ADMIRALTY COEFFICIENTS.

By Robert Mansel.

In continuation of my paper in The Engineer, September 3rd, I would offer the remark made by the late G. H. Lewes, "There is but one effective mode of displacing an error, and that is to replace it by a conception which, while readily adjusting itself to conceptions firmly held on other points, is seen to explain the fact more completely," and proceed to illustrate the same with reference to the important subject, the law of the resistance in steamship propulsion, in contradistinction to the results of the usually accepted theories. Referring to the Admiralty Trial Tables, it will be seen: On July 5th, 1878, H.M.S. Euryalus, with a displacement of 4223 tons, was tried on the measured mile—Stokes Bay—with three different rates of development of power, viz., 5109, 3468, and 1805 indicated horses. The corresponding speeds, by observation, are reported as having been 14·72, 13·16, and 10·8 nautical miles respectively. From these data, by any one of the several methods I have published, it is not difficult to determine the relation of power to speed in this vessel; which, expressed according to my notation, would be found to be—

$$E = \frac{D^{\frac{2}{3}}}{11·72} V \log.^{-1} ·081 V.$$

The a and c of my formula being the constant quantities ·081 and 11·72 respectively. The first point to notice is, that this and, indeed, nearly every vessel presents a slight incongruity in the data, which is removed by a small modification of one of the mean speeds; in the present case the speed given as 13·16 knots ought to be 13·22 knots; say, one-seventeenth of a knot greater. I shall first illustrate this by calculating, by formula, the power which ought to be necessary for the various trial speeds reported, and contrast them with the observed powers, as follows:—

H.M.S. Euryalus.

Trial speeds	=	14·72	13·22?	10·8	13·16	
Log. $D^{\frac{2}{3}}$	=	2·4171	2·4171	2·4171	2·4171	
Values ·081 V	=	1·1923	1·0708	·8748	1·0660	
Log. V	=	1·1678	1·1212	1·0334	1·1194	
Subtract Log. 11 72	=	1·0690	1·0690	1·0690	1·0690	
Sum, Log. E	=	3·7082	3·5401	3·2563	3·5335	
∴ E	=	5107	3468	1804	3416	indicated horses.
By trial data	=	5109	3468	1805	3468?	" "

Hence, it appears that the speed 13·16 knots should only have required 3416 indicated horses; therefore, if 3468 was actually the calculated result by diagrams, some disturbing cause or change of circumstances must have retarded the speed to the extent corresponding to the difference ·06 knots. Now an obvious and sufficient cause for such retardation—or, it might have been acceleration—is presented by the varying tidal or wind drift to which all vessels are exposed in running progressive speed trials. The tidal drift is not a uniformly varying quantity, and leaves residual errors which are not wholly eliminated by running the vessel with and against the tide, and taking averages in the usual method. Wind drift may act even more capriciously; and, hence, small differences, such as I now have occasion to notice, are quite within the limits of errors of observation, and do not, really, detract from the trustworthy character of the data, nor from the validity of deductions derived from them.

Again, by the same table it will be seen, on July 30th, 1879, H.M.S. Bacchante, with a displacement of 4126 tons, tried at Stokes Bay with the indicated powers, developed 5416, 3571, and 1927 horses, the corresponding observed speeds are reported as being 15·06, 13·63, and 11·69 knots, respectively. These indicate a relation of power to speed expressed by the equation—

$$E = \frac{D^{\frac{2}{3}}}{23·345} V \log.^{-1} ·1005 V.$$

In which vessel a drift correction of one-twentieth of a knot on the middle speed seems requisite; instead of 13·63, this speed should be taken as 13·68 knots.

H.M.S. Bacchante.

Trial speeds	=	15·06	13·68?	11·69	
Log. $D^{\frac{2}{3}}$	=	2·4103	2·4103	2·4103	
Values of ·1005 V	=	1·5135	1·3748	1·1748	
Log. V	=	1·1770	1·1361	1·0678	
Subtract Log. 23·345	=	1·3682	1·3682	1·3682	
Sum, Log. E	=	3·7334	3·3530	3·2847	
∴ E	=	5413	3573	1926	indicated horses.
By trial data	=	5416	3571	1927	" "

In the next place, in my letter of June 18th—page 477—I referred to the fourth set of trials on H.M.S. Iris, but having made use of an old, and it seems incorrect investigation, I overlooked a slight error in the quantity a, which instead of having been taken at its very approximate true value, ·0734, has been given as ·0750. As a useful illustration, I, therefore, wish to add the full investigation, to show the perfectly definite nature of the results obtained from very simple, yet sensitive formulas. H.M.S. Iris, displacement 3290 tons, powers developed 7556, 3958, 1765, and 596 indicated horses. The corresponding speeds are reported as 18·59, 15·75, 12·48, and 8·32 knots, respectively. First, we have to find the value of a, obtained by the following process from the formula—

$$\text{Log.} \frac{D^{\frac{2}{3}} V}{E} = \log. c - a V.$$

Trial speeds	=	18·59	15·75	12·48	8·32	12·39?
Log. $D^{\frac{2}{3}}$	=	2·3448	2·3448	2·3448	2·3448	2·3448
Log. V	=	1·2693	1·1973	1·0962	·9201	1·0931
Subtract Log. E	=	3·8783	3·5975	3·2467	2·7752	3·2467
Sums	=	−1·7358	−1·9446	·1943	·4897	·1912

From the formula, it will be readily seen, that, if we divide the difference of the first and last of these results by the difference of the speeds, the result is the value of a, thus,

$$a = \frac{·4897 - (-1·7358)}{18·59 - 8·32} = \frac{·7539}{10·27} = ·0734.$$

Now, with the value of a thus obtained, multiply each speed; the product added to the corresponding sum, given above, ought to give for each the value of log. c, and ought to have all the same value. Let us try this:

Trial speeds	=	18·59	15·75	12·48	8·32	12·39
Value of ·0734 V	=	1·3645	1·1561	·9160	·6107	·9094
Sums as above	=	−1·7358	−1·9446	·1943	·4897	0·1912
Log. c	=	1·1003	1·1007	1·1103	1·1004	1·1006

Here the first, second, and fourth speed give practically the same value; or, taking a mean, say, log. c = 1·1005. The third, however, gives log. c = 1·1103. Now, whether is it more probable that this trial contradicts the principle of the constancy of the quantity c, which is confirmed by the three other trials, or, the alternative, that the speed in this trial has, from some cause, been overstated, and that instead of having been 12·48 knots, it in reality has been only 12·39 knots; in which case, as shown in the last column, the value comes out log. c = 1·1006, which practically agrees with the others? I affirm that the latter alternative is the correct one, and that it is only the drift correction, in this way made definite and obvious, which is the cause of the anomaly. On this ground the relation of power and speed in H.M.S. Iris—fourth set of trials—is expressed by the equation

$$E = \frac{D^{\frac{2}{3}}}{12·605} V \log.^{-1} ·0734 V.$$

In proof of which

H.M.S. Iris (under fourth trial conditions).

Trial speeds	=	18·59	15·75	12·39	8·32	knots
Log. $D^{\frac{2}{3}}$	=	2·3448	2·3448	2·3448	2·3448	
Value ·0734 V	=	1·3645	1·1561	·9094	·6107	
Log. V	=	1·2693	1·1973	1·0931	·9201	
Subtract Log. 12·605	=	1·1005	1·1005	1·1005	1·1005	
Sum Log. E	=	3·8781	3·5977	3·2468	2·7751	
∴ E	=	7553	3960	1766	596	indicated horses
By trial data	=	7556	3958	1765	596	"

IRON AND STEEL SAILING SHIPS.

The proportion which sailing vessels bear to steamers, in the total tonnage built during recent years in the United Kingdom, is undoubtedly much greater than was at one time generally anticipated would be the case after so long an experience with steam navigation. At first it was thought that the marine engine would wholly take the place of sail power as a means of propulsion for ships, and that only a comparatively brief period would be occupied by the complete transition from sails to steam. This expectation seemed very likely to be fulfilled about fifteen years ago, the economical advantages of steam navigation having shortly before been much enhanced by the introduction of the compound engine. But, just as the prospects of sailing ships seemed to be at their worst, there arose a coal famine which for a time seriously handicapped steamers, and advanced the interests of sailing ship owners to a corresponding degree. The scarcity of coals did not, however, endure very long, and the increased output, which the high prices encouraged, quickly led to a reaction in the contrary direction, making coals cheaper even than they were before. Again a spurt was given to the production of steam vessels, which was accelerated by the unhealthy enterprise of three years ago in the shape of speculative shipbuilding and the formation of mushroom shipowning companies. By these means the market was flooded with steam tonnage, the competition of which for employment caused freights to be reduced to the unremunerative rates which still unhappily prevail. Hundreds of steamers which were launched during the last shipbuilding "boom" are now laid up, and many thousands of people who ignorantly handed over their savings to plausible "managing owners," have by this time discovered that steamship property is not such a mine of wealth as they were led to suppose. The building of that type of cargo steamer known as a "tramp" has for a time at least come to a stop, and the occupation of such of these vessels as are still kept running is not of a particularly lucrative character. Steamers are, it is true, still being laid down all over the country, but they are in most cases to supply the wants of the principal ocean steamship companies carrying mails and passengers, and the others are for special services abroad, either for coast or river traffic. But the type of vessel which it was at one time thought would revolutionise ocean navigation, render sailing ships useless, break large and old established companies, drive individual shipowners out of the running, and make large fortunes for their shareholders—this type is of the past, as far as can be judged by the work in progress at our ship yards.

During the depression in the shipping industries, which has now lasted for about two years, there has been a continual demand for iron sailing ships. At a time when freights are abnormally low, and when, therefore, economy in the means of transport should be of the greatest import ance, one would have supposed the advantages of steam navigation would have been most clearly apparent. The low price of coals and the economies recently effected in fuel consumption must inevitably contribute towards making propulsion by steam cheaper than that by sails. But yet in spite of all this, the sailing ship holds her own, and even makes a profit at a time when scores of steamers are laid up. This is very different to what was expected, and even predicted, by many eminent authorities upon shipping questions so recently as ten years ago. Just as iron had taken the place of wood, and just as steel was displacing iron as a material for ships, so it was expected, and reasonably too, that steam would take the place of wind as a motive power in ship propulsion.

We have not reached the end, and it may still be that steam has yet to assert itself to the full, and demonstrate its economical superiority over the older propelling force. For the transmission of mails no one would now dream of employing a sailing vessel, because in these cases speed of transit is of primary importance and sufficient to outweigh the question of relative cost. Much has already been done in econo mising the consumption of coals on shipboard, and there is every prospect of further improvements being made in the same direction. Triple and quadruple expansion produce cheaper results than the ordinary compound system, and by-and-bye it may come about that just as walking a long journey is, in the end, dearer than riding by railway, so the dearest way of transporting goods across the seas will be by sending them in the hold of a sailing ship.

For the present, however, the sailing ship has many commercial advantages over the steamer in the carriage of most kinds of cargoes. Although she would not be employed for the conveyance of early spring teas, she might still carry those of a later crop, and even be preferred to the steamer for the purpose. For the import of grain, sugar, jute, &c., and the export of coals, iron, salt, and manufactured goods which are not required to be speedily delivered, the sailing ship may at present be employed with fully as much advantage as the steamer to both shipowner and merchant. Indeed, the latter not unfrequently shows a preference for the sailing ship carriage of his goods, precisely on account of the longer time occupied in transit. Sailing ship cargoes often change hands a dozen times during a voyage to this country; so that the master has to call at Queenstown or Falmouth on his arrival to learn where the last purchaser wishes his goods to be delivered. The sailing ship is therefore a cheap warehouse for goods, and the length of her voyage is a source of advantage to the speculators upon the rise and fall of the market. This cause has contributed as much as any other to encourage the recent increased production of sailing ships in proportion to steamers.

But it must not be supposed that sailing ships have held their own in the competition with steam without some efforts having been made by their owners and designers to improve their qualities and develope their efficiency. Whatever success has been achieved with that class of vessels has, of late years at least, been confined to those built of iron and steel. Wood and composite ships are rarely taken up by charterers or insured by underwriters upon such favourable terms as ships of iron and steel. In the competition for freights and cargoes in foreign ports, the old class of ships is at a disastrous disadvantage. Not only are modern sailing ships built of better materials, but they greatly excel their wooden predecessors in regard to dimensions and good carrying form and proportions. Two thousand tons is a very usual size for an iron or steel sailing ship built at the present day, and many measure as much as 2500 tons. Indeed, one iron sailing ship, the Palgrave, is of no less that 3700 tons register. The rates of first cost, expense of maintenance and working, to each ton of cargo carried, is evidently much less in large than in small vessels, and by fitting the former with four instead of three masts, the sizes of individual spars and sails is reduced from what they otherwise would be, and therefore a less numerous crew is required. In these and other ways of lesser importance economies have been effected in sailing ship management, so that even with the low freights which have prevailed during the past year or two, it has been possible for well-managed sailing ships to make a very respectable return to their owners.

The success attained with first-class modern sailing ships at a time when shipping property generally is suffering from an almost unparalleled depression, has induced their owners to look about them with a view to competing with steamers under even still more favourable conditions. The experience of the past must suggest to all thoughtful minds that the conditions now prevailing in regard to shipping are only of a temporary character. The time is perhaps not far distant when freights will improve and trade revive so as to give profitable employment to steamers, and make the rapid carriage of cargoes of more importance than it has been during recent years. It always happens that, when trade is at its worst, merchants find the greatest advantage in putting their cargoes into sailing vessels; for it is then that the change in the market is most likely to be in the direction of advanced prices. Hence when the present depression disappears the owners of sailing ships will find it advantageous for their vessels to make quicker passages than at present, and any sailing vessel which can demonstrate her ability to do so will have the preference. Moreover, in the brisker competition with steam, the sailing ship owner will find it equally desirable to make shorter stays in port than hitherto has been usual with that class of shipping. This can be effected by first inducing the merchants to abolish the antiquated customs of the port which up to the present limit the daily output from sailing ships in the discharge of their cargoes as compared with that of steamers. Why a steamer should be given quick dispatch by the same regulations which limit the discharge from sailing ships to some eighty or a hundred tons per day it is difficult to understand. If these stupid customs were abolished and sailing ships were put upon the same terms as steamers both in loading and discharging, their prospects in the future, when trade revives, would be much brighter.

It is in the direction of auxiliary steam power for getting out of calm belts, and water ballast, that development may be expected in the sailing ship construction of the immediate future. Many of the existing conditions which tend to favour sailing ships as compared with steamers will not probably endure when a revival in trade occurs—or, at all events, they will not operate so favourably as at present. There can be no doubt that the sailing ship does possess comparative advantages which were not taken into account when its speedy disappearance was prophesied; but these are experienced in certain trades only, and the successful construction of the Panama Canal would close up some of their most lucrative sources of employment. The Suez Canal seriously affected the sailing ship trade to many parts of the East and to our Antipodes, and the Panama Canal would operate similarly in regard to voyages now made round Cape Horn.

Hence it is very clear that those who determine to embark their capital in new sailing ships must build only those which are as efficient and economical as our shipbuilders can produce. Some owners are endeavouring to carry heavy cargoes in their vessels by filling out their lines, reducing the weight of cement on the inside of the plating, laying no flat on the lower deck beams, and by other such means. But these devices are too superficial to meet the real wants of the case as they will ere long be experienced. Remunerative work will doubtless be found for sailing vessels during many years to come, but this will only be by their owners adopting every improvement in their construction which modern science may suggest.

DEAD POINTS.

Some time ago we attempted to show that in every motor designed to obtain the rotary motion of a shaft from a pressure organ there must be a reciprocating member. It is now desired to show there must be at least two. Examining the ordinary direct-acting engine, there is no difficulty in seeing that two pieces of this character enter into its composition—the piston working in the cylinder, and the connecting-rod vibrating about its joints of attachment to the piston. The first of these reciprocations is absolute, the second relative to the moving piston, but still both of a reciprocating character. It is not necessary that the two movements should be along rectilinear paths, but may be partial turning, whether the one or the other will be determined by the character of the mechanism on which the engine is based. These two movements occur also in the oscillating engine; the piston in the cylinder, which is here the relative motion; and the cylinders oscillating about the trunnions, which is absolute. The pumping engine, with the normal sliding piece in place of the connecting-rod, show the two movements very distinctly, being both rectilinear reciprocations, the piston sliding in its cylinder, and the block about the crank pin sliding in a normal path. And so we may go on through all the complete mechanisms, and discover this characteristic of two reciprocations in all. In the direct rotary engine, an example of which by Mr. Pinchbeck has been reviewed in this journal, there is the reciprocating partition block and the relatively reciprocating piece connecting this with the revolving excentric cylinder. The latter movement is in this engine employed to alternately open and close the steam ports. The spherical engines have both of the pairs which connect up the two revolving shafts of this character.

Agreeing that a reciprocating piece is necessary by considering the character of the source of energy, it is not difficult to see that another is demanded by considering the object to be attained. The ultimate object desired from every engine is the revolution of a shaft. Directing attention to this operation of turning, it is seen that it is impossible to move a point in the circular path from one side to the other without allowing for a lateral movement. It cannot be carried fair across, as would be the tendency of one reciprocating action; it must move laterally at the same time, and such a tendency must be allowed for in the structure of the engine. When a man turns a winch handle, he must not only push and pull backwards and forwards; he must also rise and stoop, to accommodate his hands to the rise and fall of the handle.

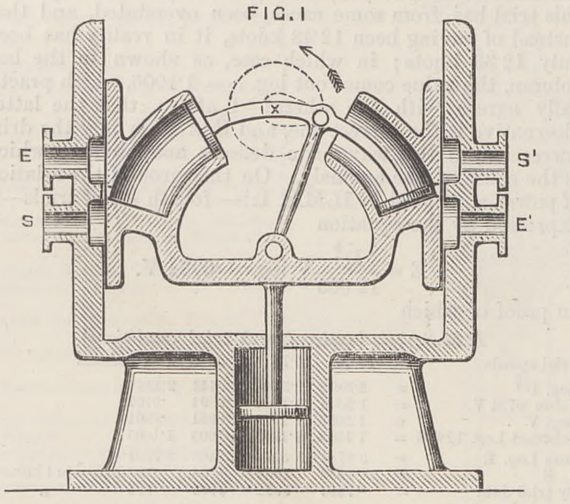
This feature seems to be similar to the method adopted in following the course of curves in geometry, where, in order to determine their form, two dimensions are employed, one to give the advance or retreat of the tracing point in one fixed direction, the other in another fixed direction. These amounts being obtained, the form of the curve is traced. In mechanism the full course of a point on the turning shaft is followed by the accommodation of two reciprocating pieces. And farther, as in geometry we can follow curves by polar diagrams, where the angles through which a line moves about a fixed point and distances measured along it determine the curve, so in mechanism the reciprocating movements may be either curvilinear or rectilinear. There is no practical difficulty in embodying either. If rectilinear, then the pairing may be by an ordinary cylinder and piston; if curvilinear, then by a piston and cylinder with a correspondingly curved axis—a kind of cylinder successfully constructed by Mr. Fielding.

An engine must have, from its nature, a reciprocating pair and a turning pair in its composition. It must also have a connecting piece, one part of which is so paired to the turning piece as to follow it round through a complete revolution, and another part so paired to the reciprocating piece as to accommodate it to the lateral movements produced by the former. Thus in the simple connecting-rod and crank gear the connecting-rod is attached to the crank pin so that it may follow it entirely round, and is so attached to the piston as to oscillate into positions corresponding to the displacements transverse to the main reciprocating piece. In the disc engine the piston piece has its rod paired to the crank arm by a pin joint, while the piston itself is paired to the piece reciprocating on the partition plate by means of a partial turning pair, which is also reciprocating.

It may be of interest now to show that the existence of these two reciprocating pieces may be made use of to avoid the difficulty of dead points. Dead points exist always when the main reciprocating piece is at either limit of its path, but the second reciprocation in general occurs in such a way as to be applicable for correcting such a result. In many cases it will be observed that though it is possible to construct almost any engine for this purpose, yet the difficulties of manufacture are such as to prevent its being practically adopted. Some engines, however, are so constructed, their peculiar mechanism enabling them to make use of the above action without adding materially to the difficulty of their construction. It is also important to know that this feature can be possessed by any known engine, and that if dead points are to be corrected employing only one system of mechanism, it is in this direction only that the solution of the problem is to be sought. Many attempts have been made to attain the object otherwise than by having two separate engines with cranks not in line, but they generally have amounted to adopting a second system, and possessed no advantages, either in the direction of efficiency of turning or simplicity of construction, over the double engine.

The ordinary connecting-rod engine can be arranged for this purpose, as shown in Fig. 1. A common double-acting cylinder is there represented connected up with the crank arm of a revolving shaft by a connecting-rod. At the piston-rod head is mounted a frame, to which is secured two single-acting cylinders with axes curved to the sweep of the connecting-rod; the pistons working into these cylinders have their rods rigidly attached to the head of the connecting-rod. Thus as the frame carrying the curved cylinders is moved upwards and downwards by the lower cylinder, the pistons playing into the curved cylinders rock backwards and forwards; and if steam ports be arranged to admit and exhaust steam behind them at the proper time, these auxiliary cylinders may be made to contribute to the turning efforts. Such a steam

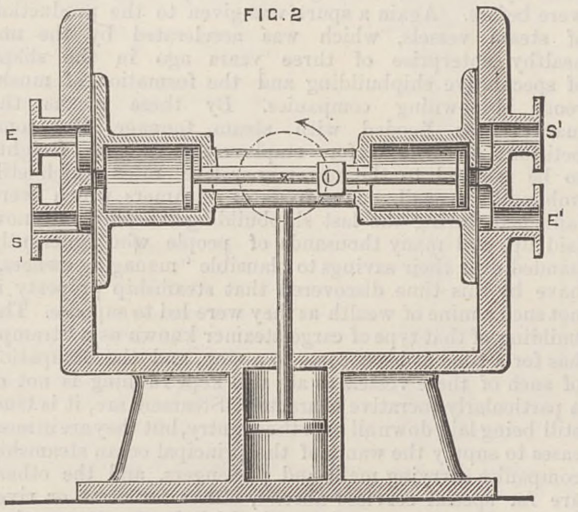
FIG. I



distribution is indicated in the sketch. The action of these subordinate cylinders is such as to be in full play while the main engine is in its dead position, and such that when they are at their dead points, as in the case represented in the figures, the main cylinder is in full action. Such an arrangement as this, considered as a whole, possesses no dead positions—a property which has been given to it by adding no additional system of mechanism, but merely by making use of the second reciprocation.

Fig. 2 shows a method of treating the type of engine having a normal sliding piece in place of a connecting-rod. At the ends of the normal sliding piece are mounted two single-acting cylinders, paired with pistons whose rods are rigidly attached to the sliding block. This cylinder frame is reciprocated up and down between suitable guides by the action of the bottom cylinder, this cylinder being constructed in the usual way. As the frame is advanced, the block geared to the crank pin slides normally to accommodate to the new position of the crank pin, and with it the pistons in the auxiliary cylinders. Steam is regulated behind these pistons to enable them to act in turning by

FIG. 2



an arrangement of steam ports shown in the sketch, S being the steam supply, E the exhaust outlet. The dead points existing in each cylinder when the pistons are at the end of the stroke are seen to be corrected, as the pistons of the main and auxiliary cylinders are never at the ends of their reciprocations at the same time.

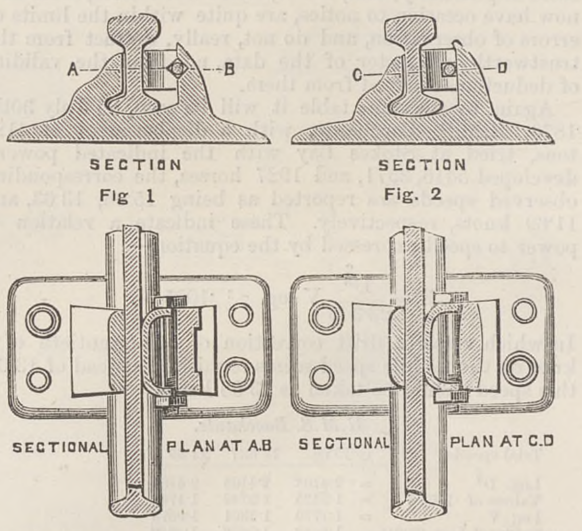
There is no difficulty in seeing how this point is attained in the spherical engine, especially in that peculiar form of it devised by Mr. Fielding, illustrated in this journal some time ago. It will be noticed that in this case, as in the universal joint, the two reciprocations are both relative, while the two turning are absolute. The two turning shafts are mounted in fixed bearings, and the intermediate connecting piece reciprocates about its junctions to the revolving arms of the shafts. One of the main features of this engine is, that each reciprocation is embodied in a cylinder pair, as in the instances above described; and hence the one assists the other in avoiding a dead position. It is not necessary to give a drawing of this engine, as it must now be widely known. In the Fielding pattern two single-acting cylinders with curved axes are mounted on faces on one turning shaft, so arranged as to suit one reciprocation; two others similar are mounted on faces on the second shaft, and so curved and fixed as to agree with the second reciprocation. The result is, of course, each comes into play at the proper time and a fairly continuous turning force is produced.

The great disadvantage accompanying such a treatment, and which would prevent its being followed for large engines, is that at least one of the sets of cylinders must be in motion. Of the two full turning and the two reciprocating pairs necessary to complete the mechanism, two only must be in the fixed frame; there may be two turning, one turning and one reciprocating, or two reciprocating. As the object is to turn a shaft in the fixed frame, at least one turning pair must be so constructed, and therefore the latter alternative of having both reciprocations in the fixed frame is inadmissible. In the ordinary engine there are in the fixed frame or link one turning and one reciprocating, the revolving shaft and the main cylinder. In the oscillating they would be of the same character; the revolving shaft and the oscillating cylinders. The Cary engine—an engine based on what is known as the "quick return motion"—has the two turning pairs in the fixed frame, the revolving shaft and the crank pin bearing; the reciprocating pairs are relative only. For the disc engine one turning and one reciprocating, while for the spherical engine the two full turning are in the fixed frame, the main shaft and the dummy shaft, and hence in this engine both sets of cylinders or chambers are in movement. Mr. Tower's system of chambering this engine somewhat disguises the application of the above considerations. It would appear as though in this engine only one chamber was required; but of course upon examination there is no doubt about the existence of the four actions in four separate compartments. It is the peculiar relation of the reciprocations that allows of one wall of the chamber being a fixed common sphere, which permits of the reciprocating pieces following their own reciprocations and the turning of the shafts to which they are attached at the same time. Although a complete revolving cylinder is thus avoided, yet the ends of each chamber which are formed by the blades of the shafts are in continual movement.

One slight benefit this method of correcting dead points would have, that both the direct and normal reciprocations could be treated to counteract the inertia. as far as regards conveying a steady pressure to the pieces with which they are connected. Both being subjected to the action of steam, such correction might be carried out by arranging that the steam in each chamber should work with high expansion and great compression. With many engines, such as those of the ordinary connecting-rod type, the lateral moving mass is not very great compared with the forward mass, and so correction is not so urgently demanded. With others, such as the spherical engines, both pieces subjected to reciprocation are of equal size, and therefore both require similar adjustment for inertia—an adjustment which is put in the power of these engines, both reciprocating parts being under the action of steam. R.

LYNDE'S PATENT ADJUSTABLE KEY.

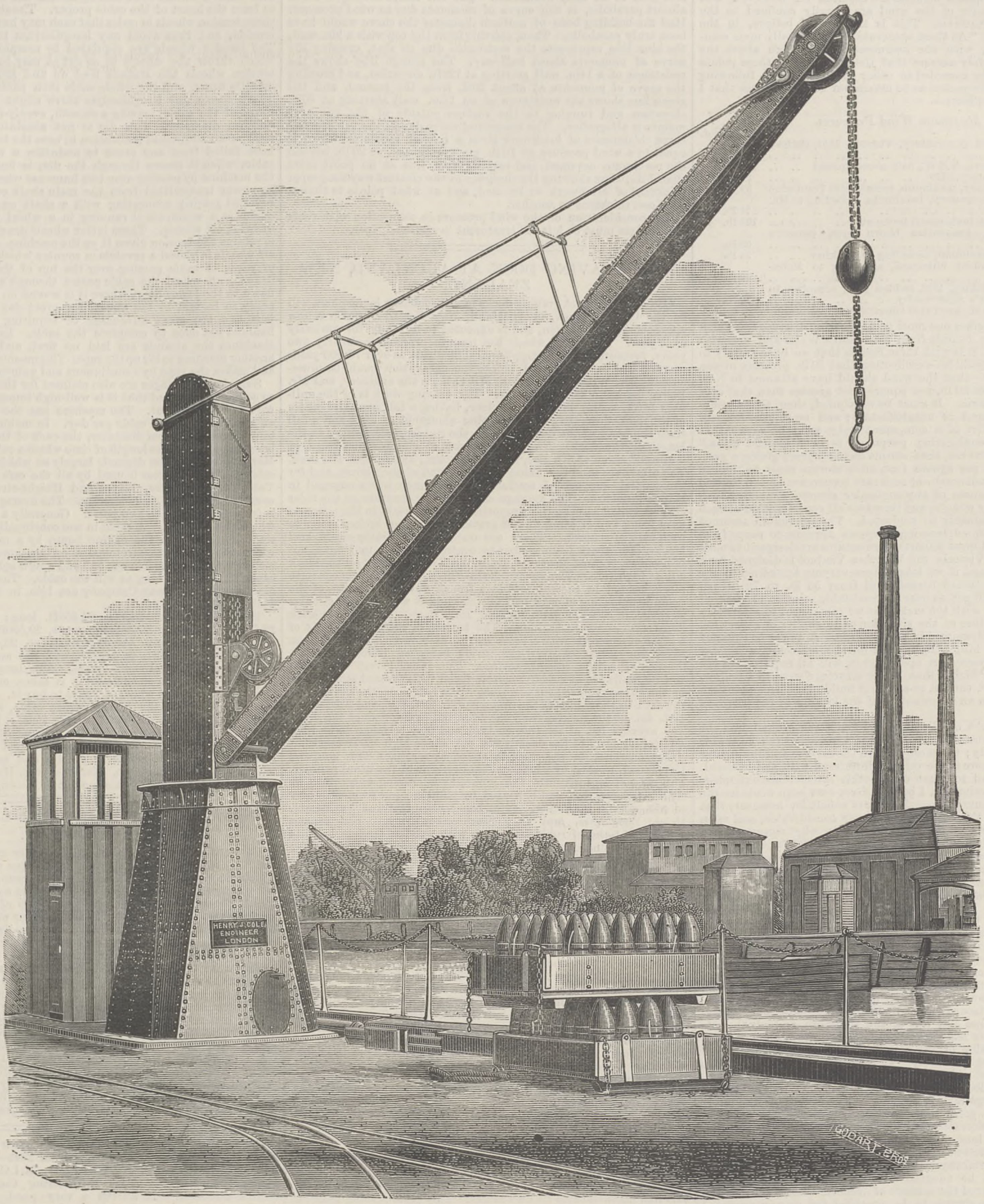
Our illustrations represent a new adjustable key, designed by Mr. J. H. Lynde, of Manchester, and applicable to any chairs and rails at present in use. The invention consists of a piece of steel, malleable iron, or other metal, curved or bow-shaped, which is placed between the web of the rail and the jaw of the chair. A bolt is passed through a slot or notch in each end of the piece of metal, so that by tightening up the nut on the end of the bolt the ends of the piece of metal which bear against the jaw of the chair are drawn nearer to each other, thereby increasing the bow or curve of the piece of metal and causing it to grip or hold the rail securely. The grip on the rail may be increased or diminished at will by tightening or loosening the nut on the bolt. The ends of the piece of metal may be made thicker than the bowed part, or they may be bent inversely if desired. Fig. 1 represents a sectional elevation and sectional plan of a specially-made chair with a V-shaped notch in the jaw to carry the shaft of the bolt. Fig. 2 represents a London and North-Western Railway chair fitted with the adjustable key. A convenient thickness of metal for the key is found to be $\frac{5}{16}$in., but this may



be varied according to circumstances. The bolts may be $\frac{3}{4}$in. diameter with square heads, necks, and nuts, similar to fish bolts; the weight of the key and bolt varies according to the design of the chair it is intended to fit. To adopt this system of keys would of course entail a considerable additional expense as compared with the ordinary wooden keys, the cost for an average size of the metal key being estimated at about £60 per mile; but to counterbalance this, it is claimed that the cost of maintenance would be reduced to a minimum, and the cost of permanent way inspection and repairs brought down to a comparatively small compass. It may be added that the railway companies are now using very much larger chairs, giving a large base bearing, whilst the rails are designed with large heads and are not intended to be reversed. The chairs are carefully fitted to the sleepers at the depôts, from whence they are sent out ready for fixing, and the only weak place in the whole arrangement would seem to be the wooden key, which is affected by every change of weather, and splits, rots, and comes out, thus causing endless trouble. The substitution of metal for wooden keys is of course not a new idea; but where metal keys are depended upon being driven into place, they are necessarily liable to permanent damage in the process of driving, and are not adjustable. With the adjustable key introduced by Mr. Lynde no hammer is required for fixing or adjusting, an ordinary spanner being the only tool the platelayer requires for tightening up the rails. Whether the vibration on the rails caused by passing trains would not tend towards a loosening of the bolts in the curved metal key is perhaps a question open for consideration; but in hot climates this key has been found to answer remarkably well, and it has been in use in India for the last six months with, we understand, perfect success. Up to the present it has not been put to any real test on the English railways, but it seems to be a very useful contribution towards the efforts for the introduction of steel rails and steel sleepers now being made to render the permanent way as perfect as possible.

HYDRAULIC CRANE, NEW PIER EXTENSION, WOOLWICH ARSENAL.

MR. H. J. COLES, LONDON, ENGINEER.



HYDRAULIC CRANE, WOOLWICH ARSENAL.

THE illustration above represents a hydraulic crane, of which three have been recently erected at the New Extension of the T pier, Royal Arsenal, Woolwich, by Mr. Henry J. Coles, of Sumner-street, Southwark, London. The cranes are of five tons power, with a working radius of 30ft., the clear height of lift being 51ft., and height from under jib sheave to ground 35ft. The foundations of the cranes are carried down to about 4ft. below ground level to allow of the slewing cylinders, &c., being fixed in a convenient position. The wrought iron pedestal is 8ft. square at the base and 14ft. high, with an octagonal cap which is bored and fitted with a live roller friction ring to take the thrust from the friction drum on the pillar. The pillar is of wrought iron fitted with suitable guides for the lifting cylinder and ram, with a pivot at the lower end to fit the toe step. The jib is of wrought iron, of plate girder section, properly secured to the main pillar, and the head fitted with a large diameter bushed chain sheave.

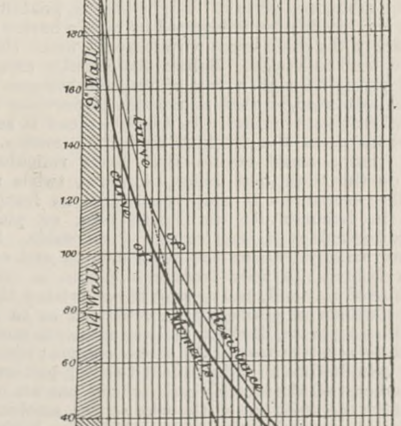
The lifting cylinder is bored the whole length and fitted with gun-metal liner, the ram and piston being respectively 14½in. and 10½in. diameter, by 9ft. stroke, the ram also fitted with gun-metal liner, and working through gun-metal bushed gland. The head of the ram is fitted with sheaves to give six returns of the chain. The slewing cylinders and rams are long enough to turn the crane through one and a-third revolutions in either direction, and drive the slewing drum by means of forged steel plate link chains with turned steel pins.

The valves are constructed for double action, and an improved arrangement of double gland to the swivel box prevents any leakage of the pressure into the exhaust. The valves with their working levers are so arranged that they may be readily manipulated by one man from the crane house. The whole of the pipes between the working valves and the cylinders are of copper, with gun-metal flanges. These cranes were satisfactorily tested with the full working load before being handed over to the authorities, all the parts having been tested by hydraulic pressure up to 2500 lb. per square inch before leaving the maker's works.

THE STABILITY OF STRUCTURES IN REGARD TO WIND PRESSURES.[1]

By FRED A. CAMPBELL, C.E.

THERE is no force upon earth more variable and uncertain than that of the wind. It approaches from every quarter; it moves in circles as well as straight lines, and vertically as well as horizontally. Its force may be as steady and continuous as that of gravitation, or as intermittent and impulsive as the blows of a battering-ram; whilst in strength it varies from the gentle zephyr that will hardly lift a feather, to the mighty hurricane which levels every obstacle to the ground. Fully recognising, then, the existence of this invisible, omnipresent, ever-varying force to which every structure is more or less exposed, it becomes a question of serious import to the engineer and architect as to what is the best—that is, the safest and most economical way of providing for it. This question is continually pressed upon our notice by the failure of structures around us during heavy gales. It was especially brought home to us in a very startling manner by the destruction in 1879 of the great Tay railway bridge. Having to erect any structure which shall be exposed to certain forces, the designer naturally ascertains in the first place as nearly as possible the extent of such forces. If these can be determined with tolerable accuracy, as in the case of a dam to retain water, or a column to uphold a known dead-weight, the way is clear, and the designer has simply to apply known laws, stresses which are calculable being provided for by the disposal of material whose resistance is calculable. But if, on the other hand, the force is one which is beyond the range of exact knowledge, the task is of a totally different kind. To this latter class the pressure due to wind undoubtedly belongs, as will be evident from what follows. It might be urged that if we have not precise data to start with, any attempt to solve the problem scientifically must be useless, and that the best method must be to work from precedent. For instance, from observation we find that a structure of certain dimensions has successfully resisted all the gales experienced since its erection; therefore in building structures in similar positions we cannot go astray in imitating such an example. This course, though one which I believe to be frequently adopted, and with some reason, in small and inexpensive structures, is, where important structures are concerned, both unscientific and unsound. It is no guarantee of the safety of the structure, still less of its economy. Notwithstanding the uncertainty as to extreme wind pressures, I believe that by bringing observation, judgment, and experience to the aid of calculation, the subject can be dealt with in a manner both scientific and logical, disposing of the material to the best advantage, and securing all reasonable safety with the utmost degree of economy. To investigate the matter as proposed, it will be necessary to consider a number of points in connection therewith, which for convenience I have classed under four heads, viz.:—(1) The maximum pressure of the wind at or near the locality of the proposed structure. (2)



[1] Read before the Royal Society of Victoria, April, 1886.

The nature of the situation as to shelter or otherwise. (3) The height of the structure above the ground, and the nature of its construction. (4) Its value, use, and whether its failure would involve loss of life or damage to adjacent property.

First.—The maximum pressure of the wind at or near the locality of the proposed structure. Stations for observing and recording the pressure of the wind are usually confined to the Government Observatories. This is the case, I believe, in the Australian colonies. As these observatories are usually upon commanding positions, with the anemometer fixed high above the ground, we may safely assume that the records from these points are not likely to be exceeded in other localities. The following list gives all the information as to maximum wind pressures that I have been able to collect:—

Maximum Wind Pressures.

	Per sq. foot.
Williamstown Old Observatory, Victoria, 1854, Ostler's anemometer	35 lb.
Sydney Observatory, N.S.W., 65ft. above ground	115 lb.
Glasgow Observatory, 1879	25 lb.
Glasgow Observatory, maximum, according to Trantwine	55 lb.
Liverpool Old Observatory, maximum, according to Mr. Russell	71 lb.
Phillipine Islands, instrument broke at	103 lb.
North America, locomotive blown over, pressure necessary	93 lb.
Great Britain, maximum, according to Rankine	55 lb.
Maximum in violent hurricane, according to Molesworth	49 lb.
Liverpool Observatory, 1868, sudden gust, according to Hartnup, Ostler's anemometer	80 lb.
During five years at Greenwich Observatory, maximum	41 lb.

