THE INSTITUTION OF NAVAL ARCHITECTS.

THE chair was taken a little after twelve noon on Friday, the 8th, by the Earl of Ravensworth. The first paper read was by Mr. W. H. White,

ON THE ROLLING OF SAILING SHIPS.

This paper was of a highly technical character, and of interest to a comparatively limited circle. Mr. White contented himself with reading only a portion of it; a part, however, devoted to the study of wind pressures is valuable to engineers, and this we give in full, while omitting the sections referring solely to the complex laws governing the rolling of ships. Mr. White began by stating that he proposed to attempt a review of the present state of our knowledge respecting the rolling of rigged ships in a seaway; to notice the various attempts that have been made to deal with the question of the safety of such ships when struck by sudden squalls or gusts of wind; and, finally, to give a brief description of a method of procedure upon which he had bestowed much thought, and which appeared to embrace more of the conditions of the problem than any published method with which he was acquainted. Any investigation of the behaviour of sailing ships at sea must take account of the conditions belonging to the discussion of their rolling when no sail is set, and must superpose upon those conditions the other and no less difficult conditions relating to the action of the wind upon the sails, the influence of heaving motions upon the stability, and the steadying effect of sail-spread. He then explained that the particulars required for the "graphic integration" of the rolling of a ship with no sail set might be briefly summarised, and from this summary of the data required for the discussion of the behaviour of rigged ships in a seaway, it was obvious that a number of preliminary conditions must be assumed before any progress was possible. The author then proceeded to general considerations respecting the application of scientific methods to the discussion of the behaviour of rigged ships in a sea-way. The conclusion he had reached, after a careful study of the subject, is that we need very considerable extensions of our knowledge of the laws of wind pressure before more exact investigations will be possible. Mr. White then proceeded to review the present state of knowledge of the laws of wind pressure. It was evident that accurate investigation of the behaviour of sailing ships must depend greatly upon correct knowledge as to the laws which govern the pressure of wind on the sails. For some years past this subject had engaged his attention, and the result of his inquiries might be briefly summarised there. Most of the data available were due to the labours of French experimentalists. Colonel Beaufoy made a few experiments on air resistance, and the late Mr. Froude gave some attention to the subject, but was prevented from pursuing it by the pressure of other work. In the following table is given the results of experiments made with thin plates, placed normal to the line of motion of the air relatively to their plane surfaces. If

A = area in square feet of plane surface of plate.
V = the relative velocity of the wind and the plate, in feet per second.
R = pressure on plate (or air resistance), in pounds.

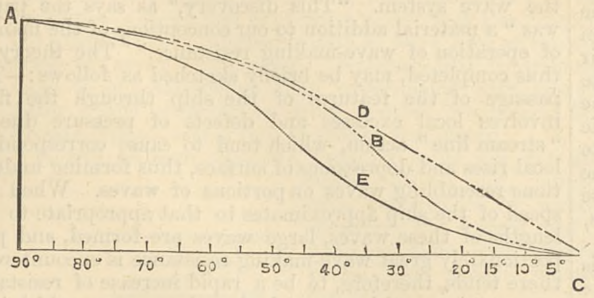
Then it is found from experiments with small plates that

$$R = k \, . \, A \, . \, V^2.$$

where k is a constant coefficient.

Experimentalist.	Date.	Value of k.	Mode of experiment.
Borda	1763	·00184	Plates moved through still air on a revolving fan-wheel.
Thibault	1832	·00206	
Morin and Didion	1835 to 1837	·0019	
		·0016	Plate falling vertically.
Rouse	—	·00229	
Hutton	—	·00188	
Paris	1872	·00239	Plate exposed to actual wind on board ship.
Froude..	1876	·0017	Plate moved through still air.

Accepting the value of k deduced from the experiments of Mr. Froude, and having regard to the more detailed experiments of his predecessors, the following points seemed to be established:—(1) That the normal pressure of wind on a plane surface varies as the square of its velocity. (2) That for small planes the normal pressure corresponding to a given velocity varies as the area, and is not affected by the form of the plane. (3) That for oblique impact, the pressure on a plane varies practically as the sine of the angle of incidence for values of that angle between 90 deg. and 50 deg.; but that for smaller angles of incidence no regular law has been established, although it is known to decrease more rapidly than the sine of the angle. The most elaborate series of experiments on oblique impact were made by Thibault, and the results had sufficient practical interest to justify their reproduction. In the diagram three curves were drawn. Abscissæ measurements corresponded to values of the angle of incidence of the wind on



the plate; while ordinates indicated the value of the normal pressures. The curve A B C showed Thibault's experimental data, the curve A D C showed what the normal pressure would be if it varied directly as the sine of the angle of incidence; the curve A E C showed what it would be if it varied as the square of the sine of that angle. It would be remarked that the curves A B C and A D C were very close together up to angles of incidence of 50 deg. to 60 deg.; and this range included the inclinations to the vertical likely to be reached when the ship was rolling. On the other end of the curves it would be noted that for angles of incidence below 30 deg., such as were likely to occur in ships sailing close hauled, the experimental curve A B C was intermediate between the other two curves. All the experiments on record had been made with comparatively small plates, the largest of them not exceeding three or four square feet in area. How far these laws and coefficients for pressure would hold for plates of very large areas was at present a matter of opinion. The evidence taken before the Tay Bridge Commission disclosed the fact that the most eminent living authorities endorse the opinion that further experiments are needed, with larger areas and more varied conditions than have hitherto been tried, and anyone who studies the question must reach the same conclusion. When we passed from plane surfaces to sails, we were in still more doubt as to the laws of wind pressure. The only experiment he had been able to trace was made by Thibault about half a century ago. He attached small sails—about 1·2 square feet in area—to the arms of a fan-wheel, and noted the resistances when the sails were tightly stretched as planes, and when they bellied out under the action of the air. His conclusion from these small scale experiments was very interesting, although it could scarcely be regarded as certainly applicable to the enormously greater areas of the sails in a large ship. It was that the normal pressure on the curved sail was equal to that on a plane sail of equal wind entrance; the effect of the curvature counterbalancing the reduction of the area when projected on a plane normal to the wind. It must be admitted, therefore, that up to the present time accurate knowledge is almost entirely wanting respecting the laws which govern wind pressures on large sails. We could not certainly express the pressure per unit of area on large sails corresponding to a certain velocity of wind and to a certain angle of incidence. Having reached this conclusion from a study of the experiments on air resistance, it naturally occurred to the author to see whether an investigation of the recorded angles of steady heel of actual ships under certain sail-spreads and forces of wind would lead to any helpful results. A considerable number of records were examined for ships of different sizes and types, of which the stability had been accurately determined, and for which the angles of steady heel had been noted when all plain sail was carried in comparatively smooth water. It had been generally assumed, from the time of Chapman downwards, and appeared to have been verified in a general way by seamen, that the force of wind in which all plain sail would be carried has a velocity corresponding to a pressure of 1 lb. per square foot on a small plane placed at right angles to the wind. But he had been unable to discover, however, that there were any conclusive observations as to the amount of this pressure on a unit of area of plain sail. Assuming for the moment that the ordinary assumption is approximately true, and that the effective normal pressure is 1 lb. per square foot, it was possible to estimate the inclining effect of the resultant pressure for any given direction of the wind and angle of bracing for the yards. Thence the angle of steady heel can be readily obtained. Making this calculation for a considerable number of rigged ships of different types, it was found that in all cases the recorded angles of heel considerably exceeded the estimated angles, and in some representative vessels for which he had special information he found that the real force of the wind must have corresponded to an average normal pressure of 8 lb. or 10 lb. per unit of area instead of 1 lb., in order to have produced the recorded inclinations. This would involve an error in the estimate of the wind force and velocity, such as could scarcely be imagined to have taken place. He had since found that the same discovery of a discrepancy between actual and estimated angles of steady heel had been made by earlier writers. Accepting Borda's experiments on air resistance as correct, it follows that for a given velocity of wind the pressure per unit of area increases with increase of area in planes of similar form. Whatever the explanation of the discrepancy might be, its existence suggested the necessity for further experiments on a larger scale, and accompanied with more accurate observations than are now common, respecting the velocity and pressure on small planes of the winds.

The author then proceeded to estimates of sail-carrying power. The present Admiralty practice in estimating the sail power of a ship might be briefly explained in passing. The whole of the "plain sail" carried by ship is supposed to be braced fore and aft, and to be acted upon by a wind having an effective pressure of 1 lb. per square foot of sail area. The resultant force is supposed to act through the centre of gravity of the plain sail—or "centre of effort"—and the leeway is supposed to develope a resistance equal in amount, but opposite in direction to the resultant wind pressure. This resistance is assumed to act at the mid-draught of the ship; and the couple formed by it and the wind pressure will heel the ship over to some angle a for which the righting moment equals the inclining moment. As the ship heels the inclining moment is usually assumed to vary as the (cosine)² of the angle of inclination. In algebraical language—

Let A = Area of plain sail.
h = Height of centre of effort above mid-draught when ship is upright.
D = Displacement of ship (in pounds).
m = Metacentric height (in feet).
a = Angle of steady heel.

Then for angle a

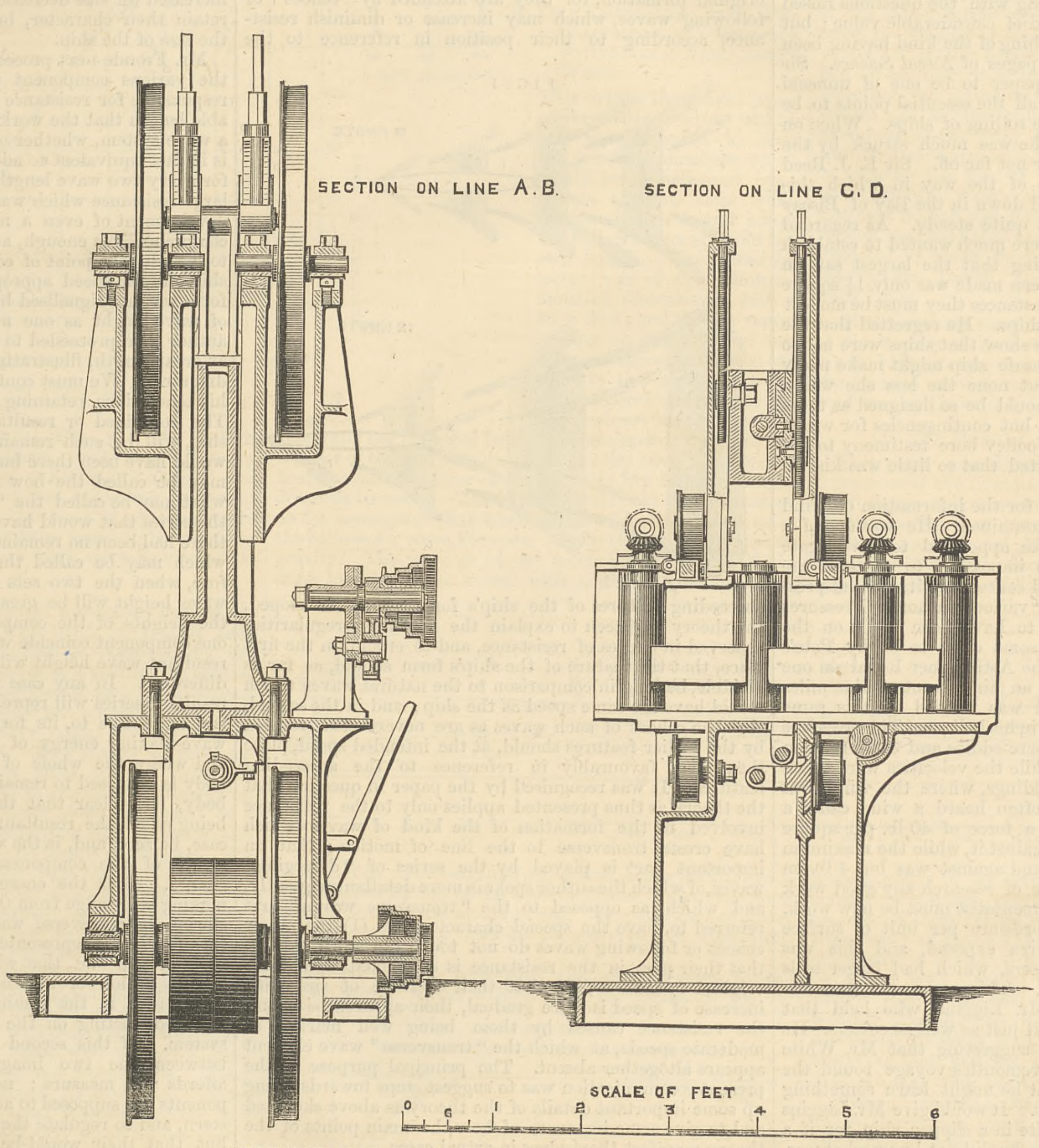
$$\text{Moment of sail} = A \times h \times \cos.^2 a$$
$$\text{Righting moment} = D \times m \times \sin. a$$

And these two moments are equal. Within the limits of a, likely to occur in practice, this equation of moments may be written:

$$Dm \, . \, \sin. a = Ah$$

Whence

$$\sin. a = \frac{A \cdot h}{D \, . \, m}$$



AYLESBURY'S DOUBLE-BAND SAW.—(*For description see page 299.*)

The ratio $\frac{Dm}{Ah}$ therefore measures the sail-carrying power of the ship; and this is the number given as denoting that power in Admiralty statements. If the number is high it indicates that the vessel is stiff; conversely, if the number is low it indicates that the vessel is crank.

The remaining portions of Mr. White's paper were devoted to a consideration of the influence of rolling motion on the wind pressure on the sails; the influence of heaving motion on the instantaneous righting motion; the influence of air resistance on the suppression of rolling motion, and lastly to a description of the author's method of dealing with the very complex questions involved, by a system of graphic integration, the nature of which it would be impossible to make intelligible within the space at our disposal. The paper was extremely long, and is really a valuable treatise on a subject of great importance to naval architects, although it has little interest for engineers.

There was very little discussion on this paper, and it is not easy to see how it could be discussed. As we have stated, the author omitted reading the larger part of it. Mr. John opened the discussion, stating that the data on wind pressures were quite new to him, and likely to prove of much value. It was quite impossible to follow Mr. White on the spur of the moment through his elaborate paper. The methods of dealing with the questions raised seemed to him to be possessed of considerable value; but they were not quite new, something of the kind having been suggested long since in the pages of *Naval Science*. Sir E. J. Reed considered the paper to be one of unusual value, summarising, as it did, all the essential points to be considered in dealing with the rolling of ships. When on board the Livadia in a gale, he was much struck by the behaviour of a Dutch schooner not far off. Sir E. J. Reed gave a very graphic account of the way in which this little craft was tossed up and down in the Bay of Biscay while the Livadia was almost quite steady. As regarded wind pressures, experiments were much wanted to establish facts. It was a startling thing that the largest sail on which an experiment had been made was only $1\frac{1}{4}$ square feet in area. Under the circumstances they must be modest in discussing the rolling of ships. He regretted that the tendency of the paper was to show that ships were not so unsafe as they were. An unsafe ship might make many voyages without accident, but none the less she was a dangerous craft. All ships should be so designed as to be quite safe against everything but contingencies for which no one could provide. Dr. Woolley bore testimony to the value of the paper, and regretted that so little was known about wind pressures.

Mr. Merrifield was grateful for the information on wind pressures which the paper contained. He was one of a British Association Committee appointed to investigate the whole subject, and it was impossible to conceive the crass ignorance which existed concerning it. Wind pressures were variously stated by various authors. Pressures which, by calculation, ought to have been 50 lb. on the square foot, were found in some cases to be, by Peto's tube, but 9 lb. or 10 lb. The Astronomer Royal on one occasion gave the velocity of an air current as nine miles an hour, while Mr. Coxwell was carried by this same current forty miles in an hour in his balloon. The pressures were taken on the ground, where eddies and earth friction interfered with the results, while the velocities were taken high up on the tops of buildings, where the wind was flowing much faster. They often heard a wind called a hurricane, and said to have a force of 40 lb. per square foot; and yet men stood up against it, while the maximum force which a man could stand against was but 4 lb. on the square foot. In this line of research any good work which was done by any experimentalist must be new work.

Mr. Inglis said that the pressure per unit of surface increased with the total area exposed, and this was proved by the fact that cutters, which had larger sails than schooners, sailed better. This statement was disputed at some length by Mr. Liggins, who held that schooners could be made to sail just as well as cutters. He created some amusement by suggesting that Mr. White should go to sea for a twelvemonth's voyage round the world in a clipper ship, so that he might learn something practical about wind pressures. It would give Mr. Liggins great pleasure to see Mr. White in a clipper ship, for if a clipper ship was not dangerous, he did not know what was.

Admiral Sir Spencer Robinson said that he, in common with all practical sailors, was much indebted to those who, like Mr. White, taught them the meaning of phenomena, which they had all perceived, but failed to comprehend.

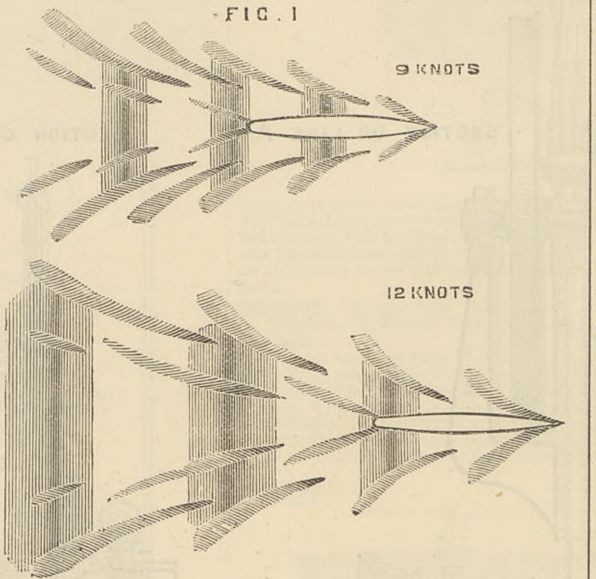
Mr. Froude thanked Mr. White for his reference to the late Mr. Froude's works. In dealing with the rolling of a sailing ship in a sea, he did not think it necessary to consider the effect of hull friction in retarding rolling. Two or three other speakers who followed added nothing new, and Mr. White briefly replied. He had tried, he said, to give quantitively what was already generally known qualitatively. It must be remembered, when dealing with the sails of cutters and schooners, that the planes of their sails were seldom exposed at right angles to the wind. Concerning Mr. Reed's remarks, he would only say that hundreds of ships which by calculation were unsafe went to sea, and came home again, and lived as long as any other ships.

A vote of thanks having been passed to Mr. White, the next paper was read by Mr. Froude,

On the Leading Phenomena of the Wave-making Resistance of Ships.

This was a very elaborate and able paper, the purpose of which was to review the more salient points in the theory of wave-making resistance; and it took as a starting point the paper on "The Effect of Parallel Middle Body," which was read before the Institution by the author's father in the year 1877. The experiments described in that paper were on a series of models, all having identical entrance and run, but different amounts of parallel middle body. The remarkable feature of the results was that the introduction of the parallel middle body not only increased the skin friction in virtue of the added area of skin, but affected the wave-making resistance also in virtue of the changed position of the afterbody in reference to the wave system left by the bow; so that if the parallel middle body were gradually elongated, the wave-making resistance would alternately decrease and increase as the after body was brought into favourable or unfavourable juxtaposition with the successive features of the wave system. "This discovery," as says the paper, was "a material addition to our conceptions of the manner of operation of wave-making resistance." The theory, as thus completed, may be briefly sketched as follows:—The passage of the features of the ship through the fluid involves local excesses and defects of pressure due to "stream line" action, which tend to cause corresponding local rises and depressions of surface, thus forming undulations resembling waves or portions of waves. When the speed of the ship approximates to that appropriate to the lengths of these waves, large waves are formed, and proportionately great wave-making resistance is encountered: there tends, therefore, to be a rapid increase of resistance as a certain speed is approached, a phenomenon which is of course the more definitely marked the more nearly uniform are the wave-lengths of the several portions of waves which the features of the ship tend to form. But the part played by the waves is not necessarily complete with their original formation, for they are attended by "echoes" or following waves, which may increase or diminish resistance, according to their position in reference to the

FIG. 1



succeeding features of the ship's form. Thus developed, the theory was seen to explain the peculiar irregularities observed in curves of resistance, and to enjoin, in the first place, that the feature of the ship's form should, as far as possible, be long in comparison to the natural waves which would have the same speed as the ship; and in the second, that the echoes of such waves as are nevertheless formed by the earlier features should, at the intended speed, place themselves favourably in reference to the succeeding features. It was recognised by the paper in question that the theory as thus presented applies only to the resistance involved in the formation of the kind of waves which have crests transverse to the line of motion; that an important part is played by the series of "diverging" waves, of which the author spoke in more detail subsequently, and which, as opposed to the "transverse waves" first referred to, have the special characteristics (1) that their echoes or following waves do not touch the ship's side, so that their part in the resistance is completed with their original formation; (2) that their increase of size with increase of speed is more gradual, their apparent size and the resistance caused by them being well marked at moderate speeds, at which the "transverse" wave element appears altogether absent. The principal purpose of the present communication was to suggest steps towards filling up some important details of the theory as above sketched and to give some instances of how the main points of the theory manifest themselves in actual cases.

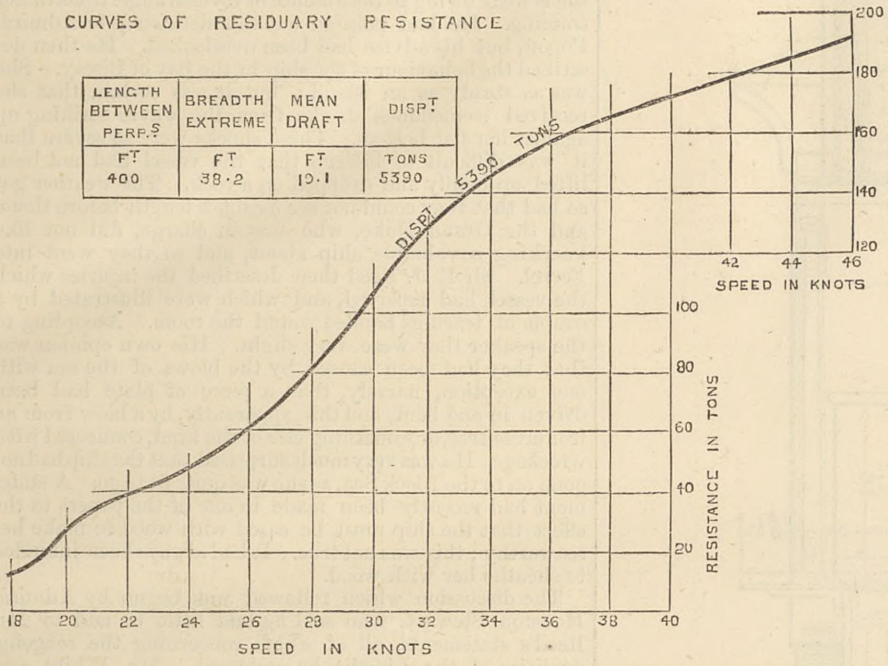
Wave-making resistance, the author explained, regarded in its actual effect as experienced by the ship, is of course simply the net fore-and-aft resultant of the fluid pressures acting normally on all parts of the surface of the vessel. If a body is at rest in undisturbed fluid, the pressures are throughout the true hydrostatic pressures, and the net fore-and-aft effect is zero. If the body is travelling through the fluid, but deep below the surface, the pressures are largely changed from the hydrostatic pressures, in virtue of "stream line" action, but still the net fore-and-aft effect is zero—except in so far as the equality between the favouring and resisting pressures is vitiated by eddy-making. If the body is travelling at or close to the surface, the pressures are still further changed from the hydrostatic pressures in virtue of the formation of waves, and such additional difference as is thereby introduced between the sum of the fore-and-aft pressures is the wave-making resistance. The approach to the surface of the fluid, by admitting of wave formation, has changed the pressures, because the wave system is really a changed set of stream lines, and involves a correspondingly changed set of pressures, the disposition of streams and pressures being throughout such that there is a perfect correspondence between the force acting on every particle and the motion thereby impressed upon it.

In its main characteristics the wave system seems the same under all conditions. It seems invariably to consist partly of transverse and partly of diverging waves, and the angle of divergence of the latter does not vary greatly. The transverse wave series consists of a row of parallel wave crests, square, or nearly so, to the line of motion, keeping pace with the ship, their length from crest to crest in the line of motion being about that proper to a deep water wave travelling at the same speed as the ship. In a very long parallel sided ship the crests of the transverse waves formed by the bow show for some distance against the side, successively diminishing in height as they spread sideways, and seemingly recede slowly from the side in virtue of any slight angle of divergence. If the parallel side is so long that these crests have in this manner disappeared by the time the afterbody is reached, the stern is seen to leave a series of transverse waves of its own, of just the same character as that left by the bow; if, however, the straight side is not so long, these two series appear to coalesce into one. The angle of divergence of the diverging waves, and the relative importance of the transverse and diverging series, varies of course in different ships and in the same ship at different speeds; the general characteristics of the system, however, as above described, seem common to all forms of vessel under all circumstances. Fig. 1 shows the wave system made by an 83ft. launch at 9 knots and 15 knots. Additional illustrations were given by the author, which we have not space to reproduce. It would be seen, the author went on to say, that at the 9 knot speed for the 83ft. launch, or at 18 knot speed for a 333ft. ship, the wave system is precisely of the character observable in large ships at full speed, showing the familiar train of diverging waves at the bow and at the stern. As the speed is increased (or size decreased) both trains of diverging waves retain their character, but expand in scale relatively to the size of the ship.

Mr. Froude next proceeded to consider to what extent the various component parts of the wave system are responsible for resistance; and he explained at considerable length that the work a ship has to do in maintaining a wave system, whether of transverse or diverging waves, is in fact equivalent to adding to the system one new wave for every two wave lengths she travels. In this light the large resistance which was found to be incidental to the development of even a moderate train of waves became comprehensible enough, and they were now in a position to see why the point of equality between the speed of the ship and the speed appropriate to the wave she tends to form was not signalised by such an emphatic exaggeration of wave height as one might at first sight expect. The author then proceeded to deal with influence of the waves at great length, illustrating his observations by the aid of diagrams. We must content ourselves with a summary of his conclusions, retaining as far as possible his own words. The combined or resultant wave series left behind the ship, will be such remainder of the bow wave series as would have been there but for the after body—and which may be called the bow component—"superposed" upon what may be called the "natural" stern wave series, *i.e.*, the series that would have been made by the afterbody if there had been no remainder of the bow-wave series—and which may be called the stern component. And, therefore, when the two sets of crests coincide, the resultant wave height will be greatest, and will equal the sum of the heights of the components; and when the crests of one component coincide with the troughs of the other, the resultant wave height will be smallest, and will equal their difference. In any case the square of the height of the resultant series will represent the energy consumed in, and resistance due to, its formation. In the case where the wave-making energy of both fore and after bodies $= 1$, and where the whole of that originally due to the fore-body is supposed to remain to be dealt with in the after-body, it is clear that the two component wave systems being equal, the resultant wave height will, in the best case, be zero, and, in the worst case, will be double that of either of the components, and involve four times the energy. Thus the energy expended in transverse wave-making will range from 0 to 4. The total expenditure of energy in transverse wave-making may be described as (1) the amount represented in the lost portion of the bow wave system—*i.e.*, that which has gone away out of reach of the action of afterbody—added to (2) the amount represented in the combined wave system made by the afterbody acting on the remaining portion of the bow system. Of this second item, the degree of coincidence between the two imaginary component wave systems affords the measure; not of course that the two components are supposed to act upon one another clear of the stern, and so regulate the height of the resulting system; but that their would-be coincidence is the criterion of what happens to one of the two when acted upon by the portion of the ship which would cause the other. The theory as thus developed attributes a twofold operation to the bow-wave series—or what remains of it—in its beneficial action on the afterbody: viz., (1) its own absorption, (2) the complete or partial frustration of the formation of the natural stern wave. But it should be noticed that where, as must always be practically the case, only a part of the bow-wave series remains, the second of the two operations grows very much in relative importance. It is a reasonable inference that the wave-making features of a ship will operate more effectively to make short waves if their displacement is disposed broadwise rather than deepwise, and more effectively to make long waves if it be disposed deepwise rather than broadwise. Now the diverging waves being necessarily much shorter than the transverse waves, we see that flaring out the end sections of a ship, or increasing the ratio of breadth to depth, will, *cæteris paribus*, tend to increase the resistance due to diverging waves and diminish that due to transverse waves; while the giving "U" sections or increasing ratio of depth to breadth will have the opposite effect. These inferences are visibly corroborated by the appearance of the wave systems caused in the cases referred to. Again it is worth noticing that the experiments at Torquay have shown that as a rule moderately "U"-shaped sections are good for the forebody, and comparatively "V"-shaped sections for the afterbody. This would seem to show that in the wave-making tendency of afterbody the diverging wave element is less formidable than in that of the forebody, and this inference corresponds with the fact that the stern diverging wave series is visibly less marked than that of the bow.

The author then proceeded to supply some practical instances of the operation of the causes we have been considering, and to do this he gave diagrams of the resistance curves of long merchant ships of the usual type, models of which have been tried at Torquay. For convenience of comparison, the ships were here brought to a uniform length of 400ft. To enable the features of the resistance curves to appear more distinctly, the resistances were shown in the form of curves of "residuary" resistance—that is to say, total resistance, minus skin friction. They included higher speeds than the vessels could attain, and for one of the ships at a lighter draught a curve was shown—on a different scale—up to 46 knots, at which speed the ship may be considered as corresponding to a torpedo boat of 100ft. long, travelling at 23 knots.

FIG. 2



This diagram we reproduce in Fig. 2. The author explained that he introduced these results into his paper chiefly in order to exhibit the remarkable "humps" and "hollows" in the resistance curves, extending in regular succession, as we advance up the scale of speed, even to torpedo boat speeds. These features begin to be visible at about 12 knots speed, and are very strongly marked at 16 and 18 knots.

This was another paper which it was almost impossible to discuss with any profit. The truth is, that in such cases all the available information is possessed by the reader of the paper, and no one is in a position to contradict his assertions. It is possible that if such contributions to the literature of a subject were put a month in advance into the hands of members they might be able to talk about them with some profit. As a matter of fact, the discussion degenerates into a cross fire of questions addressed to the author, or into expressions of admiration on the part of men who see before them the result of a great deal of labour, but concerning the accuracy and importance of which they have no means of judging. We do not mean for a moment to say that Mr. Froude's paper was not valuable and accurate, but we do mean to say that his hearers had to take its accuracy and value on trust; and if it had been neither accurate nor valuable they could not discover the truth in the time available. Mr. Denny, for example, who probably knows as much about the resistance of ships as any man living, occupied the greater part of the brief period at his disposal in paying compliments to the late Mr. Froude, well deserved no doubt, but listened to with impatience by those who wanted to hear Mr. Denny talk about ships and not about men. When he got over this part of his subject, he said what coming from such an authority was of much interest, namely, that it was by no means hopeless that very much higher speeds could be got out of ocean steamers than those now attained. The performance of torpedo boats was very wonderful. A few years since it would have been regarded as impracticable to drive a boat 70ft. or 80ft. long at 23 miles an hour. He could not hope that our Atlantic steamers would attain the theoretical velocity mentioned in the paper, namely, 46 knots per hour, but we might at least hope to progress in that direction.

Mr. Barnaby said that he had heard with pleasure Mr. Denny speak of the value of the Admiralty establishment at Torquay, where Mr. Froude had done so much good work. But the Torquay establishment was much indebted to the shipowners who supplied models of ocean ships for the purpose of comparison. The Torquay establishment was the only one then in existence, and he thought that much would be gained by the setting up of similar testing tanks in other places. One of the most important lessons ever taught by the late Mr. Froude was that very narrow ships were a fallacy. Moderate beam, he had shown, was quite compatible with speed. He never thought of war ships without becoming more and more convinced that in time of trial England must look for the protection of her commerce to her own great mercantile steam fleet, and that ships ought to be much wider than they are, that their engines might be more effectually protected by coal at each side. The ordinary steamship was too narrow to permit her machinery to be effectually protected. Concerning the speed of ships, he said that Mr. Thorneycroft had told them that he had much considered this question. If he could only get a velocity of about 23 knots, all the rest was easy, because the power required to give augmented velocities beyond this increased very slowly. But the attainment of the 23 knots demanded an enormous power.

After a couple of other speakers had been heard, Mr. White said that he liked Mr. Barnaby's hopefulness, but that he found that to overcome the residual resistance alone of a 400ft. ship at 46 knots would require 180,000-horse power. He confessed he did not quite see how this wa o be had. Mr. White then dwelt at some length on the work done by Rankine, pointing out the great change that had taken place in dealing with the theory of the resistance of ships, and expressing regret that Rankine had not available such admirable data as were now at the disposal of every shipbuilder. Nothing had contributed more to our knowledge than experiments with models. After a few observations from another gentleman, Mr. Froude replied, and a vote of thanks was passed.

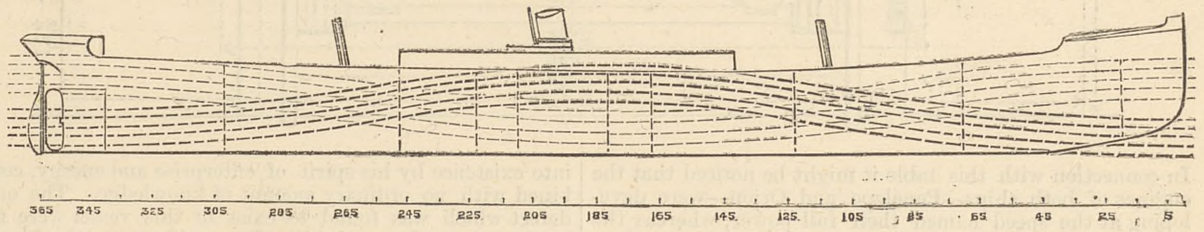
It will be seen that Mr. Froude's paper was not discussed at all, nor, indeed, even referred to by several speakers; but a great deal of valuable time was wasted, which was much wanted further on.

The third and last paper read at the morning meeting on Friday was one by Mr. W. W. Rundell,

ON FREEBOARD AND DISPLACEMENT IN RELATION TO STRAINS IN SHIPS AMONG WAVES.

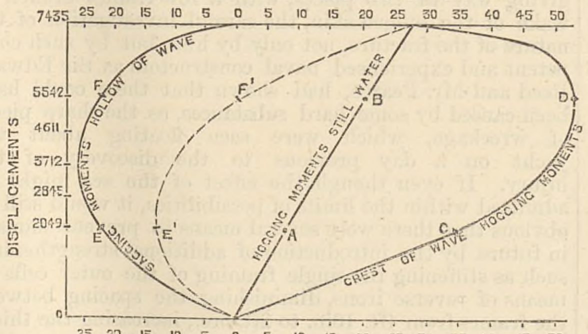
This was a theoretical paper of very little practical utility, and was intended to show the bending moments which would be experienced by a certain type of ship when astride the crest and across the hollow waves of about her own length. The vessel selected was of the following moulded dimensions: 360 × 36 × 26·4; and though representing no actual ship, was arranged throughout to be one equal to the highest class in either of the registry societies. Fig. 1 shows the profile of the vessel and her principal internal arrangements, and also the contour of the waves upon which she has been supposed to float at successive intervals of 3ft. from her light to a very deep displacement. The displacements have been calculated on the assumption that when still; water on the crest, or in the hollow of a wave, the water has the same effective specific gravity. The wave is of the trochoidal form and of the same length as the vessel, with a depth from hollow to crest of 16ft. The length of the vessel, being 360ft., facilitates the calculation of the wave ordinates. The maximum slope of the wave is about 14 deg. The draughts of water measured from top to keel are successively 10ft., 13ft., 16ft., 19ft., and 22ft.

FIG. 1



The relation of freeboard and displacement to the strain among waves is illustrated by means of Fig. 2.

FIG 2.



Vertically it represents displacements, horizontally it represents bending moments. The zero of the latter is towards the middle of the base of the figure. To the right of zero are hogging moments, to the left of zero are sagging moments. The zero of displacement is at the bottom horizontal line, the top horizontal line represents the displacement belonging to total immersion of the vessel. Taking first the bending moments for still water at the displacements for light and load draft, 2049 and 5542 tons respectively, we obtain the points A and B, indicating 6238 and 18,251 foot-tons respectively. From zero draw a freehand curve passing through A and B, and terminating at the line representing the displacement for total immersion. This curve represents the bending moments in still water for any displacement that may be required between light and load draft. Next, taking the bending moments for the vessel when on the wave crests, and for the same displacements as before, we obtain the points C D on the diagram, representing respectively 28,268 and 53,674 foot-tons. Draw a freehand curve from zero through these points, terminating it at the same point as that at which the still water curve ends. This curve will similarly give the hogging moments for any displacement between the light and deep load drafts, *i.e.*, when the weights have been carefully distributed, as described in the beginning of the paper. It will be observed that the still water strains increase regularly with the displacements. The points E, F, in Fig. 2, and the curve for the sagging moments which pass through them, have been obtained in the same manner as the similar details for the hogging moments. The ordinates are laid off as minus quantities, and may also be measured from the curve of still water moments, as shown by the curve passing through the points E' F'. We have not thought it necessary to do more than give the conclusions at which the author arrived, without setting forth the way in which they had been reached. An appendix contained an elaborate series of tables.

After a member, whose name we did not catch, had asked on what data over and above the two points A and B in the diagram Fig. 2 we reproduce, the curves had been constructed, Mr. Denny rose and said that he wanted more data. He should like to know if the strains had been estimated on a homogeneous cargo. Mr. White said that the paper possessed theoretical interest only. The conditions under which a ship was strained were so various, mixed up, and consequently complicated, that it was impossible to deal with them generally. The paper had no practical value. Mr. Curry held that the paper was of no use whatever. If the idea involved were carried a little further it would mean the loading of the ship until she just sank, then she would lie at the bottom of the sea free from all strains. Mr. West held that indirectly the paper was of use by directing the attention of shipowners and builders to the strains put on the hulls by loading and unloading them unequally at the quay side. Much injury might in this way be done unperceived, which might result subsequently in causing the loss of a valuable vessel. Mr. Liggins endorsed Mr. West's views, and gave as an instance the fact that he had lost £3000 in this very way. Mr. Rundell replied, and held that his was a thoroughly practical paper, intended to teach stevedores how to work. A vote of thanks was passed, and the meeting then adjourned until 7 p.m.

At the evening meeting on Friday, the 8th inst., the hall of the Society of Arts was densely crowded, the fact that Sir E. J. Reed was to tell the audience something about the Livadia proving a great attraction. The first paper read was by Captain E. Goulaeff, I.R.N.,

ON THE RUSSIAN IMPERIAL YACHT LIVADIA.

