AN ACCOUNT OF EXPERIMENTS TO TEST THE ACCURACY OF REGISTERING ANEMOMETERS.

By H. SAXON SNELL, F.R.I.B.A.

THE velocities of currents of air in mines and ventilating shafts are now almost universally determined by aid of the anemometers said to have been invented by Benjamin Biram. These instruments consist of series of light vanes which rotate by the action of air impinging against them, and the number of revolutions so made are by the aid of suitable mechanism recorded upon dials attached to the instruments. Each anemometer is differently affected as the forms and positions of the vanes and as the friction of the mechanism varies. It is therefore clear that this dial registration does not directly represent the actual velocity of the air, nor, indeed, the number of revolutions made by the vanes of the instruments, and consequently it becomes necessary to employ a formula for deducing the actual velocities from those recorded by the dials. It will also be obvious that for this purpose the instruments must be separately experimented upon in order that the values of the constants employed in the formula may be correctly determined in each particular case. In all such published experiments it has been found that if the actual and recorded velocities be graphically delineated the results give a straight line, or nearly so, and the formula for deducing the actual from the registered velocities is therefore of the form $V = m R + C$, where R is the velocity of the air as registered by the dial, V the actual velocity, and m and C constants to be found experimentally.

Fig. 1 represents a form of this anemometer commonly employed in English coal mines. It consists of a short cylinder of brass Y, through which the air passes, and impinging against the vanes S S S situated midway in the cylinder causes them to revolve, and the motion thus set up is transmitted by suitable clockwork arrangement to the cylindrical box P, on the front of which are dials for recording data from which to calculate, as before described, the actual velocity of the air passing through the instrument. The position of the dials is not the same in all instruments, but is varied to suit particular circumstances. The method hitherto employed for ascertaining the actual velocity of air passing through one of these anemometers, as compared with its registered velocity, is to place the instrument upon one end of a bar about 8ft. in length made to revolve on its centre with any given speed, and to register, by the means of clockwork attached to the axis of the bar, the distance passed through by the anemometer in any given time. The face of the anemometer being placed parallel with the length of the bar, the vanes are supposed to encounter the resistance of the air, through which they pass in a manner similar to that caused by moving air impinging against the vanes when the anemometer is stationary. It has been found, however, by experiments with these "Whirling machines," that when the arm upon which the anemometer is placed is varied in length, the results recorded by the dial for any given time and distance traversed are not similar, but that the greater the circumference of the circle formed by the anemometer in its passage through the air, *i.e.*, the greater the length of the arm upon which it is placed, the more slowly the vanes revolve.

It might well be conceived that this would be the case, not only because the air strikes the vanes in a direction different to what it would if the instrument were moving in a straight line, but by reason of the whirling bar and its adjuncts setting up in their rotary motion a number of eddies of air that in like manner alter the conditions under which the vanes of the anemometer are made to revolve, and such disturbing influences would necessarily become greater as the centre of revolution of the whirling machine was shortened. The variations in the readings of these anemometers resulting from this mode of testing have been found to be very perceptible when the difference in the length of the whirling arm is only a few feet, and therefore it may be assumed that the error would be very considerable when instruments adjusted by experiments made on a whirling machine of only 4ft. radius are used for measuring the velocity of air passing—as in a shaft or mine—in a straight line, or its equivalent the circumference of a circle of infinite radius. Nevertheless, it is with instruments so tested that a majority of the more recently recorded experiments on ventilation have been founded, and it would therefore appear desirable that a more reliable method of testing should if possible be resorted to. I am not prepared to say how this can always best be done, but having some few years since—1877—had occasion to test the accuracy of two of the smaller sizes of these instruments for the purposes of an extensive series of experiments on the movement of air in shafts of comparatively small diameter, it has occurred to me that the process adopted and its results might be usefully recorded.

The general form of the testing apparatus employed by me is shown on Fig. 2, and will be seen to consist of a large aspirator A, into which any known quantity of air could be drawn, but only after passing the vanes of an anemometer so constructed as to form part of the tube B, through which the air is admitted to the aspirator. The two anemometers tested by me were specially made for these experiments, and in one of them, shown at Fig. 2, the dial D was placed upon the exterior face of the brass tube enclosing the vanes. This tube, after having been tested by the makers, was elongated at either end in order that the air immediately before and after passing the vanes should have time to recover the disturbance caused by impingement against the sides of the orifices at either end. The lower end of this elongated tube was made to dip into a tin cup T, as it was found that without this a slight disturbance of the air in any part of the room, such for instance as would result from the movements of the operators, caused the instrument immediately to show an irregularity of measurement. The upper portion of the tube was attached to another and larger square horizontal iron tube C, through which the air was conveyed to the centre of the upper part of the aspirator placed in the topmost floor of the building in which the experiments were conducted. A plate of glass K was inserted in one side of the aspirator, so that the quantity of water displaced in any given time might be observed, and from the bottom of this vessel a cast iron pipe 3in. diameter was carried to the lower part of the building, and the passage of water there controlled by a cock D having a full circular way of 2in. diameter. The turning of this cock was effected by a double lever M, the shorter arm of which passed through a slotted quadrant-shaped iron guide P, having holes with a movable pin for regulating the quantity of water to be discharged at any stage of the experiments.

After the machine had been erected, a vessel so made as to very accurately measure one cubic foot of water was placed beneath the orifice of the cock, and as each cubic foot was drawn off a diamond cut was made on the glazed front of the aspirator for the purpose of marking the quantity of water displaced in the course of each experiment.

It was desirable that the speed of the air passing through the anemometer during each experiment should be as uniform as possible, but it will be obvious that the head of water, when the aspirator was full, would become less as it emptied. Consequently, the flow of air at the commencement of each experiment would gradually become less towards the end of it, and it was for the purpose of reducing this difference to a minimum, as also for obtaining a greater velocity, that the apparatus was placed in as high a building as could be obtained.

In the experiments carried out by me the distance from the underside of the aspirator to the outlet of the draw-off pipe was 43ft., with the result that the difference in the velocity of the air passing through the anemometer from the commencement to the end of any experiment was inappreciable, and considering that the difference that must have existed would be a uniform one, the results of the experiments may be considered in this respect satisfactory.

The object to be attained by the use of these anemometers is the measurement of the velocity existing in any particular current of air, but the necessary introduction of the instrument into the current to be measured must, by reason of the friction of the air against the sides and the opposition offered by the vanes, alter the condition under which the air would have been moving if the instrument were not so placed. It will therefore be apparent that although these anemometers as ordinarily tested may measure more or less correctly the velocity of air passing through them, they do not, as is required, indicate the velocity that would exist if the anemometer were removed. Although, as I shall have occasion to show hereafter, the errors arising from a neglect of this consideration must be so small that they may in the practical use of the instruments often be disregarded, yet it appeared to me that in an inquiry of this kind any such source of error should as far as possible be counteracted.

To this end I attached to the upper part of the anemometer tube what may be called a compensating valve—V, Fig. 2—capable of admitting, after adjustment, such an amount of air as should be found by experiment to have been retarded in its passage through the lower part of the instrument.

An enlarged section of this valve is shown on Fig. 3, and will be seen to consist of a small pipe E, for the admission of air to the upper part of the anemometer tube, the lower part of the pipe being made to dip into a brass cup F in a manner similar to the lower part of the anemometer tube. This cup was so screwed on as to enable the lower orifice of the pipe to be entirely closed or to be opened by it to any required distance. The clamping screw H was provided for the purpose of permanently fixing the position of the cup after the opening of the valve had been adjusted.

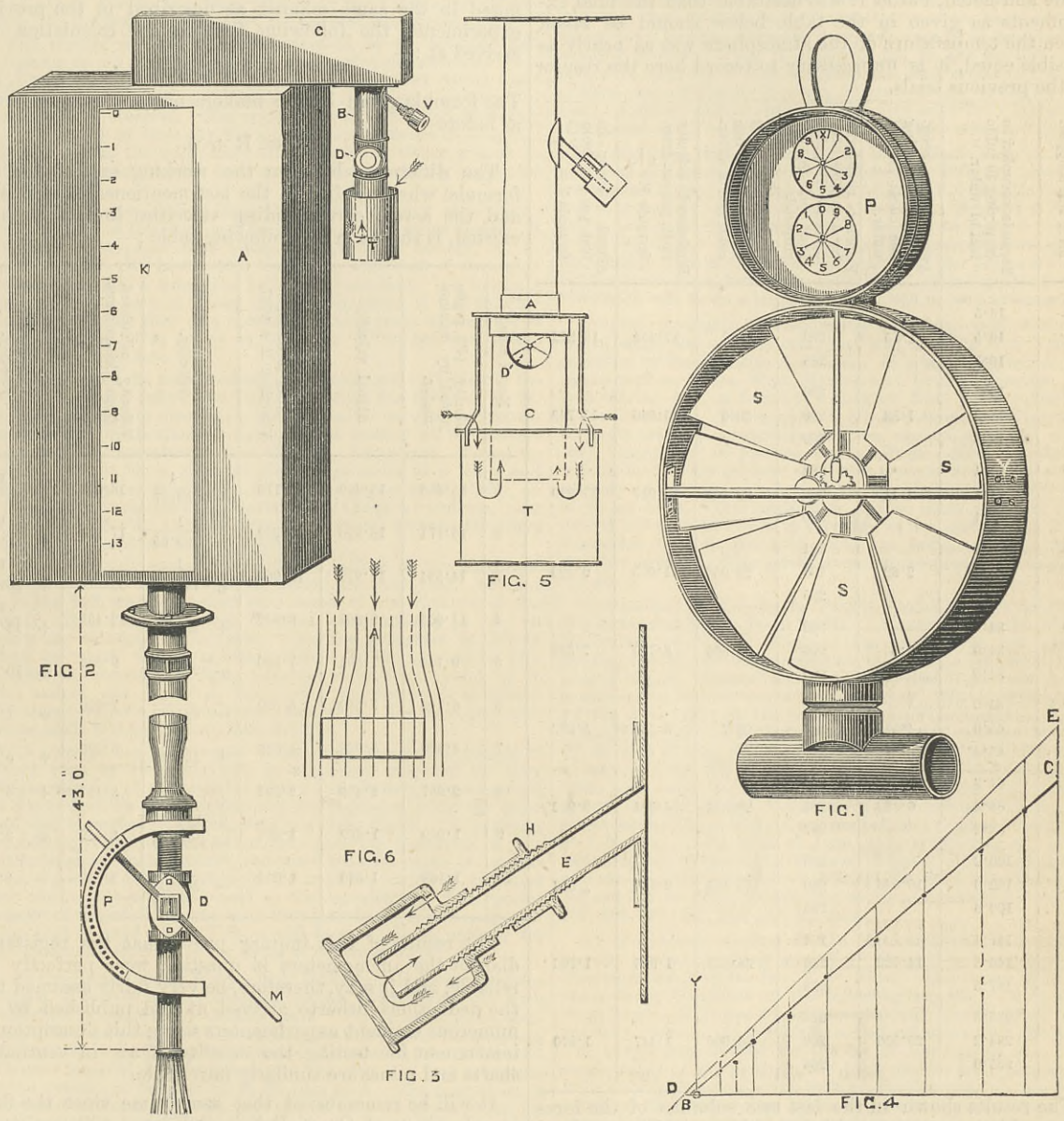
The distance to which the valve should be opened was determined in the following manner. The anemometer and tube were removed from the aspirator, the cock was then turned on to various distances marked by the movable pin and quadrant arm M, and the time occupied in emptying the cistern noted in each case. The anemometer was then again attached, and the cock being turned on to the same distances as before, the valve was opened more and more, until the relative times occupied in emptying the cistern were found to correspond with those when the anemometer was removed.

It is important to observe that it was found sufficient that the tube of this compensating valve should be but $\frac{3}{8}$in. diameter, and that therefore the area of section of any column of air passing through it could not exceed ·11 square inches, while the sectional areas of the anemometers tested were 5·725in. Now as the quantities of air admitted through the anemometer and the compensating valve would be directly as their areas, it follows that the amount of air retarded by these instruments could not—even if the valve were fully opened—have exceeded $\frac{\cdot 11}{5\cdot 725}$, or $\frac{1}{52}$ of the quantity to be measured.

When in ordinary use part only of the air passes through the instrument and part is deflected by it, as shown by the accompanying sketch, where the dotted lines indicate the boundary between the part which flows inside and the part which flows outside.*

In ordinary use the velocity of the air is computed from the sectional area of the anemometer tube, but to be correct it should be computed from the sectional area contained between the dotted lines at the point A in the sketch. The difference in these two areas would be found to be that of the sectional area of the compensating valve in the testing apparatus before described. In the one case the force of the resistances of the instrument to the flow of air is employed in deflecting the filaments of air towards the outside of it, and in the other these resistances exert themselves in retarding the flow of water in the cistern.

When the apparatus had been put together it was thought desirable to test its air-tightness, and for this purpose the compensating valve was closed and the aspirator nearly emptied of water. The cup into which the



*FOOTNOTE.—I am indebted to Professor G. G. Stokes for the following lucid statement of the action of these instruments:—"In the actual use of the instrument a portion of the air passes through it, and a portion is deflected by it. If the vanes were away and the cylinder of brass were infinitely thin and smooth, the velocity of the air passing through it would be the velocity we wanted to measure; in this case there would be no lateral deflection of the filaments of air produced by the instrument. On the other hand, if the vanes were replaced by a disc closing the cylinder, no air would get through, all the filaments would be deflected to the one side or the other. In the actual case the condition is intermediate, the vanes oppose a certain amount of resistance to the passage of the air through this cylinder, and therefore there is a certain amount of lateral deflection." I have endeavoured to represent rudely the course of the lines of motion of the air flowing partly past and partly through the anemometer, (see Fig. 6). The dotted lines represent the boundary between the part which flows inside and the part that flows outside.

anemometer tube dipped was partly filled with water, and the draw-off cock then turned sufficiently to cause the water to rise from the cup to some distance up the lower portion of the anemometer tube, and as it was found to remain for some considerable time without alteration of level, I was satisfied that the apparatus had been so carefully made that during the experiments no appreciable quantity of air could enter the aspirator that had not passed through the anemometer.

The internal diameter of the tubes of the anemometers tested was 2·7in., their area 5·725in., consequently the displacement of one cubic foot of water from the aspirator would cause air to flow through the instruments in a stream $\frac{144}{5{\cdot}725} = 25{\cdot}15$ft. in length. The actual velocity per second V of air passing through the instruments during any given time t would therefore be represented by the formula $V = \frac{25{\cdot}15}{t}$, and the corresponding registered velocity R as indicated by the readings r of the dials by $R = \frac{r}{t}$.

In the following experiments the draw-off cock was in each instance opened three times to the same extent, and the average results calculated. The time was noted by means of a chronograph. Many preliminary trials were made and noted, but as it was desirable that the final experiments as given in the table below should be taken when the temperature of the atmosphere was as nearly as possible equal, it is unnecessary to record here the results of the previous trials.

No. of hole at which lever was stopped.	Seconds occupied in emptying 10 cubic feet of water.	Average time occupied in emptying one cubic foot of water.	Velocity registered by anemometer dials for 10 cubic feet of water emptied.	Average registered velocity r for one cubic foot of water.	Registered velocity in ft. per sec. from formula $R = \frac{r}{t}$	Actual velocity in feet per sec. from formula $V = \frac{25{\cdot}15}{t}$
1	16·5		286			
,,	16·5	1·65	290	28·8	17·454	15·242
,,	16·5		288			
2	18·3		290			
,,	18·3	1·83	290	29·0	15·846	13·743
,,	18·3		290			
3	21·1		288			
,,	21·1	2·11	293	29·366	13·917	11·919
,,	21·1		300			
4	26·1		291			
,,	26·4	2·62	293	28·966	11·055	9·599
,,	26·1		285			
5	34·0		300			
,,	34·0	3·4	294	29·666	8·725	7·397
,,	34·0		296			
6	45·0		290			
,,	45·0	4·518	283	28·7	6·359	5·572
,,	45·4		288			
7	64·3		296			
,,	63·4	6·363	294	29·233	4·594	3·952
,,	63·2		287			
8	100·2		288			
,,	100·6	10·046	280	28·433	2·830	2·503
,,	100·6		285			
9	147·4		291			
,,	146·8	14·723	286	28·833	1·958	1·708
,,	147·5		288			
10	235·8		273			
,,	234·2	23·500	268	26·966	1·147	1·070
,,	235·0		268			

The results shown in the last two columns of the foregoing table are represented by the diagram Fig. 4, where the numerical values of the registered velocities R, and of the actual velocities V, are respectively the abscissæ and ordinates of the several points referred to a pair of coordinate axes O X and O Y. Through the mean position of these points passes the straight line B C, giving rise to the formula $V = {\cdot}8524\,R + {\cdot}0718$ which it will be seen is of similar form to that mentioned in the earlier part of this paper as resulting from previous published experiments with these instruments.

No. of hole.	Velocity (R) registered by anemometer.	Actual velocity.	Velocity calculated from formula, $V = {\cdot}8524\,R + {\cdot}0718$.	Differs from actual velocity.	Velocity calculated from the instrument makers' formula, $V = R + {\cdot}5$.	Differs from actual velocity.
1	17·454	15·242	14·949	$-\frac{1}{52{\cdot}02}$	17·954	$+\frac{1}{5{\cdot}6}$
2	15·846	13·743	13·579	$-\frac{1}{83{\cdot}80}$	16·346	$+\frac{1}{5{\cdot}3}$
3	13·917	11·919	11·935	$+\frac{1}{744{\cdot}94}$	14·417	$+\frac{1}{4{\cdot}7}$
4	11·055	9·599	9·495	$-\frac{1}{92{\cdot}3}$	11·555	$+\frac{1}{4{\cdot}9}$
5	8·725	7·397	7·509	$+\frac{1}{66{\cdot}04}$	9·225	$+\frac{1}{4}$
6	6·359	5·572	5·492	$-\frac{1}{69{\cdot}65}$	6·859	$+\frac{1}{4{\cdot}3}$
7	4·594	3·952	3·988	$+\frac{1}{109{\cdot}78}$	5·094	$+\frac{1}{3{\cdot}4}$
8	2·830	2·503	2·484	$-\frac{1}{131{\cdot}74}$	3·330	$+\frac{1}{3}$
9	1·958	1·708	1·741	$+\frac{1}{52{\cdot}23}$	2·458	$+\frac{1}{2{\cdot}3}$
10	1·147	1·070	1·05	$-\frac{1}{52{\cdot}20}$	1·547	$+\frac{1}{1{\cdot}8}$

The anemometers and their tubes employed in these experiments were specially made for me by one of the most eminent makers of this class of instrument with full knowledge of the use to which they were to be put, and that the results in all probability would be published. It may therefore be presumed that more than ordinary care was taken not only in manufacturing, but in testing the instruments before they were placed in my hands. The formula resulting from the makers' tests of the instrument last described as given to me was $V = R + {\cdot}5$, an equation of the same form as before, but with the constant m equal in this case to unity. The application of this formula to the diagram Fig. 4 produces the straight line D E, and it will be seen that this differs considerably both in position and direction from the line B C resulting from my own experiments. The table given at the bottom of the preceding column shows this difference numerically.