In this list, what strikes one most is the amazing discrepancy which occurs between the records from New South Wales and Victoria; and, unfortunately, it is with these figures that we have mainly to do. It is quite incredible—recollecting that 50 lb. pressure means a violent hurricane—that the wind should have attained in New South Wales, a force 80 lb. per square foot greater than that ever experienced in Victoria. It must be concluded, then, that anemometrical measurement is unsatisfactory; and most persons will agree with the verdict of a competent judge when he says "that anemometry, for engineering purposes, is in a chaotic state." Even assuming, however, that storms have occurred giving a pressure of over 100 lb. per square foot, such storms must be looked upon as highly phenomenal—of such rare occurrence and so limited in area that the chances of any particular structure meeting such a gale are extremely remote, and therefore all consideration of such pressure may reasonably be neglected. The maximum assumed in Great Britain for engineering purposes appears to range from 40 lb. to 60 lb., and most important structures are designed to meet such a force. In Victoria the Werribee Viaduct is designed for a pressure of 50 lb., and if we take a force varying according to the considerations mentioned hereafter of from 50 lb. to 70 lb. per square foot, we shall get as near a reasonable solution of the first point in connection with the matter as we can expect to attain.

Second.—The nature of the situation as to shelter or otherwise. This point may be dismissed in a few words. A tower or chimney upon a high, bare hill, a lighthouse on the sea-coast, a railway bridge swung high across an open ravine, will all require that the maximum be fixed higher than if the structure were in a hollow, or sheltered by hills, timber, or adjacent buildings. This point can only be settled from an examination of the locality of the proposed structure.

Third.—The height of the structure above the ground, and the nature of its construction. As the wind approaches the ground it diminishes in velocity; the more uneven the surface and the greater the obstacles, the more is the velocity interfered with and lessened. To what height and to what degree this interference extends is unknown. No experiments, I believe, have ever been made for the purpose of ascertaining this. We must conclude, however, that close to the ground this interference is very considerable, and upon this supposition we can explain the reason why chimneys and buildings notoriously unfit to stand a pressure of 20 lb., or less, are still standing, although gales of greater force than that have occurred since their erection. Structures in connection with this part of the subject may be conveniently divided into two classes:—(1) Those which extend from the ground continuously upwards, as a factory chimney; (2) those which extend horizontally at a constant height above the ground, as a girder bridge. If in the case of the first we assume 60 lb. as the maximum for the locality, it is evident that this will decrease as it approaches the base, and that it would be permissible to reduce this force; or if we maintain it for the purposes of calculation, it should be recognised as allowing ample margin as factor of safety. In the second class of structures, however, the maximum would have to be taken as practically uniform all over the surface exposed, allowing nothing as factor of safety.

Fourth.—The value and use of the structure, and whether its failure would involve loss of life or damage to adjacent property. The greater the value of the structure the greater will be the necessity of insuring its safety. It evidently would not be true economy to build an ordinary house chimney to withstand a pressure of 50 lb. or 60 lb. to the square foot, although it would be so in the case of a large factory chimney. The failure of the latter would not only be a great loss of valuable property, but would in all probability occasion stoppage to work, damage to adjacent property, and possibly loss of life. The structure, however, in which every condition is present, demanding the utmost degree of safety, is that of a large railway viaduct. In this the full maximum for the locality should be adopted without limitation of any kind. Having now considered the manner of deciding what wind pressure to adopt as the maximum to be provided for in any proposed structure, I will proceed briefly to examine the means of making this provision. All structures in this connection may be placed in three classes, of which the following are types, viz.—(1) a factory chimney, (2) a roof, (3) a girder bridge. (1) A factory chimney. The stresses here will be those of a beam fixed at one end and loaded uniformly. The resistance will be due to the weight of the material multiplied by half the diameter of the building. It is convenient in building structures of this kind to carry up the walls in lengths of different thickness, diminishing by half a brick at each change. The weakest points will then be the joints at which these changes take place. To these points only is it necessary to give our attention. In a brickwork chimney, where the resistance is obtained from the material itself, and not from a comparatively trifling and independent system as in the case of a girder bridge, it will be undoubtedly of the utmost importance that the material be disposed of with the greatest economy, and duly proportioned to meet the stresses it will have to bear. If the whole chimney, except one joint, will stand a pressure of 60 lb. per foot, but that joint only 45 lb., then every bit of the material going to strengthen that chimney beyond 45 lb. is absolutely wasted. The largest chimney, and the fourth highest building in the world, is Tennant's, in Glasgow. It rises 435ft. above the ground, and it might have been expected that the design would have been beyond criticism. The following figures, taken from "Rankine's Applied Mechanics," will show that this is not the case:—

Height above ground.	Resistance of joint.
435ft.	—
350ft.	77 lb.
210ft.	55 lb.
114ft.	57 lb.
54ft.	63 lb.
0ft.	71 lb.

55 lb. is therefore the resisting strength of that structure, and all the material going to raise the strength of the other parts beyond this might have been saved. The most satisfactory way to design a building of this kind is by a diagram. I have prepared one for a round brick chimney, 200ft. high, 20ft. diameter at bottom, and 10ft. diameter at top, by way of illustration. Figures have been adopted throughout to facilitate computation. The weight of brickwork is taken as 112 lb. per cubic foot, the maximum wind pressure at 56 lb. per square foot on a flat surface, giving 28 lb. per foot for the surface of the chimney. The tensile strength of the brickwork has been neglected, and the effective width has been taken from the centre of the chimney to the centre of the wall. The stresses and resistance have been calculated at intervals of 20ft. and plotted to a scale of 20ft. to an inch vertical, and 800 foot-tons to an inch horizontal. The red line, showing a curve almost parabolic, is the curve of moments due to wind pressure. Had the building been of uniform diameter the curve would have been truly parabolic. Then, starting from the top with a 9in. wall, the blue line represents the resistance due to that, crossing the curve of moments about half-way. The orange line shows the resistance of a 14in. wall starting at 120ft. elevation, and crossing the curve of moments at about 20ft. from the ground, and the green line shows the resistance of an 18in. wall starting at 40ft. elevation and running to the surface outside of the curve of moments altogether. The compound curve due to the use of these three thicknesses of brickwork gives a line of resistance which is equal to a wind pressure of 76 lb. per square foot, or 20 lb. beyond the maximum assumed, and varying from this at no point more than 7 lb., thus showing the designer in the clearest way the proper thickness of brickwork to be used, and at what points to change from one thickness to another.

The consideration of the wind pressure in connection with roofs and bridges must be left for treatment in another paper.

NEW GRAVING DOCK AT AUCKLAND, NEW ZEALAND.

One of the largest graving docks in the southern hemisphere will be the Calliope Dock, at Auckland, New Zealand, which is now approaching completion, and is expected to be ready for use early next year. The work, which has been in progress for nearly two years, presented rather exceptional difficulties, as over 70,000 yards of rock had to be removed before the excavation could be prosecuted. Mr. William Errington, M.I.C.E., is the engineer, and Mr. Pierce Lanagan the contractor. The graving dock is of the ordinary form, nearly level on the floor, having a fall from the centre of the dock floor, to gutters running alongside of 3in., and a fall from the head of the dock towards the rudder well of 15in. in the length of the dock. The sides consist of eleven stone steps, or "altars," seven of 2ft. rise, one of 11ft. 4in., and four of 4ft. each. The altars are used for fixing the lower end of the shores, and for the partial support of scaffolds for workmen when engaged in shipping repairs. The average depth of the concrete on the sides may be stated at 5ft., the proportions of materials in the concrete used being two of sand, two of gravel, and two of broken stone to each cask of cement. There are on the floor ninety-seven keel blocks, 5ft. apart from centre to centre, 3ft. 6in. in height, not detracting, it must be stated, from the 33ft. of water on the dock cill at high tide. The centre drain consists of 9in. earthenware pipes bedded in cement laid in a trench down the centre of the dock, terminating at each end at the rudder well, which, circular in shape, is 10ft. in diameter and 15ft. deep. The well is brick faced with concrete backing. The bottom of the dock consists of a layer of concrete with a brick invert of seven rings of brick on edge, the filling in over the invert being of rubble concrete, finished off with a smooth surface. The inner invert of the cill and its walls are of rubble concrete faced with dressed stone, true to the shape required for the arch. The height of the dock, from the door to the coping at the upper end, is 40ft. 1in., and necessarily 41ft. 4in. at the caisson from the 15in. fall in the floor of the dock. The average lift of the tide at Auckland may be taken to be 10ft. The coping level of the dock is 6ft. 4in. above high-water mark.

The entrance to the dock is closed by a caisson 83ft. long and 15ft. broad, worked by winch and hauling gear in the usual manner. The caisson is sunk into the groove by admitting water into its chambered interior, and is floated by pumping out so much water as will give it buoyancy. It is being manufactured by Messrs. Head, Wrightson, and Co., Stockton-on-Tees. The caisson chamber is to be of rubble concrete, with wooden fenders let into grooves at each side of the chamber to protect the facings of the caisson from chafing against the concrete. The caisson gupins are alternately 4ft. and 5ft. long. The pier heads or wing walls and side walls of entrance outside of the caisson ledge are of rubble concrete faced with masonry, from 2ft. below the low-water level to the coping. The foundations are benched into the rock. There are flights of steps at the four corners of the dock leading to the foot of the deep altar, from which there are three flights on each side, one in the centre, and the others 50ft. from each end leading to the floor of the dock. At the top of the dock are two long flights, sixty in number, which lead from the surface to the bottom. The pumping machinery is being constructed by Messrs. James Watt and Co., of London, and is of sufficient capacity to pump out the dock in four or four and a-half hours. The entrance or waterway to the dock is to be dredged to 34ft. below the datum line.

The total cost of the dock is £120,000. This will be one of the deepest docks yet constructed. The only other dock in the world which has a greater depth of water on the cill than the Calliope is that at Portsmouth, which has a depth of 40ft. The length of the new dock is 500ft. on the floor, so that it will be able to accommodate vessels at least 20ft. longer.

MAKING A STREET CABLE.

A San Francisco paper gives the following account of the manufacture of a cable as carried on in the engine-house of the Market-street Railway, for, contrary to the usual custom of cable roads, this line manufactures its own cables. This cable-making machine is a purely Californian invention, the inventor and patentee being Mr. Henry Root, who, in fact, has invented about everything which has made the Market-street system so nearly perfect. The machine is situated in the extreme rear of the engine-house, and runs from the basement clear up among the rafters of the building. This machine takes a piece of manilla rope and 114 wires, and in a few minutes places on the reel, ready for use, a cable of the most approved kind. As the work commences at the basement, or lower deck, a description of the machine properly begins there. An iron column runs up from the foundation to the top of the machine, and in this is carried the ¾in. manilla, or hemp rope, which forms the heart of the cable, and gives it "life"—that is, pliability and elasticity. It will readily be understood by even a novice that if the heart or core of the cable was a wire it would make the rope stiff, brittle, and hard to handle. Before the manilla core enters the column it passes through a box of tar, and becomes thoroughly soaked and saturated, so that it remains impervious to moisture and retains its pliant nature. In the basement is set the huge gearing which gives the machine its initial motion. Power is furnished from a small engine that looks ridiculously inadequate to do the work, but which, however, twirls the bobbins and spindles around as if they were light as feathers. Passing from the basement to the lower deck or platform, one beholds the beginnings of each strand of the cable. Six upright spindles are arranged about the main column and each spindle has seven bobbins; a wire from one bobbin is drawn off to form the core of a strand, and around it are twisted the other six wires. The system of gearing is so contrived as to give to the machine three separate, distinct, and simultaneous motions. The whole machine revolves around the centre column; each of the six sections or spindles has an independent twisting motion of its own to form the heart of the strand; each bobbin has an independent motion to take the twist out of the wire as the machine revolves. It is wonderful to watch and note one particular bobbin throughout an entire revolution of the machine. Never does the wire get into the strand with a twist in it. This preserves the life of the wire by preventing the breaking and crushing of the molecules, as would be the case were the wire twisted out of shape. From this lower deck the six cores pass up through hollow columns to another deck where the strands are completed. By an arrangement similar to that on the lower deck, twelve bobbins unreel their wires around each core, thus completing the strand. By this it will be seen that each strand of the cable proper contains nineteen wires—seven forming the heart of each strand and twelve laid up around each heart. The work of the seventy-two bobbins on the second deck completes all the strands, and they then pass up over tension wheels to be laid up around the manilla rope which is to form the heart of the cable proper. The strands are passed over these tension wheels in order that each may have a uniform strain or tension, and thus avoid any irregularities in the finished rope. The tension wheels are regulated by movable weights on levers which throw the wheels in or out as may be desired. From the tension wheels the strands lead up and are twisted about the manilla heart, and the whole cable then passes up through a die which forces any irregularities there might exist down into the heart of the cable, leaving a smooth, evenly-rounded surface and uniform diameter. This die is not absolutely necessary, but is used as an additional precaution in case the tension wheels should have failed from any cause to maintain a uniform strain. The cable, when it passes through the die, is finally drawn off from the machine by passing over two immense wheels, which are driven by power transmitted from the main shaft on the lower floor by bevelled gearing connecting with a shaft on the upper floor, on which is a worm-wheel running in a wheel connecting with the drawing off wheels. These latter wheels draw off the cable so that it retains the tension given it on the machine. Beside the drawing off wheels is placed a revolution counter which records the number of yards of cable passing over the top of the wheel. From the drawing-off wheel the cable passes through a box of tar and then down to the lower floor, where it is wound on an enormous spool, ready to be laid in the street, for every-day use. This machine possesses the great advantage of requiring the material to be handled but once to complete the cable. In other cable-making machines the strands are laid up first, and then are put into another machine to lay up the rope. This machine lays up the strands and makes the rope by a continuous and uninterrupted process.

Superior advantages are also claimed for the cable itself, as it is so compactly twisted that it is well-nigh impossible for a strand or wire to be ripped out. The machine has the capacity of turning off 1000ft. of finished cable per day. In making the cable, in order to preserve a uniform diameter, the ends of the wires are carefully brazed together. The length of time which a cable can be used on the Market-street system depends largely on which road it is laid. The cable on Market-street is used by all the cars of the system—the Valencia, McAllister, Hayes and Haight-street cars. The cable usually lasts about eight months. The average duration of a cable is from six months to two years. Generally a cable wears out first where the splice is. A cable in use continually stretches, and this slack is taken up in the engine house by a movable carriage, and when the cable has stretched a certain amount the carriage is moved up, the old splice cut out and a new splice put in, which is expected to last as long as will the cable. The cables made by the Market-street Railway Company are 1¼in. in diameter and weigh 2½ lb. to the foot.

The Market-street rope is 23,858ft. long; the Valencia-street, 23,700ft. long; the McAllister-street, 20,580ft. long; the Hayes-street, 23,385ft. long; the Haight-street, 20,452ft. The Fulton-street rope is 5580ft. in length, and the auxiliary rope at the Valencia and Market-street curve, 480ft. long. When a cable is no longer fit for use on the road it is taken out and sold for old iron to junk men or whoever wants to buy it. At 2½ lb. to the foot it will be seen that the Market-street cable, which is the longest rope, weighs on the reel nearly thirty tons. If anyone who is not familiar with machinery wishes to become hopelessly bewildered, all he has to do is to go under Market-street among the tunnels and chambers full of rambling pulleys and swiftly-passing cables where the Valencia-street, Market-street, Haight-street, and the auxiliary ropes come into and go out of the engine-house.

A NEW FORM OF LIGHT FOR LIGHTHOUSES.[1]

By J. R. Wigham.

Usually, if not invariably, in first-order revolving lighthouses the light is placed in the centre of an octagon or hexagon of lenses, which are caused by clockwork to revolve round the light, and thus the mariner gets a beam from each lens face as it is turned towards him. To vary this form of light, a group of lights, instead of a single beam, was transmitted to the mariner with the recurrence of each lens face. This is called the group-flashing system. The groups of flashes have been produced in two ways—(1) By the continuous intermissions of the illuminant, as, for example, in the gaslights at Galley Head and New Island; and (2) by giving to each lens two or more faces, so that two or more lights may be seen as the lens passes the eye. The new form of light, which is the subject of this paper, is a group-flashing light of a different kind. Instead of causing the lenses to revolve round a central light I cause two, three, or more lights to revolve with the lenses, the relative positions of lights and lenses being maintained. By this arrangement I am enabled to give the full power of each light to the mariner, and at the same time materially to reduce the cost of lenticular apparatus. In this case I only use two instead of eight or six lenses, while by intermitting the lights I have a combination of a striking and perfectly novel character.

Engine Building in Australia.—The new pumping machinery to be started at Botany to-day—June 28th—by the Mayor has been designed by Mr. Norman Selfe, M.I.C.E., M.I.M.E., and manufactured by the Atlas Engineering Company, under Mr. Selfe's direction. It affords a very good illustration of the development of the engineering and mechanical resources of the colony, for although it was deemed by some experienced persons to be impossible, the Atlas Company has constructed and erected the engines complete within the contract time—the short space of sixty days. The type of engine is, we are informed, altogether new to the colony, and may be classed as in many respects the most advanced form of high speed pump. The peculiarity of it consists in the plungers being formed with conoidal ends like a rifle bullet, and in the chambers being shaped as a parabolic spindle, the object being to enable a high speed of the pump to be maintained with the least disturbance or shock in the water. That this is very successfully accomplished in the new pumps is shown by the fact that they can be run at a speed of from 300ft. a minute, whereas the maximum speed of the large engines is only 200ft., and that is more than they should run, if it were not necessary to push them so as to meet the requirements of the city. The great advantage of this new system of pumping engines is said to consist in getting a large quantity of work economically out of relatively small engines, and is a great saving in cost of erection and buildings. Compared relatively with engines of the original Botany type, it seems the modern engines will not cost one-half the money; the erection of buildings, perhaps, one-sixth to one-tenth; and the working expenses, including fuel, at most not more than one-half. The new pumps are erected by the City Council to relieve the old engines, which have been for some time worked far beyond the power originally intended. The dimensions of the machinery are:—High-pressure cylinder, 12in.; low-pressure, 20in.; stroke, 3ft. The pumps, connected direct, have plungers 8⅜in. diameter by 8ft. 6in. long, and a stroke of 3ft. Their capacity is 1½ millions of gallons per day. The general design is similar to that of the pumps which were proposed by Mr. Selfe in his report made to the Municipal Council in 1880, on the whole question of pumping the city water supply; but in the present case, being for emergency purposes only, they are made non-condensing, as time was more an object than extreme economy of fuel. In the erection of the machinery at Botany, and in making the connection to the existing mains, Mr. Selfe has had the able co-operation and advice of Mr. Westcott, the engineer in charge of the Botany waterworks.—*Sydney Morning Herald.*

[1] British Association—Section G.

RAILWAY MATTERS.

A test of the use of oil as fuel was made on the Washington, Ohio, and Western Railway last month, a locomotive running for fifteen miles and attaining a speed of forty miles an hour with crude petroleum for fuel.

The immense locomotive made by the Cockerill Company, to the designs of M. Belpaire, for the Belgian State Railways, has been fitted with two additional axles, because one of those existing was found to sustain a load of 17 or 18 tons.

A double line of tramway is being laid down in the Bury New-road, Salford, with a new rail—devised by the borough engineer, Mr. Arthur Jacob, M.I.C.E.—rolled in steel with a tongue, which is keyed down to long cast iron chairs.

A serious fire broke out on Saturday morning—25th ult.—in the boiler-making shed of the Great North of Scotland railway locomotive works, Kittybrewster, Aberdeen, completely destroying the building, and doing damage to the amount of about £2000.

The construction of a railway tunnel 3800 metres in length under the Col-de-Cabre, the frontier of the Drôme and Hautes-Alpes, was commenced on the 27th ult. The *Times*' Paris correspondent says it is one of the most important works in the strategic line connecting Central France with the Italian frontier, by Gap and Briancon.

The Committee which was appointed some time ago with a view of obtaining railway facilities to Ambleside, either by an extension of the Furness Railway from Lakeside, or the London and North-Western from Windermere, have been unsuccessful in their negociations with the former company; but it is expected that the difficulties with which the promoters of the scheme have had to contend are about to be overcome, and from the favourable state of the negociations there is every likelihood of a railway being made to the head of Windermere Lake, if not to Grasmere.

A junction is now being put in near Creagian, on the Llantrissant and Taff Vale Railway, for the purpose of getting plant and materials on to the ground, for the construction of the last contract recently let by the Barry Dock and Railways Company. This section, being the lightest, will not require the same time to complete as the others, which have been in hand some time, but it will be ready for opening at the same time as the docks. Messrs. Lovatt and Shaw, of Wolverhampton, are the contractors, and Mr. John Robinson, the resident engineer of the docks, has chief charge of this section.

The Paris correspondent of the *Standard*, writing of M. de Freycinet at Toulouse, says that "M. de Freycinet, long before circumstances forced him into political life, had for many years resided at Toulouse, as managing engineer of the Midi Railway Company, and made himself very popular. The crowd at the station shouted '*Vive Freycinet!*' with great heartiness as the Minister drove to the Prefecture. At 2 o'clock he received the authorities and deputations of the townsfolk of the Haute Garonne and adjacent Departments, who presented petitions and memorials. Among them was a largely signed petition praying for the immediate cutting of a canal between Narbonne and Bordeaux, to be navigable for ships of war, and thus enable the French naval forces to pass from the Mediterranean to the Atlantic."

A meeting of the shareholders of the Didcot, Newbury, and Southampton Railway Company was held on Tuesday afternoon, at Southampton, for consideration of the general position of the company, and urging upon the directors the necessity of completing the line as an independent railway to Southampton. Mr. Lefeuvre moved—"That notwithstanding the scheme of Mr. Forbes—the chairman—described by him at the half-yearly meeting held on the 12th of August, this meeting is of opinion that the completion of an independent line to Southampton is absolutely necessary to ensure the success of the undertaking." Mr. Morgan seconded the motion, which was passed unanimously. Mr. Charles Lucas, of Newbury, moved a resolution calling upon Mr. Forbes to resign the chairmanship of the company The Hon. and Rev. J. H. Nelson seconded the motion, which was also adopted.

Messrs. Collier & Co., Manchester, are completing a couple of locomotive traversers for the erecting shops of the new works now being built at Horwich by the Lancashire and Yorkshire Railway. Each traverser is 15ft. 6in. wide, and 28ft. 8in. long, and sufficiently strong to carry a locomotive 52 tons in weight. The weight of the locomotive is supported by four wheels with double-flanged steel tires, four wheels without flanges, and four steel rollers, so that there are twelve rolling bearings to support the weight, and the bearings of all the wheels and rollers run in gun-metal bushes. The power for driving the traverser is transmitted from the line shafting to a chain barrel, with a worm groove cut from the solid, which is placed in the centre of the traverser bed; the chain on this barrel as it wraps off at one end wraps on at the other, so that the barrel is always full of chain, and it provides a travel for the traverser of 130ft. To bring the traverser into exact position opposite any road in the shop an auxiliary adjusting motion is provided on the top of the traverser, which is worked by hand, and at each end of the traverser supporting pulleys are fixed on brackets to carry the driving chains. Traversers of this description are, of course, very useful, not only for moving about locomotives, but also for carrying other heavy loads along the shop floor instead of by crane overhead.

The Baldwin Locomotive Works have nearly completed four Honigman locomotives. The engines are to be shipped to Minneapolis, and are for the Minneapolis, Lyndale, and Minnetonka Railway. The engine, says the *Philadelphia Record*, has much the same appearance as a passenger car. It is about 16ft. long, entirely boxed in, with no visible smoke stacks or pipes, as there is no exhaust or refuse. The boiler is of copper, $84\frac{1}{2}$in. in diameter, and 15ft. long, having tubes running through it as in steam boilers. Inside the boiler will be placed five tons of acetate of soda, which upon being damped by a jet of steam produces an intense heat. When the soda is thoroughly saturated, which will occur in about six hours, the action ceases, and it is necessary to restore it to its original state by forcing through the boiler a stream of superheated steam from a stationary boiler, which drives the moisture entirely from the soda, when it is again ready for use. The exhaust steam from the cylinders is used to saturate the soda, and by this means all refuse is used. The engines are the first of their kind that have been built in America, and are being constructed under the supervision of George Kuchler, a German engineer. The engines will have about the same power as those on the New York elevated roads, and will readily draw four light cars.

The cause of the Silver Creek accident on the Nickel Plate Railway, as it is called, is as yet somewhat obscure; but—the *Railroad Gazette* says—the "fact that the engineer of one of the trains ran away after the collision lends support to the apparent evidence that it was a case of direct disobedience or forgetfulness of orders. The train was a very heavy one, consisting of fourteen fully-loaded cars. It was, as so often happens, 'pulling around a curve' at about eight miles an hour just beyond the point to which it had orders, when it met a freight running at thirty miles an hour, with a clear right to the road, but hastening to make its meeting point—and the meeting point came just a little too soon. Then came in the secondary cause for the accident. As is particularly apt to be the case with excursion trains, the rolling stock was somewhat miscellaneous. 'The baggage car coupling was higher than the smoking car,' with the natural result that it, the latter, furnished the point of least resistance when the collision came. The baggage car mounted at once over the platform of the smoker, and telescoped the latter at the level of the top of the seats, killing or maiming every one in it who did not have the good fortune to be thrown to the floor. The whole force of the collision was therefore expended on crushing the engines and these two cars. At the rear of the train 'the shock was not felt much,' nor was a single wheel derailed."

NOTES AND MEMORANDA.

A method of rendering paper very tough is said to consist in the mixture of chloride of zinc with the pulp in the course of manufacture. It has been found that within limit the greater the degree of concentration of the zinc solution the greater will be the toughness of the paper. It can be used for making boxes, combs, for roofing, and even for making boots.

In Government contracts the only timber now employed for telegraph poles is Baltic red-wood, well seasoned and then creosoted. To obtain the specified quantity of 10 lb. of creosote injected per square foot, the fine skin which grows underneath the bark must be carefully removed by planing. The processes which require the employment of salts of zinc, copper, or mercury, have fallen into disuse, mainly on account of the solubility of these salts, and also owing to the rapid corrosion which they caused in the reservoir and apparatus used for injection.

In London 2589 births and 1403 deaths were registered during last week. Allowing for increase of population, the births were ·79 below, and the deaths 26 above, the average numbers in the corresponding weeks of the last ten years. The annual death-rate per 1000 from all causes, which had been 16·7 and 16·5 in the two preceding weeks, rose last week to 17·6. During the first eleven weeks of the current quarter the death-rate averaged 19·1 per 1000, and was 1·2 below the mean rate in the corresponding periods of the ten years 1876-85.

From certain meteorological statistics recently published in Germany, we learn that thunderstorms in that country have, during the last thirty years, been steadily increasing, both in frequency and severity. The number of deaths per annum from lightning has increased in a far greater ratio than that of the increase of population. The German *savants* incline to the opinion that the increase is to be attributed to the enormously increased production of smoke and steam which has taken place during the last three decades. Yet the number of storms attended by fatal results from lightning is far larger in the agricultural districts than in towns.

A writer in the *Revue Scientifique* affirms that from a comparison of animal and steam power the former is the cheaper in France, whatever may be the case in other countries. In the conversion of chemical to mechanical energy 90 per cent. is lost in the machine against 68 in the animal. M. Sanson, the writer above referred to, finds that the steam horse-power, contrary to what is generally believed, is often materially exceeded by the horse. The cost of traction on the Mont Parnesse-Bastille line of railway he found to be for each car daily 57f., while the same work done by the horse cost only 47f.; and he believes that for moderate powers the conversion of chemical into mechanical energy is more economically effected through animals than through steam engines.

The *Medical and Surgical Reporter* gives the following interesting facts concerning the water supply of the European capitals:—Rome heads the list with her 204,000,000 litres of pure water every twenty-four hours—her population being 345,036, every inhabitant can dispose of 591 litres per diem; London comes next, for every one of whose 4,085,040 inhabitants there are 300 litres daily; Paris takes the third place, her population amounting to 2,240,124, and each inhabitant having for alimentary uses 58 litres per diem, and for secondary purposes 169—a total of 227 litres; Berlin has 1,302,283 inhabitants, with 140 litres daily to each; Vienna, 770,172, 100 litres each; Naples, 463,172, with 200 litres; and Turin, 278,598, with 98 litres a head every twenty-four hours.

Speaking of copper solder and colouring, an American paper says that "when copper is soldered and the solder to be coloured like the surrounding copper, this can be done by moistening the solder with a saturated solution of vitriol of copper and then touching the solder with an iron or steel wire. A thin skin of copper is precipitated, which can be thickened by repeating the process several times. If a brass colour is desired, a saturated solution of one part of vitriol of zinc and two parts of vitrol of copper is used on the previously coppered solder and the latter rubbed with a zinc wire. To gild the soldered spot, it is first coated with copper in the manner indicated above, and then with gum or isinglass and powdered with bronze powder. The surface is obtained. which, after drying, can be very brightly polished."

A recent examination shows that the obelisk in the Central Park, New York, is not so thoroughly protected as many supposed it would be by the hot paraffine treatment last fall. This process consisted in heating the stone and applying a mixture of paraffine, creosote, and turpentine. Previous to this, the *Scientific American* says, the stone had been carefully gone over, and pieces supposed to be loose, on testing with a hammer, or where there were cracks, were removed. It now appears that the stone is again in some places flaking off, or showing slight signs of slow disintegration, although such action is only perceptible on careful examination. It is said to be the result of an inefficient trimming off of the surface of the stone, to remove imperfections before the paraffine was applied; others attribute the result to the application of heat to the stone before putting on the paraffine. "It has been decided best to do nothing further in the matter at present, until it is shown to what degree the preservative process will be actually effective for a longer period, although in the end it may be necessary to inclose the stone by building a light glass structure around it."

M. E. H. Amagat recently described his methods of measurement of very strong pressures. For the measurement of very high pressures he adopted the principle of the manometer with differential pistons. In order to obtain accurate results, the condition had to be realised of maintaining the pistons in complete action while keeping them perfectly air-tight. The reading of the volumes of compressed fluid was effected by the process already indicated by Professor Tait, of Edinburgh. Water and ether have been studied at zero and at the two respective temperatures of 20 deg. and 40 deg. C Respecting the variation with pressure, it is shown that the coefficient diminishes gradually with the increase of pressure, and this takes place throughout the whole scale of pressures, contrary to the opinion of some physicists. At 3000 atmospheres the volume of water was reduced one-tenth, and its coefficient of compressibility one-half. This coefficient between 2590 and 2981 atmospheres was 0·0000238, and that of ether between 1623 and 2002 atmospheres 0·000045. The study of ether will be continued and pushed to 3000 atmospheres, and in a future communication will be given the coefficients of compressibility and of dilatation for several other fluids up to 3000 atmospheres. A number of gases will then be examined with the same apparatus and within the same limits of pressure.

Professor Scheibler has described a new method of obtaining a product rich in phosphorus from the crude slag produced in Thomas's process. Whilst formerly the slag was extracted with dilute hydrochloric acid, and a precipitate rich in phosphorus obtained by adding lime to the solution, the present price of hydrochloric acid rendered it desirable to simplify the process. It was at first attempted to do this by a fractional solidification of the fused slag, the portion first solidifying containing little phosphoric acid, whilst the liquid portion separated from it furnishes an excellent material for manure. An essentially better method consists in adding the lime to the iron, not all at once, but first of all about two-thirds of the necessary quantity; the slag produced is then removed, the remainder of the lime added, and the process completed. The first lot of slag obtained in this way contains about 31 per cent. phosphoric anhydride, and 58 per cent. lime, whilst the second lot contains but little phosphorus, though it is rich in iron, of which it contains 24 per cent., the first slag having only 1·8 per cent. The second slag is returned to the furnaces used in the production of crude iron. The advantages of the method are a shortening of the blowing operation, the possibility of increasing the charge, a more complete removal of the phosphorus, less loss of iron, and considerable saving of lime.

MISCELLANEA.

Instead of saying, "Go on dead slow," refined American steamboat captains now say "Smoulder ahead."

The ceremony of turning the waters of the river Yarra into a direct canal at Fishermen's Bend, Melbourne, was performed on August 11th.

A new button-hole-working attachment for sewing machines is being exhibited at 4, Grocer's-hall-court, Poultry, by a company formed to manufacture it.

The Belgian Industrial Press has sustained a loss in the person of M. P. Desguin, founder of the *Mouvement Industriel*, and author of several scientific works.

Messrs. Wheatley Kirk, Price, and Goulty announce a sale of brickmaking plant, engines, and shafting, at the Milton Church Brickfields, near Sittingbourne, Kent, on Thursday next, the 7th inst.

The Parkfield furnaces and collieries near Wolverhampton, which have been standing idle for a very long time, are now again offered for sale, and it is understood that two tenders for purchase have been sent in. The estate comprises five blast furnaces and coal mines. Recently an unsuccessful attempt to resume operations there was made by the Sydney and Wigpool Iron Ore Company.

The old-established Chillington Ironworks, Wolverhampton, which have been in vain seeking a buyer, are now to be dismantled, and the materials comprising them are to be brought under the auctioneer's hammer. The Capponfield Works of the late Chillington Company were purchased by Messrs. Molineux and Co., who continue to work them, but the remaining Chillington works are now to suffer the fate of other old establishments and be levelled.

We have received a syllabus of Mr. Gribble's proposed course of Evening Lectures at Exeter Hall, Strand, on Science of Construction—advertised in our columns. The advanced course embraces some of the most important structures of modern times in this country and America. Mr. Gribble having during his residence in America familiarised himself with the methods adopted there, will doubtless be able to oontribute valuable information to those attending his lectures.

A fire in the Roach Mills Spinning and Manufacturing Company's Mills, Heywood, which occurred on Tuesday, is said to have been due to friction of some parts of a self-actor mule. The mill is fireproof thoughout, but the fire got a firm hold and almost wholly destroyed the warehouse, burning the contents. The fire burned itself out in the room in the mill in which it commenced, after burning 15,000 mule spindles. The damage is estimated at £15,000. The mill and machinery are fully insured, and the stock is partially covered, but some 250 hands are thrown out of employment.

The brindled brick trade, which is an important Staffordshire industry, has just received a fillip by the placing of an order for 4000 tons of bricks for the new dock at Cardiff, with Mr. Joseph Hamblett, of West Bromwich. This firm is one of the largest in the entire kingdom and turns out some 6000 tons a month. A new machine plant is just now being laid down at the works for the manufacture of fancy tiles and best finished cresses for ornamental builders' work. The quotation of brindle bricks at date is about 18s. per thousand, though upon heavy orders some concession in price is made.

The Wolverhampton lock makers, who for some time past have been complaining of serious competition in common brass cabinet locks from the German manufacturers, are now setting themselves determinedly to meet the competition, and they are meeting with much success. By the laying down of steam power and adopting other economies in production, they are successfully imitating the German goods in design, fittings, and finish, and are winning back large London orders which were formerly going to Germany. There is, however, much yet to do before the foreigners are beaten out of the field.

Messrs. Whittaker and Co. will publish shortly, in their "Specialists' Series," "On the Controversion of Heat into Work," by William Anderson, M.I.C.E., "The Telephone and its Practical Applications," by W. H. Preece, F.R.S., and Julius Maier, Ph.D. The same firm announce a new work on "Technical Education and Applied Science Buildings, including their Fittings and Sanitation," by E. C. Robins, F.S.A., &c., and "A Bibliography of Electricity and Magnetism," including the most important articles published in periodicals, &c., from 1876 to 1885, compiled by G. May and A. Salle, Ph.D.

The Norwegian Government have granted various sums of money, ranging from £25 to £100, to several engineers in order that they shall study various industries abroad. Thus one proceeds to England and Scotland to study the newest construction of steamboat engines; another to Germany, to report upon the glue industry of that country and the best modes for utilising fish offal; one to Italy, to improve the import of Norwegian wood; one to England, Germany, and Sweden, to study the mining industries of those countries; one to Germany and Sweden, to study the manufacture of paper wood pulp; one to Germany and Sweden, to study the various telephonic inventions; and one to the same countries, to study their dyeing industries.

The fatal accident with the choke damp by which several people were killed, last Saturday, in a Scotch quarry, recalls a remarkable accident which occurred in France a short time ago during some preliminary experiments with a new piece of siege artillery. A large shell was fired into a large bank of earth, where it buried itself deeply and there burst. The ground was not, however, thrown up, the projectile having simply created in bursting a cavity in the ground measuring about two metres in diameter. Two soldiers were set to work to discover what had become of the missile. After a few strokes with the pickaxe the ground gave way under them, so that they fell into the cavity, and were at once stifled to death by the deleterious gas produced by the explosion. Another soldier who ventured to descend to try to rescue them also perished.

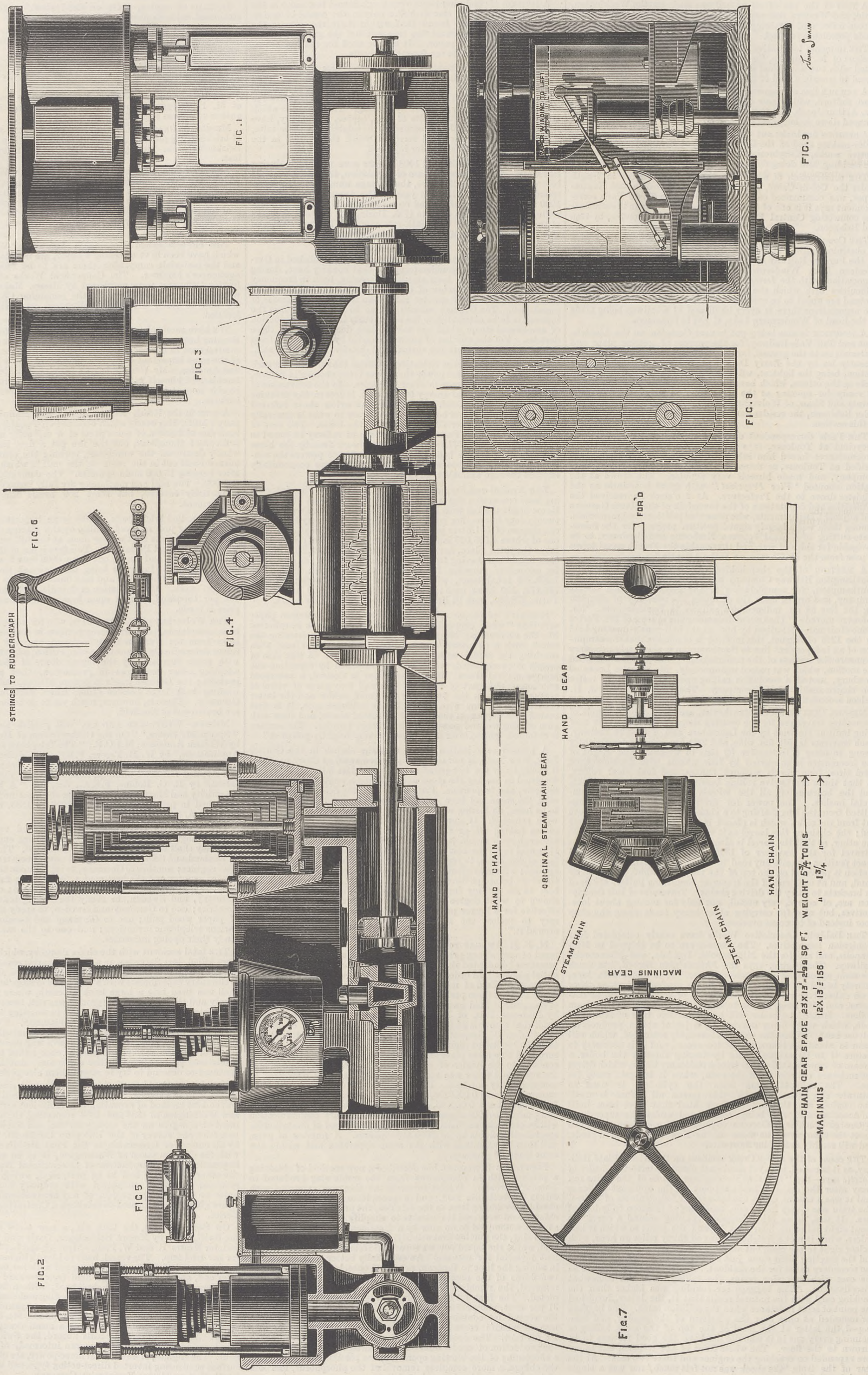
The International Geodetic Conference will assemble in Berlin on the 20th of October. Its principal business will be to deliberate on the best method of executing the resolutions arrived at at Rome and Washington in 1883 and 1884 respecting the actual measurement of a degree on the earth's surface, and likewise in reference to a scientific survey of the European Continent. The adoption by all nations of Greenwich as the First Meridian, in accordance with the decision taken at Washington, is to be strictly enforced in practice. The introduction of International Normal Time, on the other hand, has had to be postponed, owing to insuperable practical difficulties connected with ordinary business life. In order to promote the project of any international survey of the entire globe, it is proposed to establish a Central Geodetic Office in Berlin.