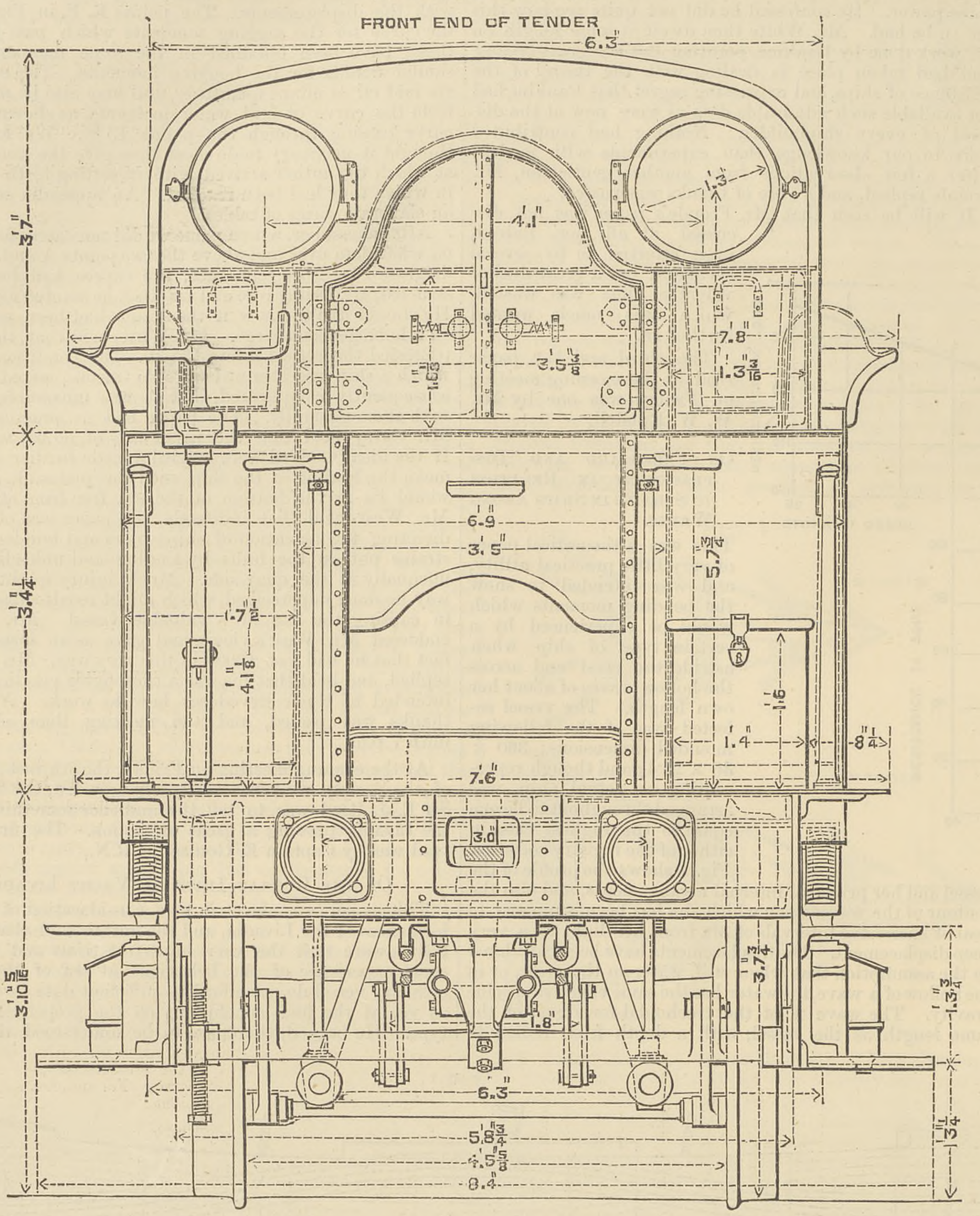
This paper was devoted to a consideration of the performances of the Livadia, and the author said that he was fully aware that the very imperfect trials and the very short experience of the behaviour at sea of this extraordinary vessel do not afford us sufficient data for arriving as yet at the final conclusions on the properties of this type. He begged, therefore, to be understood, that what he was going to lay before them that day was all that he considered himself justified in stating at present on the ground of facts realised for the moment, but it was far from being all that he should have to say in support of his arguments in favour of the Livadia's type, when he should be armed with data of carefully conducted trials. The author then proceeded to go over a great deal of well-trodden ground, and his description of the ship was illustrated by large wall diagrams. Nothing was shown, however, that will not be found in THE ENGINEER for July 9th and 16th, 1880.

Having detailed some of the considerations which led up to the design, Captain Goulaeff went on to say that according to what was thought the most advantageous arrangement, it was decided to have three separate sets of engines, each set being designed to indicate the power of 3500 horses. Each of these engines was made to propel an independent screw with its blades projecting below the bottom of the body of the vessel for about 9ft. Experiments with a model provided with similarly arranged propelling screws had shown that in this case the augmentation of the total resistance due to the action of the screws behind the ship's stern amounts only to 22 per cent. of the total resistance, while the augmentation of resistance with an ordinary arrangement of propellers was estimated by the late Mr. Froude to be from 40 to 50 per cent. On the first day of her official trials the Livadia had a mean speed, maintained during six consecutive hours, equal to 14·83 knots, with an indicated horse-power of 10,200, and on the next day on the measured mile the ship attained the mean speed of 15·725 knots, with an indicated horse-power of 12,354. The actual trials of the Livadia were sufficient to dispel prejudices against her form and against her breadth. To show how very much exaggerated was the opinion entertained a short time ago on the subject of the difference of power required to drive an ordinary ship and a vessel of the type of the Livadia, he quoted Sir Edward Reed's statement made on the basis afforded by the actual steaming performance of the Livadia, as published by him in the *Times*, October, 1880:—

	Displacement.	I.H.P.	Speed.
Penelope	4394 tons	4703	12·7 knots.
Livadia	4420 ,,	4770	13 ,,
Orion	4700 ,,	4000	12 ,,
Livadia	4720 ,,	4500	12·5 ,,

TENDERS FOR GOODS ENGINE, L. & Y. RAILWAY.

(*For description see next page.*)



In connection with this table it might be noticed that the engines of both ships—Penelope and Orion—were developing at the speed named their full power, whereas the engines of the Livadia keeping such speeds must develope only one-third of their power; consequently greater loss in overcoming engine friction and blade friction must be involved in their work. But even disregarding such considerations, the figures as they stood in the table were already sufficient to indicate that the amount of power per ton of the displacement required to drive the Livadia with a speed of at least 12—13 knots compares very favourably with that required in the case of an ordinary vessel of the size driven at the same speed. This table, valuable as it was, referred, however, only to moderate speeds. He would therefore compare the Livadia with the Iris. The following table showed that the power provided in the design and actually developed on the measured mile in the case of the Livadia was not of extraordinary amount:—

	Iris.	Livadia.	
		As provided in the design.	As actually developed by the firm.
No. of horse-power per ton of displacement	2·28	2·35	2·79
No. of horse-power per square foot of mid area	10·71	10·50	12·35

Captain Goulaeff then went on to narrate his experience of the steadiness of the ship at sea. All that he said on this subject is already, no doubt, well known to our readers. It will be enough if we say that she rolled 4 deg. to leeward, and 3 deg. to windward, in a tremendous gale, and that she pitched 5 deg.

Referring to the rumours that the ship was strained, he said it was satisfactory for him to be able to tell them that so much of strength has been evidently secured in this vessel that not the slightest sign of structural weakness could be perceived in any part of the hull. Also, the local strengthening in wake of the brackets supporting the shafting of her propelling screws and in wake of her machinery—having no massive cast iron foundation—proved to be amply sufficient. This amount of strength had been secured with a quantity of material not exceeding the weight employed in the construction of any steel vessel afloat of similar displacement. The steel had been used in the whole structure with the exception of the underwater part of the outside plating, which was made of iron. The structure and joiner's work and decorations of the upper palaces stood the effect of the storm remarkably well. Altogether the execution of the whole work throughout this vessel reflected the highest credit upon the firm of Messrs. J. Elder and Co., the present head of which, Mr. W. Pearce, had spared no efforts in bringing this ship into existence by his spirit of enterprise and energy, combined with no ordinary amount of knowledge. The only defect which was found to exist in this vessel were the unpleasant and occasionally heavy blows or shocks she was receiving from the waves in the underwater part of her bow. These blows were due, no doubt, to her small draught of water. They gave rise to the idea of attributing to them the cause of the accident with which the Livadia met before calling at Ferrol. But the members of the Institution understood that there were several means to obviate such blows—common to all shallow ships when driven against very high seas. As to the accident which resulted in the outside plating being bulged inwards and giving way in two places, with a few frames broken in wake of the bulged skin, the careful investigation of the nature of the fracture, not only by him, but by such competent and experienced naval constructors as Sir Edward Reed and Mr. Pearce, had shown that these could have been caused by some hard substances, as the sharp pieces of wreckage, which were seen floating about the yacht on a day previous to the discovery of the injury. If even though the effect of the sea might be admitted within the limits of possibilities, it would still be obvious that there were several means to prevent damage in future by the introduction of additional strengthening, such as stiffening the single framing of the outer cells by means of reverse irons, diminishing the spacing between the frames from 4ft. 10in. to 2ft. 5in., increasing the thickness of $\frac{1}{16}$in. outside plating, and many other ways which have been already adopted. In any case, the injuries received were of such unimportant character that, with the thorough development in this vessel of the cellular system of construction, they did not in the least affect the safety of the ship, as with them they were steaming in a very heavy sea at a rate of 12 to 13 knots before they got to Ferrol, and their existence was not even suspected on board by those in command of the yacht. The small extent of the damages would be obvious also from the fact that their repair has been made without any dock, and did not require any more mechanical means than those which Captain Nogack, who commands the vessel, had at his disposal on board.

When this paper was read it was proposed that the discussion upon it should be postponed until Sir E. J. Reed had read his paper on the same subject, and that discussion should be taken on both at once. This was carried *nem. con.*, and Sir E. J. Reed then proceeded to read his paper

On the Injuries Sustained by the Livadia in the Bay of Biscay.

At the outset it was explained that Sir E. J. Reed's paper was completed at too late an hour to permit it to be printed for circulation in the room; accordingly the author read from manuscript, but he largely supplemented his manuscript by remarks and explanations, so that the whole resembled a lecture delivered from notes more than the reading of a paper. All that Sir E. J. Reed had to say could have been said in five minutes, but of course not in the same way. Sir E. J. Reed has a wonderful power of taking his hearers over and over the same ground without fatiguing them, and he is one of the few public speakers who can repeat themselves without becoming very tiresome. His lecture on the Livadia was pleasant and chatty. He took for the time the place usually filled by Mr. John Scott Russell, whom we regret to say has been very ill, and is still unfit for work. In substance what Sir E. J. Reed had to say was that he did not agree with Captain Goulaeff that the hull of the Livadia had suffered no injury; and he then went on to explain that she is weak owing to the absence of reverse angle irons in her framing. He had pointed out this deficiency to Admiral Popoff, but his advice had been overlooked. He then described the behaviour of the ship in the Bay of Biscay. She was as steady as an island; but it was certain that she received tremendous shocks from the waves striking up against her flat bottom. These shocks were so severe that it was difficult to believe that the vessel had not been lifted up bodily and dropped on a rock. The weather got so bad that they could not see a cable's length before them, and the Grand Duke, who was in charge, did not like knocking a valuable ship about, and so they went into Ferrol. Sir E. J. Reed then described the injuries which the vessel had received, and which were illustrated by a couple of tracings handed round the room. According to the speaker they were very slight. His own opinion was that they had been caused by the blows of the sea with one exception, namely, that a piece of plate had been driven in and bent, and this, apparently, by a blow from an iron cross-tree, or something else of the kind, connected with wreckage. He was very much surprised that the ship had not gone on to the Black Sea, as she was quite fit to go. A statement had recently been made in one of the papers to the effect that the ship must be cased with wood to make her seaworthy; this was not true. It had always been intended to sheathe her with wood.

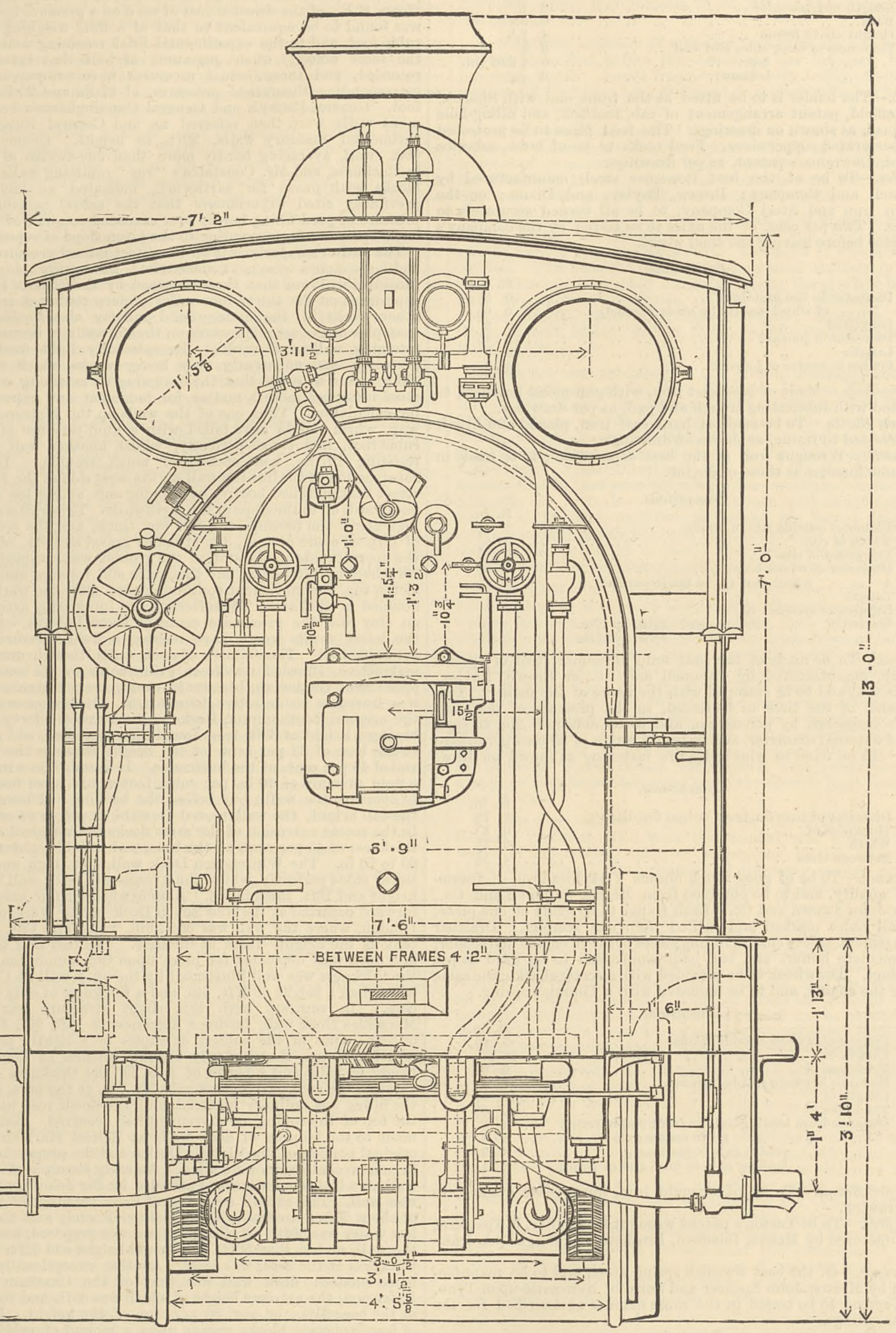
The discussion which followed was begun by Admiral Houston Stewart, who said he had little to add to Mr. Reed's statements, all of which concerning the seagoing qualities of the Livadia he endorsed. Mr. White said that although the ship had been successful in attaining even more than the anticipated speed, it would be well to consider how high a price had been paid for it. Ten thousand horse-power was an enormous price to pay for fifteen knots with so small a displacement. He then went on to speak at some length of the merits of her design, and pointed out that although a great deal of power was required to drive circular ships with flat bottoms, yet that not nearly so much was needed to drive very broad ships with properly formed hulls. As for steadiness, he did not think the Livadia was so much superior to some of our own ships, as, for example, the Monarch, which rolled only 4 deg. in heavy gales.

Mr. Froude, referring to a statement that the resistance caused by the mere presence of a screw reached as much as 40 or 50 per cent., explained that this statement was only true of ships with thick rudder-posts; without rudder-posts the resistance was 15 to 18 per cent., and with twin screws it might be reduced to 8 per cent. As regarded a statement made by his father, it would be well to explain that the late Mr. Froude did not say that the resistance of a circular ship must be five times as great as that of ordinary well-made hulls. The assertion only referred to circular ships with flat bottoms like tubs. Eddy-making was the great bane of the original Russian designs.

Mr. John cited several cases in which the damage done by blows of the sea had been mistaken for the effect of collision with wreckage. Captain Curtis said some of the effect was due to the action of air imprisoned under the ship's bottom; and Mr. Liggins gave some yachting experiences supporting Mr. John's views. Mr. Kirk criticised the dimensions of the ship, and asked what they would have been if built to Lloyd's rules, to which Mr. John promptly replied that she was not built under Lloyd's rules; if she had been no accident would have occurred to her. Admiral Selwyn held that we must have circular ironclads of about 4000 tons, on which to mount twenty 80-ton guns, radiating in all directions like the spokes of a wheel. Mr. Martell said that he had no doubt the bottom of the Livadia was very weak, and he had seen instances where the plating was beaten in by the sea between frames but 24in. apart. It was not likely the Livadia would escape with frames 4ft. asunder. Mr. Barnaby wished to know if any bending had taken place between the turbot bottom of the ship and the superstructure. As for Admiral Selwyn's scheme, he might explain that the 80-ton gun represented a dead weight of 200 tons in gun, carriage, and stores, so twenty guns would represent 4000 tons, leaving nothing for engines, coals, &c. Mr. Pearce said that the damage done to the ship was so slight that it would never have been heard of if the ship had not been so closely watched. Mr. Ravenhill wanted to know why continuous pumping was required to keep her clear of water.

Sir E. J. Reed replied on the whole discussion. He could tell nothing about the paint being rubbed off the bottom, which Mr. Liggins had said if done was evidence that she had struck wreckage, because only Russian and Spanish divers had been employed, and he did not believe a word they said. As for the pumping, that was done for purely Russian purposes, and was not necessary to keep the ship afloat. He then dealt at some length with the general design of the ship, adding nothing that was new to what he had already said, and explaining that the letters he had written to the *Times* were not intended for an educated audience, and that the contradictions which they contained when compared with his present statements were only apparent—not real. In reply to Mr. Barnaby, the turbot did work on the superstructure, and he had recommended that the junction between them should be strengthened.

GOODS ENGINE, LANCASHIRE AND YORKSHIRE RAILWAY.



He succeeded in leaving the impression on his audience that although the ship is admirable as a floating palace, she is really a fearfully weak structure. In fact, his defence of the ship has done her reputation a great deal more harm than good.

After a vote of thanks had been passed to Sir E. J. Reed, the hall, which had been crowded to excess, began to empty rapidly, and as it was then very late the rest of the work to be done was scampered through with the utmost haste.

The next paper was read by Mr. J. Biles,

ON SOME RESULTS DEDUCED FROM CURVES OF RESISTANCE AND PROGRESSIVE MEASURED MILE SPEED CURVES.

Mr. Biles began by pointing out that at no time has so much high speed shipping been in process of construction, and such high rates of speed been contracted for, as at the present. More than 30,000 tons of shipping, having an aggregate of 40,000 I.H.P., are building for Atlantic steamship companies, with intended speeds of 17 to 18 knots per hour. One might reckon steamers by dozens which are building to have speeds of 14 and 15 knots per hour, having engines from 3000 to 5000 I.H.P. each. Hence the magnitude of the interests involved in the question of steamship propulsion was sufficient excuse for his venturing to come before that Institution, not with a view to contributing anything original, but to lay before them some of the results of investigations and analyses of steamship trials made in the ordinary course of his duties as naval architect to Messrs. J. and G. Thomson, of Glasgow. For some considerable time attention had been directed to the valuable series of experiments on models that have been made at Torquay, with a view of s lving some of the problems of resistance and propulsion of ships. Some of the results obtained have been of great service to the naval architect in enabling him to predict with a considerable degree of certainty the speeds of ships of usual and unusual types. The great value of the results of these, as compared with any former experiments, is due to the fact that a true scale or law of comparison was established by the late Mr. Froude between a model and a ship, or between two forms similar in the mathematical sense, but of unequal absolute size. This law, as stated by Mr. Froude, is:—"If the ship be D times the dimensions of the model, and if at the speeds S_1, S_2, S_3, ... the measured resistances of the model are R_1, R_2, R_3; . . . . then, for speeds $\sqrt{D}\,S_1$, $\sqrt{D}\,S_2$, $\sqrt{D}\,S_3$, ... of the ship, the resistance will be $D^3 R_1$, $D^3 R_2$, $D^3 R_3$." This law is only applied to the determination of those parts of the resistance known as wave-making and eddy-making; but if frictional resistances be assumed to vary as the square of the speed, and as the wetted surface, the law may be used for the whole of the resistances. The error involved in this assumption would not appreciably affect the results that were brought to their notice in this paper. An ordinary curve of resistance is a curve of section of what may be called a surface of resistance, made by a plane parallel to the plane of reference, $\overline{R\,S}$. This curve may be more conveniently called a resistance speed curve; it gives the resistance at any speed for some particular displacement. Similarly, if a section be made parallel to the plane $\overline{D\,R}$ of this surface, it may be called a displacement resistance curve, and it would give the resistance at any displacement for some particular speed. Similarly, a speed displacement curve could be formed, which would give the speed at any displacement for some particular resistance. The law of comparison enabled them, when one resistance speed curve—or ordinary curve of resistance—was found for all speeds on some given displacement, to find the resistances for all speeds and displacements. Hence it was easy to deduce the equation to a surface of resistance. If $R = f(S)$ be the equation to a resistance speed curve at some displacement D_0 of a given form or model, then

$$r = \frac{d}{D_0} f_s \sqrt[6]{\frac{D_0}{d}}.$$

where r, s, and d, are variables, is the equation to the surface. The paper was illustrated by diagrams showing the application of these laws, and the remainder of it may be said to have been taken up by examples of calculations for given steamers.

This was a very excellent practical paper, reflecting much credit on the author, but it was read at too late an hour to a weary audience, and the discussion which followed was of no importance.

After a vote of thanks had been passed Mr. De Russet read a paper by Mr. Charles Hall, entitled,

NOTES ON SCREW PROPULSION.

This paper gave an account of a series of experiments on clockwork models to ascertain the effect of reducing screw area, the result being that an increase of speed was obtained, varying as the ·42 power of the area of the blades.

The discussion which followed was of no importance. It went to show that experiments on models made in tanks were of little or no value.

The reading of a paper by Mr. Colin Archer on

SHIPBUILDING A THOUSAND YEARS AGO

followed. This was a clever description of the Scandinavian war ship found in a large grove mound at the entrance to Christiania Fjord several months ago. This brought the business of the meeting to a conclusion. In one sense the meeting was very successful, but there were too many papers, and the discussions as a whole were second-rate. In all societies there is a tendency that the whole of the talking shall be done by a few, and this is simply ruinous and should be strongly discouraged. Almost the whole work of discussion was done during the last meeting by six gentlemen, many of whom spoke on every paper read, and sometimes twice on the same paper. We saw with great pleasure that one or two of the younger members of the profession seem to be determined to introduce a change, not only speaking, but speaking well and to the point. We hope that Lord Ravensworth, who is an admirable chairman, at once courteous and firm, will give these gentlemen every encouragement.

SPECIFICATION FOR GOODS ENGINES, LANCASHIRE AND YORKSHIRE RAILWAY.

[*Concluded from page* 281.]

WE continue the specification prepared by Mr. Barton Wright for fifty goods engines, of which we give additional illustrations on this page, and page 290.

Dimensions.

STRAIGHT AXLES:—	ft.	in.
Diameter in the middle	0	6½
,, of journals	0	7½
Length ,,	0	7
Diameter of wheel-seat (to be made parallel)	0	8½
Length ,,	0	7$\frac{1}{16}$
Centre to centre of journals	3	11½

Crank Axles.—The crank axles for the first twelve engines to be of the best mild crucible cast steel, manufactured by Vickers and Sons only; those for the remaining engines of the best Bessemer steel, manufactured by Cammell and Co., or the Bolton Iron and Steel Company, and turned accurately to gauges; right-hand crank to lead. The axles to be annealed after the sweeps have been slotted out, and to be tested in the presence of the company's inspector before leaving the steel works. For specification of tests apply to the locomotive superintendent.

Dimensions.

CRANK AXLE:—	ft.	in.
Diameter in the middle	0	7
,, of crank pin journal	0	7½
Width of ditto ditto	0	4
Diameter of journal	0	7½
Length of ditto	0	7
Diameter of wheel seat (to be made parallel)	0	8½
Length of ditto	0	7$\frac{1}{16}$
Centre to centre of cranks	2	4
,, ,, journals	3	11½
Throw of cranks	1	1
Section of inside crank arm	0	11 × 4½in.
,, outside ditto	0	11 × 4¼in.

Axle-boxes.—Made of gun-metal, with bearing surfaces of white metal, and fitted with lubricating pad and trough, as shown by drawing.

Horn Blocks.—Of crucible cast steel, horseshoe form, manufactured by Vickers and Sons, Cammell and Co., or J. Spencer and Sons of Newcastle-upon-Tyne.

Wheels.—The best description of wrought iron solid bossed wheels, with balance weights forged in, as shown in drawings. Heads of spokes to be forged solid. To be pressed on the axles with hydraulic pressure of about 85 tons.

Dimensions.

	ft.	in.
Diameter outside rim of wheel	4	0
Width of rim	0	4½
Thickness of rim	0	1¾
Diameter of wheel boss	1	3½
,, wheel seat (to be made parallel)	0	8½
Length of ditto	0	7
Throw of crank pins	0	10
Diameter of hole for crank pins	0	4½ (taper 1 in 100)
Number of spokes, 13		
Section of ditto at large end	0	3⅞ by 1½
,, ditto at small end	0	3⅜ by 1¼

Tires.—The tires for the first twelve engines to be of the best crucible cast steel, manufactured by Vickers and Sons only; the remainder to be of the best Bessemer steel, manufactured by Cammell and Co., or Brown, Bayley, and Dixon, and to be stamped with the name of the maker. Two per cent. of the tires to be tested, before leaving the steel works, by the company's inspector. For specification of tests apply to the locomotive superintendent. Tires to be of the section shown on drawings, and fixed to wheels by tire fastening, as shown.

Dimensions.

	ft.	in.
Diameter of tire on tread (when finished)	4	6
Thickness of ditto ditto	0	3
Width	0	5½
Distance between tires	4	5⅝

Frames.—To be of good tough fibrous Yorkshire iron, frame plate quality, and to be obtained from Messrs. Cammell and Co., or Sir John Brown and Co., to be planed over entire surface on inside and outside, and finished 1in. full thick. All frames marked and drilled from one template. All cross-stays and attachments to be planed where they abut on frames. When the frames and cylinders, &c., are bolted together, the accuracy of all work must be tested by diagonal, transverse, and longitudinal measurements.

Dimensions.

	ft.	in.
Between frames	4	2
Total length of frame	24	10
Depth above leading horns	1	4
,, driving ditto	1	5
,, trailing ditto	1	4⅛
Buffer beam to leading axle	5	7
Leading axle to driving ditto	7	3
Driving ditto to trailing ditto	7	9
Total wheel base	15	0

Motion Plate.—To be of wrought iron 1in. in thickness, with angle iron stiffeners as shown on drawings.

Outside Frames and Buffer Beams.—A long angle iron frame, 4½in. by 2½in. by ½in., to extend on each side of the engine full length of platform, on front curved downwards full depth of buffer beam, and at back welded to plate forming footsteps, as shown on drawings; buffer beams of wrought iron plate, at the leading end stiffened by a heavy angle iron girder in the centre, and plate gussets behind buffers.

Dimensions.

	ft.	in.
Width over angle iron frames	7	4
,, ,, foot plate	7	6
Thickness of ditto	0	$\frac{3}{8}$
,, leading buffer beam	0	$1\frac{1}{4}$
,, trailing ditto	0	$\frac{5}{8}$

Buffers.—To be Turton's patent wrought iron buffer, B3 pattern, manufactured by Messrs. Ibbotson Brothers and Co., as per drawing.

Springs.—To be made of the best Swedish spring steel, and to be manufactured by Messrs. John Spencer and Sons, of Newcastle-upon-Tyne. Each spring must be thoroughly tested before being put into its place by being weighted until the camber has been taken off, and on the removal of the weight the spring must resume its original form.

Dimensions.

	ft.	in.
Length of leading springs (loaded)	3	1
Camber ,, ,, ,,	0	3
Breadth ,, ,,	0	$4\frac{1}{2}$
Thickness—twelve plates, $\frac{1}{2}$in. full thick		
Length of driving and trailing springs (loaded)	3	6
Camber ,, ,, ,, ,,	0	3
Breadth ,, ,, ,,	0	$4\frac{1}{2}$
Thickness—twelve plates, $\frac{1}{2}$in. full thick		

Drawhook.—Drawhook to be provided with screw shackle, and to be mounted with a Timmis's spring, as shown on drawing.

Injectors.—To be two in number, of brass, Sheward and Gresham's patent, class G, No. 8 size, to be placed under foot-plate and delivering into brass clack-boxes on back plate of fire-box casing. The clack-boxes to be provided with screw cone stop valve, so as to allow for removal of pipes when boiler is in steam—see drawings. The right-hand injector must be provided with an overflow valve, closed by gear from the foot-plate, to allow for warming through to tender. All pipes to be seamless copper.

Brake.—The engine to be fitted with a vacuum brake, consisting of a 30 mm. ejector, Gresham and Craven's patent; one starting valve, fitted with sector and handle to regulate the admission of steam; one asbestos-packed cock, one vacuum gauge, one release valve, two 15in. Hardy sacks; the whole of which, including all wrought iron piping, elbows, couplings, &c., for the above, are to be obtained by the contractor from the Vacuum Brake Company. All copper piping to be furnished by the contractor. The ejector to be fixed to the inside of cab, and connected by a copper pipe to the starting valve, which is mounted on the asbestos-packed cock, the latter being fixed on the fire-box top. The Hardy sacks to be connected with the ejector by means of a copper pipe. The release valve to be fixed at back of fire-box, and to be connected with the sacks by means of a wrought iron pipe, and with the vacuum gauge by a copper pipe. The Hardy sacks to be bolted to the underside of drag plate, and to be connected by links to the levers of brake shaft. The entire arrangement of brake and details, such as brake shaft, hangers, carriers, blocks, rods, and cross-bars, must be made as per drawings supplied.

Platform or Drag-plate.—The platform behind fire-box to consist of a heavy casting, forming drag-plate, and weighing three tons; to be firmly bolted to frames, and have projections for brake shaft carrier, intermediate safety chains, &c. &c.—see drawings—to be covered with a timber platform $3\frac{1}{2}$in. thick.

Cab.—To be made of $\frac{3}{16}$in. plates, and stiffened on the edges with beading and angle iron, neatly polished. The front to be provided with two spectacle glasses, fixed in brass frames made to swivel on centre, as shown on drawings.

Splashers and Sand-boxes.—To be made of $\frac{1}{8}$in. plate, the tops curved to form flange for attachment to foot-plate. The leading splasher to be continued forward to face of smoke-box; this portion to be made of cast iron, so as to form the front sand-boxes, which must be worked simultaneously from the foot-plate. Two sand-boxes also to form part of trailing splashers, and to be connected so as to be worked together from the foot-plate.

Safety-valve Casing.—To be of wrought iron, painted; thickness, 14 B. W. G.

Dome Casing.—Made of iron plates, 14 B. W. G., and brazed up solid.

Hand-rail.—Of iron piping, $1\frac{1}{8}$in. diameter outside, polished, and carried round front of smoke-box as shown on drawings.

Lamp Holders.—To be fixed on smoke-box front, as shown on drawings.

Mountings.—Each boiler to be provided with two whistles, two injector steam cocks, one Schaffer and Budenberg's patent steel tube pressure gauge, one scum cock with copper pipe leading under foot-plate, one set of glass gauge cocks, asbestos packed, Dewrance's patent, and two gauge cocks, one blower cock on face of fire-box with copper pipe through boiler—all made on the screw cone principle, as shown on drawings.

Lagging.—The boiler and fire-box shell to be lagged with well seasoned pine, tongued and grooved, and neatly covered with sheet iron, 14 w.g., and secured with hoops. Dome to be covered with "silicate cotton," instead of being lagged with wood. There must be two discharge cocks to each cylinder, and one on steam chest, all to be simultaneously worked from foot-plate.

Bolts, Nuts, and Threads.—All bolts, nuts, and threads to be made to Whitworth standard. All brass work up to and including $\frac{3}{8}$in. diameter to be screwed 14 threads per inch. All brass work above $\frac{3}{8}$in. diameter to be screwed 12 threads per inch. Copper stays to be screwed 11 threads per inch.

Tools.—Each engine must be supplied with a complete set of screw-keys and gland-keys, all case-hardened, and stamped with the company's initials and the number of the engine; also one large and one small monkey-wrench, one heavy and one small hammer, one lead and one copper hammer, one large and one small pin punch, two drifts, three chisels, one steel-pointed crowbar, one small steel pinch bar, one gland packing bar, one 10-ton bottle-jack—to drawing—two head lamps to pattern, one hand lamp and one gauge lamp, one oil can, one large and one small oil feeder, and one tallow kettle; also one shovel, one coal-pick, one hand-brush, and a complete set of fire-irons; one tube scraper, and one wire tube brush.

Painting.—The boiler to receive two coats of oxalic paint before being lagged with wood; after lagging, the boiler, frames, wheels, splashers, handrail plates, and weather screen, to have one coat of lead colour, two coats of stopping, three coats of filling-up properly rubbed down, two coats of lead colour sand-papered, two coats of green—to sample—picked out with black, and fine lined with white. Rim of tire to be black with white line. The whole to be finished with three coats of varnish. Inside of frames and axles to be finished with one coat of vermilion and one of varnish; outside of frames, rail-guards, &c., to be finished brown, picked out with black, and fine lined with white. Front buffer beam and buffers to be finished vermilion and varnished. Number of the engine to be placed in gold leaf on engine front and tender hind buffer planks, and a brass number plate to be fixed in centre of handrail plate—see pattern. Smoke-box, chimney, back of fire-box, platforms, steps, &c., to be painted black; two coats inside of cab to be prepared similar to boiler and frame, and finished in brown and lined.

Tank.—Of horseshoe form; the sides each made of one plate, and all vertical rows of rivets countersunk. The tank plates to be made of BB Staffordshire or Yorkshire iron. The bottom plate of tank to form foot-plate of tender, and the sides and back of tank to be well stayed to the bottom plate with T-irons, angle irons, and stay plates, as per drawing. The sides and back of tank to be finished with a wrought iron half-round moulding piece, as per drawing.

Dimensions.

	ft.	in.
Length of tank sides	18	4
With	6	9
Height above frame	4	$2\frac{1}{16}$
Thickness of tank sides and end	0	$\frac{1}{4}$
,, top	0	$\frac{3}{8}$ and $\frac{1}{4}$in.
,, bottom	0	$\frac{5}{16}$

Cab.—The tender is to be fitted at the front end with Sharp's, of Sheffield, patent arrangement of cab, tool-box, and filling-hole combined, as shown on drawings. The feed pipes to be protected by a perforated copper sieve. Feed cocks to be of brass, asbestos packed, Dewrance's patent, as per drawings.

Axles.—To be of the best Bessemer steel, manufactured by Cammell and Company; Brown, Bayley, and Dixon; or the Bolton Iron and Steel Company, to be all turned accurately to gauges. Two per cent. of the axles to be tested by the company's inspector before leaving the steel works.

Dimensions.

	ft.	in.
Diameter in the middle	0	$5\frac{1}{4}$
,, of wheel seat (to be made parallel)	0	$6\frac{1}{4}$
Length of ,,	0	8
Diameter of journal	0	$4\frac{1}{2}$
Length ,,	0	9
Centre to centre of journals	6	3

Axle-boxes.—Made of hard cast iron, with gun-metal bearings, to be fitted with lubricating trough and pad, as per drawings.

Horn Blocks.—To be made of hard cast iron, planed and fitted, and rivetted to frame, as shown on drawings.

Wheels.—Wrought iron of the best description; to be made in the same manner as those of engine.

Dimensions.

	ft.	in.
Diameter outside rim of wheel	3	$1\frac{3}{4}$
Width of rim	0	$4\frac{1}{2}$
Thickness of rim	0	$1\frac{1}{2}$
Diameter of wheel boss	1	$0\frac{3}{4}$
,, wheel seat (to be made parallel)	0	$6\frac{1}{4}$
Length ,,	0	7
Number of spokes—10.		
Section of ,, at large end—$3\frac{7}{8}$in. by $1\frac{3}{8}$in.		
,, ,, small —$3\frac{3}{8}$in. by $1\frac{1}{8}$in.		

Tires.—To be made of the best mild Bessemer steel of special quality, manufactured by Cammell and Co., or Brown, Bayley, and Dixon, and to be stamped with the name of the maker. Two per cent. of the tires to be tested, in the presence of the company's inspector, by percussion, and to be deflected 2in. to each foot of external diameter, and to bear a strain of 35 tons per square inch. To be fixed to wheels by tire fastening as shown on drawings.

Dimensions.

	ft.	in.
Diameter of tires on tread (when finished)	3	$7\frac{3}{4}$
Thickness of ,, ,, ,,	0	3
Width	0	$5\frac{1}{2}$
Between tires	4	$5\frac{5}{8}$

Frames.—To be of good tough fibrous Yorkshire iron, of frame-plate quality, and to be obtained from Messrs. Cammell and Co., or Sir John Brown and Co. Each frame to be made of one plate, and all holes marked and drilled from one templet. Drawbar arrangement, safety chains, rolling pieces between engine and tender, intermediate buffers and ball-joint connection to be fixed as per drawings. Drawhook to be provided with a screw-shackle the same as for the engine, and to be mounted with a Timmis's spring.

Dimensions.

	ft.	in.
Distance between outside frames	5	$8\frac{3}{4}$
Length of ,, ,,	19	10
Thickness of ,, ,,	0	$0\frac{7}{8}$
Distance between inside frames	3	4
Length of ,, ,,	17	$9\frac{7}{8}$
Thickness of ,, ,,	0	$0\frac{1}{2}$
Distance from leading axle to front end of frame	4	3
,, ,, ,, ,, to centre axle	6	3
,, ,, centre axle to trailing ,,	6	3
,, ,, trailing axle to hind end of frame	3	1

Buffer Beams.—To be of wrought iron, frame-plate quality, as per drawing.

Buffers.—To be Turton's patent wrought iron buffer, B 3 pattern, manufactured by Messrs. Ibbotson, Brothers, and Co., as per drawing.

Springs.—Of the best Swedish spring steel, and to be manufactured by Messrs. John Spencer and Sons, of Newcastle-upon-Tyne. Each spring to be tested in the same manner as described for the engine springs.

Dimensions.

	ft.	in.
Length of leading and trailing springs (loaded)	2	9
Camber ,, ,, ,, ,, ,,	0	3
Breadth ,, ,, ,, ,, ,,	0	$3\frac{1}{2}$
Thickness, top plate $\frac{7}{16}$in., 14 plates $\frac{3}{8}$in.		
Length of centre springs (loaded)	3	3
Camber ,, ,, ,,	0	3
Breadth ,, ,, ,,	0	$3\frac{1}{2}$
Thickness, top plate $\frac{7}{16}$in., 16 plates $\frac{3}{8}$in.		

Brake.—Tender to be fitted with a vacuum brake, consisting of two 15in. Hardy sacks, which, together with wrought iron piping, elbows, and couplings, and flexible hose-pipe connection between engine and tender, are to be obtained by the contractor from the Vacuum Brake Company. A solid angle iron ring for carrying the sacks to be fixed to under side of tender at front end between longitudinal stretchers, as shown on drawings. Sacks to be connected by links to the levers of brake shaft, which is to be also provided with a lever for hand brake. The entire brake arrangement and details, such as handle, brake screw, brake shaft, hangers, blocks, carriers, rods, and cross-bars to be made in accordance with drawings supplied.