The next anemometer tested was of different construction to the last. The vanes were fixed as shown at A—Fig. 5—the dial D occupying a position beneath, and the whole of this lower portion was enclosed by a glass tube open only at its lower portion, and dipping as before into a tin cup T. The actual velocities of various streams of air passing through this anemometer and the corresponding velocities registered by the instrument having been noted in the same manner as described in the previous experiments, the following formula for calculation was arrived at :—

$$V = {\cdot}8182\,R + {\cdot}0767.$$

The formula given by the makers of the instrument was as before—

$$V = R + {\cdot}5.$$

The difference between the working out of the two formulæ when applied to the last-mentioned experiments, and the actual corresponding velocities known to have existed, is shown in the following table :—

No. of hole.	Velocity (R) registered by anemometer.	Actual velocity.	Velocity calculated from formula, $V = {\cdot}8182\,R + {\cdot}0767$.	Differs from actual velocity.	Velocity calculated from instrument makers' formula, $V = R + {\cdot}5$.	Differs from actual velocity.
1	18·446	15·429	15·170	$-\frac{1}{59{\cdot}57}$	18·946	$+\frac{1}{19{\cdot}446}$
2	16·771	13·926	13·799	$-\frac{1}{109{\cdot}65}$	17·271	$+\frac{1}{17{\cdot}771}$
3	14·524	11·976	11·960	$-\frac{1}{748{\cdot}50}$	15·024	$+\frac{1}{15{\cdot}524}$
4	11·935	9·801	9·842	$+\frac{1}{233{\cdot}36}$	12·435	$+\frac{1}{12{\cdot}935}$
5	9·145	7·591	7·560	$-\frac{1}{244{\cdot}87}$	9·645	$+\frac{1}{10{\cdot}145}$
6	6·726	5·589	5·580	$-\frac{1}{621{\cdot}00}$	7·226	$+\frac{1}{7{\cdot}726}$
7	4·820	3·988	4·020	$+\frac{1}{124{\cdot}63}$	5·320	$+\frac{1}{5{\cdot}820}$
8	2·987	2·479	2·521	$+\frac{1}{59{\cdot}02}$	3·487	$+\frac{1}{3{\cdot}987}$
9	1·969	1·689	1·688	$-\frac{1}{1689{\cdot}00}$	2·469	$+\frac{1}{2{\cdot}969}$
10	1·168	1·050	1·032	$-\frac{1}{58{\cdot}333}$	1·668	$+\frac{1}{2{\cdot}168}$

The results of this inquiry prove that the registering dials of the anemometers in question were perfectly unreliable, and it may, therefore, be very fairly assumed that the deductions hitherto arrived at and published by the numerous eminent experimenters using this description of instrument for testing the velocity of air in ventilating shafts and mines are similarly unreliable.

It will be remembered that some time since the Sanitary Institute of Great Britain delegated a Committee to carry out a series of experiments for the purpose of ascertaining the efficacy of various patterned cowls placed upon upright ventilating tubes as compared with the same tubes opening into the air without covering of any kind, and that the results arrived at not being considered satisfactory, further tests were determined upon. Understanding that Biram's anemometers—or "Lownes," which are similar—were used by the committee in the first experiments, I communicated to it the results of my inquiry as detailed above, and I have reason to believe that in consequence an exhaustive series of somewhat similar tests are being carried out by this committee. It will be interesting to learn how far the results obtained by them will accord with mine.

THE INSTITUTION OF CIVIL ENGINEERS.

MODERN FLOUR MILLING IN ENGLAND.

At the meeting on Tuesday, the 16th of May, Sir Frederick Bramwell, vice-president, in the chair, the second paper read was "On Modern Flour Milling in England," by Mr. Henry Simon.

The importance of the flour-milling industry of the United Kingdom was first noticed; as much as £2,000,000 per annum being turned over in a single milling establishment in London. Much flour was also imported from Hungary and the United States, especially from the latter country. The quantity of wheat ground in England in one year was more than 25,000,000 quarters, and for the whole of Europe the daily expenditure for cereals to be ground was about £1,500,000. It was stated that flour produced by roller mills in England was worth 2s. 6d. to 5s. more per quarter than that ground by stones, the wheat being of the same quality. The systems of low-grinding and high-grinding were then referred to. The former, until recently, was the general practice in this country; the latter was the rule in Hungary and in America. The difference between the two systems was explained. It was stated that the action of low-grinding was violent, producing heat which spoiled the flour in colour, and in baking and keeping quality, and that the damping of wheat in low-grinding was detrimental to the quality of the flour. High-grinding was carried on without damping or steaming; the bran and germ were taken out, and the flour kept well. The fundamental principle of high-grinding was gradual reduction of the grain, the branny particles being carefully separated before each succeeding step in the manufacture, for which purpose five or six breaks were sufficient. Millstones were being gradually dispensed with; all improvements now in progress in this country were in the direction of high-grinding with roller mills. Low-grinding with roller mills produced less flour and of inferior quality. Whole-meal flour was the product of the lowest step of low-grinding: the highest Hungarian brands came from the highest grinding, the equal of which was now being produced in this country. The evolution of roller mills was then detailed. Their first practical application was in Budapest, in 1839. The flour ground by rollers moving at equal speed was caked or flaked; differential speed was important, and the purification of the products before proceeding with further reduction. The first rollers, although adjustable in distance, were kept rigidly in place; the advantage of Wegmann's improvement was the fixing of the journals of the rolls in levers, acted upon by weights or springs. Wegmann had also introduced porcelain rollers, but these were not so durable as chilled iron rollers, and were not applicable for granulating grain. The different ways of driving roller mills by straps or gearing were mentioned, and serious drawbacks to the former pointed out. The various methods of fluting the rollers were described; sharp-edged grooves had proved the best, with from ten to thirty grooves in the space of an inch. Vertical grooves, and grooves parallel to the axis, had been used. Reference was then made to Carr's disintegrator, and to Nagel and Kaemp's system. The author next pointed out the advantages of roller mills over stones, among them being the fact that the former flattened the bran and germ, which could then be easily dressed out, and did not attack them. The expense of repairing the rollers was small as compared with dressing the stones; the product of flour was as great, there was less danger of explosions, less space was occupied by roller mills, and much less power was required. A statement was given of the power required in three of the mills erected by the author. Roller mills were introduced into England by Buchholz in 1862, but the results were unsatisfactory. The Hungarian process was introduced by Oexle in 1868; later an impetus was given to roller milling by Wegmann's improvement of porcelain rollers, and "middlings," formerly a drug in the market, now became valuable. The system advocated by the author was introduced on an experimental scale in 1877, and, since the Kilburn Exhibition of 1879, had met with general acceptance. The fundamental principles of this process were—first, gradual reduction of the wheat by fluted rollers with sharp corrugations; secondly, cleaning of the bran by fine fluted rollers, all with differential speed; thirdly, gradual reduction of the semolina principally by smooth rollers, or in some cases by fine fluted rollers. A description of machinery used in the author's system was given. This included (1) Daverio's roller mill, the principal feature of which was cross-fed channels and effectual friction relief; also three rollers gave the same work as four rollers in other mills; (2) dressing machinery; it was stated that the ordinary silk reel was now displaced by the centrifugal reel; the centrifugals recommended by the author were described, and the different classes of centrifugal reels made; (3) purifying machinery. Finally, the paper contained a description of the modern high-grinding process by roller mills. This was divided into three main operations—granulation, or the separation of the outer husk of the grain; purification of the product thus obtained from bran; and the gradual reduction of the purified semolina into flour. These different operations were fully described.

The third paper was by Mr. W. B. Harding, on

ROLLER MILLS AND MILLING AS PRACTISED AT BUDAPEST

In the early years of the present century it had been recognised that, in order to obtain pure wheaten flour free from particles of bran, the old custom of grinding between stones must be superseded, at least as regards its constituting a complete process. The outcome of various experiments was the roller mill, probably first brought into practical shape and used in Switzerland about the year 1820. In 1839 was established, from the designs of Mr. Fehr, a Swiss engineer, the "Josef Walzmühle," the first in Hungary to adopt the new system. The installation comprised thirty-six roller mills, with which it was originally proposed to accomplish the whole work of grinding, but subsequently eight pairs of stones were added to effect the finer reductions. This mill afterwards passed into the hands of a company, and became known as the "Pester Walzmühle," and its powers of production were increased by the addition of sixty-four roller mills, besides several pairs of stones. During the last thirty years, thirteen other large mills on the same principle had been erected in Budapest; and the result of nearly fifty years' experience was to define clearly the functions and position of the roller mill as the agent most suited for the preliminary process of granulating, requisite in the production of high-grade flour. For the subsequent reduction of the middlings produced by the rollers nothing had been found superior to the old-fashioned stones. A modern first-class mill in Hungary, therefore, contained each class of machine as the necessary complement of the other.

The system of milling adopted in Budapest had for its object to obtain, from a given quantity of grain, the largest amount of fine white flour, and the commercial success which had attended the costly and laborious efforts in this direction might be taken as a proof that the end justified the means. As a broad principle, the manipulations required in high grinding remained the same under all circumstances, although local conditions and the nature of the wheat might vary the details of the operation. The process necessitated five or six times "shroten," *i.e.*, bruising or granulating, between fluted rollers, and the passing of the produce from each break through a system of sorting and dressing machines. Further, from twice to four times "auflösing," *i.e.*, separating small portions of bran adhering to the fine middlings, between rollers either quite smooth or very finely fluted, the produce being carefully sorted and dressed as before after each operation. Lastly, the passing of the purified middlings and meal between stones, and the final dressing. The whole manipulation was arranged so as to require a minimum of manual labour, and the transport of the various products in the required direction was automatic.

The method of procedure in a large mill was described in detail, from the time the wheat, thoroughly cleaned, was delivered to the first roller mill, to the sacking of the refined flour, by which time it had undergone eighteen distinct operations, performed at different stages of a continuous journey through the mill, besides being concerned in various subsidiary processes affecting the treatment of the by-products.

Yield of Steel Plates.—The steel department of the Dalzell Iron and Steel Works, at Motherwell—Mr. David Colville's—continues taxed to its utmost capacity in the manufacture of ship and boiler-plates, beams and bars. The yield on occasional shifts reaches astonishing figures. The slabbing hammer is a fine powerful tool capable of giving a blow exceeding 400 foot-tons, and is worked in connection with three gas heating furnaces. The plate rolling mill has two pairs of 28in. rolls by 8ft. long, and is driven by a magnificent pair of Ramsbottom reversing engines. Two large gas furnaces heat the slabs for this mill. The following figures from Mr. Colville's books give the material charged and the finished ship and boiler-plates yielded during two succeeding shifts of twelve hours each on the 9th inst. :—Hammer : Day shift, ingots charged, 73 tons 7 cwt. 3 qr.; slabs and billets produced, 67 tons 0 cwt. 3 qr. Hammer : night shift, ingots charged, 79 tons 0 cwt. 2 qr. 21 lb.; slabs and billets produced, 73 tons 14 cwt. 2 qr. 21 lb. Plate mill : day shift, slabs charged, 66 tons 0 cwt. 3 qr. 9 lb.; finished plates yielded, 52 tons, 2 cwt. 0 qr. 3 lb. Plate mill : night shift, slabs charged, 67 tons 13 cwt. 1 qr. 23 lb.; finished plates yielded, 52 tons 3 cwt. 1 qr. 3 lb. With a single hammer and plate mill worked with a similar furnace power this production has never, we believe, been surpassed.

RAILWAY MATTERS.

THE Bill, which has already been sanctioned by the House of Commons, authorising the construction of a railway bridge across the Firth of Forth at Queensferry, in substitution of the one originally sanctioned in 1873, has passed unopposed through the House of Lords.

ON Monday last Mr. Gladstone was among the witnesses who gave evidence before a committee of the House of Lords in favour of the Wrexham, Mold, and Connah's Quay Railway Bill. He stated that he had an estate in the neighbourhood, and thought the scheme would be of local advantage in developing the district.

IT is probable that, in view of the Exhibition to be held in Turin in 1884, an electric railway from the Place Carlo Felix to the grounds of the Exhibition will be constructed. It is proposed to traverse the Course Victor Emmanuel and the Course Massino d'Azeglio del Valentino, and the endeavour will be to open it to the public at least four months before the opening of the Exhibition.

AN experiment was recently made by Mr. W. D. Dickey on the Long Island Railway, U.S., with petroleum as locomotive fuel. It was burned in combination with superheated steam, and the result of the trial was that the fuel cost 4s. 10d., while it was estimated that if coal had been used it would have cost 8s. Seventy gallons of oil were used in getting up steam on the trip, and it is thus put down at less than 1d. per gallon. At the same time coal is high in price compared with what it is in England, so we may reckon that in England oil would have cost at least three times as much as the coal fuel.

THE tramway at Reading runs through the centre of the town, one terminus being near the site of the coming Royal Agricultural Show, which will no doubt be largely attended, and will put a good deal of traffic on the tramway. It may therefore be hoped that the tramway company will secure a few new horses in good condition, and supply them and the horses they already possess with plenty of food, to enable them to do the extra work that will certainly be put upon them. The suggestion as to new horses may, however, be superfluous, for it is said that the company already possesses the frames for these. It has been observed that though other proprietors in Reading can at the same time work their animals and maintain them in good condition, the tramway company's possessions in this kind soon become rawbone or high-bone recollections of animals. This is a phenomenon much remarked in Reading.

THE Northern Railway Company of France is making a series of experiments with a view to demonstrate that automatic action of continuous brakes is not indispensable to stoppage of the tail of a train in case of rupture of the couplings in course of the ascent of a hill. On rising and falling gradients the stoppage of the tail of a train has been effected with the vacuum brake by means of the communication cord connecting the engine with the rear wagon, where there must apparently be another or second brake. At the moment of rupture of this cord intentionally caused the brake is set free by the descent of a counterbalance weight, and the tail of the train stopped. The experiments yet made have been between Paris and Lille, in presence of engineers from the Northern and the Belgian State Railways, and are to be continued. The *Moniteur Industriel* says the Belgian engineers have asked for a fresh trial with the train running down a gradient on the line between Paris and Montsoult.

A CURIOUS state of affairs exists with a California railroad which has been closed for over a year without apparent necessity. The road extends from Folsom to Shingle Springs, and from 1877 to to 1879 was operated by the Sacramento and Placerville Railroad Company. The American *Railway Review* says "that in 1879, in foreclosure proceedings, the road was taken from the latter company and placed in the hands of a receiver, who soon after refused to operate the road and closed it up. The result has been a matter of great inconvenience and loss to those living along its line, especially to fruit growers. Not only do the shippers suffer, but both parties to the litigation under which the receivership was established remain unbenefitted. Numerous endeavours have been made to compel the receiver to operate the road, but all without avail, till now a Court order has been obtained directing the receiver to appear May 30th and show cause for his policy of inactivity. It is one of the most remarkable cases on record."

M. MEKARSKI, well known in connection with compressed air tramway engines, has published calculations to show that compressed air could not be used for long tunnels except at some difficulty. With a pressure of 5 kilogrammes per square millimeter, and an average temperature of 15 deg. C., the work of the compressed air, expanding two and a-half times, would be 11,179 kilogrammetres, and the consumption of air per hour per horse-power would be 24·15 kilogrammes. For one passage through the tunnel, the consumption of air at ordinary pressure would be 64,915 kilogrammes, or 177 cubic centimetres, at a pressure of 30 atmospheres. Placing the latter figure at 200 for safety's sake, and computing the weight of the reservoirs to carry the compressed air at 600 to 700 kilogrammes per cubic meter, we should have a total weight of the tender containing the necessary compressed air of 200 tons, which would reduce the load carried from 400 tons, as supposed in his calculations, to 200 tons. M. Mekarski proposes instead, to use the ordinary locomotives, and to run them with a mixture of air and steam. He carries the air in reservoirs —capacity 20 cubic metres—at a pressure of 35 kilogrammes per square inch. These reservoirs communicate with the boiler through an automatic device, which allows the air to enter it only when steam pressure falls below a given minimum. An auxiliary pipe from the air reservoir is to be conducted under the grate, in order to increase the rate of combustion if necessary. The engineer runs the locomotive with a growing quantity of air as he gets farther into the tunnel, and thus M. Mekarski thinks he could reduce the quantity of coal burnt in the tunnel.