On Saturday last, the 25th ult., a new screw steamer named the Swift, built by Messrs. Schlesinger, Davis and Co., of Wallsend, for Messrs. R. and W. Paul, of Ipswich and London, went to sea for her trial trip. The vessel, built to Lloyd's highest class, 100 A1, is constructed of steel. She is arranged with her machinery in the after end, and has a long cargo hold from forward of engine and boiler space to the fore peak bulkhead, with a large hatch and powerful steam winch for the rapid loading and discharge of cargo. Her dimensions are:—Length, between perpendiculars, 110ft.; breadth, moulded, 19ft.; and depth, moulded, 9ft. 3in.; and she is designed to carry about 150 tons on a mean draught of $7\frac{3}{4}$ft. of water. With a full cargo of coals aboard, the Swift steamed at a speed considerably in excess, we are informed, of ten knots an hour. The engines, of 45 nominal horse-power, are of the compound surface-condensing inverted direct-acting type, and are built by the North-Eastern Marine Engineering Company.

STEAM STEERING GEAR, S.S. BRITISH PRINCE.

MR. MAGINNIS, BOOTLE, LIVERPOOL, ENGINEER.

(For description see page 267.)



MAGINNIS' STEAM STEERING GEAR.

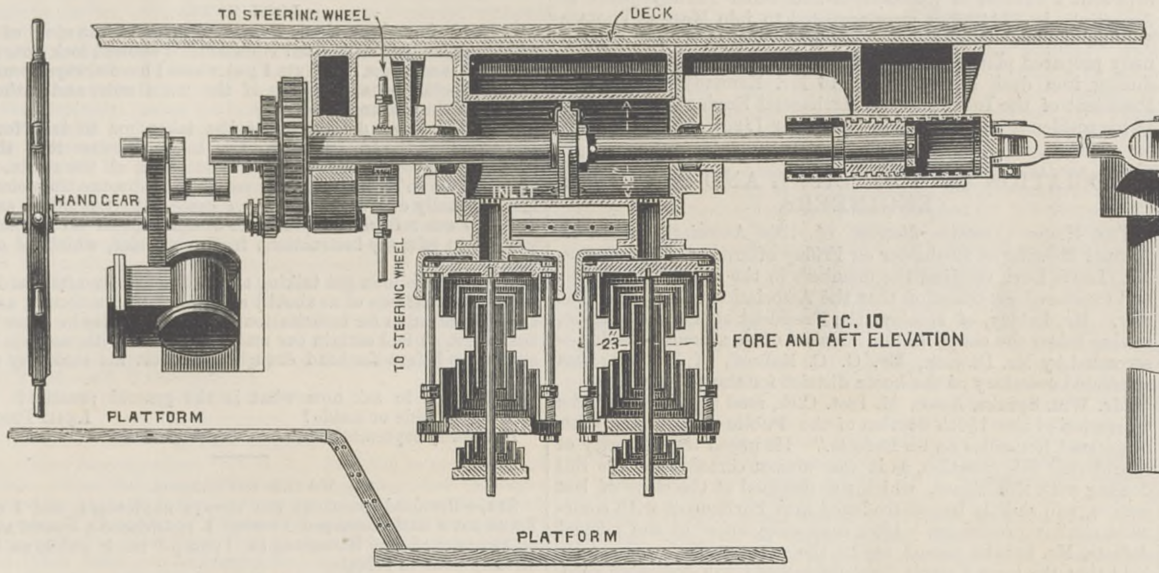


FIG. 10
FORE AND AFT ELEVATION

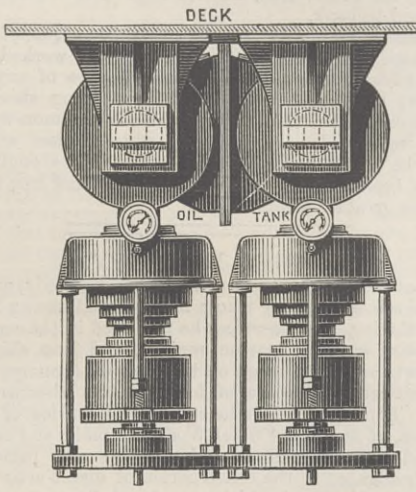


FIG. 11
END VIEW OF CUSHIONING GEAR

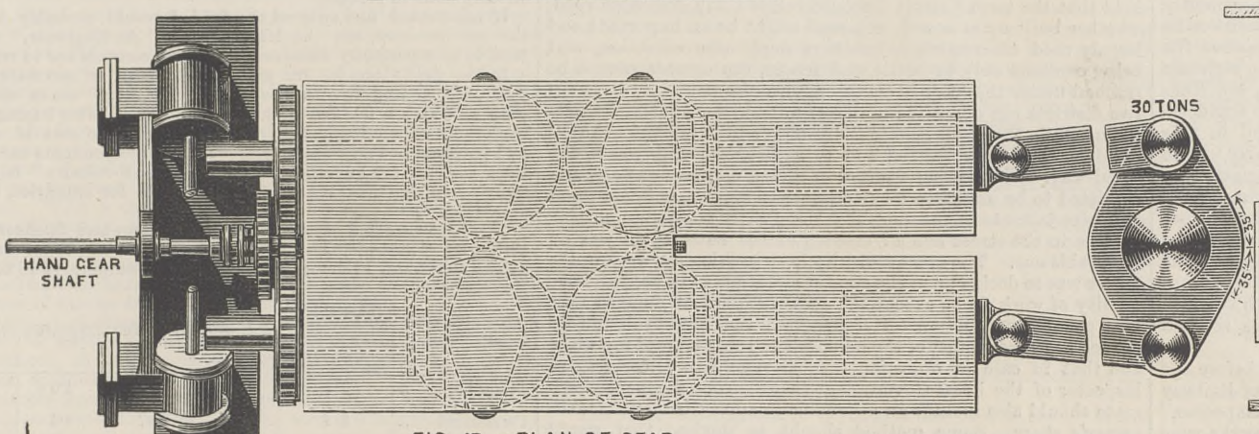


FIG. 12 - PLAN OF GEAR

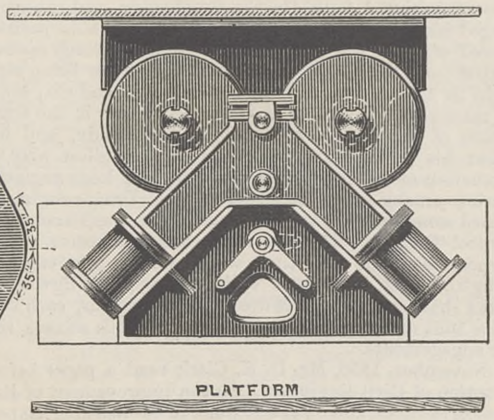
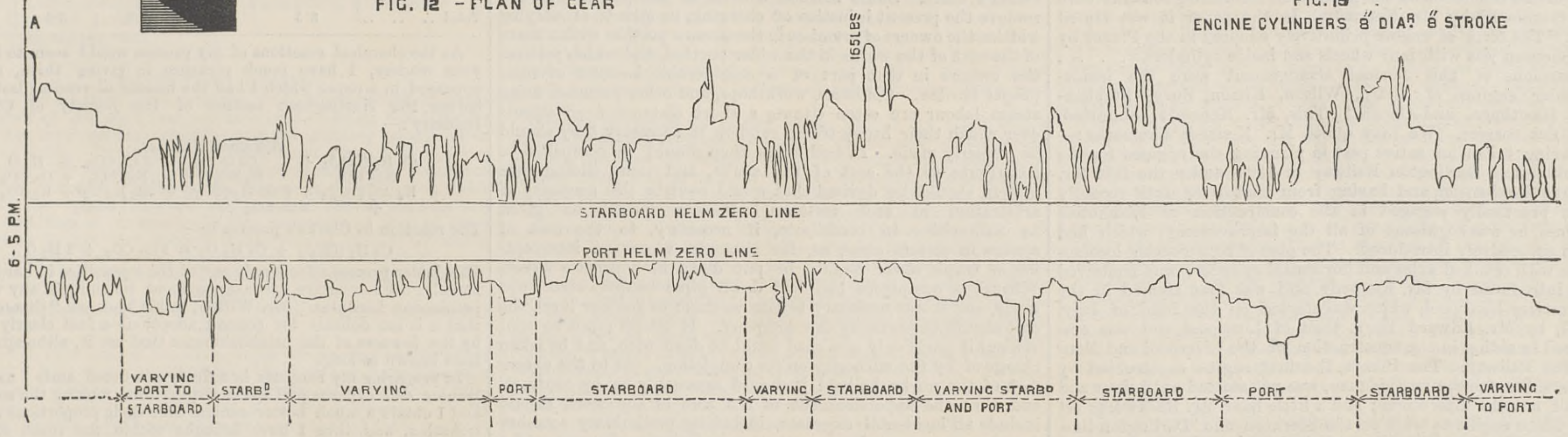


FIG. 13
ENGINE CYLINDERS 8" DIA^s 8" STROKE



MAGINNIS' STEAM STEERING GEAR.

We illustrate this week by Fig. 7, page 266, what we regard as an extremely important improvement in steering gear. In the Liverpool Exhibition a model of this gear will be found, but it is far more to the purpose that this gear has been fitted to the British Prince, a large steamer, with the most perfect success.

The Maginnis steering gear is specially designed to apply the steam power direct to the rudder quadrant without the intervention of wheelchains, and more especially to provide the much needed want of a simple easing gear which will prevent the disablement of rudders, by allowing them to yield or ease off if the safe working strain be exceeded. The principal feature of the gear—and one which we think will become useful in more ways than that now under consideration—is the entirely new idea of applying a worm, Figs. 1 and 2, in such a manner that it may also serve as a rack; this is attained—as may be seen by our illustrations—by attaching it to a piston working in a cushion cylinder filled with oil, and thus transferring all the thrust or strain of the worm on to volute springs. These volutes, Figs. 1 and 2, being adjusted to sustain a safe working strain for the rudder stock, and no more, they will compress under any excessively heavy load, thereby allowing the piston and worm to slide endways and so allow the rudder to yield, and it may be noticed that owing to the difference in the relative diameters of the cylinders a small spring compression gives considerable yield to the worm. A marked saving of power and wear and tear is also effected by taking the thrust on oil, as no collars or such like are required.

The important point of insuring the certainty of the rudder's return to its original position is automatically attained by simply placing the inlet to the cylinder from the tank so that the piston will almost close it when in working position, thus allowing for the in and outflow of oil to suit the endway movement of the worm piston, which may be caused in either direction by any sudden increase of rudder strain sufficient to force the oil shut up by it into the larger cylinder and compress the volutes; this oil will then again be forced back by the volutes on the strain falling off, and so push the worm piston back to its normal position. A very great saving in wear and tear is obtained and all noise completely abolished by the yielding worm, which—not being connected direct to the engine, but having free endway movement on its shaft by means of a large sleeve to take the turning feathers, through which rotary motion is given—entirely relieves the machinery of all jerking and straining of the rudder when in a seaway, the simple duty of the engine being to place the rudder in the required position, after attaining which it is entirely relieved of any strain whatever. The true endway motion of the worm when yielding is insured by the roller bearing, Fig. 4, which is designed to guide it the full length of its travel, the latter being easily regulated by the check nuts on the tension rods, which can be adjusted at will. Since being fitted in the s.s. British Prince—one of the Liverpool and Philadelphia 4000-ton liners—in September, 1885, continued satisfaction has been experienced, the excessively heavy North Atlantic gales of the early part of the year serving to thoroughly test it and give the utmost confidence in the principle. The arrangement fitted in that ship is shown on the plan of the wheel-house, Fig. 7, which we personally visited a short time ago, and were struck with the great saving of space and large reduction of machinery which was obtained by its adoption, as the original chain steering gear, with its train of wheels, fairleads, &c., was still in place, and on its removal a useful deck space of about 140 square feet will be gained, and a saving of nearly four tons made in weight, the direct gear being only one-third the weight of the original gear.

Besides the improvements effected in the general steering arrangements by this gear, another very desirable and useful point has been attained in the simple manner with which all the jerks and strains on rudders can be accurately ascertained by use of the ordinary Richard's indicator to the cushion cylinder, and taking diagrams in the usual manner when the helm is being put hard over; or a more simple method is by observing the pressures on the ordinary gauges which are connected with the regulating cylinders.

Another means is by use of the entirely novel instrument termed the "Ruddergraph," Figs. 8 and 9, which we now illustrate for the first time, and which was specially designed by Mr. Maginnis to obtain continuous records of the rudder's doings. This, it will be seen is simply an adaptation of two indicators, one with the pencil working upwards from the zero line, which is connected to obtain the starboard strains, and the other working downwards from the zero line and connected to obtain the port strains. The paper is wound from one drum to another by strings led to the rudder head regulated by ordinary ratchet motion. Another means of revolving the paper by clockwork can be arranged for six hour trials or such like, but has not yet been put to work. As we understand this is the first time that continuous diagrams of rudder movements have ever been obtained, we publish a portion of those taken on the British Prince between Liverpool and Queenstown, in June last, which will show the varying strains experienced by rudders in a seaway, the jerking action alone rising in some instance to three and a-half tons; the strains shown being for the most part all above the upper zero line, indicate very clearly that the ship required starboard helm to keep her straight course, and as the propeller was right-handed, this definitely confirms the correctness of Professor Osborne Reynolds' experiments, and solves the mystery of the action of propellers on the steering of screw steamers.

As an instance of the enormous strains experienced by rudders in very heavy weather, it may be mentioned that during the past winter actual notice was taken of the pressure in the cushion cylinder rising up to 500 lb. per square inch, or, say, a strain of over 30 tons, which the gear stood without the least sign of weakness or want of overhaul afterwards. Our other illustrations above, Figs. 10 to 13 inclusive, and on preceding page show some of the numerous ways in which this gear can be applied, one being an inverted arrangement for vessels not having deckhouses at the stern, and the other the system required for warships, Figs. 10, 11, 12, and 13, where little transverse space is allowed for steering purposes. The arrangement of the latter, although possessing exactly the same essential easing or yielding principle, is modified to work direct on the short tiller with two long screws, the nuts for which are the trunk pistons working in the cushion cylinders, so that all the strains come upon the volutes as in the other gears. The revolving motion is obtained by an ordinary engine geared into the wheels which turn the screws by sliding feathers, thus keeping all jerking off the machinery, and allowing considerable yield of rudder when required. The gear is the invention of Mr. Maginnis, of Canal-street, Bootle, Liverpool.

JOICEY'S PUMPING ENGINE.

The accompanying illustration represents an underground pumping engine recently built by Messrs. J. and G. Joicey and Co., of Newcastle-on-Tyne, for the Tyne Coal Company, and is now at work at their colliery at Hebburn. The design is on the system patented by Mr. F. W. Stoker, of Jarrow, and the general arrangement will be readily understood from the plans. The main engine is an ordinary compound, having high-pressure cylinder 26in. diameter, and low-pressure cylinder 48in. diameter. Pumps 10in. diameter, all having 5ft. stroke. The high-pressure cylinder is fitted with variable expansion gear, which can be adjusted while the engine is running; the pumps and valve boxes are exceedingly massive, having to withstand a column of 1100ft., giving a pressure of nearly 500 lb. per square inch. The valves, which are of phosphor bronze, are of special construction and are fitted with powerful springs, which are adjustable from the outside to enable them to close quickly at the termination of each stroke, thereby saving wear and tear of the faces of the valves and seats, and taking all shock off the column.

The principal peculiarity in the main engine is that the fly-wheel is dispensed with and a small auxiliary engine is attached to a crank at right angles to the main crank, which is the means adopted for carrying the latter over the dead points. This engine has a steam chest at either end of the cylinder with a stop valve to each, so that the velocity at which the main engine passes over the dead points at the end of every stroke is entirely under the control of the attendant.

The importance of this feature will be readily understood when it is stated that a speed of sixty strokes per minute has been attained, and that the average speed of working is four strokes per minute, or 200ft. piston speed, against the heavy pressure named above. A jet condenser is used, and the pumps are worked by an engine of the beam type. The two air pumps attached one on each side of the beam centre are single acting, 20in. diameter, and call for no special mention, being of the usual marine form. The whole of the water is taken from an underground level drift about 15ft. below the engine room floor by this engine and discharged into a large cistern—placed above the level of the rams—from whence it flows to the main pumps, and is forced to bank.

The special advantages claimed for this class of pumping engine are, the high speed at which they can be worked and the consequent lowness of first cost; the absence of any complicated gear; the impossibility of their working short or not moving through their full stroke, a fault so common with many pumping engines when hard driven, and the ease with which they can be controlled by the attendant. The engine under notice has been running about nine months, and has, we understand, given great satisfaction.

JAMES KENNEDY.

We have to record the death of Mr. James Kennedy, an engineer of the old school, and one whose name is well known in connection with the important services he rendered in the construction of locomotive engines, marine engines, and iron shipbuilding. He was born near Edinburgh on the 13th of January, 1797, and was apprenticed at the age of fourteen to a wheelwright near Dalkeith. Some years later he entered the service of Mr. John Stephenson, at Monkland Steel Works, to make and erect water wheels and pumping engines, designing his own patterns. He afterwards engaged in the construction of direct-acting engines for steam vessels, one of which was placed in a steamer of the St. George's Packet Company, Liverpool, to which port he travelled to superintend its erection. While at Liverpool he became acquainted with George Stephenson, and subsequently managed his works at Newcastle-on-Tyne. In this position he prepared plans for the first three locomotives which opened the Stockton and Darlington Railway in 1825. After being eighteen months in the service of George Stephenson and Co., Mr. Kennedy returned to Liverpool and became partner in the engineering firm of Messrs. Bury, Curtis, and Kennedy, and in this position his constructive abilities had the fullest play in the construction of marine and various kinds of land engines, constructing among other locomotives the Dreadnought, which obtained some celebrity at the opening of the Manchester and Liverpool Railway. He also made the locomotive called the Liverpool about the same time, which was the first engine made in England with horizontal cylinders applied directly to a cranked shaft or axle, and it drew twelve wagons, each containing five tons of coal, at a very good pace. This success secured other engagements.

In November, 1856, Mr. D. K. Clark read a paper before the Institution of Civil Engineers "On the Improvement of Railway Locomotive Stock and on the Reduction of Working Expenses," and in the discussion on this paper some interesting remarks were communicated by Mr. Kennedy. In the paper it was stated that "The form of engine primitively adopted in the Planet by Stephenson was with four wheels and inside cylinders. . . . . Expansions of this normal arrangement were the inside-cylinder engines of Sharp, Wilson, Kitson, Bury, Stephenson, Hawthorn, and Gooch." This, Mr. Kennedy submitted, was not correct. We may quote Mr. Kennedy's remarks:—"Having taken an active part in planning the engines for the Stockton and Darlington Railway in 1824, under the late Mr. George Stephenson, and having from that time until recently been practically engaged in the construction of locomotive engines, he was cognisant of all the improvements which had been successively introduced. The plan of constructing locomotives with cranked axles and horizontal cylinders was contrived and introduced by Mr. Kennedy, and was first applied in the locomotive Liverpool, which was started on the 22nd of July, 1830, by Mr. Edward Bury, then of Liverpool, and was employed in aiding in the construction of the Liverpool and Manchester Railway. The Planet, the first engine constructed by Messrs. Stephenson on this plan, was not started until four and a-half months afterwards; and a little later Mr. Hackworth set the Globe engine to work on the Stockton and Darlington line. The late Mr. George Stephenson had told both Mr. Bury and Mr. Kennedy, after having seen the Liverpool engine on the Liverpool and Manchester Railway, that his son, the present Mr. Robert Stephenson, had taken a fancy to the plan of the Liverpool engine, and intended to make immediately a small engine on the same principle. Further, the late Mr. Robert Stephenson, brother to the late Mr. George Stephenson, had, as soon as he saw the Liverpool, declared it was the best type for locomotives, and that all would have to come to it by-and-bye. In fact, in the engineering world the Liverpool was considered a great stride in the right direction. That engine was as efficient a machine as had ever been made of that weight. It had been stated that Mr. Brunel was the first to make wheels of more than 5ft. in diameter. Now the driving wheels of the Liverpool were 6ft. in diameter, and that engine often ran at the rate of 58 miles per hour on a level part of the line, and with a load of twelve wagons. It had also been asserted that the idea of the dome for a steam chamber on the boiler, in the case of the engines for the London and Birmingham Railway, was copied from Mr. Church's engine; but the latter was not made until seven years after the Liverpool, and it could be proved, incontestably, from an old billhead of the time, that the dome on the Liverpool was exactly similar to those on the succeeding engines made at the Clarence Foundry, Liverpool, by Messrs. Bury, Curtis, and Kennedy." In reply to some further remarks, Mr. Kennedy explained, through the secretary, that "the Liverpool, as previously stated, was first set to work on the Liverpool and Manchester Railway on the 22nd of July, 1830. After being at work some time the cranked axle was broken, when she was taken off the road to have it welded. The 25th of October, the date given by Mr. Booth, was that of Mr. Bury's second application to the directors of the Liverpool and Manchester Railway, to allow his engine to be again put on the line, after her cranked axle had been repaired, and not that of the first application, which was made and granted some months before. The letter-book of the firm for the year 1830 contained the whole correspondence on the subject between the directors and Mr. E. Bury." In reply to this, Mr. D. K. Clark said that "this was entirely a question of dates. But with regard to the cranked axle, he might remark that the question of precedence was not, in his judgment, important, inasmuch as he believed the cranked axle essentially an objectionable feature in locomotives, and one which would ultimately be superseded in railway practice by the straight axle." Although Mr. Kennedy was connected with so much that became of historic interest, the above seems to have been all that he ever communicated to the "Proceedings" of the Institution.

In 1836 Mr. Kennedy's firm proposed to Messrs. W. and J. Brown, merchants, of Liverpool, to establish steamers between that port and New York, but Messrs. Brown rejected the proposal to have high and low-pressure condensing engines on board their ships. Messrs. Bury, Curtis, and Kennedy, however, constructed four pairs of engines for vessels trading on the Rhone, and these engines carried steam at 60 lb. per square inch. The draught through the fire was maintained by an exhausting fan at the bottom of the chimney, and the speed of the pistons was about double that then in use in England. In 1832-33 the firm sent a number of locomotives and other railway plant to America. In 1844 offers were accepted to join Messrs. Thomas Vernon and Son, Liverpool, in iron shipbuilding, and Mr. Kennedy prepared plans providing for exceptional stability, introducing iron deck beams. In 1846 Mr. Kennedy was elected President of the Institution of Mechanical Engineers. He died at his residence in Cressington Park, near Liverpool.

ASSOCIATION OF MUNICIPAL AND SANITARY ENGINEERS.

The Home Counties district of this Association held its Annual Meeting at Rochester on Friday afternoon. The mayor, Mr. Lewis Levi, received the members in the council chamber, and expressed gratification that the Association had visited that city. Mr. Lobley, of Hanley, the President of the Association, having taken the chair, on the motion of Mr. Jones—Ealing—seconded by Mr. Dawson, Mr. G. C. Robson, of Kilburn, was re-elected secretary of the home district for the ensuing year.

Mr. Wm. Spinks, Assoc. M. Inst. C.E., read a paper on "The Operation of the 150th Section of the Public Health Act, with Suggested Remedies on its Defects." He urged the necessity of considering this question, as it was almost certain that the Bill dealing with this clause, which was dropped at the close of last session, will shortly be reintroduced into Parliament with somewhat similar provisions. After reviewing some of the alleged defects, Mr. Spinks passed on to the suggested remedies. He held that the term "street" should include any dedicated road, whether built upon or not, as a road might be an important and largely used thoroughfare, but in a deplorable condition, and being confined only by walls and fences, the owners cannot be reached under the present Act. Where the boundary between two districts ran down the centre of a road, the authorities proposing to do the work should have power to treat the external premises as in their district and to recover the expenses in the usual way. The present method of giving notices was generally admitted to be unsatisfactory and untrustworthy, however great the pains taken to be precise. The Manchester method of putting posters in the street and advertising in the newspapers was an admirable one. The great difficulty in describing the work in the notice was to decide upon the class of materials to be used and the quality of work to be executed. This was seldom done so as to give general satisfaction. He suggested that streets should be classed as to the quality of the materials and character of the work, and that in case of objection, appeal should be allowed to an inspector of the Local Government Board. The surveyor's estimate should also include an approximate apportionment of each owner's share. Some method should be devised that would remove the present injustice of charging, in streets of varying widths, the owners of premises in the narrow portion with a share of the cost of the works in the wider portion, and which relieves the owners in that part of a considerable amount of their proper burden. Collieries, workshops, and other premises using steam labour are often situate a short distance from streets over which their heavy traffic renders it necessary they should be properly made. In such cases they should be compelled to contribute to the cost of the works, and some sliding-scale system should be devised that would obviate the necessity of arbitration in each instance. Powers should be given to authorities to contribute, if necessary, to the cost of sewers in certain cases, as, for example, where an intercepting or trunk sewer had to be put down in a private street. Where gas companies had laid down pipes before a street was made, and it was necessary to remove them to another level, the cost should be borne by the company. It would often be convenient if parts only of a road could be dealt with, and be taken charge of by the authority on its completion. As to the execution of the works, he held it should invariably be by contract, and that the apportionment of the cost of the work should include all incidental expenses, including preliminary searches for pipes, sewers, and every other cost, including 5 per cent. for supervision and office charges. At present these charges had to be borne by the general district rate, which he considered unfair.

The paper gave rise to considerable discussion. Mr. Angell, West Ham, and several other speakers thought the existing regulations of the Act preferable to those suggested in the paper, as they would give surveyors considerably more trouble, and would afford additional facilities for objections and appeals. Mr. Savage, East Ham, Mr. Weaver, Kensington, and other speakers held that if there was to be any alteration the 105th clause of the Metropolitan Local Management Act should be incorporated into any new public health Act, as then the cost of any private improvement could be collected before the work was commenced, and all subsequent difficulty would be obviated. The President and other speakers considered that it would be absolutely impossible to get any such power conferred by a new Act, and that as it was all but certain that an amended Act would be introduced during next session of Parliament, the wisest course would be to endeavour to get such amendments inserted as would meet the views of the Association. Mr. Spinks was thanked for his paper, and it was intimated that the Parliamentary Committee would consider any other suggestions which might be sent in for the amendment of the Act.

The members of the Association then visited the Steam Roller Works of Messrs. Aveling and Porter, where they were entertained at luncheon; and after inspecting the works of the Burnham Cement Company, they also visited the Castle and Cathedral. On Saturday a visit was paid to Walthamstow, where the sewage works and farm were shown by the surveyor, Mr. Jerrom. The party also went to the pumping stations of the East London Waterworks at Lea Bridge and Chingford Mills, and afterwards dined together at the Forest Hotel, Chingford.

The Railway Servants' Congress.—The fourteenth annual Congress of Railway Servants will be held at the Town Hall, Brighton, on October 5th, 6th, 7th, and 8th, under the auspices of the Amalgamated Society of Railway Servants. Delegates, comprising men of the various grades in the railway service, will be present from all the railway systems of the United Kingdom, and there will be also a delegation from the French Railway Servants' Society of Paris. Through the absence in America of Mr. P. S. Macliver, the president of the Society, the Congress will be presided over by Mr. Clement E. Stretton, C.E., of Leicester, a vice-president, and the consulting engineer of the Society. The programme of subjects for discussion, and which will be referred to in the annual report of the general secretary, Mr. Edward Harford, is an extensive one, and embraces questions of great interest as well to the railway travelling public as to the railway servants themselves. The Brighton Railway Company has kindly placed a train and engine fitted with the Westinghouse automatic brake at the disposal of the Society on one of the days, in order that the working of this well-known appliance can be properly examined and practically tried.

LETTERS TO THE EDITOR.

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

LOCK NUTS.

Sir,—A few days since I had to make a drawing of some machinery subject to jar and vibration. I showed lock nuts on all the bolts, and these lock nuts I put where I have always seem them put in practice—that is on top of the main nuts, and rather less than half the thickness.

The chief of our drawing-office has taken me to task for this, and says that the lock nut should be below, because it is the nut furthest from the work which has to stand all the strain. This seems to me to be wrong, and I ventured to dispute the point with him. Finally our works' manager came into the office, and the question was referred to him. He would express no opinion, but told me to take my instructions from our chief, which, of course, I do.

We young fellows got talking about the matter afterwards, and we agreed that one of us should write to The Engineer, and ask through its pages for information as to the practice in other shops than ours. I feel certain our manager agrees with me, but would not say so before the head draughtsman, lest his authority should be lowered.

I venture to ask now what is the general practice? Is the lock nut outside or inside? Lead Pencil.

Bradford, September 28th.

WATER SOFTENING.

Sir,—Personal questions are always unpleasant, and I confess I was not a little annoyed at what I considered a second attempt on the part of Mr. Howatson to "pump" me in public as he had already done in private.

If none other had entered the field, I would probably have let the matter drop, but the letter signed "An Engineer," whom I take to be a perfectly disinterested party, compels me to reply.

In the first place, let me say that to base an estimate of the cost of softening by "anti-calcaire" for large works upon the price at which a 6d. tin is sold to the public, after having borne the profits of wholesale and retail chemists, the cost of carriage and packing, is obviously wrong. Your correspondents can hardly have seen in my advertisements that "anti-calcaire" is sold in casks by the cwt. or ton at reduced prices for laundries, boilers, and waterworks.

The following is a report of Messrs. Gilman and Spencer on the action of "anti-calcaire" on Lambeth water. Total hardness before softening, 14 deg.; permanent, 3·4; temporary, 10·6.

Hardness after softening.	10 grains anti-calcaire per gallon of water.	15 grains.	20 grains.	22½ grains.	37½ grains.
Temporary ..	5·1	2·8	1·2	1·0	0·15
Permanent ..	3·4	3·2	2·7	2·6	1·10
Total	8·5	6·0	3·9	3·6	1·25

As the chemical reactions of my process would seem to interest your readers, I have much pleasure in giving them, as they appeared in a paper which I had the honour of reading last spring before the Nottingham section of the Society of Chemical Industry:—

Maignen Process.

$$Ca\,H_2\,(CO_3)_2 + Ca\,O = 2\,Ca\,CO_3 + H_2\,O$$
$$Na_2\,CO_3 + Ca\,SO_4 = Na_2\,SO_4 + Ca\,CO_3$$
$$K_2\,Al_2\,(SO_4)_4 + 3\,Ca\,H_2\,(CO_3)_2 = Al_2\,H_6\,O_6 + K_2\,SO_4 + 3\,Ca\,SO_4 + 6\,CO_2$$

The reaction in Clarke's process is—

$$Ca\,H_2\,(CO_3)_2 + Ca\,H_2\,O_2 = 2\,Ca\,CO_3 + 2\,H_2\,O$$

This latter process affects only one of the impurities in hard water, namely, the temporary hardness, without touching in any way the permanent hardness. Mr. Wilson, in his book on "Steam," says that it is too delicate for general adoption—a fact clearly proved by the fewness of the establishments that use it, although it has been known so long.

In preparing my reagents in a finely powdered state I avoid the trouble and expense and space required for making the solutions, and I obtain a much better control over their proportions and distribution, and thus I have brought within the reach of every industry and of the public generally, as proved by results, a very simple process indeed of softening water.

Being given the existence of tanks or reservoirs large enough to hold twelve hours', or even six hours', supply, the anti-calcaire can be thrown in and the water allowed to settle. Having perfect rest, it quickly gets bright.

Where this rest cannot be allowed then the water may be filtered, through my "Filtre Rapide," an hour or two after softening—in other words, after having travelled through tanks holding two hours' supply. This is done by the simple and inexpensive plant already described in your columns.

I regret that I cannot satisfy your correspondents as to the exact cost of my anti-calcaire; in the first place because this varies somewhat according to the nature of the water and the quantities required; and, secondly, because I do not think that I am called upon to tell everybody my business. If "An Engineer" would be good enough to place himself in communication with me I shall, I hope, show him that I am not "too greedy" in my ideas of profit. It is, however, when we come to deal with very large quantities, such as for the London waterworks, that the matter assumes the most serious aspect. The benefits of soft water are so great that some process or other would long have been adopted by the companies but for two fatal objections, namely, what is to be done with the sediment, and, as it is impossible to have settling reservoirs large enough to deal with the enormous quantities of water pumped daily, which system of filtration can be trusted to clarify the softened water?

To the first objection I have found the remedy. Twenty grains of the sediment collected from my apparatus at the Battersea pumping station of the Southwark and Vauxhall Water Company, and retreated by me, brings down the London water to 3 deg., without leaving in the water the slightest trace of alkalinity tested with phenol-phthaleine. With regard to the second difficulty, the experiment now going on at Hampton, and already noticed by you, will, no doubt, decide whether my "Filtre Rapide" is that system or not. P. A. Maignen.

32, St. Mary-at-Hill, Eastcheap, London, September 29th.

ROCKET GUNS.

Sir,—The engraving of the broken Collingwood gun which appears in your paper of September 24th, recalls my attention to the suggestion which I took the liberty of offering in your pages, that the Government should build a light experimental vessel—which would virtually be an enlarged torpedo boat—capable of maintaining a speed of 40 knots an hour in smooth water, and armed with two great rocket guns of light scantling but large bore, from which rocket shot would be projected with a light gunpowder charge. As the possibility of realising a speed of 40 knots in a steamer of any class was denied by several of your readers with much pertinacity, it was necessary in the first place that I should be able to demonstrate the fact that such a vessel could be built. This accordingly I proceeded to do in a succession of letters, the last of which reviewing the main points of the controversy appeared in your pages on August 6th, and as there has been no rejoinder to this, I conclude that the practicability of establishing a 40-knot steamer upon the sea is at last grudgingly admitted. This being so, it only remains that I should draw attention to the flagrant imperfections of our artillery system, as revealed by such disasters as those which have occurred in the Collingwood and elsewhere. As a rule, all our guns are overstrained. The charges are too great, are often imperfectly burnt, and are injurious to the gun in many ways. No doubt a large amount of *vis vivá* in the shot is indispensable in modern ordnance. But this may be imparted without overstraining the metal by using rocket shot, in which the energy imparted by the charge when the gun is fired is supplemented by a certain amount of rocket composition, made up into a cartridge with the shot or shell, so that the rocket gas issuing sternward from the projectile, makes the bore virtually as long as the flight. When the rocket is thus propelled into rapid motion before leaving the gun there will be little waste of the rocket gas in slip, and any desired *vis viva* may be imparted to the shot with a moderate pressure within the bore of the gun, and therefore with an ample margin of safety. The projectile should be a ricocheting shell, which would be kept in the horizontal plane by the surface of the water, and the length of the flight could be increased to any desired extent by employing a corresponding quantity of rocket composition, and by suitably adjusting the rate of its combustion. It is in this direction I feel persuaded we must chiefly look for the amelioration of our artillery system. But we should also introduce the Rodman system of construction as applicable to wrought iron guns, and should try the effect of hydraulic jackets under pressure.

2, Old Oak-road, Uxbridge-road,
Shepherd's Bush, W., Sept. 28th. C. F. Hurst.

MIXED TRAINS.

Sir,—Your correspondent "C. R. J.," page 245 in your issue of this date, states that I am in error in supposing that passenger carriages are ever run behind coal trains. Having received much of my railway education on a line where mixed trains are run, and having also had to examine and report upon the subject recently, I cannot think that your correspondent is quite correct when he implies that I have had no experience with regard to such trains. I beg to refer him to the West Bridge, Leicester, and Coalville section of the Mildand Railway. The loads for engines are fifty and thirty-two empty wagons and thirty-two and forty loads of coal, the change of load taking place at Desford Junction. Passenger carriages are run in the rear, not one or two, but four, six, and eight. On Saturdays especially, several passenger carriages are always required. These trains run down the Bagworth incline, some parts of which are 1 in 66 and 1 in 70; the time allowed to start, run four and a-half miles and stop at Desford, is nine minutes. With a chronograph I have found the speed for part of the distance to be fifty-seven miles an hour, and this with passenger carriages behind a train of coal wagons, many, if not all, of such wagons belonging to private owners and therefore not so well looked after as railway companies' wagons. The brake power consisted of one tender and one van hand brakes.

The recent circular issued by the Board of Trade will form a subject for consideration at the forthcoming Railway Congress at Brighton, in October, and it will be interesting to know the practical opinions of sixty railway men upon it. In the meantime I can simply maintain my former opinion that the Board of Trade is right, and that the safest place for carriages in a mixed train is in front, next the engine. Clement E. Stretton.

306, City-road, London, E.C.,
September 24th.

WATER-TIGHT GLAZING.

Sir,—We see from some remarks made in your Sheffield correspondence of last week that you have been noticing the difficulty there is in keeping glass roofs tight with the ordinary system of iron bars and putty. You also ask if there is not some better system than this. We therefore beg to say that we have been fitting our system of puttyless glazing for the last seven years, during which time we have covered many of the principal railway stations and other buildings of importance in this country, and that in every case where it has been applied it has proved thoroughly watertight, although dispensing altogether with putty and paint.

The Pennycook Patent Glazing and Engineering Company, Limited,
Glasgow, September 22nd. Peter Y. Lyle, Secretary.

Sir,—In your issue of the 17th, under the heading of "Sheffield District," your correspondent asks, "Is there any insurmountable obstacles to making an iron and glass roof water-tight?" After some remarks about various roofs, he refers to Messrs. J. Brown and Co.'s works. Will you allow us to say that at these works he can have ample proof that, whatever obstacles there were, there are none now? There is a roof on those works of our patent "Eclipse" glazing that has stood the test of the last severe winter and sundry heavy storms, and it is perfectly "drop dry." We are prepared to warrant our roofs so for a number of years, and the many we have glazed during the last four or five years have given entire satisfaction. Mellowes and Darby.

Church-street, Sheffield, September 28th.

CHARGING FOR ENTRY OF NAME IN DIRECTORY.

Sir,—The charge for entering the names of firms in the various directories adds up to a considerable total. As the directories would be useless without the names and addresses of the chief manufacturers, the entry of the name and address is necessary to make the book of any value.

