Regent-street, and W. T. Taylor, Westbourne-terrace.—4th August*, 1882. 6d.

The button consists of knob and a shank, the former composed of two equal circular convexo-concave discs of thin steel, in the centre of one of which is a hole to allow of the passage of the shank head, while in the centre of the other disc is a smaller perforation from which four slots radiate to near the circumference. The shank is narrowed below the head, which is flat, forced through the hole in the upper disc, and can only be withdrawn by turning the shank edgewise, so that two opposite slots allow it to pass through.

3725. APPARATUS FOR VAPORISING, REFRIGERATING, &c., *E. J. C. Fear, near Bristol.—4th August*, 1882.—(*Not proceeded with.*) 2d.

This relates to apparatus for use for purposes of vaporising, refrigerating, or heating, and application of heated, refrigerated, scented or medicated vapours, the primary object being to employ the fan-operating mechanism described under patent 2452, dated 3rd June, 1881, or to employ for the production of the initial blast of air, bellows, turbine screws, rotary fans, or pump device.

3726. PRODUCING FAC-SIMILE COPIES OF WRITINGS, &c., *T. H. Taylor, Manchester.—4th August*, 1882. 2d.

Two boards are employed, one recessed inside and saturated with waterproofing matter, each recess containing a sheet of waterproof cloth. Between the boards are placed two or more cushions, consisting of endless sheets of calico, with an interior layer of felt covered with flannel, and on one side of each cushion is placed a thin sheet of metal or waterproof material which folds over the transfer sheet.

3727. TYPE-WRITERS, *A. H. Boulton and C. Dickie, London.—5th August*, 1882.—(*A communication from A. P. Hansen, Hamburg, Germany.*) 6d.

The printing is effected by a movable bar upon the lower side of which the letters are secured, such bar sliding in a hinge, from upon one or both sides of which corresponding letters are marked. On one or both sides of the frame are rack bars with recesses corresponding with the letter of the frame, and into which an index figure attached to the bar fits. The bar extends beyond the frame and passes over the roller on which the printing is effected, such roller being moved from right to left as the printing progresses.

3728. RAILWAY CARRIAGES, &c., *U. Scott, London.—5th August*, 1882. 6d.

This consists, First, in applying rollers to window frames so that they bear against the sliding sashes and prevent them rattling; and Secondly, in the use of india-rubber combined with wood and metal in making tires and naves of the wheels, and also in making brake blocks of india-rubber, felt, or similar material.

3729. WASHSTANDS, *A. J. Boult, London.—5th August*, 1882.—(*A communication from N. O. Bond, Fairfax, U.S.*)—(*Not proceeded with.*) 2d.

The bowl is suspended so that it may drop down within the stand to empty its contents, or be raised to a horizontal position, and means are provided for operating the bowl. The overflowing of the bowl or of the stop tank is also prevented.

3730. APPARATUS FOR REGULATING THE SPEED OF BICYCLES AND TRICYCLES, *J. G. Horsey and T. Bell, London.—5th August*, 1882. 6d.

A box is fixed round the axle between the fork of a bicycle, and in it is a series of toothed wheels capable of being put into gear by a cam under the action of a lever within reach of the rider, so that the speed is regulated according to the wheels put into gear.

3732. FASTENINGS TO PREVENT REMOVAL OF STOPPERS AND CORKS FROM BOTTLES, *H. Shaw, near Birmingham.—5th August*, 1882.—(*Not proceeded with.*) 2d.

The object is to fasten or prevent the removal of the stoppers of the bottles excepting by the person having possession of the key of the fastening.

3733. PROPELLERS FOR VESSELS, *G. C. Parini, Lombardy, Italy.—5th August*, 1882. 6d.

The object is to provide a propeller in which the force obtained from the steam engine will act directly in a horizontal line on the water to propel the vessel. According to one arrangement two or more pistons working in open cylinders are caused to act directly on the water.

3735. APPARATUS FOR REDUCING MINERALS AND METALLIC ORES, *R. J. Cunnack, Helston, Cornwall.—5th August*, 1882. 6d.

This consists mainly of two horizontal rubbers of similar dimensions, the lower one being applied with its upper surface in a level position, while the upper rubber is moved upon it. Apertures are made in and around the centre of the upper rubber, through which a small stream of water carries in the stuff to be treated. The upper rubber is caused to move excentrically over the lower one, the unequal friction on its opposite circumference causing it at the same time to revolve on its axis about the crank by which it is driven.

3737. CERAMIC COMPOSITION, *B. J. B. Mills, London.—5th August*, 1882.—(*A communication from F. Gillet, Paris.*) 4d.

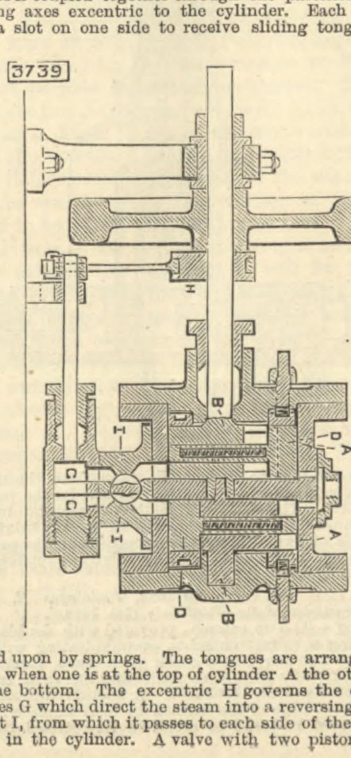
The inventor claims, First, a composition formed of pulverised volcanic matter known as lava and scoriæ mixed with fluxes and clay or other equivalent plastic material, as also with colouring matters; Secondly, all applications of this composition.