THE total number of deaths and injuries reported by the railway companies to the Board of Trade during the year 1881 is given in the following table:—

	Killed.		Injured.	
	1881.	1880.	1881.	1880.
Passengers:—				
Accidents to trains, &c.	23	28	993	905
Accidents from other causes	85	114	867	709
Servants:—				
Accidents to trains, &c.	19	23	168	118
Accidents from other causes	502	523	2278	1962
Level crossings	83	74	32	30
Trespassers, including suicides ..	328	330	131	156
Other persons	56	43	102	79
Total	1096	1135	4571	3959

In addition to the above—One passenger was killed and 112 injured whilst ascending or descending steps at stations; forty-four injured by being struck by barrows, falling over packages, &c., on station platforms; thirty-six injured by falling off platforms; and two killed and sixty injured from other causes. Of servants of companies or contractors, six were killed and 963 injured whilst loading, unloading, or sheeting wagons; one was killed and 303 were injured whilst moving or carrying goods in warehouses, &c.; five were killed and 172 injured whilst working at cranes or capstans; fourteen were killed and 239 injured by falling off platforms, ladders, scaffolds, &c.; eight were killed and 576 injured whilst working on the line or its sidings; and one was killed and 231 were injured from various other causes. Nine persons who were transacting business on the companies' premises were also killed, and 119 were injured—making a total in this class of accidents of fifty-three persons killed and 4015 injured. The total number of personal accidents reported to the Board of Trade by the several railway companies during the year amount to 1149 killed and 8676 injured. For 1880 the total was 1180 killed and 6692 injured.

NOTES AND MEMORANDA.

THE atomic weight, 240, of pure metallic uranium has been confirmed by recent investigations of Herr Zimmerman.

M. VIOLLE finds the temperature of fusion of zinc, free from lead, cadmium, arsenic, and other impurities, to be 929·6 deg. Cent.; the value previously found by Edm. Becquerel was 932 deg.; that given by Sainte-Claire Deville and Troost being 1040 deg.

THE following composition for removing incrustations in boilers has been patented:—Barium carbonate, 250; ammonium nitrate, 325; sodium chloride, 225; vegetable charcoal, 200—total, 1000. The above ingredients are mixed together and used in the powdered form.

THE value of exports in the Australian Colonies:—New South Wales, £15,525,138; Victoria, £15,954,559; South Australia, £5,574,505; Queensland, £3,448,160; Tasmania, £1,511,931; Western Australia, £499,183; New Zealand, £6,352,692. Total, £48,866,168.

THE following figures is the result of an analysis, by Herr Hans von Jüptner, of "arguzoid," an alloy having a silvery appearance and some good mechanical qualities:—Tin, 4·035 per cent.; lead, 3·544 per cent.; copper, 55·780 per cent.; nickel, 13·406 per cent.; zinc, 23·198 per cent.; iron, trace; total, 99·963 per cent. Its density is 8·109 per cent.

NOTWITHSTANDING the circumstance that the competitive trial of chronometers at the Greenwich Observatory in 1881 was more severe than usual, on account of the greater range of temperature, the first six chronometers performed on the average slightly better than those in any year since 1877, and the first chronometer was exceptionally good. The improvement shown was probably to some extent due to the prizes offered by the Clockmakers' Company, for the first time last year, for the first two chronometers.

THE rapidly reversed currents generated in an ordinary Bell telephone do not sensibly affect the needle of a galvanometer; but M. Chardonnet has observed that, during the short period while the note is increasing or diminishing in intensity, a deviation of the needle is observed. The explanation advanced is that during the rise or fall in intensity the alternate currents are no longer of equal strength, the odd semi-oscillations being either greater or less in amplitude than the even semi-oscillations during the period of rise or fall.

IN 1879, Meyer showed that the vapour density of chlorine between 1200 to 1500 deg. was two-thirds of its vapour density at 600 deg. In a paper read before the Chemical Society, A. P. Smith and W. B. Lowe state that they find that if they pass chlorine through a tube into iodide of potassium, less iodine is liberated, if the tube is heated to 1030 deg., than if the chlorine was cold. To use their own phraseology, one grain of chlorine at 6 deg. becomes 0·744 grams at 1030 deg. What becomes of the rest they do not state.

IN a paper on the measurement of carbonic acid contained in the atmosphere, read before the Paris Academie des Sciences, by M. Mascart, the author describes a method based on direct measurement of the diminution of pressure of a mass of air at constant volume and temperature, when the CO_2 is removed. Travellers may take about 500cc. of air in glass tubes sealed at a lamp, and afterwards analyse at leisure. In another paper by M. Risler, on the quantity of carbonic acid contained in the air at Colèves, near Nyon (Switzerland), altitude 430m., the general average for three years is given at 3·035 vols. in 10,000.

THERE was only one case of accidental failure in the automatic drop of the Greenwich time-ball during the year 1881. On four days the ball was not raised on account of the violence of the wind. The Deal ball was dropped automatically at 1h. on every day throughout the year, with the exception of fifteen days, on which there was either failure in the telegraphic connection or interruption from telegraph signals continuing up to 1h., and of one day when the current was too weak to release the trigger without the attendant's assistance. On three days high winds made it imprudent to raise the ball.

AN attempt has been made to determine the specific gravity of liquid steel by Herr Alexjeff, by a method proposed by Herr Petruschewsky. A porcelain tube, open at both ends, was connected at one end with a forcing pump and a manometer, while the other end was immersed in liquid steel to a given depth. On pumping bubbles appeared at the latter end, and the indication of the manometer at that moment, compared with the depth of immersion, served for determination of the relative density of the steel and the liquid—naphtha—used in the manometer. The specific gravity of liquid steel was thus found to be 8·05, and so greater than that of solid steel. This, it will be seen, allows nothing for the molecular cohesion of the metal as a viscous fluid.

AT the Balau Copper Works, near Czik-Szeüt-Domokos, Siebenbürgen, a pyrites layer containing copper pyrites was met with embedded in quartz and chlorite slate. This circumstance, combined with the absence of lime salts, gives this pyrites the property of partially decomposing by atmospheric action to form sulphates. The raw material broken into pieces the size of a nut are moderately roasted in heaps of 30 to 40 tons each. The roasted ore is then crushed to small pieces, and stirred up with green vitriol ley to a mortar-like consistency. The material is then transferred to a furnace heated by gas. The glowing product is then transferred to the extraction vessel. The vessels are so placed above and next to each other that one at the top stands for the reception of dilute vitriol ley. At each side lower down a vessel stands for the reception of powdered ore, and still deeper a vessel to collect the copper ley, and underneath a vessel for emptying the product. Nine to ten washings follow the dilute vitriol solution in this extraction method. A part of the copper ley thus obtained is concentrated in wooden vessels lined with lead and heated by steam in a leaden coil. The "Journal" of the Society of Chemical Industry says the greatest part of the copper is precipitated by iron.

OIL dries by taking up oxygen from the air, the result being an elastic varnish. With pure oil, however, this takes place only under the influence of light or heat. Light is the first and most important drier of oils; heat is only second to it. Both these, according to the *Railroad Gazette* in some useful articles on painting, are drying forces. There are, however, many substances which act as driers, and some as anti-driers, as a well-known experiment by Chevreul showed. He painted the following substances with linseed oil, linseed oil and white lead, and linseed oil and zinc white, the drying in the case of linseed oil taking the number of days indicated by the figures:—Copper, 5; brass, 2; zinc, 3; iron, 3; lead, 1; varnished porcelain, 4; not varnished porcelain, 3; glass, 3; plaster, 4; panel of poplar wood, 9; panel of fir, 15; panel of oak, 159 for three coats. With linseed oil and white lead and with linseed oil and zinc white some difference in the relative quickness of drying is shown, but in all cases the drying on lead is quickest. Chevreul was specially interested in the quick drying of oil over lead and the slowness of its drying on a panel of oak. He found it would dry somewhat faster upon the bright lead—scraped lead—than upon the dark surface or lead rust which usually coats the surface of this metal. The first coat dried in a few hours; the second coat in five days. The difference was due to the lead with which the first coat of oil was in immediate contact. When bright lead is exposed to moist air, especially if an acid is present, it quickly combines with the oxygen of the air. The black film which was scraped from the lead was a thin coating of oxide of lead. The pure lead has a strong affinity for oxygen, and will even take fire if very finely divided and thrown into the air. When lead is heated it takes up oxygen from the air and becomes yellow lead, containing of oxygen about 4 to 7 parts; lead, 93 parts. If this yellow lead is melted, it becomes litharge. If heated to 600 deg., it becomes red lead, which is a compound of yellow lead and an oxide of lead containing twice as much oxygen, or 9 per cent. of oxygen.

MISCELLANEA.

THE number of Acts of Parliament passed this session is 73, of which 16 are public and 57 local.

THE *Journal Officiel* publishes a report, addressed by the Minister of Public Works to the President of the Republic, proposing the nomination of a Commission to be charged with the consideration of the projected canal between the ocean and the Mediterranean Sea.

A MEMORIAL of the late Rowland Hill, to whom we are to a great extent indebted for the penny postage, was unveiled on Saturday, near the Royal Exchange, by the Prince of Wales. The pedestal upon which it stands is of fine red granite from the Dalbeattie quarries of Messrs. Shearer, Field, and Co.

THE following gentlemen have accepted the presidentship of the various sections at the congress of the Sanitary Institute of Great Britain, to be held at Newcastle-upon-Tyne on September 26th, 1882:—Dennis Embleton, F.R.C.P, Section I., Sanitary Science and Preventive Medicine. Mr. Henry Law, M.I.C.E., Section II., Engineering and Sanitary Construction. Mr. Arthur Mitchell, F.R.S., Section III., Meteorology and Geology.

ON Monday afternoon an iron screw steamer was launched from the dockyard of Messrs. Raylton, Dixon, and Co. Her dimensions are: Length over all, 250ft.; breadth, 34ft.; depth of hold to floors, 17ft.; and she will carry about 1800 tons dead-weight. She is built for the coal trade of Gibraltar, and will be fitted with engines of 130-horse power, by Messrs. Blair and Co. Limited. This, and a sister vessel launched about a month ago, will be the first two British ships owned in Gibraltar.

A LARGE crane in the shipbuilding yard of Messrs. C. Mitchel and Co., Low Walker, near Newcastle, was on Saturday being taken down by some workmen in consequence of its machinery not working properly, when it suddenly fell to the ground. Three men were upon top of it at the time, and came down with it. One of them, named Charles Hoskins, 40 years of age, was killed on the spot. Another, named Joseph Rooke, was so severely injured that it is feared death will ensue. Two others were severely injured.

AN exhibition, to be known as the North-East Coast Exhibition of Naval Architecture, Marine Engineering, Fishery, Life-saving, and Coast Lighting Appliances, is to be held at Newcastle-on-Tyne, and to be opened on the 6th September next. The Earl of Ravensworth, president of the Institution of Naval Architects, is president of the exhibition. Mr. G. Renwick is the honorary secretary, and Mr. Sidney Old is the acting secretary, and the offices are at 21, Collingwood-street, Newcastle-upon-Tyne. It is expected that the exhibition will be on a large scale, and will be well attended.

A NOVEL apparatus for separating gold from sand without the use of water was recently completed and tested in New York, and described by the *Scientific American*. It is intended for use in the placer regions of the West, Mexico, and Central America, where gold-bearing sand is found at a distance from water sufficient for hydraulic mining. The machine is 5ft. in diameter, and is arranged to throw the sand by centrifugal force against a "wall" of mercury, maintained in position by centrifugal action. In this way, it is claimed, every particle of gold is brought in contact with the mercury and amalgamated, while the sand is blown away by means of an air blast. The machine is said to clean a ton of sand in twenty minutes, and to be so thorough in its operation as to make it possible to work over with profit the tailings of mines worked by other systems. The power required to operate the machine not given.

"SHANGHAI to London in Twenty-seven Days" is the heading of a letter sent to the *Times* by Mr. G. Martin, giving the following particulars:—"I left China in the magnificent new steamer, Stirling Castle, the latest addition to the fine fleet of the Castle Line of Messrs. Thomas Skinner and Co., East India-avenue, which is believed to be the fastest steamer afloat. We dropped the pilot off the Red Light at the mouth of the Yangtse-Kiang, 42 miles below Shanghai, at 3.30 a.m. on May 23rd, reached Singapore 9 p.m. 28th of May, sailed thence 9 a.m. 29th of May, and arrived at Suez, *viâ* the one and a-half degree channel, at 6 a.m. on June 12th, two hours in advance of the mail, which left Shanghai sixteen days before us. I came through from Suez with the mails, which left on the evening of our arrival, and reached Charing-cross at 6.30 p.m. on the 18th of June, thus completing my journey, including all stoppages, in 26 days 15 hours. The Stirling Castle will show an average speed of 16 knots, her daily runs between the 1st and 7th of June, against the south-west monsoon, being 372, 387, 380, 378, 401, 375, and 371 miles."

AT the closing meeting of the Meteorological Society for the present session, a paper was read "On a New Metal Screen for Thermometers," by the Rev. F. W. Stow. This screen differs from the ordinary Stevenson in the following respects:—(1) It is somewhat larger; (2) it has a single set of double zinc louvres; (3) it is partially closed at the bottom to cut off radiation from the ground. The advantages claimed for the use of zinc louvres are: (1) The conductivity of metal causes the heat derived from the sun's rays to be distributed over every part of the louvres; (2) the louvres, being much thinner than those of wood, the circulation of air through the screen is not only much greater absolutely, but much greater also in proportion to the bulk of the louvres; (3) the zinc louvres, therefore, are much more sensitive to changes of temperature than wooden ones. Comparative readings of thermometers in this screen, along with those in an ordinary Stevenson screen, were made during the summer of 1881. From these the author is of opinion that the Stevenson becomes unduly heated when the sun shines; but this may be as much due to its small size as to the material of which the louvres are made. The thermometers in it are only 3in. to 5in. from the louvres at the back of the screen, against 7in. to 8in. in the zinc screen. The roof, too, is single, and the box is open at the bottom. The author also says that there is no need to condemn all wooden screens; but there does seem to be some reason to think that screens with metal louvres might be better.

IN a recent lecture on some of the dangerous properties of dusts, Professor Abel, F.R.S., said that many experiments were tried with sensitive coal-dust from Seaham and other collieries for the purpose of ascertaining whether results could be obtained supporting the view that coal-dust, in the complete absence of fire-damp, is susceptible of originating explosions and of carrying them on indefinitely, as suggested by some observers, but, although decided evidence was obtained that coal-dust, when thickly suspended in the air, will be inflamed in the immediate vicinity of a large body of flame projected into it, and will sometimes carry on the flame to some small extent, no experimental results furnished by these experiments warranted the conclusion that a coal-mine explosion could be originated and carried on to any considerable distance in the complete absence of fire-damp. Some experiments made in a large military gallery at Chatham showed that the flame of a blown-out shot of 1½ lb. or 2 lb. of powder might extend to a maximum distance of 20ft., while in a very narrow gallery, similar to a drift-way in a mine, the flame from corresponding charges extended to a maximum distance of 35ft. These distances are considerably inferior to those which flame from blown-out shots has been known to extend, with destructive results, in coal mines, and there appears no doubt that, in the latter cases, of which the lecturer gave examples, the flame was enlarged and prolonged by the dust raised by the concussion of the explosion. But in the presence of only very small quantities of fire-damp, dust may establish and propagate violent explosions; and that, in the case of a fire-damp explosion, the dust not only, in most instances, greatly aggravates the burning action and increases the quantity of after-damp, but that it may also, by being raised and swept along by the blast of an explosion, carry the fire into workings where no fire-damp exists, and thus add considerably to the magnitude of the disaster.

FISHER'S PATENT BANKING GEAR, CLIFTON COLLIERY, NOTTINGHAM.

MESSRS. WARSOP AND HILL, NOTTINGHAM, ENGINEERS.

FIG. 2.