The owners of one of the principal directories plainly state that unless the entry is paid for, the firm—however eminent—will be omitted. Such charges as these should be resisted by every firm of standing; it is a species of black mail. Manufacturer.

Colchester, September 24th.

THE LARTIGUE RAILWAY.

Sir,—I notice in The Engineer of to-day a letter about "Forerunners of the Lartigue Railway." It may be interesting to some of your readers to know that there are accounts of several such in the library of the Institution of Civil Engineers—notably, one of H. Temple Humphreys, to which Lartigue's is very similar.

Westminster, S.W., F. G. D.
September 24th.

Colonial and Indian Exhibition.—H.R.H. the Prince of Wales has decided that the present Exhibition shall close on the evening of Wednesday, November 10th.

Engineers and Football.—We learn that a football club is being formed by the junior members of the profession, entitled "The Civil Engineers' Football Club." Strong teams are very likely to be made up from the large numbers of young men in the profession residing in London and the environs. It is their intention to play both Rugby and Association teams, and as such pastimes promote health and vigour, it ought to be heartily supported, and we wish them every success. Further particulars may be obtained by applying to the honorary secretary, Mr. H. T. Procter, 2, Old Palace-yard, S.W.

Birkbeck Literary and Scientific Institution.—The sixty-fourth session of this institution will commence on Monday, October 4th. The class list is of the most comprehensive character, and both sexes will be able to obtain instruction in languages—ancient and modern—art, literature, history, mathematics, natural, applied, and mental science, music, law, &c. Special classes meet for University and Civil Service examinations. The services of many eminent lecturers have been engaged, including Professor Gardiner, Messrs. H. M. Stanley, Samuel Brandram, Archibald Forbes, Max O'Rell, Charles Dickens, Oscar Wilde, and J. T. Carrodus. In addition to the usual evening classes, several morning classes will assemble in the various departments of education.

RAILWAY COUPLINGS.

By Mr. Edwin H. A. Heinke, M.E., Loco. Department, L.C.D.R.[1]

The simplest form of coupling, as it has existed for many years, and which is now employed for wagons, is that which takes the form of several links, generally three or five or seven, 1in. to $1\frac{1}{2}$in. section, and from 4in. to 12in. long inside; these are dropped by hand over the draw-hooks as the wagons come together. This style of coupling, when there is a good deal of slack to be taken up, would, as one could easily imagine, cause a great amount of discomfort to passengers, on account of the shocks and jerks which it would subject them to when the train was starting or pulling up. To do away with this jolting and jerking, the screw coupling was introduced on the London and North-Western Railway, by an inspector and shunter at Rugby Station, about twenty-five years ago, and as a mechanical contrivance adapted for this purpose it is hard to say where it can be improved upon. It consists of a shackle that is passed through the draw hook, and a second shackle that is dropped over the next hook; connecting these two shackles is a bar, one half of which is screwed with a right-hand thread passing through a nut between the jaws of one shackle, and the other half screwed with a left-hand thread passing through a nut in the other shackle; a bar weighted at the end is connected to the centre of the screwed spindle, and by turning this bar round, after coupling, the vehicles are kept with their buffers well up against each other as the shackles are drawn in till they are in a straight line by the action of the double and opposite screws, the carriages are thus kept well together, their only movement being due to the compression of the buffer springs, and the jerking motion thus being reduced to a minimum, or entirely obviated. This is a great improvement on the old system of coupling carriages, which was to back them against a dead buffer stop, and then run an engine against them at a slow speed, the links were held ready, and as the buffers compressed, were dropped over the hooks, so that when the pressure was taken off the couplings were taut. This was a primitive and rough way of doing things, exceedingly uncomfortable for passengers, and also very detrimental to the rolling stock, as the speed was not always regulated to a nicety, and the frequent occurrence of these shocks would naturally tend to shorten the life of the vehicles. The slack in the links for goods and mineral traffic is not of so much importance, though no doubt brittle goods stand a very great chance of getting broken if the engine-driver is not very careful in starting, and feeling the weight of his train gradually; and that many links and not a few draw bars owe their retirement from active life to the tremendous strain that is suddenly put upon them by the violent jerks they are so often subject to in taking up the slack, as to the inferiority of the iron. An alteration, which the author believes is not an improvement, has been made by making the last link, which is connected to the draw-hook, with jaws at one end and attaching it to the draw-bar by a pin and cotter, instead of welding the link up; in practice, the enormous strain that the couplings are liable to tends to lengthen them, the jaws then nip on to the draw-hook and the links stand straight out, which is objectionable on several grounds.

The ideal coupling that is required is one that is cheap; this is most essential, and must be easily and universally applicable to all classes of wagons of various companies and able to couple up to all kinds of hooks, so that a foreign wagon can go into a home yard and be worked in without difficulty. This last may appear a simple matter, but those who are connected with a railway know what a variety of sizes and patterns of hook can come into a yard in a day.

It ought to couple up to any wagon that is not fitted with a similar apparatus, without reverting to the present or old system of going between the buffers; it ought to couple up quickly under all conditions, such as on a curve, when the buffers are compressed as they may be on live stock, and when the buffers are different height from rail, due to load; and last, and almost one of the most important of the conditions, is, that it must be made to suit different lengths of buffer-head from headstock, and the different distances between the hooks of two wagons. It may seem curious, but it is a fact, that the author has seen the front edge of draw-hooks knocked up, showing that another hook has actually run into it. This would occur only with transverse laminated buffing springs; but as there are a good many of this class of wagon running, it would have to receive attention, and it shows how little room there is in some cases to arrange any mechanism. To stand any chance of being adopted or applied within a measurable distance of time, it ought not to interfere very much with existing arrangements, so that it could be introduced gradually. So when we come to consider all these varied conditions, the enormous and sudden strains that wagon couplings are liable to, and which are enough to put the strongest mechanism that can reasonably be added out of order in a moment and render it unworkable, besides which it is exposed to all weathers, the deteriorating action of dirt and rust, and the little or no attention that is bestowed upon it to keep it in order, it will easily be perceived that it is a very difficult matter to get hold of a really good coupling.

Having now given some idea of what an ideal coupling should be, and the difficulties it has to contend with, we will proceed to see why it is required. The chief reason is for the prevention of accidents, loss of life, and the reduction of risks generally to the men employed in railway work, principally goods guards and shunters. The percentage of death and injury among this class of men being very high, higher than any other class; for the year 1884 it was 1 in 17 injured, and 1 in 139 killed. Now this is why the question is a public and leading one, and we must admit that it is a very serious state of affairs, and one that naturally calls for some improvement; and as the work is particularly laborious, it ought to be as much as possible devoid of danger, the danger consisting in the necessity of the men having to go under and between the buffers in order to couple.

Another reason is the saving of time, as an automatic coupling which has an instantaneous movement would not take more than two seconds, and the author doubts whether a man could get under, couple, and out again under six seconds, so according to that two-thirds of the time is saved, which is an advantage; but the saving of labour is a far greater one, for he knows by actual experience how hard the work is, so what with running up and down the length of trucks, stooping low to get under the buffers, then lifting heavy links up and dropping them over the next hook, getting out again, then shouting and whistling, and doing all this perhaps on a bitterly cold dark night in a blinding storm of rain or snow, it can be imagined that a goods guard or shunter's life is not a happy one.

Why won't the different railways do anything in the matter? The answer is not difficult to seek, and is simply the question, "What return shall we get for our outlay? We are not a benevolent institution, but a company intrusted with other people's money, who rely on us to return them the best interest we can. If we lay out, say, £2 on each wagon we possess, on the total number that will represent an immense sum, roundly more than three-quarters of a million. What shall we gain by it? A saving of life?—certainly. A saving of time?—perhaps. Now lives don't cost us anything, and the time saved is not of much value, as a small portion only is saved each journey, and the trucks would therefore be waiting at either end instead of on the journey, the engine probably being in steam about the same length of time in each case. Now we are only officials, and if the shareholders should disapprove of the outlay, and perhaps reduction of dividend, we should get into trouble."

Mr. Heinke holds that what is called the non-automatic system is the best, his reasons are these:—In the first place, if an automatically fitted wagon comes next to a non-fitted, it is useless as regards the coupling process, which has then to be effected by going underneath and coupling in the old style. Secondly, the basis of all automatic couplings is a rigid projection on one wagon sliding up a similar rigid projection on the opposite one. Now a rigid projection in front of the hook is objectionable and dangerous, not so much on what is called dead buffer stock, because the distance between two wagons is fixed and unalterable; but with live or spring buffers the case is very different as the strokes vary so much, ranging from $10\frac{1}{2}$in. to $3\frac{1}{2}$in., or even less when the wagons have been on the road some time and the springs are worn. The difficulty of arranging the mechanism that will suit these different lengths is easily understood, and though everything may be nice and comfortable when the buffers of the wagon are just touching, it is a different matter when they collapse, and as this distance varies from 7in. to 21in., something will in all probability foul, unless of course special arrangement is made for special cases; but that is not of much use, as wagons are continually being changed as regards their relative position to each other, and it is as likely as not for one to get another next to it that will render the arrangement useless although fitted in the same way. It is then that this rigid projection becomes dangerous, as the man must in that case go underneath to couple. Another point is that although automatic couplings couple automatically they cannot of course uncouple in the same way; having, therefore, to be uncoupled by hand, they do not do away with the necessity of a man to attend to them, and he ought in either case to be on the spot and to make sure that the coupling has been properly performed, and that those wagons that are not required are out of gear; for if they were in gear, the shock of the engine running back on a line of trucks would probably couple up more than was wanted, the driver would go off with the wrong ones, and much delay and inconvenience would be caused. Now, with the non-automatic couplings this could not happen. The man would have to perform the coupling operation as he does now, only without danger to himself, more quickly, and with less fatigue; but doing it himself, he would be quite sure it was properly done.

The author has given the subject of coupling a good deal of attention lately, and the result is that he has produced one. Through the kindness of Mr. Kirtley, two wagons have been fitted with it, and are running on the London, Chatham, and Dover Railway. The principle of the coupling is that by means of a handle on the outside of the wagon a single and instantaneous movement effects either the coupling or uncoupling, by means of the lifter, and is worked by one hand. This raises the suspension link in a slanting direction to a horizontal position, and clear of the opposite hook when the buffers are touching. At the moment this takes place the auxiliary links, which are connected to the coupling link and to the cross shaft, come into play and turn the coupling link on the centre or joint between the suspension and coupling link and tilt it over the draw-hook on the opposite wagon; it is now coupled.

In one arrangement shown, the handle can then be swung back and out of the way, the lifter being divided for that purpose; to uncouple, raise the lifter smartly by means of the handle again, the coupling link is raised clear out of the hook, and, being balanced, drops back again into the normal and vertical position under the hook out of the way and clear of everything. If anything goes wrong with the mechanism the pins can be knocked out and it can be coupled by hand in the ordinary way, not being much heavier than the links now in use. In the sudden and rough stoppages that often occur in goods' trains, the sudden reduction of distance between the wagons, due to the compression of the spring buffers, is taken up in the joint between the suspension and coupling link, so there is no liability of parts fouling or damage occurring to headstocks or ends of wagons. The auxiliary links, on which there is no strain at all in the ordinary way, would, in the event of the suspension link breaking, form a safety chain. For coupling on curves the top of the coupling link is widened. The whole of the lifting arrangement, brackets, cross shaft, handle, and lifters, go up together bolted to the headstock, and if Gedge's hook is used the suspension link can be dropped in and the whole arrangement is applied in a very short time, and at a moderate cost, as there is no fitting required; the parts being forgings in the rough, all the machining that is required is the drilling of the holes. Another point is that in this arrangement you can feel by the weight on the handle whether the trucks are coupled or not without looking, or if unable to see on account of the darkness. In reference to the cradle coupling system, it has many good points, one being absence of any attachments to the links, thus leaving them free after the coupling has been effected; though, on the other hand, on a dark night there would probably be some difficulty in getting the links set properly in the cradle before lifting them up to couple.

Then there is the pole coupler. Opinions appear to differ very much on the point of its utility and convenience; but there is no doubt about one thing, and that is its cheapness. I have seen it at work, and the coupling can be done quickly by those who have practised with it, but it requires two hands, and light; the pole has to be carried about, which is objected to very much, as the shunter has already his flags or lamp to carry, as the case may be; and I have heard that the men have often thrown down the pole and have coupled by hand.

The adoption of a mechanical coupler is a serious matter for a railway company to consider, the North-Eastern alone having over 75,000 wagons, the other companies possessing varying numbers, according to the size of the line, going down as low as 516 on the North London Railway. The total number of wagons in the United Kingdom is nearly half a million, so that what is called a non-automatic system is the best, and the most likely to be adopted, as, generally speaking, it involves less expense, and meets more of the conditions which are so numerous and that have to be studied on a railway.

[1] Abstract of paper read before Balloon Society.

The Production of Phosphorus in Russia.—The manufacture of phosphorus in Russia dates from the year 1871, when Jewgraf Kusmitsch Tupizyn set up at Perm the first phosphorus factory in Russia. Nothing of the kind had ever before been heard of in that district, nor had the founder himself ever before seen a phosphorus factory or even obtained the advantage of a technical training. Notwithstanding the very defective construction of his foundry, Tupizyn managed to turn out in 1872 347 poods—13,492 lb. avoirdupois. Hitherto all the lucifer match factories in Russia had been supplied exclusively with English phosphorus, for which they paid as high as 60 roubles, sometimes even 120 roubles per pood. So soon as Tupizyn's phosphorus was brought into the Russian market the price of the English phosphorus was lowered in order to extinguish the new Russian establishment. Tupizyn found himself compelled therefore to reduce the price of his phosphorus to 45 roubles per pood. In spite of the powerful English competition, the new factory fought its way into credit, turning out in 1873 700 poods and next year 1200 poods. In 1875 Tupizyn found it necessary to enlarge his factory, and produced that year 1800 poods, a figure which in 1878 was driven up to 2350, and in 1879, after the death of the founder and under the management of his widow, to 3000. Thereupon, the agent of English phosphorus entered into a contract with Tupizyn's factory to raise the price of phosphorus, which, accordingly in 1881 and 1882 was sold in Russia at the old figure of 60 roubles per pood. Dissolving the contract with the English agency, Tupizyn's factory turned out, in 1883, 4000 and in 1884 4300 poods. Whereas the average yearly import of phosphorus from England during the five years 1870-74 amounted to 3015 poods, the yearly average of the five years 1875-79 fell to 2102 poods, a decline of 30 per cent., and of the five years 1880-84 to 1827 poods—*i.e.*, 39 per cent. less than in the five years 1870-75. The total consumption of phosphorus in the match factories of European Russia is estimated at 6000 poods. Of this quantity only about 1500 poods are now imported from England; 4000 poods are contributed by Tupizyn's establishment, and the remainder by all the other phosphorus factories in Russia. According to data supplied by Rudolf Wagner, the production of phosphorus in 1880 was—in France, 90,000 poods; in England, 105,000 poods; and in Philadelphia, 1050 poods,

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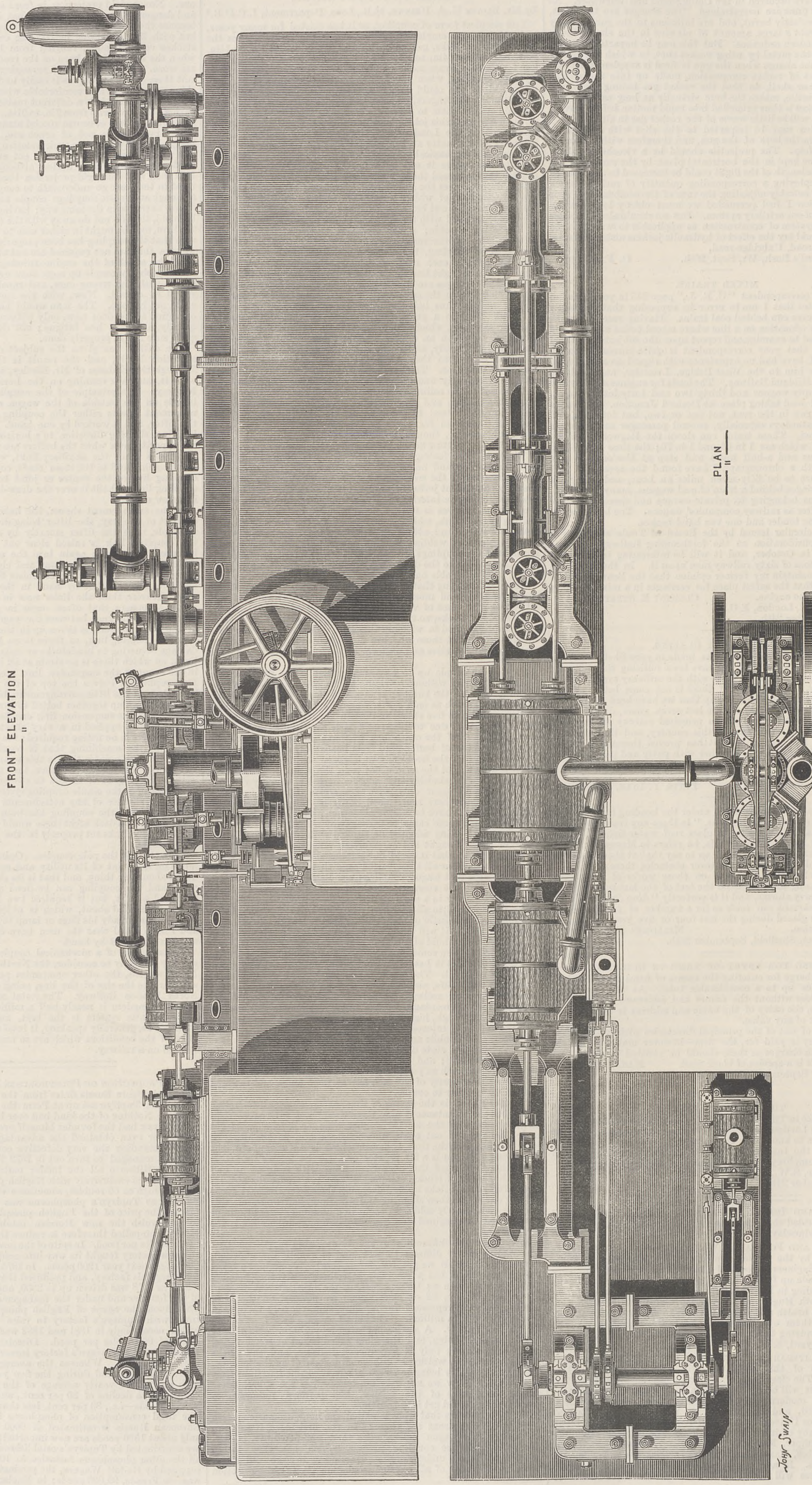
(*For description see page 267.*)



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THE ENGINEER, October 1st, 1886.

TO CORRESPONDENTS.

Registered Telegraphic Address—"ENGINEER NEWSPAPER, LONDON."

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J. T.—*The address is Newcastle.*

A. H. (Knowle-road).—*If you like to send a description of your invention, in confidence, we shall be happy to advise you.*

G. L. M.—*There is no special treatise on lucifer match machinery. You will find articles on the subject in "Ure's Dictionary," "Encyclopædia Britannica," &c. In a recent number of "Good Words" there is an article by Professor Thorpe which you may read with benefit.*

P. D. H.—*Any stationer will supply drawing paper and tracing cloth. There are so many books on drawing published that we cannot advise you. You may read with great advantage a treatise "On Mathematical Instruments," published by Stanley, Great Turnstile, Holborn.*

LIQUID FUEL STEAM BOILERS.

(*To the Editor of The Engineer.*)

SIR,—I would thank any of your readers to give me the name of a firm, or firms, who manufacture steam boilers for using liquid fuel.

September 27th. T. O. S.

OIL WELL BORING GEAR.

(*To the Editor of The Engineer.*)

SIR,—Can any reader of THE ENGINEER send me a rough sketch of the machinery and tools used by the Americans for putting the deep oil holes down. By so doing they will greatly oblige J. H. R.

Droitwich, September 21st.

BOOK-KEEPING.

(*To the Editor of The Engineer.*)

SIR,—In reply to "Ledger's" inquiry last week, I may say that Messrs. Crosby Lockwood and Co. are about to issue a book "On Factory Accounts, their Principles and Practice," by Messrs. E. Garke and J. M. Wells, which may suit his purpose. A CIPHER.

London, September 26th.

WHEELS FOR WIRE ROPE.

(*To the Editor of The Engineer.*)

SIR,—Will you allow me to ask if any of your readers can inform me as to the best angle for the groove of a turned rope pulley, to drive, or be driven by, steel wire rope without any clipping device, and as to the life of the rope in constant work under such conditions? S.

WHITE ON BLUE, AND BLUE ON WHITE, PHOTO TRACINGS.

(*To the Editor of The Engineer.*)

SIR,—I should esteem it as a favour if any of your readers would give me some information as to the process of reproducing tracings in white on blue ground. If the prepared paper can be bought you would much oblige by letting me know the name of the suppliers. D. W. B.

London, September 29th.

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

MEETINGS NEXT WEEK.

SOCIETY OF ENGINEERS.—On Monday, October 4th, at the Town Hall, Caxton-street, Westminster, at 7.30 p.m., a paper will be read "On the Lartigue Single Rail Railway," by Mr. F. B. Behr, A.I.C.E.

THE IRON AND STEEL INSTITUTE.—The autumn meeting of the Institute will be held at the Institution of Civil Engineers, 25, Great George-street, London, S.W., on Wednesday, Thursday, and Friday, the 6th, 7th, and 8th of October, commencing each day at 10.30 forenoon, when the following papers will be read:—"On the Iron-making Resources of our Colonies, as illustrated by the Colonial and Indian Exhibition," by Mr. P. C. Gilchrist and Mr. Edward Riley, London. "On the Chemical Composition and Mechanical Properties of Chrome Steel," by M. Brustlein, Unieux, France. "On American Blast Furnace Practice, with Special Reference to the Works of the South Chicago Iron Company," by Mr. F. W. Gordon, Philadelphia. "On Combustion, with Special Reference to Practical Requirements," by Mr. Frederick Siemens, London. "On Some Early Forms of Bessemer Converters," by Sir Henry Bessemer, F.R.S. "On Modifications of Bessemer Converters for Small Charges," by Mr. John Hardisty, Derby. "On Silicon in Pig Iron," by M. Gautier, Paris. "On the Elimination of Silicon, Phosphorus, &c., in the Basic Open-hearth Process," by Mr. F. W. Harbord, Bilston. "On the Erosion of Gun Barrels by Powder Products," by Sir F. Abel, C.B., F.R.S., and Colonel Maitland, Woolwich. "On the Process Employed in Casting Brass Chains at Jeypore, Rajputana," by Surgeon-Major T. H. Hendley. Illustrated by examples. Contributed by Mr. C. Purdon Clarke, C.I.E., Keeper of the Indian Museum, South Kensington. "On the Casting of Chains in Solid Steel," by M. Ferd. Gautier, Paris.

DEATH.

On Wednesday, the 22nd September, at Hasledene, Balham Park-road, S.W., WILLIAM MORRIS, C.E., late of The Limes, Grosvenor-road, Chiswick, and 2, Westminster-chambers, third son of the late John Morris, of Poplar, aged 50. Canadian papers, please copy.

THE ENGINEER.

OCTOBER 1, 1886.

THE IMPERIAL INSTITUTE.

A MEETING of influential men has been held in the City to consider the Prince of Wales' proposal for the establishment of an Imperial Institute. We have already fully explained what this Institute is supposed to be, and we shall not go over old ground. Once more, however, we counsel extreme caution. At the present moment, fortunately perhaps, nothing definite has been put forward. It is extremely easy to suggest the formation of an Institute which will bind England and her Colonies closer together; but the moment we come to details we find the whole question beset with difficulties. In the first place, there must be a building of some kind. Where is this building to be? What is it to be like? What is the accommodation that it must provide? The paramount idea in certain quarters is of course that the existing buildings at South Kensington are to be utilised for the purpose. If the object was merely to have a species of perpetual exhibition of Indian and Colonial produce this might do; but the theory of an Imperial Institute contemplates something more than this. It cannot be expected that the public would visit year after year such an exhibition pure and simple in any great numbers, or that if they did, our colonists and our Indian Empire would be in any way the better for the visiting. The Exhibition at South Kensington depends enormously for its popularity on its music and the electric light. The fountain plays no inconspicuous part as an attraction. These things are well enough for an exhibition, they would be costly excrescences on an Imperial Institute. If that is to be of use, it must be so situated that men engaged in commerce can gain ready access to it; and this fact puts South Kensington out of the question as a locality for the requisite buildings. To common-sense individuals, the City seems to be the only place where the Imperial Institute can find a home; but the purchase of land and the erection of a suitable edifice would require the expenditure of an enormous sum of money, and it is very difficult to see how any adequate return could be reaped. This is only one of the numerous difficulties in and objections to the whole scheme—if scheme the chaotic speculations now before the public can be called; others present themselves at every turn. The London Chambers of Commerce have long contemplated the formation of a museum, and they look now with disapproval on the new plan; but without their aid, how can the proposed Institute be a success? There are two existing societies which are intended to perform much the same functions as the proposed Institute. One of these is the Royal Colonial Institute. If it is a success, what more is wanted? If a failure, what guarantee have we that another will be more successful?

It is at present impossible to form anything more than the vaguest idea of what is intended, or indeed of what such an Institute should be. The only thing certain is that South Kensington cannot be its home. Merchants coming to the City to transact business cannot spare the time required for a trip to South Kensington. Yet we have no hesitation in saying that a desperate effort will be made to utilise the existing building and the existing officials at South Kensington for the purpose. Nothing, however, can be done without money, and we once more urge on our readers, home and colonial, the utmost possible caution in giving money. It is probable that a satisfactory scheme may be elaborated in process of time; but it cannot be done in London, and it cannot be done in a hurry. Commercial circles in India and our Colonies must be consulted, and their expressed wishes must have the fullest consideration. An Imperial Institute, to be worthy of the name, must be the work of all the great dominions embraced under Queen Victoria's rule. They must all have a voice in saying what it is to be and how it shall be managed. Without their co-operation success is impossible. The very first step to be taken is to adopt such means as may elicit an expression of opinion from properly qualified persons in Canada, Australia, India, New Zealand, &c.; and until these opinions have been obtained it would be premature to do anything in this country. Nothing perhaps would be easier than to obtain a certain amount of colonial support from non-influential men abroad, and to make this a means of raising money at home. Failing other things, a determined effort may be made to constitute the South Kensington show a temporary home for the Imperial Institute; and if this is once done, it will be quite impossible subsequently to get rid of South Kensington. There never was produced, we suppose, a scheme which lends itself so readily to the perpetration of a gigantic job. Who, we ask, is to prevent the job from being perpetrated? The Prince of Wales can and will, no doubt, do a great deal; but he cannot work impossibilities. So long, however, as money is neither given nor promised, so long will no harm be done. When a plan fairly satisfactory in all its details has been produced, and put in something like a complete form—complete in details especially—then money may be given or promised. It is a matter of small importance to many rich firms to subscribe large sums, but in doing this they will do harm. Nothing is more to be dreaded about the whole matter than giving offence to our colonial friends, and indications are not lacking that unless South Kensington influence is very carefully eliminated, India and our Colonies will leave the Imperial Institute to shift for itself.

THE FATAL DISASTER ON LOCH FYNE.

THE terrible accident at the Crarae Quarries at Loch Fyne must not be allowed to pass by without careful consideration of the causes which led to it and their future prevention. What has happened before may occur again. The less cause there was for expecting it, the more likely it is to be repeated. It is our positive duty, then, to examine the circumstances of the case. The facts briefly stated are as follows:—A thousand spectators witnessed a gigantic blasting operation, by which 60,000 or 70,000 tons of rock were dislodged by the explosion of 7 tons of gunpowder. The rock had been bored, it appears, for 60ft. in a straight line, with branch chambers running 20ft. right and left from the innermost end of the main chamber, thus forming a sort of T. The charge was fired by electricity, and the work seems to have been well and scientifically performed, the whole mass yielding without awkward waste of force. When the smoke had somewhat cleared away, a large party landed and proceeded at once to visit the quarry and examine the effect produced. Entering the quarry, which is described as being in the form of a horseshoe, the visitors stood about conversing for a few minutes, when one after another different members of the party fell down insensible, till in a few minutes some eighty or a hundred were lying prostrate. This had occurred so rapidly that the state of matters had only dawned on a few and had not been apprehended generally by the party in time to get them out. As it was, however, such strenuous efforts were made that all those fallen were very quickly carried forth. A warning seems to have been given by a quarry man which was not regarded, and probably was only heard by a few. The insensible sufferers were carried to the shore and most of them gradually came to their senses, with the painful manifestations attending certain forms of semi-consciousness—screaming, raving, and convulsions, while some moaned, and others were bereft of speech. The scene cannot have failed to be distressing beyond description, the worst being that it shortly appeared that in seven cases death ensued. The names of the deceased being: Councillors John Young and Thomas Duncan, and Mr. Matthew Waddell, of Glasgow; Mr. Steel, of Ann-street, Belfast; Mr. Peter Stevenson, Forest-road, Edinburgh; Mr. James Shaw, of Glasgow; and Mr. Small, of Dalry in Ayrshire. The accounts of those present speak of smoke oozing from the cells where the powder had been charged. They mention a pungent smell. The gas is spoken of as "sulphurous gas" and "sulphurous hydrogen." On what ground it was so designated does not appear. Some silver money was found tarnished by Mr. Councillor Brechin, but probably it was assumed to be "sulphurous gas" by most. It is to be observed that some who were inside the quarry and who suffered very little, such as Mr. Garcia and Doctor Taylor, had mounted up on some stones above the ground level.

The above facts we think point out pretty clearly what happened. One or two questions were raised as to "fire damp" existing in the quarry. These may be at once dismissed, seeing that we have to deal with granite, not with coal. The action of the powder moreover is sufficient to account for what took place. Ordinarily no one thinks of incurring danger from the products of fired powder, because it generally is burnt in the open air and in comparatively small quantities. In the case of mines, however, it has to be considered. About three years ago, we think, a German soldier lost his life in some siege operations from venturing into a mine soon after a charge of powder had been exploded in it; and in the case before us the quarry men knew danger existed, and brought up instances of temporary prostration being caused by rashly approaching a spot where blasting had been performed. When the magnitude of the charges fired at Crarae Quarries is considered, and the fact that the charges had been imprisoned in chambers from which the gases would only gradually escape, and that the visitors were standing in a sort of pit in which the gases might lie some time before they became dispersed, the results, however deplorable, are easily explained, if they are such as might be produced by the products of fired powder. The products of explosion of powder have been the subject of investigation from time to time during the last century. The crowning examination of the subject was a series of experiments made by Captain Andrew Noble and Sir Frederick Abel, in the course of which powder was exploded in a completely closed vessel made of mild steel, which was sufficiently strong to hold the gas so that it could not escape or alter its composition by access to the air before it was examined. A detailed account of this will be found in Bloxam's "Chemistry," by which it appears that the results obtained with three samples of powder furnished from Waltham Abbey showed that a solid residue was found which consisted chiefly of carbonate, hypo-sulphate, sulphate and sulphide of potassium; while the gases evolved were principally carbonic acid gas and nitrogen, with a small quantity of carbonic oxide.

We have, of course, only to consider the possible effects of the *gaseous* products—that is to say, the carbonic acid, nitrogen, and carbonic oxide. The two former, which constitute the main volume of the gas generated, will not support life, but they are not actively injurious. A man would die in an atmosphere consisting wholly of these gases simply because his lungs would not find the free oxygen needed to support life, but he would not be poisoned any more than he could be said to be poisoned by strangulation. As far as the carbonic acid is concerned, he would be strangled, because that gas causes spasms of the glottis, and cannot be inhaled at all unless largely diluted. Supposing then that those in the quarries had merely found themselves in such an atmosphere, they would have moved into purer air. It is probable that this was the experience of some of them, because carbonic acid and nitrogen are formed out of all proportion to any other product. The sensation, however, would hardly be that of complete stoppage of breath, seeing that the air would be mixing with these gases. Atmospheric air consists chiefly of nitrogen, and it contains a little carbonic acid, in greater or less proportion according to circumstances, and these are the two gases expelled from the human lungs in each act of respiration, so that nothing more than a choking sensation or difficulty in breathing could arise from the presence of these main products of explosion, if no other gas were present. These two were, doubtless, present in large quantities. Dr. Taylor, of Port Glasgow, says that he was standing on a heap of stones in the quarry, "when he perceived a pungent odour, and, *stepping down*, he found 'a difficulty of breathing.'" Now it happens that carbonic acid is a very heavy gas, more than half as heavy again as air, consequently it clings to the ground. Doubtless then Dr. Taylor, when he stepped down off the heap of stones, descended into an atmosphere consisting largely of the ordinary products of fired powder, that is, carbonic acid and nitrogen. Naturally, then, he felt a difficulty of breathing. This did not, however, disable him, nor would it have disabled the men who became insensible with such extraordinary rapidity. For this we must look for another cause, and, unfortunately, such a cause is only too readily presented by the remaining gas mentioned above, namely, carbonic oxide. This was found only in small quantities by Noble and Abel, but their powder was in each case a superior sample, and was very perfectly exploded. Powder used for mining operations is generally of a very inferior kind; indeed, it would be wasteful to use any but second-rate or damaged powder for such purposes. Here the explosive action would be less perfect, and probably carbonic oxide would be produced in much larger quantities than in Noble and Abel's experiments, and possibly other gases in small proportion. Now, carbonic oxide is of so poisonous a character that, according to Leblanc, one volume of it diffused through 100 volumes of air totally unfits air to sustain life. It is this gas rather than carbonic acid which has caused the death of persons sleeping with charcoal stoves in closed rooms. Dr. Percy, in his "Metallurgy of Iron and Steel," gives some lengthened accounts of poison by carbonic oxide, C O —pp. 528, &c.—chiefly supplied by Dr. A. S. Taylor in "Medical Jurisprudence." Dr. Christison mentions a gentleman in Dublin who inhaled it two or three times as an experiment, and was at once "seized with giddiness, tremors, and an approach to insensibility, succeeded by languor, weakness, and headache of some hours' duration. Another, who exhausted his lungs and then filled them by inhaling pure carbonic oxide three or four times, fell down supine, and continued for half an hour insensible, apparently lifeless, and with the pulse nearly extinct. Various means were tried for rousing him without success; till at last oxygen gas was blown into his lungs. Animation then quickly returned; but he was affected for the rest of the day with convulsive agitation of the body, stupor, violent headache, and quick irregular pulse, and after his senses were quite restored he suffered from giddiness, blindness, nausea, alternate heat and chills, succeeded by feverish, broken, but irresistible sleep." Bernard, after careful investigation, speaks of convulsions as a characteristic effect of carbonic oxide, and a peculiar reddening of the blood, which may continue for two or three weeks. We give these symptoms at length because they furnish a standard by which to compare the experiences of the sufferers in Loch Fyne quarries. Probably the daring gentleman in Dublin took as strong a dose of carbonic oxide as a man can well take; happily for him he was surrounded by all the skill and expedients that Dublin affords. Had oxygen not been forced into his lungs it appears very likely that he would have expired. Considering that the sufferers in this case had been breathing gas consisting of the negative ingredients of atmospheric air, namely, nitrogen and carbonic acid, and the positive poison carbonic oxide, we conceive that oxygen pumped into their lungs would have been the most powerful remedy, as both neutralising the poison and supplying the other gases with the needed complement to form an atmosphere suited for human lungs.

As noted above, it is rash to speak positively as to the products of very imperfect explosion of powder, but when we know that carbonic oxide must have been produced in considerable quantities, it seems hardly necessary to inquire whether other gas may have been present in small quantities. The results manifested are likened to those produced by the inhalation of laughing gas—impure nitrous oxide—but it should be borne in mind that the phenomena which gave the name of laughing gas to this compound are those mainly dependent on its being used in an impure condition, and not as now prepared for use in surgical operations, and probably may be nearly identified with the effects above noted produced by carbonic oxide gas. The practical questions to solve are, what caused the chief injury, and how to avoid it for the future. We believe that those who know most about these matters will agree in attributing the evil to the products of the fired gunpowder, and mainly to carbonic oxide. The chief lesson to learn is the danger of approaching the spot where any blasting operation has taken place until abundant time has been given for the gases to disperse; and it may be observed that this applies quite as fully to the cases where nitro-glycerine and other compounds have been employed as to the case of powder. Even as we write an account comes of three soldiers in France losing their lives from falling or entering a hole made by the explosion of a shell charged with some special new explosive compound. It is seldom necessary to approach immediately; it is well therefore to give abundant time, and to consider the circumstances. The more perfectly the work is done, the more the gas has been held in, and the less the opportunity for it to escape by openings, and consequently the more time should be allowed to it. Then, of course, the magnitude of the charge and the measure in which the locality is walled in, must be further allowed for. In this case, apparently, the heavy carbonic acid appears to have lain close to the ground, the carbonic oxide, which is a very light gas, would emerge from it and diffuse through the air. Those standing on stones may have smelt it, but it may have mixed too rapidly with the air to injure them. Those who breathed it while it was still mixed with the carbonic acid and nitrogen, which would in no way neutralise it, would do so with the worst effects.

To those who may have to approach localities containing dangerous gas of this character in ironworks, Dr. Percy gives the following advice:—"Should any accident arise from its inhalation"—speaking of carbonic oxide—"the patient should be instantly removed from its influence, and conveyed where he may breathe as pure air as possible. Everything about the neck should be either removed or loosened, and the body should be kept warm by friction or otherwise. We have seen that inflation of the lungs with oxygen appeared to save life in one case; but in ironworks, even when provided with chemical laboratories, this remedy could hardly be prepared in time, and it might therefore be desirable to keep a caoutchouc bag filled with oxygen always at hand." These directions may be applied, with the necessary variation, to the work of mining and blasting operations.

RAILWAY RATES.

Last week we placed before our readers a multiplicity of facts concerning railway charges for goods which throw no small light into a very dark place. In this country traders and railway companies are alike dissatisfied. The former assert that the railway companies are so greedy that they are ruining trade by excessive charges. The railway companies, on the other hand, point to falling dividends, and assert that even at existing rates they can hardly pay their way. It is clear, therefore, that a change of some kind is desirable; when two parties with clashing interests are both discontented, it ought not to be difficult to alter existing arrangements. That the traders, that is to say, those using railways, are heavily burthened, is beyond question. There is a good deal of sense in the argument of the firms making rolled girders, for example; that they cannot compete with Belgium, because that country has less to pay for the conveyance of girders from Antwerp to London than the English firm has to pay for sending girders from Birmingham to the metropolis. But while we concede that a difficulty, if not a hardship, exists, we have to consider whether and how the hardship is to be done away with. No one desires to see railway dividends reduced. The capital invested is so enormous, and stocks and shares are held by so many individuals, that a reduction in dividends is little short of a national calamity. Yet, on the other hand, manufacturers must be considered, and if it can be shown that the railway companies do not carry on their business or work their lines to the best advantage, then we must side with the traders, and insist on the railway companies putting their houses in order, or suffering severely.