Hand-rail.—Hand-rail of iron piping $1\frac{1}{8}$in. diameter outside, polished and fastened by two brackets to end of tank. Two hand-rail pillars to be placed on each side of foot-plate and fixed to tank, as shown on drawings.

Lamp-holders.—Two to be fixed on back of tender, as shown on drawings.

Bolts, Nuts, and Threads.—To be of Whitworth standard.

Painting.—The inside of the tender tank to have two coats of good, thick red lead, the outside of the tank, cab, and tool-box to be prepared and finished in the same manner as the engine boiler covering. The inside of the cab to be treated exactly the same as the inside of the engine cab. Inside of frames to have two coats of lead colour. Outside of frames and wheels to be prepared and finished identically the same as those of the engine. Hind buffer beams and buffers to be finished vermilion and varnished. Coke space, foot-plate, bottom of tank, and brakework under tender to have two coats of black.

W. Barton Wright, Locomotive Superintendent.
Victoria Station, Manchester, January, 1880.

THE INSTITUTION OF CIVIL ENGINEERS.

THE ACTUAL LATERAL PRESSURE OF EARTHWORK.

At the meeting on Tuesday, the 5th of April, Mr. Brunlees, F.R.S.E., Vice-President, in the chair, the paper read was by Mr. B. Baker, M. Inst. C.E.

The author dealt with the actual lateral pressure of earthwork as distinguished from the "text-book" pressures which, as Professor Barlow pointed out half a century ago, were based upon theoretical calculations that disregarded the most vital elements existent in fact. The question affected the stability of retaining walls, the strength of tunnel lining, the timbering of shafts, headings, tunnels, deep trenches for sewers, and many other works of every-day practice. Attention was directed to the measurements by Lieut. Hope, R.E., of the direct thrust of sand on a pressure board, which was found to be equivalent to that of a fluid weighing 19 lb. per cubic foot, and to the experimental brick retaining walls tested by the same officer, when pressures of half that intensity were recorded, and these actual pressures were compared with the corresponding theoretical pressures, of 27 lb. and 23 lb. per cubic foot. General Pasley's and General Cunninghame's model revetment walls were then referred to, and General Burgoyne's experimental masonry walls, 20ft. in height. Colonel Michon's 40ft. wall, averaging hardly more than one-twelfth of its height in thickness, and Mr. Constable's "toy" retaining walls of wooden blocks with pease for earthwork, indicated no less than the previously cited experiments that the actual measured lateral pressure of good filling hardly ever exceeded one-half of the "text-book" pressure corresponding to the given slope of repose.

The author's experiments on the direct lateral pressure of ballast and large stones were next summarised, the results being in general considerably lower that those obtained by Lieutenant Hope. His experience on the thirty-four miles of deep timbered trenches and other works of the underground railway also furnished many examples of the actual pressure on timber walings, tunnel headings, retaining walls and vaults. Exceptionally light work standing perfectly, and apparently very heavy works which had failed, alike served to prove that the designing of retaining walls was in most instances more a matter for judgment and experience than for calculation. Thus one of the walls on the Metropolitan Railway, which should have failed with a fluid pressure of 19 lb. per cubic foot, had stood perfectly, whilst another wall capable of resisting 107 lb. had occasioned much trouble. During the construction of the line the wall on the west side of the Farringdon-street Station failed bodily, by slipping out at the toe and falling backwards on to the slope of the earthwork. This wall was 29ft 3in. high above the footings and 8ft. 6in. thick, and the soil consisted of 17ft. of made ground, 3ft. of loamy gravel and 9ft. of clay. On the opposite side of the station the ground was retained by vaults, 29ft. high by 17ft. deep, but these also slid forward and came over at the top, the movement continuing even after the work had been doubled in thickness. The softening and lubricating action of water on clay was the proximate cause of these failures, as otherwise the latter vaults would have resisted a fluid pressure of 92 lb. per cubic foot. The failures of dock walls, though numerous and instructive, afforded no direct evidence as to the actual lateral pressure of earthwork, because in nearly every instance the failure was traceable to defective foundations. Reference was made to the original Southampton Docks wall constructed forty years ago, having a height of 38ft. from foundation to coping, and a thickness at the base of 32 per cent. of the height between the buttresses, and of 45 per cent. at the buttresses. If founded on a rock bottom, a fluid pressure of 40 lb. per cubic foot would have been required to overturn the wall; but before the backing had been carried to the full height, the wall moved forward in places as much as 3ft. In the recent extension of the same docks the wall had an effective thickness of 45 per cent. at the base, and a fluid resistance of from 60 to 70 lb. The Whitehaven Dock wall, 38ft. high and 13ft. 9in. thick, stood perfectly, whilst the Avonmouth Dock wall of the same height and 16ft. thick failed. A somewhat similar case of sliding forward occurred at the New South Dock of the West India Docks, London, where the wall was 35ft. 9in. high, and 13ft.—or 36 per cent. of the height—thick at the base. The fact that the stability of a dock wall depended far more upon the foundation than upon the thickness was well illustrated by the quay wall at Carlingford, which had a height of 47ft. 6in. and a thickness of only 15ft. at the base. In contrast with this slight structure was cited the Marseilles Dock wall, having a thickness of 16ft. 9in. for a height of 32ft. One of the boldest examples of a lightly proportioned wharf wall was that built by Colonel Michon at Toul. With a height of 26ft. and a batter of 1 in 20, the thickness of the wall through the counterforts was only 3ft. 7in. at the base, and though the filling was ordinary material, and the floods rose within 6ft. of the top of the coping, no movement had occurred. Reference was made to the failures of dock walls at Belfast Harbour and in the original portion of the Victoria Docks, and the proportions adopted in more recent works were cited. An early example of a successful wall on a bad foundation was afforded by Sir John Rennie's Sheerness wall. The subsoil consisted of loose running silt for a depth of about 50ft., covered with soft alluvial mud, and the depth at low water was 30ft. A piled platform was prepared, and upon this the wall, no less than 50ft. in extreme height and 32ft. in effective thickness at the base, was built. Another exceptionally heavy but more modern dock wall was that of the Chatham Dockyard Extension, the extreme height of which was 43ft. and the thickness at the base 21ft., or, say, 50 per cent. of the height. Walls made of large concrete blocks resting upon a mound of rubble had been constructed in many of the Mediterranean ports, generally with success but occasionally with failure, as at Smyrna, where, owing to the great settlement, six and seven tiers of blocks had to be superimposed instead of four, and the quay wall had after all to be supported by a slope of rock in front. The proportions arrived at by experience were a width of 9 metres at the top, and a thickness of not less than 2 metres for the rubble mound, a depth of 7 metres below water, and a thickness of 4 metres for the concrete block wall resting on the mound, and a minimum thickness of 2·5 metres, and a height of 2·4 metres for the masonry wall coping the concrete blocks. Examples were not wanting of walls founded on rubble mounds where the thickness held a smaller ratio to the height than the 42 per cent. considered necessary by French engineers. The lightest of all, perhaps, was the dry masonry outer wall of the St. Katharine's breakwater, Jersey, which was only 14ft. wide at the base, for a total height of 50ft. The most cursory examination of the cases of failure alluded to would serve to justify the statement that the numerous failures of dock walls did not afford any direct evidence as to the actual lateral thrust of earthwork. Thus, remembering that General Burgoyne's battering wall, only 17 per cent. of the height in thickness, supported perfectly the heavy sodden filling at its back, no calculation was required to show that the 32 and 45 per cent. Southampton Dock counterforted wall, the 42 per cent. Avonmouth Dock wall, the 36 per cent. West India Dock wall, the 50 per cent. Belfast Harbour wall, and the 30 per cent. Victoria Dock wall, would all have stood perfectly had the foundation been rock, as in the instance of General Burgoyne's experimental walls, instead of mud, clay, and silt, as was actually the case. The aim of the author in the present paper had been to set forth, as briefly as possible, what he knew regarding the actual lateral thrust of different kinds of soil, in the hope that other engineers would do the same, and that the information asked for by Professor Barlow more than half a century ago might be at last obtained. Although the acquirement of the missing data would probably lead to no modification in the general proportions of retaining structures, since these were based upon dearly-bought experience, and not upon theoretical treatises, it was none the less desirable that it should be obtained, for an engineer should be able to show why he believed a given wall would stand or fall. To assume upon theoretical ground a lateral thrust, which experiments proved to be excessive, and to compensate for this by giving no factor of safety to the wall, was not a scientific mode of procedure.

As a result of his own experience the author made the thickness of retaining walls in ground of an average character equal to one-third of the height from the top of the footings, and if any material was taken out to form a panel, three-fourths of it was put back in the form of a pier. The object of the panel, as of the $1\frac{1}{2}$in. to the foot batter which he gave to the wall, was not to save material, for this involved loss of weight and grip on the ground, but to effect a better distribution of the pressure on the foundation. It might be mentioned that the whole of the walls on the Metropolitan District Railway were designed on this basis, and that there had not been a single instance of settlement, or of falling over or sliding forward.

RAILWAY MATTERS.

THE Toronto Street Railway Company was at date of recent news hard at work laying the track.

THE Government of New South Wales has in hand contracts for the construction of 868 miles of railway.

THE construction of the new Woolwich and Plumstead tram lines has progressed from Plumstead old church to the Arsenal main gate, with the exception of short distances. The contractor has nearly three months to complete the line, but it is expected that the cars will commence running on Whit-Monday.

THE Manchester, Sheffield, and Lincolnshire Railway station, and that of the Midland, at Sheffield, are to be connected with the Telephone Exchange on the 1st of June. Eight hundred and sixty-eight purely business messages passed through the Sheffield Telephone Exchange on a single day last week. The total for the week was 4400.

THE contract has been given out for making the first portion of the new line from Rhondda to Newport, and from this week the Pontypridd, Caerphilly, and Newport Railway will be pushed on with vigour. The first contract is for five miles, from Treforest to Nantygarw, and here it will fall in with the Rhymney line from Caerphilly, which will very likely be utilised. The cost of this new branch will be from £70,000 to £80,000, and will occupy eighteen months in construction. It is expected to prompt other movements, such as increased dock extension at Cardiff, and the formation of the new Roath Dock. The project, too, for entering the Rhondda Valley from the Swansea side, is also to be pursued.

IT would seem as though the project for constructing a tramway to connect Wolverhampton with Sedgley and Dudley had been abandoned. Parliamentary sanction was given to the scheme in July last year, and £2000 was deposited with the Board of Trade as a guarantee that the line was intended to be made. But as yet there are no signs of the work being commenced. By the terms of the provisional order, if the works are not commenced within a year of the granting of the permission, the powers conferred cease with certain exceptions and limitations. Knowing this and remembering that nine months out of the twelve have already elapsed, it is understood that the promoters are to be strongly urged by certain of the inhabitants along the proposed line of route to begin operations at once.

ON Wednesday a meeting of manufacturers and other traders of Birmingham was held in that town, called together by the Chamber of Commerce with a view of obtaining authentic information touching the excessive and differential rates levied by the railway companies for the carriage of goods to and from the Midlands, with a view to the guidance of the Parliamentary Committee. It was determined that evidence should be set before the committee from the Birmingham Chamber, since many instances of excessive freights working to the disadvantage of the iron and hardware trade of Birmingham were mentioned at the meeting. The South Staffordshire Ironmasters' Association have appointed their president, Mr. N. Hingley, together with Mr. A. Hickman, of the Spring Vale furnaces, and Mr. Hipkins, finished iron manufacturer, to give evidence on behalf of the iron trade.

THE Lancashire and Yorkshire Railway Company stands at the head of the list of sums paid as compensation to passengers. For every million of passengers carried the company paid last year £1200; the Midland Company, £1100; the London and North-Western, £700; the Great Western, £450; the North-Eastern, £350; the Great Northern, about £300; the Manchester, Sheffield, and Lincolnshire, £60; and the Metropolitan only about £6. These figures include nothing to injured servants, but it will be noticed that though the trains on the Metropolitan line are more numerous and frequent than on any other line, the accidents are fewer. The traffic on this line is, however, very different in many ways. The trains are numerous, but they are slow, junctions and branches are few, and the traffic is all of the same character. The danger of travelling due to goods traffic is absent. The goods traffic and the passenger traffic will have to be kept separate and distinct before we can secure immunity from the most frequent cause of accident on main lines.

IN examination before the Railways Committee, Mr. H. Harrison, of Blackburn, stated that the quantity of cotton cloth manufactured in North and North-East Lancashire in the year 1880 was about 220,000 tons, or about two-fifths of the entire manufacture of the country. He also said, respecting the weights of cotton and cotton products carried by railway to and from the Blackburn district, that the "amount of cotton received in North and North-East Lancashire, so far as the Master Cotton Spinners' Association was concerned, was about 145,000 tons from Liverpool in the year, and from Manchester, about 77,000 to 80,000 tons of yarn were received in the year. Very little cotton came from Manchester." In the municipal borough of Blackburn there are about 1,600,000 spindles, and 58,000 looms. The consuming power is equal to about 70,000 tons of yarn per annum, and the producing power is equal to 75,000 tons of cloth per annum. Blackburn receives about 36,000 tons of cotton from Liverpool, and about a similar amount, say 36,000 tons, of yarn from Manchester. The previous figures relate to North and North-East Lancashire; not to Blackburn alone.

THE Blackburn and Over Darwen tram line, in Lancashire, is the first in this country that has been constructed specially for being worked by steam power exclusively. On the 14th April the line was publicly opened for traffic. The distance between the two towns is about three and three-quarter miles. The line is a single one, and is provided with nine passing places at equal distances, and at each end a triangle is constructed, so that the engine and car can be reversed without uncoupling. The system of construction is that known as "Barker's," and the permanent way consists of cast iron sleepers, affording a continuous support for a steel rail, and also for the paving stones on each side. The rails are 4ft. apart, thus being 8½in. narrower than the usual width. The groove in the rail is 1in. wide, and ⅞in. deep. The work has been carried out under the superintendence of Messrs. Lynde and Son, M.M. Inst. C.E., of Manchester. The engines were made by Messrs. Kitson and Co., of Leeds. The cars are reversible, and are constructed on the principle known as Eades' patent, by the Ashbury Carriage Company, of Manchester. On the opening day the Corporation of Blackburn and Over Darwen made a trial trip, great satisfaction was expressed at the arrangements generally.

A MOST important railway item, particulars of which have never been collected for any line in the United Kingdom, is—Mr. Green remarks, in a recent paper on light railways, read before the Institution of Civil Engineers, Ireland—the number of passengers per carriage mile. On the French lines it averages 9·24, varying with the classes; the weight of carriages per seat is 517 lb., but the real weight of carriages per passenger, allowing for empty seats, is 1632 lb., or 1881 lb., dividing the weight of the brake van among the passengers. The weight of vehicle, reduced in construction to double the weight per passenger, is exaggerated in practice to eight or ten times the same weight. To obtain the gross dead weight it is necessary to also add a proper proportion of the weight of the engine and tender; and taking into account trains with two engines, empty running, and bank engines, it is found that the engine mileage exceeds the passenger train mileage from 3 to 5 per cent. Unfortunately, the passenger trains cannot be separated from mixed trains carrying high-speed goods—*i.e.*, luggage, carriages, horses, &c.—but in such cases apportioning the weight of engine and tender—assumed to be two-thirds full on an average—between the passengers and high-speed goods, the total dead weight is 17 and 10½ times the paying load respectively, while on the new systems the result is more unfavourable, the numbers being 22 and 14 respectively. On one of the Spanish railways, for each ton of passengers, the weight of vehicles run was 9·18 tons, or 18·98 including the engine.

NOTES AND MEMORANDA.

THE first rough results of the census of Assam proper in the six districts of the Brahmaputra Valley give the population at 2,207,000, which is an increase of 290,000, or 15 per cent. on the last census.

A MAGNETIC anomaly of meteoric iron of Santa Catharina was recently described before the Académie des Sciences, by Prof. Lawrence Smith. Small fragments are very feebly affected by a magnet till they have been flattened on a steel surface with a steel hammer, or heated red hot.

THE first published result of the census in Ceylon gives the population of Colombo as 111,942, against 95,145 in 1871. The real increase of population is still larger than these figures show, since the villages of Bambalapitiya and Welikada were included within the limits of the city in 1871, but excluded in 1881.

IT appears that at the close of the year 1880 there were in the United States 170,103 miles of telegraph line, and during that year 33,155,991 messages were sent. The miles of wire were about 300,000. This does not include the lines used exclusively for railroad business. The other countries having the greatest length of lines are as follow:—Russia, 56,170 miles; Germany, 41,431; France, 36,970; Austria-Hungary, 30,403; Australia, 26,842; Great Britain, 23,156; British India, 18,209; Turkey, 17,085; and Italy, 15,864.

THERE are now published in the United Kingdom 1986 newspapers, distributed as follows:—England—London 378, provinces, 1087—1465; Wales, 66; Scotland, 181; Ireland, 154; Isles, 20. Of these there are 123 daily papers published in England, four in Wales, twenty-one in Scotland, eighteen in Ireland, and two in the Channel Isles. On reference to the first edition of the "Newspaper Press Directory" for 1881, for the year 1846 it appears that in that year there were then published in the United Kingdom 551 journals. Of these fourteen were issued daily, viz., twelve in England, and two in Ireland are issued daily. The increase in daily papers has been most remarkable; the daily issues standing 168 against 14 in 1846. The magazines now in course of publication, including the quarterly reviews, number 1097.

THE attention of the Société des Ingénieurs Civils, Paris, has been directed to a series of comparative trials of gas burners, and a paper has been published giving a table, from which it appears that while the ordinary street gas-jet—*bec à papillons*, or butterfly's wing—gives for every 1000 litres of gas 7·70 to 8·60 units of light, the latest gas burner, that of Herr Siemens, of Dresden, for the same quantity of gas exactly, gives 29·00 units of light, being an increase from nearly four to one. The compound burner, used in the Rue du Quatre-Septembre, gave from 9·20, that of Ulbrich Messurer, similar to one of Sugg's burners, 14·0; the Bengel spheroidal burner, 12·80; the Marine Goelzer, 10·6 to 11·3; and the Siemens "Regenerateur," 20·0 to 29·0. Gas is thus, perhaps, in a position four times better to meet the electric light competition than it was.

IN the new edition of his book on the coal-fields of Great Britain, Professor Hull puts the annual coal produce of the world at 289,000,000 tons, of which the British Isles furnish 134,000,000, the United States and Germany coming next with 50,000,000 tons apiece. The production of Bengal in 1879 was 523,097, that of New South Wales was 1,444,271 in 1877; but in each case, he says, the merest fringe of the coal districts has been touched; vast accumulations, readily accessible, remain behind. Referring to the decrease in the rate of the growth of the English coal production, he remarks that many and various means of economising fuel have been brought into use, and that in future, no doubt, that, as about a hundred times the amount of light through the medium of electrical apparatus can be obtained from the coal burned in a steam engine grate, as compared with the coal distilled into gas, the rate of growth will further decrease.

IN connection with the discussions which continually take place on the corrosion of mild steel and iron, the following note by Dr. T. L. Phipson to the *Chemical News* may be of interest. He refers to the remarks of a correspondent who had found that iron and steel do not rust when immersed in solutions of caustic soda and caustic potash, but was unable to understand why the alkali in the solution prevented the oxygen in the water acting on the iron or steel. The fact has been known for many years, and the explanation was pointed out by the late Dr. Grace-Calvert, his explanation being in accordance with the theory propounded by Dr. Phipson some years previously—1858—in a paper on catalytic force. His experiments showed that the phenomenon of the rusting of iron was due to the presence of carbonic acid, this body forming the third substance requisite, according to the theory of catalysis, to complete the galvanic chain. Without the presence of this carbonic acid, or some third substance capable of taking its place, the oxygen cannot combine with the iron at ordinary temperatures. A high temperature acts like electricity in promoting the combination.

A PORTION of the South Kensington Museum has now been lighted by sixteen electric lamps for some time. The first outlay for the purchase and fixing of engine, dynamo machine, &c., amounted to about £1200. According to the Post-office electrician, Mr. Preece, the cost of working from June 22nd to December 31st, during which period the lights were going on eighty-seven nights, for a total time of 359 hours, was £69 2s., being at the rate of 3s. 10d. per hour of light. The consumption of gas would have been 4800 cubic feet per hour, which at 3s. 4d. per 1000ft. would have cost 16s. per hour, thus, according to this calculation, showing a saving of working expenses of 12s. 2d. per hour, or, since the Museum is lit up for 700 hours, a total saving at the rate of £426 per annum. In estimating the cost, only half that of the engine is taken, as a second dynamo machine has been added to light picture galleries and the Art School. The capital is thus taken at £994. In making a fair estimate of the annual cost, something should also be made, making an allowance of 5 per cent., for percentage on capital, and something for wear and tear. £109 10s. has to be added to the £69 2s., leaving a balance to the good of £316 10s. as against gas. The last allowance is probably not sufficient, but if the figures as to actual expenditure are correct—20 per cent. interest—depreciation and renewals may be deducted, and then leave a large balance to the good.

PAPER is extensively manufactured in the numerous little Chinese villages in the valleys about eight miles south-east of the city of King-hien. It is made from the paper-mulberry tree bark, called T'an-shu-p'i, and wheat straw, which, after having been well washed and boiled with some lime, is again washed, and exposed to dry for a whole year on the sides of the hills. After this it is again washed, and then pounded on a stone with a large wooden hammer. After this it is left to soak until it becomes quite a pulp, in a large earthenware vessel, containing a liquid glue made from boiling the branch of a tree called the Yangkow-t'ên, a species of hooked vine. This pulp is then put into a cistern of water, and well stirred up. A finely-made bamboo frame, or oblong sieve, is taken by two men, one at either end, and dipped twice into this liquid, which is made to run equally over the whole surface, as in English hand-paper making. The layer left soon partially dries and forms the sheet of paper, which is removed by reversing the frame. The sheets are taken to the drying room, which room contains a large brick oven, coated on the outside with lime, and built up to within a few feet of the roof. Upon the top of this oven the paper is placed in parcels of about a foot in thickness until perfectly dry; after which sheet by sheet is damped once more, and while still moist is, by means of a soft brush, made to adhere to the sides of the oven for a short time to undergo final drying. It is then made up into bales weighing from 80 to 120 catties each, the catty being equivalent to 1⅓ lb. avoirdupois. The largest sized paper is about 1 "chang"—11¾ft.—long, and is worth one dollar a sheet.

MISCELLANEA.

THE Patent Shaft and Axletree Company is advised that its exhibits of wheels and axles, steel and iron axle and tires, bar and other iron, have gained a first award and gold medal at Melbourne.

THE water consumption of Sydney, New South Wales, is again causing anxiety; 27,000,000 gallons were consumed from Botany reservoir the week before the last mail left, which is a rate much over the resources of the supply.

MESSRS. W. SIMONS AND CO., shipbuilders and engineers, Renfrew, have obtained a first-class award for the model of their hopper dredger exhibited by them at the Melbourne Exhibition, and of which they have constructed ten.

FOR the maintenance of public libraries and mechanics' institutes in the colony of Victoria, £133,569 was spent. The receipts in 1879 were £27,313, and the libraries contained an aggregate of 245,068 volumes, besides periodical literature.

COTTON is now being used in the construction of buildings. It is converted into a paste by chemical treatment, which afterwards becomes extremely hard, and is moulded into large slabs and other forms, and designated as architectural cotton.

EXCEPT that the Island of Chios stands as a pinnacle, it seems remarkable that no serious disturbance took place on the surrounding water at the time of the recent great earthquake, especially as such island earthquakes are often the result of great shocks transmitted by sea-bed waves.

ABOUT 150ft. of the Penzance promenade sea wall, the foundation of which had been undermined by the sea, fell away on the evening of the 17th inst., carrying with it a portion of the asphalted promenade. A strong breeze from east-south-east had prevailed all day, causing a ground sea.

THE most glowing description has been issued by the Indian Government of the richness of the iron ores in Gwalior, and of the ease with which they can be worked, with fuel from the extensive forests in the vicinity. It will not, however, be readily forgotten that the Bengal Ironworks, situated in the centre of a large coal-field, failed as a commercial speculation.

THE exports from Birmingham and the surrounding district to the United States during the quarter ending 31st March last were of the aggregate value of 1,047,567 dols. This is a decrease upon the corresponding quarter last year of 396,593 dols., or about 27 per cent. The falling-off has been chiefly in hardware, steel, and iron. Anvils and vices, chains, hoes, scythes, guns, &c., on the other hand, show an increase.

STATISTICS made up to the close of March show that in South Staffordshire there are 146 blast furnaces, and that of these, 44 are in blast. In North Staffordshire there are 36 furnaces, of which 32 are in blast. In North Staffordshire the number is one fewer than were blowing at the close of December; but in South Staffordshire there is no decrease upon the three months. Among the furnaces now in course of erection is one which is being put up by Earl Granville in North Staffordshire.

BORING operations near Port Clarence, on the Durham side of the Tees, opposite Middlesbrough, have been successful, and at a depth of about 1043ft. the first bed of solid salt has been reached. It is expected that in a short time pumping operations will be commenced, and that the Durham salt will become, as in the past, an article of commerce to a large extent. The deposit of salt thus reached is at a similar depth to that ascertained to underlie part of Middlesbrough, a paper on which was read at a meeting of the British Association several years ago, and which was found to have an immense thickness, and to give on analysis over 96 per cent. of chloride of sodium.

AN account of the massacre of the expedition under Colonel Flatters is given in the *Times* of Monday as furnished by the four natives who arrived at Ouargla on the 28th ult. The engineers and others of the party were killed by Touaregs, into whose hands they seem to have been betrayed by Segheir Ben Cheik, of the Chambaa, and Ali Ben Dain Salah. The members of the expedition, when assailed, fought hard, first with fire-arms, and afterwards with swords, but the big sabres of the Touaregs seem to have cut them to pieces quickly. Some of the men of the rear party were also poisoned with poisoned dates, but those remaining barricaded themselves in a cave, four of them having escaped by night for assistance to Ouargla.

THE *Statist* in an analysis of the trading results of the leading Civil Service Co-operative Stores, amongst other information shows that last year's turnover of the principal stores has been as follows:—Army and Navy, £1,930,000; Civil Service Supply Association, £1,420,000; Civil Service Co-operative, £514,000. One of the interesting features of its analysis is the comparisons of the percentages of profits and working expenses. According to a calculation it has made, the business of the stores is equal roughly to about £1 a-head of the population of the metropolis, and may be taken to represent the amount of trade done by the minor shops on both sides of Oxford-street, from the Marble Arch to Holborn Viaduct, assuming the annual sales of each shop to be an average of £6000 each.

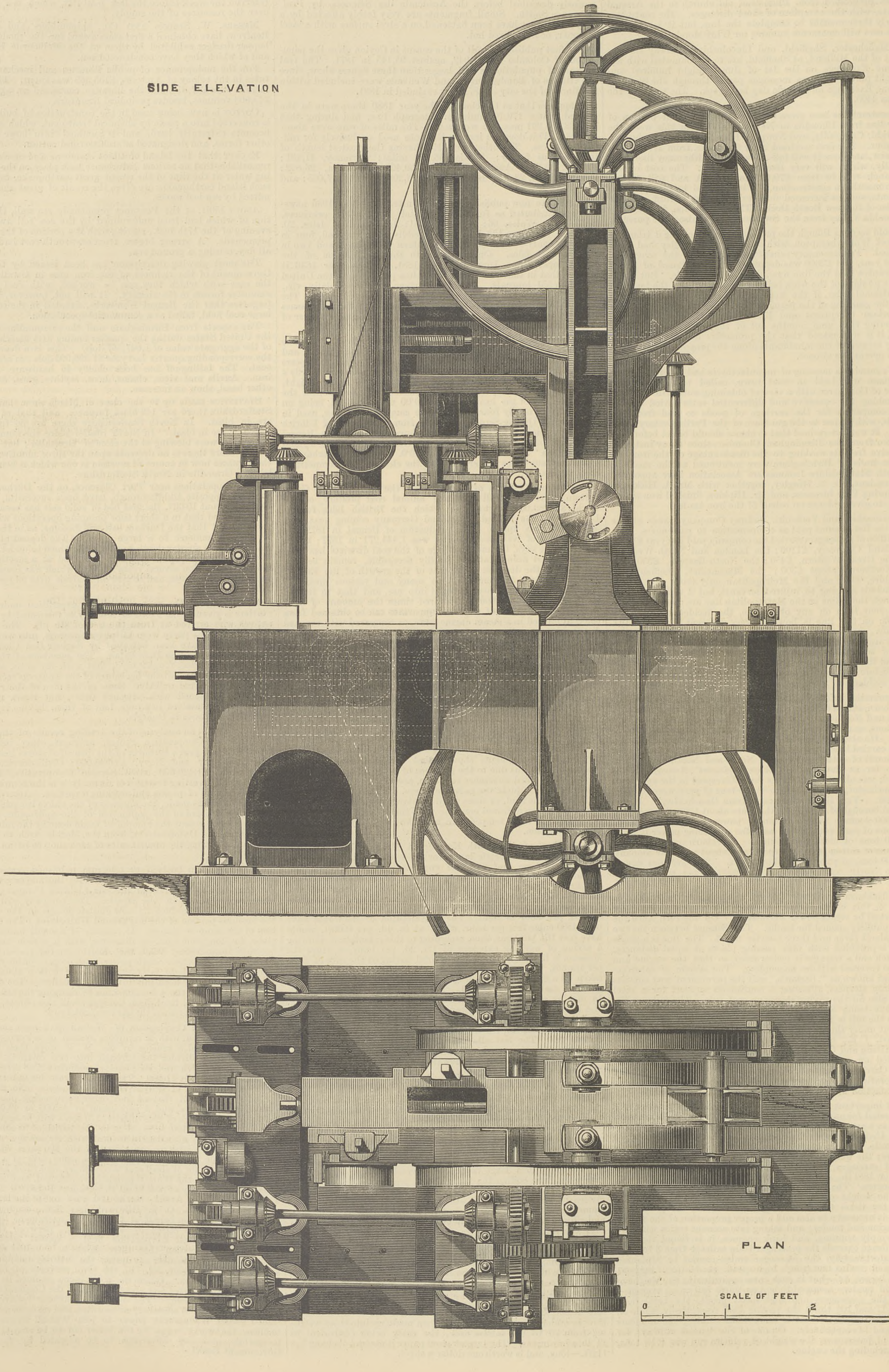
ACCORDING to a *Daily News* telegram published yesterday, the aldermen of New York have passed over the mayor's veto, the Ordinance giving the Edison Electric Lighting Company permission to lay tubes in the streets. The company will proceed immediately to introduce its new electric lamps in the offices in the business portion of the city around Wall-street. The construction of the lamp is simple. It consists of a small bulbous glass globe, 4in. long and 1½in. in diameter, with a carbon loop which becomes incandescent when the electric current passes through. Each lamp is of sixteen-candle power, with no perceptible variation, in intensity. The light is turned on or off with a thumbscrew. Wires have already been put into forty buildings. The company will compete with the gas companies by charging the same rates. If the latter reduce, the Edison Company will also reduce, and are prepared to go lower than the gas companies can.

SINCE 1876 the Corporation of Walsall have been seeking to provide that town with a complete system of sewerage. They have now adopted a scheme by Mr. W. J. Boys, their borough surveyor, which divides the borough into two districts. No. 1 embracing Bloxwich and its vicinity, comprises 2708 acres, and a population of nearly 11,000. This would drain by natural gravitation on to a piece of land at Harden or Goscote. No. 2 district includes the town of Walsall and other surrounding places, and comprises 5300 acres, and a population of 48,000 or 49,000. To deal with the sewage of this district, 170 acres will be required in the Tame Valley, 100 acres of it in the parish of Wednesbury. Now, Wednesbury also desires to deal with its sewage, and the local board there wish to use thirty of the 100 acres which the Walsall people want. There has been some talk of a united drainage district for Walsall and Wednesbury, and there have been negotiations; but the Walsall people have objected, and have now sought the authority of the Local Government Board to take the land they require. At the close of last week and at the beginning of this, Captain R. C. T. Hildyard, late R.E., conducted an inquiry at Walsall on behalf of the Local Government Board to hear the objections raised by Wednesbury. Between the two sittings the Walsall Corporation held a special meeting to consider the suggestion that there should be a united drainage district, which was thrown out during the first day's inquiry, this time by Mr. W. Fowler, Mr. Till, the town surveyor of Birmingham, and Mr. Lemon. When the commission resumed its sitting on Monday, the Town Clerk announced that the Corporation had accepted the suggestion. The announcement was received with satisfaction by the Wednesbury authorities, and an agreement was signed giving Wednesbury power to join Walsall within three months, the works begun by the latter not to be stayed in the meanwhile, and any differences to be adjusted by the Local Government Board.

DOUBLE BAND SAW.

MESSRS. WATTS AND CO., BRISTOL, ENGINEERS.

(*For description see page 299.*)



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 2d. 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.*

H.W.M.—*We are making the inquiry.*

ENQUIRER.—*Messrs. Kirby, Beard, and Co., Redditch.*

ST. ROLLOX.—*They may have something in California with which they saw redwood logs 10ft. in diameter, but they certainly would not know their own machine by the description you have sent us from what you say is a mechanical journal. We cannot cut the logs with the saws mentioned.*

G. M. G.—*Coat the inside of your tank with Portland cement. If the tank is a small one, use the cement as you would use paint, putting on about three coats. If it is a large tank, the whole inside may be rendered with Portland cement, gauged with one-half clean fine river sand.*

ENQUIRER.—*We cannot answer your question save in general terms. You will find it extremely difficult to get 18 miles an hour, even in still water, out of a 48ft. launch, and you cannot get it at all on 2ft. 10in. draught with a screw. It is barely possible that it might be done with paddles, but we know nothing of the width of wheel which you could use, and we do not see how you could perch paddles of the required size high enough without making the whole craft top-heavy.*

LINK.—*There is a little book by Cowling Welsh, published by Spon, which will supply all the information you require. We could not say what is the proper length of link for a valve with a travel of 3½in., without knowing all the conditions. If the link is of the suspension type, its length will affect the lead, which may or may not be a matter of importance. Speaking in the most general terms, a link with a travel of about 12in. would suit a valve with a travel of 3½in.*

SEAGE'S APPARATUS FOR RINGING BELLS.

(*To the Editor of The Engineer.*)

SIR,—Can any of your readers tell me where I can obtain a circular or drawings of Seage's apparatus for silent practice, being a contrivance for ringing bells by which the clappers are tied, but the music is produced on small hand-bells in the ringing chamber. E. W. B.

Newtoun, April 19th.

PILLAR AND STALL MINING.

(*To the Editor of The Engineer.*)

SIR,—I shall feel extremely obliged to any of the readers of your paper who will inform me as to the proportionate number of miners engaged in getting coal in the United Kingdom working on the pillar and stall system, as compared with the long wall system. I shall also be equally obliged by being informed of any book that gives the localities of each system. H. O.

London, April 20th.

MEETINGS NEXT WEEK.

THE INSTITUTION OF CIVIL ENGINEERS.—Tuesday, April 26th, at 8 p.m.: Paper to be read and discussed, "The Relative Value of Upland and Tidal Waters in Producing Scour," by Mr. Walter R. Browne, M. Inst. C.E.

SOCIETY OF ARTS.—Wednesday, April 27th, at 8 p.m.: Ordinary meeting, "Five Years' Practical Experience of the Working of the Trade Marks' Registration Acts," by Mr. Edmund Johnson. Thursday, April 28th, at 8 p.m.: Applied Chemistry and Physics Section, "Impurities in Water, and their Influence upon its Domestic Utility," by Mr. G. Stillingfleet Johnson, F.C.S. Mr. Allen Thomson, M.D., F.R.S., will preside. Friday, April 29th, at 8 p.m.: Indian Section, "The Building Arts of India," by General Maclagan, R.E. Mr. Andrew Cassels, Member of the Indian Council, will preside.

DEATHS.

On the 14th inst., at Lucknow, India, JOSEPH GREEN COOKE, C.E., aged 48.

On the 14th inst., suddenly, at his residence, No. 1, Portland Villas, Brixton-hill, Surrey, WM. HUMBER, C.E., M.I.M.E., of 20, Abingdon-street, Westminster, S.W., aged 61.

THE ENGINEER.

APRIL 22, 1881.

THE MYSTERY OF STEEL.

MR. PARKER's paper on the now famous boilers of the Livadia, and the discussion which followed its reading during the recent meeting of the Institution of Naval Architects, have added little or nothing to the existing stock of information concerning the characteristics of steel. They have, however, gone far to prove that the number of those who hold that the world knows all it needs to know about the metal is very small; and it is not too much to say that the opinion that the behaviour of steel is full of mysteries once held by a few, is now in a fair way of being held by every one who has much to do with it. The more carefully we examine the statements contained in Mr. Parker's paper, the more we are at fault. It is almost impossible to see in what respect the plates were defective—yet that they were not trustworthy is beyond doubt. It seems that the metal sustained every test to which it was submitted in the yard; and we have reason to believe that it was manufactured on the most approved methods. It was suggested during the course of the discussion that the metal had been insufficiently worked from ingots or slabs which were too small. We have, however, ascertained beyond doubt that this was not the case, the ingots being all 20in. square. Hundreds of tons of steel plates have been made from just such ingots, and they have all given perfect satisfaction. Again, it was urged that the annealing was improperly done; but it seems that the process was carried out slowly and with great care, and this being the case, the argument against the piling up of the plates on each other falls to the ground. So far as we can ascertain—and we have taken some trouble to obtain accurate information—Messrs. Cammell left nothing undone to obtain a good result by means of well-known and approved methods of manufacture. From end to end the case is full of anomalies, inconsistencies, and mysteries. For example, we find a piece of plate which put into the testing machine is not only enormously strong, but, apparently, as ductile as a bit of lead, easily broken by a blow with a hammer, and utterly intolerant of being straightened or bent through insignificant angles. How is this? We do not expect a strip of glass to bear bending, for while the tensile strength of glass is comparatively high, of ductility it has none. Ductility has always been regarded as the great factor in determining the power of a metal to bear bending strains. When a strip is bent the outer portions of the metal stretch while the inner portions are compressed; and lacking ductility, strips cannot be bent without fracture; while its presence in gold, copper, lead, and good iron enables these metals to be bent and contorted and twisted into all kinds of forms. But the steel of the Livadia's boilers possessed ductility in a remarkable degree so long as a direct tensile strain was put on the metal, while, as we have said, it gave way on the slightest provocation when an attempt was made to bend it. No one knows why, under the circumstances, the test strips referred to by Mr. Kirk at the meeting of the Institution of Naval Architects, broke when he tried to straighten them. Their brittleness was of one kind only, and whatever was the defect in the process of manufacture, or whatever the deleterious ingredient present, it possessed a peculiarly discriminating character, defining exactly under what conditions of stress the metal should be weak and under what strong. It has long been known that phosphorus makes steel brittle, but it makes it brittle all round, so to speak. Thus a phosphorised steel will have a high tensile strength and next to no ductility, but such a steel is tough under no conceivable circumstances. Are we to assume that the 0·03 per cent. of silicon, on the presence of which in the Livadia's boilers Dr. Siemens laid so much stress, is to be credited in future with the power of making steel incapable of resisting bending stress, while concerning longitudinal stress it is inert? If so, the sooner the fact is authoritatively made known the better.