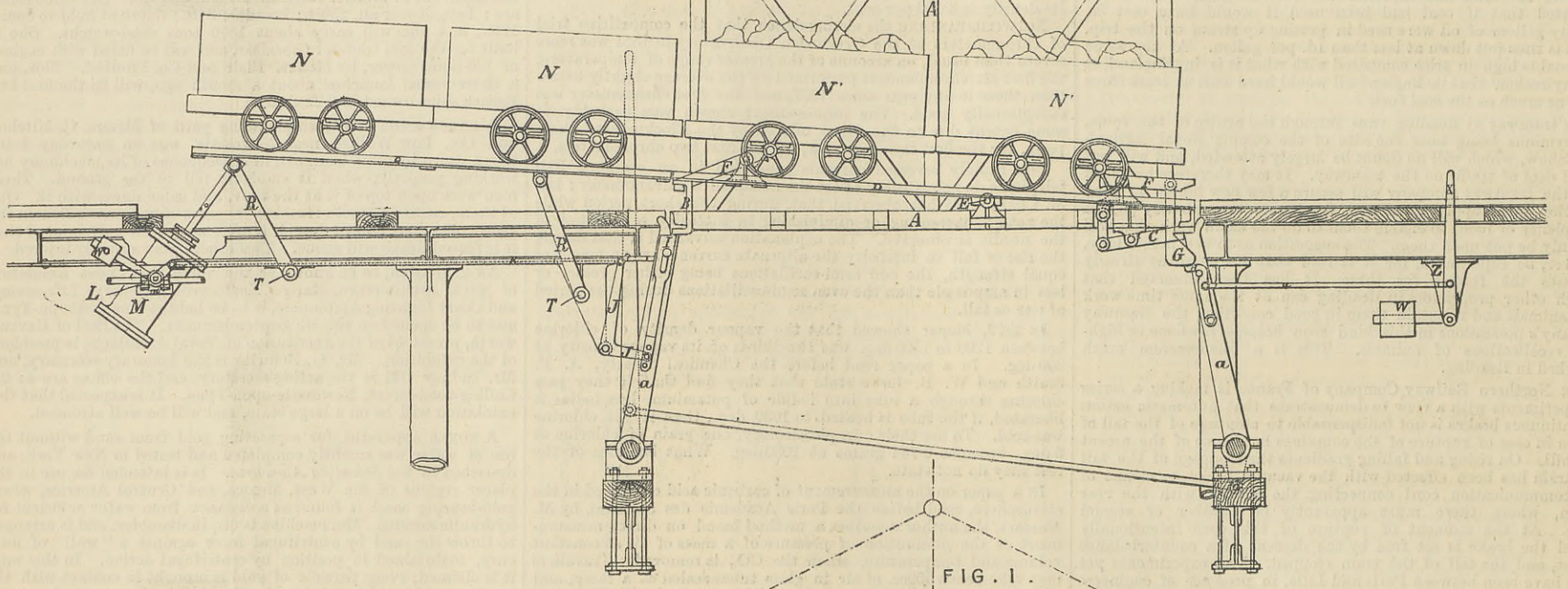
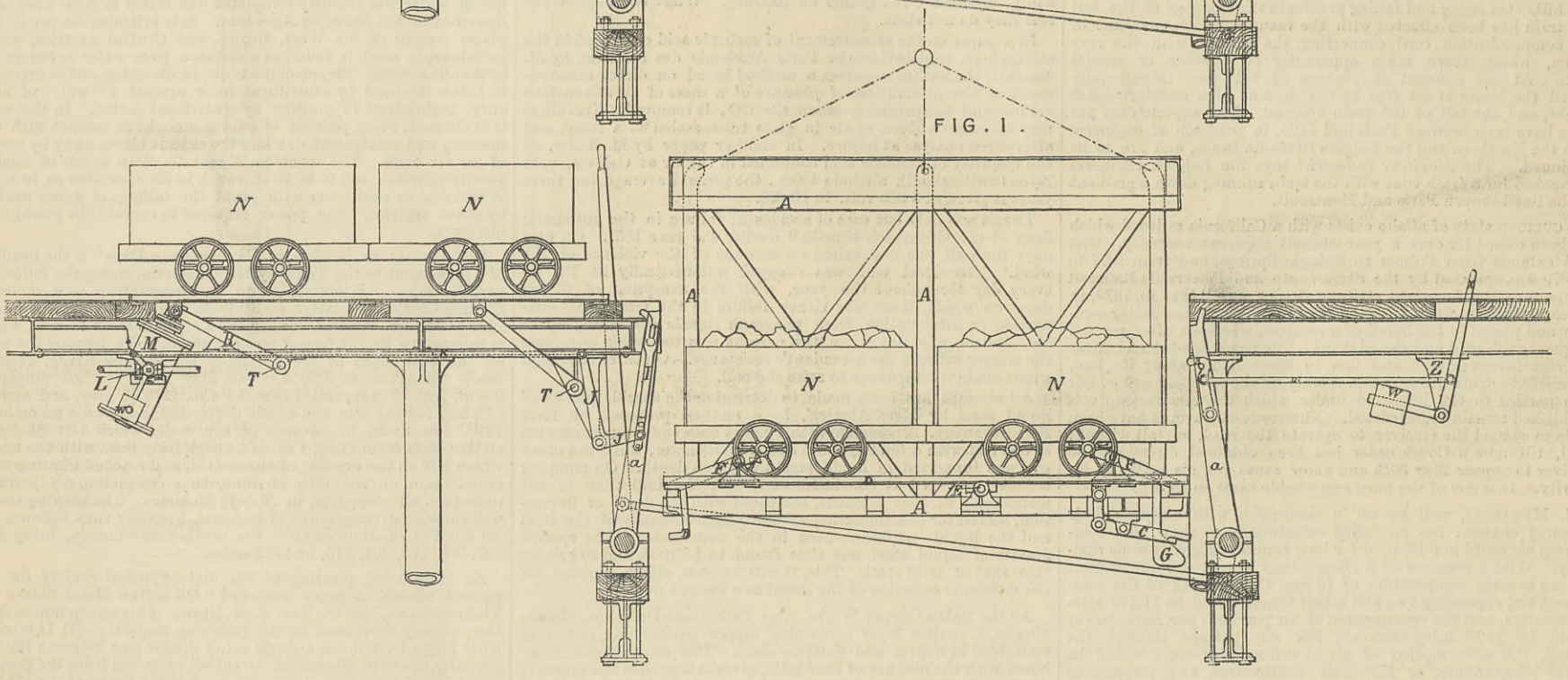


FIG. 1.

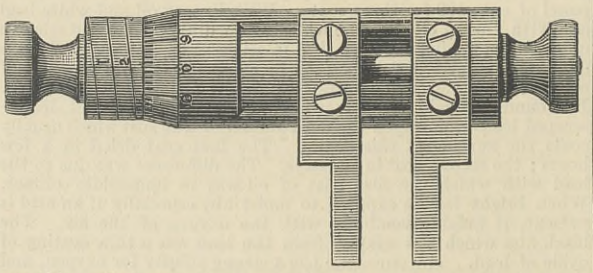


WE illustrate herewith a self-acting arrangement for unloading and loading colliery cages, now being introduced with great success by Messrs. Warsop and Hill, Nottingham. In the accompanying engraving, Fig. 1 shows the position of the apparatus and cage while the latter is being raised from the shaft; and Fig. 2 shows the position of the whole when the change or banking of the trams is taking place. The action of the apparatus is briefly as follows:—Instead of fastening the cage rails D to the cage A, as is usually done, they are swung intermediately between the ends on axles E E attached to the rails, and which work in the bearings shown fixed to the cage. The rails are also fitted at one end with L-pieces B B, and at the other end with deflecting levers C C, arranged to project below the bottom of the cage A in such a manner that when the cage settles on the props *a a*, they incline or tilt the rails D D independently of the cage, as shown in Fig. 2, and to such an extent that the loaded trams N¹ N¹ run off the cage to the weighing machine and screens by virtue of their own gravity alone; the action of the tilting of the rails D D by settling on the props *a a* at the same time automatically deflects the front stops F F, which hold the trams in place on the cage by reason of the foot-lever G, attached to the stops F F, resting on the hooked lever H, and being raised thereby as the cage settles down on the props *a a*.

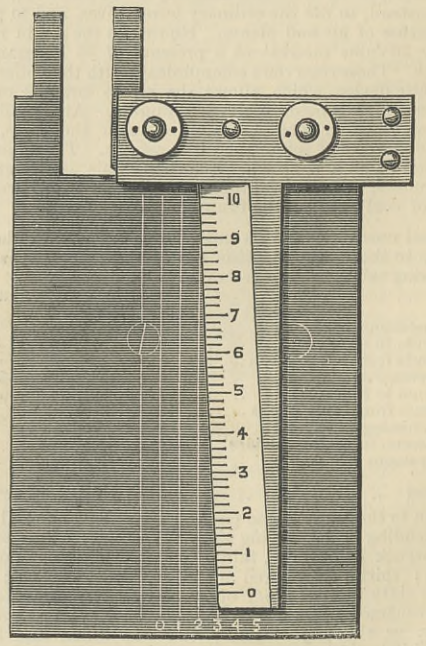
Simultaneously with this action on the cage the loading platform and rails Q Q, which are attached to the four lifting levers R R, two at each end, working on bearings and axles T T, fixed on a staging underneath the rails, and which carry the empty trams N N, are automatically raised by the small single-acting cylinder M to a similar inclination to and in a line with the rails on the cage. This action of raising the loading platform propels, so to speak, the empty trams down the incline thus made on to the cage, where they take the place of the loaded trams which are now at the weighing machine. The empty trams N N are arrested at the proper place on the cage by the front axle of the first loaded tram striking the lever X—shown at the right-hand of Figs. 1 and 2—and by means of the connecting rod U draws back the hooked lever H from G, allows this latter to fall, and with it the front stops F F, to the position shown in Fig. 1. The cylinder M for raising the platform Q is likewise automatically brought into action at the same time that the cage is settling on the props by the L piece B coming into contact with and deflecting the rod I working at the side of one of the props *a*, and by means of the bell-cranked lever J and rod I gives motion to the lever on the plug of the three-way cock L, which admits steam or compressed air to the underneath side of piston in the cylinder M, and by means of piston rod O, which is attached to the platform Q by the crosshead P, the platform is raised to the position shown in Fig. 2. The cylinder M is provided with a pneumatic cushion at the upper end to prevent the piston striking the top cylinder cover. When the cage is raised from the props A ready for its downward journey again, the weight W attached to the lever of the valve L falls, closes the admission port to the cylinder, and at the same time opens the exhaust port, allowing the piston with the rails and platform Q to fall to the position shown in Fig. 1, to enable more trams to be run on for loading. The rails D on the cage also fall of themselves to the horizontal position shown in Fig. 1, when the whole is raised off the props *a a*, and the operation of loading is completed. All the motions described above are effected perfectly automatically and simultaneously in a few seconds of time, the winding engine having barely time to be brought to rest before the trams are changed and all is ready for another journey.

MILNER'S PATENT GAUGES.

WE illustrate herewith two excellent forms of wire gauge, patented by Mr. Milner, and manufactured by Messrs. Elliott Bros., West Strand, London. Our engravings show the instruments full size, and nearly explain themselves. The principle involved in both is that of the well-known diagonal scale. In



one this scale is described as a spiral line round a cylinder; in the other the edge of the bar, which moves over the surface of the flat plate, is inclined as shown, and is marked with one series of figures up to 0·5in., while the other has ten sets of figures, by which measurements to the ·001in. can be made. The bar is compelled to move properly by a simple parallel rule arrangement at the back of the plate. The value of these instruments depends in great measure on the accuracy of their workmanship, and we need hardly say that Messrs. Elliott Bros. have left nothing to be desired in this respect. The instruments are

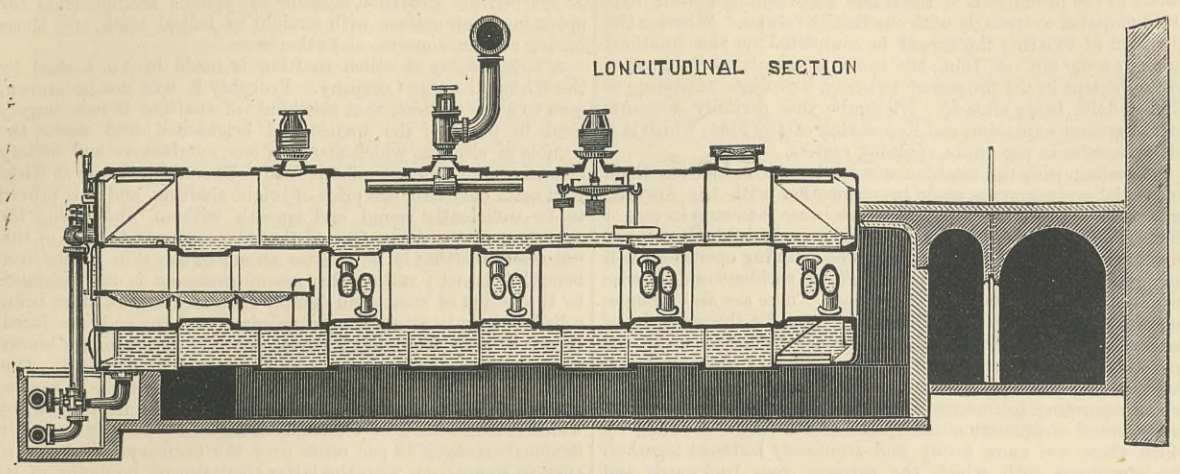


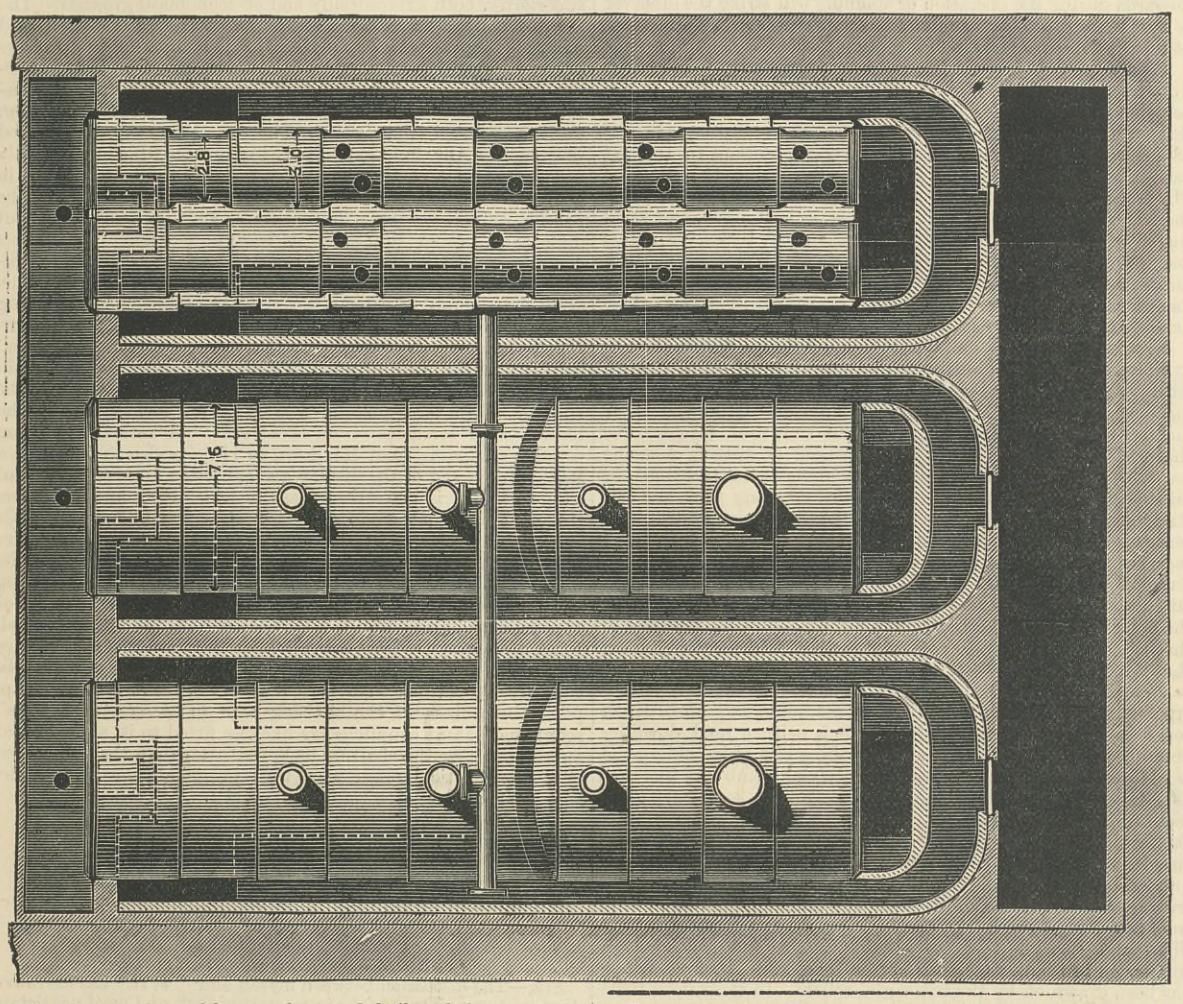
beautifully finished, and will give inside as well as outside measurements. We have no experience of any gauges of greater merit.

MINING DEVELOPMENTS IN CUMBERLAND.—On the proposed branch line of the Cleator and Workington Junction Railway a fine vein of iron ore has been discovered. A very fine band of ore has also been found at the Tod Holes mines. Manganese and ferro-manganese, which are known to exist in considerable quantities in different parts of Cumberland, cannot at present be worked at a profit, owing to the low price at which foreign ores are selling.

FLANGED FLUE BOILERS, FOR THE CANADIAN PACIFIC RAILWAY.

MESSRS. HAWKSLEY, WILD AND CO., SHEFFIELD, ENGINEERS.

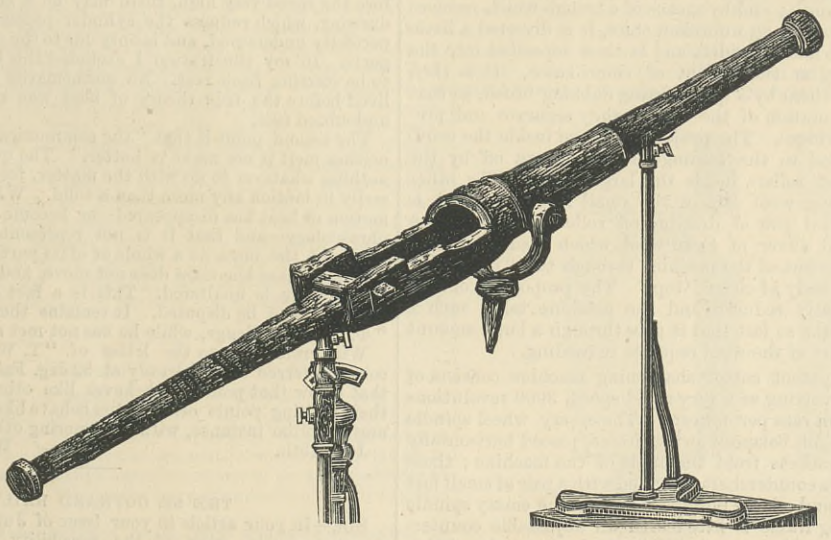




We illustrate herewith one of several boilers being made by Messrs. Hawksley, Wild, and Co., Brightside Boiler Works, Sheffield, for the Canadian Pacific Railway Company. The engineer of the line selected these boilers after a careful examination of the work of various makers.

The construction of the boilers made by this firm is now well understood, the flanged flues constituting their principal peculiarity. One great advantage of the system is that when a flue has to be replaced it can be done without taking out the furnace front, which is necessary with other boilers.

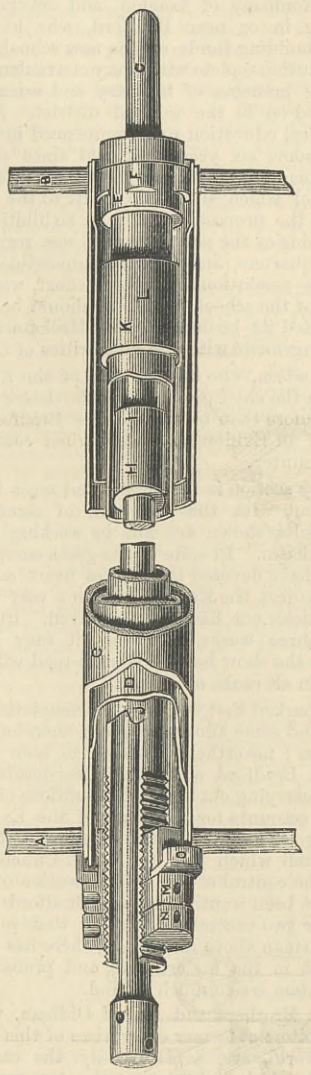
GUN RECENTLY DISCOVERED AT SANTANDER.