3738. HOLDER FOR CHALK FOR THE USE OF TAILORS, &c., *C. E. Bryant, London.—5th August*, 1882. 6d.

This relates to a clip for holding the chalk, and which is fitted with a sheath so as to cover up the chalk when desired to be put into the pocket.

3739. ROTARY ENGINES, *J. G. Jones, Stoke Newington.—5th August*, 1882. 6d.

The horizontal cylinder A is divided by a central partition, on each side of which are cylindrical blocks B coupled together through the partition, and having axes excentric to the cylinder. Each block has a slot on one side to receive sliding tongues D



acted upon by springs. The tongues are arranged so that when one is at the top of cylinder A the other is at the bottom. The excentric H governs the cut-off valves G which direct the steam into a reversing valve chest I, from which it passes to each side of the partition in the cylinder. A valve with two pistons can be shifted in the valve chest I so as to reverse the motion.

3740. CHEMICAL PRODUCT FOR BLEACHING, *J. C. Mewburn, London.—5th August*, 1882. 4d.

This consists of a mixture of equal parts of hypochlorites of soda, potass, and magnesia, put in a solution with one-thousandth of potassic permanganate.

3741. BRICKS, TILES, PAVINGS, &c., *A. Bouquié, Paris.—5th August*, 1882. 4d.

This relates to the manufacture of bricks, tiles, and other articles from sand and gas or mineral tar or pitch, by mixing them together and converting them by heat into a plastic mass, which is then moulded and compressed. The articles so prepared can then be immersed in water saturated with sulphate of iron mixed with red or yellow ochre.

3742. TRICYCLES, *J. T. Townsend, Coventry.—5th August*, 1882. 6d.

This relates to convertible sociable tricycles, the object being to enable two riders of unequal strength to ride the tricycle without any liability of running to one side, with equal advantages for one rider when converted into a single machine. The main shaft passes across the machine, but is coupled at its centre in such a manner as to divide into a single tricycle, so that the machine in both its double and single condition is driven by doubling driving gear from one chain or other medium.

3744. PAINTING, PRINTING, OR DYEING WOVEN FABRICS, &c., *D. Guille, South Molton-street.—5th August*, 1882. 4d.

The fabric or material is steeped in a colourless size prepared from skins of animals, and then coated with a vegetable size prepared from linseed or other suitable seeds, such size being quite colourless. When dry ordinary colours or dyes are applied and the material placed in a hot dry kiln, after which it is submitted to the action of a jet of steam.

3745. REGULATING THE FLOW OF GASES AND LIQUIDS, *R. Macintyre, Forest-gate.—5th August*, 1882. 6d.

The apparatus consists of a valve through which the steam, gas, or liquid passes, and another valve or cylinder so arranged and connected with the first that the combination will cut off the flow after a given time previously decided upon. The regulating valve consists of a cylinder containing a perforated piston to enable the liquid in the cylinder to pass to the underside as the piston is raised. The piston is acted upon by a weight which causes it to descend, the liquid passing back to the top of the piston through suitable ports and passages, and as the piston completes its down stroke, a projection on its rod acts on the valve in the supply pipe and closes the same.

3747. SPRINGS FOR SPRING MATTRESSES, &c., *G. H. Slack, Manchester.—5th August*, 1882. 4d.

An eye is formed at one end of a piece of steel wire, and at a suitable distance therefrom the wire is first bent into a semicircular segmental form and then into one, two, or more coils of smaller diameter, after which it is again bent to a segmental form, and continued in a straight line to be made at its end into a loop or eye, similar to that at the other end.

3748. MULES FOR SPINNING WOOLLEN FIBRES, &c., *J. E. Heppenstall, near Huddersfield. — 5th August*, 1882.—(*Not proceeded with.*) 2d.

Instead of a tapering scroll for winding the carriage in and out for drawing the thread and for winding it on the spindles, a parallel scroll or barrel is employed, so that the traverse of the carriage is regular, the delivery rollers being driven so as to revolve and continue to deliver until the carriage reaches the end of its traverse, when they stop for the twist to be put in the thread and wound upon the spindle, the necessary draught or lengthening medium being obtained by the carriage travelling outward faster than the thread is delivered.

3749. FABRIC FOR WALL HANGINGS, &c., *A. M. Clark, London.—5th August*, 1882.—(*A communication from A. Hutchinson, Paris.*) 4d.

The body of the fabric consists of a novel composition of waterproof agglomerating and textile matters, the latter in the form of loose fibres distributed throughout the mass.

3750. APPARATUS FOR THE MANUFACTURE OF DENTAL PLATES, &c., *J. H. Gartrell, Penzance.—5th August*, 1882. 6d.

This relates to apparatus in which the cellular or other plastic material to form the plates is forced into moulds after the flask containing the same is placed in the boiler or heater and tightly closed, and it consists of improved means for tightly closing the mould, and in constructing the apparatus so that it can be heated either by steam or hot air. Means are also provided whereby in the latter case the necessary steam pressure can be obtained for indicating the temperature upon a gauge, and the supply of gas to the burner be regulated. The cylinder for injecting the celluloid is also of special construction to facilitate the manipulation.