Roughly speaking, it may be taken that the cost of working the traffic of British railways is one-half of the gross receipts. In one sense this leaves a very large profit. We cannot name any other business conducted on a great scale in which the profits made equal half the whole turnover. If, however, we estimate the profits in terms of interest on capital invested, we find that they are not great. Six per cent. for money invested at some little risk is not much; and the circumstance that all paying railway shares are much over par of course tends to make the profits appear much smaller than they really are. Traders look on this question from one point of view and shareholders from another. The outsider may be permitted to regard the matter from a third standpoint, and assert that unless railways are worked as cheaply and efficiently as possible, they cannot be said to possess that national utility which is essential to commercial prosperity. Now, it does not need a very deep acquaintance with railway history and management to perceive that directors do not rightly study and practise economy. They never have done so, and very energetic action indeed will be found necessary to induce a change for the better. Dividends are small, although profits are immense, because the capital spent has been colossal. Much of this capital has been wasted. Law costs, due to the quarrelling of railway companies, have absorbed immense sums, and the same statement is true of branch and rival lines of no use to anyone. Latterly things have been somewhat better in this respect, but there is still room for improvement. Again, we find very large sums being continuously expended by railway companies in making changes. It is a peculiarity of railway companies that they perpetuate nothing. The cost of carriages, for example, is advancing by leaps and bounds. So is the dead and non-paying weight of rolling stock, and with this naturally rises the weight and cost of locomotives. The increase in weight has rendered necessary the rebuilding of bridges and augmented expenditure in various ways. All this has to be met either out of profits or by adding to the capital account. While their outlay is so lavish it is hard to ask directors to reduce rates. The directors assert that the public demand luxurious travelling, and they provide it, but the public has to pay for its whistle, and it unfortunately includes folk who are compelled to pay for what they do not want and have not asked for. Some people will ask how it is that the coach which satisfied everyone ten years ago will not satisfy them now, and it is very difficult to give a satisfactory reply. The answer must, we think, be sought not in the general public, but in the railway companies. If we take great rival lines we shall find that all their passenger fares are nearly alike. As competition cannot take place in fares it assumes another form, and one line vies with another in providing luxurious accommodation. One section of the public gains, but another suffers; and we may suggest that the nation, as a whole, is paying more for railway work than it can afford. The problem to be solved is how to pay dividends as now and yet reduce rates. It can be done we firmly believe, but it can only be done by practising economy scientifically, and with a keen perception of what saving can be effected without a reduction of efficiency. It would, of course, be utterly impossible in an article like this to indicate even a few of the leaks which railway money now escapes through; but we believe we are correct in saying that many directors fully appreciate the nature of the situation, although they are so far overruled by stronger minds that they are unable to act as their own right judgment dictates.

In this connection there is a multiplicity of points presented for our consideration, from which we can only pick out one. It appears that traders have placed far too much reliance on railway companies as carriers. In fact, the value of railways as goods' carriers has been overrated. There is nothing about a railway which gives it superiority over a canal but the circumstance that it carries goods quicker than the canal can. But in a very large number of cases speed is of no importance at all. It takes longer to get girders from Antwerp to London than it does to send them to the metropolis from the Midlands. But what then? Simply nothing. In a recent impression we have dealt very fully with canals, and we shall not unnecessarily prolong this article by repeating what we have said. There can be no room to doubt that the value of canals as carriers of heavy goods of all kinds might be very much ncreased by a moderate outlay, and that even as they stand they could be made extremely useful if the railway companies did not interfere to prevent any alterations, any improvement on the existing system. At present the railway companies are masters of the situation all round. How long they will remain so has yet to be seen. Much, of course, depends on the action taken by those most concerned, namely, the traders. It is for the railway companies to prove not that they cannot carry goods more cheaply than they do, but that they carry them as cheaply as possible. This, we think, cannot be proved. At present rates and classifications are simply chaos, and the servants of the companies hardly know what they ought to charge. To illustrate this point, we may cite a case which came under our own observation not long since. Some heavy machinery for an ironworks was sent over one of the great main lines to a roadside station, from which it was conveyed by wagons to the works, which had a wharf on a canal. The bill was sent for the railway charges, amounting to £26. The works manager refused to pay it, asserting that the rates charged were made for light finished machinery, and this was nothing of the kind. The reply of the railway company was that no mistake had been made, as the machinery consisted in part at least of rolls which were turned bright. A long correspondence ensued. The railway company reduced its charges step by step, re-classifying the machinery almost every week, discovered that a mistake had been made in the weight, and finally accepted £9 in full of all demands. If the railway companies, instead of quarrelling, would lay their heads together, and prepare rational classifications and equalise rates, very great advantage would be derived all round. It is for their own interest, above everything else, to show to the world that they are doing their best to carry on their business cheaply and efficiently. It is impossible, with the facts we published last week before us, to believe that they are at present doing either the one thing or the other. Economy and disorder never yet went together, and never will, even on a railway.

RENEWAL OF THE EASTERN MAIL CONTRACT.

The announcement that the Peninsular and Oriental Steam Navigation Company has secured the renewal for a period of eight years of its existing contract for the conveyance of the Eastern mails will be received with general satisfaction. We have heretofore pointed out in these columns the several considerations to which such a feeling must be due, and we have been at some pains to learn the conditions under which the renewal of present arrangements has been secured. The present contract terminates in February, 1888; therefore for a term of rather more than nine years to come no interruption of the service is likely to occur. This has not been secured, we learn, without the surrender of a very considerable sum by the company. At present it receives from our Government a subsidy of £360,000 per annum. Under the new contract the company is to receive but £265,000, thus involving a reduction of £95,000 in its annual receipt. At the same time that this loss has to be conceded, the Postmaster-General has further secured an increase in the rate of speed on the several lines served. This increase, however, so far as regards a gain to the public, is more nominal than real, because the higher rate of speed now guaranteed has, in effect, been almost invariably attained already by the vessels of the company, although it was not bound, under the terms of its contract, to give it. The increased speed may be stated in round numbers to be as follows:—On the Bombay line, the number of knots per hour is to be 12½, as against 11 as at present; and on the Ceylon, Calcutta, and China lines, 11¼, as contrasted with the existing rate of 10½ knots. To more particularise these speeds the exact decimal figures may be given, *i.e.*, between Brindisi and Port Said, 12·50 knots; between Suez and Bombay, 12·54 knots; and between Suez and Colombo, and from the latter port to Calcutta and Shanghai respectively, 11·20 knots. The contract for the Australian mails has not, we hear, yet been decided upon; but we believe that a considerably higher speed has been proposed by the company for the boats which will be detailed for that service should it secure the contract. In the event of the company doing so, passengers for Ceylon, Madras, and Calcutta, will participate in the advantage, as the Australian mailboats will invariably call at Colombo *en route*. We have been given to understand that little or no alteration will have to be made in the Peninsular and Oriental fleet to enable these several services to be accurately performed. Most of the vessels are equal to maintaining even a higher rate of speed than that now guaranteed, and a slight increase of boiler power will bring the residue of them up to the required standard of efficiency. But we learn that in view of all possible requirements the addition to the fleet of two very fine vessels has been ordered, and that Messrs. Caird and Co., of Greenock, and Messrs. Harland and Wolff, of Belfast, have each in hand at the present time a steamer of 6000 tons, the capabilities of which will be equal to the highest demand likely to be made for the Australian mail service should the contract for it be secured. Of course it can be foreseen that, unless trade materially improves, the company will have hard work in the face of recent increased competition by the German steamers to compensate its shareholders for the surrender of £95,000 of their annual income.

OUR LEAD IMPORTS.

The recent changes in the value of silver have had a serious effect on the silver-lead trade, which is largely dependent on it. We import a large quantity of lead both in the shape of ore and of pig and sheet lead. Last year there were 26,738 tons of lead ore, and 108,012 tons of pig and sheet lead imported, London, Newcastle, and Liverpool being the chief seats of the trade. In some considerable part of the lead there is silver, and the desilverisation has been rendered much less profitable by the long fall in the price of silver. In some cases the desilverisers are paid for their work by a tribute of silver out of that which they extract, so that not only has the owner to suffer, but the desilveriser also; and thus there was for a time disorganisation, which was increased by the fact that a large part of the lead we import is from Spain, and prior to the change in the tariff the approach of that change had its effect. The lead trade is one which is conducted under very peculiar conditions, and somewhat singularly, the causes which hurt the imported lead trade benefitted the native lead. But now that silver seems to have for the present reached the lowest point in the fall of its values, and now that the Spanish lead is brought in with a lower impost upon it, the lead trade has been benefitted in its imported section, whilst the native lead feels only the benefit of that slight improvement in the general trades of the country which seems to have shown itself of late. The lead trade feels such improvement in its home aspect only slowly. When there are very large building operations—the building, for instance, of large erections requiring sheet lead for roofs in large quantities—then the lead trade feels an impetus in all of its branches; but this has not been generally the case of late. There has been some recovery in the demand from some of our foreign customers, but the exports of pig lead seem to grow more than those of manufactured. Our lead imports fell last year, but seem likely now to rise again; but on the other hand the exports increased, so that the quantity retained for home consumption was considerably less; and this and the limited production gave a slight improvement to the position of the trade. How far the reduction in the importation was due to the low price known, and how far to the fall in the price of silver and to the effect of the Spanish tariff, cannot now be settled in proportion; but in all these three things there seems to have been a change now, so that it may reasonably be believed that we shall have a better state in the lead trade, as far as imports are concerned, and the importation from Spain is under much fairer conditions than down to a recent month. Our home lead producers are benefitting by the higher prices, which are the result of the lessened production brought about by the closing of mines, and of the sales of the stocks of pig lead which had accumulated, but for a permanent and large improvement the general revival of trade must be waited for.

LITERATURE.

Die Graphische Untersuchung der Centrifugalregulatoren. By Gustav Herrmann, Professor in the Technical High School in Aix-la-Chapelle. Berlin: Julius Springer. 1886.

We recently reviewed Professor Gustav Herrmann's work in representing graphically the laws of thermodynamics and their applications to boilers and steam engines. We had much to say in favour of his treatment of this subject. It put many old things in a new and forcible light, and it developed some not generally known and important results. Prof. Herrmann still appears as a foremost exponent and advocate of the graphic faith. It seems that in Germany, the adopted home and nursery of this new "*culte*," which has done so much to revolutionise modern engineering science, the once ardent disciples are showing some tendency to backslide into coldness, indifference, and scepticism. So at least one judges from some controversial parts of the book before us, in which Professor Herrman makes some very pertinent remarks in defence of his position that "Graphics" ought to be incorporated in the normal programme of study in all technical schools. It seems that it has been objected to graphic methods that they require great exactitude in drawing, and constant practice to prevent loss of skill. The very evident reply is that arithmetical and algebraic calculations require absolute avoidance of mistakes in order to make them of any value; that there is no art in which skill is so rapidly lost by want of continued practice as in the arts of arithmetical and algebraic reckoning; and that exactitude in draughtsmanship is in so many ways a supreme advantage to the engineer that any system which has a tendency to encourage and promote this particular kind of accuracy should have this tendency counted as one of its special advantages.

In this connection Herrmann makes another remark to which it is well worth paying particular attention, because the matter is one which concerns one of the most prevalent and dangerous vices of our "professional" engineers. He points out—and the same has been insisted on more than once in our own columns—that the degree of possible accuracy in graphical calculation is in general agreement with that of the experimental data upon which technical calculations are founded. These are almost always only approximations to the unknown actual quantities, and yet it is the common practice of too many "professionals" to deduce from them results which they express by rows of many significant figures. The results are in most cases really uncertain beyond the second figure, and very seldom is there any certainty about the fourth figure. Yet we are treated to numbers of six, seven, sometimes nine or ten, significant figures. This may have an imposing effect with those who do not understand such matters; may produce in the minds of innocents the impression of scientific profundity and skill on the part of the operator. But if this sort of proceeding is adopted knowingly, and, perhaps, although not necessarily, for the purpose of producing this impression, it amounts, to put it plainly, to nothing but downright dishonesty. Whereas, if it is done in unconscious innocence of its intrinsic absurdity, it convicts the perpetrator of what ought to be stigmatised as scientific ignorance and want of intelligence. If the public could only be got to recognise the misleading character of such displays of numerical calculation and to stigmatise them as above, they would very speedily disappear from pretended scientific reports. Now, one advantage of the graphic method is that by it it is generally impossible to read off your result to more than three figures, and never possible to do so to more than four. Combined with this there is the equally important advantage that most graphic calculations are self-checking and that it is thus impossible in them to make any gross, *i.e.*, any very large error without its being detected, whereas such errors are easy to make by inadvertence or want of skill in arithmetic and algebraic reckoning. At the same time Professor Herrmann is careful to admit that there are many sorts of calculations for which the graphic is not the most suitable method.

In the present book Professor Herrmann expounds the graphic calculation of centrifugal governers. In doing so he is able to take into account the centrifugal force and the weight of the arms and links of the mechanism as well as of the balls and central loads; and he also brings into the reckoning the friction at the joints. He says it would be practically impossible to do this by any other than the graphic method. We cannot quite agree with him in this last assertion, but heartily agree that graphic construction is an excellent and expeditious method of investigating the properties of any given governor. By using it one recognises that one of its special merits is that when the construction has once been made for one configuration and speed of the mechanism, it takes very little extra time to repeat the construction for a number of other configurations. By doing so one is enabled to draw out a curve diagram which displays the important characteristics of the governor throughout its whole range in such a clear and comprehensible manner as no other method of investigation can at all compete with.

Professor Hermann first draws out the "force diagram" for the mechanism in the given configuration irrespective of friction, and taking the centrifugal force as a single one acting through the centre of the rotating ball. This is done in the illustrations for some five or six different well-known forms of governor. He then proceeds to show how the centrifugal forces of the various parts of a geometrically regular or irregularly distributed mass can be compounded into a single resultant force. This resultant does not in general pass through the centre of the ball, but Herrmann substitutes for it a force passing through this centre that will have the same turning moment round the suspension pin. In this way the masses of the ball suspension arms, and of the links from the ball to the sliding sleeve are brought into account, their weights being similarly compounded according to well-known rules.

In the later part of the book these constructions are repeated, taking into account the friction at the three pin joints. This is done by the method of friction circles, which was, so far as we know, first invented and published by Professor Fleeming Jenkin, but which is here explained as if it were Professor Herrmann's own. By this means is calculated the variation of speed that occurs before the friction of the governor itself, exclusive of the resistance of the gear which it controls, permits a change of configuration and a movement of the valve. The ratio of this to the mean speed is called the coefficient of insensitiveness. There is next found another fraction called the "energy" of the governor. Suppose the speed of rotation to be increased 1 per cent. of the normal speed, then find what extra force in the direction contrary to that in which the sliding sleeve tends to move in consequence of the change of speed—which direction is parallel to the axis of the rotating spindle—must be applied to this sleeve to prevent this motion taking place. This is the force the governor is capable of exerting to overcome the resistance of the gear it is expected to control on the occurrence of a standard variation of speed, namely, 1 per cent. It is a measure of the power of the governor, using the word "power" in the sense of force. It is unfortunate to call it the "energy" of the governor, because this tends to perpetuate the confusion that still exists between "force" and "energy." There can be no harm, however, in adopting in England the term "power of the governor." "Shifting force," or "controlling force," would be a more scientifically unambiguous phrase. This controlling force increases in proportion to the moving masses in the governor construction, and therefore, in order to compare fairly one design of governor mechanism with another without reference to their mere size, the Germans divide this force by the total weight of the moving parts; this being considered right, "especially," as Herrmann says, "as the price is roughly in proportion to this weight." In passing, two objections to this proceeding may be pointed out: Firstly, the above force increases not only in proportion to the mass, but also in proportion to the normal speed—not the square, but the first power of the speed. Therefore to be quite fair in our comparison, from a scientific point of view, we must take the force not only per pound of weight of the moving portion of the mechanism, but also per revolution of its normal speed; or rather, it would be necessary to take all governors, for the purpose of this comparison, at one standard speed—say 100 revolutions per minute. But from another point of view this would be obviously unfair, because one governor is specially designed for a high speed, and will either not work at all or will do so very badly at the standard speed; while others are designed for a much lower speed than 100 revolutions, and will show up just as badly at this standard. Again: it is the gross amount of this force that is really of importance to the buyer and user of the governor, and within certain limits as to bulk on the one side and mechanical durability on the other, it matters little to him whether the governor is made more powerful by increasing its weight or by adopting a more ingenious form of mechanism. We think therefore that the total controlling force—unreduced to per pound of moving mass—per one per cent. of variation of speed is the fairer measure of the power of the governor. If this be so considered, then the ingenious maker of governors has a fair field of pecuniary reward before him in increasing this power by adopting high speed without simultaneously incurring extra expense in bearings to secure durability, and in obtaining the required power with a smaller expenditure in weight of metal.

As examples of these coefficients, we quote the following as worked out graphically by Professor Herrmann for a Proell governor:—The speed ranges from 92·7—highest—to 90·9—lowest—revolutions per minute, the mean being 91·3. The "coefficient of speed variation" is therefore $\{92{\cdot}7 - 90{\cdot}9\} \div 91{\cdot}3 = 0{\cdot}02$. There is needed a variation of $\frac{7}{10}$ per cent. of the normal speed to overcome the friction of the unloaded mechanism hindering up or down motion from the normal position, and thus $\frac{7}{10}$ per cent. is the "coefficient of insensitiveness." To prevent 1 per cent. variation of speed shifting the sleeve on the spindle, there requires to be applied to this sleeve a force of $\frac{8}{10}$ kilog. parallel to the spindle. This $\frac{8}{10}$ kilog. is the gross "power," and reducing it to per kilog. of mass in the moving parts, it is $15\frac{3}{10}$ grammes. This $\frac{8}{10}$ kilog., however, includes the internal frictional resistance. Over and above this, the governor is able to exert only $\frac{52}{100}$ kilog. on the sleeve per 1 per cent. variation in speed, the internal friction being equivalent to a pull of $\frac{28}{100}$ kilog. on the sleeve.

At page 5 our author says that after finding the centrifugal force, we may eliminate consideration of the rotation of the spindle, and solve the problem as if it were one in statics. We would take no exception to this if the mechanism were to be taken as frictionless, but it cannot be admitted when the friction has to be reckoned as one of the forces. Even in steady running the resistance of the air to the balls' passage through it puts a twisting stress on the driving pin joints, which is greatly increased when change of speed occurs because of the acceleration of angular momentum. This twisting stress causes far more friction at these joints than do the simple tensional pulls exerted by the suspension arms, and its amount depends on the speed of rotation and on the rate of change of that speed. Herrmann, in his calculation here given, has taken a coefficient of friction of from $\frac{1}{8}$ to $\frac{1}{12}$ for these pin joints. This would be altogether extravagantly large if the friction were caused only by the direct pull, but taken as a ratio between the actual friction and this pull, we are convinced that it is too low for some governors where the end surfaces of the pin joints are large in comparison with the other dimensions, and where the speed of rotation is great, the friction due to twisting stress being sometimes so great as to hinder the outward and inward motion of the balls almost as much as if these joints were regularly jammed. In Pickering's governor this pin joint friction is entirely done away with, and with it one of the chief causes of insensitiveness. We are surprised that the principle of Pickering's governor is not more followed in this country.

Again, objection must be made to Herrmann's mode of substituting an equivalent centrifugal force through the centre of the ball for the actual resultant centrifugal force. Here again, if friction were not to be considered, this substitution would lead to no error. But by following this construction, as done in the book under review, one important component of pressure on the pin where most of the friction arises, is neglected altogether. The resultant is resolved into two parallel components, one acting at one end of the arm, acting round the suspension pin with a moment whose leverage equals the arm length resolved vertically. The other component passes through the pin centre, and has thus no leverage round that centre. It is therefore that it is neglected, but in doing so it has been forgotten further on, when taking friction into account, that this component pressure produces friction at this pin. The error would not occur if the actual resultant centrifugal force were used in the calculation, and to do this would not in any degree make the graphic construction more complicated or difficult.

Finally, in the calculation of the sensitiveness, we would suggest that it is not only the internal friction and the resistance of the gear to be controlled that have to be reckoned with. If the mechanism were frictionless and the resistance of the gear zero, it would still require an effort to change the speed of the governor. At the changed speed the kinetic and gravity-potential energies of the balls are different, and work has to be done to produce this increase of energy. To calculate this work and the force required to do it is a dynamical problem which we worked out some time ago. The force required evidently depends on the rapidity with which the change of configuration takes place. Now, if one considers these elements of the problem as well as the others, one finds oneself compelled to take a wholly different view of the sensitiveness of governors. In Herrmann's coefficients, which are the same as in common use in Germany, no consideration is paid to the rapidity with which the governor shifts from one configuration to another. But evidently the utility of the device for controlling the supply of steam to, and through it the speed of, an engine, does really depend on this rapidity. It seems therefore to us that a correct coefficient of sensitiveness must take account of this rapidity. The coefficient must include a dynamical element as well as a statical one.

R. H. S.

A Search for Coal.—It is now stated that the experimental boring which is being sunk at the Channel Tunnel works is for the purpose of ascertaining whether the geological formations contain any evidence of the presence of coal in the district. It is contended by some geologists that coal beds should exist somewhere in the south-east of England. Boring operations proceed daily, and a considerable depth has already been pierced. The site of the boring is immediately on the west side of the Shakspeare Cliff Tunnel.

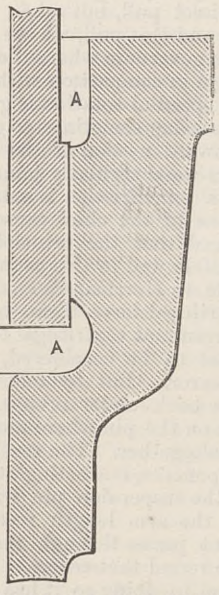
VISITS IN THE PROVINCES.

COCHRANE AND CO.'S IRON WORKS, DUDLEY.

Messrs. Cochrane and Co., whose works cover twenty-five acres of ground at Woodside, Dudley, make pig iron, cast iron pipes and columns, bridges and girders; but they do not convert their pig into finished iron, although all their castings are made from the product of their blast furnaces, and they have long ago abandoned the manufacture of boilers. Independently of the blast furnace department, about 500 men are employed at the present time, as there is a considerable amount of bridge and girder work in progress. The works adjoin the Dudley and Stourbridge Canal, by means of which they are placed in communication with all their markets; and they are also connected by a siding with the Great Western Railway, which is in close proximity. It is, however, found more convenient, as a rule, to load goods directly on to canal boats, by which they are conveyed to their destination or to the railway goods stations.

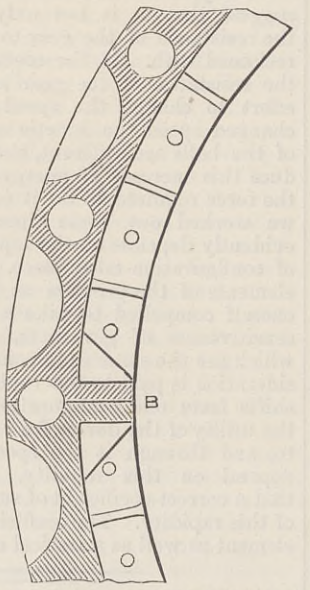
There are three blast furnaces, with mouths closed by bell and cone. Besides heating the blast in Cowper stoves, the gases are utilised for firing the blowing engine boilers. When, as usual, two furnaces are in blast—producing 450 tons of pig weekly—the gases suffice for this purpose by themselves; but now that there is only one furnace "in," it is found necessary to keep a slight layer of slack on the furnace, to again ignite the gases, after having been allowed to escape on lowering the charge. Besides producing foundry pig, the furnaces make an esteemed brand of forge pig known as "Woodside" after the works. One of the furnaces is now being raised, and also iron-cased. Some old externally-fired "balloon" boilers are still making steam at 7½ lb. per square inch.

The foundries are capable of turning out 2000 tons of pipes and columns weekly. Pipes are cast vertically with the socket downwards, a considerable length of head being left on the spigot end, and afterwards cut off in the lathe, to insure a sound casting. Moreover, each separate pipe, from 2in. to 48in. diameter, is tested by hydraulic power, before being sent out, the joints for this purpose being made by rope grummets. The moulds for large pipes are made upon a foundation plate, supported on legs, at the bottom of the casting pit. This plate has four lugs cast on its upper surface for retaining the lowest ring of the foundry box. The cast iron pattern of the socket is laid downwards on the plate, when sand is rammed between it and the foundry box ring. The ring and mould are then raised together by a crane, leaving the pattern behind, which is removed and the mould replaced. Another ring is then added on the top of the foundry box; and a cylindrical pattern is dropped over the socket mould, sand being rammed between the two, and so on until the full length is completed. The mould is dried in place in the pit, air being forced by a fan through a coke furnace, down a tube, and up the mould. A loam core is then put in place, resting on a conical flange in the foundation plate; and the metal is poured in the usual manner. When set, the core tube is pulled up by a crane, being twisted with a bar so as to loosen it, when the pipe is readily withdrawn from the mould. The spigot and the socket are cast with annular projections, as shown at A A in the annexed sketch, which are turned and bored respectively. The spigot is driven tightly into the socket, making a water-tight joint, supplemented only by running in lead.



COCHRANE & Co.'s CAST IRON PIPE JOINT.

Messrs. Cochrane and Co. have obtained the contract for widening the South-Eastern Railway Company's bridge at Cannon-street, and they are now engaged in making the pier rings, which are cast in six segments, the lowest ring having a bevelled edge to favour its sinking. A segment of the fluted portion is shown by the accompanying horizontal section, the two longitudinal faces, B, being planed in an inexpensive and ingenious manner. The foreman of the shop, with a keen eye to adaptability, has turned up on end an old planing machine that had long been disused, and works by a belt-driven drum, pitch-chain, and spocket wheel, the now vertical table carrying the tool-boxes, making them reverse at top and bottom by coming into contact with stops, so as to cut in both directions. The segments are now bolted together, with only a little red lead between, the holes having been left so true in casting that they do not require boring; and the whole ring is made to revolve in a lathe, the horizontal faces being turned simultaneously.



COCHRANE & Co.'s SEGMENT OF BRIDGE PIER.

The marking off of holes in girder plates is usually dispensed with, because the plates are planed on all their edges, thus trueing them up. All the holes are then drilled simultaneously by a multiple drilling machine, the plate being set by one edge, thus ensuring absolute exactitude. When holes are punched, which is rarely the case, an iron template is used for marking them off. Rivetting is done by steam and by hydraulic power, the latter being preferred because it can be brought to the work. Some large Warren girders were being built up while the works were thrown open to the members of the British Association, and also some 100ft. span box girders with an additional vertical plate in the centre. The T stiffeners for plate and lattice girders are bent to form under the steam hammer, the head of which is brought down gently on to the red-hot bar, and then pushed, like a ram, by admitting steam above the piston, the top and bottom blocks being made of the required shape. Frames for connecting two girders are bent out of a single T-bar—so as to require only one weld—in a horizontal hydraulic press with suitable heads. In both cases the bars receive a few blows with the sledge, in conjunction with a sett, for taking out the irregularities of surface caused in bending.

Messrs. Cochrane and Co., who put up the Holborn Viaduct, designed by the late regretted Mr. Ordish, the Charing Cross and Cannon-street railway bridges, the Clifton Suspension Bridge, and the large bridge over the Mersey at Runcorn, deserve our best thanks for having, after some hesitation, so unreservedly placed at our disposal the above information.

PARNELL'S SLIDE VALVE AND LAUNCH ENGINES.

FIG 1

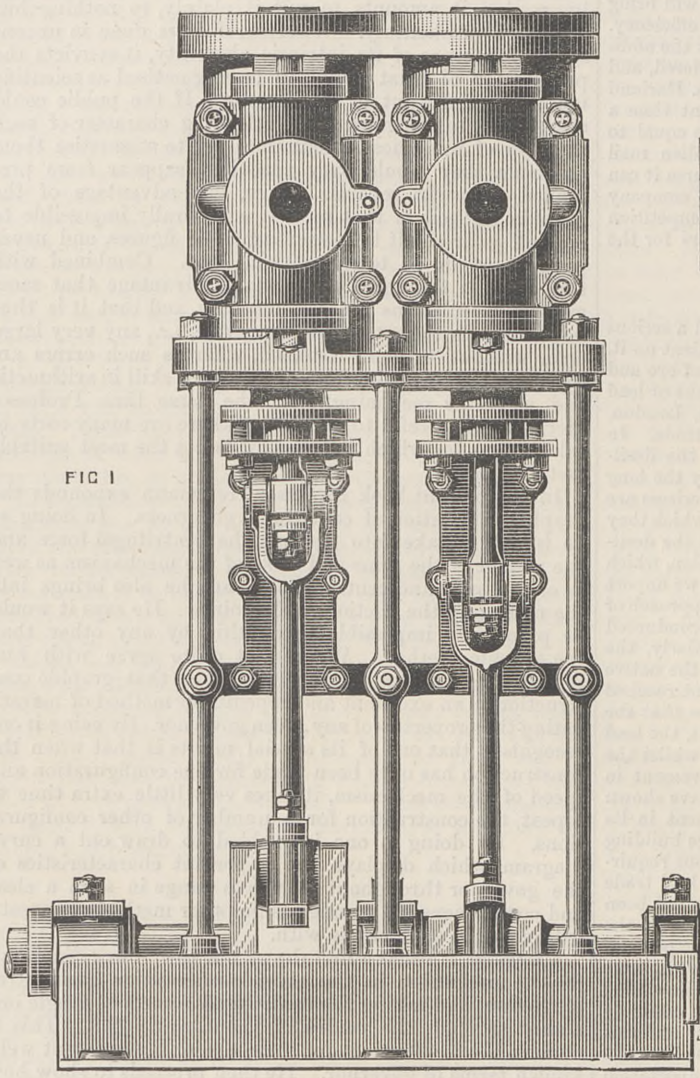


FIG 2

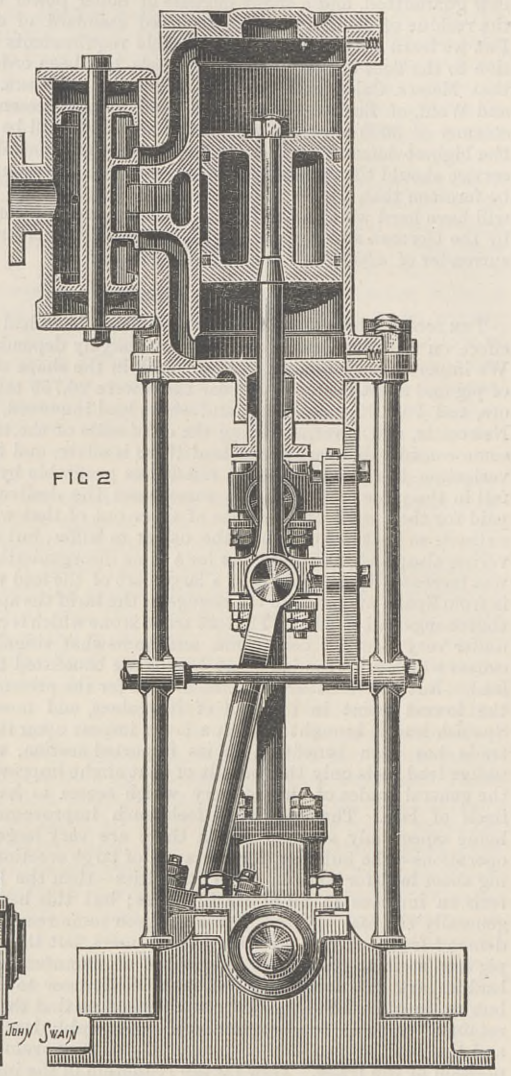


FIG 3.

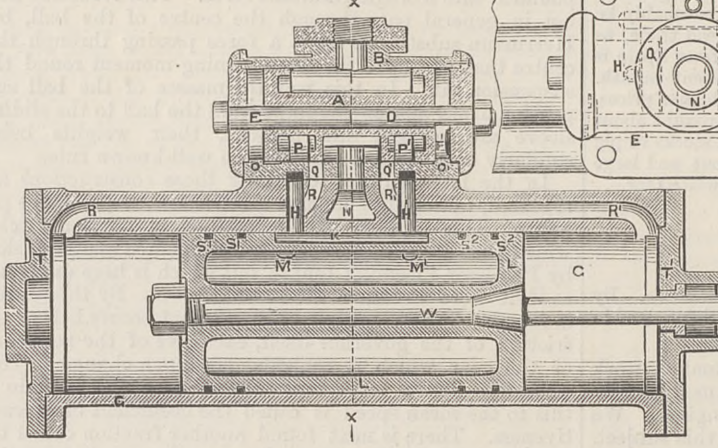


FIG. 4.

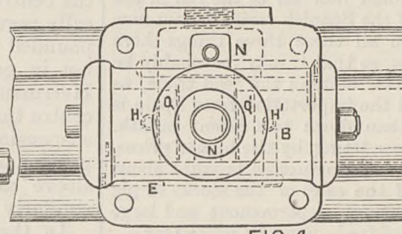
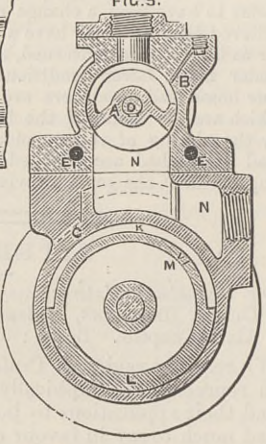


FIG. 5.



PARNELL'S PATENT SLIDE VALVE.

The accompanying illustrations represent a novel departure in the method of actuating the slide valves of engines; the patentee, Mr. G. T. Parnell, in the present case having applied his invention to a pair of launch engines, which are now on view at the International Exhibition, Liverpool. The striking feature of the invention lies in the fact that although the distribution of the motive power is effected by a slide valve, yet it is accomplished in such a manner as to admit of all slide spindles, stuffing boxes, and the usual extraneous gearing being dispensed with. As will be seen hereafter, not only is the movement of the valve imparted to it by the steam itself, after having done its work on the piston, but its motion is also directly controlled by the movement of the piston, hence the pair of launch engines illustrated may, by the aid of a simple three-way cock, be run in either direction as readily as if fitted with the usual link motion. The side and end elevations, Figs. 1 and 2, will show on reference that apart from the valve arrangements the engines in their general design possess no special features of novelty calling for explanation; we shall therefore confine ourselves to a description of the valve and its mode of action. The valve, piston, and auxiliary ports and passages, through which steam passes to impart motion to the valve, are shown in detail in Figs. 3, 4, and 5, of which Fig. 3 is a longitudinal section, Fig. 4 a plan, and Fig. 5 a cross section taken on the line *x*, *x*, of Fig. 3.

From these latter illustrations it will be seen that the cylindrical valve A is formed with a piston at each end and a recessed projection in the centre, having a sufficient width transversely to cover the exhaust port N, the whole being of such a length as to allow of passages P and P^1 between the pistons and the projection, by which the live steam gains access to the openings Q Q^1 formed in the valve case B. The valve, turned to fit the correspondingly bored out valve case, has a reciprocating motion within the case on the central bar D, which, in addition to thus acting as a guide, serves also to secure the covers of the valve-case in place, a long feather preventing any rotary movement of the valve. The arrangement and object of the auxiliary ports and passages and the recessed piston, will be best explained by considering the *modus operandi* of the invention. Assuming the valve in Fig. 3 to be to the right of the position in which it is shown, and steam to be shut off; now on the admission of steam it will enter the cylinder by the passage P, opening Q and port R, forcing the piston outwards until it clears the small vertical port H. Part of the steam then passes by the port H, along the passage E—see Figs. 4 and 5—and thence by the controlling port F^1 to the outer face of the righthand piston of the valve. The valve then moves over to the left, cutting off the admission of steam to that end of the cylinder, and steam is admitted to the opposite end of the cylinder. This cycle of operations is repeated for every revolution, the recessed projection on the valve alternately placing the ports R and R^1 in communication with the exhaust N. The steam which causes the movement of the valve serves on its return stroke as a cushion to prevent a blow against the valve-case cover, and is finally and alternately exhausted by one or other of the controlling ports F or F^1, passage E or E^1—see Fig. 4—and vertical port H or H^1 to the recess K in the piston, from whence it escapes by the opening M or M^1 to the exhaust N—see Fig 5.

As previously stated, reversing, in the case of a pair of engines, is effected by a simple three-way cock. By this means steam is admitted to which ever piston is then standing in the most favourable position—near the end of its stroke—for the way in which it is required to run, and as soon as the engine commences to move in the required direction steam is admitted to both cylinders. In the case of a single engine steam is admitted by an ordinary stop-valve, and provided the piston is not standing on a point of its stroke favourable for the engine to travel in the required direction, then only sufficient steam is admitted to slightly move the piston, which in turn regulates the valve to the required position for reversing the engine.

A small locomotive, named the Excelsior, built by Messrs. Manning, Whardale, and Co., and fitted with these valves, created a considerable amount of interest at the late Inventions Exhibition, but owing to the non-completion of his patents the inventor was reluctantly compelled to abstain from answering the numerous inquiries then made. In addition to the launch engines herewith illustrated, Mr. Parnell, whose London address is 22, Charing-cross, S.W., is exhibiting at Liverpool a compact pair of horizontal engines fitt d with this type of valve.

GAS ENGINES.[1]

The practical problem of the conversion of heat into mechanical work has been partially solved by the steam engine; but its efficiency is so low that it cannot be considered as complete or final. Hot air in the past has been looked upon as a possible advance. Owing, however, to many futile attempts, it has long been deemed useless to look in that direction for better results. The great progress made in recent years with the gas engine has shown that gas might, after all, be the chief motive power of the future. Three distinct types of gas engines have been proposed:—(1) An engine drawing into the cylinder gas and air at atmospheric pressure for a portion of its stroke, cutting off communication with the outer atmosphere, and immediately igniting the mixture, the piston being pushed forward by the pressure of the ignited gases during the remainder of the stroke. The instroke discharges the products of combustion. (2) An engine in which a mixture of gas and air is drawn into a pump, and is discharged by the return stroke into a reservoir in a state of compression. From the reservoir the mixture enters into a cylinder, being ignited as it enters, without rise in pressure, but simply increased in volume, and following the piston as it moves forward, the return stroke discharges the products of combustion. (3) An engine in which a mixture of gas and air is compressed, or introduced under compression, into a cylinder, or space at the end of a cylinder, and then ignited while the volume remains constant and the pressure rises. Under this pressure the piston moves forward, and the return stroke discharges the exhaust. Types 1 and 3 are explosion engines, the volume of the mixture remaining constant while the pressure increases. Type 2 is a gradual combustion engine, in which the pressure is constant, but the volume increases. Calculating the power to be obtained from each of these methods, supposing no loss of heat to the cylinder, an engine of type 1, using 100 heat units, would convert 21 units into mechanical work. In type 2, with the same amount of heat, 36 units will be given, and in type 3, 45 units. The great advantage of compression over no compression is clearly seen, by the simple operation of compressing before heating. The last type of engine gives for the same expenditure of heat 2·1 times as much work as the first. Compression, as used by the second type, does not afford so favourable a result.