Even if we had made the ground under our feet sure thus far, we should not have solved half the mysteries presented by the Livadia's boilers. It is very often stated that the punching of holes in steel plates causes the plates to crack. If we are to credit no less an authority than Dr. Siemens this is a delusion; but for the moment we do not credit him. We believe him to be quite mistaken. It is held that punching creates zones of hard compressed metal round the punched holes, and that these zones act as so many wedges tending to split the plate. Now these zones may or may not exist. No one, so far as we are aware, has ever proved that they are there; that is to say, when sharp punches, which shear and do not wedge their way through the metal are employed, as they ought to be. For the sake of argument, however, we shall for the time admit their existence. If our readers will turn to the drawings we have published on page 254, they will see that cracking took place in the boilers which failed, not only through the rivet-holes or near them, but through the solid plate further in. We confess that it seems to us impossible to associate wedge zones with this failure. We cannot see how a row of wedges close to the edge of a plate could set up a fracture in a line parallel with but some distance away from that occupied by the said wedges. Other cracks in other boiler plates can still less be accounted for in this way, and we are told that they are the results of severe internal strains. It is we think high time that this internal strain theory should be reduced to some definite proportions. At the present moment it is as vague as it well can be, and it is employed apparently as a refuge for the destitute—an asylum to which every one who has no explanation to offer of the cracking of a steel plate flies. Now the words "internal strains" may mean a great deal, and may be intelligibly used to explain a fact; but this cannot be done unless what they imply is clearly understood. They may mean many things; for our present purpose, however, their use is restricted. Let us see what they ostensibly convey. To this end, let us suppose the existence of a steel plate 3ft. wide and 6ft. long and ½in. thick. Strips cut from this plate anywhere give a tensile strength of 31 tons to the square inch, and an extension of 25 per cent. This plate is sheared all round over night, and the next morning it is found to have a crack in it, running back 12in. from the edge. This crack has been caused by internal strains. If so, it is easy to calculate the amount of the strain. The area of the fracture is $12 \times 6 \times \cdot 5 = 6$ square inches, and the breaking strain being 31 tons, the total internal strain must have been $31 \times 6 = 186$ tons. How did the act of shearing the plate set up a strain of 186 tons in it? Let us go a little further. This steel will not, as we have seen, break under strain without stretching, but it cannot stretch without becoming thinner or narrower. Can any one assert that he has ever seen in a cracked steel plate the faintest trace of extension? Has the least symptom of contraction of area been manifested? It is well known that steel bars and strips, when broken in the testing machine, show on their black oxidised surfaces curves and lines of the flow of the metal as the area contracted and extension took place. Is anything of the kind ever met with in a cracked steel plate? So far as our knowledge extends, the answer to all these questions must be in the negative. What, then, we ask, is the nature of the internal strain which pulls a plate in two without causing any contraction of area in a most ductile metal? To this question a definite answer must be given if the theory is to assume a proper scientific shape. We do not assert that the fracture is not due to internal forces. For the moment we express no opinion of any kind; but we mention the fact that no one has attempted to formulate the internal strains, or to define their nature, or tell us anything about them. There is a more or less vague, hazy idea floating about that they are tensile and compressive in their character, and that is about all. Let us apply what we have said to the plates of the Livadia. Why did one of these crack, apparently, entirely as a result of internal strain, and yet not the slightest evidence was apparent in the plate, either in the neighbourhood of the crack or anywhere else, that the metal had ever endured 31 tons to the inch, or anything approaching that strain? So close an observer as Mr. Parker could not have failed to notice the contraction of area, and to speak of it if anything of the kind had existed; but he is quite silent on the subject. As the crack began and ended in the middle of a plate, and did not reach the edge, it is difficult to see how Dr. Siemens' well-known nicked india-rubber theory will apply. So much concerning the Livadia's boilers. We have yet to say a few words on certain phenomena connected with steel, which may or may not help to throw light on the fracture of these boilers; but before doing so we should like Messrs. Elder to tell us, and through us that section of mankind interested in the use of steel, whether the new shells made by the Steel Company of Scotland were manipulated in quite the same way as were the shells of Cammel's steel; and we want particularly to know how the caulking was done.

A circular has recently been issued by the Admiralty on the effects of temperature on steel, which is calculated to cause lively apprehension in the minds of the owners of steel boilers. It appears from this circular that at comparatively very low temperatures steel becomes much weakened. Strips which when cold could be bent on themselves, and behaved like so much lead, when heated to a light straw colour, corresponding to a temperature not very much in excess of that carried in some modern marine boilers, so far lost its ductility that it could no longer be bent without fracture. In fact at very moderate temperatures steel becomes a material very different indeed from what it is when cold. We have before now urged the necessity of testing steel boiler plates at the temperature at which they will have to work. When this is done we have reason to think that some very startling results will be obtained; but for the moment the Government circular will be found to supply ample food for thought and reflection. The use of steel is rapidly extending, and it is of more and more importance every day that as little uncertainty as possible should exist about it. It has been openly stated that nothing but the very large factor of safety present in boilers has averted, up to the present, disastrous results from the use of steel for boilers. Whether this is or is not true we shall not pretend to say. Until we saw the results of the Government experiments just referred to, we would have said it was untrue. Now we reserve our judgment. It is, however, to the last degree undesirable that all this uncertainty should exist. It is not to be denied that shipowners and others are becoming fidgetty, to use an expressive word. They are not quite certain about steel. Steel manufacturers have already received many hints and warnings from shipbuilders and engineers, and they have been told very plainly by Mr. Denny that they must look to themselves. The failure of the Livadia's plates does not stand alone. Testing in future will be more severe than it has been. All things put together show that more information is wanted, and we would urge on all concerned the necessity for going out of the old beaten paths, and testing under working conditions. Nothing more is to be learned by putting cold strips of steel in a testing machine. Boiler steel should be tested hot—ship steel cold; but the specimens should not be planed or got up. A great many experiments remain to be made. Who will take the subject up, and undertake an original investigation into the properties of steel? We think we could promise him the aid of every steel maker and user of the metal in Great Britain.

THE ZERO MOTOR.

MR. ISHERWOOD has recently been employed to report to the United States Government on the merits of a very remarkable proposal made by Professor Gamgee. It will be remembered that this gentleman has given much attention to the construction of ice-making machines; and a few years ago his real ice skating rink in Chelsea attracted a great deal of attention. Of late Professor Gamgee has resided in the United States, and continued to occupy himself with ice and its artificial production. During the early portion of the present year he submitted to the United States Government the proposal to which we have referred, which is that he shall construct a new motor which will, to a large extent, take the place of the steam engine and work without fire. If such a scheme had been brought forward a few years since its inventor would have been regarded as a lunatic. But so much knowledge has been disseminated concerning the behaviour of gases, and the conditions under which work is performed, that Professor Gamgee need have no fear now that his ideas will be neglected or passed over without due examination. Apparently the "zero motor" is "perpetual motion" over again. But the inventor of perpetual motion engines is always trying to produce a machine which will work itself without external aid of any kind. Professor Gamgee's scheme has nothing in common with this. He proposes to utilise natural forces; and his engine would be, if constructed, a heat engine in just the same sense that the steam engine is a heat engine, only he proposes to work at much lower temperatures than the steam engine requires, and to use ammonia instead of water.

In order to make the principle involved perfectly intelligible, let us consider for a moment what takes place in a steam engine. We take water and heat it, thereby enormously increasing its volume, and converting it, in a word, into what we may call, for convenience, a gas. This gas is used to propel a piston against a resistance. It is then suffered to escape into a cool chamber, condensed, or in other words, reduced in volume as much as it was before augmented, and pumped back into the boiler. We have thus a complete cycle, and the engine works between two temperatures, that of the boiler, say 320 deg., and that of the condenser, say 120 deg., and the efficiency of the engine is determined solely by the difference between these two temperatures. Now let it be supposed that the normal heat of the atmosphere was 320 deg., then water could not exist, but it would be still quite possible for beings who could live in such a temperature to work a steam engine, if only they could isolate steam from the air, which might be done easily enough; and if, besides, they possessed any means of reducing the temperature of a condenser to 120 deg. Given these two conditions, and their steam engine would work without fire. Considerable difficulties would, however, be met with in producing the low temperature required, while without it the steam engine would be impossible. Now we have several liquids which behave at normal temperatures, such as 60 deg., just as water would behave at 320 deg., and these liquids might be used to develope power if only we could obtain the low temperature needed to condense them. So long as sufficient difference of temperature exists, power can be had; and it is of no consequence whatever whether the range of temperature is at one end of the scale or the other. Power can just as well be obtained from a fluid working between zero and — 200 deg., as from a fluid working between 320 deg. and 120 deg. In the one we must provide heat to raise the temperature above the normal. In the other we must provide a source of cold, to speak popularly, and it is far more convenient to do the former than the latter. We have no stores of ice and salt, for example, to draw upon for the production of zero temperature, but we have stores of coal which will give us high temperatures. So much being understood the rest will be easily comprehended. Without going into details it will be enough to say that Professor Gamgee proposes to work an engine between 60 deg. and —40 deg., that is to say, through a range of 100 deg.; and this he purposes to do by taking a quantity of liquid ammonia and putting it into a vessel, which we may call the boiler. In this the ammonia will be heated by the atmosphere to its own temperature. It will boil, and the gas will be used in an engine. So far all is quite clear. We have one half the cycle, but we have yet to see how the low temperature — 40 deg. is to be obtained. It is of course out of the question to get this by the use of refrigerating agents; and it is here that the really beautiful portion of the invention comes in. When a gas is expanded and does work, it is cooled down. Professor Gamgee proposes to use his ammonia so expansively, that it will be cooled down sufficiently to liquefy. Then it will be pumped back into the boiler and the cycle will be complete. An engine would thus be obtained capable of developing very great power without the use of fuel. It need hardly be said that the man who can achieve this object may hope for riches and honours such as the world has never before bestowed on inventors. Before we can say whether Professor Gamgee is or is not likely to obtain success, we must clearly understand the properties of the fluid with which he proposes to work.

Ammonia is a compound of one atom of nitrogen with three of hydrogen (NH_3). At ordinary temperatures and pressures it is a gas. Concerning certain of its physical properties a diversity of statement unfortunately exists. Thus, according to one authority, liquid ammonia—which must not be confounded with the water saturated with ammonia used by Lamm in a totally different way to propel tram-cars, as described in THE ENGINEER for January 12th, 1872, and popularly known when diluted, as sal volatile and hartshorn— boils at — 36 deg. Fah.; while according to another it does not liquefy until a temperature of — 40 deg. is reached. The difference is apparently small, but it is very important at the lower end of the scale of temperatures. The higher the temperature at which liquefaction takes place the better in one way for Professor Gamgee. The specific gravity of the gas is ·59, air being unity; and that of the liquid is ·76, water being unity. The specific heat of the gas is ·508. At a temperature of — 22 deg. the gas—to carry out the analogy we might term it ammonia steam—has a pressure of 17 lb. on the square inch absolute. At 32 deg. its pressure is 60 lb. At 68 deg., which is about the highest air temperature it is wise to reckon on, its pressure is 126 lb. on the square inch. The volume of the gas as compared with the fluid which produces it has not been tabulated. At atmospheric pressure and 62 deg., 1 lb. of the gas would occupy about 23 cubic feet, and 1 lb. of liquid ammonia would occupy about 36·5 cubic inches. The latent heat, or the heat absorbed by the liquid in becoming a gas, does not appear to have been ascertained. All the figures we have given must be considered as approximate only. Hitherto comparatively little interest has attached to what we may term the mechanical properties of the gas, and this may account for the differences in the figures given by various authors, and the silence of all on such a question as the latent heat of gas. It will be seen that the maximum pressure which Mr. Gamgee can reckon on without the aid of artificial heat is 126 lb. absolute. But there is some doubt as to whether the gas will remain wholly unliquefied at this pressure and temperature. Kemshead states that it will liquefy at 60 deg. and 105 lb. on the square inch; and it is more than probable that the pressures and temperatures we have given above are all critical—that is to say, those at which the gas is on the point of liquefaction. We do not think it would be safe under the circumstances to assume that a higher working pressure is attainable without the aid of heat than 100 lb. on the square inch.

So many points have to be considered that it is by no means easy to say precisely to what extent the gas must be expanded to produce the cold necessary for liquefaction. If we deal with it as a perfect gas we find that, if the initial temperature is 68 deg. or 529 deg. absolute, and the gas be expanded adiabatically three times, the final temperature would be — 81 deg., or very much more than low enough. As, however, it will be impossible to prevent the gas from picking up some heat, it will not be safe to reckon on less than this amount of expansion; possibly much more will be required. A three-fold expansion would give a terminal pressure of 33 lb. on the square inch absolute, but before this liquefaction would have begun. The average effective pressure in the cylinder would be 66 lb. less the atmosphere $15 = 51$ lb., which is a good working pressure. So far it will be seen that much is in Professor Gamgee's favour; but it must not, therefore, be assumed hastily that his success is assured. Something remains to be learned concerning the behaviour of the ammonia. The zero motor is in this dilemma, that if the expansion be not sufficiently extended no liquefaction will take place; while on the other hand, if it is sufficiently great, the engine may waste all its energy in overcoming the back pressure of the atmosphere. The intense cold of the cylinder will tend powerfully to reduce the pressure of the gas at the beginning of a stroke, while towards the end it will give out heat and prevent liquefaction. A very complex action has to be provided for, and nothing but direct experiment can settle the questions at issue. Theoretically the zero motor is, so far as can be ascertained from the somewhat limited data available, sound in principle. It remains to be seen whether it can be reduced to practice. We agree with Mr. Isherwood, however, that the invention is one having sufficient promise to make its further investigation very desirable. "What is now mainly desired," writes Mr. Isherwood, "is that Prof. Gamgee may be permitted to prosecute his experiments at the Washington navy-yard to a conclusion, and there bring his engine to a practical test with as little delay as possible. Should the department be able to grant this, the favour will be well and properly bestowed in the interest of the navy and of the world."

THE DURHAM SALT DEPOSITS.

THE attempt of Messrs. Bell Brothers to utilise the immense deposits of salt known to underlie portions of the country near the mouth of the Tees is of much interest. There is a very great chemical trade centred on the northern rivers, which depends for salt upon districts at a distance. It is about eighteen years since the discovery of these large salt deposits on the southern bank of the Tees by Messrs. Bolckow and Vaughan, and after considerable delay the late Mr. Henry Bolckow was able to assure the shareholders in the company that had purchased their works that they had obtained the knowledge that about 1000ft. below the surface there was a bed of rock salt, at least 100ft. thick. It was estimated about this time that the cost of carriage of the salt from the Cheshire district to the Tyne was about £150,000 yearly, and it was apparent that this sum, if the bulk of it could be saved, would materially affect the development of the industries dependent upon salt. A good while ago Messrs. Bell Brothers proved that the salt deposits were to be found on the northern bank of the Tees, and last year they commenced sinking. A few days ago, at a depth of 1043ft., the first bed of solid salt was reached. The explorations have been carried on with the aid of the Diamond Rock Borer, and so far they are successful in demonstrating the presence of vast deposits, the exact extent of which cannot yet be stated. It is proposed, we believe, to extract salt in the form of brine, and then to evaporate it, much on the Cheshire method. The place where the boring has taken place is eminently suitable for chemical works; for between Port Clarence and Seaton, a little to the south of West Hartlepool, there is a long shore, with little vegetation to destroy, and on which houses are few, whilst the firm which has proved the presence of salt has a royalty over a very large portion of it. Years ago, the salt trade in its olden phase was carried on in miniature in that district of South Durham, and there is now a probability not only that it will be undertaken on a large scale, but also that it may cause the chemical trade to be planted in the north-east of Durham. The demand for salt increases. The trade has become one of the most important of the mineral industries, and the occasional stoppage of old works in consequence of subsidences is a proof that there is need for the utilisation from time to time of new supplies. Hence it may be that the north, richly gifted in minerals, may add to the trades that centre in and near the Tees, another very valuable, which may prove the parent of chemical manufactures in a suitable locality in the early future.

ELECTRIC LIGHTING IN STEEL WORKS.

MESSRS. WILSON, CAMMELL, and COMPANY, of the Dronfield Steel Works, near Sheffield, have satisfactorily established the utility of the electric light for the illumination of large steel-making premises, both as regards its effulgence and also on the ground of economy. On the latter point it should be mentioned that the company have not had to put down an engine for the purpose, as the ordinary engine used for driving the machinery of the fitting shops has been found sufficient. At present the lamps number eighteen, and are distributed over the works in such a way that the light falls equally on all portions of the premises. They are more numerous on what is called the rail bank, especially at the part where the rails are straightened—a process which requires great accuracy of sight to secure nicety of adjustment. The steam machinery is also most efficiently lighted, and the steam gauges are as distinctly visible as in broad daylight. A lamp is placed in the Bessemer engine house, which serves to light the whole of the extensive building, within the walls of which are two Bessemer blowing engines, with hydraulic engines and apparatus. The method of lighting is that known as the "Brush system," of which Mr. Edmund, Halifax, is the agent, and this gentleman has carried out the arrangements at Dronfield. Each of the eighteen lights has an illuminating power equal to 2000 candles. As the Dronfield Steel Works are the first important industrial establishment where the electric light has been adopted in the district, the experiment has been watched with great interest, and the success of the Brush system at Dronfield will probably lead to its being brought into requisition in other large steel and iron works.

THE WATER SUPPLY OF MIDDLESBROUGH.

THE Stockton and Middlesbrough Corporations Water Board has become not a little famous in various ways. Its undertaking was the first instance where municipal corporations became possessed by special Act of Parliament of their own water supply. The payment of the enormous sum of £800,000 by an award rendered necessary by the obstinacy of one or two local dignitaries, and when £525,000 might otherwise have been accepted, is now a matter of history. The water meter difficulty too, which led to so much public comment, and which has never been satisfactorily explained, is still unforgotten. But the Corporation's Water Board appears still to be seeking fame. On Tuesday it summoned one William Oliver, an innkeeper of Redcar, for payment of £5 6s., alleged to be due, and made up as follows :—2000 gallons of water supplied by meter during the quarter ending February 14th, 1881, £1 17s. 6d.; meter hire, 4s.; arrears, £3 4s. 6d.; total, £5 6s. The chairman of the Guisborough Bench—Admiral Chaloner—asked the representative of the board—Mr. Berry—if there was not a mistake in the charge—18s. 9d. per thousand gallons. Mr. Berry, after examining the account, said it was strictly correct, as defendant was an innkeeper, and the water was used for domestic purposes. The chairman asked for the clause in the Act enabling such a charge to be made. Mr. Berry said that by the Act—which does not appear to have been forthcoming—hotel keepers were to be charged by special agreement. He admitted no such agreement had been signed by defendant, but contended the price was a minimum under the circumstances. The chairman characterised the charge as extraordinary, preposterous, and out of all reason. If it had been 9d. instead of 18s. 9d. per thousand gallons he might have made an order for payment. Mr. Berry still protesting, the case was adjourned for a week to give an opportunity for complainants to produce further evidence.

LITERATURE.

River Bars; Notes on the Causes of their Formation, and on their Treatment by "Induced Tidal Scour;" with a Description of the Successful Reduction by this Method of the Bar at Dublin. By ISAAC J. MANN. Crosby Lockwood and Co. 1881.

SOME of the most important contributions to our information on specific points in engineering practice are wont to appear as short monographs like that before us, and, like the papers read before the Institute of Civil Engineers and other kindred societies, furnish in many instances the most trustworthy information on the subjects specifically treated. Indeed, works of an encyclopædic character have as a rule come to possess but a limited value except for the general student who has not associated himself with any special branch of engineering practice.

The subject of the removal of river bars should possess an interest not only for civil engineers, but for all connected with commerce and those engaged in mercantile pursuits. In degree the subject is one of national importance; for the wealth of a country may be said to depend upon its trading power; and trade, again, must necessarily be to a great extent proportional to the facilities, natural or artificial, which each country affords for the admission of vessels of large tonnage to the interior modes of communication, whether they are rivers, railways, or canals. Taking such a port as Barrow-in-Furness, where there is considerable mineral wealth close to the seaboard, and apparently an unlimited amount of enterprise capable of developing the mineral resources of the district, it became evident, after large sums had been spent in providing dock and railway accommodation, and numerous other improvements had been effected, that if ever the port was to become one of first-class importance the bar at the entrance to the harbour must be cut through, for the admission of trading vessels of the highest class. This has been done, and there is nothing now to prevent the port from steadily advancing in development and importance.

So in the case of Dublin, although the necessities of the case were not so readily recognised or dealt with so rapidly, the one great requirement for bringing the port up to the position which it should justly hold as the capital city of the country, was the removal of the river bar; and from the statements given by the author, it is evident that the anticipations of the Dublin Port and Dock Board, as to the result of this removal, have been to a large extent realised. "The tonnage entering the port annually between the years 1788 and 1825 fluctuated between 193,830 tons and 416,978 tons. Since the latter date, which corresponds with the completion of the great North Wall, the annual tonnage, with a few trifling exceptions, has steadily increased from 396,052 tons in 1825, producing an income of £12,841, to 1,953,902 tons in 1879, producing an income of £59,315. Thus, in a little over fifty years the income has been considerably more than quadrupled." There were doubtless other influences at work, all tending to the development of trade, but there can be little doubt that the improvement of the estuary is the main cause of the advances which Dublin has made as a port since 1825. To the engineering profession, however, the chief point of value will be the means adopted for the removal of the bar which formerly obstructed the entrance to the river Liffey, and we believe that those who read Mr. Mann's account of the work will be not a little interested. The author, who has been for several years associated with the improvement of the port, is thoroughly conversant with his subject, and presents it to his readers in a clear and even attractive style.

Eighty years ago the river Liffey was placed in the charge of a properly constituted corporation, in which was vested the responsibility of preserving and improving the port of Dublin; but before this time it was found necessary to call in the aid of some of the highest engineering talent at the time available. The subject was acknowledged on all hands to be one of no small difficulty, and there can now be little doubt that the conservancy authority acted at the time with considerable judgment in adopting the principle which has been followed for deepening the approach to the estuary. To Captain Bligh and Captain Corneille is due the credit of suggesting a continuous training wall, which, with the previously existing south wall, would, it was hoped, have the effect of scouring the river bed, and removing the bar of sand from the entrance to the channel. This scheme was approved by the elder Rennie, and it has been carried out in a slightly modified form with excellent effect; so that at the present time vessels of 23ft. draught may now enter the port, though formerly only vessels of about 400 tons could do so.

Not to pursue the subject farther, we would recommend all interested in harbour works—and indeed those concerned in the improvement of rivers generally—to read Mr. Mann's interesting notes on the treatment of river bars; they are well written, and cannot fail to impart useful information upon a subject of considerable importance.

LETTERS TO THE EDITOR.

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

HIGH-SPEED LOCOMOTIVES.

SIR,—I have read with much interest the letters which have lately appeared in THE ENGINEER on railway speeds on the Great Western and the narrow gauge railways; but I do not think any of the writers have settled the question, which after all is this—Can the broad gauge engines of the Great Western run heavier loads at higher speeds than the narrow gauge engines? They did this in 1846, when trials were instituted by the Gauge Commission, the best bit of line then in England, between York and Darlington, being selected by the narrow gauge people, and a locomotive built specially by Stephenson for the occasion. On the other hand, the Great Western used an old engine, the Ixion, in the trial between Paddington and Didcot. The full particulars I have not now by me, but this I remember—the narrow gauge people were simply nowhere in the race. It may be different now, and I should be very sorry to pronounce any opinion dogmatically, but the only way to settle the point is to run the old race over again between London and Didcot for the broad, and York and Darlington for the narrow. The tests should be in the first case with equal weights, and then with heavier, on the part of the Great Western. In this way only can the question be settled. S. DARTON.

Mansourah, Egypt, April 4th.

SIR,—I read with much interest a letter from "Fair Play," in the number of March 18th, giving an account of his run from Euston by the 4 o'clock express. What he says shows, I think, that the London and North-Western Railway is not behind any other in the matter of speed; its 4-wheeled coupled engines do their work very well, and I do not think that Mr. Stirling's engines on the Great Northern Railway do their work any better than the London and North-Western, for, as it stated in "Fair Play's" letter, that they travelled as quick as seventy-four miles an hour, doing four and a-half miles in 3 minutes 37 seconds, which is quite as good as the Great Northern Railway. The whole run throughout was remarkable for its speed, which was no doubt very good; and when the fact that the weather throughout a good part of the journey was very wet is considered, it is certain that the run was very well performed, for although they were stopped at Willesden slightly over their time, and again at Denbigh Hall, they reached Rugby exactly at their time, 5.48, not being one minute late which was very creditable indeed on such a heavy road and in such bad weather. Mr. Stirling's engines, with their 8ft. drivers, don't do better than that, and I should think there are not many engines which would do as well. Certainly the Great Western would not do as well, for I have seen the Dutchman stick at Bristol on a wet day with six carriages, and it was quite two or three minutes before the engine would move the train at all. Now the 4 p.m. to Rugby took fifteen carriages behind her, and I believe the Great Western maximum load is about nine of their bogie carriages, if as much. The London and North-Western are not timed to run at an excessive speed, not over about forty-seven miles an hour, but that is not to say that they do not, for it is a very punctual line, and trains are often obliged to run very hard to keep their time, which they do very well. The Irish mail runs generally very quick between Chester and Bangor, doing the journey, sixty miles, in an hour, or perhaps a little over. The Great Northern are timed to a very high speed, but I do not think that really they go any quicker than the London and North-Western. The Midland expresses average about forty-five miles an hour; and I beg to differ with "G. N. R.," your correspondent of last week, about them. The Midland 7ft. coupled engines are specially built for their main line expresses, with which they always run, and take eleven to fourteen bogie carriages at a very good speed—about fifty miles an hour—and are specially good on a road with steep gradients and curves, like that from Derby to Manchester. "G. N. R." says that coupled engines are never put on a main line express; that is a mistake, for the London and North-Western nearly always use them on theirs, and the Midland, Great Eastern, Lancashire and Yorkshire and North Eastern do also. If coupled engines are not put on expresses, why do locomotive superintendents nearly always prefer to build them instead of singles? I expect it is because they can climb banks better than the singles do, and do not slip so much in wet weather, taking heavier loads as a rule; in fact, because they do their work much better as a whole than singles. The London and North-Western does not build any single engines now, all the new ones are coupled, 5ft. 6in. Indeed the Great Northern and Great Western are among the only lines that use single engines always. I should be much obliged to "Fair Play" if he would state what engine it was that took the 4 p.m. to Rugby on the 5th March, and whether it was a single or coupled. B.

March 30th.

SIR,—I cannot refrain from saying what a treat it is to read such a letter as that from Fredk. H. Cridland, in your last week's paper. I certainly never knew before that the dome had any influence upon the speed of a locomotive. I can hardly think the extra height would make that morning train on a southern line invariably late. I can only account for the fact in one way—that the domeless engines ran regardless of their doom, and that those with domes were doomed to be late. However that may be, I beg to dispute Mr. Cridland's statement that drivers prefer engines without domes, as I believe the contrary is the fact, and if all the drivers were canvassed, that at least 99 per cent. would vote for the dome. Moreover, as the London and North-Western, Midland, Great Eastern, London, Brighton, and South Coast, Great Western—narrow gauge—North-Eastern, Manchester, Sheffield, and Lincolnshire, North Staffordshire, North British, and Caledonian Railways all use domes, where are the several other companies of any importance that do not? No one admires the graceful outlines—barring the cab—of Mr. Stirling's magnificent engines more than myself, but at the same time I know they are ticklish on the water level question, especially with the round topped fire-box, which must be carried so very high to get a fair quantity of tubes in that the steam space is much crippled, and on that account the drivers would as a rule prefer the flat topped fire-box and a dome; the vacuum brakes also add to the difficulty of carrying the water steadily. I must not, however, trespass further upon your space. J. J. T.

Lincoln, April 12th.

SIR,—I have read Mr. F. H. Cridland's letter in your issue of the 8th, which is a reply to my letter of the 25th, and would again like to say a little in reply thereto. In his first remark he says he has generally found drivers prefer engines without domes to those with them. Now I have found drivers who prefer domes. Only within the past few days I have spoken to drivers who have had domeless engines, and they prefer them with domes. Again, Mr. Cridland remarks that the domeless engines are the higher speed engines. I can say from experience, without hesitation, that the question, dome and no dome, has nothing whatever to do with the speed of an engine. Then your correspondent goes on to say if the engines of the Great Northern Railway express trains were run as described by me, many accidents would result, while none have yet occurred through low water to any of them. In reply to this I would remark that I have been informed by persons who have been in the employ of companies who possessed domeless engines, that drivers now and then run eight and ten miles without ever seeing the water in the water-gauge glass. Drivers have had their engine boilers washed out alternate nights for a week together, because, as I know from my own experience, the engine would not be able to carry the water in the boiler with the little grease which might get worked in. This is again quite the reverse of an engine with a dome on, for I have known drivers not unfrequently give them a little grease in the boilers.

And again, Mr. Cridland says, were the running of engines without domes accompanied by the inconveniences and dangers described by me, the practice would be immediately condemned by the engineers of the present day, and that many companies which up to 1870 never possessed a domeless engine have now numbers in daily use. When your correspondent speaks of the engineers of the present day, I think it not right to assume that the engineers of two companies represent all our great railways. I cannot personally say what class of engines run on the southern lines, but I can quote some of the leading railways in the kingdom that run engines with domes, and I think if I give great odds the benefit of the doubt ought to be on my part.

I may commence with the Midland and the London and North-Western Railways. The former company I am given to understand will very shortly attain No. 1500. The latter is running No. 2200 and over, and out of these two numbers alone scores—nay, shall I say hundreds—have been turned out of the shops in the last very few years, and all with domes on. On the North-Eastern and North Stafford all new engines of the latest designs have domes on. By-the-bye, I nearly forgot the Lancashire and Yorkshire some few years ago had some new engines built by Sharp, Stewart, and Co., Manchester. These were of the Great Northern type, four-coupled domeless; but I saw a short time ago that the engineer of the Lancashire and Yorkshire is having domes put on. Also some of their older passenger engines. And lastly, our own small but enterprising company, the Manchester, Sheffield, and Lincolnshire. I can well remember when No. 121 was the highest; now it has this week turned out of the works No. 451, every one with domes on. And in conclusion, I hope, with the very high figures which I have shown, that your readers will be well satisfied that engines with domes on are the engines for the present day, and that your readers must not be surprised at a future date of seeing some of the domeless engines figuring with domes on. W. T.

Stockport, April 14th.

SIR,—"S. R." in his formula for speed steel tires may be run at is in error, having neglected multiplying D by $\frac{\pi}{2}$, which reduces the mileage to 346 per hour; the simple formula being

$$S = \frac{\text{seconds per hour}}{\text{feet in mile}} \times \sqrt{\frac{rad \times g \times j}{\frac{D}{288} \times \frac{\pi}{2}}}$$

for the bursting of a steel hoop of any diameter ½in. in section under centrifugal force. As to coupling rods, I make the mileage S for the example given 110 miles in place of 84. Taking the data, the distributed weight to break the coupling rod 102in. in length by 4½in. depth, weight 127·5 lb. per inch thick—

$$\frac{2{\cdot}31 \times 20{,}000 \times 4{\cdot}5^2}{102} = 9172 \text{ lb.}$$

$$\text{the velocity of crank } r = \sqrt{\frac{r \times g \times 9172}{12 \times \text{wt. rod}}} = 50{\cdot}1\text{ft.}$$

$$\text{velocity wheel} = 50{\cdot}1 \times \frac{R \times 12}{r} = 162\text{ft. per sec.}$$

$$\text{miles per hour } S = 162 \times \frac{15}{22} = 110 \text{ miles.}$$

As to breakage of coupling rods, I fancy this is due more to the inherent mechanical difficulties than weakness to resist centrifugal force—a rigid tie betwixt two wheels, which let them be ever so exactly made can never be perfectly alike. I notice the engine in question has lateral side play of axles in addition, which throws another element of uncertainty in the matter. For high speed locomotives the doing away with these coupling rods would add another factor in security. W. S.

Liverpool, April 13th.

SAFETY VALVES.

SIR,—I trust you will allow me sufficient space to reply to the personal remarks of Mr. Adams, the well-known maker of safety valves, Manchester, which appear in your issue of the 8th inst. I think, as a "member of the brotherhood," he had no right to make them. We were not discussing each other's personal qualities, but a scientific question. Mr. Adams shows, and has before shown, great pique at my safety valve. Is that because he has recognised in it the carrying out of higher principles than he had himself foreseen? I admire Mr. Adams' force of character; but he is a thorough Englishman—possessed of great virtues and of great faults. If he had a good patent to work upon, I believe he is just the sort of man to make a fortune. But!—*Non omnia possumus omnes.* JOHN C. WILSON.

5, Westminster Chambers, Victoria-street,
London, April 11th.

SIR,—Having seen a letter on the subject of safety valves generally, and Adams's valve particularly, in a recent number of THE ENGINEER, I have thought that my experience of Mr. Adams's valve may be of interest to some of your readers, and I therefore ask for a little space in your paper. I have been engaged in the capacity of a seagoing engineer for some years, and during that time I have been in four steamers fitted with these safety valves, so that I am justified in claiming to have some experience of them. Now in none of these instances was the valve anything like so perfect in its action as Mr. Adams asserts it to be, and in two of the four cases it was glaringly defective. In the first of these it was fitted on board a steamer having engines of some 600-I.H.P. We had two boilers with a pair of Adams's valves on each. They were loaded to a pressure of 75 lb. per square inch. They lifted most accurately at the proper pressure, and beyond a doubt they eased the boilers rapidly, but they eased them too much, for they never shut until the pressure had dropped to 62 lb. During last summer I left England as engineer, in charge of a steamer built for a company of Greek merchants, her trade being to carry passengers, mails, and now and then troops, amongst the islands of the Grecian Archipelago. We had engines of some 300 I.H.P., and these were supplied with steam by one boiler, which was fitted with a pair of Adams' valves. We left England in the autumn of 1880, and almost from the beginning we had trouble with our safety valves. They were loaded to a pressure of 75 lb. per square inch, and in November they began to leak very seriously; I had them opened and thoroughly cleaned, but saw that the temper of one of the springs was rapidly leaving it. Having, however, cleaned everything thoroughly, I reconnected the whole thing, but on going to sea the blowing was almost as bad as before, and this kept increasing at so serious a degree that in the following month I was unable to keep more than 65 lb. of steam, and having no opportunity of stopping for a sufficiently long period to get the steam away at the time, I was obliged to cut off the brass washer and screw the covering cap, until I could carry the necessary pressure. On the first opportunity I put in a new spring which I had amongst my spare gear, and for a little while all went well. One day, towards the end of January, the ship being then lying under steam, waiting for the mails, the third engineer—who had just joined, and was on duty in the engine room—reported to me an excessive pressure by the gauge. I immediately ran down and found a pressure of 95 lb. on the gauge. Having plenty of water in the boiler I endeavoured to ease the valves, and on shaking their connection they lifted with a roar, and soon eased the boiler to its proper pressure, but not until a very considerable quantity of water had escaped. The next entry I find in my log book is on the 25th of February, and is to the effect that "the safety valves are again working badly, and are blowing considerably below the proper pressure." On the following day I read, "The safety valve which has not hitherto given us any trouble is blowing at 70 lb.," and on the 27th I have the following entry: "Whilst discharging cargo at Salonica, obliged to cut the washer out of defective valve, so that I may screw it down to blow off at 75 lb." A week later I put a new spare spring to this valve, and then all went well until I come to my last entry on the subject, made at Constantinople on the 20th of March, which is as follows: "The safety valves having been giving me much dissatisfaction during the last week, alternately leaking and sticking, I opened the casing to-day and found them in a very dirty state, in addition to which I found the spring sleeve fast jammed on the spindle, and the spindle on its passage through the lower part of the casing." Such, Sir, has been my experience of this valve. I do not go into figures to prove anything, I simply state the facts of my experience, and with these facts before my eyes I cannot yield unto Adams's safety valve the homage which Mr. Adams seems to consider as its due. I have just arrived in England from Greece, and have not yet had time or opportunity to read the letters of Mr. Messenger, "X.X.," or John C. Wilson, to which Mr. Adams, in his letter published on the 8th, alludes, but I shall look with much interest for further correspondence on this most important subject. CHIEF ENGINEER.

London, April 19th.

SIR,—Mr. Adams asserts that I have thrown down the gauntlet; in this he is mistaken, as I only wished to convey to "Inquirer"—see ENGINEER of February 25th—and others information which I had some trouble in collecting at a time when I had to design safety valves for large marine boilers under Board of Trade supervision. The valuable information published by the Engineers and Shipbuilders of Scotland materially assisted me, and if Mr. Adams had seen my book he would see that my indebtedness is duly acknowledged in the first sentence.

The rule based on the above authority Mr. Adams calls my "muddled rule," and he then proceeds to give his own rule, which is certainly very simple, viz., that for a good natural draught a good practical rule for the opening of safety valve orifice in square inches is the total grate area in square feet divided by one-fourth the absolute pressure in pounds per square inch. I should like to know what Mr. Adams considers a "good natural draught," because if I begin to design a safety valve I must know this before starting, then I shall no doubt have a very simple rule indeed for future use. But from experience I know that the natural draught in boilers varies as much as 200 to 300 per cent.

Again, his rule takes no notice whatever of the evaporative efficiency of the boiler, and gives us no idea of lift or diameter of valve; in fact, his rule is very much like calculating the strength of a beam by multiplying the breadth by the square of the depth and taking no notice whatever of its length. I must, therefore, decline with thanks the offer of Mr. Adams's nice little rule for the next issue of my book. I must also remind him that in my letter in your issue of March 18th the rule I gave applied to safety valves of the ordinary construction, and that my muddled rule, in place of giving the indefinite factor of a good natural draught, was based—(1) On the rate of consumption of fuel per square foot of fire-grate, which is the result of draught whatever it may be; (2) the evaporative efficiency of the boiler; (3) the necessary area of safety valve opening; (4) the lift and diameter of valve.

Again, Mr. Adams calls on me to demonstrate the reason why an ordinary valve should be of such a diameter that it will provide the necessary opening for the outflow of all the steam any boiler can make by a lift of one thirty-sixth of its diameter, and which he asserts is a serious offence against philosophical knowledge.

The first reason is that when steam is flowing in a large volume out of an opening, such as that underneath an ordinary safety valve, the pressure falls in the immediate vicinity of the opening below that in the body of the boiler, and the more the valve lifts the greater will be this fall of pressure as compared with that in the body of the boiler. The second philosophical reason is that when a spring is used, the higher the valve lifts the greater will become the resistance of the spring due to this lift. So that if a valve is so small that it must lift a considerable distance more than one thirty-sixth of its diameter the steam will be seriously falling in pressure below, and the spring seriously obstructing the lift above the valve.

I have one more question to answer, viz., the comparison of the British and German regulations as to the area of safety valves. The British Board of Trade rule is half a square inch of safety valve area to every square foot of fire-grate, ignoring the pressure altogether. Whereas by the German law, valves are so proportioned that they vary in size exactly in the inverse ratio of the absolute pressure, and I for one certainly think they have philosophy on their side. Ordinary safety valves, if proportioned by the Board of Trade rule, are undoubtedly too small for low pressures and too large for high pressures. If proportioned by the German law they are about the same size as those by the British at about 72 lb. absolute pressure; but for pressures below 72 lb. the German are larger, and above 72 lb. they are smaller.

With regard to spiral springs, I fear, Mr. Editor, I shall extend this to too great a length for your valuable space—but I must give the Board of Trade rule, by which all springs must be proportioned which come under their supervision, and which "Inquirer" and perhaps some of your other readers may not know. It is—

$$\sqrt[3]{\frac{S \times D}{C}} = d$$

S = load on spring in pounds; D = mean diameter of coil in inches; *d*, the diameter if round, or side if of square steel in inches; C = 8000 for round steel, and C = 11,000 for square steel. All my information I have imbibed from such well-matured works as those of the Engineers and Shipbuilders of Scotland, Professor Rankine, Napier, and others. Safety valves which I have designed for boilers up to 120-N.H.P. each, by the assistance of this information, have enabled me to prove that in practice the results thereby obtained are correct, and they have all passed the strict Board of Trade tests under full fires with stop valves closed; all the steam passing the safety valves without undue accumulation of pressure.