3760. TURBINES, *J. McConnell, Ireland.—7th August*, 1882. 6d.

This relates to the construction and to means for regulating or governing the speed of turbines, of the kind in which the water for driving is caused to flow towards the centre. The turbine has curved blades or buckets increasing in depth as they approach the centre. A chute surrounds the wheel, and in it are stationary guide blades set at such an angle to the radial position as to cause the water delivered between them to strike the buckets at right angles, the outer ends of the buckets being curved back to receive the full effective pressure of the water. Outside the chute casing are four register gates or movable guide blades centred close to the outer edge of the casing, and when the wheel is out of action they lie in close contact with the guide blades, so that no water can pass through the chutes.

3761. IMPREGNATING WOOD FOR ITS PRESERVATION, *F. C. Glaser, Berlin.—8th August*, 1882.—(*A communication from P. J. F. Röper, near Hamburg.*) 4d.

This consists in first treating the wood with a solution of zinc vitriol, and then with a solution of chloride of calcium, so that the preservative coating is formed upon the wood by the chemical action of both substances on one another.

3765. SPOOLS OR BOBBINS FOR SEWING THREAD, *E. Hunt, Glasgow.—8th August*, 1882.—(*A communication from I. C. Davis, New Jersey, U.S.*) 6d.

One improvement consists in forming on the head which is to be undermost when on the spindle of a sewing machine, a boss grooved or undercut so as to have the outer part larger than the part nearer the head, the object being to prevent the thread winding on the spindle. The object of the Second improvement is to enable the fineness and colour of the thread to be ascertained better than it can be from the closely set and compressed coils, and without requiring the end to be picked out, and a portion of the thread unwound, and it consists in carrying the end of the thread over the end of the bobbin.

3766. MOUNTING AND TRAINING LIGHT ORDNANCE, &c., *A. C. Kirk, Glasgow.—8th August*, 1882.—(*Not proceeded with.*) 2d.

The object is principally to improve the arrangements for supporting and allowing a light piece of ordnance to be trained inside a protective casing or turret of circular form. A main standard fixed with the case has a main carrying frame mounted so as to turn thereon, and the arm of the frame is formed with a centre bearing for the carrying frame or block of the gun.

3768. LAMPS, *H. Cullabine, Sheffield.—8th August*, 1882. 6d.

The lamp has six or other number of sides, the roof being of opal glass, and the sides of clear glass, with a centre large glass lens attached to the outer surface of each. One or more burners are fixed at the back of each lens inside the lamp, and a suitable reflector provided to concentrate the rays of light upon the lens.

3769. SEWING MACHINES, *H. Gardner, London.—8th August*, 1882. —(*A communication from R. M. Wanzer, Hamilton, Canada.*) 6d.

This relates, First, to a special form of excentric, excentric box, and excentric box case placed on the upper shaft and connected by a vertical and horizontal lever to the shuttle so as to actuate the same; Secondly, to mechanism for operating a four-motion feed and for deadening the sound of its action, also to devices for regulating the stitches: Thirdly, to mechanism for spooling bobbins, by which an upward pressure is given to the bobbins to effect an uniform tension and enable the thread to be wound firmly and tightly; Fourthly, to an improvement in the throat plate so as to enable the slides to be dispensed with; and, Fifthly, to a device for throwing the hand-wheel in and out of gear, and so enable the bobbin winder to be run without running the machine.

3771. MINING MACHINES, *W. R. Lake, London.—8th August*, 1882.—(*A communication from G. D. Whitcomb, Chicago.*) 8d.

This relates to machines operated by admitting steam or compressed air at the rear end and exhausting it at the forward end of a piston cylinder, and *vice versâ*, alternately, and the object of one part of this invention is to prevent the shock of the piston against the rear head of the cylinder by interposing an air cushion of adjustable pressure between them. A sliding valve regulates the admission and escape of air, and is operated by an auxiliary engine provided with an exhaust outlet, through which the escape of air is regulated by a valve. The invention further relates to so constructing the machine that the exhaust ports are between the admission ports and the ends of the cylinder. The piston head and rod are made in one piece, the latter being formed so that cushion discs can be passed over its end not attached to the head. Other improvements are described.

3772. THRASHING MACHINES, *W. R. Lake, London.—8th August*, 1882. —(*A communication from J. Schleyder, Vienna.*) 8d.

This consists in increasing the diameter of the pulley mounted on the thrashing drum, an intermediate power-transmitting apparatus being inserted between the thrashing machine and the portable engine which drives the same so as to obtain the desired speed.

3773. SULPHITES AND BISULPHITES FOR BLEACHING PURPOSES, *J. Imray, London.—8th August*, 1882.—(*A communication from F. C. Kudelski, France.*) 6d.

This relates to a process for transforming sulphates of soda, potassa, magnesia, or ammonia into sulphites or bisulphites suitable for bleaching materials for pulp or textile purposes. In a vessel with an agitator a current of sulphurous acid is passed through a milk of lime or carbonate of lime, and when the solution is concentrated to 8 deg. or 9 deg. Beaumé the sulphate to be treated is added. When the solution is sufficiently sulphited the current of sulphurous acid is stopped, the vessel emptied, and when settled the liquor is decanted and can be used for bleaching.

3774. REPEATING FIRE-ARMS, *J. Imray, London.—8th August*, 1882.—(*A communication from F. Mannlicher, Vienna.*) 6d.

This relates to an arrangement of the stock of a rifle, so as to form a magazine for cartridges provided with means for advancing them and raising each in turn to a position where it can be introduced into the breech of the barrel.