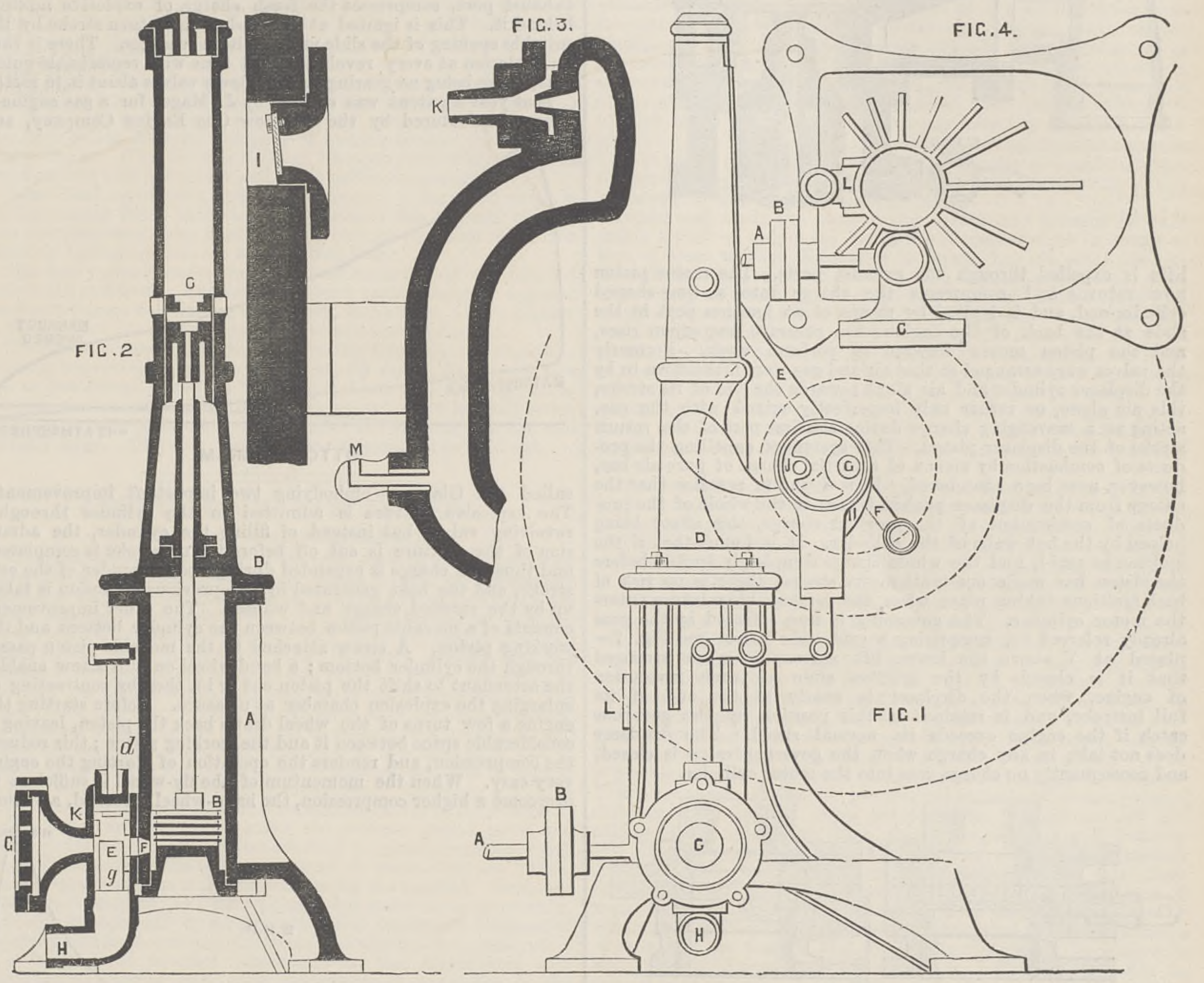
In any gas engine compressing before ignition, igniting at constant volume and expanding to the same volume as before compression, the possible efficiency D is determined by the atmospheric absolute temperature T′, and the absolute temperature after compression T; it is $D = \frac{T - T'}{T}$ whatever may be the maximum temperature after ignition. Increasing the temperature of ignition increases the power of the engine, but does not cause the conversion of a greater proportion of heat into work. That is, the possible efficiency of the engine is determined solely by the amount of compression before ignition. What compression does is to enable a great fall of temperature to be obtained due to work done with but a small movement of the piston, the smaller volume giving greater pressures and thus rendering the power developed more mechanically available. The higher the maximum temperature the greater the amount of compression which can be used advantageously. There is a degree of compression for every temperature, beyond which any increase causes a diminution of the power of the engine for a given size. By experiment it has been found that the compression engine has the advantage over the non-compression of a lower average temperature and a greater amount of work done; also of less surface exposed to flame, and consequently of less loss of heat to the cylinder. Taking all the circumstances into consideration, it is certainly not over-estimating the advantage of the compression engine to say that it will, under practical conditions, give for a certain amount of heat three times the work it is possible to get from an engine using no compression.

To find the amount of gas required by the three types. Taking the amount of heat evolved by 1 cubic foot of average coal gas as equivalent to 505,000 foot-pounds, and the number of foot-pounds required for 1-horse power for one hour being $33{,}000 \times 60 = 1{,}980{,}000$; if the whole heat to be obtained from gas were converted into mechanical work, 1-horse power for one hour requires $\frac{1{,}980{,}000}{505{,}000} = 3{\cdot}92$ cubic feet. Therefore the amount of gas required by the three types are:—Type 1, $\frac{3{\cdot}92}{{\cdot}21} = 18{\cdot}3$ cubic feet per horse-power per hour; type 2, $\frac{3{\cdot}92}{{\cdot}36} = 10{\cdot}9$ cubic feet per horse-power per hour; type 3, $\frac{3{\cdot}92}{{\cdot}45} = 8{\cdot}6$ cubic feet per horse-power per hour. Comparing these figures with results obtained in practice from the three types losing heat through the sides of the cylinders, it was ascertained that the amount of gas consumed was:—Type 1—Lenoir, 95 cubic feet per 1-horse power per hour; Hugon, 85 cubic feet per 1-horse power per hour; type 2—Brayton, 50 cubic feet per 1-horse power per hour; type 3, Otto, 20 cubic feet per 1-horse power per hour. The Otto engine converted about 18 per cent. of the heat used by it into work, while the Hugon engine only converted 3·9 per cent. To account for the so-called sustained pressure in this engine, Mr. Otto has advanced the theory that inflammation is not complete when the maximum pressure is attained at the beginning of the stroke, but that by a peculiar arrangement of strata he has made it gradual, and continued the spread of the flame while the piston moved forward. He calls it slow combustion. The cause of the comparative efficiency of the modern gas engines over the old Lenoir and Hugon type is to be summed up in the one word "compression." Without compression before ignition an engine cannot be produced giving power economically and with small bulk. The mixture used may be diluted, air may be introduced in front of gas and air, or an elaborate system of stratification may be adopted, but without compression no good effect can be produced.

The following are some general conclusions with regard to the working of gas engines, which have been drawn from the consideration of a great many indicator diagrams taken under different conditions:—With perfect ignition the rate of increase of pressure is very nearly uniform up to the maximum, which is reached in about the $\frac{1}{30}$th of a second. That the maximum pressures obtained in successive strokes are not the same, nor the times required for the maximum. That the greatest amount of work is done when the maximum pressure is reached at the beginning of the stroke. That with a very hot cylinder, the heat developed on compressing the gases may be sufficient to cause the explosion without a flame to fire the gases, and that even the greatest pressure may be reached before the return stroke is finished. That the greatest pressure reached in large and small engines is practically the same—considering the amount of compression—but that the time of reaching the greatest pressure is somewhat less in small engines than in large ones. With higher compression of the gases before ignition, the maximum pressures are increased, and the efficiency of the engine is greatly increased. A considerable amount of loss of energy may arise from not carrying the expansion far enough before discharging the exploded gases.

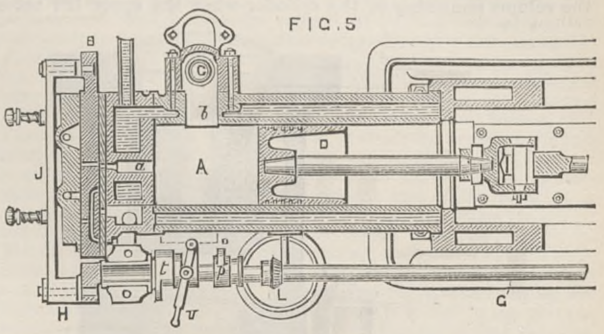
There are manifestly two very great defects in gas engines:—(1) One-half or two-thirds of the heat resulting from the explosion of the gases passes away through the sides of the cylinder, and is thus entirely lost in heating the cylinder. (2) The exploded gases are discharged from the engine at a temperature of about 700 deg. C. or 1000 deg. C., and so carry away with them a very large portion of the remainder of the heat due to the explosion of the gas. If possible, this heat should be saved by communicating it to the incoming gases, so that their temperature before combustion should be 100 deg. C. instead of 60 deg. C. This, however, is impracticable in the present form of gas engine, in which a piston works within the cylinder. In 1860 Sir W. Siemens had constructed a gas engine in which compression was employed, and in which the heat from the used-up gases was communicated to the incoming gases, thus carrying out the principle of using up, as far as possible, energy which would otherwise escape as wasted energy. In this engine the combustion of the gases took place as they entered a cylinder under compression, without a working piston; the cylinder could be kept hot, so that the heat of the gases would not be lost.

I will now proceed to follow the progress of the gas engine from the first known. Abbé Hautefeuille appears to have been the first, and in the year 1678 invented a powder machine for raising water; and Huyghens, seven years later, improved on that, for he employed a cylinder and piston. But John Barber, in 1791, was really the first to take out a patent for the production of force by the combustion of hydrocarbons in air. F. Lebon in 1801 constructed a furnace for making gas, which gas, mixed with air, he compressed into a recipient, and exploded the mixture by means of an electric spark. To the Frenchman Lenoir is due the honour of starting the gas engine on its road to success, for he did produce a practical motor, which subsequently fell into disrepute because of the failure of engines not made under his own cognisance, and to the high consumption of gas. Hugon and Reithmann claimed the invention, but there is much uncertainty about the matter. Subsequently to the engine of Lenoir, a later construction of Hugon's was brought out, with two principal alterations. The electrical ignition was set aside and replaced by a flame ignition; and instead of cooling the cylinder he injected water into it.[2] This was changed into steam, and therefore took up a part of the heat arising from the explosion, thus protecting the moving parts from overheating, as well as operating as expanding steam, driving up the piston. In 1867, at the second Paris International Exhibition, Otto and Langen, of Deutz, exhibited their newly-invented atmospheric gas engine. The explosion of a mixture of gas and air in an open-ended cylinder drives up a light piston provided with a light rod, on which is a rack, which, when the explosion took place, was jerked upwards, and a partial vacuum being formed in the cylinder, the piston was forced downwards, the rack, by means of an ingenious clutch gear, imparting motion to the shaft. This engine had many drawbacks, chief of which was the noise it made. Gilles, of Cologne, having succeeded some time after in making a comparatively noiseless engine, Otto was put on his mettle, and produced his well-known "silent" motor.



BISSCHOP'S GAS ENGINE.

Now I have mentioned the Otto, I will proceed to describe it with reference to Fig. 5. In the working of the Otto engine the forward motion of the piston draws into the cylinder air and an explosive mixture of air and gas, the return of the piston compressing this mixture into a space at the end of the cylinder equal to 38 per cent. of the entire cylinder volume. The charge is then ignited and the explosion takes place, raising the temperature and pressure to their highest value. The piston is driven forward to the end of its stroke, and the pressure and temperature fall through work being done on the piston, and the heat passing through the sides of the cool cylinder. On the return of the piston a portion of the exploded mixture is driven from the cylinder. The work done in the explosion and expansion of the gases takes place in less than a quarter of the period of two revolutions. In Fig. 5, A is the cylinder provided with a cooling jacket, at one end taken from one of the Otto patent drawings open, at the other considerably lengthened beyond the inner dead point of the piston. The space thus formed, or so-called combustion chamber, amounts to about two-thirds of the play of the piston. In this part of the cylinder there are two openings, *a* and *b*, *a* for the inlet and the ignition, *b* for the exhaust. The first is opened and closed by the slide B, the latter by the valve C. The piston D transfers the force taken up by the piston rod, crosshead, and connecting-bar to the crank shaft, which carries pulley and fly-wheel, and by which the slide movement is promoted through the gearing F, the shaft G, crank H, and connecting-bar J. The slide cover is pressed by spiral springs against the slide; two suitable nut screws secure it when the springs are not of sufficient tension. The cylinder serves alternately as compression pump and working cylinder. The regulation of the engine is very ingenious. It is necessary to take care in the governing that the mixture of gas and air required for combustion is in proper measure. That is not possible with a



OTTO ENGINE.

valve on the gas pipe, which is closed more or less by a centrifugal governor. Otto has arranged his regulating valve so that it either provides for the entrance of the proper gas mixture, or admits no gas at all into the engine, so that this runs empty or only draws in air, compressing, expanding, and expelling it. The economy in the consumption of gas of the Otto engines of small powers is largely due to the incomplete combustion of the explosive mixture, enabling a higher pressure to be obtained at the commencement of the stroke, when the combustion is retarded by the portion of burnt gases left in the cylinder from the previous charge, the maximum pressures obtained are later in the stroke, and the mean effective pressure less. Diagrams taken from the Otto engine show that the best results per effective stroke are obtained when the mixture contains no part of the burnt gases of the previous charge and the combustion is incomplete—*i.e.*, when the hydrogen burns before the carbon.

The best known engine of the type having two cylinders, the working cylinder and the displacer cylinder, is the Clerk.[2] The cylinders have equal diameters, but the stroke of the displacer or pump is usually about one-half longer than the working piston. The piston of the working cylinder is connected to the crank in the ordinary manner, but the piston of the displacer, in which the pressure never exceeds 5 lb. per square inch, is driven off a pin fixed on one of the arms of the fly-wheel placed slightly in advance of right angles to the crank. The cycle of this engine is as follows for one turn of the shaft:—The pump, during the course of the outstroke of its piston, draws in the volume of explosive mixture of air and gas necessary to actuate the outstroke of the driving cylinder, and an equal volume of air is drawn in that is not to mix with the explosive mixture at all. During the instroke there is expelled, first the air not mixed with the explosive mixture, second the combustible products remaining unexploded. During the outstroke of the driving cylinder there occurs the explosion of the compressed mixture under nearly constant volume, the expansion, and exhaust of the burnt gases. During the instroke there occurs the ends of the exhaust and the clearance of the cylinder by air from the displacer, the piston of which is at the middle of its backstroke when that of the working cylinder is commencing its stroke. The exhaust is then closed, and compression of the mixture takes place in the working cylinder and in the explosion chamber during the first half of the backstroke by the displacer.

As now made, however, the air and gas are mixed before entering the cylinder. The admission of the mixture of gas and air to it is by means of a valve below the small end of the cylinder, and the products of combustion exhaust from the opposite end of the cylinder proper—see THE ENGINEER, 2nd October, 1885. The displacer draws in a uniform mixture of gas and air through an automatic valve X, placed below the upper lift valve W, controlling the admission of mixture to the cylinder. These valves are seen at Fig. 6, page 276. The engine is governed by cutting out ignitions

[1] Paper read at a meeting of the King's College Engineering Society by Mr. J. Kempe Brydges, and awarded the Society's prize. It is here published as the work of a student interesting to learners on the subject.

[2] Flame ignition due to Cecil, 1820; water jacket to Sam Brown, 1820.

[2] For some of the above paragraphs on the theory of the gas engine I am indebted to Mr. D. Clerk's paper, read before the Institution of Civil Engineers, April, 1882, on "The Theory of the Gas Engine."

without waste of gas, as will be explained. The cycle of the engine, igniting the charge at each stroke, is as follows:—The displacer piston, which leads the motor by half a revolution, draws in a charge of gas and air through the lower lift valve X, and the grid governor valve V, seen at Fig. 6 and 7, thence through an inclined pipe into the displacer cylinder, gas entering through the cock K, Fig. 6. On the return stroke of the displacer piston, the lower lift valve closes, and the upper lift valve W opens automatically, allowing the charge to pass into the cylinder. The air enters at the bottom of Fig. 6. The piston being at the outer end of its stroke, the volume remaining in the cylinder when the upper lift valve

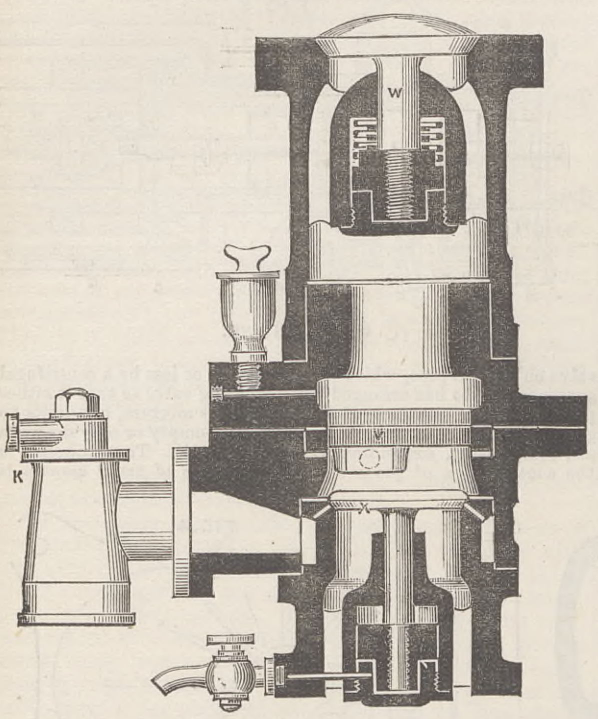


Fig.

lifts is expelled through the exhaust ports. The motor piston now returns and compresses the charge into a cone-shaped cylinder-end, and is ignited by means of an ignition port in the slide at the back of the engine; the pressure thereupon rises, and the piston moves forward to perform work. Formerly the valves were arranged so that air and gas were first drawn in by the displacer cylinder and air alone towards the end of its stroke, this air alone, or rather only imperfectly mixed with the gas, acting as a scavenging charge during the first part of the return stroke of the displacer piston. This system of expelling the products of combustion by means of a partial charge of pure air has, however, now been abandoned. It is found in practice that the charge from the displacer pushes before it the whole of the products of combustion of the previous charge, this effect being helped by the hot walls of the cylinder. It is found that if the ignition be rapid, and the whole charge completely ignited before the piston has made one-tenth of its stroke, there is no risk of back ignitions taking place when the combustible mixture enters the motor cylinder. The governing is now effected by the gear already referred to, comprising a grid slide valve—see Fig. 7—placed at V above the lower lift valve. It is so arranged that it is closed by the ignition slide at each revolution of engine, when the displacer is nearly at the end of its full instroke, and is retained in this position by the governor catch if the engine exceeds its normal speed. The displacer does not take in any charge when the governor valve is closed, and consequently no charge goes into the motor cylinder.

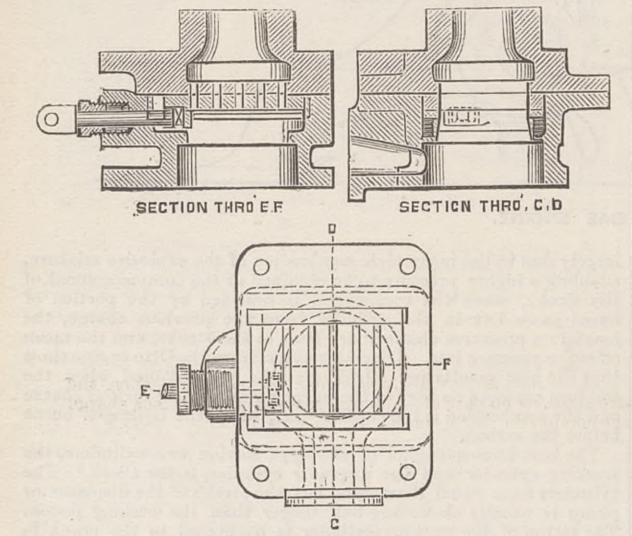
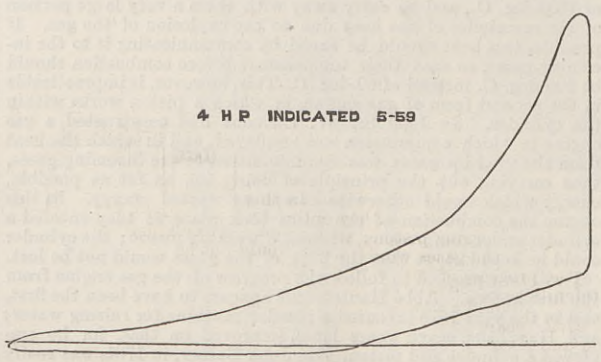


Fig. 7

The next engine I will mention is the Tangye. This engine makes an ignition at every revolution. It has one cylinder, closed at both ends, in which works a piston and rod with the usual connections to crank shafts, &c. At one stroke of the piston the explosive mixture is drawn into the front part of the cylinder by means of a valve. On the return stroke this charge is forced into a reservoir, communicating with the back portion of the cylinder, and retained there by a self-acting valve, till the piston has completed its outstroke, when the exhaust valve is opened and permits the products of combustion to escape. The valve in the reservoir now opens by the pressure of the mixture, and the compressed gases enter the cylinder and expel the remaining products of combustion through the escape port. The piston is now returning on its next instroke, and has moved back a short distance when the exhaust and self-acting valves are closed, and the explosive mixture compressed by the piston into a space at the end of the cylinder and portway. At this time a slide containing a gas flame is brought over a porthole in the cylinder, and ignites the compressed gases, the piston being driven forward under the pressure produced. At the closing of the exhaust a portion of the burnt gases are left in the cylinder. These mixing with the incoming charge during compression increase the temperature, but upon ignition reduce the pressure and retard the combustion. This additional increase of nitrogen and carbonic acid, as the mixture is used in a diluted state, so retards the rate of combustion of the mass, that the maximum pressure is not reached till the piston has travelled some distance on its outstroke. The greatest defect in this engine is that the mixture is so diluted, and ignition so slow, that the pressure does not reach the maximum till late in the stroke. With a quicker ignition better results would be obtained.

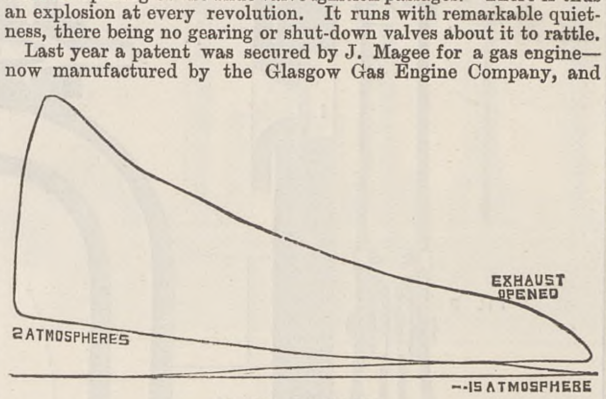
A comparatively new compression engine is the Stockport, manufactured by Andrew, the maker of the well-known Bisschop, which I shall mention amongst non-compression engines. The Stockport has two cylinders arranged on the same axial line and attached to the same bed-plate. The pistons of both cylinders are on one rod, the power being taken off the connecting trunk between the pistons by a connecting rod which actuates the crank shaft. A water jacket is provided to keep the cylinder cool. The method of working is as follows:—Air and gas in suitable mixture are admitted to the pump cylinder, and forced at some pressure into the pipes between the two cylinders. The slide valve of the working cylinder admits the mixture into that cylinder when at the outstroke, and the mixture entering under pressure behind, the piston drives forward the spent products of combustion of the previous stroke, which pour out at an opening which is uncovered



OTTO DIAGRAM.

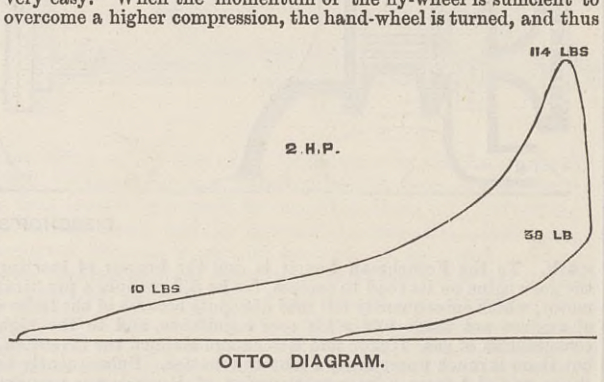
by the piston when at its most forward position. The working piston returns as the crank continues to revolve, and closing the exhaust port, compresses the fresh charge of explosive mixture behind it. This is ignited at the end of the return stroke by the suitable opening of the slide valve ignition passages. There is thus an explosion at every revolution. It runs with remarkable quietness, there being no gearing or shut-down valves about it to rattle.

Last year a patent was secured by J. Magee for a gas engine—now manufactured by the Glasgow Gas Engine Company, and



OTTO DIAGRAM.

called the Glasgow—embodying two important improvements. The explosive mixture is admitted to the cylinder through a revolving valve, but instead of filling the cylinder, the admission of the mixture is cut off before the outstroke is completed, and thus the charge is expanded during the remainder of the outstroke, and the heat generated by the previous explosion is taken up by the rarefied charge and utilised. The other improvement consists of a movable piston between the cylinder bottom and the working piston. A screw attached to the movable piston passes through the cylinder bottom; a hand-wheel on this screw enables the attendant to shift the piston out or in, thereby contracting or enlarging the explosion chamber at pleasure. Before starting the engine a few turns of the wheel draws back the piston, leaving a considerable space between it and the working piston; this reduces the compression, and renders the operation of starting the engine very easy. When the momentum of the fly-wheel is sufficient to overcome a higher compression, the hand-wheel is turned, and thus



OTTO DIAGRAM.

with a diminished charge a high compression is secured, resulting in great economy of gas. The necessary contact between the revolving admission valve and its seat is accomplished in a novel and ingenious manner. A small piston open to the explosion chamber is connected by a lever with the admission valve, so that the exact pressure due to the explosion is instantaneously communicated to the valve. The action is automatic, and cannot fail to give the exact pressure on the valve to keep it perfectly tight, while during the remainder of the revolution the valve works free from pressure and with very little friction.

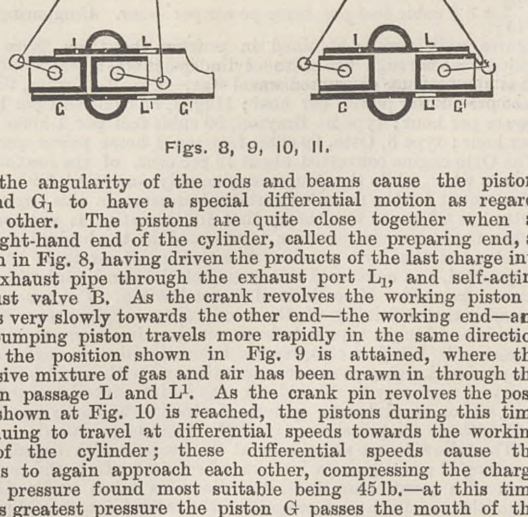
Another engine of this type is the Körting-Lieckfield's, which has two vertical cylinders, and a peculiar method of regulation, based upon the idea of altering the tension of compression of the mixture; also the Turner engine, in which the compression cylinder is dispensed with by a different arrangement of the two cylinders, which are alternately working, and auxiliary cylinders. Others are those of Robson, Maxim, and Sir W. Siemens.

Now I will mention one or two engines of the non-compression type. The one about the best known is the Bisschop—manufactured by J. H. Andrew. This is one of the best engines for small power up to about ½-horse. In this engine the gas and air are drawn in for about two-thirds of the upstroke; the ignition then takes place. The strongly compressed combustible products then drive the piston to the end of its lift. This short space of time is the working period of the engine. It receives during that time the necessary impetus to drive out the residuum, and with fresh action to be able to draw new mixture in again. A locally separated introduction of gas and air into the cylinder takes place, but in such a way that there are formed below the piston layers of gas and air; each singly approaching the direction of the axis of the cylinder has an equal combination, whilst in the normal direction the single layers are essentially separated from one another. The layer which lies over the gas valves and the air valve quite close to it contains mixture easily ignitible, whilst the layers over the air valves farthest from the gas valves consist of almost pure air; and between the first and these latter of transition mixtures. The ignition takes place in the layer of the easily ignitible mixture over the gas valves, and is here conducted with the greatest certainty. In the single-working cylinder A the piston B operates. Its rod carries the crosshead C, which is introduced into a hollow column and constructed with the cylinder lid D in one piece. This colemn is opened up lengthwise. Through the opening the bent lever E enters, which operates the crank F. The shaft G, worked by the latter, is held in a casting H on one side of the cylinder cover, the excentric J, fly-wheel, and pulley being also carried on the shaft. Such a restricted crank action is not to be commended. The circumstance that the crank action for the up movement of the piston is greater than that for its lower, does not improve the regularity of the movement. But it must be noted that those circumstances which make the construction of large machines worthless are, in very small machines, of less importance. The gas pipe A is provided with a clack valve B, Fig. 1. Gas and air mix in the regulating cylinder or distributor K, between the pistons of which *d* and E they enter, when the under one does not close up the inlet conduit into the cylinder through the conduit. Of the two pistons *d* and *e*, the upper one only serves for the closing of the distributor. The under one operates, besides, the discharge of the combustion products, which by means of the opening *g* can enter through it into the discharge pipe H. The ignition takes place through a hole in the cylinder wall. This hole is provided with a little clack of steel plate which is opened by the external pressure when the aspiration piston has passed it. A gas flame at K, Fig. 2, 3, burns before the aperture I below the flue *l*, Fig. 4. The burner is constructed with an igniting flame M to relight the gas flame K if extinguished. Haigh and Nuttall, besides improving the valves that admit the gas and air, replace the clack valve in the ignition orifice by a ball or bullet.

Another gas engine of the non-compression type, at present, I believe, little known, is the Syrinx. It is useful for small powers of from ¼-horse power to 1-horse power. The explosion occurs once in every revolution, a trunk piston, working in a water jacketted cylinder, conveying the force of the explosion to the crank shaft in the ordinary manner. During the first part of the working stroke the piston draws in a charge of gas and air through a self-acting valve, consisting of a loose disc covering two series of holes on the inner side of the cylinder cover. The loose disc by the suction of the piston is drawn slightly away from the cover against the resistance of an adjustable spring, allowing the gas and air to be drawn in through the holes in the cover until the piston passes a port on one side of the cylinder where a jet of gas is burning, when the flame is drawn into the cylinder through a self-acting valve and explodes the mixture, the increased pressure consequent on the explosion forcing the loose disc against the cylinder cover, and so closing the inlet for the gas and air. At the end of the stroke the exhaust is opened by a cam on a side shaft operated by bevel gearing—in a ½-horse power engine an excentric is used—from the main shaft. The engine can be stopped and restarted in an opposite direction if desired.

In conclusion, I will refer to the self-starter used with the Clerk and the Otto engine. These self-starters save a great deal of labour, which is expended in turning the fly-wheel before engines can be got to start. With the Otto self-starter the engine can be put in motion by simply opening a valve. The apparatus consists of a small receiver, into which the engine exhausts, for a very short portion of its stroke, the burnt gases which result from the ignition of the charge in the cylinder. These gases fill the receiver, and in the course of half a minute raise a pressure in it nearly corresponding to the pressure in the cylinder during the moment of ignition. These stored burnt gases are admitted again into the cylinder at the moment of starting, and thus put the engine in motion, thus saving the trouble of pulling the wheel round to get the first charges in. The gas engine has yet to be improved upon, and many long years of work are necessary before it can rank with the steam engine in capacity for all manner of uses, but no doubt it can and will be made as manageable as the steam engine in by no means a remote future. The time will come when factories, railways, and ships will be driven by gas engines as efficient as any steam engine, and much more safe and economical of fuel.

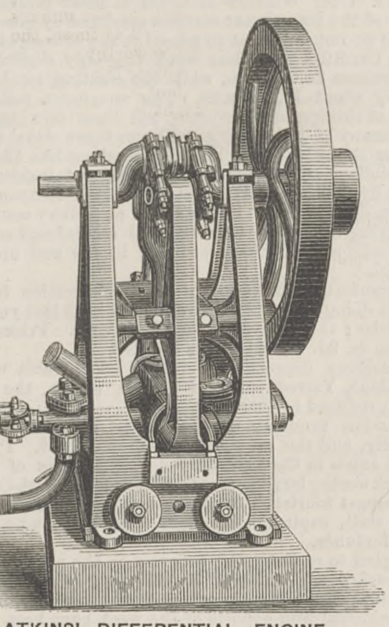
Atkinson's differential gas engine must be described. This consists of a horizontal cylinder G, Fig 8, open at both ends, fixed near the base of the engine, and fitted with two pistons G and G_1, piston G being called the pumping piston, and piston G_1 the working piston; these pistons are connected by links to the lower ends of the bent vibrating beams, working on centres fixed in the main framing of the engine. These beams are connected at their upper ends by short connecting rods to one crank pin, fixed in a disc N, which is keyed on to the main shaft, this shaft lying between the upper ends of the beams; the radius of the crank



Figs. 8, 9, 10, 11.

pin, the angularity of the rods and beams cause the pistons G and G_1 to have a special differential motion as regards each other. The pistons are quite close together when at the right-hand end of the cylinder, called the preparing end, as shown in Fig. 8, having driven the products of the last charge into the exhaust pipe through the exhaust port L_1, and self-acting exhaust valve B. As the crank revolves the working piston 3 moves very slowly towards the other end—the working end—and the pumping piston travels more rapidly in the same direction until the position shown in Fig. 9 is attained, where the explosive mixture of gas and air has been drawn in through the suction passage L and L^1. As the crank pin revolves the position shown at Fig. 10 is reached, the pistons during this time continuing to travel at differential speeds towards the working end of the cylinder; these differential speeds cause the pistons to again approach each other, compressing the charge —the pressure found most suitable being 45 lb.—at this time of this greatest pressure the piston G passes the mouth of the igniting tube I; this tube is open at its lower end to a small hole drilled through the wall of the cylinder; it is closed at its upper end, and is kept red hot near the cylinder, so that when the piston passes the small hole a small portion of the combustible charge rushes into it, is instantly ignited, flashes back into the cylinder, and fires the charge. During the passage of the crank pin from the position shown at Fig. 10 to that at Fig. 11, the pistons have very rapidly increased the space between them; during the earlier part of this movement the piston remains almost stationary. At or about the position shown at Fig. 11 the working piston G_1 uncovers the exhaust L_1, letting out the consumed gases, which are completely expelled by the pumping piston G as it travels to the position shown in Fig. 8, from which the cycle of operations recommences and is repeated at each revolution of the crank shaft.

In the arrangement shown in the elevation a governor is used, which controls the admission of the gas by the following arrangements:—The governor acts on an excentric rod, which



ATKINS' DIFFERENTIAL ENGINE.

is operated up and down by an excentric; the governor decides whether or not the excentric rod acts on one end of a double lever on its downward movement; if it does, it lifts up the other end of the lever, which lifts up a small gas valve contained in a valve-box, thereby admitting gas to the engine, which is drawn in and mixed with the entering air.

The "Universal" gas engine:—The essentially new feature of this non-compression single-acting engine is the employment of a simple rotary ignition valve, consisting of a ratchet-plate or flat disc with a number of small radial slots, which necessarily pass a small slot in the end of the cylinder, and through which the flame is drawn to ignite the charge. The explosive mixture is drawn through two ordinary lift valves, and exploded once in a revolution in the following way:—When the piston has drawn in the requisite amount of gas and air, the ratchet-plate is pushed into such a position that the flame from the igniting jet passes through one of the radial slots when opposite the only hole in the end of the cylinder, and explodes the charge, thus driving the piston to the end of its forward stroke. The exhaust valve is kept open during the whole of the return stroke by means of an excentric, thus allowing the products of combustion to escape. The ratchet plate or ignition valve has so very small a range of motion per revolution that it cannot get out of order, and requires no lubrication.

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

(*From our own Correspondent.*)

The end of the quarter having arrived, consumers of manufactured iron are attempting to gauge the probabilities of the October quarterly meetings, which will be held in Wolverhampton on the 13th of the month and in Birmingham on the 14th. These gatherings being in prospect, current buying is mostly confined within narrow limits, consumers preferring to hold over business of much value until they see what course prices may take.

It does not seem likely that buyers will have much to gain by the delay. Makers declare this week that there will be no alteration in crucial prices of either raw or manufactured iron, and they discourage any expectation by merchants and other buyers in a contrary direction. The Earl of Dudley, Messrs. William Barrows and Sons, and Messrs. Noah Hingley and Son—the three firms to whom the market looks for the initiative in any new departure in the matter of prices—will be found, it is believed, to adhere to the existing quotations of £7 12s. 6d. for his lordship's common bars; £7 for the first qualities of the other two houses; and £6 for the second qualities of Messrs. Hingley and similar class firms. Earl Dudley's single best bars would, in that event, remain at £9; double best, £10 10s.; and treble best, £12 10s. Best pig iron, it is also expected, will continue at 52s. 6d. to 55s., and occasionally 57s. 6d. for Staffordshire makes; and 50s. for hot-blast Shropshire makes. Neither is there any good ground for anticipating that medium and common finished iron will be any easier at the quarterly meetings than it is to-day.

There were ironmasters on 'Change in Birmingham to-day—Thursday—who, in making reference to the ensuing quarterly gatherings, ventured to remark that there would be as much business doing as at present if iron were £1 per ton higher. Such makers, however, forget the competition which Staffordshire has to meet from other districts, in the face of which it is impossible to maintain any artificial standard. They overlook the fact, too, that marked bars have been reduced to their present standard of £7, specially to prevent all the trade leaving the best bar firms, and drifting into the hands of second and third-class bar makers. It is only legitimate demand that can warrant better prices. As an example of the present competition, it may be mentioned that London buyers assert that they are now buying sheets—singles—from the North of England, at £5 17s. 6d. delivered into the Thames; and doubles at £6 7s. 6d. per ton.

The list of Messrs. W. Millington and Co., Summerhill Ironworks, stands at date as follows, and Quarter-day is likely to see it confirmed:—Bars, £7; small rounds and squares, £7 10s.; $\frac{5}{16}$in. bars, £8; $\frac{1}{4}$in., £8 10s.; No. 5, £9; $\frac{3}{16}$in. £9 10s.; No. 7, £10 10s.; No. 8, £11 10s.; and No. 9, £13. Best bars they quote £8; double best, £9; and treble best, £11. Plating bars and cable iron, £7 10s.; and best ditto, £8 10s.; with double best, £9 10s. Rivet iron, £7 10s.; best, £8 5s.; and double best, £9 15s. Angles, £8 to £8 10s., and on to £9 10s., according to quality. Boiler plates and sheets, £8 10s.; best, £9; double best, £10; and treble best boiler plates, £12.

The irregular distribution of orders in the sheet trade continues a conspicuous feature of current business. Numbers of makers are able to secure only sufficient specifications from the galvanisers to afford them rather over two weeks' work out of four, and are running their mills during the other two weeks largely upon stock. Other makers there are who have had a very good month, and are well booked forward, and are returning inquiries and demanding an advance in price. The experience of these latter makers is, however, admittedly exceptional. The shorter supply of sheets, due to special circumstances, is this week causing an advance of 2s. 6d. per ton to be demanded on galvanising doubles, bringing the quotation to £6 2s. 6d.; lattens are quoted £6 17s. 6d. to £7.

A good business has of late been doing with Russia in thin roofing sheets, and in superior sheets for button making and the like. The season for the Russian trade is fast drawing to a close, yet some makers have still orders upon their books, which they are now executing with all possible despatch. Certain firms who are well in with the roofing sheet business will accept, for 29 gauge easy, slightly under £7 2s. 6d. per ton f.o.b. Thames, yet the same firms, where asked to quote for galvanising sheets of 24 gauge, delivered Liverpool, quote quite 5s. per ton in advance of what the bulk of the galvanising sheet makers will take. It is assumed that they give this quotation not desiring the business offered.

Cooperage hoops are being bought largely, among some of the best purchasers being brewing firms. In this description of material steel hoops appear to be the most saleable. Iron coopers' hoops are quoted £5 5s., and steel hoops somewhat more. Export hoops are £5 10s. easy at works. Gas-tube strip is in rather better request with the coming on of the winter season, though some makers have not yet experienced any revival. Narrow widths are selling at £4 12s. 6d. upwards. Common bars are changing hands at values varying from £4 10s. to £4 15s., while ordinary bars are £5 to £5 10s.