I am aware that Mr. Adams has a valve of his own, which is, I hear, highly approved by the Board of Trade. The results he has obtained will no doubt be different to those obtained by ordinary safety valves, to which my letter referred, and on which my book was written, and we shall all be glad to know what he has accomplished in this field. THOMAS MESSENGER,

43, Strond-street, Dover, April.

THE CLARK AND WEBB CHAIN BRAKE AND THE CONTINUOUS BRAKE RETURNS.

SIR,—In the Blue Book containing the continuous brake returns for the six months ending December 31st, which has just been issued, will be found a surprising assertion as to one particular merit which is claimed for the Clark and Webb chain brake. On page 9 of the "Returns" it is stated by the London and North-Western Company, and on page 10 by that company and the Caledonian—working as the West Coast Railway—that this brake "cannot creep on when not required to do so whilst the train is running at speed, all danger on that score being consequently avoided." This surprising assertion was first made in the returns for the six months ending June 30th, 1880, and although its publication might pass unchallenged for once, as it might possibly have been made by mistake, it is too great a claim upon one's credulity to pass a second time unnoticed.

It is only necessary to turn to the returns made by the above companies of the working of the above brake during the year 1880 to find abundant disproof of the bold assertion that this brake "cannot creep on when not required to do so whilst the train is running at speed." The first instance reported is, "March 3rd, 9.10 p.m. train, Glasgow to Carlisle, delayed three minutes. Brake went on of itself three times on W.C.J.S. carriages 24 and 72; caused by cord slackening and trailing on the ground." Then follow: "June 30th, 1.40 p.m., Carlisle to Glasgow, delayed one minute; brake having gone on of itself on W.C.J.S. carriages 62, 15, and 22. Cause unknown. August 11th: 8.5 p.m. Holyhead to Crewe, delayed four minutes through the blocks of the countinuous brake going on to the wheels, owing to a cord getting entangled in a horse-box, which had no loop for the cord. August 16th: 8.35 Victoria to Willesden, the blocks of the continuous brake went on to the wheels and delayed the train sixty-five minutes. Friction wheels were adjusted too close to each other. November 29th: 9.15 p.m. from London, continuous brakes went on, and the blocks skidded the wheels. The chain had been secured too tightly at Tamworth; nine minutes delay. December 7th: 11.10 p.m. Liverpool to London, delayed six minutes at Camden through the continuous brake going on. The cause of the occurrence cannot be ascertained, as the brakes were in good order when examined on the arrival of the train at Euston. December 20th: The 5 p.m. London to Holyhead, delayed five minutes at Colwyn through the blocks of the continuous brake going on to the wheels. The cord which actuates the brake from the engine had become contracted through wet. October 2nd: 9.40 p.m. Perth to Dundee, West, delayed eight minutes near Glencarse. Brake went on of itself, brake lever in W.C.J.S. van 156 having sprung up. October 8th: 7 p.m. Carlisle to Glasgow delayed eight minutes. Brake went on of itself on W.C.J.S. van 83, cord being too tight. October 19th: 1.40 p.m. Carlisle to Glasgow went partially on of itself on W.C.J.S. van 90, the wheels and tires of which became so hot as to necessitate its being detached and another van attached in lieu of it at Lockerbie, delaying the train thirteen minutes. November 20th: 4.30 p.m. train Glasgow to Carlisle delayed ten minutes near Thankerton. Brake partially went on of itself, owing, it is supposed, to tightening of cord." In addition to the above there are seven instances of "working on" of this brake reported by the North London Company during the last twelve months. All the above instances occurred whilst the train was running at speed, thus completely disproving the assertion of the London and North-Western and West Coast Companies, that "all danger on that score is avoided." It is difficult to believe that any supervision was given to the returns by the above companies, when preparing them for the Board of Trade, or such an unfounded statement would surely never have been allowed to be issued. According to the Railway Returns (Continuous Brakes) Act of 1878, "any person who makes or is privy to the making of a return under this Act, which is to his knowledge false in any particular, shall be liable, on summary conviction before a court of summary jurisdiction, to a fine not exceeding £50." It is to be desired that either the above clause, or the love of truth, will cause the London and North-Western Company to withdraw the objectionable assertion from their next return to the Board of Trade. J. N. Armitage.

Shakespeare-street, Bradford, April 9th.

RAILWAY CARRIAGE LIGHTING.

Sir,—May I be permitted a small space in The Engineer to explain the systems of illumination by means of compressed gas patented by my father and myself, inasmuch as I think that the paper upon this subject read by Mr. Nursey before a meeting of the Society of Engineers, taken by itself, without the discussion which followed it, and which was decidedly favourable to our present method, is liable to leave a wrong impression upon the minds of those who see it?

It will no doubt be generally conceded that the one thing needful in lighting railway carriages, buoys, &c., is as much light in as small a space as possible, and at the smallest possible cost; up to the present date we have employed two methods of doing this. The first of these was suggested some fifteen or twenty years ago in "The Gas Engineer's Book of Reference," published by my father, and consists simply in compressing a rich gas into receivers placed upon the vehicles or edifices to be lighted. The gas when required passes through an automatic regulator which preserves a constant burner pressure, no matter what that may be, existing in the cylinders, or what number of lights may be burning within the capacity of the regulator. This system is certainly, as Mr. Nursey truly remarked in his paper, thoroughly practical. The objections, however, which we see to this plan, are—First, that special gas works are required at each filling station; secondly, that a rich gas will not stand a very high compression without losing an appreciable percentage of its illuminating power; and, thirdly, the great cost compared with that of an equal amount of light furnished by our second system.

In carrying out this plan, we compress ordinary coal gas to any pressure that may be considered desirable, ranging from 50 lb. to 500 lb. per square inch, according to the requirements of the case. The regulator is employed as before, and the gas, at the burner pressure of say seven or eight-tenths of an inch column of water, passes through a carburetter placed upon the object to be lighted, and automatically takes up about two gallons of hydrocarbon per 1000 cubic feet, without the possibility of its being dropped again before consumption. The amount of light per cubic foot is rather more than that obtained by the consumption of the same quantity of oil-gas, and the cost, as proved by a trial lasting 125 consecutive hours, which took place the week before last upon a Great Northern Railway carriage running between Peterborough and King's-cross, does not exceed $\frac{1}{10}$th of a penny per light per hour, as against $\frac{1}{4}$d. per hour per light of equal intensity supplied with oil-gas on the so-called Pintsch system. This result, I may say, will be verified at any time by Mr. Oakley, the general manager of the Great Northern Railway Company, under whose direction the practical experiment was made.

Our carburetters only require filling once a week; no extra gas works are necessary; the storage power is much increased, as there is no fear of losing illuminating power to any appreciable extent by compression, and the whole plan seems to me to be more cleanly and compact than any system of making a special gas, or of doctoring common gas before compression.

In conclusion, I must say that I quite agree with Mr. Horsley's final remarks upon the paper that I have just referred to, and I think that in most of the oil-gas trains the supply of gas is too much "pinched" in one sense, and too little "Pintsched" in another, and that, as a rule, passengers to read comfortably, still require more light. Anthony Spencer Bower.

St. Neots, April 11th.

THE STRENGTH OF STEEL PLATES.

Sir,—I have not had an opportunity until this morning of looking over The Engineer of the 4th inst., when I observe that regret has been expressed by yourself, as well as by some gentlemen who took part in the recent discussion upon the Livadia steel plates at the meeting of Naval Architects, that no representative of Messrs. Cammell—who made the plates—was present. Permit me to observe that we share most fully in this regret. We understood that notice would be given of the time of meeting, and it was intended that some one from these works, acquainted with the details of the manufacture of the plates in question, should be present. Under the circumstances, therefore, we were much surprised to learn that the discussion had taken place without any such intimation having been received by us. I observe that the method of annealing adopted has been adversely criticised. I certainly should not assert that our furnace is not susceptible of improvement, but it should be kept in view that time was of serious importance. This would have proved an obstacle to any annealing of plate by plate; but such an objection could not, of course, be held to sanction the application of any method known to be imperfect. The fact is, however, that we have frequently annealed with entire success batches of plates arranged as in the present instance, and I fail to see why plates in numbers should not be annealed together as efficiently as wine-glasses or tumblers can be, when properly packed upon one another. The term "annealing" has of late been often applied to a mere heating to redness, the plate being then immediately dragged out upon the floor. To speak of "annealing" in connection with any such operation is a misapplication of the term, the essence of which consists in prolonged heating and a prolonged cooling. No doubt it would be easy in our furnace, or in any other, to injure the material by "forcing" the process, just as a too rapid attempt to attain a welding heat will simply burn the exterior before the interior is affected. I contend, however, that when the bridges are properly arranged so as in a great measure to diffuse an equable temperature throughout, and the heat is brought up gradually, there should be no difficulty in annealing successfully with the furnace actually employed; and, of course, it was supposed that such success had indeed been attained.

There can be no doubt that mild steel is injured to some extent by punching, not perhaps in strength but in ductility. The reason, viz., the formation of a hard zone round the punch hole, is very obvious. The question has now arisen: Why should there be a liability in a steel open to no objection on the score of chemical composition, and competent to meet all the mechanical tests heretofore imposed, to sustain more damage from this process than another in no way superior to it in other respects? What is the precise nature of the concealed "rift within the lute?" How can it be detected in time? how prevented? I agree with Mr. John that it would have been as well to take the opinion of steel makers on such points.

As to the improvement brought about by increased working of the plates, before we can venture to be precise in this matter I think we should be able to distinguish clearly between what we owe to such working and the increased flexibility due to the diminished thickness of the specimens. This does not appear to have had the attention it deserves. The proper method would appear to be, not to roll down suspected material to different thicknesses, but to start with ingots of different sizes, then finish and test at the same thickness. A. Alexander, M.A.

Cyclops Works, Sheffield, April 14th.

SOUND STEEL CASTINGS.

Sir,—In referring to your very interesting articles upon the above subject, it is not my intention to enter upon a discussion of the merits or demerits of the several methods enumerated for the consolidation, or of the theories offered to account for the formation of cavities within steel ingots; but I note at least one error that calls for correction, viz., that the "mechanical method" has been abandoned at the Abouchoff Works. Now, up to June last I was directly responsible at those works for the successful results of this process, which was then in daily operation upon a large scale, whilst in a letter of recent date from the chief of those works, I am informed that all is still going well with the plant and process.

That the compressed steel is "stronger or more ductile than if made by other methods does not appear" from the results of Chernoff; but it does most certainly appear from the results of Sir Joseph Whitworth, published from time to time in the "Proceedings" of the Institution of Mechanical Engineers, &c. But independently of these, it is scarcely necessary to remind engineers and metallurgists that there is steel and steel, and that the methods of making sound ingots have not as yet been set up as antidotes to bad materials, or bad melting in either crucibles, furnace, or converter; and further that the same metal will give widely different results according to the subsequent treatment it has received. Therefore, before Chernoff's results can have any value as applied to the "mechanical method," it is necessary that he shall give the results as applying to ingots of the same metal fluid-compressed and uncompressed, or from forgings of the same metal, each having been treated to a like amount of hammering and annealing under the same conditions, and when he has complied with the necessary conditions, I venture to believe that his figures will permit of a different construction to that which they are intended to bear. W. H. Greenwood.

Phœnix Foundry and Engineering Works,
Derby, March 30th.

AVELING *v.* MCLAREN.

Sir,—Allow me to offer a few words in reply to the curious letter by Mr. Aveling, contained in your journal of 15th April, 1881. Whatever remarks Mr. Aveling may have to make respecting my letter on the above subject, I sincerely trust that he will address them to the writer only, and not allude to my superiors, who are in no way responsible for my friendly criticisms, which were written in the intervals of business and altogether unknown to them.

Mr. Aveling cannot have read my letter very carefully or he would have seen that before there could be any desire on my part to imitate his patented arrangement of 1870, my opinion would have to be totally changed. For the present, I consider the box bracket as made and fitted by one of the firms named in my letter to be as good in many respects, and certainly better in some particulars than Mr. Aveling's plan. Mr. Aveling can therefore allow his mind to be at rest, and he may with perfect safety permit the jury to pursue their ordinary avocations; for I do not wish to imitate his extended side plates, any more than I wish to appropriate the white horse of Kent, that is used to ornament his smokebox doors; and much less do I wish to copy the tone of Mr. Aveling's letter, which I cannot admire. Draughtsman.

19th April, 1881.

CRANK SHAFTS.

Sir,—In your article on "Express Atlantic Steamers" in your last number, you make some remarks on the manufacture of crank shafts, to which I must take some objection. You seem to infer that the larger the forging the greater the liability for it to be unsound. This I cannot allow to be the case. That it is a difficult thing to make a sound forging is quite true, but that its size makes the difficulty any greater—provided the plant for its manufacture be on a commensurate scale—I must deny. Shafts of the size you name—viz., 30in. diameter—can be made quite as sound as any of smaller diameter. That there are strong objections to the use of such large cranks forged of iron I am quite aware; but their unsuitability is not caused by their greater unsoundness, but from a different reason altogether, to which the manufacture is, or ought to be, fully alive.

Beaufort-road, Birkenhead, Frank B. Salmon.
April 11th.

A LINEN EXHIBITION.

Sir,—I beg to inform you that a linen exhibition and fair will be held at Kesmark in Hungary, from the 15th to the 17th July, 1881, whereby foreign exhibitors may participate in the following groups, viz., Foreign textile manufactures, machinery and implements, or improvements therein for the preparation or manufacture of flax; looms and weaving machinery and implements; literature referring to the preparation of flax and the manufacture of linen. Applications to exhibit are to be addressed, up to the 1st May, 1881, in duplicate, to the President of the Exhibition Committee, Herr Paul Kiler, Advocat, in Kesmark, Hungary, of whom also the requisite blank application forms can be obtained. Objects intended for exhibition should be forwarded, carriage paid, to following address:—"Herr Paul Kiler, Advocat, Praeses des Ausstellungs Commité's, in Kesmark Station, Poprád Folka, Hungary," and must not arrive later than the 15th June, 1881. No charge will be made for space. The objects will be placed by the committee, or the exhibitor may place them according to his desire at his own expense. The said objects have subsequently to be removed within one week after the close of the exhibition, or the committee will pack them safely and send back the goods at nominal expense to be paid by the exhibitors. Honorary and acknowledging diplomas will be awarded. I should feel obliged for your kind publication of this notice in your valuable paper.

London, 19th April. F. Krapp, A Consul-General.

LINKS IN THE HISTORY OF THE LOCOMOTIVE.

Sir,—Doubtless your correspondent, Mr. Cargill Fyfe, will excuse my correcting an error in his letter appearing in your impression of the 25th ult., in which he states that the whole of the family of Mr. Alexander Fyfe, with the exception of his daughter Isabella, are dead. This is not correct, as his son George is still living, and now resides with his son, Alexander Fyfe, who is employed as an engineer at an oil and flour mill in Airvale—a town on the coast of Asia Minor, and nearly opposite the island of Mytoline. Letters sent to the British Post-office at Smyrna would, no doubt, reach him. S. H. Papps.

Smyrna, 6th April.

THE ALLIANCE MAGNETO-ELECTRIC MACHINE.

Sir,—I notice in your last week's Engineer, in your "Notes and Memoranda" column, you say that Joseph Van Malderen was the inventor of the "Alliance" magneto machine. In justice to myself I must deny this. I am the inventor of that machine, and at the time of the invention Van Malderen worked for me as a carpenter, and could neither read nor write. The Alliance Company have retained the very patterns which I designed, and which Van Malderen made under my instructions. I can give you, if required, any amount of proof of what I have written above. F. H. Holmes.

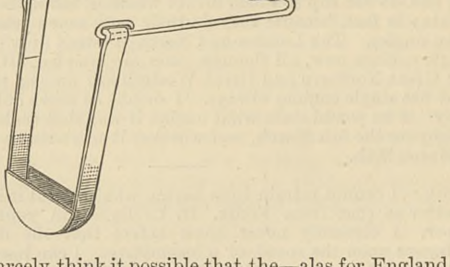
15, Walham-grove, London, S.W., April 18th.

BARON MAX VON WEBER.

On Easter Monday there died, in Berlin, Baron Max Maria von Weber, who had attained a distinguished name in Saxony, Austria, and Prussia, and in fact in all Europe and America, in connection with railway engineering. Baron von Weber was the only son of the celebrated musical composer, Carl Maria von Weber, who died in London in 1826, leaving his son, only four years of age. After being educated at the Dresden Polytechnic School, young Weber acquired a practical knowledge of engineering in the great locomotive works of Börsig, at Berlin. After this he visited similar establishments in Germany, Belgium, France, and England. In this country young Weber was employed by Brunel and Stephenson. In 1850 he entered the Government service of Saxony, where he stayed until 1870. In that year he was appointed a Privy Councillor in the Ministry of Commerce at Vienna. In 1878 he entered the Prussian service, in a similar position. Baron von Weber had attained a considerable name in the literature of his own country, not only as the author of an excellent biography, which has been translated into several European languages, but also as the writer of a number of valuable works on railways and other departments of engineering. Baron von Weber was deputed quite recently by the Prussian Government to make a report on the canal system of England, and visited this country less than two years ago for the purpose of inspecting the principal works of that class, and acquiring the materials for his report at first hand. The principal works of the deceased are:—"The Technical Side of Railway Traffic," "John Cockerill's Portfolio," "The School of the Railway System," "Insurance of Railway Passengers," "The Labour and Endurance of Railway Employés," "The Telegraphic and Signalling System," "Legal Liabilities of Railways," &c. Baron von Weber had made an official inspection of the railways of the United States, on behalf of the present Government, last year, and only presented his report on this subject to the Prussian Minister of Commerce two days before he died.

MR. SMITH'S PATENT CATAPULT.

As an example of the skill and efficiency with which the examiners at the United States Patent-office do their work, we publish the enclosed from No. 14 of the "United States Patent-office Gazette for 1881:"—"As an improved article of manufacture, a sling, made substantially as herein shown and described, with a forked handle carrying an elastic band and central pocket, as set forth. In a sling, the combination, with the elastic band, of a pocket in the middle of the same for receiving the missile, the fork and the handle substantially as herein shown and described, and for the purpose set forth."



We can scarcely think it possible that the—alas for England!—much-too-well-known catapult is still regarded as a new invention in the States. The only explanation of the granting of a patent under the circumstances is that the whole thing is a deep-laid plot of the United States Government against the peace and happiness of the hitherto confiding schoolboy. Finding that various legislative enactments to put down the use of this malign instrument have been in vain, the Government have had a patent applied for by Mr. Smith—the name is as vague as a name can be—of Sabula, Iowa. No one is likely to go to Sabula to find out if a Mr. Smith really lives there and holds a patent. Under this veil of mystery the Government can pounce on any one vending or making catapults, in the name of Mr. Smith of course, and levy appalling royalties, to say nothing of impounding the machine. It is improbable that any one will plead prior user, and so the scheme will work well in all probability. It is much to be regretted that the same plan cannot be tried here. For instance, would it not be well if the various metropolitan authorities were to get a Mr. Smith to patent street slides, the use of snowballs in a game, tip-cats, kites, leap frog, tops, and hoops. All these things ought to be patented, and large royalties charged on licences for their use within twenty miles of Charing Cross in public thoroughfares.

Exemption of Civil Engineers from Jurors' Duties.—At the Commission of Oyer and Terminer, Dublin, before the Right Hon. the Lord Mayor and the Right Hon. Mr. Justice Fitzgerald, the names of the jurors on the county petty list claiming exemption having been called, Mr. Robinson, C.E., architect, Great Brunswick-street, claimed that he was by reason of his profession exempted from serving under the provisions of Lord O'Hagan's Act. Mr. Justice Fitzgerald said he could not see why civil engineers should be exempted. Such a provision was improperly introduced into the Act, probably in the interest of some persons. Mr. Ormsby, city sub-sheriff, said that Mr. Robinson was properly summoned to serve. He had written a most impertinent letter to the high sheriff. Mr. Robinson: I respectfully submit that I am clearly exempted under Lord O'Hagan's Act from serving as a juror. Mr. Justice Fitzgerald: I did not say you were not exempted, but I say it is a mistake in the Act which ought to be remedied. I must yield to your application. Another juror who had been summoned said there was no proper definition of "Civil Engineer," and he did not see why he, as a director of works, should not be exempted. Mr. Justice Fitzgerald said the Act of Parliament said that civil engineers were to be exempted, but it did not say that the directors of works were.

AYLESBURY'S DOUBLE-BAND SAW.

We illustrate on pages 287 and 294 a double-band sawing machine invented and patented by Mr. Aylesbury, and constructed by Messrs. Watts, of Bristol. Its construction will be readily understood from the drawings. Four pulleys are used, mounted in pairs side by side. One of the band saws passes over a tension pulley, and this tension pulley is carried by a stud fitted to a slide, which can be moved on V's horizontally. It will be seen that by drawing this tension pulley out a space will intervene between the planes of motion of the saws, and in this way two cuts may be put at the same time in a log or beam at any reasonable distance apart. Although both saws are driven at the same speed, they work independently of each other. The tension of the band saws is determined by the springs shown overhead, the outer ends of which are held down by tie-rods and nuts, while the inner ends carry the saw pulley bearings in a way sufficiently obvious.

The construction of the weighted feed rollers, and of the gearing driving them, and of the various means of adjustment, are so clearly shown, that no more particular description is required.

TENDERS.

TENDERS FOR THE SEWERAGE OF KENILWORTH.

Mr. G. A. Lundie, C.E., engineer, Cardiff, and 1, Westminster-chambers, Victoria-street, S.W.

	£	s.	d.
John Fell, Leamington—accepted	3935	11	0
James Marriott, Coventry	5555	0	0
William Boon, Coventry	5462	16	0
F. Melland Smith, London	5250	0	0
F. G. Smith, Leamington	5079	13	10
Wm. Davison, Shildon-by-Darlington	5016	15	0
Alfred Palmer, Birmingham	4470	0	0
James Dewitt, Harbury	4337	0	0
Currall and Lewis, Birmingham	4037	17	5
John Mackay, Hereford	4014	0	0
Herbert Hughes, Gornall	3846	17	1
Stephen Edward Frayne, James's Bridge	3825	11	0

TENDERS FOR THE SEWAGE FARM.

	£	s.	d.
Bryan W. Ward, Leicester	2655	15	0
James Dewitt, Harbury	1722	18	0
John Fell, Leamington—accepted	1421	17	8

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

(*From our own Correspondent.*)

This week has been marked by the issue of complete price lists by all the chief firms, but not by the booking of orders either upon the Wolverhampton or the Birmingham Exchange. Messrs. Phillip Williams and Son announce their new prices as: "Mitre" bars, £7 per ton; and "Mitre" hoops, £7 10s.

The Patent Shaft and Axletree Company, Limited, made a reduction of 10s. per ton; their new prices being on the basis of £7 for common bars.

Messrs. William Millington and Co.'s new prices are: S.H. bars, £7; S.H. plates, £8 10s.; and best plates, £9.

Messrs. E. T. Wright and Sons' new quotations are: "Monmoor" plates, £8 10s.; "Monmoor" sheets, £8. The "Wright" qualities of the same firm are 10s. per ton lower than the above figures.

Messrs. Wm. Barrows and Sons, of the Bloomfield Ironworks, Tipton, quote their Best B B H crown, rounds and squares, ½in. to 3in., £7; flats, 1 by ¼ or ⅝ by ⅜ to 6 by 1¼in., £7; best bars, £8 10s. to £9 10s.; best scrap bars from £8 10s. to £9 10s.; best chain bars from £8 10s. to £9 10s.; plating bars, £7 10s. to £9; best angle iron (B B H crown plating), £9 to £10; best T-iron, £9; best rivet iron, £9; boiler plates from £9 for B B H, to £15 for extra treble best. The boiler plates for which this firm are so well known range—for 15ft. lengths and 4 cwt. weights—from £9 for B B H quality, to £12 for treble best, and £15 for extra treble best; whilst their best charcoal plates are £19 5s. Their B B H sheets to 20 w.g. are £9; 21 to 24 w.g., £10 10s.; and 25 to 27 w.g., £12; B B H hoops are £8.

Messrs. John Bagnall and Son's, Limited, prices are as follows:—Bars, 1in. to 6in., flat, £7; 6½in., 7in., 8in., and 9in., flat, £7 10s.; 7/16in. to 3in., round and square, £7 11s.; 3⅛in. to 4in., £7 10s.; 4⅛in. to 5in., £8 to £9 10s. Best and best best rivet iron, £8 10s. to £9 10s.; angle bars, £7 10s.; boiler plates, £8 10s. to £11 10s.

Unmarked iron has not been much affected by the drop in marked qualities, for the prices have been regulated independently hitherto, and have been reduced heavily, while the best brands have been stationary. At the quarterly meetings last week unmarked bars could be had as low as £5 12s. 6d. per ton, fairly good bars being obtainable at £6, and excellent bars at £6 10s. These were the prices at which business might have been done yesterday in Wolverhampton, and to-day in Birmingham.

There were present on each day buyers ready to purchase hoops and strips for America, but they were seldom ready to give the £6 5s. to £6 10s. per ton for the quality required, cut to lengths, delivery at makers' works.

The quotation for single sheets was from £7 to £7 15s.; for doubles, £8; and for lattens, £9 10s. per ton. The galvanisers declined to buy, asserting that they could "do better." Best galvanised sheets were quoted at, delivered in London, £15 for 24 w.g., and £17 for 26 w.g. The business doing was not brisk; yet most of the leading makers reported themselves well employed, and it is noteworthy that among the chief of the work in hand at the engineering establishments is machinery for the galvanisers.

Boiler plates were slow of sale to-day, attributable to the growing demand for steel plates. Plate firms here are anxious to learn what may be the character of the discussion yet to come off at the Institute of Engineers upon corrosion.

The wages of the operative makers of gas rivets in the Blackheath and Rowley districts have been reduced 6d. per cwt. These rivets are being made nearly 50 per cent. below the price paid three or four years ago.

The iron tube makers, who have lately been under-quoting one another with much persistency, are making yet another effort to get up a trade association to put a stop to this state of affairs.

NOTES FROM LANCASHIRE.

(*From our own Correspondent.*)

Manchester.—The past week has partaken more of a holiday character than anything else. Ironworks and collieries in most cases have been closed for three or four days, and the few transactions which have taken place scarcely afford any basis for accurately estimating the real condition of business in either the iron or the coal trades of the district. There is, however, still the same generally depressed tone throughout the market, and prices show a decided weakness wherever they are tested. The quarterly meetings have not resulted in any material accession of new business to the iron trade; and as the spring season is now rapidly advancing, without any of the anticipated revival in trade being realised, buyers seem to have collapsed for the present, and there are extremely few inquiries of any description in the market. Consumers and merchants confine their transactions to small hand-to-mouth purchases just as their requirements compel them to come into the market, and it is questionable whether any concessions in price would just now lead to business unless sellers were prepared to defer deliveries over extended periods.

For pig iron the demand is extremely quiet. So far as Lancashire brands are concerned there is nominally no alteration in price, local makers still quoting 45s. for forge, and 46s. for foundry, less 2½ per cent. delivered into the Manchester district, but very few new orders are coming in, and the above quotations are open to offers. In outside brands there has scarcely been anything doing to test the lowest prices which sellers would take, and I can only give for what they are worth the figures at which it was reported orders could be placed. These, for delivery equal to Manchester, ranged from 46s. 3d. to 46s. 6d. net cash for g.m.b. Middlesbrough, and 43s. 6d. and 44s. to 45s. and 46s., less 2½ for forge and foundry Lincolnshire and Derbyshire irons. Finished iron meets with very little inquiry and prices are easier. Ordinary bars, delivered into the Manchester district, are quoted at £5 12s. 6d. to £5 15s. per ton, but buyers, with good specifications for prompt delivery, could no doubt place them at something under even these low figures.

Although the engineering branches of trade in this district have for a long period, as in my weekly notes I have had so frequently to point out, been in a very depressed condition, and the prospects for the future do not at present wear an encouraging appearance, no very pessimist view of the situation would seem to be taken by at least some of the leading engineering firms in the neighbourhood of Manchester, if I may judge by the enterprise which is at present being shown in the development of engineering establishments. Several new works and enlargements of old works are being carried out on an extensive scale, and it will be of interest if I briefly notice in this and my next few letters what is being done in the Manchester district in this direction.

For some time past Sir Joseph Whitworth and Co., of Manchester, have been erecting new works at Openshaw, in the outskirts of the city, which, when completed, will form certainly one of the finest establishments of their kind in the kingdom. The area to be actually roofed in for the various shops extends over upwards of six acres, and the plant will be of an exceptional character, both as regards heavy tools and the necessary appliances for producing Messrs. Whitworth's well-known specialities in fluid compressed steel castings. Operations are still to some extent being carried on at the old works in Chorlton-street, Manchester, but the company is moving away as rapidly as possible to its new establishment, where it is now fairly well at work.

During the past week I have had, through the courtesy of Col. Dyer, an opportunity of inspecting the portion of Messrs. Whitworth's new works which is now practically completed, and although the limited space at disposal in my weekly "notes" will not permit of anything like a description, which will be best held over until the whole of the departments are in operation, one or two anticipatory statements will, no doubt, be of interest. The portion of the works at present in the most advanced stage is the large machine shop, a lofty, well-lighted building divided into four bays, each 50ft. wide, with a length of 550ft. in one bay, and 350ft. in the three remaining bays. This shop is being fitted up entirely with the most modern machinery, and amongst the heavy tools which the company are erecting expressly for dealing with their heavy forgings of fluid compressed steel, I noticed a massive lathe weighing 110 tons, with 60in. height of centre, and two 40in. lathes of similar pattern, but shorter beds; also a couple of very large slotting machines made specially strong for cutting steel in marine engine work.

Amongst the chief specialities at Messrs. Whitworth's works, as I have already stated, are heavy steel castings and forgings, and for producing these the company is laying down plant, which of its class will be unequalled in the kingdom. I had an opportunity of inspecting some of the specialities in this direction, including cylinder linings made of fluid-pressed steel forged hollow, with a diameter of 7ft. and 6ft. in length. There were also steel castings weighing 30 tons, which up to the present are, I believe, about the heaviest produced at any steel works in the country; but Messrs. Whitworth are putting down steel casting furnaces to cast up to 60 tons in weight. For producing their fluid-pressed steel the company is also erecting heavy forge presses with engines of 34in. cylinders, and capable of exerting about 1200 tons pressure. One of these presses is nearly completed, and a second is in course of construction.

Before concluding these few jottings of my visit to Messrs. Whitworth's new works, I may just add that in passing through the machine shop I noticed, nearly completed, perhaps one of the heaviest cranks yet constructed. This was a three-throw crank for the new Atlantic steamship, the City of Rome, each piece of which weighs upwards of 20 tons, giving a total weight to the crank when completed of about 61½ tons. There was also the propeller shaft for the same steamship, made of fluid pressed steel forged hollow, which, when finished, will weigh 18½ tons, and this was also nearly ready for delivery. The company is also just completing the last four armour-plates for the Polyphemus. These plates will form a portion of the deck armour, but as their general principles of construction has already been described in The Engineer, I need only add that they consisted of sectional plates about 10in. square, screwed together in two layers, the upper plates being of very strong hardened steel, and the back plates of a softer and more ductile material.

While I am noticing Messrs. Whitworth's exceptionally heavy slotting machines, I may mention that Messrs. Craven Brothers, of Manchester, are at present constructing a machine of this class with 8ft. stroke, which, when completed, will be one of the largest machines of its kind yet made. The machine is to be employed for slotting marine engine cranks, and when it is in a more finished state I may be able to send you a detailed description.

The other day I made a tour of several of the locomotive building establishments in this district, and although I found them generally tolerably busy completing orders in hand, one firm having as much as they could get through, I could not hear of much new work in prospect. There are a few enquiries from the Continent, but these are so keenly competed for by foreign makers, that English locomotive builders have but a very indifferent chance, except at prices so low as to be unremunerative, whilst so far as home railways are concerned, the companies who do not make their own plant are, as a rule, at present sufficiently well supplied with stock, to be under no immediate necessity of coming into the market.

In the coal trade the tendency of prices, so far as all classes of round coal are concerned, is decidedly downwards, and from many of the Lancashire collieries circulars are now being sent out at prices which are practically the same as those ruling prior to the recent strike. The average prices at the pit mouth may be given about as under:—Best coal, 9s. to 9s. 6d.; seconds, 6s. 9d. to 7s. 6d.; common coal, 5s. 3d. to 5s. 9d.; burgy, 4s. 6d. to 5s.; good slack, 4s. 6d. to 5s.; and common slack, 2s. 9d. to 3s. 6d. per ton.

So far as trade matters are concerned, the most striking feature during the past week has been the failure of Messrs. Clive Bros., wagon builders and paper-makers, of Bury, near Manchester. The liabilities are put down at about £100,000, and of these a considerable portion will fall upon the iron merchants of Manchester and timber merchants of Liverpool, but it is expected that the estate will show well.

Barrow.—The hematite pig iron market, so far as this part of the country is concerned, cannot be said to be either satisfactory or anything at all approaching to what it was confidently expected would be its position at this time of the year. The trade now is much worse than it was two months ago. I have made careful inquiries at sources likely to be well informed on the subject, and their opinion is unless the Americans come forward and negotiate for some of the iron which it is well known they stand in need of, prices will show a still further reduction, for be it noted a reduction in price has taken place since I last wrote. Makers refuse in most cases to do business at the lower rates now quoted, though some little business has been done by one or two makers who fear a still further reduction. It is to be hoped that the American demand will shortly be forthcoming, as, owing to the very heavy output of metal at the furnaces, a large tonnage of pigs is going into stock, and should the inquiries from America not set in to the expected extent, prices will show a still lower tendency.

The steel mills are still maintaining the activity I have noticed for some time back, though in this trade a lower price is ruling. A very heavy tonnage of metal has to be exported this year, but very little has been shipped as yet. Iron shipbuilders are exceptionally busy, though I have nothing new to report. Engineers, ironfounders, railway rolling stock works, are well employed. Coal and coke in fair demand, as is also iron ore.

THE NORTH OF ENGLAND.

(*From our own Correspondent.*)

The quarterly meeting of the Cleveland iron trade was held in the Exchange at Middlesbrough on Tuesday week, and was attended by various persons from a distance, as well as by the usual frequenters connected with the local trade. Notwithstanding this additional attendance, and that the large hall was also enlivened as to its general appearance by several stalls decked out with exhibits, the tone of the market was as flat, if not flatter, than ever. The causes assigned for this were in the main two—firstly, the usual one, that the Glasgow market had given way until pig iron there was again below 48s. per ton; and secondly, that the Tees shipments had been very poor for the week. They only reached 11,700 tons, or about half the average weekly rate for March. Merchants say this is because the iron is not in demand, and that those who own ships are sending them to Newcastle, Hartlepool, and other ports to find employment. No. 3 G.M.B. pig iron was 38s. sellers, and 37s. 9d. buyers, for prompt delivery. Forge iron, 37s.; warrants, the same, all f.o.t. makers' works, cash, less 2½. It will be observed that warrant holders continue to give way as to the amount of premium they demand. A few weeks since the difference between warrants and makers' iron was 1s. 6d. Now it has gradually diminished to 1s. per ton.

The stock in Connal's Middlesbrough stores had increased 1473 tons during the week, and amounted to 163,276 tons. At Glasgow they hold 544,263 tons. Smelters are complaining with some bitterness that the production of pig iron is altogether excessive, and that nothing but a curtailment thereof, in accordance with the known rate of consumption and distribution, will put the market into a proper condition from their point of view. They say that from eight to twelve furnaces ought to be put out, and will probably have to be put out before long, unless the demand should unexpectedly and largely increase.

In manufactured iron the tone of the market was certainly better than in pig iron. The large buyers of plates, angles, and bars on the east coast have had it all their own way for some weeks, and have refused to buy at all, notwithstanding the eager competition of sellers. Now, however, the consumers are rather anxious buyers, at about £6 for plates, and £5 for angles and bars, delivered into yards. These prices are not accepted by the manufacturers, except, perhaps, in one or two instances where there is great need of specifications. About £6 to £6 5s. f.o.t. may be considered the general price of ship-plates, angles and bars being less in proportion. Curiously enough there seems at the moment to be a certain revival of the iron rail trade, especially in lighter sections; and this has come in most opportunely to keep the large angle mills going.

Messrs. Dorman, Long, and Co., of Middlesbrough, who are able to make over 1000 tons per week of angles, are now almost entirely engaged on rails, having booked a large order for export. The projected alteration of the North Yorkshire Ironworks at Stockton into plate mills, and re-starting them by a new company, seems to hang fire. This is partly because the manufactured iron trade has again become unremunerative, and partly because of the difficulty in raising the requisite capital. Most of the local works continued in operation right through Good Friday, but were be laid off on Easter Monday and Tuesday. The supply of coal from the Durham collieries has lately been very irregular, and this affects the iron manufacturers most seriously. They cannot keep an adequate stock of this material, on account of the room taken up, and of the deterioration which it suffers if laid down and afterwards moved. Besides it is affected by continued exposure to the weather. The scarcity has arisen from the peculiar habits of the colliers, who are continually losing time. At one time the explanation given is that they are "cavilling" or changing their working places, at another they are gone to Durham races, at another to Newcastle races, and so forth. Meanwhile, a large trade, and the interests of thousands engaged therein are jeopardised.

The paper recently read by Mr. Parker, of Lloyd's Registry, upon the failure of the steel boilers of the Livadia, is being discussed with great interest in the Cleveland district. It has followed not inopportunely upon that of Mr. Phillips upon "The Relative Liability to Corrosion of Iron and Steel," read at the Institution of Civil Engineers. It would seem that the owners of steel ships and boilers cannot be altogether free from anxiety as to capriciousness in the behaviour of the new material. According to Mr. Parker larger and not smaller ingots must in future be made, and more and not less hammering and rolling must be done, in order to perform sufficient work upon the metal, and to close up or dissipate the original blow holes. According to Mr. Parker, or rather to the conclusions which are irresistible after reading his paper, steel ships and boilers should be made of thicker and not thinner plates, than where iron is used, or ultimate failure by corrosion may probably ensue. Then the much cherished idea that mild steel plates may be punched with safety, if only the holes are afterwards rimed, must now be given up, and drilling must be held to be in future indispensable. The tests hitherto imposed by Lloyd's surveyors, and which have been considered by most steel makers and users as so needlessly severe, are, it would seem, by no means severe enough to ensure trustworthy material. All these things tend to increase the cost of steel structures, whilst even then mysterious and uncertain behaviour on the part of the material will still be suspected. The steel age has not yet superseded the iron age, and some time seems likely to elapse before it does.

Easter-tide had a marked effect upon the attendance at Middlesbrough Exchange on Tuesday, not more than one-third of the usual frequenters being present. Under such circumstances it is not easy to get at the market price, there being few buyers and sellers. As far as could be ascertained the value of foundry 3 g.m.b. was steady at 38s. 3d. for prompt makers' iron, 39s. 3d. for warrants, and 37s. 3d. for forge, in all cases free in trucks, less 2½ per cent. for cash. The Glasgow market was reported firm to commence with, but afterwards weak, and this produced corresponding fluctuations at Middlesbrough. The demand for forge iron was naturally slacker, in view of the diminished quantity which will be consumed this week at the rolling mills.