3775. BRICKS, TILES, OR SLABS, *J. C. Bloomfield and J. McGurn, Ireland.—8th August*, 1882. 2d.

The object is to produce bricks, tiles, and slabs, strong and impervious to moisture. It consists in mixing sand and chalk together and adding sufficient water to cause the mixture to cohere. It is then moulded and baked at almost a red heat without preliminary drying, and while still hot are put into boiling coal and kept there from one to two hours, when they are thrown into cold water.

3776. MANUFACTURE OF COKE, *J. Wood, near Wakefield.—8th August*, 1882. 6d.

A retort of ⋂-form is employed, but is considerably longer at its vertical sides than those usually employed in the manufacture of gas. These retorts are enclosed in brickwork, having flues for the passage of heat, which may be obtained from ordinary coke ovens, with or without the addition of gas, which is produced in the retort after such gases have been distilled and the bye-products extracted. The retorts are made up of parts, so that they may be taken to pieces and fresh parts substituted without deranging the others.

3777. GUN CARRIAGES, *P. Jensen, London. — 8th August*, 1882.—(*A communication from M. M. A. Buassiere, Paris.—(Not proceeded with.*) 2d.

The action of the recoil causes the piece of ordnance to descend or lower down, in which position it is loaded and pointed under cover. It is protected by a parapet of horseshoe shape with two loading recesses. Part of the mechanism is underground and protected from shots, consisting of a crane post which can turn on its axis and carries the brake, utilising the power of the recoil to raise the gun again. A frame extending towards the front is fastened on the head of the post, and to it is jointed a limb, in the upper forked end of which the trunnions rest, and at a point between the ends of this limb a rod is jointed which connects with the top of the ram which works in a hydraulic cylinder in the crane post.

3778. WASHING MACHINES, *C. C. Greenway, New South Wales.—8th August*, 1882. 6d.

An open cage works up and down in a box and compresses or squeezes the clothes against a stationary grating corresponding to the internal area of the cage.

3781. VELOCIPEDES, *C. Crozat, Paris.—9th August*, 1882.—(*Not proceeded with.*) 2d.

The machine consists of two large wheels keyed on a double-cranked axle, the seat being arranged below the axle.

3782. BICYCLES, *J. Beale, Blackheath.—9th August*, 1882. 6d.

This relates to improvements on patent No. 332, A.D. 1878, and consists in the application to the treadles of the bicycles therein described of a combination of levers and rods, arranged so as to render the mode of working the cranks applicable to bicycles of various heights. The fork is continued below the centre of the wheel, and to it on each side of the wheel a lever is jointed, and to its other end a frame is connected with bars for the foot of the rider, the frame being kept in a vertical position by a rod partly revolving round a centre in the prolongation of the fork in or during all positions of the lever, the reciprocating motion imparted to which through the intervention of a connecting-rod works the crank on the driving axle.

3786. FURNACES, *J. Imray, London.—9th August*, 1882.—(*A communication from C. H. F. Russmann, Hamburg.*) 6d.

The inventor claims in combination with the fire-grate and the fire space and ashpit of a furnace, a heating shield, and its communications with a nozzle, a mouth and flame space.

3785. REGULATING APPARATUS FOR STEAM ENGINES, *H. Davey, near Leeds.—9th August*, 1882 6d.

This relates to means for controlling steam engines, especially direct-acting pump engines, under great variations of resistance. For this purpose either in the inlet or outlet passage, or in the case of compound engines, between the two cylinders, a valve is placed, which in the ordinary working of the engine is kept open by a catch held by a trigger. The trigger is released to allow the valve to close by a cataract cylinder having a passage from one end to the other, which can be regulated by a cock or valve. The piston of the cataract cylinder is connected to the engine by a differential lever, one end of which is connected to the engine and the other actuates the trigger by a tappet rod acted upon by opposing spring. When the opposition of the liquid in the cataract cylinder to the motion of the piston exceeds that of either, spring motion is imparted to the tappet rod and the trigger released, so that the valve closes.

3787. GENERATING ELASTIC FLUID UNDER PRESSURE, *H. Davey, near Leeds.—9th August*, 1882. 6*d*.

Into a strong boiler with an internal fire-box, air and gas under pressure are introduced. From the fire-box passages lead into the body of water in the boiler, the passages being provided with check valves to prevent return of water from the boiler into the fire-box. An engine working pumps supplies the air and gas in proper proportions and water for feed. The supply to the furnace, and consequently the generation of fluid, is governed by regulating the pumping engines automatically by connecting the throttle valve to a piston loaded to the maximum pressure desired, and subjected to the pressure of the fluid in the generator.

3788. SEWING MACHINES FOR BUTTON HOLE AND OVERHEAD STITCHING, *J. Imray, London.—9th August*, 1882.—(*A communication from Messrs. Grimme, Natalis, and Co., Brunswick.*) 6*d*.

This consists, First, in the combination with a needle bar receiving only lateral to-and-fro motion within a needle slide which receives only vertical motion, of a yoke receiving lateral motion from suitable mechanism, and imparting such motion to the needle bar, while at the same time it acts as a guide to the vertical motion thereof; and Secondly, the use, for imparting lateral to-and-fro motion to the needle bar, of an adjustable cam, a bar, and a spring operating in combination with a lever, whereby the lateral motion of the needle bar is stopped or regulated.