We have been favoured with a photograph reproduced in the cut herewith, showing an ancient piece recently fished up in the harbour of Santander, which appears to have attracted considerable attention. It is a wrought iron breech-loading piece—length of gun, 1·85 metres (6ft.); that of lever or tail piece, 0·85 metres (2ft. 9in.); calibre, 50mm. (nearly 2in.). It will be seen then that this piece has four features that we generally associate with very modern guns—(1) It is wrought iron; (2) it is a breech-loader; (3) it is about 36 calibres long; (4) it is a pivot gun without provision for recoil. Those who are at all familiar with ancient pieces, however, know that these features were found at times. In the Rotunda Museum at Woolwich are several guns resembling the above in some features, among them an English gun of the fifteenth century, a Chinese gun taken in the last Chinese war, of unknown date, and a gun taken out of a vessel of the Spanish Armada. It is not easy to say exactly what was the office of this Santander piece. The spike pivot generally was fixed in a tripod, but no doubt might equally well have been fixed on the side of a ship. Probably the gun was a Spanish one of the fifteenth century. More than that can hardly be said, especially without seeing it. The effect of the sea water on it might tell something. Iron has been found so completely honeycombed by the action of the sea water that when shot were first taken out the finely divided mass of iron was so attacked by the oxygen of the air that the metal steamed and became hot. Indeed this effect is said to have caused considerable alarm to the finder in one instance, who ran away from the shot on observing its strange behaviour.

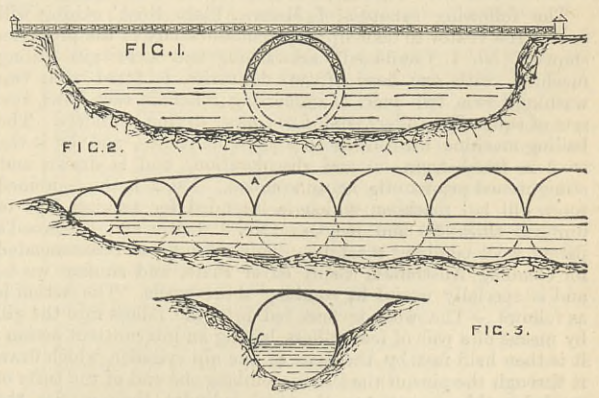
MORGAN'S PATENT TUBE STOPPER.

The accompanying engraving illustrates a tube stopper manufactured by Messrs. W. Reed and Co., New London-street, E.C. The illustration represents the stopper ready for use. It will be seen that a specially prepared tube is inserted in the leaking tube, which is expanded in the outer tube at each tube plate; in the engraving, A is the tube plate at smoke-box or front end; B, tube plate at combustion chamber or back end; C, tube, as fixed in A and B; D, inner tube or stopper fixed inside tube C; E, expander, in position, to expand inner tube or stopper D in tube C, opposite tube plate B at combustion chamber or back end; F, rollers in expander E; G, mandril for turning rollers F and expander E; H, connecting rods with socket, to connect mandril G, so as to expand inner tube or stopper D at the combustion chamber or back end tube plate B from smoke-box or front end; I, pin for securing connecting rod H to the mandril G; J, tube for adjusting, so as to have the rollers F in proper position at tube plate B; K, socket for connecting adjusting tube J to expander E; L, pin for connecting expander E to adjusting tube socket K, which, when connected, allows the expander E to revolve freely; M, nut on adjusting tube J, to adjust rollers F in position at back tube plate B; N, check nut on adjusting tube J to keep nut M in desired position; O, cap on adjusting tube J, to rest on tube plate A between tube plate and nut M. The principle involved is very simple. It consists in inserting a sound tube within that which is split, and expanding it until it fits at each end.



PROPOSED NEW FORM OF BRIDGE SUPPORTS

The accompanying diagram illustrates designs by Mr. J. F. Smith, Leicester. He proposes that bridges shall consist of iron or steel cylinders of any reasonable diameter, made up with plates rivetted to rolled iron or steel ribs, the strength necessary to carry any weight required; they are generally of a circular section, and the lower half of the cylinder, or inverted portion of the arch, supports the upper half, and has a continuous bearing on the ground or bed of the river its whole length; the larger the cylinders the more stable the bridge. These bridges, or cylinders, may be rivetted up in dry dock, a portion of the ends covered with movable plates, floated into position and sunk; the only trouble in foundations being in cases where the bed of the river is rocky and uneven, then it is necessary to level or groove the bottom with "jumpers" from a platform over the line of intended cylinder. For small watercourses under turnpike and other roads, Mr. Smith says these bridges may be rivetted up on the spot, rolled in, covered over, and the bridge is made as in Fig. 3 without any pileing, diverting watercourse, building foundations and arches, or other trouble and expense usual in the old style of building bridges.



Where railroads are to be formed over frequently flooded or boggy land, a number of these cylinders laid side by side—as in Fig. 2—will, it is claimed, save railway companies the enormous cost of foundations. The cylinders having a continuous bearing the whole width of the railway cannot possibly sink very much, and the rail level would be made good on the top in case of any subsidence.

NAVAL ENGINEER APPOINTMENTS.—The following appointments have been made at the Admiralty: Frederick Ward, chief engineer, to the Excellent; William Bryan, chief engineer, to the Agincourt, vice Glasspole; and John Noble, assistant engineer, to the Alexandra, additional, for temporary service.

THE ART AND INDUSTRIAL EXHIBITION AT BRADFORD.

No. I.

An Exhibition of rather more than local significance has just been opened at Bradford by their Royal Highnesses the Prince and Princess of Wales. The enterprise has been commenced in conjunction with the opening of the new technical school, on the occasion of which event their Royal Highnesses were some months ago invited to visit Bradford. The public is chiefly indebted to the Council of the Technical School, supported by the Clothworkers' Company of London, and several private individuals residing in or near Bradford, who have contributed liberally to the building funds of the new school, for the existence of an institution replete with every convenience for technical training in those branches of industry and science which affect the trades carried on in the worsted district. An agitation in favour of technical education was commenced in the columns of the local press some six years ago, and since that time every effort has been made to provide the necessary means for erecting a technical school which should do credit to the town. Only a few months ago the proposal to hold an Exhibition on the occasion of the opening of the new building was regarded with disfavour in some quarters, and thought impossible to successfully carry out. The resolution, after some effort, was at last passed by the Council of the school, which it should be mentioned has hitherto conducted its business at the Mechanics' Institute, by provisional arrangement with the authorities of that institution.

Mr. George Hodson, who is chairman of the Exhibition Committee, has been the chief promoter of the latter enterprise, and to him perhaps more than to anyone else Bradford people owe the existence of an Exhibition, which, when completed, will do honour to the country.

The machinery section is the largest and most important part of the show, but with the exception of some two or three exhibits the articles shown are not in working order, or ready for practical criticism. In spite of the great energy displayed by gentlemen who have devoted themselves heart and soul to the success of the project, the Exhibition is in a very backward state, many of the articles not having yet arrived. In the course of some two or three weeks, however, it may be confidently anticipated that the show held in Horton-road will prove attractive to visitors in all ranks of society.

It may be remarked that the time for completing the work has been limited, and some allowance must, therefore, be made for its non-readiness ; nevertheless, there has been evident in the undertaking at Bradford a want of clear-headed management and dispatch in carrying out the good intentions of the promoters, which partially accounts for the state of the Exhibition on the day of opening. The systematic planning out of work and attention to detail which won for Sir P. Cuncliffe Owen such admiration in the control of the British section of the late Paris Exhibition, have been wanting in the Bradford enterprise, and save with one or two exceptions, such as that instanced in the case of the chairman above mentioned, there has been a want of executive talent in the undertaking, and probably this is one reason why matters are so much behind.

Messrs. Platt Brothers and Co., of Oldham, who have been such large exhibitors at former enterprises of this kind in various parts of the world, are, as is usually the case, the largest exhibitors, their display presenting the appearance of a small factory in full and complete operation. Visitors of a mechanical turn of mind, and especially such as are interested in the question of mule spinning on the French system, cannot spend an hour better than in studying the various processes illustrated in Messrs. Platt Brothers' show of machinery. This exhibit will probably be all the more interesting to Bradford people owing to the numerous comments on the French as opposed to the Bradford system of spinning. It has been shown that the French comber backwashes after combing, consequently leaving no oil in the top, whereas the English comber backwashes before combing, and then puts oil in again. In the method pursued by the latter some eight or nine operations are used wherein twist is added to the yarn, and this great amount of twist and superabundance of oil used has a tendency to make a comparatively hard dense thread. The oil also after a time becomes viscid and presents an obstacle to even dyeing. On the other hand the French spinner, commencing with his tops free from oil, is continually drawing them through porcupines, which process keeps the fibres apart and helps to form a bulky thread. He puts no twist in until he begins to spin, and spinning on the self-acting mule, there is no strain upon the yarn as it is being wound on the spindle. The combing machine mentioned below is adapted for working the shortest wools and producing results which cannot be obtained by the ordinary Bradford machinery.

The following synopsis of Messrs. Platt Bros.' exhibit will enable the visitor to take up a systematic study of the processes shown :—No. 1. Combined backwashing and screw gill balling machine, with one head of two deliveries, is fitted with two washing bowls, two pairs of immersing rollers in each bowl, two sets of squeezing rollers, and five copper drying cylinders. The balling machine has one head of two deliveries, and by it the wool is freed from oil and discoloration, and is drawn and straightened prior to its being combed. No. 2 is the combined screw gill lap machine, which is intended for making laps of uniform thickness and length. No. 3. Little and Eastwood's patent wool combing machine. This machine is recommended for combing Australian, Cape, River Plate, and similar wools, and is specially useful in combing short wools. The action is as follows :—The wool is first fed into the fallers into the gill by means of a pair of feed rollers having an intermittent action ; it is then held fast by the jaws of the nip cylinder, which draw it through the pins of the fallers, combing one end of the tufts of wool by this operation ; the nip cylinder then carries the combed tufts forward, and deposits them on the pins of the circle comb, placing the uncombed or noil ends behind the pins ; this noil end is then combed by being drawn through the pins of the circle comb by means of the drawing-off rollers. No. 4 is the screw gill balling machine, containing one head of two deliveries with front and back rollers fluted ; screw gills for one set of fallers, fourteen fallers up, and balling motion, &c. This machine is for finishing after combing, and can be made either with one or two heads. No. 5, the finishing roving frame, has six boxes, twelve porcupines, and twelve bobbins of 7in. traverse or lift. The headstock or gearing head is built upon a strong base plate, which prevents vibration of the gearing and rubbing motion, and the whole is so arranged that changes can be made readily, the draft wheels, rubbing motion, surface rollers, and lift being the same pitch and size of hole. The porcupines or combs are worthy of minute attention, the pitch of the pins being graduated exactly to suit the quality of wool operated. They are driven with fine pitch wheels at each end of the machine, so as to give steadiness of motion, and prevent cutting the wool. No. 6 is the self-acting mule for spinning worsted.

As there has been a good deal of controversy regarding the introduction of this machine into the Bradford trade, visitors will do well to regard its main principles, which are quite different from those upon which the Bradford frame is built. This "mule" is precisely the kind of machine so largely in use abroad in the production of those fine soft cashmere goods that have competed so strongly with our British fabrics. Whereas the operation of twisting the thread is completed on the Bradford frame in some 9in. or 10in., the mule is calculated to cover a greater extent in the process of twisting, a distance extending to 62in. or 64in. being allowed. No doubt this partially accounts for the greater expansion and humouring of the fibre, which is a salient feature in the mule spinning system.

In dealing with the machine at work in the exhibition there are special arrangements made in connection with the drawing out and taking in of the carriage which cause it to stop in case of obstruction during the outward run and also to be suddenly stopped during the going in of the carriage. The spinning operations will cease automatically should the cam shaft by accident or otherwise make its change before the proper time. There are also arrangements for disengaging the taking-in motion by the going in of the carriage. Several patented motions are noticeable about the machine, one being for regulating the tension of the backing-off chain during the depression of the faller wire to the spindle point preparatory to commencing the backing off. There is also an improved construction of square and carriage coupling by which these are more firmly and accurately fastened together. The steadiness with which the carriage goes backwards and forwards during the operation of spinning will strike the observer as indicating much nicety of mechanism, the various parts being fitted with the most accurate attention to detail.

No. 7 exhibit is a power loom for weaving fancy woollen and worsted goods. It is of low pattern, with lathe centre at the bottom of the loom. The going part is 96in. reed space, with three shuttle-boxes on each side. There is a Jacquard for 28 shafts fitted with ungearing and reversing motions for turning back the loom to the broken weft without moving the shuttles. The letting-off motion is on the worm-and-wheel principle, and there is a balance take-up motion, single roller temple, and wood lagged yarn and cloth beams, &c. &c. Warp drum, warp reel and proportion balance, complete this highly interesting and instructive display of machinery, fitted so as to place Bradford manufacturers on an even footing of competition with their neighbours across the Channel.

Messrs. Greenwood and Batley, of Albion Works, Leeds, exhibit Lange's patent wool-combing machine and screw gill box with balling head ; Shackleton and Binns' patent tying-in machine for warps ; Parker's patent automatic machine for making screws ; Kreutzberger's patent universal machine for sharpening milling cutters ; small nicking or slitting machine for screw heads ; universal milling machine with attachment for making milling cutters and twist drills, grooving taps, and for straight milling ; machine for sharpening twist drills ; 6in. centre self-acting, sliding, surfacing, and screw cutting lathe, carrying its own countershaft ; screw planing machine with Baville's patent tool holder ; Keat's patent waxed thread lock-stitch sole sewing machine ; ditto, welt stitching ditto. One of the chief objects of the Lange patent wool-combing machine is that of combing all the top out of the wool before letting it go, thus leaving nothing but "noil" to be stripped out of the comb, to go away as noil in reality. The wool is left the full length after combing because it is invariably "placed on two combs which comb the wool by separating, so that it is neither held down by pressing plates nor drawn off with anything like a nip holding the wool fast." There is a large circular receiving comb very like that used in a Lister or Rawson machine, but having as a rule more teeth in it set at a finer pitch. The head of the machine with the feeding comb brings the wool forward and places it on the circular receiving comb and head comb, into both of which it is pressed by the brushes. The head recedes and leaves a combed fringe on the circular comb while retaining a fringe of combed wool in the head comb ; this latter fringe on the second stroke is lifted and thrown over the circular comb, and is drawn off further on in the revolution from the back, after the front fringe has been drawn off by the horizontal rollers. In these operations there is nothing to break the wool. There are drawing-off rollers both inside and outside the large circular receiving comb. The outside rollers taking the largest quantity of top are horizontal, while those inside are vertical. Both the slivers from these rollers are run out of the machine together, through one "tweedler" or revolving funnel. There is a small circular receiving comb placed inside the large receiving comb, and almost touching it at one point. At a short distance before this point of coincidence there are lifting knives, to lift the wool remaining in the large comb out of that comb ; and by means of a trough which receives the wool so lifted out in an unbroken state, it is diverted a little sideways, by about half its width, and is then deposited into the two combs exactly at their point of coincidence. It is then dabbed down into them by a quick-acting dabbing brush, so that on the continued rotation of the combs they separate and present two combed fringes. The projecting fringe inside the comb after passing round to the feeding-head is drawn off by the vertical drawing-off rollers inside the large comb. The other clean fringe of long wool left in the small receiving comb is drawn off by a third pair of drawing-off rollers, and forms an additional or third sliver of clean wool, which is added to the other two, and runs out of the machine through the "tweedler," so as to form one body of clean "top." The proportion of noil to cardings is greatly reduced, and the machine takes such a heavy feed and works so fast that it goes through a large amount of work, and no part of the wool requires re-carding.

Kreutzberger's patent cutter sharpening machine consists of an emery wheel revolving at a very rapid speed, 3000 revolutions being the minimum rate per minute. The emery wheel spindle is mounted in a light balanced swing frame, placed horizontally and carried by brackets from the table of the machine ; these brackets also carry a countershaft, provided with a pair of small fast and loose pulleys, and a large pulley for driving the emery spindle wheel. The swing frame is fitted with an adjustable counterbalance, hand lever and connecting link, the lever motion being attached to a central post springing from the middle of the table. The post is provided with an adjustable stop screw for the swing frame, and also a radial slot which allows the swing frame to be firmly fixed in any required position. It will thus be seen that the emery wheel can be used in a fixed position or allowed to rise and fall at will. The appliance for checking and manipulating the cutter operated upon consists of a pair of slides placed at right angles to each other, and each worked by a separate screw. The lower slide is secured to one corner of the table, and placed at right angles to the line of the emery wheel spindle, but when required it can be swivelled about 40 degrees to the left. Upon the upper side is mounted a small swivelling upright having a circular base, which can be firmly secured to the slide by a central bolt. In the upper end of this upright is fitted a swivelling bearing which can be set to any required angle. This bearing is provided with a steel spindle having a handle at its outer end, and its opposite end is formed to receive and secure a parallel mandril at right angles to axis of steel spindle. Upon this is fitted an adjustable arm to which the cutter mandril is attached, and there is also a small slot plate secured to the same arm carrying a pawl, which takes in the teeth of the cutter to be sharpened. Provision is made by various arrangements for operating upon cutters with straight or helical teeth, and those having convex, concave, and other faces.