Native pig iron has but a quiet sale, and prices are still in favour of purchasers. The quantities changing hands are in almost every instance required for early consumption. Prices keep at 50s. to 55s. for all-mines, and 35s. to 40s. for part-mines, with 27s. 6d. for common forge. Foundry iron is scarcely so firm in price, owing partly to the quietude at the foundries, and partly to the rather lower quotations from outside districts. Supplies are abundant at 31s. to 32s. per ton delivered Birmingham. Northampton and Derbyshire pigs fairly well maintain the advanced quotations recently asked by sellers, but little business is doing. Northampton tons are quoted 34s. at stations, or 34s. 9d. delivered to consumers' works. Some Derbyshires may be got at 35s. at works, but for special brands 36s. and 36s. 3d. is quoted.

The miners' leaders in the South Staffordshire coal field are erecting barriers to any alteration in the present working hours, similar to those raised by the Cannock Chase colliers. At a meeting of the Staffordshire agents a few days ago, a resolution was passed declaring that the time had come when the entire mining population should see the necessity of becoming thoroughly combined to stop the effort now being made in the district to lengthen the hours of labour, and advising a stubborn resistance to all such attacks.

Ironmasters here note with satisfaction that it is proposed to place Mr. B. Hingley, M.P., the chairman of the South Staffordshire Iron Trade, on the Commission to be appointed by the Admiralty to enquire into the system of purchase and contract for the Royal Navy.

The Indian Railways are again likely to afford some good work for this district. The Indian State Railways are requiring wrought iron tanks, pumping engines, boilers, and railway material, while the East Indian Railway Company is seeking tenders for cast iron bridge chairs. The Madras Railway Company also will soon be in want of tires and fastenings and other railway necessaries.

Some local engineering firms are trying for a big order which is on the market from Belfast. This includes the engines, boilers, and pumping machinery required for a new graving dock which the Harbour Commissioners are constructing there.

The heavy pipe founders fail to secure contracts at the rate old orders are executed. Engineers continue pretty steadily engaged on steam pumps and mining machinery, and a more active inquiry is experienced for colliery pipes and ventilation appliances.

The chainmakers of Old Hill and Cradley Heath do not find their position improving so rapidly as they would wish. Each week sees one or two names added to the list of firms who have agreed to concede their demands, but those who as yet show no inclination to do so, or who positively refuse to alter the existing list, are still wofully large. The men, however, are determined to hold out.

NOTES FROM LANCASHIRE.

(*From our own Correspondent.*)

Manchester.—The condition of the iron trade in this district may be said to remain about stationary; there is still no appreciable increased weight of business coming forward, and quoted prices are about maintained at late rates. The better feeling to which I have referred in previous reports still finds expression here and there in the market, and the belief is pretty general that the present restriction of the output will prevent prices returning to the very low figures which they touched a short time back. The weak point, however, is that the stronger tone has been produced by artificial means, not by an actual increase of requirements, and below the surface the outward firmness of the market is not so real as it appears. The necessities of makers, and also of holders of iron, which under the existing conditions of trade are not likely to get less, are in some instances compelling them to force sales at figures which are very much below the current quoted rates, and although these are mostly transactions of a special character which places them outside the ordinary course of trade, they are indications of the weakness which still underlies the market. Real and established strength, as I have pointed out many times previously, can only be attained by a substantial and legitimate increase of requirements for actual consumption, and this has not come yet.

A fairly good average attendance on the Manchester iron exchange on Tuesday gave some appearance of animation to the market, and here and there a more hopeful tone seemed to prevail as to the future. Although there was not much more actually doing, there was a disposition to believe that trade had at last "turned the corner," and that the demand would now improve. There is no doubt that both makers and users of iron are rather better off for work than they have been recently; but, to quote an expression I heard on 'Change, "there is a good deal of slack on the rope yet to be taken up" before trade can be described as anything like good, and even the restricted output is quite sufficient to keep pace with the present requirements of consumers. For pig iron there is still only a limited inquiry in the market. For local brands fair orders have been booked on the basis of 35s. 6d. to 36s. 6d., less $2\frac{1}{2}$, for forge and foundry qualities delivered equal to Manchester; but in district brands I hear of very little business doing. Good Lincolnshire brands are still quoted at 35s. 6d. to 36s. 6d., less $2\frac{1}{2}$, for forge and foundry delivered here, but there are sellers at 6d. and 1s. per ton under these figures, and some district makes are to be got as low as 34s., less $2\frac{1}{2}$, for foundry qualities delivered here. In outside brands offering in this market makers both of Scotch and Middlesbrough iron are generally firm at their quoted rates.

Hematites still meet with only a limited demand in this district. The current quoted prices remain firm on the basis of 51s. 6d., less $2\frac{1}{2}$, for No. 3 foundry, delivered equal to Manchester, but I hear of sales outside this district, where buyers have been in a position to take large quantities at considerably under this figure.

Manufactured iron makers are in most cases just now fairly off for work, and a pretty general attempt is being made to get the prices of bar iron up to £5 per ton for delivery into this district, but so far this has not been very successful, and there are still sellers at £4 17s. 6d., with hoops to be got at £5 5s., and sheets at £6 5s. for singles and £6 10s. per ton for doubles.

There is no material change to notice in the condition of the engineering trades upon what I reported last week. Any real activity is confined to a very few firms chiefly engaged on special work. In the ordinary run of engineering work slackness continues to be reported generally, and in most cases shops are only kept indifferently employed from hand to mouth.

The steel tube gauge for pressures recently introduced by Messrs. Schaffer and Budenberg, of Manchester, has proved very successful not only for recording hydraulic pressures for which it was originally designed, but also in a modified form as a gauge for all ordinary steam purposes. Objections have, however, been raised that in using these gauges on steamships the action of the salt water would have an injurious effect upon the steel tube, which would destroy its accuracy for recording purposes. There is no direct evidence that such is actually the case, but to remove the possibility of objection Mr. Budenberg has just patented a preparation resembling a sort of nickel by which the steel tube is thoroughly coated both internally and externally, and which is a complete protection against any injurious effect the salt water might possibly have on the tube.

One or two special tools, of which a short description will be of interest, are just being completed by Messrs. W. Collier and Co., of Salford. One of these is a double-headed drilling machine, adapted for ship-plates and general work. The chief feature in this machine is that when the plate is once set two holes can be drilled simultaneously in any part of the surface of the plate. The general construction is a strong plate bed, provided with grooves for traversing tables to slide in, and the tables are arranged to slide on the bed longitudinally, either together or separately. The uprights carrying the traversing frame are fitted with two independent drill headstocks capable of drilling two holes either together or separately, and which are also adjustable independently. Another tool is a plate-bending machine for bending plates up to 9ft. in width, and in this the special feature introduced is a departure from the ordinary construction, by providing an adjusting motion not only for the top roll but also for the front bottom roll. This enables the plate to be bent to a circle in the least possible space of time, and gives a better grip to the plate. The side roll is raised or lowered as required by means of a strong, square-threaded screw and slide blocks, and one end of the machine is arranged with a turn-down housing working on a hinge for taking out the plates when they have been rolled to a complete circle. The rolls, which are each 13in. diameter, and provided with sufficient power for rolling a $\frac{3}{4}$in. plate cold, are made of cast iron with a steel shaft running through their entire length, and forming the journals at the end. Adjustable steps are provided in the place of solid bearings for the ends of the rolls to run in, so that they can be easily replaced to meet wear and tear, and are readily accessible for repairs.

On the authority of Alderman W. H. Bailey, one of the directors of the Manchester Ship Canal Company, and who has during the past week addressed a very able letter to the local press propounding a plan by which workmen's shares can be taken up by shilling weekly payments, the new prospectus of the company will very soon be published. I understand the independent committee of consultation has presented to the board of directors a number of very valuable suggestions, and the promoters of the scheme have been strengthening their position in a variety of ways, such as the obtaining from the various branches of trade official statements of the benefits the canal will confer upon their respective industries, and what is of very considerable importance, the great proportion of the steamship owners have expressed their perfect willingness to send their vessels up the canal, any lowering of masts which may be requisite not being regarded as any appreciable obstacle. This of course practically removes one very serious objection, which the opponents of the canal urged would be raised to the use of this waterway by the owners of steamships.

In the coal trade the close of the month has brought forward rather a push of orders for house fire classes of fuel in anticipation of some upward movement in prices, but all other descriptions of fuel for iron making, steam, and engine purposes still meet with a very slow sale, and supplies are plentiful in the market with many of the collieries still not working full time. At some of the best Lancashire collieries prices for house fire coals have been put up 6d. per ton, but there is no general advance, and in the Manchester district the leading colliery owners have made no change whatever upon their September rates. At the pit mouth the quoted rates are now about 8s. 6d. to 9s. for best coals, 7s. to 7s. 6d. seconds, 5s. 6d. to 6s. common coal, 4s. 3d. to 4s. 9d. burgy, 3s. 6d. to 4s. best slack, and 2s. 6d. to 3s. per ton for common sorts.

Barrow.—A steady tone continues to characterise the hematite pig iron trade of this district, but the improved trade which has set in during the past few weeks has been more shown in the disposal and clearance of stocks than in increased activity in the make of pig iron at the furnaces. It is satisfactory to find that the stocks of iron at makers' works, and in the hands of holders of iron, have been very sensibly reduced. The output of iron has been increased, but only to a trifling extent, and makers and others are exercising what is considered a wise discretion in clearing off the over-large stocks in preference to augmenting the output by the relighting of idle furnaces. There is a healthful tone all round, and a probability that the improved demand for iron will be felt to the great advantage of producers during the winter season. It is also confidently believed that next spring will introduce a better market than has lately been experienced, and that a return at any rate of a portion of the good trade of past years will again be with us. Prices are steady at 42s. 6d. per ton net at makers' works, prompt delivery, with 1s. 6d. extra for forwards. Some makers are asking higher quotations than this. Forge No. 3 and foundry No. 3 are quoted at 41s. 6d. per ton net. Steel makers are not only busy and are well sold forward, but they are fortunately receiving many inquiries for the delivery of rails to home as well as foreign buyers during the ensuing winter, and during the early part of next spring. A large tonnage of rails is in the market, and some heavy contracts have already been placed. Prices show no change, and £3 15s. may still be quoted as the price of heavy sections of rails net at makers' works; tin-plate bars are in good request, and orders are well held. The business doing in other departments of steel, however, is not very satisfactory, although there is a growing feeling in the direction of improvement. Shipbuilders are badly placed for orders, and no new contracts have recently been secured. There is, however, a much better tone, and as a deal of shipping which for months, and even years has been idle, is now called out and placed under charter, it is believed that new orders will soon be secured. Iron ore is in fair demand at full prices, 9s. per ton being about the average for good samples; but the mines are not better employed, as stocks are supplying the new orders. Coal and coke steady. Shipping fairly employed.

THE NORTH OF ENGLAND.

(*From our own Correspondent.*)

During last week a considerable amount of business was done in Cleveland pig iron. Consumers have evidently come to the conclusion that things are at last improving. Most of them have bought what they want for prompt delivery, and they are now eager to buy ahead. Consequently prices are steadily advancing. At the market held at Middlesbrough on Tuesday last there was a large attendance, and the tone was firmer and more hopeful than it has been for a long time. Sellers were asking 30s. $4\frac{1}{2}$d. per ton for No. 3, g.m.b., for prompt delivery, and buyers were offering 30s. 3d., that being an advance of 3d. per ton on last week's purchases. For delivery to the end of March consumers offered 31s. per ton, but, makers demanded 31s. 6d., and in view of their improved prospects would not take less. Forge iron has advanced to 29s. 3d. ton. Warrants are 30s. 6d., with few or no holders willing to sell.

But little pig iron is being sent into Messrs. Connal and Co.'s Middlesbrough store, the increase last week having been only 205 tons. The quantity held in stock on Monday last was 299,787 tons.

The shipments of pig iron from Tees wharves continue to proceed at a satisfactory rate. The quantity sent away between the 1st and 27th September inclusive, was 65,519 tons, as against 57,794 tons in August.

There is a slight improvement in the demand for all kinds of finished iron, except plates. Prices, however, remain the same as quoted last week.

Messrs. Bolckow, Vaughan, and Co. are well supplied with orders for steel plates, rails, &c., and have decided to work their mills eleven shifts per week, instead of ten, as they have been in the habit of doing for some time past.

Mr. Waterhouse's report to the Board of Arbitration for the North of England manufactured iron trade has just been issued. It covers the two months ending August 31st, 1886. The net average selling price of all kinds of finished iron was £4 12s. $6\frac{1}{2}$d. per ton, or 4d. per ton more than was realised during the previous two months. The output, however, has only reached 45,558 tons, or 2604 tons less than during May and June. As a whole, therefore, it would appear that the Northern finished iron trade is still dwindling. The slight improvement in price is more apparent than real, and is easily accounted for. The output of iron plates has diminished by 11 per cent., and that of angles, also mainly used for shipbuilding, has diminished by about 20 per cent. On the other hand, the output of bars has increased by 17 per cent. Inasmuch as £4 18s. 8d. was realised for bars, and only £4 10s. 2d. for plates, and still less for angles, it is clear that the additional output of bar iron replacing the loss of output in the other specialities accounts for the difference. The reason why bar iron has latterly commanded a price relatively so high, even though there is less waste in making it than in making plates, is that so much, probably 50 or 60 per cent. of the output, is required in the higher or smithing qualities. The wages of iron-makers will not necessarily be affected by this report, as there is at present no sliding scale in operation. It is understood, however, that there will shortly be an arbitration to determine future labour rates, as the employers are now paying 2s. above shillings for pounds, which they certainly cannot afford to do much longer. It will be remembered that Dale's scale which worked so long and so fairly, only gave 1s. 6d. above shillings for pounds, and that in the early part of 1879, when prices of finished iron were 15s. per ton higher than at present, puddlers' wages were only 1s. 3d. above shillings for pounds.

At Shields the English seamen are again combining together to endeavour to prevent foreigners from successful competition with them. Some time since they tried hooting at them, and hustling them, but without the desired effect. Then they sent a deputation to wait upon certain shipowners to lay before them their objections and grievances. The answer they got was probably not satisfactory to them. The shipowners' case is perhaps best stated by quoting the words of the captain of an American vessel, on board of which Mr. J. A. Froude, the historian, lately sailed from Sydney to New Zealand. Said the captain to his eminent passenger:—"I make a rule when I engage my men for a voyage, to take no English, no Scotch, no Irish, no Americans. There is no getting along with them. They go ashore in harbour, get drunk, get into prison, give me nothing but trouble. It is the same with them all, my people and yours equally. I take Danes, Norwegians, Germans, Swedes; all these I can trust. They are sober, they make no rows, are never in the hands of the police; they save their wages, are always quiet and respectable, and I know that I can depend on them. The firemen, ship's servants, &c., are Chinamen; I can trust them too." "I recollect," added Mr. Froude, "a Portuguese nigger at the island of St. Vincent once showing me, with a grin, an iron-grated cage, and telling me it was specially reserved for English sailors. At the time I thought him a malicious, lying rascal—one never knows about these things."

THE SHEFFIELD DISTRICT.

(*From our own Correspondent.*)

Count Saigo, the Japanese Minister of Marine, accompanied by his suite and aides-de-camp, arrived in Sheffield from Glasgow on Tuesday afternoon, and was received at the Midland-station by the deputy-mayor—Alderman W. H. Brittain—and the town-clerk; the Master-Cutler, Mr. G. F. Lockwood; Mr. Alexander Wilson, J.P.—Messrs. Charles Cammell and Co.; Mr. J. E. Townsend—Messrs. John Brown and Co.; Mr. E. Tozer, J.P.—Messrs. Steel, Peech, and Tozer; Mr. C. H. Firth—Messrs. Thos. Firth and Sons; and Mr. Edgar Allen—Messrs. Edgar Allen and Co. On the following day the Count and his party visited the Atlas, Cyclops, and Norfolk Works, as well as the steel establishment of Messrs. Steel, Peech, and Tozer, at Rotherham.

The circular from the Government inspector relating to the use of safety lamps in collieries, to which I referred some time ago, has now been issued in this district. Our colliery proprietors can have no possible objection to seeing it carried out, as it was mainly upon their evidence that the Government were placed in possession of the information which enabled them to take such action as is embodied in the circular.

There has been no change in the heavy and light industries of the district during the week, though a perceptible increase of orders from colonial markets encourages hopes of a brisker business in the forthcoming spring. The "boom" in wool is an important factor in the Australian, New Zealand, and South American markets.

Rotherham people appear to have been exercising their minds somewhat anxiously over the importation of some twenty tons of iron girders from Belgium which were said to be required for the construction of the baths and free library there. According to one informant numbers of ironworkers gather in small groups round the quantities of girders which have been delivered near the site of the new baths and free library. They have examined the iron and passed various comments upon it, the remarks, "Englishmen are no use now," being frequently heard. The extraordinary question how, in a district where iron is so largely manufactured, the material should be brought from so long a distance to supply local needs, is one which affords room for much speculation. This is rather out of date, considering that scarcely anything else but Belgian girders have been used in erecting buildings where their use has not been specifically prohibited. A leading contractor told me several years ago that Belgian-made girders could be delivered at £2 per ton less than English-made iron. Even now, with the present low price of iron, the Belgian girders can still be sent into the heart of the Yorkshire iron district at a lower rate than English girders can be made. It must be remembered, however, that girders are not made in this locality in anything like the sections required by builders; and when they have to be brought from Middlesbrough or other parts the inland rates of carriage are so high that practically the sea voyage from Belgium, with through rates, does not cost any more than the heavy railway tariff over the lesser inland distance. Still, the fact that Belgian girders continue to be delivered in Yorkshire should interest the enterprising firms in the North to further efforts to make English builders and contractors independent of foreign iron. If this cannot be done now, with iron at its present value, when will it be possible?

Another successful experiment has been made in the water-cartridge system of blasting, conducted by Mr. W. Chappell, of Nobel's Explosives Company, Glasgow. Mr. Chappell, who superintends the work in Yorkshire and North Derbyshire, arranged with Mr. T. Newbould, mining engineer to Earl Fitzwilliam, to test the method at Simon Wood Colliery, Elsecar. There were six shots. The first is known as a "blow-out shot," and was therefore put into the "fast," with a view of settling whether a flame could be raised. The shot was fired in total darkness, and no flame could be detected. The second shot was a "breaking-in shot," which ordinarily takes about 2¼lb. of powder, the charge when completed being nearly 30in. in length. Under the water-cartridge system the charge is about 10in. in length and weighed about 8 oz. The work done was regarded as a slight improvement on that of powder. The third shot was placed within 4in. of the fast side, and, as in the first case, was bored 5ft. deep. This shot, with the others, gave much satisfaction to Mr. Newbould and the other officials. Other experiments have been conducted at Killamarth, Norwood, End, Birley, &c., and both miners and officials have declared the work to be done quite as effectively as with powder, with the additional and great advantage of perfect immunity from peril.

NOTES FROM SCOTLAND.

(*From our own Correspondent.*)

The iron market has again been firm this week in consequence of the restriction of output. The ironmasters are still holding out against the demand of their colliers for an increase of wages, and it looks just now as if they would be successful in their resistance. During the week three furnaces were put out of blast at Coltness and one at Shotts, but three that were out for repairs at Langloan have been re-lighted. The total number blowing is now 77 against 78 last week and 90 in the same week of last year. The curtailment of production is tending very materially to reduce the quantity of iron going into the warrant stores. The weekly addition was lately about 4000 tons, but in the past week it has only been about 930, and on Monday last no iron whatever was sent into store. The shipments of pig iron from Scottish ports during the week ending Saturday last amounted to 7861 tons, as compared with 9396 tons in the preceding week, and 11,022 in the corresponding week of 1885.

Business was done in the Glasgow warrant market on Friday at 39s. 10½d. cash. Monday's market was strong, with a further improvement to 40s. 2½d. On Tuesday the market was again firm at 40s. 2d. to 40s. 3½d. cash. Business was done on Wednesday at 40s. 4½d. to 40s. 8d. cash, coming back to 40s. 5d. cash. To-day—Thursday transactions occurred at 40s. 6d. to 40s. 8d., closing with sellers at 40s. 7½d. cash.

The values of makers' iron are advanced from 6d. to 1s. per ton, the quotations being as follows:—Gartsherrie, f.o.b. at Glasgow, per ton, No. 1, 44s. 6d.; No. 3, 41s. 9d.; Coltness, 49s. and 43s.; Langloan, 44s. 6d. and 42s.; Summerlee, 46s. and 41s. 9d.; Calder, 46s. and 41s. 6d.; Carnbroe, 42s. and 39s. 3d.; Clyde, 42s. 6d. and 39s. 6d.; Monkland, 41s. 6d. and 36s. 9d.; Govan, at Broomielaw, 42s. and 36s. 9d.; Shotts, at Leith, 44s. and 43s.; Carron, at Grangemouth, 46s. 6d. and 43s. 6d.; Glengarnock, at Ardrossan, 42s. 6d. and 40s.; Eglinton, 40s. 3d. and 37s.; Dalmellington, 41s. 6d. and 38s.

The arrivals of Middlesbrough pigs in Scotland for the year to date are 47,500 tons less than at this time last year.

During the past week there was shipped from Glasgow £8400 worth of machinery, of which a large proportion was new plant for the sugar plantations; £3451 sewing machines; £5400 steel goods, and £30,000 general iron manufactures.

There has been a brisk demand for coals, and notwithstanding the restrictions of output by the colliers, shipments appear to compare well in most instances with the quantities dispatched in the corresponding week of 1885. The shipments from Glasgow were 26,033 tons; Irvine, 1364; Troon, 6455; Burntisland, 24,685; Leith, 4552; Grangemouth, 14,058; and Bo'ness, 2814 tons.

The request made by the colliers for a second increase of 6d. a day in their wages has at present not much chance of success. So far only one or two of the ironmasters have given the past advance to their colliers, and the others are resolute in their opposition, putting out furnaces, and throwing the coals they do not require into the open market. A strike which lasted for a number of weeks, at Dalry, in Ayrshire, is now at an end, the men, who came out on the question of short time, having agreed to return to work on the compromise of reducing the hours by one instead of two per day. In reply to letters sent them by workmen on strike, Messrs. William Baird and Co.—the Eglinton Iron Company—write:—"We are at all times most anxious to preserve good relations with our workmen, and use every means in our power to promote these. When, however, our works are carried on at a loss, we cannot agree to a proposal which might increase that loss, and which would not in any case afford us relief in the present critical state of the trade. We extremely regret the long-continued depression, which severely affects capital and labour, and which made the recent reduction of wages absolutely necessary." On receiving this communication, the feeling of the men appeared to be that the strike should be brought to a close as speedily as possible, and they appointed a deputation to wait upon Mr. Angus, the managing partner at the Lugan Ironworks, to ascertain if he could make any concession to them. There can be no doubt that the time is most inopportune for pressing the ironmasters for an advance of pay. The volume of the Scotch iron trade has, so far, not made any expansion, and until more business is done and higher prices obtained any increase in the cost of production, such as advanced wages would involve, could only have the effect of aggravating the present unsatisfactory state of the trade.

A very powerful set of engines are at present being fitted up by Messrs. Fullerton, Hodgart, and Barclay, of the Vulcan Works, Paisley, in the new factory in course of erection by Messrs. J. and P. Coats, thread manufacturers, of that town. The engines are compound tandems, of 1600-horse power, the fly-wheel being 35ft. in diameter, having forty grooves for ropes, by which the machinery in the five flats of the mill will be driven. This enormous wheel will be upwards of 100 tons in weight.

It is intimated that Mr. William Pearce, M.P., of the Fairfield Shipbuilding Company, Glasgow, is making arrangements for taking over the entire control of the marine engineering works at Liverpool connected with the Guion Line. Important repairs to these vessels, hitherto done in Glasgow, will henceforth be executed on the Mersey.

In Aberdeen and the north-eastern district trade is now only beginning to be relieved of the congestion caused by its previous abnormal activity, and it will be a long time before the improvement now setting in makes itself generally felt. In textile fabrics —with the exception of wool—manufacturers experience great difficulty in supplanting old and completed orders by new. In wool, however, owing to the recent phenomenal advance in the raw material, much activity prevails, although the complaint is general that prices for manufactured goods are not yet commensurate with the advance in the raw material. In shipbuilding, extreme lifelessness is still the prominent feature, although signs are not awanting of brighter prospects. Messrs. Hall, Russell and Co., shipbuilders and engineers, Aberdeen, have received from the North of Scotland Steam Navigation Company an order to construct a first-class passenger steamer for the Norwegian tourist service—a service the company has, during the past summer, been exceedingly successful in, financially and otherwise. The new vessel is to be of steel, 225ft. in length, 29·6ft. in breadth, and 14·6ft. deep, with triple expansion engines, and a guaranteed speed of fourteen knots. Her probable cost will be about £25,000. In all branches of engineering business is still in a very backward state, and orders are only received at very low rates, and in most cases merely to keep moving.

WALES AND ADJOINING COUNTIES.

(*From our own Correspondent.*)

As a faithful recorder of the mining life of the district, I must not pass unnoticed a new movement, quite apart from the usual round of things such as output of coal, and wage questions, and differences. This new movement is a step towards the improved education of the miner, and is taken by Sir William Thomas Lewis. The education of the schools will perceptibly affect the men of the future, but we have a large mass of adults, young colliers, who have not had the advantages children now get, and to improve the education of these is of material consideration. In addition to founding a colliers' scholarship at Cardiff University, Sir William has now started a school at Aberdare for miners, and the subjects selected from the Science and Art Department list have been "Principles of Mining," "Applied Mechanics," and steam. The number who attended first session was fifty-one, and the last session an account of the falling off in trade and removals of colliers, thirty-seven. Of these thirty-seven miners fourteen passed in all the subjects, ten passed in only two of the subjects, ten passed in only one, and only three failed in all subjects. The distribution of prizes to the sixteen out of the thirty-four successful students took place on Monday evening at Aberdare, and in the unavoidable absence of Sir William T. Lewis, were presented by Lady Lewis. I am told that strenuous efforts will be made to get up a school in each district. The ultimate object, inducing many students to attend, is, of course, the practical and commendable one of getting a colliery manager's certificate, but there will be a wider and more beneficial result than the benefit of the few. General improvement is certain, and the mere hewer of coal take better rank with the skilled artisan. Deplorable ignorance and unacquaintance with the first principles of mining science have cost South Wales hundreds of thousands of pounds sterling, and so, even from this lower standpoint, an improvement in the miner's education is desirable. On loftier grounds as well as these, the initiative of Sir William T. Lewis is most praiseworthy, and is another of the many great services rendered by him to the country.

I have no improvement to record in any branch of local industry. In coal, Cardiff export last week was only slightly over 100,000 tons, Swansea 25,000 tons, while the coasting total from Newport was only about 16,000 tons. The enormous collections of coal wagons at sidings, and at ports, tell their own tale. I find, too, that at many of the leading collieries three days' work a week is becoming the rule. This means something like 12s. a week wages to the collier, and deducting his rent and incidentals, it is hard work to live upon it. As a fact, the recoil is upon the wholesale provision dealers. The little grocers at colliery communities fail in these trying times, having exhausted capital and credit in supplying the colliers, and the blow falls in the end upon Bristol and Liverpool.

It is comforting in these periods of depression to hear of some collieries doing well. I am told of one that last year paid £14,000 as royalties; this is a very exceptional case. Prices continue firm, 8s. 6d. to 8s. 9d. ruling figures for best.

The colliery depression is telling on rateable values. In one parish alone, Ystrad, in the Rhondda Valley, the rateable value has been reduced by £9000.

A London company is at the head of the new leadworks at Caerphilly, and the promise is said to be good. Probably a finer field yet exists in Cardiganshire. In the times of Carbery Price, and Mackworth, large sums were realised, and the impression this year amongst tourists visiting that country, notably Aberystwith, is that skill, capital, and engineering appliances could yet win greater fortunes.

I am glad to report good progress on the new railway to Cardiff Waterworks, suggested in these columns. The conveyance of the pipes alone—another contract—will materially reduce cost.

The principal iron exports of the week have been few, and of an ordinary character; 900 tons to San Francisco, 300 to Buenos Ayres, and a small cargo of pig iron to Santos.

Consignments of tin-plates from Newport show no improvement, but at Swansea the tone is much better. Last week the exports exceeded 55,000 boxes, and there was a perceptible reduction in stocks. With regard to prices, common brands are still to be obtained at 12s., but I have heard of 13s. asked for and had for best brands.

As the advance in tin and pig iron has been marked, it is tolerably certain that prices of tin-plate will advance too. Last week shows a strong tendency in this direction, and in the face of some works coming to a full stop, and lessening stock, there is certain to be a pressure for supply, which will send prices up.

NOTES FROM GERMANY.

(*From our own Correspondent.*)

The rolling mills in Silesia are at present working full time on bars and girders, as also are the converters, at the chief works, making both acid and basic steel; and the thin sheet mills have orders for as much as they can conveniently make. This temporary activity has, however, made no alteration in prices, which still remain nominally as last quoted in this place. The outlook, on the whole, for the Silesian works is not a pleasant one. Jammed up in a far-off corner as they are, it is essential for them to get an outlet to Poland and Russia, but it looks as if the latter country were bent upon fostering its southern ironworks and establishments, and does not feel disposed to make any alterations in tariffs and freights which would favour the Silesian iron industry, although the German Government has ardently pressed the matter at St. Petersburg. A rather more cheering account can this week be reported from Rheinland-Westphalia; not that prices have risen, but because they have become more stable and have in no case fallen, and because for forge and foundry pig, steel wire rods, bars and girders there is a brisk demand, and a large number of works are fully engaged night and day in completing the orders. It is now hoped that this spurt may lead to a continuation of better things and raise the prices at least to such a point that there will be no longer a loss in working. The fact also that the neighbouring countries of Austria and Belgium are now doing a more satisfactory business, coupled with better news from America and other parts, strengthens the manufacturers in this hope. Spanish ores have also been exported lately in rather larger quantities than for some time past, but prices of ores are unchanged here as yet. Spiegeleisen keeps up its price pretty well, and has been more called for during the last month. Basic pig maintains itself firmly, but Bessemer pig is still weak, and business in it inanimate. Luxemburg forge is a trifle lower, but foundry pig is firmer in price. As remarked, the bar mills have full work in hand, but prices remain, as yet, at the old low level. In plates and sheets the mills are also quite busy, and a number of good orders have come to hand for steel wire rods, without, however, affecting the prices. In rails and railway material no change for the better has occurred. Some considerable orders for rails are shortly expected for the State railways, but as the last Belgian offers were at M. 105, which means at the Westphalian works M. 90 to 95 p.t., there will not be much inducement for the latter to tender—that is, in so far as hopes of making any profit are concerned. The constructive workshops have still too little work at too low prices, but still here and there a few new orders have been booked.

The tone of the Belgian market is so far encouraging, as the works have orders enough to keep them well going. The combination is in force, although the binding agreement has not been yet definitively signed, and that steadies prices if it does nothing else. Girders are quoted at 100f., merchant iron at 105f., angles 115f., and plates 125f. p.t. list prices.

In France the manufacturers are quite firm in their quotations, sticking loyally and rigorously to the combination agreement; but the singular phenomenon is presented at Paris of the iron merchants competing against one another to the extent of selling at the cost price at the works in the Nord, and thus losing by the amount of the freight and other charges on their transactions, and this in the face of great firmness in the provincial markets, and the large orders for ironworks for the great exhibition building looming in the immediate future. The makers' quotations at works are—for girders 135f., merchant iron 140f. p.t., whilst the Paris houses are selling at 140f. for both sorts.

The following piece of sensational news must be noted for what it is worth, namely, that at Creusot it has been determined to give up the steel manufacture, and it is reported that the orders which the company had on its books have been transferred to other works! Presumably this would only refer to steel rails, because it is further stated that in future the company intends to turn its attention principally to the manufacture of war materials. A couple of years ago a large gun, as a trial, was made at Creusot, as the writer was then informed, and that the company has made steel armour-plates for a long time all readers of The Engineer are well aware, and it is not at all improbable that the Government may desire to see a French "Essen" established in the country.

The prices of coal and coke remain as last noted. It appears the German coals cannot hold their own against the English in Italy, because of the high freights on the Swiss, notably on the St. Gothard Railway. If these freights were lower, the Germans being able to deliver more promptly and directly, without the costs of unloading and reloading and marine insurance, they would be able to compete successfully they believe. In 1885 Italy imported from England 2,254,129 tons, from France 138,404 tons, Austria 87,505 tons, and only 70,004 tons from Germany, which it is anticipated will be still less in 1886.

NEW COMPANIES.

The following companies have just been registered:—

Darling Safety Coupling Company, Limited.

This company proposes to manufacture railway carriage and wagon couplings and other railway appliances, and for such purpose will acquire the British patent rights granted for "Darling's Automatic Coupling," upon terms of an agreement made with Darling's Automatic Railway Coupling Company, Limited, of 11, Bothwell-street, Glasgow. It was registered on the 17th ult. with a capital of £65,000, in £1 shares, with the following as first subscribers:—

	Shares.
A. Rummely, Coatbridge, Lanark, ironmaster	1
W. McGowan, 2, Peel-terrace, Edinburgh, coal-master	1
H. Cuthbert, 52, Great King-street, Edinburgh, shipowner	1
A. A. Macfarlan, 2, Ann-street, Glasgow, cashier	1
R. O. Murdoch, 180, West Regent-street, Glasgow, merchant	1
R. C. Lyness, 11, Bothwell-street, Glasgow, merchant	1
R. Starke, 43, West Regent-street, Glasgow, solicitor	1

The number of directors is not to be less than three nor more than seven; qualification, 250 fully-paid shares; the subscribers are to nominate the first; the company in general meeting will determine remuneration.

Duke's Patent Combined Brake and Starter Company, Limited.

This company proposes to acquire and work the letters patent No. 5659, dated 24th April, 1886, granted to John Frederick Duke, for a combined brake and starting apparatus for tramcars and other vehicles of a like nature, and also the patent rights of the same invention for France, Germany, Belgium, and the United States of America. It was registered on the 20th ult. with a capital of £30,000, in £5 shares, with the following as first subscribers:—

	Shares.
G. Davies, New Beckenham, solicitor	1
J. Todd, 14, Wandsworth-road, engineer	1
G. Treadwell, 12, Cumberland-street, Barnsbury	1
H. A. Fleuss, 83, Warwick-street, engineer	1
E. T. Collis, 70, Cloudesley-road, N., clerk	1
J. T. Bingham, 88, Grosvenor-road, S.W, clerk	1
G. H. Davis, Addiscombe, solicitor	1

Registered without special articles.

Garner and Company, Limited.

This company was registered on the 20th ult. with a capital of £15,000, in £2 shares, to purchase the business of Mr. John Garner, known as the Forest-hill Metal Works, and to carry on and extend the business, to build new premises on a site acquired from the London, Brighton, and South Coast Railway adjoining their station at Forest-hill, and to purchase all rights of an invention known as Garner's patent asbestos boiler. The subscribers are:—

	Shares.
F. Melhuish, 45, Cranfield-road, Brockley, engineer	1
W. Hixon, 11, Cross-lane, E.C., auctioneer	1
F. L. Jeyes, C.E., 9, Victoria-chambers, S.W.	1
W. H. Fuller, 6, Railway Approach, London Bridge, blind maker	1
H. T. Bonner, 108, High-street, Lewisham, architect, &c.	1
F. J. Greive, 1, Arthur-street, W., surveyor	1
J. Silvester, 43, Farleigh-road, Stoke Newington, brewery valuer	1

The number of directors is not to be less than three nor more than seven; the subscribers are to appoint the first; qualification, £200 in shares; remuneration, £300 per annum, and also one-tenth of the net profits in each dividend period in which 15 per cent. or upwards is paid to the shareholders.

Robert Owtram and Company, Limited.

This is the conversion to a company of the business of warehousemen, carried on by Messrs. Robert Owtram and Company, of 13, Watling-street, and Nos. 16, 17, 18, and 19, Friday-street. It was registered on the 17th ult. with a capital of £100,000, in £10 shares. The subscribers are:—

	Shares.
H. Marlow, 30, Hopton-road, Streatham, warehouseman	10
J. R. Holmyard, 19, St. Kilda's-road, Stoke Newington, warehouseman	10
J. H. Williams, 18, Upper Glo'ster-place, Dorset-square, warehouseman	10
H. T. Orpwood, 13, Watling-street, accountant	10
J. Bates, 19, Belmont-hill, Lee, warehouseman	10
W. Morgan, Essex-road, Enfield, warehouseman	10
F. K. Urch, 251, Camberwell New-road, warehouseman	10

The number of directors is not to be less than three nor more than seven; qualification, 100 shares; the subscribers are to appoint the first; remuneration, £400 per annum. Messrs. C. H. Owtram and John Frewen are appointed joint managers, and Mr. Richard Mould is appointed counting-house manager.

Peter Connor, McIntyre, and Company, Limited.

This is the conversion to a company of the business of copper, brass, iron, lead, and general metal merchants, carried on at Liverpool by Peter Connor and James McIntyre, trading as Peter Connor, McIntyre, and Co. It was registered on the 18th ult. with a capital of £70,000, divided into 11,550 preference or "A" shares, and 2450 deferred or "B" shares of £5 each. An agreement regulates the purchase, which includes interest in premises situate in Hanover-street, Duke-street, Westenholme-square, and Parr-street, Liverpool. The purchase consideration is £24,500, one moiety being payable in fully-paid preference shares, and the other in fully-paid deferred shares. The vendors are appointed managing directors at salaries of £600 per annum each. Each of the vendors will also be entitled to £10 per cent. on the net profits remaining in any financial year after payment of £8 per cent. dividend on both classes of shares. In the event of the report of Messrs. Chadwick and Boardman, valuers, showing a smaller return than anticipated, the purchase consideration will be reduced proportionately; 20 per cent. of the purchase consideration will be set aside to meet any bad debts which may have been contracted up to the 31st August. The subscribers are:—

	Shares.
W. Heaton, Rotherham, brass and iron founder	800
D. Crawford, Washington Foundry, Liverpool, engineer	100
P. Connor, 26, Hanover-street, Liverpool, metal merchant	800
J. McIntyre, 26, Hanover-street, Liverpool, metal merchant	800
J. Stevenson, 40 and 42, Cable-street, Liverpool, wholesale stationer	100
T. Ibbotson, jun., 36, Whitechapel, Liverpool, export merchant	400
W. Hill, Appleton, near Widnes, accountant	100

The number of directors is not to be less than three nor more than seven; the subscribers are to appoint the first; qualification, 50 shares; minimum remuneration, £500 per annum, of which sum £100 is to be paid to the chairman.

Soothill Wood Colliery Company, Limited.

This company was registered on the 16th ult. with a capital of £40,000, in £50 shares, to trade as colliery proprietors, coke manufacturers, miners, ironmasters, smelters, engineers, and ironfounders. An agreement of the 24th May (unregistered) with Alfred Brooke Blakeley and John Whitehead Blakeley will be adopted. The subscribers are:—

	Shares.
*A. B. Blakeley, Dewsbury, colliery proprietor	1
*R. Illingworth, Critchley, Dewsbury, colliery proprietor	1
*Charles Blakeley, Dewsbury	1
Stanley Blakeley, Dewsbury, merchant	1
J. Whitehead Blakeley, Scarborough, solicitor	1
G. Clay, Dewsbury, wool broker	1
J. H. Oates, Dewsbury, surgeon	* 1

The number of directors is not to be less than three nor more than seven; qualification, £500 in shares or stock; the first are the subscribers denoted by an asterisk. The directors are authorised to appoint their own remuneration.

MR. VANDERBILT'S NEW BOAT.