3790. PAINT FOR PRESERVING WOOD, *E. P. Wells, Notting Hill.—9th August*, 1882. 2*d*.

This relates to a paint or composition consisting of tannic acid, or a substance containing tannic acid, mixed with paint or other substance capable of being used as paint.

3792. PRODUCING DISTILLATES FROM KIMMERIDGE SHALE, *E. K. Mitting, Rye, Sussex.—9th August*, 1882. 4*d*.

This consists, First, in the distillation of Kimmeridge shale by the introduction of superheated steam when the retort is at a temperature of 210 deg. C. to 250 deg. C., to effect the decomposition or absorption of various nitrogenous bases, and to add to the quantity of ammonia in the aqueous portion of the distillate; Secondly, the cooling of the carbonaceous residue in closed chambers or vessels distinct from or forming part of the distilling retort, to prevent access of the atmosphere or other gases; and Thirdly, the combination in a Kimmeridge shale distilling retort of a large surfaced condenser with a vacuum "drag" to produce the least proportion of permanent gas in the first portion of the distillate.

3794. LIDS OF FUEL ECONOMISERS, &c., *E. Green, Wakefield.—9th August*, 1882. 4*d*.

This consists in the use of lids or covers with angled edges to fit corresponding apertures in the top casing of fuel economisers, such lids being put into position from the inside.

3796. APPARATUS FOR SUPPORTING AND FIXING SWING LOOKING-GLASSES, &c., *W. J. Hinde, London.—9th August*, 1882. 6*d*.

This relates to the construction and combination of parts for supporting and fixing swing looking-glasses, swing ventilators, and other swinging articles.

3797. LOCKS AND LATCHES, *J. Walker and H. B. Worsey, Birmingham.—9th August*, 1882.—(*Not proceeded with.*) 2*d*.

This relates to the construction and arrangement of parts so as to simplify the combined lock and latch, the use of springs being avoided, and the lock and latch rendered unpickable.

3799. STEAM STEERING GEAR, *J. H. Smiles, Stockton-on-Tees.—9th August*, 1882. 6*d*.

This relates to the method of controlling the valves so that the steersman has more complete control over the admission of steam to the cylinder in any position of the rudder. A sheave is attached to and slung from and round a shaft, so that its centre is allowed the freedom of a given radial movement from side to side in the plane of revolution of the shaft. It is slung on a fulcrum, the centre of which is in line with the centre of the shaft and that of the crank pin, but at the opposite side of the shaft to the crank pin. The fulcrum is arranged on a radial arm on the shaft, so that it is concentric in its mid position, and when moved from side to side it becomes respectively a "backward" or "forward" excentric. The sheave as an excentric gives motion to the valves through the usual gear, and when concentric, the valves are closed, and are in mid gear. By the side of the sheave is a wheel engaging by a pin and slot with the sheave, so as to carry it round with it. The secondary wheel is connected by any suitable gear to the steering wheels.

3800. CARDBOARD BOXES, *P. Jensen, London.—9th August*, 1882.—(*A communication from D. L. Caillat, Paris.*) 6*d*.

This consists essentially in the manufacture of cardboard in one piece by the operation of suitable dies.

3801. CUTLERY AND TOOLS, *D. Hummel, jun., Fenchurch-street.—9th August*, 1882.—(*A communication from H. Hallström, Sweden.*) 6*d*.

The object is to manufacture cutlery and tools with hollow handles all in one piece of iron or steel, the handle being formed in two parts (one of which may be in one piece with the blade) and then welded together.

3807. APPARATUS FOR CONVEYING STEEL INGOTS IN A HEATED STATE, *J. Riley, Glasgow.—10th August*, 1882. 6*d*.

The apparatus consists of double metal shells with an intermediate space filled with non-conducting material. It is mounted on wheels, and provision is made for heating the compartments containing the ingots by means of combustible gas. The carriage may consist of a platform on wheels, and a hood provided to cover the ingots during transit, the hood being lined with or made principally of non-conducting material.

3808. STEAM BOILERS, *G. Sinclair, Leith.—10th August*, 1882. 6*d*.

This relates to improvements on patents No. 2004, A.D. 1877; No. 1388, A.D. 1878; and No. 2035, A.D. 1880, and it consists, First, of improved mechanical stoking apparatus. A reciprocating pusher box pushes the coals from the bottom of a hopper into the furnace. The fire-bars are made to reciprocate longitudinally by cranks on a shaft, and their inner ends are a little above a transverse water casing, the fire-bridge being some distance inwards from the ends of the bars. The invention further consists in forming fire-brick air inlets above the fire-bars and projecting into the furnace, so as to heat the air entering through them. A Third improvement in boilers with internal furnaces consists in forming in the lower parts of the outer shell, and the lower parts of the internal flues one or more indentations or corrugations, so as to prevent them being injured by the top parts becoming heated while the bottom parts are still cold.

3811. CLEANING AND POLISHING WINDOWS, *C. H. Southall, Leeds.—10th August*, 1882. 6*d*.

This relates to an apparatus to clean windows on the inside and outside at the same time, and it consists of a spring bow frame, each arm of which carries a rubber to bear on one side of the window pane.

3815. TYPE-WRITERS, &c., *H. J. Haddan, Kensington.—10th August*, 1882.—(*A communication from B. Schmitz, Germany.*)—(*Not proceeded with.*) 2*d*.

This consists of a new method of forming symbols for type-writing machines of printing telegraphs. Instead of using a different type for every letter, different symbols or letters are formed by the combination of five straight lines placed in different positions. It further consists in mechanism for printing the symbols on a travelling sheet of paper by means of five parallel keys.