A large display of rolled shafting is made in No. 4 shed by the Kirkstall Forge Company. Probably it will not be known, save to a few visitors, that this kind of shafting is now largely used in place of the turned and brightened iron shafts, the trouble of cleaning which many of our overlookers and factory operatives are well acquainted with. The article made at Kirkstall costs only half the price of bright shafting, and it is proved to be sufficiently round and smooth without undergoing the operation of turning. One of the advantages in the use of this unturned shafting is its greater strength, the skin of the iron being left intact ; and another recommendation is its resistance to the action of steam and damp. The shafting is, after being rolled, cut up to actual lengths required, and the ends are faced, as will be seen from the samples shown. The samples shown are from seven inches down to a quarter inch in diameter. One great feature in the manufacture of this commodity is, however, that of its passing through the exhibitors' patent process, by which it is increased in torsional strength 20 per cent., and in flexional strength 33 per cent. over the ordinary rolled bar, so that in comparison with the latter there can be no doubt of its superiority, both substantially and on economical grounds. The above facts are supplemented by the test table of Mr. David Kirkaldy, experiments having been made by him upon four pieces of the Kirkstall forge wrought iron shafting with a view of ascertaining the resistance to deflection and set under a gradually increased bending stress. The patent frictional coupling of this firm meets a practical objection raised by some users of patent rolled shafting, viz., the slight irregularity in diameter which occasionally occurs in shafts of the same size, owing to the variation in contraction which takes place after the completion of the patent rolling process. To obviate this difficulty without materially raising the price it became necessary to adopt a coupling which would adapt itself to any such trifling irregularity, and which would still be effective and run absolutely true. Over the exhibit is shown the arrangement of a 2in. coupling connecting two pieces of shafting, in order to illustrate the torsional power of the coupling. As shown, it bears a torsional strain of 13 tons at each end. Visitors will understand the main features of this arrangement by looking at the two levers, at the ends of which are suspended 5 cwt., representing with the levers, &c., a torsional strain of 13 tons. A series of reducing couplings, ranging from 4in. down to 1¼in., is also shown. On a table at each end of the display are exhibited various samples of iron, and there is also a show case in which is a numerous selection of broken specimens of the excellent quality of materials produced by the exhibitors. One large sample of best Yorkshire iron in particular has been twisted and punched to test its quality in every conceivable way. In front of the stand is a 6in. ordinary shafting bar 23ft. long. There are also samples of turning and fluting iron. The shafting made by the Kirkstall Forge Company is often cut up into short lengths for spindles and arbors of all sizes and lengths, and these are found to be considerably cheaper than turned spindles. The firm have supplied three lines of the shafting seen in Messrs. Platt Bros'. room, and patent couplings are likewise fitted to it, and so far as appearance goes the shafting looks far better than the half-rusted or stained article often met with in mills where only bright shafting is supposed to be used.

LETTERS TO THE EDITOR.

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

THE FOUNDATIONS OF MECHANICS.

Sir,—The discussion between myself and "Φ. Π." has narrowed down to two points, which are matters of fact, and need not detain us long. The first is whether the pressure in the cylinder of a steam engine is measured by the resistance. Surely every engineer knows, as a matter of fact, that this pressure, as given on an indicator diagram, is always within a very few pounds of the boiler pressure, whatever the resistance may be. If the locomotive superintendent in the case of the two trains I cited found that while one of them had 150 lb. pressure in the boiler it had only 100 lb. pressure in the cylinders, he would not pay much attention to the driver's excuse that the train was a light one ; he would tell him to go and find out the leak. Of course, if the load is very light, and therefore the speed very high, there may be a certain amount of wire-drawing, which reduces the cylinder pressure slightly ; but this is perfectly understood, and is only due to the small area of the steam ports. In my illustration I excluded this by supposing the trains to be starting from rest. No mathematics of De Pambour—who lived before the true theory of heat was known—will shake this undoubted fact.

The second point is that "the communication of heat to ice will neither melt it nor make it hotter." The question of melting has nothing whatever to do with the matter, for a liquid is not necessarily in motion any more than a solid. What I said was that the motion of heat has disappeared—or become latent, to use the old phraseology—and that it is not represented by existing motion either of the mass as a whole or of its particles ; the former being known because the mass does not move, and the latter because the temperature is unaltered. This is a fact of elementary physics which cannot be disputed. It remains therefore that I have met "Φ. Π.'s" challenge, while he has not met mine.

With reference to the letter of "T. W.," my illustration of course referred to ice already at 32 deg. Fah. I am quite aware that below that point ice behaves like other bodies, and that at their melting points other bodies behave like ice. I simply took the most familiar instance, without ignoring others.

June 15th. Walter R. Browne.

THE ST. GOTHARD RAILWAY.

Sir,—In your article in your issue of June 2nd you do not take a very sanguine view of the possibility of keeping open the approaches in winter, and of regularly working the traffic over the steep gradients of the St. Gothard Railway. Permit me briefly to refer to these and other points which are discussed. I have twice crossed the St. Gothard Pass in the early spring, and stayed for some days near Göschenen and at Airolo, the northern and southern entrances to the great Alpine tunnel. The snow does not lie heavily at these places, and I do not anticipate there will be so great a difficulty in keeping open the St. Gothard as, for instance, the Highland Railway, where snow ploughs have often to be used during a severe winter. The average height of level of rails at the tunnel entrances is 3700ft., but it must be remembered that these are situated about latitude 46½, while Inverness is in latitude 57½. The railway appears to be well secured against danger from avalanches or mountain torrents, which are avoided with great ingenuity by means of tunnels thrown back into the mountains, or by bridges at a sufficient height above the streams. In a few instances where the levels did not admit of these expedients, protecting archways have been built with paved shoots or slides above, extending some distance up the mountain for the passage of water and *débris*. With regard to the spiral tunnels, which are severely

criticised, it would have been easy to devise means of hauling traffic up the suggested direct inclines of 1 in 10, and it was not from any deficiency of mechanical engineering talent that another method of construction was decided upon. A number of detached inclines on the north and south approaches must have involved great delay in working the traffic, and it would have been necessary to divide each train into several sections for haulage up and for lowering down. It is also obvious that for descending traffic the spiral tunnels have a great advantage over the suggested method, as with sufficient brake power trains of any length can traverse the valleys of the Reuss and the Ticino to the low level without being divided, without stoppage, and at a uniform rate of speed. The cost of maintenance of permanent way in the spiral tunnels may be slightly greater than would have been the case on steep direct inclines, but we have, even on English railways, many gradients steeper than 1 in 43·5, and many curves of less radius than 15 chains. Having made a careful inspection of the St. Gothard Railway, I venture to think that the best possible means have been adopted for overcoming the almost insurmountable difficulties of the work. C. G. ETHELSTON.

Balham, S.W., June 17th.

HYDRAULIC SHIP LIFTING DOCKS.

SIR,—It is within the knowledge of most engineers that Mr. Edwin Clark was the inventor, patentee, and engineer of all the hydraulic docks and canal lifts that have yet been constructed, although there have of late been attempts made to divide the honours between him and others. The letter in your number for the 9th inst. is a glaring instance of this, and a very unjust one. Referring to the Bombay Hydraulic Dock, of which Mr. Edwin Clark appointed me resident engineer in sole charge, I may mention that the transverse girders, weighing about 1800 tons, were made at Hamilton's Windsor Ironworks at Liverpool, and the pontoon, weighing about 1600 tons, was made by Messrs. Jones Brothers, at the Victoria Docks, London, and that previous to going to Bombay I inspected these girders and the pontoon at the above-mentioned works. In addition to my duties as resident engineer, I personally directed and superintended the erection of the dock, and the whole of the scaffolding and staging, which is usually designed by the contractor's engineer, was designed by me. The firm mentioned by your correspondent had nothing to do with the engineering or design of the Bombay Dock, and it will be seen from the foregoing that they were not the sole constructors, but must share the credit of its construction with the two large firms above mentioned. Neither had the said firm anything to do with the engineering and design of the Malta Hydraulic Dock. Besides the gentleman named by your correspondent, several others of Mr. Edwin Clark's assistants worked hard on the Bombay Dock; notably one who, long before the said gentleman had anything to do with it or even became a member of the staff, had done a large proportion of the work.

Of your nine illustrations of hydraulic docks three only referred to the Bombay Dock, to these it was not strictly accurate to attach the name of Clark and Standfield as engineers, as Mr. Edwin Clark and myself were not then partners; we could not, however, have been more closely connected in the work than we were, one being the engineer and inventor and the other the resident engineer. It was, however, quite accurate to do so to all the others. Mr. Edwin Clark and myself have long been partners, and with Mr. Latimer Clark also, are engaged on the design and construction of several large hydraulic works for foreign Governments; one of these —the Fontinettes Canal Lift—you illustrated in your number of 7th April. JOHN STANDFIELD, M.I.C.E.

6, Westminster-chambers, 22nd June.

WHAT IS THE USE OF PATENTING?

SIR,—I have often wished to address you on this topic, and "J. D.'s" letter on "American Patents" seems an appropriate opening of the question. Before going further, however, I would wish to direct his attention to patent No. 4092, English Patent-office, which he will probably find reported in your issue for May 25th, in which a well known firm of agricultural engineers "patents," *inter alia*, "a lever fitted to vibrate on a stud, to impart the to-and-fro motion to the sickle of a Marsh harvester, to one end of which a Pitman rod is connected, while its other end is connected *by a rod* to the sickle," and to ask him if he does not think this rocking lever as "unpatentable" as Mr. Roberts' dog link, it being as commonly fitted to sheaf binders as the link is to donkey pumps. I presume the claim to originality is based on the words I have italicised, but if so how is the lever itself claimable?

Now for my question, by which I really mean—What is the use of taking out a patent unless you thereby cover, not only the way of making and the disposition of parts when made, that you intend to follow, but also any other likely and rational means of effecting the same object by practically similar design and construction that anyone else might be intending to follow, so soon as your specification sets him thinking how he can best pick your brains?

By way of illustration, let me instance three out of, say, 3000 cases:—A short time back Messrs. Cochran, of Birkenhead, patented a most successful, I had almost said, revolution in making and working vertical boilers, the result of which so well-known success was the "patenting" of the same idea by two or three other persons or firms, who, but for Messrs. Cochran's specification, would probably have left the vertical boiler as unimproved as they found it. A few years ago Mr. Gibbs patented an apparatus for making hay when the sun does not shine; it also was a success, but has taken some time coming into general use. As surely, however, as the use does promise to be general, we find Messrs. Jones and Robinson, of Lincolnshire, duly "patenting" the same idea, to be effected in a manner so original that my weak intellect is unable to appreciate the difference between their *modus operandi* and that of him whose brains they have so obviously "picked." A few years back Mr. Samson Fox took out a patent that has simply "made" the Leeds Forge Company, and now Messrs. J. and R., of "near Leeds," are "patenting" the manufacture of corrugated flues. I have said enough to warrant my question; can "J. D." answer it? C. W. V.

June 16th.

RETURN OF STAMP DUTIES ON PATENTS.

SIR,—In a recent return of stamp duties on patents, made to the House of Commons on the motion of Mr. Anderson, the figures shown will suggest to persons conversant with the subject various inferences. I propose at present to notice one, relating to a point which I have always regarded as one of great importance to patentees. I refer to the preliminary examination of all applications for patents.

I propose to draw attention to the large amount represented by abandoned applications for patents in a single year, showing how much is effected by the silent operation of our existing system, without preliminary examination such as is practised in America, Germany and some other countries.

The amount paid on "Petitions for Letters Patent" was £29,520 and that on "Final Specifications" and "Applications with Complete Specifications" taken together was only £19,775, leaving a difference of £9745, as stamp duty sacrificed through abandoned applications.

In this estimate it is assumed that all the "Applications with Complete Specifications" were completed patents, which in all probability was not the case, so that the cost in every instance of failure to complete would form an additional sacrifice. Then, again, there would be some instances of sacrifice by payments of stamp duty beyond that on the petition. In evidence of this it is to be observed in the "Return" that the amounts paid keep diminishing at each stage between the "Notice to Proceed" and the "Final Specification," but the diminution is especially noticeable on the "Warrants" as compared with the "Notices to Proceed." There is a difference here of £1545, which sum added to £9745 will give a total of £11,290.

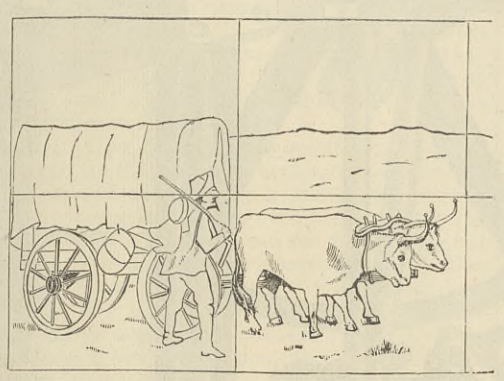
This sum represents a sacrifice in stamp duty alone, but to this is to be added the amount paid to agents for their services, and also the cost of the time, labour, and experiments incurred before the applications were abandoned. The point to which I wish especially to draw attention is the very large amount sacrificed by abandoned applications in a self-acting system, which appears to be acquiesced in much more readily than would a much smaller amount of loss, caused by official rejections after examination. I have for many years past been persuaded that the system of preliminary examination introduces more evils than it cures, and I am not surprised, therefore, at inventors objecting to it as they do. It appears to me to be a curious commentary on the system, that when—as I have experienced—patents for an invention are applied for in several countries where preliminary examination is practised, the objections urged should differ so much in different countries. I think there is a serious defect of this system in principle involved in the fact that in the matter of originality the official mind is unable to keep pace with the inventive mind.

WILLIAM SPENCE, Assoc. Inst. C.E.

8, Quality-court, Chancery-lane,
June 8th.

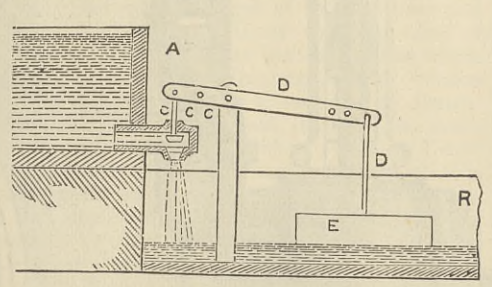
AMERICAN PATENTS.

SIR,—You recently published for me two examples of antique inventions re-patented in the States. I now beg to enclose you two more from the official gazette received in London to-day—Monday:—



"258,651. Dissected Toy Picture. George H. Ireland, Springfield, Mass. Filed June 27th, 1881. (No model.) Claim: The combination, with a dissected toy picture, of one or more substitute sections to be introduced into the said toy picture to convey something additional to the original dissected toy picture, substantially as set forth."

Need I say that such toy pictures have been known for I fear to say how many years in most nurseries?



"258,619. Watering Animals. Isaac Welty, Olney, Ill. Filed October 5th, 1881. (No model.) Claim: In an automatically operating apparatus for watering stock, the combination of the reservoirs A and B, the pipe C, having a horizontal opening communicating with the reservoir A, and a vertical opening for the discharge of water into the reservoir B, said vertical opening being provided with a valve seat for the automatically operating valve to close upon, the float E, the graduated lever D, the valve C^1, and the connecting rod D^1, the parts being constructed and arranged as shown and described."

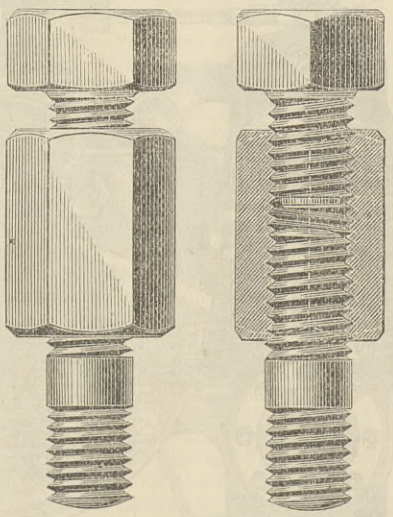
The ball cock can hardly be called new, but it would seem that the combination of a ball cock with a tank out of which cattle drink is new enough to get a patent in the United States.

There are well-meaning folk in this country who want official examiners here like those in the States. J. D.

London, June 12th.

FIXING STUDS.

SIR,—In the early days of steam engines and locomotives studs used for cylinder covers and other joints had a square at the centre, the holes in the cover being square to correspond. This caused considerable expense in the manufacture of the studs and of the square holes, and also difficulty in adjusting the squares to the exact positions necessary to fit the holes in the cover.



Some twenty-eight years ago I designed an instrument, shown on annexed tracing, to enable round studs to be used; and I have had this in use ever since in its exact original form. These have become well known to workmen, and have been translated to the various shops in the country, Messrs. Vickers, Sons, and Co., of Sheffield, using them for putting studs into propeller bosses up to as large as 3½in. diameter. Since I made this instrument other arrangements have been made to do without set screws; but they are not so reliable or so good as this one, as they are apt to draw back the stud in taking off the stud-driver, and are altogether less satisfactory.

I saw in your paper a week or two ago a sketch of this design, which someone claimed to have introduced recently. The tool, however, is well known to all railway men and to most other mechanics by this time. W. STROUDLEY.

Brighton, 13th June.

BOILER INSPECTION.

SIR,—It is a pity your anonymous correspondents could not notice my letter on the "Morality of Boiler Assurance" without introducing personal and extraneous matter. In this respect an anonymous correspondent has an advantage over one who is not ashamed or afraid to put his name to the end of his letters, as I always do. I don't wish to deny that I was employed by an insurance company some twenty years ago, neither have I any reason to regret leaving that same company and being cast on my beam ends here a perfect stranger now more than nineteen years ago. But, Sir, what has this personal question to do with the "Morality of Boiler Assurance?" As to Mr. "Secretary's" other insinuation, viz., that I was begging for an agency to another company about three years ago, that is entirely untrue. I suppose it is an allusion to an offer I believe I made to inspect boilers for a new company that was about commencing operations here, and I certainly made use of language to the effect that "could I insure boilers as well as inspect them I could do more business." But what inconsistency is there in that? It is only an admission that "nothing succeeds like success," and if manufacturers, "rightly or wrongly," will "have something" when their boilers blow up, is that a reason why I, as an inspector, should be idle or only half employed as an inspector? Let Mr. "Secretary" reply please, avoiding personal matters.

Birmingham, June 20th. JOHN SWIFT.

PHOTOGRAPHY FOR COPYING DRAWINGS AND MANUSCRIPTS.

ONE of the first, if not the very first, record we have of photography undertaking the duty of copying clerk is that cited by Professor Alexander Herschel. He has told us how his father, the late Sir John Herschel, made use of photography with iron salts—the blue process—for copying his calculations and intricate tables. These cost so much trouble to produce, and represented such valuable investigations, that he was exceedingly loth to trust them out of his hands. For many reasons it was necessary to prepare a copy or copies of his work, and as he could not rely implicitly on anybody's figures but his own, he himself had the trouble of writing them out. To photography, then, he turned; he could trust it, obviously, even better than himself to copy the elaborate calculations, and could rest quite sure that not a single error crept into the mass of figures during their reproduction.