The new steam pleasure yacht Alva, which is being built by the Harlan and Hollingsworth Company for William K. Vanderbilt, is rapidly approaching completion, writes a Wilmington—Del.—correspondent of the *Philadelphia Press*, and the hull will be ready for launching about the middle of next month. Meanwhile her machinery and fittings are well advanced in the shops. The vessel will be the largest and probably the most elegant and costly private steam yacht in the world, surpassing Jay Gould's Atalanta, James Gordon Bennett's Nourmahal, or the late Mr. Tilden's Yosemite. The vessel is built entirely of the best quality of steel—both ribs and sheeting. She is 285ft. long over all, 252ft. on the load line, 32ft. 3in. beam, and 21ft. 6in. depth of hold. She is built for classification in the highest class of the English Lloyd's. She will be rigged as a three-masted schooner, with square topsail on the foremast. The propelling machinery will consist of an inverted double-action surface condensing three-cylinder compound engine, the high-pressure cylinder being placed in the centre and the low-pressure cylinders at each end. The high-pressure cylinder is 32in. in diameter, and the low-pressure cylinders each 45in.; the stroke is 42in. Besides this engine there will be reversing engines, pumping engines, turnover engines, engines for working the steam steering gear, windlasses and electric light machines, and for numerous other purposes in handling the ship. The propeller is a solid casting of manganese bronze made in Scotland, and arrived at the yard a few days ago. It has four blades, and is about 10ft. in diameter. There are two boilers of the circular single end, horizontal tubular pattern, with four patent corrugated furnaces in each. They are made of the finest steel plates, 1in. thick, and are 17ft. in diameter, and 10ft. long. They will stand back to back, with a fire room at each end. They are built to stand a working pressure of 100lb. to the square inch. Besides these there is a donkey boiler of steel for working the donkey and hoisting engines when steam is not up in the main boilers. The deck houses of the vessel are of steel, bolted and framed into the main deck. The accommodations for the owner and his friends will be forward of the machinery, and will be of the most luxurious description. The cabins will be fitted up in chaste and elegant designs, but without an over display of elaborate carving in hard woods. There will be much pine used in the joinery work that being considered by the builders as one of the best kinds of lumber for sea-going service. This will be finished mainly in white, with gold relief. The cabins will be fitted with mantels, fire-places, electric incandescent lights, electric bells and every convenience to be found in the rooms of the most elegant mansions. There will be more than a dozen bath rooms and closets, the plumbing of which will be of the very best character, and air pressure will be kept on all the water tanks so that water will run from the faucets with a strong head without requiring pumping. The carpets, upholstery, bedding, furniture and all the fittings and furnishings will be of the most luxurious character. The accomodations for officers and crew will be aft the machinery. The officers quarters will be fitted up elegantly and with every appliance for comfort and convenience, while the sailors will have such quarters as will make the old fashioned forecastle seem like the memory of a nightmare. This splendid pleasure boat is not built especially for speed. As one of the builders said, "She is not intended for a harbour racer, but for a safe, strong, comfortable cruiser, in which her owner and his friends may go in comfort and security around the world if they choose. She will probably develope about 14 knots per hour in ordinary weather.' The builders, by instruction of Mr. Vanderbilt, are not to make public the cost of this magnificent pleasure craft.

On the 18th ult. Messrs. Manlove, Alliott, Fryer, and Co., with all their staff and workmen, made an excursion to Hoveringham, and celebrated the coming of age of Mr. Fred. H. Manlove.

THE PATENT JOURNAL.

Condensed from the Journal of the Commissioners of Patents.

Applications for Letters Patent.

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

21st September, 1886.

11,961. Stopper for Bottles, J. Holmes, Keighley.
11,962. Sewing Machinery, J. Reece, London.
11,963. Printers' Spaces, R. F. Haller, London.
11,964. Instantaneously Stopping Breaches in Ships, J. H. Smith, Halifax.
11,965. Adjustable Chin-holder for Violins, &c., F. W. Leviergo, London.
11,966. Police Lantern, A. D. Melson, Birmingham.
11,967. Paraffin Oil Lamps, C. F. Wood, London.
11,968. Ranges, D. Taylor, Birmingham.
11,969. One Way Ploughs, E. Riemer, London.
11,970. Bankers' Cheques, F. N. Seyde, Birmingham.
11,971. Recovering Tin from Tinned Plate, J. Park, Glasgow.
11,972. Purification of Iron Ore, B. H. Thwaite, Liverpool.
11,973. Pressure Gauges, A. Budenberg.—(—— *Schäffer and —— Budenberg, Germany.*)
11,974. Octave Coupler for Pianos, W. E. Heys.—(*A. Ascuna, Spain.*)
11,975. Linking, &c., Machines, A. Paget, Radmoor.
11,976. Hand Trucks, R. J. Saxton, London.
11,977. Induction Coils, W. Stanley, jun., London.
11,978. Induction Coils, W. Stanley, jun., London.
11,979. Induction Coils, W. Stanley, jun., London.
11,980. Shuttle-actuating in Looms, R. L. Hattersley and J. Hill, Keighley.
11,981. Cleansing Composition for Linen, A. Hodgkinson, Ireland.
11,982. Printing Passenger Fares on Tickets, G. White, Springbrook.
11,983. Latches, P. M. Justice.—(*F. T. Davis, United States.*)
11,984. Preventing Water Pipes Bursting during Frost, W. W. Dunn, London.
11,985. Preventing Freezing of Water in Pipes, W. W. Dunn, London.
11,986. Batching Jute, E. Heumann, London.
11,987. Automatically Indicating Weights, W. S. Oliver, London.
11,988. Vehicle Wheel Hub, &c., J. L. Johnston, London.
11,989. Frame Joint Fasteners, A. J. Boult.—(*W. Cutts, Canada.*)
11,990. Transmission of Electrical Energy, G. J. Kornmiller, London.
11,991. Telephonic Systems, A. J. Boult.—(*W. Marshall, United States.*)
11,992. Ventilating Apparatus, J. M. Garfield, London.
11,993. Imprinting Designs upon Oil Cloth, G. W. Williams, London.
11,994. Disinfecting Apparatus, L. Dove and J. S. Bush, London.
11,995. Baking Powders, W. G. Dunn, London.
11,996. Arrangement of Lubricators, W. H. Thompson, Lewisham.
11,997. Producing Carbon Fibres, W. Maxwell, London.
11,998. Spinning Apparatus, H. E. Leetham and J. Jones, London.
11,999. Preserving Meat, L. von Wohlfarth, A. Tausky, and F. R. von Friedland, London.
12,000. Lamps, E. L. Bill, London.
12,001. Auxiliary Mouth-piece for Telephones, N. A. Hanner, London.
12,002. Turning Gear for Swing Bridges, C. Wawn, London.
12,003. Steering Gear of Tricycles, &c., G. Singer, London.
12,004. Primary Batteries, E. W. Adcock and J. W. Trotman, London.
12,005. Cricket Stumps, J. O'Connor, Hulme.
12,006. Securing Coal Plates, F. J. Bantin, London.
12,007. Fastening Tapes for Spindle, &c., Purposes, J. Wilson, Halifax.
12,008. Fastening Tapes for Spindle, &c., Purposes, J. Wilson, Halifax.
12,009. India-rubber Tip for Pencil-holder, H. Anderton, Sheffield.
12,010. Hair Rolls, J. L. Wells, London.
12,011. Safety Razors, H. H. Lake.—(*T. F. Curley, United States.*)
12,012. Treatment of Sugar Cane, H. H. Lake.—(*T. F. Krajewski, United States.*)
12,013. Cigarette Paper, C. J. Singleton, London.
12,014. Filter Presses, R. J. Friswell and A. Myall, London.
12,015. Roughing Horseshoes, J. Mills and J. Head, London.
12,016. Bottles, R. H. Barrett, London.
12,017. Receiving, &c., Messages, T. J. Hewson, London.
12,018. Automatically Compressing Air, A. M. Clark.—(*V. A. Pilloud, France.*)
12,019. Frames for Umbrellas, &c., W. Carter, London.
12,020. Studs, &c., J. C. W. Jefferys, London.
12,021. Button Hole Sewing Machines, E. B. Moore and G. and M. O. Rehfuss, London.
12,022. Preparing Colouring Matters, A. Kern, London.
12,023. Bottle Stopper, J. B. Helsby, London.

22nd September, 1886.

12,024. Strengthening Metallic Boxes, H. H. Chilton, Wolverhampton.
12,025. Folding Stool, J. M. Martin, Edinburgh.
12,026. Cutters of Wood-planing Machines, J. Rawlings, London, and J. and G. Pickles, Hebden Bridge.
12,027. Handles for Carrying Articles made of Metal, W. H. and B. Jones, Wolverhampton.
12,028. Ventilator and Chimney Cowls, A. W. Harrison, Bryn Usk.
12,029. Electrical Indicators, J. Stephen, Blackhall.
12,030. Removing Grease Stains from Cloth, W. H. Brassington and J. Mooney, Manchester.
12,031. Syphon Water Waste Preventers, M. Syer, London.
12,032. Electric Incandescent Lamps, A. Featherstonhaugh, London.
12,033. Cure of Certain Diseases, J. Shaw, Manchester.
12,034. Dentifrice Water, F. Bosshardt.—(*H. Peschard, France.*)
12,035. Regulating Flow of Water, A. Pohlman, Halifax.
12,036. Guiding Fabrics into Stentering Machines, D. P. Smith, London.
12,037. Wire Nail, A. E. Gorse, West Bromwich.
12,038. Barbed Wire Fencing, A. E. Gorse, West Bromwich.
12,039. Adjustable Coat Cuff, J. Barnes, Halifax.
12,040. Straining Wire, &c., Ropes, G. Hughes, Wolverhampton.
12,041. Metallic Chill Core, T. Blackmore, Aston New Town.
12,042. Casement Stays, H. J. Broadway, Handsworth.
12,043. Insulator for Fixing, &c., Wires, H. Hobson, S. Rushton, T. M. Harrigan, and R. H. Schofield, Rochdale.
12,044. Forced Draught for Boilers, J. B. Archer, Newcastle-on-Tyne.
12,045. Envelopes, E. Harris, London.
12,046. Means for Advertising, A. J. Maffuniades, London.
12,047. Locks or Latches, C. J. Reynolds, London.
12,048. Self-lighting Cigar, H. K. Bromhead, London.
12,049. Two-wheeled Carriages, J. Rook, London.
12,050. Dynamo Electric Machines, F. Wynne, London.
12,051. Casting Statuary Works, J. F. L. Moeller London.
12,052. Breakwater, &c., H. Defty, London.
12,053. Furnaces for Smelting Copper, D. McKechnie, Liverpool.
12,054. Forming Blacklead into Packets, R. Ripley Liverpool.
12,055. Collecting Finely-divided Gold, M. Vesenmayer, London.
12,056. Mules for Spinning, W. Tatham, London.
12,057. String Instruments, J. Gegenschatz, London.
12,058. Tandem Bicycle, J. M. Starley, London.
12,059. Standards of Electro-motive Force, A. Muirhead, London.
12,060. Portable Photographic Camera and Stand, G. J. Michel, London.
12,061. Softening and Purifying Water, H. R. Lipscombe, London.
12,062. Cap and Fastener for Umbrellas, L. Dove and J. S. Bush, London.
12,063. Photographic Plates, A. C. Henderson.—(*G. E. Thiellement, France.*)
12,064. Non-alcoholic Beverage, F. Woolway, London.
12,065. Electrical Telephones, R. Theiler, London.
12,066. Name Tablet, O. Fitch, London.
12,067. Propelling Ships, T. Hitt, London.
12,068. Motor Engines, R. R. Hutchinson, London.
12,069. Sea Anchor or Drag, E. S. Copeman London.
12,070. Treatment of Copper and Iron Pyrites, A. and L. Q. Brin, London.
12,071. Supplying the Gasometer of Continuous Action Liquid Aerating Machines, F. Foster, London.
12,072. Knitting Machines, B Kerr, London.
12,073. Bread, &c., H. W. Hart, London.
12,074. Self-filling, &c., Machines for Weighing Cereals, R. Simon, London.
12,075. Continuous Filtration of Sewage, G. H. Leane, London.
12,076. Glass, T. C. J. Thomas, London.
12,077. Triturating Cylinders, J. R. Alsing, London.
12,078. Promoting Combustion in Boiler Furnaces, H. H. Lake.—(*C. Bianchi, Italy.*)
12,079. Delivery of Prepaid Goods, G. A. Macbeth, London.

23rd September, 1886.

12,080. Shuttles for Looms, S. Hainsworth, Bradford.
12,081. Reversible Waterproof Garments, I. Frankenburg and W. Line, Manchester.
12,082. Substitute for Quinine, &c., J. Allpass, Manchester.
12,083. Moleskins, J. E. Harrison and D. Madeley, Manchester.
12,084. File for Filing Papers, &c., C. D. L. Greenhalgh, Manchester.
12,085. New Game, M. Owen, West Felton.
12,086. Yielding Heddles for Wire Weaving, G. H. May, Glasgow.
12,087. Finder for Photographic Purposes, F. W. Branson, Leeds.
12,088. Stoppering Bottles, T. Bintliff and M. Crossley, Ashton-under-Lyne.
12,089. Riding Saddle, C. Ashmore, Darlaston.
12,090. Fixing Double Saw Teeth, E. Sykes and E. Wilkinson, Huddersfield.
12,091. Filters, C. A. Clapham, Bradford.
12,092. Pig Ringer, A. D. Melson, Birmingham.
12,093. Construction of Manholes, W. C. Tyndale, London.
12,094. Needle Threader, J. Wallis, Birmingham.
12,095. Holders for Tools, O. Bussler, Berlin.
12,096. Apparatus to Dispense with the Long Check Strap employed in Looms, T. Knowles, Halifax.
12,097. Electrical Communicating Apparatus, W. Chadburn, Liverpool.
12,098. Electro-magnets, T. H. Williams, London.
12,099. Ventilator for Rooms, &c., E. J. Gillis, Southampton.
12,100. Combined Penholder and Blotter, J. Frankel and A. F. Wells, London.
12,101. Expanding Ends of Tubes, G. Fletcher, London.
12,102. Sanitary Ventilated Bedding, E. H. Benson London.
12,103. Gassing Machine, W. Ellis, London.
12,104. Adjustable Sleeve Guide, J. S. Bush and L. Dove, London.
12,105. Water-posts, &c., C. G. Schmidt, London.
12,106. Cue Tip, W. J. Napier, Liverpool.
12,107. Bakers' Ovens, C. H. Harding and A Hunt, London.
12,108. Sectional Steam Generators, C. A. Knight, Glasgow.
12,109. Electrical Drop Indicator, R. Price, London.
12,110. Meta-stannic Acid, J. J. Hood and A. G. Salamon, London.
12,111. Seed Drills, F. H. Ryland, London.
12,112. Velocipedes, O. Uhlitzsch, London.
12,113. Securing the Lids or Covers of Vessels, F. Baumgartner and W. Kumpfmiller, London.
12,114. Galvanic Battery, J. Noad, London.
12,115. Feed-water Heating, T. J. Rayner, London.
12,116. Lifts or Elevators for Mines, &c., J. H. Edwards, London.
12,117. Electric Furnace, W. Maxwell, London.
12,118. Calendars, W. H. H. Cooper, London.
12,119. Steam Condensing Apparatus, J. C. Fell.—(*J. B. Friend, New Zealand.*)
12,120. Oil Lamps, N. Pouchkareff, London.
12,121. Brakes for Road Vehicles, J. Liversidge, London.
12,122. Scratch Brushes, J. Masters, London.
12,123. Hand Stamp, W. G. Sullivan, London.
12,124. Pneumatic Clock, A. M. Clark.—(*V. A. Pilloud, France.*)

24th September, 1886.

12,125. Circular Revolving Panoramic Train, J. Bromley, Leeds.
12,126. Horse Hay Rakes, J. Mackenzie, Cork.
12,127. Self-feeding Eyeletting Machines, J., J. M., A. J., and S. A. Gimson and J. Craig, Leicester.
12,128. Annealing Cover for Sheet Iron, R. Poole, Handsworth.
12,129. Brackets for Curtain Rods on Doors, &c., J. Saunders, Cirencester.
12,130. Extinguishers for Hydro-carbon Lamps, F. R Baker, Birmingham.
12,131. Dress Fasteners, F. Iles, Birmingham.
12,132. Receiving or Delivering Coin, W. S. Oliver, London.
12,133. Wire Ropes, L. Hill, Stockton-on-Tees.
12,134. Obtaining Power in Engines by the Ignition of Combustible Mixture, B. and J. Butterworth, Rochdale.
12,135. Fixing Door Knobs, G. Wicks, Ayton.
12,136. Drawing Wire, M. F. Roberts, Manchester.
12,137. Removing Kite-tails from Telegraph Wires, J. Poole and K. MacIver, Manchester.
12,138. External Bottle Stoppers, G. W. Ellis, Halifax.
12,139. Making Two folded Twist Yarn, G. Kirkman, Halifax.
12,140. Foot Adjustable for Ladders, &c., T. Monk, Birmingham.
12,141. Automatic Delivery of Prepaid Goods, F. C. Lynde, Manchester.
12,142. Fountain Penholders, R. F. Ballantine, Manchester.
12,143. Food for Horses, J. Parker, Birmingham.
12,144. Brooms for Road Sweeping, &c., J. Sainty Norwich.
12,145. Crinolette, E. Hughes, London.
12,146. Stoppering Bottles, G. A. Cubley and J Preston, Sheffield.
12,147. Metallic Composition, J. Ridge, Sheffield
12,148. Machinery for Working Glasses, E. H Pearce and H. Besson, Birmingham.
12,149. Trusses for Ruptures, E. Jones, Liverpool.

12,150. Berths for Ships, G. A. Billington, Liverpool.
12,151. Calks for Horse-shoes, E. Dejean and E. Rochester, London.
12,152. Roller Mills for Crushing Corn, G. Hudson, Durham.
12,153. India-rubber Rings for Jointing Pipes, C. J. Watts, London.
12,154. Applying Pressure for Surgical Purposes, W. Matthews, London.
12,155. Introducing Cold Air into Refrigerating Chambers, G. Fry, London.
12,156. Thawing Frozen Meat, &c., G Fry, London.
12,157. Tinned Copper Goods, J. Dale, London.
12,158. Drilling Rock, T. Mayne.—(*C. W. Potter, United States.*)
12,159. Reclaiming Waste Moorlands, C. Weygang, London.
12,160. Measure Index Tap, C. Bordes and E. I. Redgrave, London.
12,161. Kent Patent Brick Cover, &c., G. Austen, Northfleet.
12,162. Combination Screw-plate, &c., R. Allen and W. J. Wakefield, London.
12,163. Steam Engine Indicators, R. H. Smith, Birmingham.
12,164. Toy Designed as a Vanishing Figure, J. Strick, London.
12,165. Electric Generator, &c., W. Stanley, jun., London.
12,166. Centrifugal Pumps, H. J. Allison.—(*J. Richards, United States.*)
12,167. Mortise Bolt, J. D. Tucker, London.
12,168. Carpets, J. Brinton and Co. and T. Greenwood, London.
12,169. Dynamo-electric Machines, G. C. Fricker, London.
12,170. Sewing Books, J. R. Reynolds, London.
12,171. Book Sewing Machinery, E. F. Cone, London.
12,172. Fastenings of Bangle Bracelets, F. A. Walton, London.
12,173. Lifting Syphon with Valve Combined, R. Wicks, Croydon.
12,174. Register Stoves, T. W. Barnet, London.
12,175. Spanners or Wrenches, G. J. Child, London.
12,176. Mariner's Compasses, H. H. Lake.—(*L. Ripamonti and H. Drivet, France.*)
12,177. Working Railway Signals, &c., J. T. Bold, London.
12,178. Embossing or Printing, J. G. Lorrain, London.
12,179. Brackets and Conduits for Cable Railways, A. J. Boult.—(*E. D. Dougherty, United States.*)
12,180. Hand Electric Lamp, W. E. Moser, London.

25th September, 1886.

12,181. Game of Drawing-room Tennis, Hon. W. E. Fitzmaurice, Croydon.
12,182. Safety Apparatus for Steam Boilers, R. N. Boyd, London.
12,183. Solid Topped Picker, J. Fielden and W. Craven, Todmorden.
12,184. Spinning Tackle for Live or Dead Baits for Taking Fish, A. Morriss, Redditch.
12,185. Rolling Wire for Making Wire Cards, &c., W. Walton, Manchester.
12,186. Chamfering and Facing Screw Nuts, R. S. Wood, E. N. Dunderdale, and J. A. Kinder, Manchester.
12,187. Shuttle Guards in Looms for Weaving, H. Livesey, Halifax.
12,188. Automatic Pump, J. A. S. Watson, Liscard.
12,189. Girthing Tapes for Measuring Round Timber, J. C. Watkins, Bradford.
12,190. Self-adjusting Kidney Link, R. Campion, London.
12,191. Cases for the Conveyance of Live Animals, H. Fort and J. Cockshott, Skipton-in-Craven.
12,192. Screening, Grain, &c., C. L. Wray and W. J. Radford, Liverpool.
12,193. Baking Bread, &c., R. R. Gibbs, Liverpool.
12,194. Feed-water Heaters, S. W. Wiles, Liverpool.
12,195. Moderating and Extinguishing Lamp Flames, W. R. Birch, London.
12,196. Accelerating the Generation of Steam in Boilers, L. Gjemre and E. Oftedahl, Newcastle-on-Tyne.
12,197. Railway and other Carriages, G. Hodgkinson, London.
12,198. Lowering and Raising Window Venetian Blinds, W. Vaughan, Birmingham.
12,199. Bags or Packets for Tea, &c., S. Washington, Manchester.
12,200. Cutting Discs of Wood, &c., J. F. Smyth, Belfast.
12,201. Packing Cigarettes, F. C. Lynde, Manchester.
12,202. Bronze Guns, &c., J. Whitley, Leeds.
12,203. Compound for Marking Boxes, &c., C. Astfalck, Paris.
12,204. Tricycle, H. Edwards, Anglesea.
12,205. Plug Valves for Water-closets, H. W. Buchan, Glasgow.
12,206. Beaming Machines, J. Bradshaw, Bolton.
12,207. Bar Frames used in Beehives, G. Castleden and A. H. S. White, Framlingham.
12,208. Folding Boxes, I. W. Parmenter.—(*C. W. Elliott, Canada.*)
12,209. Safety Collar Stud, S. Reeves and S. H. Reeves, Birmingham.
12,210. Metallic Sleepers, A. T. Allen and H. Cavill, Sheffield.
12,211. Pneumatic Action of Organs, C. Brindley, Sheffield.
12,212. Printing Coat or Cloth, T. S. Brigg, Leeds.
12,213. Cloth, T. S. Brigg, Leeds.
12,214. Collapsible and Expansible Cage, W. J. Payne, London.
12,215. Bolt for Wire-work Doors, G. Billett, London.
12,216. Oil for Turkey Red Dyeing, &c., J. Kirkpatrick, Glasgow.
12,217. Paper, Antiseptic and Germ Proof, R. D. Sinclair and J. G. Brown, Glasgow.
12,218. Automatic Landing Brow, W. May, London.
12,219. Joints and Tongues for Brooches, &c., H. Dalgety, London.
12,220. Clamps for Boxes, &c., E. Pick, London.
12,221. Self-enveloping Writing Paper, T. O. Wethered, Great Marlow.
12,222. Electric Apparatus for Indicating Time, R. J. Rudd, London.
12,223. Moving Key-hole Cover to admit of Key, J. G. Howard, London.
12,224. Unloading Grain, &c., from an Endless Belt, Z. Szanlawsky, London.
12,225. Registration of Fares of Railway, &c., Tickets, W. E. Miksch, London.
12,226. Sheep Stamp, C. W. Maclean and W. Sutherland, London.
12,227. Cutting into Slices Almond Rock, &c., W. G. G. Sharp, H. C. Sharp, and I. A. Ogden, London.
12,228. Cleansing Hulls of Ships, S. Hallett, London.
12,229. Waste Preventer Nozzle, L. Dove and J. S. Bush, London.
12,230. Movable Elbow Rest, R. Chanony, Paris.
12,231. Twist Lace Machines, A. Mosley, London.
12,232. Hollowing, &c., the Edges of Skates, W. S. Simpson, London.
12,233. Copying Presses, H. A. C. Lehmann, London.
12,234. Novel Compressed Air Engine, E. Mein, London.
12,235. Primary Electric Batteries, G. F. Rose, London.

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12,236. Automatic Self-inking Marker, H. Ferguson, Belfast.
12,237. Reflecting Appliances for Miners' Safety Lamps, W. Fairclough and W. Warburton, Manchester.
12,238. Lens, &c., J. E. Thornton, Manchester.
12,239. Cleaning, &c., Machine, R. B. Lytle, Belfast.
12,240. Rollers for Tendering Meat, M. Scheller and A. Del Medico, London.
12,241. Heads, &c., for Pick Shafts, &c., F. Skelton, Heeley.
12,242. Flush Sash Lifts and Drawer Pulls, J. F. H. Cartland, Birmingham.
12,243. Tires of Wheels for Tricycles, &c., J. Hudson, Birmingham.
12,244. Delivering Prepaid Liquids, W. S. Oliver, London.
12,245. Leathers for Hats, &c., F. W. Cheetham, Manchester.
12,246. Holding, &c., Gas Moons, E. J. Shaw, Walsall.
12,247. Extinguishing the Flame in Lamps, E. J. Shaw, Walsall.
12,248. Furnaces for Desiccating, &c., Refuse, T. Ogden, London.
12,249. Obtaining Zinc, W. S. Squire and S. C. C. Currie, London.
12,250. Photographic Camera Lens Shutters, J. Swift, London.
12,251. Electric Batteries, G. Binswanger and C. Pollak, London.
12,252. Automatic Fire-extinguishers, T. Witter, London.
12,253. Chemical Fire-extinguishers, J. Haslam, London.
12,254. Taps and Cocks, &c., J. Read, Sheffield.
12,255. Hyposulphite of Soda, T. Raynaud, London.
12,256. Pneumatic Holder, E. O. Grünert, Liverpool.
12,257. Co-acting Apparatus for Railway and other Signals, E. Russell, New Malden.
12,258. Self-acting Mules and Twiners, W. T. Watts and W. Storrs, London.
12,259. Desiccation, &c., of Precipitants or Solids Resulting from Sludge, &c., R. de Soldenhoff, London.
12,260. Forging Horseshoe Nails, J. Y. Johnson.—(*C. R. Ellacott, Canada.*)
12,261. Fastenings for Wardrobe, &c., Doors, E. Tonks, London.
12,262. Utilising the Tides and Running Streams as a Motive Power, T. D. Hollick and W. E. Rickard, London.
12,263. Bicycles, &c., H. A. Couchman, London.
12,264. Transformer, W. H. Snell, London.
12,265. Marking, &c., Engineering and other Work, F. W. Munro, London.
12,266. Obtaining Heat and Light, W. Boggett, London.
12,267. Bush or Bearing for Axles, R. Hitchcock, Taunton.
12,268. Heel Trimming Machines, H. H. Lake.—(*A. F. Smith, U.S.*)
12,269. Steam Engines and other Pistons, F. J. Talbot, London.
12,270. Wire Gauge for Electricians, L. Epstein, London.
12,271. Plant for Casting Steel Ingots, W. H. Follett, London.
12,272. Flower Holders for Brooches, E. B. Harrop, London.
12,273. Trunnion Bearings for Ordnance, R. T. Brankston, Newcastle-on-Tyne.

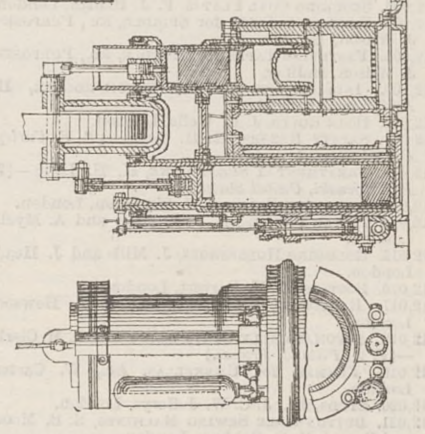
SELECTED AMERICAN PATENTS.

(From the United States' Patent Office official Gazette.)

345,450. Air Engines, *Alexander K. Rider, Walden, N. Y.—Filed January 30th, 1886.*

Claim.—(1) The combination, with an air engine acting in closed cycle, and having uncovered cylinders and pistons, and an external heating device for heating the air within the engines, of an air-supply pump for maintaining the desired initial pressure in the engine, substantially as herein described. (2) The combination, with an air engine, of an air-supply pump having its clearance space variable by adjustment, substantially as herein described. (3) An air engine provided with an air-supply pump, and in which the increment of pressure caused by increasing

345,450



the initial pressure is wholly or partially balanced by the weight of the pistons, substantially as herein described. (4) The combination, with an air engine provided with a suck-in valve to prevent the minimum pressure in the engine from falling materially below the atmosphere, of an air-supply pump, whereby a sufficient pressure of air will be reduced to lift and open the suck-in valve before a partial vacuum is formed in the engine, substantially as herein described.

345,662. Cutter Head, *Elbridge G. Blaney, jun., Swampscott.—Filed December 7th, 1885.*

Claim.—The improved cutter stock, its cutters and their clamping screws, constructed, combined, and arranged substantially as set forth, the same consisting of the tube C, the two arms B slitted lengthwise partly through each, and projecting in opposite directions from such tube, both horizontally and vertically, and each having its outer end the arcal portion of the periphery of a cylinder whose axis corresponds to that of the tube,

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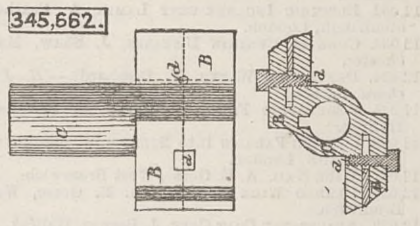
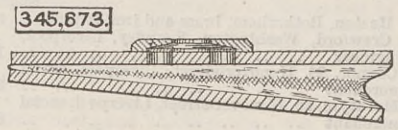


the two cutters *a*, arranged in the slits of the arms, and each projecting from its arm the thickness of a shaving to be cut by such cutter, and screws *d* extending into the arms transversely thereof and through the cutters, and operating while being screwed up to contract the arms upon the cutters, as explained, all being for the purpose specified.

345,673. Valve for Organ Bellows, *J. Herbert Chase, Brooklyn, N. Y.—Filed October 5th, 1885.*

Claim.—(1) The combination, with wind inducing apparatus, comprising a board or piece provided with a series of holes for the passage of air, of a valve of flexible material confined about its edge, but unconnected to said board or piece, adapted to cover the holes, and having a central opening inward of the range of holes, whereby when the valve is forced against the holes it may close them, and when it is moved away from the holes air may pass through it and the holes, substantially as described. (2) The combination, with wind inducing apparatus, comprising a board or piece provided with a series of holes for the passage of air, of a valve of flexible material

345,673.

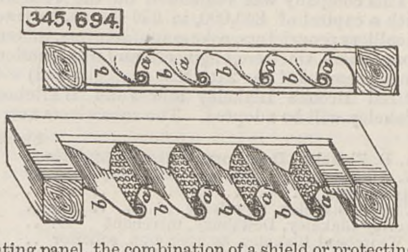


adapted to cover the holes, and having a central opening inward of the range of holes, and a chamber containing the valve, confining the same about its edge and having a central opening, substantially as specified.

345,694. Louvre and Blind, *George Hayes, New York, N. Y.—Filed January 15th, 1886.*

Claim.—(1) A panel composed of strips or slats alternately perforated—or otherwise apertured—and plain or without apertures, the two being separate, but in conjunction to form a protected ventilating screen, one portion or slat adapted for opening, essentially as shown and described. (2) In a ven-

345,694.



tilating panel, the combination of a shield or protecting slat *b*, and a perforated—or otherwise apertured—screen *a*, one of which is fixed and immovable, and the other pivotted or otherwise adapted to be movable, essentially as shown and described.

345,748. Spring Hinge, *Geo. W. Warner, Freeport, Ill.—Filed September 1st, 1884.*

Claim.—In a spring hinge, a core C, directly connected with one leaf of the hinge, so as to swing, in combination with the leaves of the hinge and a coil

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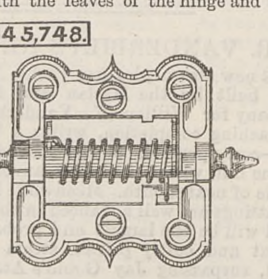

spring encircling the core and connected at one end with the core and at the other end with one of the leaves of the hinge, substantially as and for the purpose specified.

345,751. Rotary Blower, *Peter L. Weimer, Lebanon, Pa.—Filed March 17th, 1886.*

Claim.—(1) A drum provided with a series of chambers or cylinders having solid pistons adapted to the form thereof, and unobstructed grated heads flush with the periphery of said drum, in combination with an outer casing having chambers containing packing, forming abutments of a width in excess of the width of the ingress and egress passage of the cylinders, and arranged diametrically opposite to each other, substantially as and for the purpose set forth. (2) A drum composed of a series of separate detachable triangular boxes and discs, forming rectangular chambers, in combination with rectangular pistons, substantially as described. (3) A drum provided with a series of

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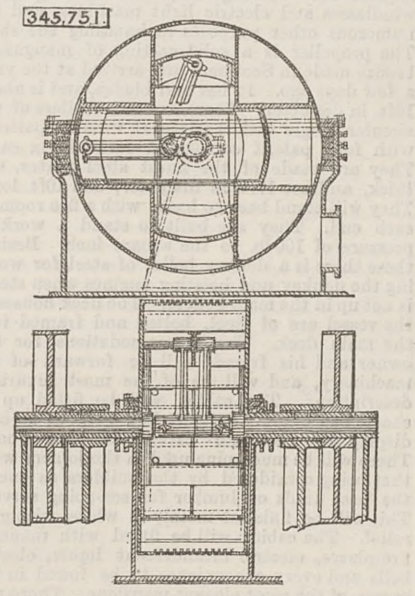

radial chambers or cylinders, in combination with an outer casing provided with diametrically opposite abutments of a width in excess of the width of the ingress and egress passage of the cylinders, and packing chambers extending across both sides of the casing, substantially as described. (4) A drum having hollow trunnions supported on suitable bearings, a shaft passing through said trunnions and apertures formed in the latter to lubricate the journals from the interior of the drum, substantially as described. (5) A drum provided with a series of radiating cylinders and solid pistons, in combination with a casing entirely surrounding the drum, and provided with packing chambers, substantially as described, for separating between the ingress and egress side of said casing, as and for the purpose set forth.

345,777. Pipe Wrench, *Geo. E. Franklin, Natick, Mass.—Filed January 22nd, 1885.*

Claim.—The movable jaw E, having a screw threaded shank, in combination with the nut *b*, which turns on

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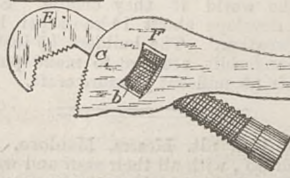

said shank, and the fixed jaw, which is provided with head C, having an oblique passage or opening D, which is enlarged at each end to allow play of jaw E, and the opening F, which receives nut *b*, and extends beyond the same, having the shape of the arc of a circle to allow slight motion of nut *b* with jaw E, while permitting said nut to act as a pivot, substantially as set forth.

345,929. Cylinder Lubricator, *Charles W. Sherburne, Boston, Mass.—Filed April 15th, 1885.*

Claim.—(1) The reservoir A, having its wall thickened near its top on one side and provided with the boss A^1 at or near its top, said thickened wall and boss having oil channels b^5 and steam channels b^6 therein, substantially as and for the purposes described. (2) The two-way cock F, provided with two sets of exterior grooves $f^3 f^4$, at different levels and of different lengths

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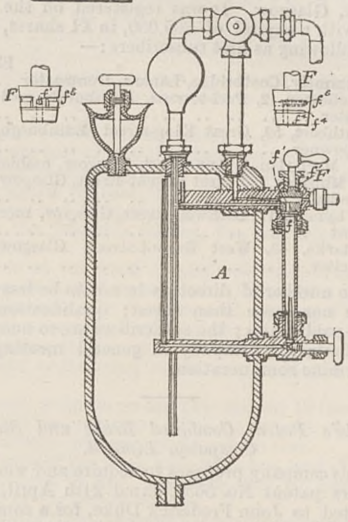

which two sets of grooves communicate with each other, substantially as described. (3) The two-way cock F, having the interior vertical passage f, and interior transverse passage f^1, in combination with the exterior connecting passages f^3 f^4, of different lengths, substantially as and for the purposes described.

345,951. Method of Saving Floating Materials in Ore Separation, *Hezekiah Bradford, Philadelphia, Pa.—Filed June 22nd, 1885.*

Claim.—The method herein specified of saving floating materials in ore separation, consisting in passing the water and floating materials along in an open unobstructed sheet from the table or separating machine with but little agitation of the water, thus preventing

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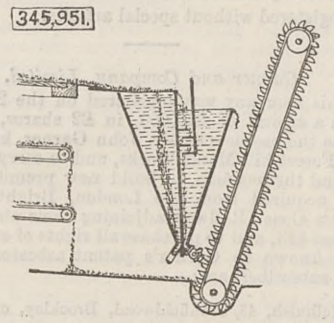
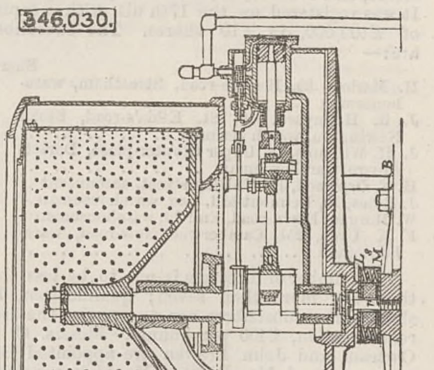


such materials from being carried beneath the surface and subsiding, then causing the water and floating materials to plunge or fall into a water receptacle, and then retaining said floating material in said receptacle until they lose their floating power and sink, substantially as specified.

346,030. Centrifugal Hydro Extractor, *Charles E. Dulin, Philadelphia, Pa.—Filed December 8th, 1885.*

Claim.—(1) A centrifugal machine provided with a rocking frame supporting the basket shaft, and a motor engine supported by said frame and connected with the shaft, substantially as described. (2) The combination, in a centrifugal machine, of a fixed curb, and a frame supported upon rocking bearings and carrying a shaft, basket connected to the shaft, and engine connected with the shaft in fixed relation thereto, substantially as described. (3) The combination of the curb supported in a fixed position, a frame supported on a rocking bearing below the curb, a shaft rotating in fixed bearings on the frame, and an engine connected to the shaft and secured to the frame, substantially as described. (4) The rocking frame having bearings for a shaft carrying a basket, and an engine supported by the frame, and having

346,030.



flexible connections with a supply pipe, and connected to drive the shaft, substantially as described. (5) The combination of the frame E, having a bed plate and over-hanging arms, a crank shaft turning in bearings of the frame, and an engine supported by the bed plate and connected to the crank, and a rocking bearing for the frame, substantially as described. (6) The combination of the frame supporting the basket shaft and driving engine, and a bearing consisting of springs arranged below a bearing plate or face of the frame, to permit the latter to be tilted in any direction, substantially as described. (7) The combination of the bed B, frame supporting the basket shaft and engine, plates L M, springs *s*, and bolt *r*, substantially as described.

Naval Engineer Appointments.—The following appointments have been made at the Admiralty:—Robert Harding, engineer, to the Lizard; George Aborn, engineer, to the Vesuvius; Josiah H. Hunt, engineer, to the Hecla; E. J. Rutter, assistant engineer, to the Devastation.