3819. GAS ENGINES, *J. M'Gillivray, Glasgow.—10th August*, 1882. 6*d*.

This relates especially to the construction and arrangement of the valves for admitting the gas and air, causing the ignition of the charge and exhausting the waste vapour. In one arrangement the valves regulating the admission of gas and air, and that controlling the ignition, are arranged horizontally and transversely or across the cylinder, and are operated against springs by cams or wipers on a shaft parallel to the longitudinal centre line of the cylinder, and driven by gearing from the crank shaft. The valve to admit the gas consists preferably of a sliding tube, which, when pushed back by the cam or wiper, opens a port to admit the gas through a tubular casing to an inlet tube leading to the rear end of the cylinder. The air enters by a similar valve.

3823. ENDLESS BAND KNIVES, *T. Clark, London.—10th August*, 1882.—(*A communication from J. A. Kay and D. Beath, Melbourne.*) 6*d*.

This consists in forming the cutting edge of band knives used to cut cloth, leather, rubber, or other material, with a succession of curves or waves so as to enable it to cut through tough, gritty material more easily.

3826. KNITTING MACHINES, *A. M. Clark, London.—10th August*, 1882.—(*A communication from I. W. Lamb, Michigan, U.S.*) 8*d*.

This relates to improvements on patent No. 1445, A.D. 1865, and consists, First, in a sectional needle-bed in combination with needle shifters, whereby great facility of construction and great durability are secured; Secondly, in the manner of supporting and securing the shifters in their upper and lower positions; Thirdly, in the construction of the bed sections and the manner of attaching the jacks thereto; and, Fourthly, to the general construction and arrangement of the machine.

3828. CAST IRON LINING FOR WALLS OF FURNACES, *W. H. Beck, London.—10th August*, 1882.—(*A communication from L. Wallet, Paris.*) 6*d*.

The object is to dispense with the fire-bricks at the level of the grate bars of the furnace, which quickly deteriorate and require renewing, and it consists in the use of cast iron linings or bearers applied to the sides and end of the grate and formed with perforations on their faces next the grate and on their lower faces, through which cold air passes and prevents coal adhering to the linings.

3830. DRYING AND TREATING TEXTILE FABRICS, *W. M. Riddell, London.—11th August*, 1882. 6*d*.

The object is to treat rags of textile fabrics composed of cotton and wool so as to separate the animal from the vegetable fibres. The rags, after being subjected to a chemical treatment as usual, are passed between rollers which squeeze out excess of moisture, or they may be dried in a centrifugal machine or by hot air. They are then conveyed round a large cylinder heated to a temperature of from 200 deg. to 280 deg. Fah., by which means the molecular state of the cotton is completely changed, and under the action of beaters can be easily separated from the wool fibres in the form of dust.

3831. EXTRACTING PRECIOUS METALS FROM THEIR ORES, *A. K. Huntingdon, Strand, and W. E. Koch, Kensington.—11th August*, 1882. 4*d*.

This consists in calcining the ores and then subjecting them to heat and agitation in a deoxidating atmosphere in presence of melted metal, such as lead, zinc, or their equivalents.

3839. MACHINERY FOR BREAKING UP THE GROUND, &c., *J. H. Johnson, London.—11th August*, 1882.—(*A communication from J. A. Kay, Melbourne.*) 6*d*.

The machine consists of a succession of lines of picks, multiple or otherwise, carried on discs supported by and revolving with shafts or gudgeons, the lines of picks being on the same or on different levels. The multiple picks are formed by bolting them together and to a disc. A series of revolving scoops or shovels are arranged behind the picks and turn over the loosened earth; when necessary they discharge it into elevators for removal. A seed sower and a harrow are combined with the machine.

3844. REED FABRICS FOR CEILINGS, *E. A. Brydges, Berlin.—12th August*, 1882.—(*A communication from P. Stauss and H. Ruff, Prussia.*) 6*d*.

This relates to the use of fabrics of reeds and wire for making ceilings, such fabrics being woven in looms, the wire serving to secure the reeds together.

3858. TREATING SOLUTIONS USED FOR PURIFYING COPPER ORES, &c., *D. Watson, Manchester.—12th August*, 1882. 2*d*.

The object is to remove arsenic and phosphorus from alkaline solutions which have been employed for the purification of copper ores, so as to render them available for use again, and it consists in treating such solutions with calcium hydrate.

3863. DEODORISING AND PURIFYING HUMAN EXCRETA FOR MANURIAL PURPOSES, *R. Nicholls, Hendon.—12th August*, 1882. 6*d*.

The excreta is caused to fall together with cinders, ashes, or like absorbent material into a vessel, which when charged is heated externally, whereby the ammonia and moisture are driven off through a bed of soot or like deodorant into a receiver where the ammonia crystallises whilst the aqueous vapour escapes.

3870. STEAM BOILERS, *J. Imray, London.—14th August*, 1882.—(*A communication from C. H. F. Russmann, Hamburg.*) 6*d*.

The boiler or generator consists of a number of sets of zigzag pipes, each set forming a section which by means of cocks can be cut off from the rest when required, and all the sets when the boiler is in use have common water and steam connections, and are enclosed within a fire-box. The lower limbs of the pipes are so arranged as to act as the fire-grate.