The blue process, which gives white figures on a blue ground, is still frequently employed, especially by scientific men who want simply a rough copy of their work; but it naturally has the disadvantage that the ground is not white. Still the paper is so exceedingly easy to prepare, and the process so simple, that it will long command attention where occasionally a valuable MS., an intricate calculation, or an elaborate plan has to be copied. The ink of the original should be as black as possible—Indian ink is best; and for printing the document is simply placed above the prepared paper, the two being kept flat by means of two plates of glass held together by clips or other simple contrivance. The process is already well known to our readers, but it may well be repeated in Professor Herschel's own words:—"The solution for treating the copying paper is as under:—Citrate of iron (or ammonie citrate), 140 grains; ferricyanide (red prussiate) of potash, 120 grains dissolved together in two fluid ounces of water. The solution can be kept in a glass stoppered bottle, well wrapped up in a dark cloth, or shut up in a dark cupboard, for any length of time. It is applied to the paper by means of a brush, or tuft of cotton wool, and the surface dried in the dark. Two or three minutes' bright sunshine suffices, if the original is on thin, or tracing paper, for printing, and the fixing is done by washing in clear water for a few minutes."

The "Pellet" paper, a patented article, which may be readily purchased in any large town, is better than the above process, for the reason that the copy is in blue upon a white ground. But the manipulations, on the other hand, are a little more elaborate, and the method is more costly. Where much copying is done, the Pellet paper is largely used, as, for instance, in the engineering departments of the Great Eastern and other railways. The use of photography in such connections is very obvious for contract as well as ordinary workshop tracings.

Among diplomatists and lawyers, photography as an accurate copyist is also beginning to be appreciated, but here it is desirable to have a reproduction in black, and for this reason we think that the process of nigrography, to which attention has recently been called by Captain Pizzighelli, is likely to find favour. The ordinary autographic copying processes to which we have alluded, and which give from one copy to two or three score, handy as they are, do not suffice to satisfy the lawyer and diplomatist's wants In the first place, the document to be copied may have been written ages ago, or it may happen that it cannot be copied until it is signed, and when this takes place the writing has lost its virtue to copy in the ordinary way. In these circumstances the photographic art is singularly useful. Copying by hand is out of the question, for even if done correctly, the copy may lose all its value by not being a *fac-simile*.

Diplomatic enclosures, which are generally confidential, are now frequently repeated by photography, either by the aid of the camera, or by simply printing through, while lawyers also employ the art for making *fac-similes* of authentic documents. A photographic copy is held in a court of law now-a-days to be as good almost as the document itself, for a witness can swear to the handwriting and style just as well as if he had the original before him. Any intelligent man, too, can do the work of copying after a little practice, whether it is the blue process, Pellett process, or nigrographic process he makes use of. The last is more elaborate than the blue process, but with a little practice is soon acquired, while it yields most excellent results. Paper thoroughly sized is floated in a darkened room upon a solution of gum-arabic, 25 parts; water, 100 parts; bichromate of potash, 5 to 7 parts; alcohol, 1 part. Or the mixture may by applied with a broad camel's hair brush. Dried, and kept in a cool dark place, it will remain fit for use a long time. It is exposed in the same manner, and for about the same time as in the blue process, and is then put into cold water for twenty minutes to wash out the unchanged bichromated gum. When dry a dozen or more prints may be taken at a time and treated with a black colour, made up of shellac, 5 parts; alcohol, 100 parts; finely ground lampblack, 15 parts. This is applied with a sponge. Afterwards the papers are laid in water acidulated with sulphuric acid (containing 2 or 3 per cent. of acid), when the superfluous black colour is removable by a brush, and the writing or design appears in fine black lines upon white paper.

Another process, which has been recently worked out by Captain Pizzighelli, also yields capital prints. Thirty volumes of a solution of gun-arabic (water five parts, gum one part), are mixed with eight volumes of an aqueous solution of citrate of iron and ammonia (water two parts, double salt one part), and to the mixture is added five volumes of an aqueous solution of perchloride of iron (water two parts, iron one part).

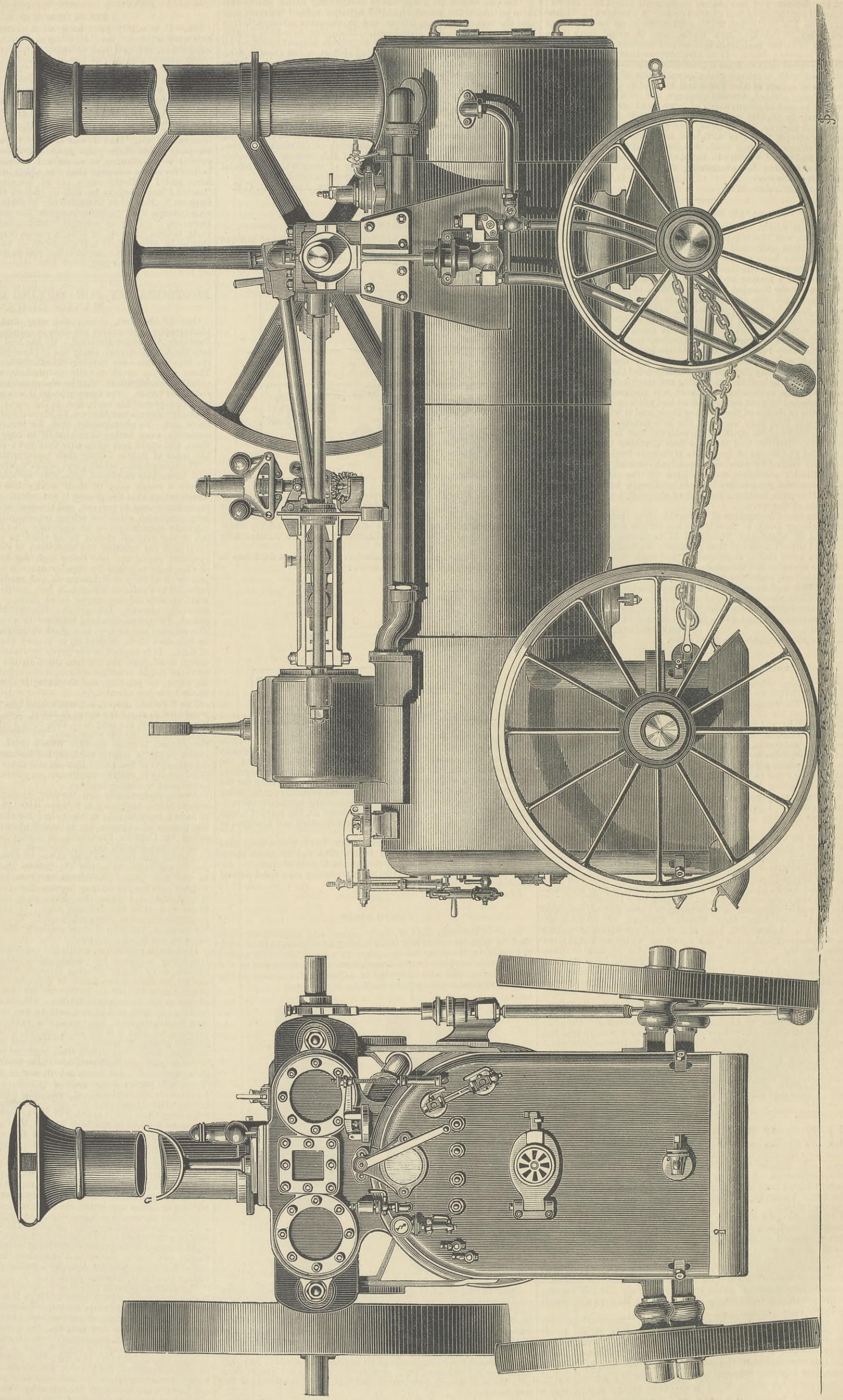
The mixture appears limpid at first, but soon grows thicker, and it should be used quickly after mixing; it is applied to well sized paper by means of a brush, the paper being dried in the dark.

Any design, drawing, or tracing may be employed as negative, and, after printing a few minutes, the development is proceeded with. A solution of ferro-cyanide of potassium (water five parts, ferro-cyanide one part) is applied with a brush, and the picture appears almost instantly as a dark-blue positive. As soon as every detail has appeared, the print is quickly rinsed, and then put into a dish containing dilute hydrochloric acid (water ten parts, acid one part), when the image becomes clearer and brighter, the ground gets white, and the gum-iron film is removed. After further washing the print is dried.—*Photographic News*.

DOUBLE-CYLINDER PORTABLE ENGINE.

MESSRS. MARSHALL, SONS, AND CO., GAINSBOROUGH, ENGINEERS.

(*For description see page 459.*)



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

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

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

W. S.—*So far as we are aware, the valve gear in question is not patented in this country.*

F. M. M.—*Consult Anderson's book on "Lightning Conductors." It is published by E. and F. N. Spon.*

FOUNDRY.—*Messrs. Bolling and Lowe, Laurence Pountney-hill, E.C., will supply you with what you want.*

LEX.—*See* THE ENGINEER *19th April*, 1878, *and 26th April*, 1878. *Another article on the subject will be found on page* 453.

J. A.—"*A Practical Treatise on Tunnelling,*' *by Simms, last edition, revised by D. K. Clark, is the best book on tunnelling with which we are acquainted.*

SUMEN.—*The only thing new about your invention is the use of perforations, and it would not be easy to get a patent for these, although it may be done if you can show that by their use you obtain a new and good result.*

J. F.—*So far as we can see, a belt* 12*in. to* 14*in. wide will work with certainty. If there are now and then very heavy resistances to be overcome, the belt will be liable to slip, and a chain would answer better than a belt, but a belt is always to be preferred to a pitch chain when it can be used.*

A SUBSCRIBER.—*It is impossible to give any numerical statement of the force of a blow. The words are too vague and indefinite. The work in foot-tons or foot-pounds which any moving body can perform on being brought to rest is expressed by the formula* $\frac{W}{2g} v^2$. *In other words, multiply the weight into the square of the velocity in feet per second, and divide by, in round numbers,* 64. *The quotient is the weight in tons or pounds which the moving body could lift through* 1*ft. in coming to rest. Thus* 42 *miles an hour is* 61·5*ft. per second, omitting fractions, and* 61·5 × 61·5 = 3782, *and* 3782 × 225 *tons, and divided by* 64 = 13,297. *That is to say, the stored-up energy in a train of* 225 *tons running at* 42 *miles an hour would suffice to lift* 13,297 *tons* 1*ft. high, or* 1 *ton* 13,297*ft. high.*

THE VALUE OF BILGE PIECES.

(*To the Editor of The Engineer.*)

SIR,—I shall be glad if any of your numerous and kind readers would give me their experience of, and the effect of, bilge clogs on flat-bottomed steamers, *i.e.*, without keel. Do they really prevent rolling?

Sunderland, June 21st. R. C. T.

PRESERVING STONE.

(*To the Editor of The Engineer.*)

SIR,—Can any of your readers give me the name of the best preparation for preserving the polished surface of stone from the action of the atmosphere—say, for instance, the sandstone of the Park spring and like quarries in Yorkshire? I have heard somewhere of a preparation of sulphurised oil, made by a Mr. Davis, and should be glad of information regarding this or any other process. MASON.

Runcorn, June 17th.

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THE ENGINEER.

JUNE 23, 1882.

BOILER INSURANCE.

AN article on the Morality of Boiler Insurance, which appeared in our impression for the 2nd inst., appears to have raised angry feelings in the breasts of some of our readers. They are not so much vexed with us as incensed by the shortcomings of the inspectors of the insurance companies; at least this is what we gather from their letters. Our correspondents take it for granted that so long as a steam user pays only for the periodical inspection of his boilers, they are certain to be properly examined; but if in addition he insures them, they are certain to be neglected. This is to say, that so long as the inspecting company has no interest in keeping the boiler from blowing up, it will do its duty efficiently; but the moment the steam user gives the inspecting company a direct interest in boilers, it will neglect its work and perform its task of inspection in the most unsatisfactory and perfunctory manner. This appears to us to be one of the wildest theories ever broached. It is totally opposed to all experience of human nature; and were it true, it would be impossible to find any other case resembling it in the avocations of business men. There are two or three explanations which may be given to account for the origin of this belief. We are disposed to be charitable and to reject two of them. The third finds its analogue in the statement that "Tenterden steeple is the cause of Goodwin Sands." There is one boiler inspection company, namely, the Manchester Steam Users' Association, which inspects boilers but does not insure them. The Association consists of comparatively few members. The number of boilers on its books is small; and as no boilers will be taken which are not in perfect condition, it follows almost as a natural consequence that its chief engineer, Mr. Lavington Fletcher, never is troubled with explosions among the boilers under his supervision. There are a great many boiler insurance companies which insure and inspect a very large number of boilers by no means of the best quality. It would be remarkable indeed if none of these boilers ever exploded. Now and then a boiler under the care of an insurance company bursts. The boilers of the Manchester Steam Users' Association do not explode, and from this circumstance is at once drawn the corollary that insurance and explosions go together, while inspections without insurance mean safety. There is really no connection whatever between the two things; and insurance has no more to say to the blowing up of the boilers under the care of any company which can be named than it has to do with the tides or the troubles in Egypt.

It appears to us that this point is worth insisting on, because we hold that the insurance companies are doing a very good work, and it would be a lamentable circumstance if that work was stopped, or even hampered, by the injudicious utterances of men who can see things from but one point of view—and that a very narrow one. Boilers may be divided into four classes—very good, good, bad, and very bad. We have heard it argued that the insurance companies ought to follow the example of the Manchester Steam Users' Association, and refuse to take charge of any but very good boilers. Unfortunately such boilers are altogether in the minority. By far the greater number of land boilers at work while we write are more or less deteriorated by wear and tear. Their average age is probably about ten years, and their average condition will be that proper to a boiler which has worked ten years. To put the facts in another form, we may say that Mr. Fletcher resembles an insurance office which would accept lives only between the ages of twenty-three and thirty, in robust health, and without the least taint of hereditary disease. Are we to say that the offices which accept lives of any age up to absolute senility behave immorally? The question has only to be asked to demonstrate its inherent absurdity. Indeed, it is not too much to say that the rules of the Manchester Steam Users' Association rigorously exclude the very boilers which it is most essential should be regularly inspected. It is quite well known that even very old boilers, if carefully looked after and properly repaired, will last a long time and work safely, while if neglected they may spread death and destruction around them at any moment. It is, perhaps, a sad thing that an old, patched steam boiler should be used at all; but they are used now; they have been used for many years, and they will be used far into the future. By all means let such boilers be insured and inspected. The new and excellent boilers can almost take care of themselves, but the good, and the bad, and the very bad, certainly cannot.

It is charged against the insurance companies that they will accept almost any boiler, and that so long as the premiums are paid they care nothing about inspecting, and that their staffs are small and composed of inefficient men. We have not the least hesitation in saying that such statements are not even half true. Not one of the boiler companies will accept a boiler until it has been put into fair repair; and, on the whole, the inspectors are men competent to do their duty. We constantly find that when explosions occur the company concerned has done all that lay in its power to get the boilers examined. The work of pressing for permission to examine may have been going on for months or years before; but this is not allowed to tell in the insurance company's favour, and we are told that it ought to have cancelled the insurance and declined further responsibility. In certain cases this has been done, but we confess we much doubt if an insurance company is really justified in adopting such a course. So long as the boiler is insured there is a chance that facilities may be given for inspection, and some precautions are taken; but the moment an insurance is cancelled the boiler is left to its fate, and with the worst consequences. We constantly find in the records of boiler explosions statements to the effect that such and such a boiler was at one time insured but that the insurance had been cancelled, and that no examination of the boiler had been subsequently made up to the date of the explosion. On the other hand, there are dozens of instances where a company's inspectors have obtained access to a boiler almost at the eleventh hour, and secured its utter condemnation or persuaded the owner to make the requisite repairs. Those who find fault with the insurance companies overlook the fact that they are doing a great deal of good under very trying and difficult conditions.

We have often advocated the passing of an Act of Parliament which, if it did not make the inspection of boilers compulsory, would at least indirectly but forcibly tend in that direction. If Mr. Fletcher's principle was to be carried out under such conditions, it would be found impossible to make the law work, because the condemnation of boilers would be wholesale. But wiser counsels would no doubt prevail, and boilers would be classified and allowed to pass on their merits without drawing any hard-and-fast line. The passing of an Act of such a nature as that we have indicated would at once throw a large amount of extra work on the boiler insurance companies, and would be of very great advantage in more ways than one. It is not to be disputed that the insurance companies have for some time past been charging such very small premiums that it is almost impossible to cover working expenses. If inspection became compulsory the tariffs might be raised a little; but even as it is, it appears to us that there are certain risks which all the companies ought to unite together and absolutely refuse to take. One of the most prominent of these is the coming down of flues from shortness of water. If the books of some companies which we could name were examined by our readers they would be surprised on finding how much is spent yearly for compensation for this class of accident in sums varying from £10 to £80. Nothing that the insurance companies can do will avert the burning of furnace crowns. They are absolutely at the mercy of every ignorant stoker who takes shovel in hand. Certain companies we believe absolutely refuse to pay claims for this class of accident unless it can be proved most conclusively that the furnace has not come down because the boiler was short of water. But others rest content with sending boilermakers and effecting the necessary repairs. This we venture to think is bad policy. It has really nothing to do with the inspection of boilers, and the companies have no right to inspect stokers or engine drivers. Why they should be made to pay for a loss which ought to fall on the steam users' pocket we cannot quite understand. It is, perhaps, too much to hope that anything will be done in this direction. The boiler insurance companies are too weak for the public. If they followed Mr. Fletcher's system they would get nothing to do. As it is they are willing to do too much. Competition for business among them is far too keen, and better results would be obtained all round, if, while retaining each its freedom in all respects save a very few, they united together on certain points and adopted a policy from which they would not depart. Thus, for example, it might be made a rule that compensation would not be paid for burned furnaces; and one or too other matters will readily suggest themselves to the experienced reader. Whether anything does or does not come of this suggestion, the fact will remain that the insurance companies are doing a good work just among that class of boilers which most needs looking after, and we would strongly impress on our readers that a very heavy responsibility, which may become disastrous at any moment, rests on every steam user who does not do all that lies in his power to facilitate the operations of the inspectors. These last have been found fault with by more than one of our correspondents. The steam users should give the inspector no chance of neglecting his duty. In all other matters when a man pays he expects to get full value for his money; but, as regards boiler inspection, we too often find that the very opposite practice exists. The insurer pays for inspection, and instead of getting as much of it as he can, he seems to be never so well pleased as when he gets none of that for which he has paid.