Some considerable orders for iron rails for export are being executed by the angle mills, and enable them to be independent of orders for angle iron for some time to come. About £5 7s. 6d. per ton f.o.t. makers' works, is being obtained for these rails. The price of plates continues at £6 2s. 6d. to £6 5s. f.o.t. Middlesbrough. Bars and angles are 20s. per ton less.

The coal trade of the county of Durham is scarcely in a satisfactory condition. Prices are tending downwards, in view of the near approach of the summer season, and of the possible damping down of some furnaces, in order to reduce the redundancy of production in pig iron.

THE SHEFFIELD DISTRICT.

(*From our own Correspondent.*)

There has been very little work done since my last letter—the Easter holidays having been very generally observed.

A special meeting of the Bilbao Iron Ore Company is summoned for next Wednesday, when the shareholders will be invited to divide their £50 shares into five shares of £10 each.

Reductions of colliers' wages are being talked of at one or two distant pits. The men are endeavourin to resist any further lowering of wages, but the local trade is so languid, and competition so keen, they will probably bow to the inevitable without a struggle.

There is a good deal of feeling in the South Yorkshire coal district owing to the drawbacks under which the coalowners labour for the development of their property. The South Yorkshire district is one of the most important in the kingdom, having the most valuable seams of coal, including the well-known Silkstone, where it is found at its best as regards quality and thickness. Yet this vast field makes little progress, owing to the railway rate, and its being dependent on one line—the Great Northern—for reaching the London and other southern markets. It is urged that the rate should be greatly reduced, and that the Great Northern should increase its carrying power. At present the bulk of the trade is thrown into other districts, where the seams are of an inferior quality. The grievance is one which concerns the London consumers very nearly, for they have to pay a much higher price for the coal than they would otherwise have to do, were greater facilities afforded for coal going within the radius of the City dues.

NOTES FROM SCOTLAND.

(From our own Correspondent.)

The Glasgow iron market was closed from Thursday till Tuesday, on account of the Easter holidays, although none of the public works were shut. Business was resumed on Tuesday with a comparatively steady market at prices slightly in advance of those with which the market closed last week.

There are 121 furnaces in blast, as against 115 at the same time last year. Several hundred tons of iron were taken out of store at the end of last week, yet the deliveries have been such as to increase the stocks by nearly 2000 tons, and Messrs. Connal and Co.'s stores contain, at the time of writing, close upon 547,000 tons. The exports of Scotch pig iron during the past week are returned at 13,736 tons, as compared with 10,647 tons in the preceding week, and 15,794 tons in the corresponding week of last year, but this week's figures are somewhat larger than they would have been had a return been made from Ayr last week, the figures from that port containing two weeks' shipments. The arrivals of Cleveland pigs at Grangemouth for the week are 7029 tons against 3934 in the preceding week, and 2575 in the corresponding week of last year.

Business was done in the warrant market on Tuesday at 47s. 8½d. to 47s. 10½d. cash, and 48s. one month. On Wednesday business was done up to 48s. 4½d. cash and 48s. 6d. one month. To-day—Thursday—the market has been flat, with quotations from 48s. 6d. to 48s. 1½d. cash and 48s. 3d. one month.

Makers' special brands continue to be had on easy terms in second hands. The quotations are as follows:—G.m.b. f.o.b. at Glasgow, No. 1, 49s. per ton; No. 3, 47s.; Coltness, No. 1, 58s.; No. 3, 50s.; Gartsherrie, do., do.; Langloan, 58s. 6d. and 50s.; Summerlee, 57s. 6d. and 50s.; Calder, 58s. and 50s.; Carnbroe, 54s. 6d. and 49s.; Clyde, 49s. 6d. and 47s.; Monkland, 49s. and 37s.; Quarter, do., do.; Govan and Broomielaw, 49s. and 47s.; Shotts, at Leith, 59s. and 51s. 1d.; Carron, at Grangemouth, 52s. 6d.—specially selected, 56s.—and 51s. 6d.; Kinneil, at Bo'ness, 49s. and 47s.; Glengarnock at Ardrossan, 55s. and 50s.; Eglinton, 49s. and 47s.; Dalmellington, 49s. and 47s.

The harbour of Leven is about to be enlarged and improved at a cost of £70,000.

The ship-joiners of Glasgow threaten to strike at the end of the present week unless they receive an advance of 7½ per cent. on their present wages. Messrs. Robert Napier and Sons have already made this concession to the men in their employment.

WALES & ADJOINING COUNTIES.

(From our own Correspondent.)

There has been a little upset at the Bute Docks during the last few days consequent upon a change in the arrangements for unloading ballast. A Mr. Hill, contractor, has been endeavouring to bring about a change which would give regular work and fair wages. The old plan has been piecework, by which the men have been enabled to earn large sums on two or three days of the week, and the rest of the week would be spent in idleness and drunkenness. Mr. Hill's remedy for this has been to offer them 24s. per week, work or not, all the year round. Some tumult and a few police cases have been the results so far, and the ferment still prevails.

Over 10,000 tons of iron and steel left the Welsh ports last week, and fully 130,000 tons of coal, notwithstanding Good Friday holiday.

Prices of coal are tolerably firm at Cardiff, and at Newport, but are slightly falling at Swansea. Iron rails are quoted from £5 5s. to £5 10s. Steel rails are steady and in demand. Old iron rails are very stagnant, and abundance of parcels of all sections show this in various parts of the district. Several substantial American orders for steel rails have been placed at £6 10s., usual sections and weights.

The improvement, slight as it was, shown last week in tin-plate, is maintained. Makers, however, say that there must be a falling away in output, by the stoppage of a proportion of the works, ere much good can be expected.

The London Association of Foremen Engineers.—The twenty-eighth anniversary festival of the London Association of Foremen Engineers and Draughtsmen is appointed to take place on the 23rd inst. at the Cannon-street Hotel; Capt. John Davis, F.S.A.—Messrs. Dewrance and Co.—in the chair, Mr. Joseph Newton, C.E., in the deputy-chair.

The British Association.—The evening discourses at the meeting of the British Association at York will, *Nature* says, be delivered by Professor Huxley and Mr. Spottiswoode. Mr. Huxley will speak of the "Rise and Progress of Palæontology" on Friday, September 2nd; and Mr. Spottiswoode "On the Electric Discharge, its Forms and its Functions," on Monday, September 5th.

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 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.

12th April, 1881.

1583. Sewing Machines, J. H. Johnson.—(*C. H. Willcox and J. E. A. Gibbs, U.S.*)
1584. Ores, J. Hargreaves & T. Robinson, Widnes.
1585. Gas, J. Somerville, Denmark Park.
1586. Alimentary Substances, G. Allender, London.
1587. Mineral Oil, &c., W. Young, Lasswade.
1588. Couplings, W. R. Lake.—(*W. Scott, U.S.*)
1589. Purifying, H. Haddan.—(*E. Dronet, Algeria.*)
1590. Pipe Joints, T. Lloyd, Winchester.
1591. Laminated Springs, J. W. Spencer, Newburn.
1592. Indicators, A. Budenberg.—(*C. F. Budenberg and B. A. Schaeffer, Buckau-Magdeburg.*)
1593. Injectors, A. Budenberg.—(*C. F. Budenberg and B. A. Schaeffer, Buckau-Magdeburg.*)
1594. Bicycles, &c., R. O. Rowland, Manchester.
1595. Portable Railways, E. Leahy, London.
1596. Electric Lamps, A. W. L. Reddie.—(*H. Sedlaczek and F. Wiknlill, Leoben.*)
1597. Gas Burners, H. H. Doty, London.
1598. Horseshoes, G. W. von Nawrocki.—(*A. Finze, Knittelfeld Stiermark, Austria.*)
1599. Lacing Hooks, W. R. Lake.—(*M. Bray, U.S.*)
1600. Tanning, C. Michel, C. Kollen, and G. Hertzog, Reims, France.
1601. Brakes, C. Fairholme.—(*W. Bandel, Berlin.*)
1602. Photographic Objectives, H. Steinheil, Munich.
1603. Speed Gauges, M. B. Edson, Brooklyn, U.S.
1604. Lanterns, F. H. Bailey, Hillsdale, U.S.
1605. Extracting, &c., Ores, A. M. Clark.—(*L. L. C. Krafft and J. E. Schischkar, Paris.*)
1606. Traction Engines, A. M. Clark.—(*A. Frick, U.S.*)

13th April, 1881.

1607. Gas, &c., A. Alcock, Sheffield.
1608. Sifting Flour, R. W. Dobing, Durham.
1609. Raising, &c., Liquids, J. H. Kidd, Wrexham.
1610. Umbrella Furniture, G. Lusher, Birmingham.
1611. Cocoa, W. Barry, Peckham.
1612. Power Looms, J., F., and G. Priestley, Bradford.
1613. Signalling, W. R. Lake.—(*I. T. Campbell, U.S.*)
1614. Roller Mills, W. L. Wise.—(*Messrs. Seck Brothers, Dresden.*)
1615. Sewing Machines, J. G. Wilson.—(*A. M. Leslie, and the Teller Manufacturing Company, U.S.*)
1616. Sash Bars, F. A. Lawrance, Stevenage.
1617. Sewing Machines, F. Heyrich and F. Quenstedt. (*Actiengesellschaft, vorm, Frister und Rossmann, Berlin.*)
1618. Latches, G. E. Wilson, Leeds.
1619. Gas Lamps, W. J. Brewer, Bombay.
1620. Fusible Plugs, H. Adams, London.
1621. Gas Burners, W. J. Brewer, Bombay.
1622. Fastenings, J. Doodey, Birmingham.
1623. Fusible Compounds, J. D'Arcy, Belvedere.
1624. Electric Telegraphs, A. Muirhead and H. A. C. Saunders, London.
1625. Metal Pipes, S. Fox, Leeds.
1626. Umbrellas, W. R. Seaton, Manchester.
1627. Carpets, G. O'Connor Holloway, Kidderminster.
1628. Ventilating Drains, G. E. Mineard, and T. Crapper, London.
1629. Drills, E. E. Bentall, Maldon.
1630. Ores, J. H. Johnson.—(*N. E. Reynier, Paris.*)

14th April, 1881.

1631. Permanent Ways, A. J. Acaster, Sheffield.
1632. Trawling Apparatus, J. Caux, Great Yarmouth.
1633. Separating, &c., F. J. Drechsler, London.
1634. Looms, W. Morgan-Brown.—(*G. Crompton, U.S.*)
1635. Boxes, &c., J. Darling, Glasgow.
1636. Producing Motion, St. G. L. Fox, London.
1637. Colouring Matters, T. Holliday, Huddersfield.
1638. Azo Colours, T. Holliday, Huddersfield.
1639. Nitro-Benzole, J. Deucker, Manchester.
1640. Bottles, H. J. Haddan.—(*B. Ainé, France.*)
1641. Liquid Meter, J. H. Blum, Bienne.
1642. Chain, &c., E. Wilkins, Birmingham.
1643. Steelyards, O. Jones, Salford.
1644. Cast Crucible Steel, J. H. Wilson, Liverpool.
1645. Breast Shields, C. H. Bradley, London.
1646. Sanitary Appliances, H. P. Holt, Leeds.
1647. Pencil Cases, P. Lawrence.—(*J. Reckendorfer, U.S.*)
1648. Packages, &c., R. R. Gray, Liverpool.
1649. Signals, A. J. Boult.—(*W. C. Seaton, Quebec.*)
1650. Steam Pumps, T. H. Ward, Tipton.
1651. Excavating Apparatus, J. D. Brunton, London.
1652. Propelling, J. H. Johnson.—(*J. E. J. d'Arembècourt, Paris.*)
1653. Electric Lamps, J. H. Johnson.—(*Société la Force et la Lumière Société Generale d'Electricité, Brussels.*)
1654. Casks, A. M. Clark.—(*T. Sourbé, France.*)
1655. Cotton Gins, A. M. Clark.—(*A. G. Jennings, U.S.*)
1656. Copying Process, D. Gestetner, London.
1657. Fabrics, &c., W. Thacker, Nottingham.
1658. Sugar, H. E. Newton.—(*A. L. Thibaut, Paris.*)
1659. Capstans, E. E. and F. A. Bentall, Maldon.
1660. Furnaces, A. W. L. Reddie.—(*W. Duryea, U.S.*)
1661. Velocipedes, W. Hillman, Coventry.
1632. Crates, J. Pullen, London.
1663. Sewing Machines, L. Silverman, London, and J. R. Cumming, Ilford.
1664. Tricycles, &c., W. H. Bliss, Forest Hill.
1665. Gas Burners, J. Lewis, London.
1666. Double Spring Saddle Bar, F. Dovey, London.

16th April, 1881.

1667. Fastenings, J. E. H. Colclough, Dublin.
1668. Curtains, &c., G. Hurst, Nottingham.
1669. Type Setting, H. Springmann.—(*E. W. Brackelsberg, Hagen, Westphalia.*)
1670. Electric Lamps, G. S. Grimston, Kent.
1671. Regulating, G. H. Flood and D. Young, London.
1672. Sketching Easel, A. J. Welsby, Bristol.
1673. Ventilating, &c., A. J. Goulstone, London.
1674. Gun Carriages, J. Vavasseur, Southwark.
1675. Beverages, A. Elliott.—(*C. V. Outrive, Roulers.*)
1676. Batteries, J. H. Johnson.—(*C. A. Faure, Paris.*)
1677. Coke Ovens, J. Hunter, Durham.
1678. Woollen Fabrics, J. H. Rily, Bury.
1679. Telephonic Exchange Systems, J. N. Culbertson, Antwerp, and J. W. Brown, Surrey.
1680. Hot Bed Frames, A. Tyson, Ulverston.
1681. Reels, F. Wirth.—(*P., P., jun., J. B. and E. Adt, Forbach, Germany.*)
1682. Regulating Apparatus, L. Wall, London.
1683. Signalling, A. M. Clark.—(*A. d'Auriac, France.*)
1684. Regulating Gas, J. H. Weston, London.

18th April, 1881.

1685. Lamps, A. Clark.—(*J. Gerard-Lescuyer, Paris.*)
1686. Proteine, H. H. Lake.—(*E. Portheim, Prague.*)
1687. Stalls, H. Lake.—(*T. Utley and J. Fawcett, U.S.*)

Inventions Protected for Six Months on deposit of Complete Specifications.

1599. Lacing Hooks, W. R. Lake, Southampton-buildings, London.—A communication from M. Bray, Newton, U.S.—*12th April*, 1881.
1604. Astral Lantern, F. H. Bailey, Hillsdale, U.S.—*12th April*, 1881.
1655. Cotton Gins, A. M. Clark, Chancery-lane, London.—A communication from A. G. Jennings, Brooklyn, U.S.—*14th April*, 1881.

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

1442. Artificial Lights, G. E. Alder and J. A. Clarke, Croydon.—*11th April*, 1878.
1463. Slating Roofs, J. Groves, Halton, near Leeds.—*12th April*, 1878.
1468. Casting Metal, E. H. Waldenström and W. Sumner, Manchester.—*12th April*, 1878.
1479. Washing, &c., Machines, T. Bradford, High Holborn, London.—*13th April*, 1878.
1540. Opening, &c., Cocks, S. Owen, Coventry.—*17th April*, 1878.
2065. Permanent Way, V. Demerbe, Jemmapes.—*23rd May*, 1878.
1474. Enemas, &c., J. G. Ingram, sen., Felstead-street, Hackney Wick, London.—*12th April*, 1878.
1610. Ring Spinning, T. Coulthard, Preston.—*20th April*, 1878.
1651. Frames for Mattresses, J. B. Rowcliffe, Glossop.—*24th April*, 1878.
1662. Sewing Books, W. R. Lake, Southampton-buildings, London.—*25th April*, 1878.
1678. Ice Apparatus, F. Windhausen, Berlin.—*25th April*, 1878.
960. Dynamo-electric Machines, L. Simon, Nottingham.—*11th March*, 1879.
1524. Washing, &c., Stands, B. Barnard, St. Paul's-road, Canonbury, London.—*16th April*, 1878.
1530. Lubricating Apparatus, T. White, Landport, Portsmouth.—*17th April*, 1878.
1551. Cooking Apparatus, T. J. Constantine, Fleet-street, London.—*17th April*, 1878.
1511. Rotary Pumps, &c., E. Waldron, Gaywood-street, London-road.—*16th April*, 1878.
1526. Metallic Composition, A. M. Clark, Chancery-lane, London.—*16th April*, 1878.
1529. Manure, H. Hartmann, Greiffenberg.—*17th April*, 1878.
1561. Magazines, &c., B. J. B. Mills, Southampton-buildings, London.—*18th April*, 1878.
1562. Reeds for Weaving, W. F. Bateman, Low Moor, near Bradford.—*18th April*, 1878.
1572. Bars of Carding Engine Flats, G. and E. Ashworth, Manchester.—*18th April*, 1878.
1635. Charging, &c., Gas Retorts, W. J. Warner, South Shields.—*24th April*, 1878.

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

1314. Treating Wool, &c., A. Smith, Manchester.—*16th April*, 1874.
1319. Twisting Machinery, J. Lumb, Folly Hall Mills, Huddersfield.—*16th April*, 1874.
1430. Tube Expander, W. Thomson, Glasgow.—*24th April*, 1874.
1521. Projectiles for Ordnance, J. Vavasseur, Bear-lane, Southwark.—*30th April*, 1874.

Notices of Intention to Proceed with Applications.

Last day for filing opposition, 4th May, 1881.

5462. Preparing, Spinning, &c., Machinery, A. M. Clark, London.—Com. from La Société anonyme des Corderies Parisiennes.—*28th December*, 1880.
63. Inflammable Composition, W. R. Lake, London.—Com. from C. D. Bradley.—*5th January*, 1881.
95. Locking, &c., Points of Railway Sidings, W. Pinkerton, Larne.—*8th January*, 1881.
267. Tubing, J. C. Mewburn, Fleet-street, London.—A communication from La Société J. L. Martiny et Compagnie.—*21st January*, 1881.
304. Carbon and Graphite, R. Werdermann, Princes-street, Surrey.—*22nd January*, 1881.
524. Filling, &c., Bottles, F. G. Riley, South Lambeth-road, Surrey.—*7th February*, 1881.
549. Hydraulic Lifting Apparatus, M. Scott, Great Queen-street, Westminster.—*9th February*, 1881.
600. Lines or Cords, J. D. Sprague, Norwood.—*11th February*, 1881.
680. Securing the Heads, &c., of Vessels, N. Thompson, London.—*16th February*, 1881.
747. Stoves of Combustion, H. Defty, Middlesbrough-on-Tees.—*22nd February* 1881.
795. Wooden Packing Cases, &c., F. Myers, Southampton-buildings, London.—*24th February*, 1881.
891. Wheels, T. Humber, T. R. Marriott, and F. Cooper, Beeston.—*2nd March*, 1881.
905. Direct-acting Engines, C. T. Wordsworth, Leeds.—*2nd March*, 1881.
980. Soda, W. Weldon, Rede-hill, Burstow.—*8th March*, 1881.
1108. Cop Spindles, G. W. von Nawrocki, Berlin.—A communication from R. Sehrke and Messrs. Büldge and Hildebrandt.—*15th March*, 1881.
1110. Fastenings for Bale Ties, R. J. Jenkins, London.—Com. from C. B. Morse.—*15th March*, 1881.
1147. Transparent Ice, H. J. West, Southwark Bridge-road.—*16th March*, 1881.
1151. Firemen's Dresses, &c., C. Wraa, Blackfriars-road, Surrey.—*16th March*, 1881.
1176. Welded Iron and Steel Tubes, J. C. Johnson, Wednesbury.—*17th March*, 1881.
1186. Chain Gearing, N. K. Husberg, Stockholm, Sweden.—*18th March*, 1881.
1188. Alkali Manufacture, J. Mactear, Glasgow.—*18th March*, 1881.
1216. Lamps, J. D. Rippingille, Aston-juxta-Birmingham.—A communication from Messrs. Schwintzer and Gräff.—*19th March*, 1881.
1248. Twist Lace Machines, J. Newton, Kimberley.—*22nd March*, 1881.
1253. Substitute for Coffee, J. Challinor, Liverpool.—*22nd March*, 1881.
1283. Mixture for Cholera, &c., W. Williams, Hampden-street, London.—*23rd March*, 1881.
1291. Treating Hominy, B. J. B. Mills, London.—Com. from W. S. Boon, M. Boon, and R. H. Hall.—*23rd March*, 1881.
1395. Electrical Apparatus, W. R. Lake, London.—Com. from A. E. Dolbear.—*29th March*, 1881.
1429. Sanitary Receptacles, &c., J. Turner and J. Robertshaw, Manchester.—*31st March*, 1881.
1476. Producing Designs, &c., R. H. Brandon, Paris.—Com. from I. S. Hyatt.—*5th April*, 1881.
1477. Imitation Ivory, R. H. Brandon, Paris.—A communication from I. S. Hyatt.—*5th April*, 1881.
1480. Manufacturing Articles from Powdered Substances, R. H. Brandon, Paris.—Com. from I. Hyatt.—*5th April*, 1881.

Last day for filing opposition, 6th May, 1881.

5164. Drain Pipes, &c., E. Brook, Huddersfield.—*10th December*, 1880.
5173. Artificial Manures, &c., F. J. Bolton, London, and J. A. Wanklyn, Westminster.—*10th December*, 1880.
5183. Ornamental Mouldings, P. Bedeau, Rue Garnier, Paris.—*11th December*, 1880.
5187. Washing, &c., Machines, J. Summerscales, Keighley.—*11th December*, 1880.
5188. Paint, P. M. Justice, London.—A communication from M. F. I. R. Seaver.—*11th December*, 1880.
5196. Screw Clamps, H. Metham, Church-street, Deptford.—*11th December*, 1880.
5209. Shirts, W. and G. Benger, Stuttgart, Wurtemburg, Germany.—*13th December*, 1880.
5210. Shirts and Drawers, W. and G. Benger, Stuttgart, Wurtemburg, Germany.—*13th December*, 1880.
5213. Liquor Stands, &c., J. Burley, Birmingham.—*13th December*, 1880.
5228. Striking, Scouring, and Fleshing Leather, &c., E. Wilson, Exeter.—*14th December*, 1880.
5229. Cutting Tenons, E. Cory, Porteus-road, Harrow-road, London.—*14th December*, 1880.
5251. Bows, &c., for Watches, W. R. Lake, London.—Com. from C. S. Hirst.—*14th December*, 1880.
5264. Bottles, F. Trotman, Albert-street, Regent's Park, London.—*15th December*, 1880.
5265. Covering, &c., Metal Busks, W. R. Lake, London.—A communication from M. H. Fouillet-Chevance.—*15th December*, 1880.
5284. Supplying Fresh Air, O. Seydel, Birmingham.—*16th December*, 1880.
5288. Iron, P. S. Justice, London.—A communication from C. M. Dupuy.—*17th December*, 1880.
5290. Paving Roads, &c., B. J. B. Mills, London.—Com. from A. Trenaunay.—*17th December*, 1880.
5292. Pumps, R. G. Abercrombie, Alloa.—*17th December*, 1880.
5293. Furnaces, &c., E. P. Alexander, London.—Com. from C. Nikiphoroff.—*17th December*, 1880.
5300. Iron and Steel, S. Pitt, Sutton.—A communication from M. Rollet.—*17th December*, 1880.
5334. Burnishing Heels of Boots, &c., H. J. Haddan, Strand.—A communication from B. F. Larrabee.—*20th December*, 1880.
5383. Ships, &c., J. Tangye, Birmingham, and R. J. Cunnack, Helston.—*22nd December*, 1880.
5385. Extracting Gold from Auriferous Deposits, W. R. Lake, London.—A communication from O. Bailey.—*22nd December*, 1880.
182. Metallic Compounds, &c., H. Hutchinson, Muschamp-road, East Dulwich.—*14th January*, 1881.
220. Making Ice, J. H. Johnson, London.—Com. from A. J. Rossi and L. F. Beckwith.—*18th January*, 1881.
223. Glazing Rice, &c., H. J. Haddan, Strand.—A communication from A. Leytens.—*18th January*, 1881.
360. Rotary Fans, J. S. Davidson, C. R. Steele, and J. Lyon, Whitehaven.—*27th January*, 1881.
461. Skates, H. Dobson, Hull.—*3rd February*, 1881.
471. Ice, H. J. Haddan, Strand.—Com. from T. L. Rankin and C. A. Randall.—*4th February*, 1881.
886. Locomotive Cars, F. E. B. Beaumont, Victoria-street, Westminster.—*2nd March*, 1881.
969. Grates and Stoves, R. Crane, Stockwell Park-road, Clapham.—*7th March*, 1881.
983. Treating Cellulose, A. Parkes, Gravelly-hill, near Birmingham.—*8th March*, 1881.
1014. Endless or Portable Railways, A. Dunlop, Glasgow.—*9th March*, 1881.
1084. Self-governing Gas-burners, J. B. Fenby, Sutton Coldfield.—*14th March*, 1881.
1162. Furnaces, J. Swain, Oldham.—*19th March*, 1881.
1240. Armatures for Dynamo, &c., Machines, E. G. Brewer, Chancery-lane, London.—A communication from T. A. Edison.—*21st March*, 1881.
1297. Coating Iron or Steel Ships, W. Welsh, Portsmouth.—*23rd March*, 1881.
1299. Making up Packets, G. Pritchard, Seaforth, near Liverpool.—*23rd March*, 1881.
1351. Capsuling, &c., Bottles, J. Dunbar, Glasgow.—*26th March*, 1881.
1357. Hot-air Engines, W. H. Bailey, Salford.—Partly a communication from Messrs. Zipf and Langsdorff and the Berlin Anhaltische Maschinenbau Actien Gesellschaft.—*26th March*, 1881.
1372. Iron and Steel, W. J. Clapp, Nantyglo, and T. Griffiths, Blaenavon.—*28th March*, 1881.
1389. Caloric Engines, M. P. W. Boulton, Tew Park, Oxford.—*29th March*, 1881.
1403. Substitute for Coffee, J. Anderson, Glasgow.—*30th March*, 1881.
1410. Steam Washing Machines, G. Collier, Newcastle-on-Tyne.—*31st March*, 1881.
1424. Acetate of Soda, &c., W. G. Forster, Pelham Villa, Streatham Common.—*31st March*, 1881.
1449. Firegrates, &c., A. MacPhail, Cannon-street, London.—*2nd April*, 1881.
1451. Using Liquefiable Gas, &c., as a Motor Fluid, J. C. Mewburn, Fleet-street, London.—A communication from J. Gamgee.—*2nd April*, 1881.
1506. Pencils, W. R. Lake, London.—A communication from B. A. Fiske.—*6th April*, 1881.
1512. Spectacles, &c., W. R. Lake, London.—A communication from A. R. Carter.—*6th April*, 1881.
1537. Locks and Staples, H. J. Haddan, Strand.—Com. from G. Hathaway and B. Taylor.—*8th April*, 1881.

Last day for filing opposition, 11th May, 1881.

5206. Steam Generators, H. J. Allison, London.—Com. from J. MacNicol.—*13th December*, 1880.
5212. Ash Pans for Fireplaces, B. Banks, Leeds.—*13th December*, 1880.
5217. Pistons, J. Wavish, Leytonstone.—*13th December*, 1880.
5220. Firegrates, J. R. Pickard, Leeds.—*13th December*, 1880.
5231. Sugar, H. Stokes, Liverpool.—A communication from O. A. de Gramont.—*14th December*, 1880.
5237. Covering Telegraph Wires, &c., W. T. Glover and G. F. James, Salford.—*14th December*, 1880.
5253. Gun Carriages, F. C. Glaser, Berlin.—A communication from O. Krell.—*15th December*, 1880.
5255. Spinning, &c., Fibres, J. B. Farrar, Halifax, and W. Lumb, Mytholmroyd.—*15th December*, 1880.
5277. Churns, C. Ahlborn, Hildesheim, Hanover.—*16th December*, 1880.
5305. Forming Sheet Metal, &c., into Various Shapes, H. R. Minns, London.—*17th December*, 1880.
5308. Clips for Gutter Spouting, J. Wiley, Darlaston.—*18th December*, 1880.
5329. Jacquard Apparatus, J. Irving, Barnsley.—*20th December*, 1880.
5365. Basic Fire-bricks, &c., A. M. Clark, London.—Com. from J. B. M. P. Closson.—*21st December*, 1880.
5402. Syruping Aerated Beverages, J. McEwen and S. Spencer, Manchester.—*23rd December*, 1880.
3. Floor Springs, E. Bull, Halifax.—*1st January*, 1881.
79. Chronograph, A. M. Clark, London.—A communication from H. J. Eisen.—*6th January*, 1881.
289. Producing Benzaldiacetate, J. A. Dixon, Glasgow.—Com. from Dr. Kœnig.—*22nd January*, 1881.
327. Supplying Air to Furnaces, C. Haupt, Brieg, Germany.—*25th January*, 1881.
545. Corking Bottles, W. H. Beck, London.—A communication from E. Guichard.—*9th February*, 1881.
622. Coast Defences, T. R. Timby, Nyack.—*14th February*, 1881.
650. Looms, A. M. Clark, London.—Com. from C. Coupland and J. H. Tingue.—*15th February*, 1881.
736. Drying, &c., Sugar, A. Sauvée, Westminster.—Com. from E. Commerson.—*21st February*, 1881.
1018. Compound Packing Material, J. A. Turner, Nutsford Vale.—*9th March*, 1881.
1049. Pickling, &c., Metal Plates, &c., D. P. G. Matthews, Newport.—*11th March*, 1881.
1212. Producing Colouring Matters, J. A. Dixon, Glasgow.—Com. from Dr. Fischer.—*19th March*, 1881.
1224. Ornamental Glass, J. Couper, jun., and J. Elcock, Glasgow.—*21st March*, 1881.
1279. Preparing Fibres for Spinning, I. Holden, Bradford.—Partly a communication from W. C. Bramwell.—*23rd March*, 1881.
1315. Valves and Ports, &c., J. Snelling, Gilbert-road, Lambeth.—*24th March*, 1881.
1332. Preserving Organic Substances, F. S. Barff, Kilburn, London.—*25th March*, 1881.
1356. Condensing, &c., Vapours, T. N. Kirkham and T. Hersey, Westminster, D. Hulet, London, and S. Chandler, sen., J. Chandler, and S. Chandler, jun., Newington-causeway.—*26th March*, 1881.
1358. Electric Lamps, R. Harrison and C. Blagburn, Newcastle-on-Tyne.—*26th March*, 1881.
1447. Dynamo-electric, &c., Machines, C. W. Siemens, Westminster.—A communication from Messrs. Siemens and Halske.—*1st April*, 1881.
1453. Interlocking Points, Signals, &c., C. Hodgson, Canterbury-road, London.—*2nd April*, 1881.

Patents Sealed.

(List of Letters Patent which passed the Great Seal on the 14th April, 1881.

3759. Lighting Buildings, &c., C. W. Kitto and W. H Thomson, London.—*16th September*, 1880.
4230. Explosive Compounds, S. J. Mackie, Linden-grove, Peckham.—*18th October*, 1880.
4235. Looms, R. Hindle and G. Greenwood, Blackburn.—*18th October*, 1880.

4242. REGULATING, &c., the FLOW of FLUIDS, W. R. Lake, London.—18th October, 1880.
4243. PIANOFORTES, E. G. Brewer, Chancery-lane, London.—18th October, 1880.
4248. OBTAINING COPIES of DRAWINGS, &c., O. Lelm, Farringdon-street, London.—18th October, 1880.
4256. ISSUING TICKETS, &c., J. H. Betteley, Fleet-street, London.—19th October, 1880.
4257. VELOCIPEDES, E. C. F. Otto, Peckham.—19th October, 1880.
4259. OBTAINING PHOSPHORIC ACID, A. Gutensohn, London.—19th October, 1880.
4260. GAS MOTOR ENGINES, H. Robinson, Manchester.—19th October, 1880.
4261. SCOURING, &c., FIBROUS MATERIALS, J. Petrie, jun., Rochdale.—19th October, 1880.
4270. GAS MOTOR ENGINES, C. G. Beechey, Hilgay.—20th October, 1880.
4277. ROLLERS and BEAMS for LOOMS, &c., T. Reeder, Preston.—20th October, 1880.
4284. MATTINGS, &c., P. MacLellan, Glasgow, and W. Jones, Maryhill—21st October, 1880.
4288. STEAM GENERATORS, J. Windle, Moston.—21st October, 1880.
4291. BREECH-LOADING SMALL-ARMS, J. F. Swinburn, Birmingham.—21st October, 1880.
4310. SEPARATING, &c., PARTICLES of IRON from GRAIN, W. R. Lake, London.—22nd October, 1880.
4323. PURIFYING GAS, A. Ford, Stockton-on-Tees.—23rd October, 1880.
4333. KILNS, P. Montagné, Rue de la Fidélité, Paris.—23rd October, 1880.
4338 GAS VALVE, P. J. Wates, Balham, and S. and J. Chandler, Newington-causeway.—25th October, 1880.
4443. MILLING CUTTERS, &c., A. Muir, Manchester.—30th October, 1880.
4461. ENGINES, A. M. Clark, Chancery-lane, London.—1st November, 1880.
4686. SIGNALLING on RAILWAYS, W. W. Biddulph, East Sheen.—13th November, 1880.
4712. GLAZIER'S POINTS or TACKS, A. M. Clark, Chancery-lane, London.—16th November, 1880.
4772. POLISHING METALS, W. J. Clapp, Nantyglo.—19th November, 1880.
4874. DECORATING CELLULOID, &c., A. J. Boult, High Holborn, London —24th November, 1880.
5511. VELOCIPEDES, J. Starley, Coventry.—31st December, 1880.
57. FASTENER for WINDOWS, &c., J. Stables, Eldon House, Longsight.—5th January, 1881.
266. PRODUCING SURFACES for PRINTING, &c., J. J. Sachs, Manchester.—21st January, 1881.
368. GAS, S. Holman, London.—27th January, 1881.
385. CHRONOGRAPHS, J. H. Johnson, Lincoln's-inn-fields, London.—28th January, 1881.
450. SEWING MACHINES, A. M. Clark, Chancery-lane, London.—2nd February, 1881.
466. PREPARING ARTIFICIAL INDIGO, &c., J. H. Johnson, London.—3rd February, 1881.
641. MOTOR ENGINES, E. M. Strange, Baltimore, U.S.—15th February, 1881.

(List of Letters Patent which passed the Great Seal on the 19th April, 1881.)

4276. SEPARATING IMPURITIES from AURIFEROUS ORES, E. G. Brewer, London.—20th October, 1880.
4287. DROOPING, &c., MACHINES, C. Harvey, Brackenbury-street, Preston.—21st October, 1880.
4290. CASTING ARTICLES in BRONZE, &c., P. M. Parsons, Blackheath.—21st October, 1880.
4292. PORTLAND CEMENT, D. S. W. Dawe, Brading, Isle of Wight.—21st October, 1880.
4293. COMBUSTION of GAS, W. R. Lake, Southampton-buildings, London.—21st October, 1880.
4295. RAISING WINDOW SASHES, P. Langridge, Eastborne.—21st October, 1880.
4299. FOLDING, &c., LABELS, E. A. Palliser, Leeds.—21st October, 1880.
4301. PRINTING MACHINERY, F. Payne, Otley.—21st October, 1880.
4312. TEMPLES for LOOMS, J. Parkinson, Bradford.—22nd October, 1880.
4316. TWISTING, &c., STRANDS, CORDS, or ROPES, S. Wilson, Belfast.—22nd October, 1880.
4318. BICYCLES, J. F. R. Wood, Newcastle-street, London.—22nd October, 1880.
4327. LOOMS, J. Cook and W. L. Heaton, Bolton.—23rd October, 1880.
4331. AXLE, &c., BEARINGS, C. F. Parsons, Hamilton-terrace, London.—23rd October, 1880.
4353. COMBINED IRON or STEEL, J. H. Johnson, Lincoln's-inn-fields, London.—25th October, 1880.
4361. WELDING GAS-PIPE FITTINGS, &c., J. C. Johnson, Wednesbury.—26th October, 1880.
4369. HORSESHOES, W. R. Lake, Southampton-buildings, London.—26th October, 1880.
4370. WATER-CLOSETS, &c., J. W. Holland, Crossley-street, London.—26th October, 1880.
4377. FACILITATING REPAIRS, J. T. Parlour, Fleet-street, London.—27th October, 1880.
4378. MULTITUBULAR FIRE-ARMS, G. Pace, Valetta, Malta.—27th October, 1880.
4379. DETECTING, &c., CORROSION in STEAM BOILERS, G. and J. Weir, Glasgow.—27th October, 1880.
4394. SPOOL TUBES, W. Ambler, Bradford.—27th October, 1880.
4409. SCREENS, T. Davids and C. Weiss, Hanover.—28th October, 1880.
4429. COILING, &c., WIRES, B. Talbot, Wellington.—29th October, 1880.
4436. LOOMS, I. Bradshaw, Preston.—30th October, 1880.
4554. SHIPS' VENTILATORS, J. W. Shepherd and G. Lines, London.—6th November, 1880.
4600. CUT PILE FABRICS, R. Atherton, Bradford.—9th November, 1880.
4636. FURNACES, W. R. Lake, Southampton-buildings, London.—11th November, 1880.
4669. PAPER, W. H. Richardson and H. Glenny, Jarrow-on-Tyne.—12th November, 1880.
4728. LAMPS, S. Pitt, Sutton.—17th November, 1880.
4807. CANS, T. G. F. Dolby, Dulwich.—20th December, 1880.
4828. SPINNING and DOUBLING COTTON, &c., C. E. Thompson, Harpurhey.—22nd November, 1880.
4860. LAMPS, S. Pitt, Sutton.—23rd November, 1880.
4886. DYNAMO-ELECTRIC MACHINES, J. Hopkinson and A. Muirhead, Westminster.—24th November, 1880.
4006. ARTIFICIAL STONES, H. G. Grant, Market-place, Manchester.—25th November, 1880.
5117. DREDGING BUCKETS, R. Hadfield, Bloomsbury, London.—8th December, 1880.
5148. FURNACES, &c., A. M. Clark, Chancery-lane, London.—9th December, 1880.
5394. BICARBONATE of SODA, W. Weldon, Rede Hall, Burstow.—23rd December, 1880.
5435. STEAM HAMMERS, A. C. Wylie, Cannon-street, London.—24th December, 1880.
136. CONSTRUCTING SLABS, W. Page, Brixton-rise, Lambeth.—12th January, 1881.
386. STARCH, &c., W. R. Lake, Southampton-buildings, London.—28th January, 1881.
422. CHLORATE of LIME, &c., W. Weldon, Rede Hall, Burstow.—1st February, 1881.
423. CHLORATE of POTASH, W. Weldon, Rede Hall, Burstow.—1st February, 1881.
424. CHLORATE of SODA, W. Weldon, Rede Hall, Burstow.—1st February, 1881.
425. CHLORATE of SODA, W. Weldon, Rede Hall, Burstow.—1st February, 1881.
426. TREATMENT of STEEL, &c., A. J. Boult, High Holborn, London.—1st February, 1881.
440. SUPPLYING, &c., WATER, T. Jackson, Edinburgh.—2nd February, 1881.
448. LAMPS, &c., E. A. and J. D. Rippingille, Aston-juxta-Birmingham.—2nd February, 1881.
476. PREVENTING RAILWAY COLLISIONS, W. L. Wise, Whitehall-place, London.—4th February, 1881.

List of Specifications published during the week ending April 16th 1881.