3879. TYPE SETTING AND DISTRIBUTING MACHINES, *E. W. Brackelsberg, Westphalia.—14th August*, 1882. 1*s*. 2*d*.

This relates to improvements on patent No. 1669, A.D. 1881, and consists, First, in adjusting the type ejector frame of the setting frame, and also that of the distributing machine, completely by the hand of the operator, and before the ejector bar is depressed; Secondly, the ejector bar is actuated at the required moment by a mechanism worked by any available power, such mechanism being made to act on the bar by the same motion of the operator's hand which causes the adjustment of the ejector frame; Thirdly, in effecting the removal of the lines of type from the composing race to the galley by a mechanical device; Fourthly, the types delivered from the distributing race into the type channels are pushed forward within the latter by a device operating independently of the ejecting mechanism.

3953. DREDGING MACHINERY, *H. C. Lobnitz, Renfrew.—18th August*, 1882.—(*A communication from H. Hersent, Paris.*) 10*d*.

The inventor claims, First, the application of guide wheels to the descending side of endless chains of dredging buckets; Secondly, the application of endless pitch chains or endless ropes for driving the upper pulleys of endless chains of dredging buckets; Thirdly, an arrangement for moving a dredger boat wherein the moving chains are led down fixed wells or tubes and through swivelling tubes therein, such swivelling tubes having guide pulleys at their lower ends; Fourthly, the arrangement of machinery for winding or hauling the mooring chains of dredgers, wherein each chain is led round two grooved barrels; Fifthly, the arrangement of colour in combination with one or more endless chains of dredging buckets.

3969. GLAZING GREENHOUSES, &c., *J. Chaffin, Bath.—19th August*, 1882. 6*d*.

This relates to improvements on provisional protection No. 1228, A.D. 1882, and it consists essentially in securing to both edges and to both sides of the sheets of glass a layer of felt or other soft waterproof material, so that they may be supplied ready for laying on the rafters, where they are secured by placing a strip of metal over the adjacent edges of the sheets of glass, between which sufficient space is left for the passages of screws into the rafters. The top layer of felt may be secured to the under side of the metal strip.

3972. UTILISING THE HEAT IN MOLTEN SLAG, &c., FOR CALCINING, AGGLOMERATING, OR SINTERING TOGETHER OTHER SUBSTANCES, *G. H. Blenkinsop, Swansea.—19th August*, 1882. 4*d*.

The inventor claims adding lime or limestone or iron ore or other suitable material to slag or other products containing iron while in a molten state, so as to extract the iron contained therein, and for the purpose of purifying the same.

4240. LIFTS AND HOISTS, *J. S. Stevens and C. G. Major, Battersea, and D. P. Edwards, Glamorgan.—6th September*, 1882. 6*d*.

The object is to enable the load to be held automatically in any attained position without running back when the motive power is withdrawn, but upon the reversal of the direction of the motive power the load will be automatically freed. According to one arrangement, when the motive power is withdrawn the load reverses the motion of the winding barrel, and cams in contact with one end thereof are turned and bear upon a collar, whereby the winding barrel (which is mounted loosely on a sleeve surrounding the driving axle) is thrust against a fixed bearing, and its motion arrested.

4518. MOUNTING SO AS TO FACILITATE THE SHIPPING OR UNSHIPPING OF RUDDERS, *M. Horsley, Hartlepool.—21st September*, 1882. 6*d*.

The inventor claims the method of mounting so as to facilitate the shipping or unshipping of the rudders of ships and other vessels by making the rudders in two or more parts, and coupling such parts together when mounted.

4850. APPARATUS FOR VENTILATING, *W. Teague, Cornwall.—12th October*, 1882. 4*d*.

A wheel with flaps or fans is fitted at the upper end of the outlet pipe, with one or more encircling tubes or covers, to each of which another pipe is attached, and leads into the place to be ventilated.

5020. MECHANICAL MUSICAL INSTRUMENT MOTORS, *G. D. Garvie and G. Wood, New York.—21st October*, 1882.—(*Complete.*) 4*d*.

The object is to utilise the table and driving mechanism of sewing machines for the purpose of operating mechanical musical instruments, the band from the driving pulley of the sewing machine stand being passed over the driving wheel of the musical instrument.

5201. MACHINERY USED IN THE MANUFACTURE OF PAPER, *F. Wrigley and J. Robertson, Bury, Lancashire.—1st November*, 1882. 6*d*.

This relates to the "jog" knotter or strainer, the object being to render the movement or action equal over all its surface. The strainer consists of the ordinary vat and strainer plate frame, the former mounted on vertical standards, and under it is a horizontal shaft with stepped cams or tappets, the shaft being driven by a pulley. The bearings are fixed in boxes connected by a tube, through which the shaft passes, the whole being filled with lubricant. The strainer plate frame is supported by vertical rods, the lower ends of which are in contact with the cams or tappets. The amount of jog is regulated by a wedge adjustable by screws. The pulp on leaving the vat, and on its course to the machine wire, passes down an inclined plane covered with wire cloth, through which the surplus water falls into a box and is drawn off.

5535. METALLIC PACKINGS, *A. M. Clark, London.—21st November*, 1882.—(*A communication from L. Hatzenstein, New York.*)—(*Complete.*) 6*d*.

The object is to produce a packing which can be readily put in place, and which on account of its elasticity will adjust itself and yield when there is any displacement or movement of the pipe joints or rod to which it is applied. The packing rings are hollow, and, preferably, of triangular shape, and are arranged round the rod or pipe with their bases alternately in opposite directions. Each ring consists of a hollow tube with wire round it, and then enclosed in a metal tube, the whole being covered with a fibrous coating of asbestos or equivalent of fibrous strands. The ends of the ring are left open to admit steam or water to the interior, the pressure of which will assist in forming a tight joint.