2941, 4d.; 3324, 2d.; 3474, 1s. 2d.; 3481, 6d.; 3483, 6d.; 3486, 6d.; 3489, 6d.; 3494, 6d.; 3498, 6d.; 3502, 6d.: 3503, 8d.: 3505, 10d.; 3512, 6d.; 3516, 6d.; 3517, 10d.; 3523, 10d.; 3530, 6d.; 3538, 6d.: 3547, 6d.; 3548, 6d.; 3564, 6d.; 3574, 10d.; 3589, 6d.; 3621, 6d.; 3627, 6d.; 3628, 6d.; 3636, 6d.; 3637, 6d.; 3638, 8d.; 3639, 2d.: 3647, 6d.; 3649, 6d.; 3652, 4d.; 3659, 6d.; 3666, 6d.; 3667, 6d.; 3676, 6d.; 3677, 6d.; 3688, 4d.; 3691, 10d.; 3692, 6d.; 3697, 6d.; 3699, 2d.; 3700, 2d.; 3707, 2d.; 3712, 6d.; 3715, 6d.; 3723, 4d.; 3725, 6d.; 3730, 8d.; 3733, 2d.; 3734, 6d.; 3736, 4d.; 3738, 2d.; 3739, 4d.; 3740, 6d.; 3742, 2d.; 3743, 6d.; 3744, 6d.; 3746, 2d.; 3748, 4d.; 3750, 2d.: 3751, 2d.; 3753, 2d.; 3754, 4d.; 3755, 4d.; 3758, 2d.; 3760, 6d.; 3764, 2d.: 3766, 2d.; 3768, 2d.; 3771, 2d.; 3772, 2d.; 3773, 6d.; 3776, 2d.; 3777, 2d.; 3778, 6d.; 3782, 2d.; 3787, 2d.; 3791, 2d.; 3794, 2d.; 3795, 2d.; 3800, 2d.; 3804, 2d.; 3808, 2d.; 3827, 4d.; 3837, 6d.; 3839, 6d.; 3868, 6d.; 3926, 6d.; 4015, 6d.; 4453, 6d.; 4599, 6d.; 5416, 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.*

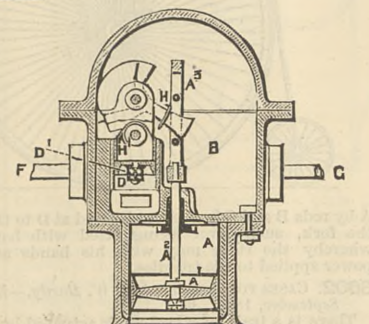
2941. SPRING MATTRESSES, &c., *W. R. Lake.—Dated 16th July, 1880.—(A communication from A. Yarolimek.) (Void.) 4d.*

The springs are formed of spiral coils of steel wire, stretched and kept under tension on the article of furniture.

3261. WATER-METERS OR MOTORS, *T. Melling.—Dated 10th August, 1880. 8d.*

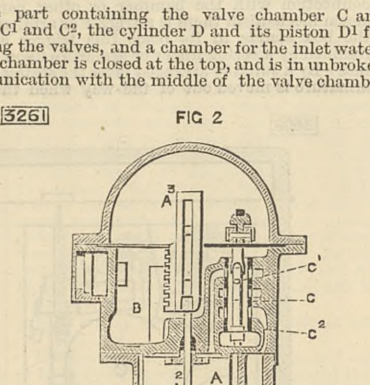
This relates to improvements on patents No. 2647, dated 10th July, 1877, and No. 93, dated 9th Jan., 1879. The drawing shows a vertical section through the meter, in which A is the measuring cylinder with its piston A^1, piston-rod A^2, and cap A^3, which works the valves and gives motion to the clockwork; B is the

3261 FIG 1



middle part containing the valve chamber C and valves C^1 and C^2, the cylinder D and its piston D^1 for working the valves, and a chamber for the inlet water, which chamber is closed at the top, and is in unbroken communication with the middle of the valve chamber

3261 FIG 2



C and the bottom end of the cylinder D. With these exceptions, that is to say, excepting the chamber for the inlet water, the space between the valves in the valve chamber C, and the space under the piston D^1 in the cylinder D, the whole of the interior of the middle part B is open to the outlet water; F is the inlet pipe and G the outlet pipe; H is a cam lever which alternately acts upon and is acted upon by a roller H^1, the axis of which roller is carried by the piston D^1.

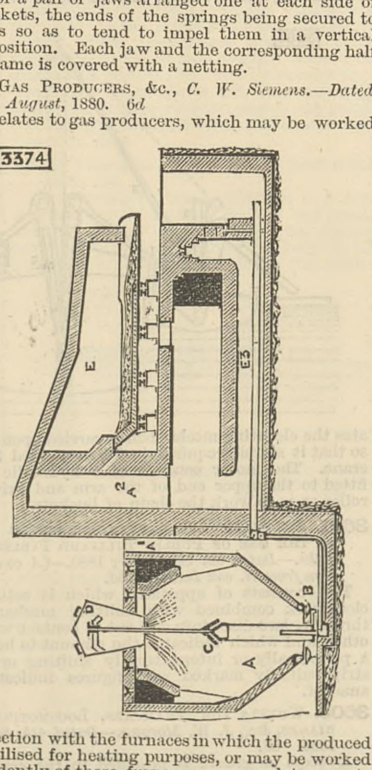
3451. TRAPS FOR BIRDS, &c., *R. J. Sankey.—Dated 26th August, 1880. 6d.*

A skeleton frame is used, its inner ends being shaped to enter sockets formed in two brackets each carrying a compound helical spring, the cores of which form pivots for a pair of jaws arranged one at each side of the brackets, the ends of the springs being secured to the jaws so as to tend to impel them in a vertical closed position. Each jaw and the corresponding half of the frame is covered with a netting.

3374. GAS PRODUCERS, &c., *C. W. Siemens.—Dated 19th August, 1880. 6d*

This relates to gas producers, which may be worked

3374



in connection with the furnaces in which the produced gas is utilised for heating purposes, or may be worked independently of these furnaces, arranged to operate in connection with such producers. The drawing is a longitudinal section of a combined gas-producer and regenerative furnace. The producer A is of a conical form in its lower part, and is gathered in above its middle. It has at the bottom an opening, under which is placed a dish B to receive the cinder, which may be cooled by water supplied to the dish by a pipe with a cock. In the centre of the producer is the air supply pipe C. The fuel is supplied to the producer by the hopper D, which has removable covers. The gas produced in A passes by numerous lateral channels to the flue A^1 leading to the furnace chamber E, where it meets and burns with heated air rising through the shaft A^2 from the generator below, the flame entering the furnace E by the throat E^3, and beating down upon its bed.

3474. EXCAVATING AND REMOVING COAL, &c., *F. Hurd.—Dated 27th August, 1880. 1s. 2d.*

This consists, First, in forming a grooved arm or lever in one or more parts, in the groove of which an endless chain provided with rollers and cutters works. This arm is so constructed that the chain runs round it on the rollers attached to the chain, no guide pulley being needed on the arm. Recesses are formed on the arm or lever which are filled with lubricants. This arm or lever is caused to make a partial revolution when necessary, in order to change the direction of the cut from horizontal to vertical without stopping the machine, thus enabling the operator to "nick on end" any portion of the face under cut, so that it can be filled out while the machine is in progress; and a radial motion may also be imparted to the arm when requisite. Cutters are placed on one half only of the length of chain, so that the machine can be advanced or moved forward when no cutters are operating on the mineral. Another part consists in placing inside a rifled tube-cutter a piston with a hollow shaft, and one end of the rifled tube is closed on to the hollow shaft, so as to form an internal piston, which works inside a carrying tube which is attached to the hollow shaft. The cutter can thus be advanced or withdrawn by air or water pressure while the cutter tube is in motion or stationary.

3481. LOCOMOTIVE ENGINES FOR RAILWAYS, TRAMWAYS, &c., *T. Hunt.—Dated 27th August, 1880. 6d.*

This consists in mounting one or more of the wheels of the engine loose upon one or more of the carrying axles, and providing an intermediate wheel between each loose wheel and the driving wheel on the same side of the engine, and in providing a corresponding intermediate wheel or wheels at the other side of the engine, between the fixed wheel or wheels and the driving wheel. To the said intermediate wheels an adjustable arrangement is attached, by which, when necessary, one or more of the said

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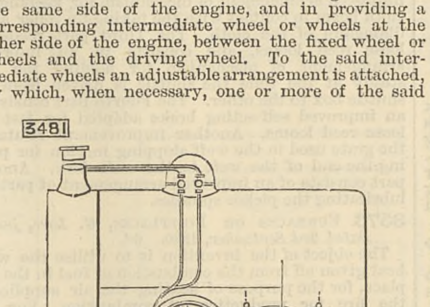

wheels can be separately or simultaneously forced in contact with the peripheries of their respective carrying and driving wheels, and thus by frictional pressure prevent the driving wheels from slipping on the rails, and at the same time enable the engine to pass more freely through curves than if both the wheels of the carrying axle were fixed upon the axle, or than if the driving and carrying axles were coupled together by the rigid connection of coupling rods and cranks.

3483. FEED AND AIR PUMPS, *F. C. Simpson and J. B. Denison.—Dated 27th August, 1880. 6d.*

A metal valve is used in the air pump to obviate the many inconveniences which arise from the use of india-rubber. The bottom valve in the feed pump is formed with a long spindle, is made a working fit in a hole bored in the pump plunger, which spindle becoming coated with grease, causes sufficient friction to lift the valve at the commencement of the up stroke of the plunger and keeping it open during the stroke, thereby leaving a free passage for the water, and to close it at the commencement of the down stroke, thereby compelling the water in the pump barrel to pass through the top valve. The bottom valve in the air pump is made in the piston, which is allowed a small amount of vertical motion on the piston-rod, and is so arranged that on the down stroke the friction of the packing against the bore of the pump raises it, thereby leaving a free passage through the valve, and on the up stroke presses it down and so closes the passages, thereby compelling the contents of the pump barrel to pass through the top valve, which is also constructed of metal, and closed by the action of a spring on the top or otherwise.

3486. PLACING AND ARRANGING SCREW PROPELLERS, &c., *W. J. Griffiths.—Dated 28th August, 1880. 6d.*

The drawing shows a side view of the stern of an ordinary screw ship altered in accordance with the improvements. The rudder post A is cut, and the bearing B inserted; the screw shaft C is lengthened to come through this bearing, and the screw propeller D is placed behind the rudder post. The rudder E is

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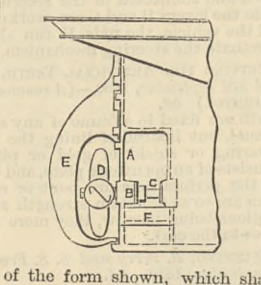

constructed of the form shown, which shape leaves space for the screw to work in. Plates F are used to cover the bottom part of the screw frame and assist in strengthening the rudder post. A modification is shown in which radial arms are attached to the rudder.

3502. SAFETY CASES FOR PIPES, &c., *F. Cooper.—Dated 28th August, 1880. 6d.*

The case is made entirely of thin metal tubing, so arranged as to partake as near as possible of the configuration of the pipe. That portion of the case which envelopes the bowl of the pipe consists of a short length of tubing of suitable diameter, and which is enclosed at one end by a flat or suitably curved disc of metal soldered or otherwise fastened in position, and one side of this bowl portion is partially cut away to facilitate the introduction of the pipe, whilst branching out of the opposite side at a suitable angle is a piece of tube of smaller diameter to receive the stem of the pipe, and which is soldered or otherwise secured to the bowl portion, and, if desirable, may be in two or more lengths, arranged to slide one within the other telescopically.

3489. GOVERNORS FOR MARINE AND OTHER ENGINES, *J. Kennedy.—Dated 28th August, 1880. 6d.*

This consists essentially of the following principal parts: First, a pump with its valves; Secondly, mechanism for driving the pump synchronously with the engines; Thirdly, a tank acting also as a foundation or dead plate; Fourthly, a connection or pipe returning the discharge of the pump to the tank; Fifthly, a stop cock on the line of this discharge with a fine pitched screw or its equivalent, so as to regulate the discharge at pleasure; Sixthly, a cylinder freely open

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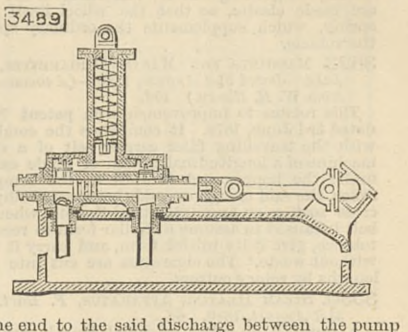


at one end to the said discharge between the pump and the stop cock, which cylinder is provided with a tight-fitting piston kept down against the ordinary pressure of water in confined discharge pipe by means of a spring or its equivalent.

3498. IRON GRILLS FOR PROTECTING SHOP-FRONTS, &c., *H. W. Perrers.—Dated 28th August, 1880. 6d.*

This consists of a hinged grill, arranged to slide under the stall board, and brought forward sufficiently to allow the upper points to be thrust under catches, so that the grill when again brought to its vertical position can be locked or fastened.

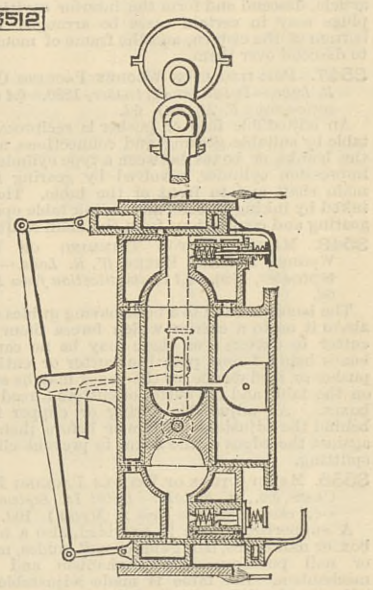
3503. FLEXIBLE BOATS FOR PRESERVING LIFE AT SEA, *T. Foster.—Dated 28th August, 1880. 6d.*

The boat is made with a bottom of waterproof material; the sides and ends are waterproof bags or cells made up in one piece with the bottom; the ends are tapered to a point and curved upwards, so as to be higher at the stem and stern than at the centre. The air-tight bags or cells along the sides of the boat are divided by a vertical longitudinal flexible partition, each into two compartments; the ends also are similarly divided into two or more compartments; small air passages are provided in the partitions between the compartments, so that when air is pumped into one of them it may pass into and inflate the others. An air pump of a bellows-like form is fitted in preference on the top of the air-tight compartments at the bow and stern, and is worked by a lever handle. The air-tight bags or cells are somewhat of a rounded form, so that their inner sides to some extent overlap the waterproof bottom. Upon the top of this bottom is placed a rigid floor, which goes under the overhanging sides.

3512. GAS ENGINES, *H. Aylesbury.—Dated 30th August, 1880. 6d.*

The air and the gas are admitted by two valves on the same stem at each end of the cylinder; the fresh mixture of gas and air enters the cylinder at the end where the explosion has just taken place, the exploded mixture escaping through one or more apertures at the centre of the cylinder. The said fresh mixture is compressed in the return stroke of the piston, and when the latter has reached the end of its stroke this charge is exploded. The connecting rod is by preference forked and connected to crossheads in one with the piston, and working steam-tight in each

3512

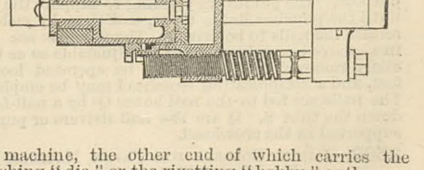


side of the cylinder; an ignition slide or other valve at each end of the cylinder is worked from studs on the crossheads by bell-crank or other levers. The valves for air and gas are worked from the crossheads or by an excentric or crank. The cylinder is wholly or partially surrounded by a water jacket, and the exhaust pipe passes through a body of condensing water.

3516. PUNCHING AND RIVETTING MACHINES, *F. Deering and J. D. Morrison.—Dated 30th August, 1880. 6d.*

The ram or piston of the machine is attached by a tension bar or bars to a crosshead by a rigid connection. One end of this crosshead carries the punch (in the case of a punching machine), or the die in a rivetting machine, and the other end of the crosshead is guided by a strong bar, either fixed in one of the stationary crosshead (forming part of the structure of

3516



the machine, the other end of which carries the punching "die" or the rivetting "hobby," as the case may be), or fixed in the moving crosshead, and sliding through a boss or stationary crosshead. Coiled round this guide bar is a strong spring which is compressed in the act of punching or rivetting, and serves to open the jaw of the machine when the operation is completed, such opening being assisted or not by the pressure reversed on the ram or piston.

3517. VEHICLES FOR ROADS, TRAMWAYS, AND RAILWAYS, *H. Ciotti.—Dated 30th August, 1880. 10d.*

This relates to improvements on patent No. 5006, dated 6th December, 1878. The guiding wheel on the fore carriage is actuated by a chain, one end of which is attached to one arm of a bell-crank lever, the other end of which forms a handle, conveniently placed within the reach of the driver. The chain passes over the pulley on the body of the carriage, and from thence over a pulley on the fore carriage. It is essential that these two pulleys should be placed centrally, so that the turning of the fore carriage shall not cause a pull to come on the chain, thus raising the guiding wheel. The wheels of the vehicles are made elastic, so that the wheel itself forms a spring, which supplements the ordinary springs of the vehicle.

3523. MACHINES FOR MAKING CIGARETTES, *W. R. Lake.—Dated 31st August*, 1880.—(*A communication from W. H. Emery.*) 10d.

This relates to improvements on patent No. 2206, dated 3rd June, 1879. It comprises the combination with the travelling filler carrier belt of a cigarette machine of a longitudinal trough or guide extending under the hopper and forward to the compressing roller, the said trough or guide being semi-elliptical in cross section or approximating thereto, whereby the belt is caused to assume a similar form to receive the tobacco, give it its initial form, and carry it forward without waste. The cigarettes are cut into suitable lengths by rotary cutters.

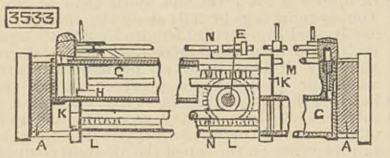
3530. STEAM HEATING APPARATUS, *F. Hart.—Dated 31st August*, 1880. 6d.

A number of tubes of equal length are placed parallel with one another, and all at both their ends connected with hollow chambers, to which steam is admitted. Each steam chamber is formed of a plate cast hollow to permit of steam being passed into it, and also with a number of tubes or nipples projecting from one of its faces, each of such tubes or nipples communicating with the hollow space of the plate.

3533. PROPELLING CARRIAGES UPON TRAMWAYS, &c., *E. Edwards.—Dated 31st August*, 1880. 8d.

This relates to machinery for propelling vehicles by means of compressed air, steam, or other elastic gas, in which cylinders are used containing movable pistons of great length of stroke, operating by means of toothed racks upon pinions which actuate the driving wheels. In the drawing A is the frame of the carriage and E the driving axle, on either side of which is arranged, in the same line, a cylinder G, but one on a

3533



higher level than the other. In the cylinders work pistons H, the rods of which are connected to brackets K, one at each extremity of the rack frame L, moving to and fro on guides M on the frame of the carriage. The rack frame is provided with an upper and lower rack N, gearing with separate pinions on the driving axle, on which they revolve freely, but are provided with pawls gearing with ratchets fixed to the axle.

3538. MOULDS FOR MANUFACTURE OF PRESSED GLASS, *S. Neville.—Dated 1st September*, 1880. 6d.

A cistern is used to contain the molten glass, the bottom surface of which may form the lower portions of the moulds when required. Into this cistern containing the proper quantity of molten glass, a frame consisting of the requisite number of moulds of the external form of the articles to be made is caused to descend and cut out in divisions the quantity of glass required for each article. Following this operation, or it may be simultaneously with it, a corresponding number of plugs of the shape of the interior of the article, descend and form the interior cavities, or the plugs may in certain cases be arranged upon the bottom of the cistern, and the frame of moulds made to descend over them.

3547. PRINTING UPON WOODEN PACKING CASES, *W. R. Lake.—Dated 1st September*, 1880.—(*A communication from F. Myers.*) 6d.

An adjustable feed or pusher is reciprocated on a table by suitable gearing and connections, and forces the blanks or boxes between a type cylinder and an impression cylinder, revolved by gearing from the main shaft and in front of the table. The type is inked by inking rollers, and an ink table operated by gearing and connections from the main shaft.

3548. MACHINERY FOR TRIMMING OR DRESSING WOODEN PACKING BOXES, *W. R. Lake.—Dated 1st September*, 1880.—(*A communication from F. Myers.*) 6d.

The boxes are fed to a table having guides on it, and above it on to a carrier which forces them past the cutter or cutters; or there may be no carrier, the boxes being forced past the cutter or cutters by a pusher or feed device, or the boxes may be stationary on the table and the cutter or cutters forced past the boxes. An adjustable spring or clipper is placed behind the adjustable cutters or before them to bear against the edges of the boxes to prevent clipping or splitting.

3555. MANUFACTURE OF WOODEN PACKING BOXES OR CASES, &c., *W. R. Lake.—Dated 1st September*, 1880.—(*A communication from F. Myers.*) 10d.

A supporting frame is provided, also a table, nail box or nail boxes, nail guide or nail guides, nail punch or nail punches, stop mechanism and starting mechanism. The table is made adjustable or self-adjusting for different sized boxes, and may drop to receive boxes under the nail boxes and rise to bring the packing boxes or cases to the nail boxes, or the nail boxes and nail punches may rise and fall for the

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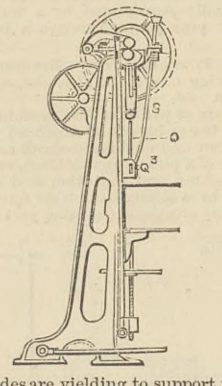

purpose. The guides are yielding to support the nails until the punches strike them, and then by yielding, release the nails to be driven. The punches are loose in a grooved crosshead, fixed or adjustable so as to be easily removed or not, and to be operated loose or fast, and a reciprocating crosshead may be employed. The nails are fed to the nail boxes Q^3 by a nail-feeder down the tube S. Q are the nail drivers or punches supported in the crosshead.

3563. DANDY ROLLERS FOR PAPER MACHINES, *W. Green.—Dated 2nd September*, 1880. 6d.

This relates to means for preventing the pulp

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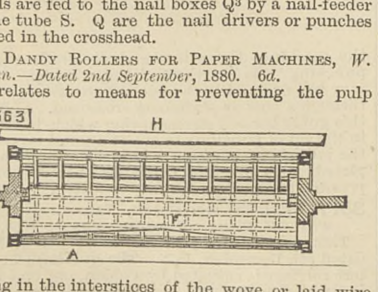

collecting in the interstices of the wove or laid wire upon the roller by continually cleansing it by a flow of water and steam if desired through the upper travel. The roller is fixed on two ends forming journals outside and within the rollers, and from the inner journals a trough F is suspended. A stream of water flows from the perforated pipe H on the upper part of the wire A, and passing through it carries off the pulp from the interstices, and falling into the trough F, passes out at the open ends of the roller.

3564. COMPENSATING APPARATUS FOR THE CONTRACTION AND EXPANSION OF SIGNAL WIRES, *C. Gaunt.—Dated 2nd September*, 1880. 6d.

On the stud of a bracket fixed in the signalman's or pointsman's cabin is fitted a fork-ended lever, between the fork ends of which, and working loose on a pin at the end of the lever, there is a brake pulley, sufficient room being allowed in the fork ends to admit of the free working of a connecting rod which is coupled to the fore arm of the signal lever in the cabin. The bottom end of the signal lever is also forked, the forked arms working outside the flanges of the brake pulley and between the forked arms which carry the pulley. The forked arm of the signal lever is slotted at the part thereof that passes the spindle of the brake pulley, the slot being of such a length as not to interfere with the working of the brake pulley. At the bottom of the connecting rod, and between the forked arms of the signal lever, is fixed a brake block, the sides of which are, by preference, of a wedge form, and when brought into operation wedges itself between the flanges of the brake pulley. To the bottom of the bracket is attached a projecting arm, on which is mounted an intermediate pulley. At the end of the signal wire is attached a piece of chain or its equivalent, which passes over and is belted to the rim of the brake pulley, passing under the intermediate pulley to a third pulley, which is connected to the back tail of the signal lever in the cabin. To the end of a chain is attached a compensating weight, such weight being utilised in pulling off the signal.

3574. LOOMS, *T. Singleton.—Dated 3rd September*, 1880. 10d.

This relates, First, to the weighing motion of the loom, and consists in various arrangements and contrivances in connection with the yarn beam, for the purpose of maintaining the yarn at the desired tension during the shedding of the warp and the beating up of the cloth. The Second part consists in an improved arrangement of mechanism for keeping the cloth beam in contact with the taking-up roller at all diameters of the cloth. The Third part relates to loose reed looms, and consists in an improved arrangement of mechanism for holding the reed steady at the time the shuttle is driven from one shuttle box to the other. The Fourth part consists of an improved self-acting brake adapted for fast and loose reed looms. Another improvement relates to the grate used in the weft stopping motion for pushing the end of the weft to the weft fork. Another part consists of an improved arrangement of parts for lubricating the picker spindles.

3576. FURNACES OR FIREPLACES, *G. Love, jun.—Dated 3rd September*, 1880. 6d.

The object of the invention is to utilise the waste heat given off from the combustion of fuel in the fireplace, for the purpose of heating the air supplied to the fire for production of combustion. For this

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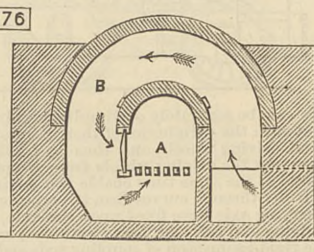

purpose a flue B is formed round the fire chamber A, and through it air enters at C, and passes through the underside of the fire-bars and also through side-bars or grating on to the fuel.

3578. VEHICLES PROPELLED BY MANUAL POWER, *W. J. Fraser.—Dated 3rd September*, 1880. 6d.

This relates to improvements in actuating the steering gear of vehicles propelled by the combined power of the arms and legs, as described in patent No. 4458, A.D. 1879, while the hand levers are in motion. For this purpose near the oscillating point

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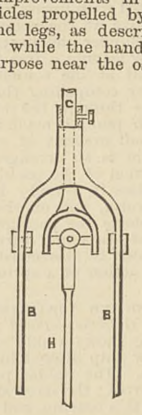

of these levers B and C, a "universal joint" is introduced and connected to the steering rods H, so that while the levers B and C are worked to and fro to propel the vehicle, the rods H can also be turned so as to actuate the steering mechanism.

3588. SETTING FOR ARTIFICIAL TEETH, *P. Jensen.—Dated 3rd September*, 1880.—(*A communication from E. Rauzerot.*) 6d.

The teeth are fixed to a frame of any suitable material as usual, but instead of lining the frame with a solid covering or shield of gold or platinum, such shield consists of an openwork plate, and the partitions between the perforations are bent or curved in the form of an arc so as to obtain strength and lightness. The partitions being narrow, they more readily adapt themselves to the cast.

3589. SPINNING, *B. Berry and S. S. Freeman.—Dated 3rd September*, 1880. 6d.

This consists of a self-acting apparatus for giving motion to the lifter plate of spinning and twisting frames for forming the bobbins.

3595. BOXES, CASES, OR RECEPTACLES FOR CIGARS, &c., *L. Wahltuch.—Dated 4th September*, 1880. 6d.

A strip of paper, cardboard, or other suitable material is scored in the required place, so that when folded together it forms a skeleton drawer, which is fitted to slide within a box or case. The cigars or other articles rest in the drawer, which is pulled outward by its top edge when required to remove one or more cigars, such edge projecting above the top of the box and serving as the cover, its outer end entering a slit formed in one side of the box.

3597. TRAM RAILS, *J. Smith jun., E. Lones, and J. Hill.—Dated 4th September*, 1880. 4d.

The rail is first rolled in a horizontal attitude, so as to produce the flanges projecting on both sides of the base and the head projecting on each side of the middle rib, the head as yet having no groove in it as indicated at A. The rail is then passed in an inclined attitude through a pair of rolls, one of them so shaped as to bear on the underside of the flanged base, and on the underside of one of the shoulders of the rail head, and the other so shaped as to bear on the under surface of one of the flanges, and on the rail head. The part which bears on the rail head has a projecting collar A^1 which forms a groove in the head, but wider at the mouth than required. This rolling operation is indicated at B. The rail is finally passed again in a horizontal attitude through a pair of rolls which finish

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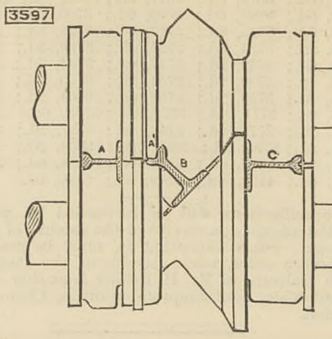

the surface, pressing in the sides of the rail head, so as to bring it and its groove to the desired shape, as indicated at C.

3598. BICYCLES AND TRICYCLES, *C. D. Abel.—Dated 4th September*, 1880.—(*A communication from La Société Clement and Cie.*) 6d.

The object of the invention is to enable the rider to assist the action of his feet by the action of his hands and arms, and consists in connecting the foot treadles

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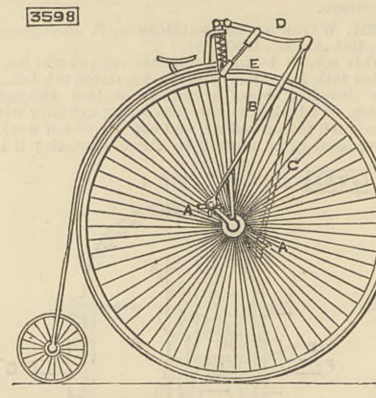

A by rods B and C to a lever pivotted at D to the top of the fork, such lever being fitted with handles E, whereby the rider may with his hands assist the power applied to the treadles.

3602. CASES FOR JEWELS, &c., *W. Hardy.—Dated 4th September*, 1880. 6d.

There is a train of wheel work actuated by a coiled spring, and this train, when allowed to run, gives motion to a hammer which strikes upon a bell. In connection with the hammer or other part of this alarm mechanism there is a trigger or arm, and when the box stands in its place this trigger or arm is retained by a spring finger or armature upon which it lies. By a suitably arranged lever the spring finger or armature is moved out of the way when the box is

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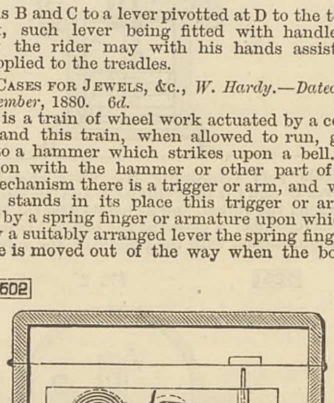

lifted from its place; the train of wheel work then commences to run and the alarm is sounded. When the first alarm has continued to sound for a certain time unattended to a second and more powerful alarm comes into operation. This second alarm is a train of wheel work similar in construction to the first, and it is set free by the uncoiling of the spring of the first alarm train.

3603. DISCHARGING GRAIN, &c., *P. G. B. Westmacott.—Dated 4th September*. 1880. 6d.

A barge A carries a crane B with a tall jib and with slewing and buffing gear. From the jib is suspended an elevator arm E which is lowered into the hatchway of the ship to be discharged. The elevator arms are of ordinary construction, but the motor which actu-

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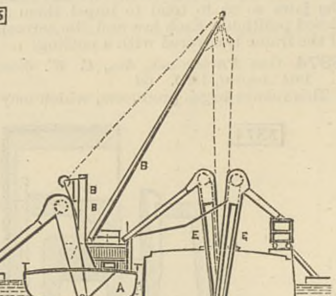

ates the elevating mechanism is carried upon the arm, so that it simply requires to be suspended from the crane. The motor consists of a hydraulic engine, fitted to the upper end of the arm and driving the roller so as to work the chain of buckets.

3621. AUTOMATIC APPARATUS FOR KEEPING ACCOUNT OF THE USE OF PUBLIC BILLIARD TABLES, *W. R. Lake.—Dated 6th September*, 1880.—(*A communication from H. von Leesen.*) 6d.

This consists of apparatus which is actuated by clockwork combined with shifting mechanism for throwing two discs into and out of contact with each other, and which indicates the amount to be paid by a periodically or intermittently shifting or moving strip suitably marked with figures indicating the amount.

3605. WHEELS FOR TRAMCARS, LOCOMOTIVES, CARRIAGES, &c., *J. W. Morgan.—Dated 4th September*, 1880. 6d.

A recess or groove is provided in the centre, or a groove or flange is provided at the side or shoulder of the wheel, around or in its periphery, allowing or forming a space for the insertion of a fillet or flange, removable at the will of the driver, guard, or other person in charge, and acted upon by levers, screws, or wedges, and thereby enabling the tramcar, locomotive, carriage, or other vehicle, to travel on road, rail

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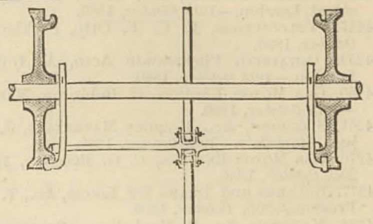

roadway or carriage way, with equal facility, and with or without brake power, supplied if and when required by such fillet or flange.

3620. STRAINER OR KNOTTER APPARATUS FOR THE MANUFACTURE OF PAPER, &c., *F. N. Miller.—Dated 6th September*, 1880. 6d.

This relates to apparatus capable of use as an auxiliary strainer in connection with the ordinary strainer, or to replace the same, and it consists of a vat A carrying inclined strainer plates B, beneath which are cylinders C having attached to them diaphragms D. At one end of the vat is a trough or sand intercepting box E, into which the pulp is

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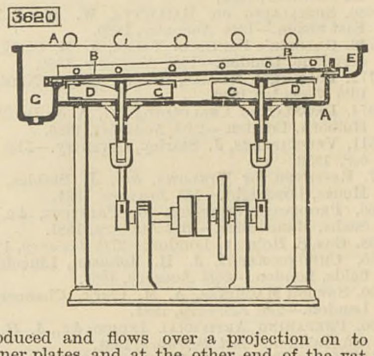

introduced and flows over a projection on to the strainer plates, and at the other end of the vat is a separator or knot box G into which the matter separated from the pulp is discharged, and from which any fine stuff can flow back to the strainer plates. The diaphragms consist of rigid discs D connected by a ring of india-rubber to the edges of the cylinders, and caused to reciprocate vertically by means of cranks and connecting-rods, whereby the fine pulp is drawn through the strainer plates and is conveyed to the wire.

3627. MAKING BRICKS, &c., *C. H. Murray.—Dated 7th September*, 1880. 6d.

This consists in apparatus in which a column of clay or plastic substance, after issuing from the mouth or die of a moulding machine, is divided into lengths, each sufficient to make several bricks, of hinging or jointing the brackets or standards that carry the rollers on which the clay is received from the mouth or die of the moulding machine in such manner that these brackets or standards may, when desired, be turned upwards or swung round, so as to allow of easy access to the die.

3628. TUBE EXPANDERS, *F. W. Bond.—Dated 7th September*, 1880. 6d.

This consists in composing the body or roller bearing part of the tube expander of two or more pieces joined together, in such a manner that the rollers are thrust outward from the axis of the expander by the introduction of a conical or wedge-shaped mandril, but prevented from shifting against each other in the direction of their axis; also in the application of guard slides or stops, preferably one on each of the pieces forming the body of the expander, intended to butt against the end of the tube or tube-plate, and

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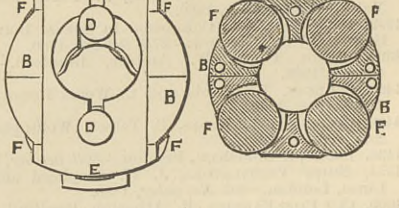

movable in the direction of the axis by turning a screw spindle or by any equivalent device. B are semi-cylindrical pieces forming the body of the expander, covered by plates and united by a dovetailed slide C. Each half contains two rollers F and a guard slide or stop E provided with an internal screw thread, and movable in a recess by turning the spindle D, which is secured with its neck in the slotted slide C which guides the halves B and gives room for the neck of the spindle D, when the halves B are thrust outwards by introducing the mandril.

3630. GOVERNING OR REGULATING ILLUMINATING GAS, *D. B. Peebles.—Dated 7th September*, 1880. 6d.

The drawing shows a combined burner and governor for regulating the flow of gas, and it consists of a cone A, which, when not raised by the gas, rests on a needle or central spindle. The apex of the cone which forms the valve for closing the passage from the regulating chamber to the burner has a fine hole drilled through it, through which a small quantity of gas can pass when the cone is raised, and this renders the action more uniform under extreme variations of pressure. The cylindrical part of the chamber

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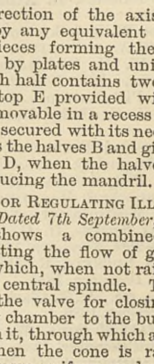

in which the cone works is, together with the cover of the chamber, made in block tin, and is inserted in a cylindrical brass casing B, the bottom of which is made with the usual nozzle for insertion into the gas pipe. The burner tube C is screwed into the tube B. A hollow dome D is placed over the cover of the regulating chamber, and causes the gas to pass downwards and issue in a thin film under the edge of the dome into the space in the burner tube C, the object being to prevent noise and keep out dust.

3636. CLOSING OR STOPPERING BOTTLES, JARS, &c., *H. Mardon.—Dated 7th September*, 1880. 6*d*.

This consists in forming one or more protuberances or excrescences on the inside of the neck or mouth of the bottle, jar, or other receptacle, and in forming in the side of the plug or stem of the stopper, which fits into the said neck or mouth, one or more grooves, which start from the bottom or lower edge of the plug, and after extending a certain distance vertically diverge in an oblique or upwardly inclined direction.

3638. HOISTING OR LIFTING MACHINERY, *W. R. Lake.—Dated 7th September*, 1880.—(*A communication from B. Hinsley.*) 8*d*.

This consists in combination with a wheel or pinion fitted upon a shaft of loose pulleys of different diameters mounted on said shaft and provided with clutches, whereby they can be alternately clutched with the said wheels.

3639. VALVES FOR GAS AND OTHER FLUIDS, *J. Woodward.—Dated 8th September*, 1880.—(*Not proceeded with.*) 2*d*.

The body or casing of the valve is formed by a casting, with a facing that can be readily surfaced in a lathe. The valve is a disc with a stem at the back, the face of the disc being also surfaced in a lathe. The stem part of the valve is jointed by a pin, with an arm secured on a shaft formed of square iron turned cylindrical at the ends, one end of the shaft having its bearing in a hole in the inside of the casing, the other end passing through a hole in the side of the casing, which is formed into a stuffing box. There is a bush inserted in the hole round the shaft which allows the large part of the shaft to be first inserted before the box is packed.

3641. DECOMPOSITION OF SALTS OF AMMONIA, *L. A. Groth.—Dated 8th September*, 1880.—(*A communication from W. Rube, H. T. Engelcke, aud C. J. B. Krause.* 6*d*.)

This relates to improvements in the decomposition of salts of ammonia with aid of lime or magnesia, also in the apparatus used for this purpose. The apparatus is constructed as a pillar or column and is divided into different compartments D D, one compartment being placed upon another and fitted together by means of flanges and screws. The floors of the compartments are conical, and thus forming funnel-like receptacles, whereby all the heavier substances are collected or assembled in the point of the funnel. Each compartment is to be filled with the solution to correspond with the height of the pipe E, placed vertically and

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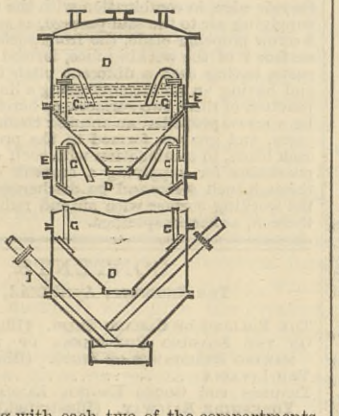

communicating with each two of the compartments, and over the edge of which the liquid will flow and pass through its under opening into the compartment below. The gas which is evolved from the mass ascends with the moisture and is imparted downwards through a pipe I into the bottom part of the lowest compartment, and from there upwards into the respective compartments through bent pipes G, two of which are fitted opposite each other on the conical sides in each compartment. The uppermost compartment will thus contain the greatest amount of ammonia.

3647. HORSESHOES, &c., *W. W. Box and T. J. Beadle.—Dated 8th August*, 1880. 6*d*.

The drawing is a plan of the underside of a shoe; A is the shoe proper; B projections thereon; serving not only as wearing piece but also as sockets for the

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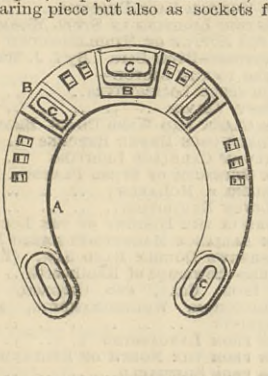

calks C, which are made taper, that is to say they are of a larger sectional area at the top than at the bottom, the lesser surface serving as the wearing calk.

3649. SPRING SOLITAIRES OR SLEEVE BUTTONS AND SHIRT STUDS, *J. Appleby and A. L. Stamps.—Dated 8th September*, 1880. 6*d*.

This consists in making the front parts of spring solitaires or sleeve buttons and shirt studs, consisting of a central hollow peg having a disc at its end, spring teeth projecting from the said central peg on opposite sides, and pushers connected with the said spring teeth, from one piece of sheet metal.

3650. MATERIALS FOR CASTINGS, CEMENTS, &c., *J. J. Sachs.—Dated 8th September*, 1880. 4*d*.

Sulphur is melted with other than metallic substances in the statO of a fine powder, and the compound is used for making castings, and also as a cement.

3652. VERTICAL STEAM ENGINES, *R. Wilson.—Dated 8th September*, 1880. 4*d*.

This consists in obtaining a perfect balance with or

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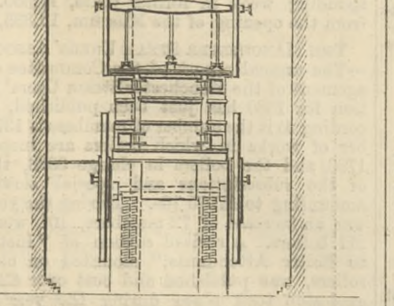

without a fly-wheel, by means of a counterbalance weight suspended by a strap, chain, or otherwise, which strap or chain passes over a pulley or pulleys above the cylinders, and is connected to the piston, or to the crosshead to which the pistons are attached; or a lever or levers with segmental ends may be used in place of the pulley, the counterbalance weight being attached by a strap or otherwise to one end, and the piston or crosshead being attached to the opposite end. The drawing shows a front elevation of a vertical blowing engine.

3656. MATCH-BOXES, *A. M. Clark.—Dated 8th September*, 1880.—(*A communication from M. Olive.*) 4*d*.

The box is formed of cardboard, and is formed with a lid capable of turning backwards as on a hinge, the underside of the lid having a groove in which one end of an india-rubber band is secured, the other end being attached to the inside of the box.

3659. STEEL WIRE CARDS, &c., *G. and E. Ashworth.—Dated 9th September*, 1880. 6*d*.

An apparatus is employed to detect soft portions of the wire, and to give warning to the attendant, or to arrest the movements of the machine, or of parts thereof, or to impart such a set curl, bend, or kink to the wire as shall prevent the formation or setting of the teeth, or shall otherwise lead to the detection of the inequality in the wire.

3663. BOILING OR COOKING EGGS, *J. C. Mewburn.—Dated 9th September*, 1880.—(*A communication from L. M. A. Couchoud.*) 6*d*.

The vessel is divided by two partitions B and C into three compartments, the upper partition B is concave and the lower one C of convex form, and they are connected together by a tube D opening into the top and bottom compartments. The middle compartment is fitted with a spout H. In the upper partition is a hole covered with wire gauze, below which is a disc I with a small aperture in its centre. The basket for

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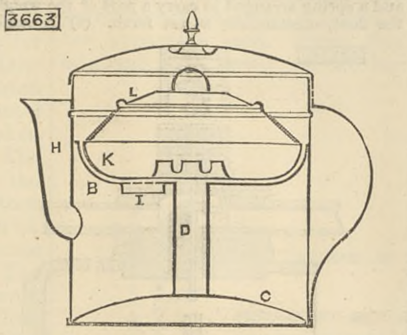

holding the eggs is composed of a plate K with an opening in the centre, the edges of which are raised to keep off the eggs. From the edges of the plate arms are carried up and support a disc L, which prevents the water boiling over. The top compartment contains water, and in it the basket is placed, when the apparatus is set on the fire, and the water gradually passes from the top to the middle compartment through the hole in disc I, and when all the water has passed through the eggs are done. The spout H serves to empty the apparatus.

3664. TREATING SEROUS MATTER TO OBTAIN NITROGENOUS PRODUCTS AND ALBUMEN, &c., *R. Werdermann.—Dated 9th September*, 1880. 4*d*.

This relates to the treatment of blood for obtaining a dry product rich in nitrogen compounds, and to the treatment of albuminous matter for obtaining pure and colourless albumen. The blood is mixed with lime or calcic oxide and stirred, when the lime is allowed to settle. After the blood has coagulated it is cut into pieces and allowed to dry in a warm place. The serum obtained from blood is, according to the second part of this invention, mixed with water, and acetic acid is added, or a current of carbonic acid is passed through it, causing the other albuminous substances to be precipitated. The liquid is then decanted and submitted to dialysis, and a current of ozone or ozonised air is passed through it, whereby the serum is entirely discoloured.

3666. METAL FENCING, *D. Ross.—Dated 9th September*, 1880. 6*d*.

This consists in the construction and use of spiral or U-shaped grippers for the securing of the horizontal wires of fences at any desired vertical distance apart to their posts or droppers by a vertical wedge.

3667. RAISING AND LOWERING OBJECTS, *C. D. Abel.—Dated 9th September*, 1880.—(*A communication from E. Borde, J. Petit-Laroche, and E. Labalette.*) 6*d*.

The raising and lowering of objects is effected by the direct action of a piston inside a cylinder arranged in combination with a three-way cock in such manner that the load is raised by the admission of fluid pressure into the cylinder, is held suspended by the retention of such pressure in the cylinder, and is lowered by permitting the escape of the fluid pressure.

3670. AN IMPROVED PROCESS OF REGENERATING THE FLUIDS OF GALVANIC BATTERIES, IN WHICH CAUSTIC ALKALIES ARE EMPLOYED, AND OF RECOVERING THE ZINC HYDRATE FROM SOLUTION, *A. M. Clark.—Dated 9th September*, 1880.—(*A communication from E. Reynier.*) 4*d*.

The proceeding is as follows:—The inventor separates by decantation the insoluble carbonate of zinc, which may have been formed by the carbonic acid of the air, or by any carbonates that may accidentally be present with the caustic alkalies; he then adds to the liquid left four to eight volumes of water, which precipitates the zinc hydrate, then decants, collects the zinc hydrate, washes thoroughly, drains and dries it; he next evaporates the dilute lye which has been drawn off, concentrating it till it attains its original density, and finally eliminates any carbonic acid the liquid may still contain by caustification with lime.

3673. FURNACES, *A. C. Engert.—Dated 10th September*, 1880. 6*d*.

This consists in the application to a furnace of a movable flap or shutter, or like contrivance, which can be closed down towards the fire-bars, so as temporarily to separate from the body of the furnace a front compartment to receive the fresh fuel, and

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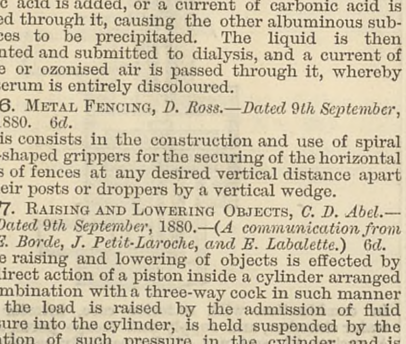

which flap or shutter serves to prevent a rush of air into the furnace, and to compel the gases and smoke evolved from the fresh fuel to come into close proximity with fuel already in a state of active combustion.

3676. PRESSING OR FLATTENING THE SEWN SEAMS OF BOOTS AND SHOES, &c., *W. Marsh and J. Morris.—Dated 10th September*, 1880. 6*d*.

The pressing or flattening is effected by pressure between two suitably-shaped rollers, to one or both of which motion is imparted by any suitable means. One or both of these rollers is or are so arranged that they can be readily adjusted by screws or otherwise to a certain distance apart, dependent upon the thickness of the seam to be pressed or flattened. One or both of these rollers may be acted upon by a pressure spring, weight, or other suitable appliance, whereby the one is caused to press with a certain adjustable pressure towards the other.

3680. SUGAR CANDY, *T. Morgan.—Dated 10th September*, 1880.—(*A communication from J. Pitman.*) 4*d*.

The sugar is mixed with water, and boiled for a certain period in vacuum or in open iron pans. Raw eggs in certain proportion are added. The mixture is then boiled slowly and the scum removed. The syrup is then drained and poured back into the boiling pans until it gains the proper consistency; it is then poured into crystallising pans, in which reticules of bamboo, or wooden strips, or network of thread with air-tight covers have been previously fixed in such a manner as to divide the mass into convenient sections, when it solidifies about them.

3681. HEATING AND ILLUMINATING GASES, &c., *J. A. Stephan.—Dated 10th September*, 1880.—(*Not proceeded with.*) 2*d*.

Solid sewage matters after filtration from their fluids, either mixed or not with ashes, are heated in retorts formed of iron, encased with fire-clay or brick set in fire-clay to a red-heat. Steam is then passed over the heated matters from similar retorts in course of action and also from boilers, which are heated by the operation of cooling the gases. These boilers are constructed with an internal lining, consisting of a worm or coil of tubing, through which the gases pass from the retorts. The coil is surrounded by water, which the gas in the pipes heats, and thus produces steam by boiling the water.

3687. DRESSING STONE, *O. O. Williams.—Dated 10th September*, 1880.—(*Not proceeded with.*) 2*d*.

The machine consists of a gauged anvil or block, which forms a bed on which to rest the stone during the operation of dressing. The dressing is performed by a steel flat-edged or pick cutter having a reciprocating or steam hammer action which is imparted to it by an inverted steam or other cylinder placed over the anvil or bed, and carried by a suitable framework.

3688. SPRINGS FOR WASHING, WRINGING, AND MANGLING MACHINES, *H. L. Wilson and J. Clegg.—Dated 10th September*, 1880. 4*d*.

The springs consist of two or more layers of the length of the completed spring. These are so bent as to form two or double bows, upon each of which are shorter layers and bearing pieces, which, when the spring is in use, bear against the underside of the top

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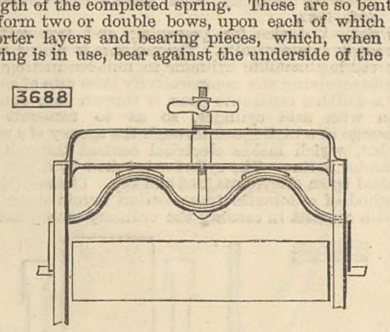

rail of the machine. The spindle of the adjusting screw is attached to the spring at a point between the two bows, and in applying the spring the spindle is, by screw and pressure wheel, raised in contradistinction to being screwed down. The raising the spindle as referred to puts the pressure upon the necks of the rollers as required.

3689. ICED AIR INHALATORS, *W. Brierley.—Dated 10th September*, 1880.—(*A communication from S. Stackfleth.*) 4*d*.

The apparatus consists of two concentric cylinders, closed at each end, and with an intermediate space between them. The inner vessel B is divided by a perforated diaphragm, above which are placed alternate layers of ice and salt, the water formed passing

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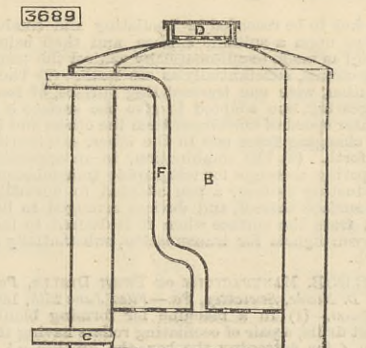

through the diaphragm and out at C. A tube F passes down to the diaphragm, and is connected to a flexible tube forming the connection with the mouth of the patient. The air enters at D, and passing through a perforated disc down through the layers of salt and ice, is cooled, and then passes to the underside of the diaphragm and up through tube F.

3692. DAMASK LOOMS, *W. R. Lake.—Dated 10th September*, 1880.—(*A communication from J. L. Dhöner.*) 6*d*.

For each row of lifting wires two lifting blades are employed, one being at the right-hand and the other at the left-hand side, and the lifting wires are provided with two hooks, one at the right-hand and the other at the left-hand side. When in their normal

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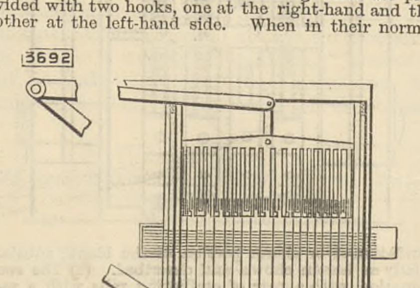

position the lifting wires are pressed towards the right-hand side by the springs of the needles, so that a blade at the right-hand side will lie beneath the hook at the right-hand side and will lift the wire, whereas when the needles are pressed backward the wires move to the left over their vertical position, and their other hooks assume their position above the blades at the left-hand side.

3694. SPRING MATTRESSES, *H. Lazarus.—Dated 10th September*, 1880.—(*Not proceeded with.*) 2*d*.

This consists of a rectangular frame, the rails of which for convenience of carriage can be separated the one from the other. This frame at one end carries a roller, and at the other a foot-board or bar. Between these two parts a sheet formed of interlocking spirals or springs of coiled wire is strained.

3693. MANUFACTURE OF PECKS, HOES, &c., *G. R. Postlethwaite.—Dated 10th September*, 1880. 1*s*.

This consists partly in making the eyes of pecks, hoes, &c., together with their necks, shoulders, ribs, and poles, from blanks or shaped bars of iron, or from

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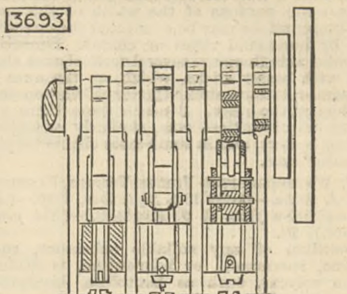

flat bars of iron, by a combination of processes. The arrangement for throwing the working slides or upper tool-holders into and out of gear without stopping the machinery is represented in connection with the right-hand slide of the machine in the drawing.

3696. COUPLINGS FOR TAPS AND PIPES, *S. Mason.—Dated 11th September*, 1880.—(*Not proceeded with.*) 2*d*.

On the spout end of the tap is formed an annular collar, and on the pipe is formed a free collar box. The face of the collar box where it is to engage with the collar on the tap is cut into a number of sides corresponding with those on the collar, and the thickness of the metal forming this face is bevelled on the underside, to afford a wedge-like hold when the parts are combined.

3697. FUEL ECONOMISERS, *J. Parker.—Dated 11th September*, 1880. 6*d*.

This consists in connecting together the two scraper-carriers, or the two carriers in each pair, in such a

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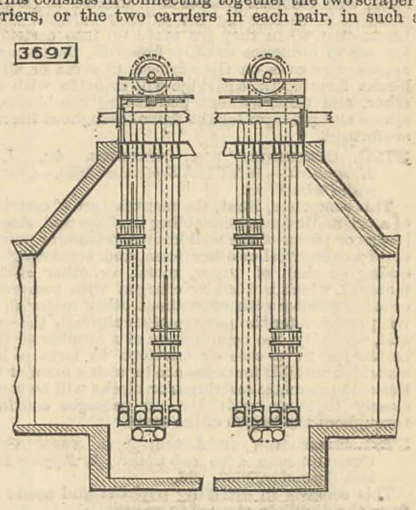

manner as that the ascending carrier shall be capable of drawing downwards the descending carrier.

3709. BOTTLES AND STOPPERS, *J. Neal.—Dated 11th September*, 1880. 6*d*.

The body A of the bottle is of ordinary form, but where it joins the neck B projections D are formed, to

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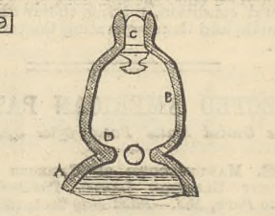

prevent the stopper passing down. The shape of the neck B is such that the stopper C cannot turn over.

3710. LIDS OF TEA AND COFFEE POTS, &c., *J. Clarke.—Dated 11th September*, 1880.—(*Not proceeded with.*) 2*d*.

About one-third of the circumference of the verge or ledge at the back or handle part is dispensed with, but immediately above the same are arranged one or more projections, which prevent the lid or cover from falling off when in manipulation.

3711. MANUFACTURE OF ENAMELLED JEWELLERY, &c., *W. R. Lake.—Dated 11th September*, 1880.—(*A communication from F. Boucheron.*)—(*Not proceeded with.*) 2*d*.

The body or core is first prepared, and is made of any suitable metal or alloy. This body or core is then placed in a mould or support, having the same form as itself, and designed to keep the core in position. The melted enamel is then poured over the metal framework, core, or body until the latter is surrounded thereby; the enamel thus enters all the openings, spaces or interstices in the metal frame, and covers the same to the desired thickness, and the metal frame so covered has the appearance of veins in the petal of a flower.

3712. TOOL FOR CUTTING CIRCULAR HOLES IN METAL PLATES, *E. H. Bennett.—Dated 11th September*, 1880. 6*d*.

This consists of a combination of a hollow spindle A, a pointed rod B partly contained within the spindle and pressed outwards from it by a spring,

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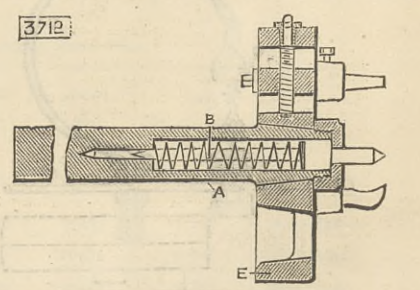


and a disc E secured to or forming part of the spindle and carrying tool-holders, which can be moved towards or away from the spindle.

3714. MACHINERY FOR BEATING CARPETS, *S. Simmons.—Dated 11th September*, 1880.—(*Not proceeded with.*) 2*d*.

This consists of a frame, at the upper part of which there is a pair of horizontal rollers. Between these rollers the carpet is passed, and it hangs from them in a vertical position, whilst at the same time that th0 rollers slowly revolve the carpet is moved progressively forward. In front of the carpet thus held suspended series of axes are arranged; some of these axes are horizontal and others vertical, and they all receive a semi-rotary motion, first in one direction and then in the other. Thus the uppermost axis may be horizontal, with a number of beater sticks fixed into it, and in some sections of the width of the machine these beater sticks may be connected the one with the other by horizontal ropes or chains. Beneath this horizontal axis there are several vertical axes also provided with beater sticks, which, as the axes make their semi-rotations, strike the carpet first on one side and then on the other. Beneath these there may be another set of vertical axes, similarly arranged and carrying beaters, and in some cases chains connecting the beater arms.

3717. Waterproofing Fibres, Tissues, Fabrics, &c., *J. J. Sachs.—Dated 13th September*, 1880.—(*A communication from C. O. Ramstedt.*)—(*Not proceeded with.*) 2*d.*

A solution of any suitable substance, such as paraffine, spermaceti, or belmontine, is made in a volatile solvent, such as benzoline, bisulphide of carbon, or naphtha.

3719. Bands or Clasps, *W. F. Brown.—Dated 13th September*, 1880.—(*Not proceeded with.*) 2*d.*

This relates to bands for ladies' hair, scarfs, ties, &c. In the place usually occupied by the joint, a hole is pierced through which a rod or bar having a knob at each end is passed, so as to move freely, the collar of the outside knob resting against the hole; this forms the substitute for the usual joint; the other end of the rod is made by its knob to take into a curved slot, catch, or spring lock.

3726. Furnaces for Steam Generators, *D. A. Horsnell.—Dated 13th September*, 1880.—(*Not proceeded with.*) 2*d.*

Movable balanced or suspended fire-bars are employed with or without wings or cross projections cast or otherwise formed transversely thereon, such wings when used being disposed either in line with each other or in steps, so as to leave free air spaces between them.

3728. Gunpowder and Cartridges, *G. V. Fosbery.—Dated 13th September*, 1880.—(*A communication from H. Studer.*)—(*Not proceeded with.*) 2*d.*

This particularly relates to powder compressed and formed into blocks or bars of a polygonal or prismatic form, with external grooves of truncated angles, and consists in so forming the exterior surfaces of said blocks that when they are made up into cartridges, for use in ordnance or other fire-arms, the truncated angles or grooves on the surfaces of some or all the blocks forming the cartridge will coincide with each other, and thus, without perforating the blocks, air spaces and passages for the flame throughout the mass are formed.

3729. Cartridges for Ordnance, &c, *J. G. Marqwardt.—Dated 13th September*, 1880.—(*Not proceeded with.*) 2*d.*

This comprises, First, the manufacture of cartridges of a prismatic form, resembling in shape and size the blocks or pieces of the well-known prismatic powder, or of a cylindrical or other form, and consisting of a casing or shell of paper, metal, or other suitable material, which is filled or charged with compressed or other powder with or without other material, and has provision for the passage of air through the same; and, Secondly, the combination of a number of these cartridges in a case or envelope to form a large cartridge suitable for ordnance in such a manner that the said prismatic cartridges or blocks will be packed closely together with the air passages continued throughout the length of the same.

3731. Separation of Acetic Acid from Crude Pyroligneous Acid and Spirit, *B. Biggs.— Dated 13th September*, 1880. 2*d.*

This consists in distilling naphtha and acetic acid from the distillate of wood in vacuo.

3745. Purifying and Whitening Oils and Fats, *P. M. Justice.—Dated 15th September*, 1880.—(*A communication from A. W. Winter and W. T. Coleman.*) 4*d.*

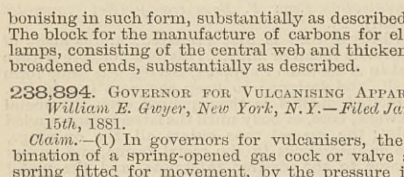
This consists in the process of treating animal fats and oils and certain vegetable oils, by reducing them to a liquid condition, mixing therewith pulverised fullers earth, and then separating the earth from the oil or fat.

SELECTED AMERICAN PATENTS.

From the United States' Patent Office Official Gazette.

238,868. Manufacture of Carbons for Incandescent Electric Lamps, *Thomas A. Edison Menlo Park, N.J.—Filed May 24th*, 1880.

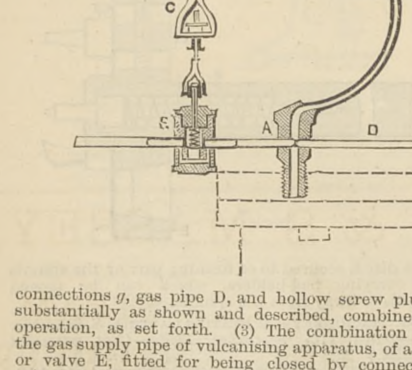
Claim.—(1) The method of forming carbons for electric lamps, which consists in shaping a block of wood as described, then cutting, splitting, or shaving into straight pieces, adapted for simple carbons, then bending such pieces into the desired form and car-



bonising in such form, substantially as described. (2) The block for the manufacture of carbons for electric lamps, consisting of the central web and thickened or broadened ends, substantially as described.

238,894. Governor for Vulcanising Apparatus, *William E. Gwyer, New York, N.Y.—Filed January 15th*, 1881.

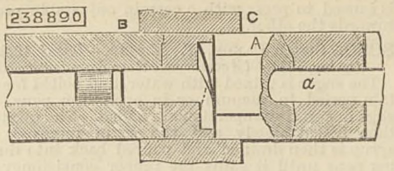
Claim.—(1) In governors for vulcanisers, the combination of a spring-opened gas cock or valve and a spring fitted for movement, by the pressure in the steam box, to close the cock, substantially as shown and described. (2) The governor for vulcanisers, consisting of the hollow C spring B, valve E, turn-buckle



connections *g*, gas pipe D, and hollow screw plug A, substantially as shown and described, combined for operation, as set forth. (3) The combination with the gas supply pipe of vulcanising apparatus, of a cock or valve E, fitted for being closed by connections actuated directly by the pressure in the steam box, substantially as shown and described.

238,890. Nut-making Dies, *William Gray, Beardstown, Ill.—Filed June 18th*, 1880.

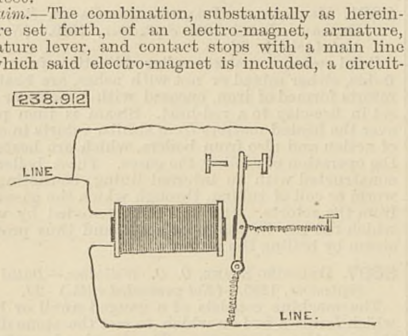
Claim.—In a machine for making nuts, the combination with the die box C and the pressing punch B, of the die A, having the inclined projections on its face and the piercing rod *a* within said die A, and adapted to move through the die A toward the die B, whereby



the rod cuts away from the inclines instead of toward them, as described.

238,912. Shunt for Speaking Telephone Systems, *Francis W. Jones, Chicago, Ill.—Filed August 25th*, 1880.

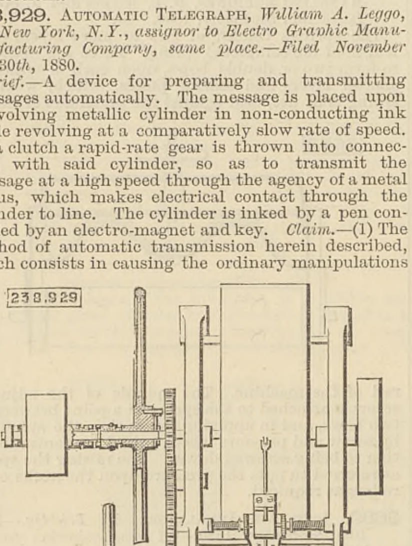
Claim.—The combination, substantially as hereinbefore set forth, of an electro-magnet, armature, armature lever, and contact stops with a main line in which said electro-magnet is included, a circuit-



connection between the back contact stop and a point in the main line on one side of the electro-magnet, a circuit connection between the armature lever and a point on the opposite side of the electro-magnet, and an artificial resistance included in one of said circuit connections.

238,929. Automatic Telegraph, *William A. Leggo, New York, N.Y., assignor to Electro Graphic Manufacturing Company, same place.—Filed November 30th*, 1880.

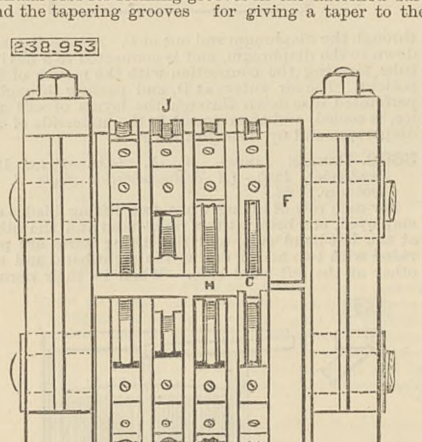
Brief.—A device for preparing and transmitting messages automatically. The message is placed upon a revolving metallic cylinder in non-conducting ink while revolving at a comparatively slow rate of speed. By a clutch a rapid-rate gear is thrown into connection with said cylinder, so as to transmit the message at a high speed through the agency of a metal stylus, which makes electrical contact through the cylinder to line. The cylinder is inked by a pen controlled by an electro-magnet and key. *Claim.*—(1) The method of automatic transmission herein described, which consists in causing the ordinary manipulations



of a key to be recorded in insulating and conducting spaces upon a suitable surface, and then using the record so made to automatically control the transmitting circuit, substantially as set forth. (2) The combination, with one transmitting surface, of two sets of gearing, one adapted to give the surface a much greater speed of movement than the other, and means for changing from one to the other, substantially as set forth. (3) The combination, in an apparatus for preparing messages for telegraphic transmission, of a conducting surface, a pen adapted to normally ink the surface thereof, and devices arranged to lift the pen from the surface when it is desired to indicate thereon signals for transmission, substantially as set forth.

238,953. Manufacture of Twist Drills, *Parshall D. Nicole, Sewickley, Pa.—Filed June 25th*, 1880.

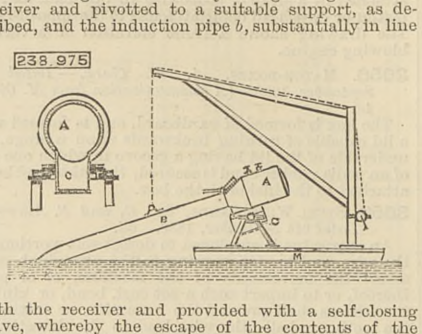
Claim.—(1) In a machine for forming blanks for twist drills, a pair of oscillating rollers having the flat pass *f* for flattening the bar, the grooves *g h*, with annular ribs for forming grooves in the flattened bar, and the tapering grooves for giving a taper to the



unflattened or shank portion of the blank, substantially as herein shown and described. (2) The combination, with a pair of oscillating rolls with a pass and grooves for flattening and forming grooves in a metal bar, of dies secured to said grooves and formed with tapering grooves for tapering the end of a bar previously passed a portion of its length only through said pass and grooves, substantially as described.

238,975. Vacuum Dredging Apparatus, *Henry C. Sears, Boston, Mass.—Filed January 4th*, 1881.

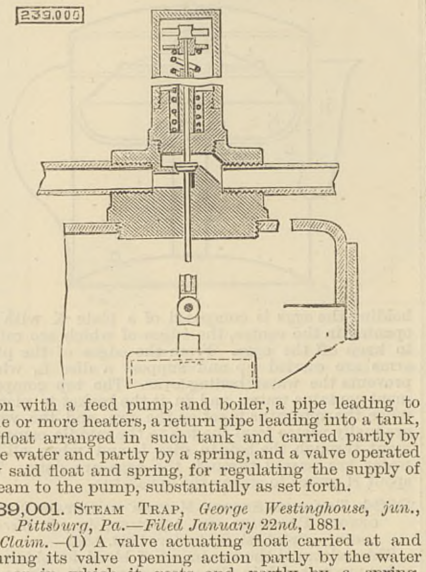
Brief.—The dredge is adapted to swing vertically and horizontally, and is manipulated by a derrick crane. *Claim.*—(1) A vacuum dredging apparatus or Savary pump of the class herein described, adapted to swing both vertically and horizontally on a scow or other support by means substantially as and for the purpose set forth. (2) The improved vacuum dredging apparatus or Savary pump, composed of the receiver *a*, the induction pipe *b*, and the lateral discharge pipe *c*, having trunnions combined with the frame, adapted to rotate horizontally, and provided with bearings for the trunnions, as set forth. (3) The combination, in a vacuum dredging apparatus, of a scow or vessel having the annular track or support *k*, the annular frame adapted to rotate on said track, and the Savary pump having trunnions fitted in said bearings in said frame, as set forth. (4) The improved Savary pump herein described, composed of the receiver *a*, adapted to receive steam and water, the lateral discharge pipe *c*, arranged substantially at right angles to the receiver and pivotted to a suitable support, as described, and the induction pipe *b*, substantially in line



with the receiver and provided with a self-closing valve, whereby the escape of the contents of the receiver through the induction pipe is prevented, as set forth. (5) The combination of a scow or vessel *m*, a Savary pump adapted to swing both vertically and horizontally thereon by means substantially as described, and a derrick crane for swinging said pump in either of said directions, as set forth.

239,000. Feed-water Apparatus, *George Westinghouse, jun., Pittsburg, Pa.—Filed February 7th*, 1881.

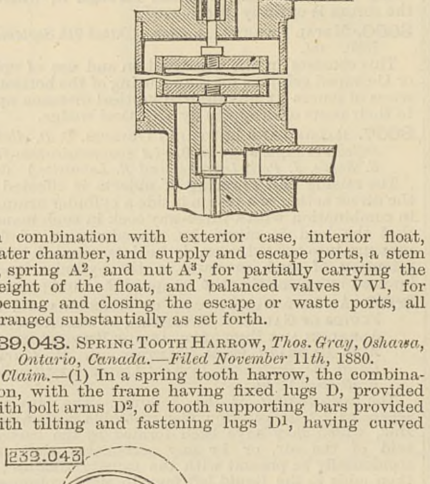
Claim.—(1) In combination with a feed pump and boiler, a valve arranged to regulate the supply of steam to the pump, a float connected with the valve stem, and a spring arranged to carry a part of the weight of the float, substantially as set forth. (2) In combina-



tion with a feed pump and boiler, a pipe leading to one or more heaters, a return pipe leading into a tank, a float arranged in such tank and carried partly by the water and partly by a spring, and a valve operated by said float and spring, for regulating the supply of steam to the pump, substantially as set forth.

239,001. Steam Trap, *George Westinghouse, jun., Pittsburg, Pa.—Filed January 22nd*, 1881.

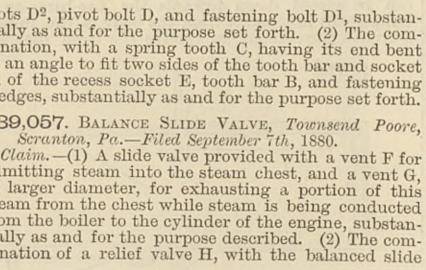
Claim.—(1) A valve actuating float carried at and during its valve opening action partly by the water on or in which it rests and partly by a spring, arranged for operation substantially as set forth. (2)



In combination with exterior case, interior float, water chamber, and supply and escape ports, a stem A, spring A^2, and nut A^3, for partially carrying the weight of the float, and balanced valves V V^1, for opening and closing the escape or waste ports, all arranged substantially as set forth.

239,043. Spring Tooth Harrow, *Thos. Gray, Oshawa, Ontario, Canada.—Filed November 11th*, 1880.

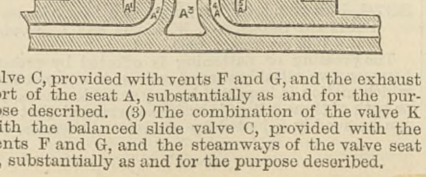
Claim.—(1) In a spring tooth harrow, the combination, with the frame having fixed lugs D, provided with bolt arms D^2, of tooth supporting bars provided with tilting and fastening lugs D^1, having curved



slots D^2, pivot bolt D, and fastening bolt D^1, substantially as and for the purpose set forth. (2) The combination, with a spring tooth C, having its end bent at an angle to fit two sides of the tooth bar and socket E, of the recess socket E, tooth bar B, and fastening wedges, substantially as and for the purpose set forth.

239,057. Balance Slide Valve, *Townsend Poore, Scranton, Pa.—Filed September 7th*, 1880.

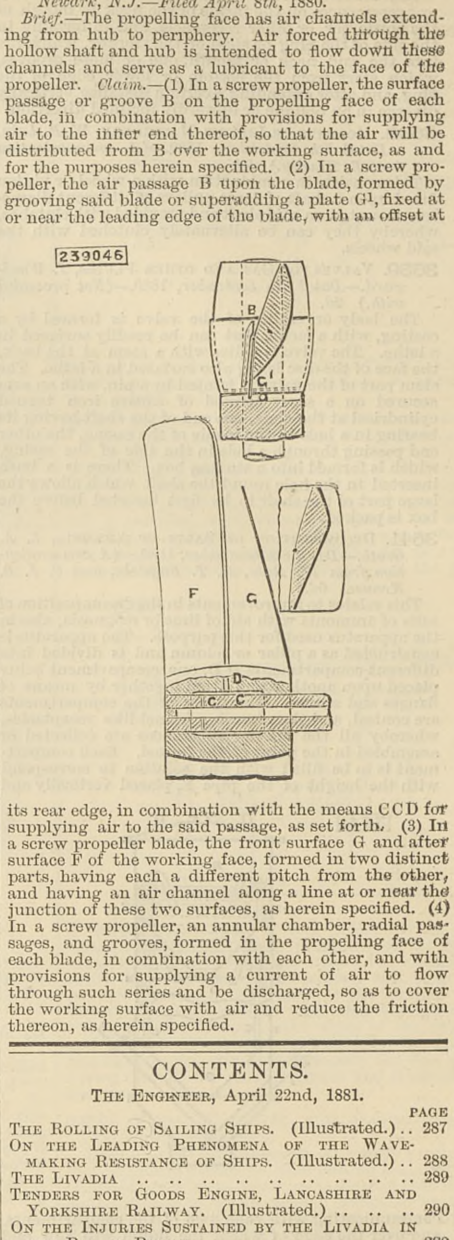
Claim.—(1) A slide valve provided with a vent F for admitting steam into the steam chest, and a vent G, of larger diameter, for exhausting a portion of this steam from the chest while steam is being conducted from the boiler to the cylinder of the engine, substantially as and for the purpose described. (2) The combination of a relief valve H, with the balanced slide



valve C, provided with vents F and G, and the exhaust port of the seat A, substantially as and for the purpose described. (3) The combination of the valve K with the balanced slide valve C, provided with the vents F and G, and the steamways of the valve seat A, substantially as and for the purpose described.

239,046. Screw Propeller, *John P. Holland, Newark, N.J.—Filed April 8th*, 1880.

Brief.—The propelling face has air channels extending from hub to periphery. Air forced through the hollow shaft and hub is intended to flow down these channels and serve as a lubricant to the face of the propeller. *Claim.*—(1) In a screw propeller, the surface passage or groove B on the propelling face of each blade, in combination with provisions for supplying air to the inner end thereof, so that the air will be distributed from B over the working surface, as and for the purposes herein specified. (2) In a screw propeller, the air passage B upon the blade, formed by grooving said blade or superadding a plate G^1, fixed at or near the leading edge of the blade, with an offset at



its rear edge, in combination with the means CCD for supplying air to the said passage, as set forth. (3) In a screw propeller blade, the front surface G and after surface F of the working face, formed in two distinct parts, having each a different pitch from the other, and having an air channel along a line at or near the junction of these two surfaces, as herein specified. (4) In a screw propeller, an annular chamber, radial passages, and grooves, formed in the propelling face of each blade, in combination with each other, and with provisions for supplying a current of air to flow through such series and be discharged, so as to cover the working surface with air and reduce the friction thereon, as herein specified.

CONTENTS.

The Engineer, April 22nd, 1881.

South Kensington Museum.—Visitors during the week ending April 16th, 1881:—On Monday, Tuesday, and Saturday, free, from 10 a.m. to 10 p.m., Museum, 10,264; mercantile marine, building materials, and other collections, 5210. On Wednesday and Thursday, admission 6d., from 10 a.m. till 6 p.m., Museum, 983; mercantile marine, building materials, and other collections, 212. Total, 16,669. Average of corresponding week in former years, 17,555. Total from the opening of the Museum, 19,833,860.

The Manchester Steam Users' Association.—The annual report of the Committee of Management of the Manchester Steam Users' Association for 1880 has just been published, and according to it the number of members is 1373, number of works in which boilers are inspected is 1786, and the boilers in charge 3868, the total of the subscriptions and special service fees amounting to £7975 10s. During the year there was an increase of 72 members, 101 works, and 211 boilers. A revised edition of "Instructions to Boiler Attendants," mounted on cloth and rollers, was published and cost over £249. No explosion took place during the year of any boiler under the Association's inspection, though twenty-four explosions occurred killing seventy-seven people, fifty of whom were engaged in iron works.