5654. HOLDERS FOR OPERA GLASSES, *A. J. Boult, London.—28th November*, 1882.—(*A communication from W. Mack, Terre Haute, U.S.*)—(*Complete.*) 6*d*.

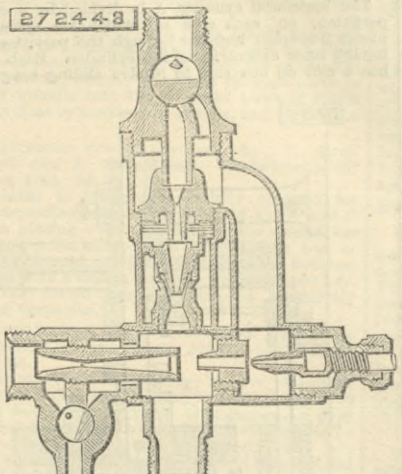
The holder is formed with a kind of spring clutch to grasp the transverse bar of opera glasses, and which is operated by pulling the handle. The handle can be made telescopic, or so as to fold up small enough to be put into the case of the opera glasses, or to be put into the pocket.

SELECTED AMERICAN PATENTS.

From the United States' Patent Office Official Gazette.

272,448. COMBINED INJECTOR AND EJECTOR, *Geo. H. Little, Peabody, Mass.—Filed April 17th*, 1882.

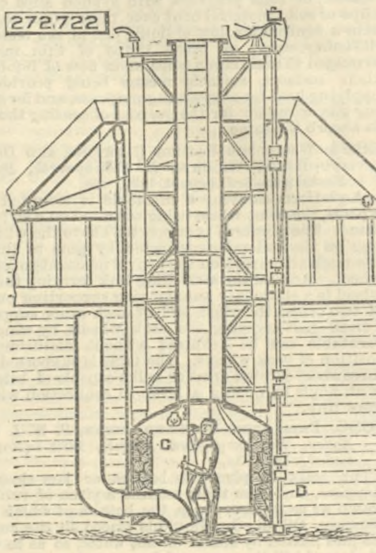
Claim.—A combined injector and ejector in which the ejector feeds the water to the injector, and in which the water thus fed is first lifted to the ejector by means of a tube within the steam nozzle of the injector, substantially as shown and described. An ejector placed above the injector, as set forth, and having an independent connection with the overflow,



and operating to deliver the water from the ejector into the injector, substantially as and for the purpose set forth. The described method of maintaining the vacuum in the injector or ejector by the mixing of liquids of two different temperatures in the priming chamber, and regulating the relative supplies, substantially as set forth.

272,722. FLOATING CAISSON, *Philologus H. Loud, Williston, S.C.—Filed July 17th*, 1882.

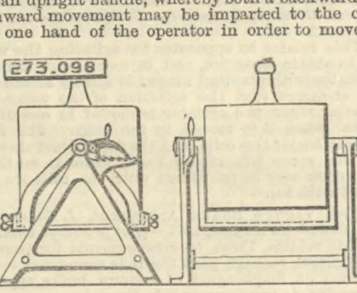
Brief.—(1) The caisson, provided with double walls forming a ballast chamber communicating with the caisson interior, has a stack with doors, forming an air lock, and valves communicating therewith capable of operation from each side. A suction tube extends below the edge of the caisson to take water with the excavated material to assist in its removal. Drills outside of the caisson assist in sinking the same. *Claim.*—(1) In combination, in a caisson an air-tight working chamber having an open-ended bottom, a compressed air-supply tube opening into said chamber, and an exhaust tube opening into said chamber at a point slightly below the lower edge of the same, as specified. (2) In combination, in a caisson an air-tight working chamber having an open bottom, a stack communicating with and leading from said chamber, two or more air-tight doors arranged at different points within said shaft, and air valves communicating



with the two adjacent compartments located and adapted to be operated upon each side of said doors, respectively, as specified. (3) In a caisson an annular chamber formed of double walls C D, said chamber having an open top communicating with the interior of the working chamber for the supply or removal of weight material. (4) The combination with the framework of a caisson, and upon the outside of the same of drills or stamps K K, for the purpose specified.

273,098. HOLDER FOR ACID CARBOYS, *Charles S. Joslin, Attleborough, Mass.—Filed April 5th*, 1882.

Claim.—In a holder for acid carboys, the combination of the supporting standards and ratchet bar with the pivotted frame, and the ratchet catch provided with an upright handle, whereby both a backward and downward movement may be imparted to the catch with one hand of the operator in order to move the



carboy to an inclined position for pouring acid therefrom, and to retain the point of the catch in contact with the notches of the ratchet bar, and whereby the point of the catch may be elevated preparatory to the backward movement of the carboy from its pouring position, substantially as described.

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THE ENGINEER, March 30th, 1883. PAGE

SOUTH KENSINGTON MUSEUM.—Visitors dur ng the week ending March 24th, 1883:—On Monday, Tuesday, and Saturday, free, from 10 a.m. to 10 p.m., Museum, 10,997; mercantile marine, Indian section, and other collections, 4893. On Wednesday and Thursday, admission 6d., from 10 a.m. to 5 p.m., Museum, 947; mercantile marine, Indian section, and other collections, 175. Total, 17,012. Average of corresponding week in former years, 14,973. Total from the opening of the Museum, 21,795,592.