DIRECT-ACTING STEAM PUMPS.

THE words "direct-acting steam pumps" we intend just now to apply only to that form of water-raising apparatus in which pistons are dispensed with, and the steam presses directly on the surface of the water to be raised. This is a very old form of apparatus, but it has undergone several ingenious modifications of late years, and is competent to discharge useful and important functions. Various forms of the Pulsometer may be cited as the best known examples of this type of pump. But recently Mr. Kidd, of Wrexham, has succeeded in obtaining unanticipated results from the water lifter or steam pump which he has invented. As a rule inventors are so sanguine, that it is not often that others find their devices do all that has been promised concerning them; but Mr. Kidd's steam pump is an exception. In the first place he intended that it should always be worked by some agency external to itself; but to his great surprise he finds that it is automatic, and that when it works automatically it wastes a great deal of steam. All the facts concerning this apparatus are so interesting that it deserves more notice than we have yet given it. If our readers will turn to THE ENGINEER for April 21st, 1882, they will find the machine illustrated and described. Here we may say that it is a modification of Savery's engine, just as the Pulsometer is a modification of the same invention. Kidd's water lifter consists of a cylinder, at the bottom of which is a foot valve to a rising main. On the top of the cylinder is a chamber which contains two poppet valves—one opening inwards, and fitted with a spring; the other opening outwards, and actuated by a cam fixed on a small shaft. By turning this cam slowly the valve which it governs is raised and allowed to fall again. The apparatus is nearly immersed in water, and steam is admitted to the chamber on top of the vertical cylinder. It finds its way into this cylinder through the cam-worked valve, and expels the air. As the cam shaft rotates the valve drops and water rushes in to fill the vacuum made in the cylinder by the condensation of the steam. Then steam is admitted once more through the inlet valve, and the water is driven up the rising main, and so the action goes on. We have spoken of two valves in the steam chamber; one is the cam-worked valve, whose action we have just explained, the other is really a snifting valve, and it is not easy to see what its functions are, but the apparatus will not, it seems, work at all without it. When the apparatus has once been started, if left to itself the steam, after a stroke has been made, will blow to waste through the snifting valve until it has acquired sufficient velocity to lift the valve and close it. Then all the water will be expelled; but the moment this happens, and the steam tends to find its way into the rising main, condensation takes place as quick as lightning; the air valve opens and cold water rushes in by the action of gravity and fills the cylinder. Shortly afterwards the air valve closes, and a stroke is made as before described. We understand that when the cam shaft is driven, say by hand, about forty-five strokes per minute can be made; when the machine works automatically not more than half that number. Experiments made recently at Watford show that the delivered water is raised in temperature 2 deg

when the machine is worked by hand, while when it works automatically it is raised by from 8 deg. to 12 deg. This is a remarkable fact, but it is perhaps yet more remarkable that steam having a pressure above the atmosphere of but 8 lb. on the square inch will lift water with violence some 17ft., equivalent to a pressure of 7·478 lb. per square inch, to which must be added the resistance of a heavy foot valve. It seems to be evident that this excellent result is due to the momentum of the water. The Watford cylinder is 4·5ft. long and 14in. in diameter, and the lift at the beginning of a stroke is but 15ft., which augments probably to nearly 19ft. at the end. A sketch of the Watford apparatus will be found on page 441 of our last impression. It would seem, if we may make use of the phrase, as though the water was jerked out of the apparatus when the cam shaft is rotated. Why it should work automatically at all is very nearly as great a puzzle as was the working of the injector at first. Our explanation is that an action takes place between the steam and the snifting valve very similar to that which goes on in a hydraulic ram, and we may add in support of this view that the automatic working of the apparatus depends on the tension of the spring on the snifting valve.

The most important feature about the whole apparatus is the augmentation of temperature acquired by the water pumped. It is well known that the Pulsometer, although an extremely convenient, cheap, and handy apparatus for raising water, wastes a great deal of steam in raising it, because it augments the temperature of the water lifted very considerably—as much, we believe, as 8 deg. to 12 deg. We have not as yet personally tested Mr. Kidd's apparatus, but it appears that the results obtained at Watford were that 30,000 gallons of water were lifted per hour through an average height of 17ft., the temperature of the water being elevated 2 deg. It is very easy from that data to calculate the gross expenditure of steam. The pressure used seems to have been usually 40 lb. above the atmosphere, although as little as 8 lb. was used for experiment. The total pressure was therefore 55 lb., and each pound of steam in falling to 64 deg. could part with 1137 heat units. Assuming the temperature of the water pumped to be 62 deg. in the well, and 64 deg. on delivery, we have a rise of 2 deg., and $\frac{1137}{2} = 568$ in round numbers. That is to say, each single pound of steam of the stated pressure in being condensed would raise 568 lb. of water 2 deg. Now the total quantity pumped was 30,000 gallons, or 300,000 lb. per hour, and $\frac{300{,}000}{568} = 528$ lb. as the total weight of steam condensed per hour. The total work done was 300,000 lb. × 17ft. = 5,100,000 foot-pounds, and this divided by 60 and by 33,000 gives 2·57-horse power. Condensation being already provided for, it may be taken for granted that about 30 lb. of steam would, under the conditions, give out a horse power, and 30 × 2·57 = 77·10; the total quantity used per horse per hour, would be in round numbers, say, 605 lb. per hour, or say 235 lb. of steam per horse power per hour—indisputably an enormous consumption. It by no means follows as a consequence that the machine is to be condemned; on the contrary, it is evident that the apparatus has a very large sphere of usefulness, because, so far as we are aware, it is absolutely unrivalled in its simplicity and its power of dealing with very large volumes of sewage and such like. It could pump out a ship, for instance, even if the water pumped was charged with grain; but furthermore it must not be forgotten that the apparatus at Watford seems to have been worked under very wasteful conditions, the whole cylinder being submerged. We have, however, recently received a communication from Mr. Kidd, from which it appears that he has successfully used the apparatus when not submerged, but so that it had to raise water by suction.

We have said so much concerning this invention for two reasons. First, because the automatic action of the apparatus is in many respects curious, novel, and interesting; and secondly, because while there is a large field open for the use of steam pumps or water lifters of very simple form, but little has been done to occupy that field. We see no reason why the excessive waste of steam which has hitherto attended the use of apparatus like—let us say—the Pulsometer should not be very much reduced. It is well-known, for example, that water conducts heat downwards very slowly. If steam is admitted into a vessel containing cold water, whether much or little steam will be condensed is purely a question of detail. If the steam is permitted to rush down on the surface of the water, as in the Pulsometer and in Kidd's water lifter, the condensation will be great, as any one can ascertain for himself if he will turn steam even gently through a hose held in the hand on to the surface of the water in a bucket. There is, of course, no good reason why an analogous process should be carried on in the Pulsometer or any similar apparatus. When steam enters a chamber gently, so as to expel the water quietly though rapidly, condensation is caused almost wholly by the steam coming in contact with the iron of which the chamber is made, and the heavier and thicker that chamber the greater will be the condensation. Furthermore, the better conductor the metal is, and the higher its specific heat, the more efficient will it be as a condenser. Now, iron is perhaps the best material that it is possible to use to secure a large condensation and waste of steam. If economy is sought, then the vessels should be of lead, which is a bad conductor and has little specific heat. For example, let us say that the vessel is alternately heated and cooled through a range of temperature of 200 deg.; let us also assume that sufficient time is allowed to elapse between each stroke for the whole of the metal to pass through this range of temperature. Now, the specific heat of lead is ·0314, that of water being 1, while that of iron is about ·1200. These figures represent the respective loss caused by condensation proper to lead and cast iron. For every 314 lb. of steam condensed by the first-named metal, 1200 lb. will be condensed by the latter. In other words, the use of lead instead of cast iron would save about 70 per cent. of the steam now wasted. There should be no difficulty in constructing such an apparatus as Mr. Kidd's of thin welded steel cylinders, lined inside with lead or some good non-conductor. Up to the present moment the public have been well content to accept wasteful appliances, because the value of steam is as nothing compared with the value of simplicity; but we have no doubt that in a little time makers of water-lifting apparatus will see that they can secure economy without sacrificing simplicity, and they will find it well to do so.

A NARROW ESCAPE (?)

THE following "item" is to be found in the *Utica Herald* of May 20th. The title above is the title given by the *American Railroad Gazette* to this item. The note of interrogation is ours:—"An engineer on a Boston, Hoosac Tunnel and Western Railroad train on Thursday, by rare presence of mind, averted what would have been a terrible accident. Between Reynold station and Mechanicsville is a deep cut. On one side is a hill of clay and on the other a deep ditch. The train was just entering the cut when the engineer, Charles Siloway, of Mechanicsville, discovered that the hill was moving, and that in a moment it would be down upon the cars, causing great damage and probably loss of life. He knew he could not stop in time to avert the accident, so he grasped the throttle with a strong hand and pulled it wide open. The train sped with lightning-like rapidity, and it had barely cleared the cut when the earth fell with terrific force, covering the track 10ft. deep for a distance of 200ft. Had the earth struck the train it would without doubt have been hurled down the embankment and the loss of life must have been great." It is quite time this sort of thing was stopped. We have heard the same story with variations until it begins to cloy. In days long gone by it was a bridge: "The engineer grasped the throttle lever with his sinewy hand as he felt the bridge sink beneath his feet. Another moment and all would have been lost. With one despairing thought of his happy home far distant, of his wife, and innocent babes, he flung the throttle wide open One agonised moment, and the train leaped the chasm as the bridge thundered down the abyss, and he and his human freight in his charge were safe." Train stopped, subscription for engineer, &c. Sometimes we find the engineer's wife and family in the train. After a time the bridge idea began to get worked out, then came the hand car on the track, again "the engineer grasped the throttle lever" and so on. The hand car is dissipated in fragments. Now and then we find the hand car mixed up with cattle, or horses, or petroleum, but the foundation idea is always the same, namely, that by putting on full steam an obstacle can be overcome in a moment; that a train can jump across a river or demolish an obstruction, and so on. The theory is a delusion from beginning to end. In the first place the throttle valve is always wide open when the locomotive is working—that is if the engineer knows his business—and the valve gear is "linked up" to give expansion. In the second place, even if this were not the case, there can no more be a sudden acceleration of velocity from one speed to another than there can be a sudden starting of a train at full speed out of a station. If the velocity of a train could be suddenly altered from 30 miles an hour to 60 miles an hour, the effect on the passengers would be just the same as though the train they were in being at rest, another train running at 30 miles an hour had pitched into it behind. In fact, the throttle valve story is very pretty and sensational, but it has not the least foundation in truth, and ought to be banished from literature. There are plenty of opportunities open in other directions to the man who will seek for them. Carrying a cow about on a buffer beam is not bad and is nearly new. A double-tooth imbedded in the smoke box door, leading to the discovery of a suicide fifty miles further down the line, sounds pretty well. Then we want to hear again of the fight on the foot-plate, in which the virtuous stoker overcomes the drunken engine-driver. In fact to a man with sufficient ingenuity there are many chances still open. Some years ago the *Railroad Gazette* contained a very able story, "The Lost Palace Car." Nothing like it has ever appeared before or since. After it all other railway sensation "items" seem feeble. The "Lost Palace Car" did not pretend to be true. If our American friends like to publish sensational railway stories let them do so by all means, but it is hardly fair to themselves to put them forward as true. If they believe them, the fact redounds to their simplicity. If they do not, it gives rise to the unpleasant theory that they are wittingly mendacious.

THE PUMPING POWER OF COAL.

SOME time ago we referred in THE ENGINEER to experiments that had been made in the North of England with different qualities of coal to ascertain the pumping power of the various qualities. These experiments having been renewed, it may be of interest to give the results. The test is made by the Stockton and Middlesbrough Water Board, of course with the intention of determining the value of different classes of coal offered to it for the pumping of the water it draws from the river Tees near Darlington. Instead of naming the different kinds of coal, we shall indicate four by different letters of the alphabet, but the figures are exactly copied from the report to the Water Board. The return is as follows.

Coal.	Price per ton at railway junction. s. d.	Pounds coal per 1000 gals.	Cost per million gals. pumped. s. d.
A	6 0	3·90	10 5
B	6 4	4·61	12 4
C	5 5	4·72	11 4½
D	7 6	3·74	12 6

In all the four cases the test was the pumping of considerable quantities of water—from twenty-three million gallons to thirty-four million gallons—and every effort seems to have been made to make the test fair. The quantity of water pumped is given in each case, but the table above is complete without it. The difference in the cost of pumping, from 10s. 5d. to 12s. 6d., is one that is so remarkable as to induce the belief that it would be to the advantage of other water companies that have to pump their water supply if they would institute similar comparisons between the different classes of coal. The waterworks named are in a good position so far as the supply of fuel is concerned, for they are very near the edge of the northern coalfield, but if it is to their advantage to test the value of coal when they can have their supply as low as 5s. 5d. per ton, it must be much more to the advantage of some of the companies that are situated so far from the coalfields that their fuel costs them three or four times that sum. The comparison of the facts above given with those we presented a few months ago, will add to the value of both, and should the experiments be renewed from time to time, a mass of information may be accumulated that will be of the utmost value to those interested in the question of how to use fuel for this special purpose to the best advantage.

HENLEY WATERWORKS.

NEW works for the supply of water to the pretty little old town of Henley-on-Thames were opened, on Saturday last, with what seemed to be evidence of very considerable rejoicings. Henley is, however, to a great extent a holiday town, and probably a smaller event than the opening of the new water supply works would have afforded sufficient reason for a little escape from business on a fine day. The works were opened by Mr. W. H. Smith, M.P., who with the county members and a large number of engineers and capitalists interested in waterworks, were invited by the Waterworks Company, or by Mr. Jabez-Church, M.I.C.E., the engineer, or by Messrs. the Atkins Water Softening and Purifying Company, by whom the arrangements and apparatus were made for carrying on the Clarke's water softening process by Atkins' continuous method and filters, the water being derived from a well sunk in the chalk. The water is about 19½ deg. of hardness before treatment and about 15 deg. less than this after treatment. The Henley works are the first of a public character at which this process has by these means been carried out, and considerable interest attaches to it, as there are many towns whereat it is very desirable that the water should be softened. At Henley the Thames water was available, and we do not know why resort to a well should have been deemed desirable, especially as every town and village up the river is under orders to keep sewage out of the river. As, however, water could be obtained from a well at only a few feet from the surface, it was almost as easy to pump from this to the reservoir as from the river. The reservoir is some distance from the works, which are compact, and are designed with a view to supply the whole town. At present there seems considerable reluctance to pay for a water supply, instead of obtaining it by the household pump, which at present obtains in every house in Henley; but the purer and softer water which will be supplied by the company will no doubt gain in favour, though a few years will be required to displace the pumps. We will not describe the works here, as we shall probably refer to them in detail on another occasion. At the lunch which followed the opening ceremony, the occasion was made the opportunity for a number of speeches of a political character, which, in some respects, were to be expected; but a few words about the water supply would not have been inappropriate. Of course the engineer said something about it when his turn came, but this was not until the political speakers had filled up all the time available, and had gone, or were going, for the train.

THE WATER SUPPLY OF ALEXANDRIA.

ALEXANDRIA has been threatened with a water famine. Its supply is drawn from the Mahmoudie Canal, which communicates with the Nile at Atfeh. Into this canal runs also the Khatatbeh Canal, which at one time drew its supply from the Raid Canal, but now gets its water from large pumps erected last year by Messrs. Easton and Anderson, Erith Ironworks, Kent. These pumps are fixed at Khatatbeh. There are ten of Airy and Anderson's patent screw pumps, each 12ft. diameter, and capable of delivering 144 tons of water per minute to a height of 10ft. 6in. Eight pumps are worked together, delivering 1152 tons per minute. They are driven by two pairs of compound inverted direct-acting engines of the marine type, running at 75 revolutions per minute under 65 lb. steam. There is also one reserve engine. The pumps have been working regularly since the middle of April, and were stopped about the 18th inst. in consequence of the danger to the staff employed about them. The pumps were made for the Behera Irrigation Company, for which Messrs. Easton and Co., of London and Cairo, were consulting engineers. The works were under the immediate charge of Mr. H. C. Anderson, at Cairo. On the 12th of June, a 24 hours' run gave the extraordinarily high duty of 1-horse power of water lifted 3·25 metres per hour for 3·05 lb. of Welsh coal which had deteriorated considerably from long exposure to a tropical sun. The duty has ranged between 78 and 85 per cent., that is, the ratio between the work done in lifting water and the indicated horse-power. We understand that a guard has been sent out to protect Atfeh. If the works there are stopped, Alexandria will be without water, but this is not now feared.

THE STAFFORDSHIRE STEEL-MAKING EXPERIMENTS.

MR. P. C. GILCHRIST, and the Committee of Staffordshire ironmasters with whom he is associated in the conducting of experiments at Wednesbury, which aim at the making of basic Bessemer steel from Staffordshire cinder pigs, have brought their labours to a close. One hundred tons of pigs probably have been blown, and perhaps seventy tons of ingots made. Middlesbrough pigs are computed to contain about 1½ per cent. of phosphorus. The phosphorus in the Staffordshire pigs, which have been most largely used, is about 3 per cent. With such pigs the results were obtained which were last week described in THE ENGINEER. Since that time pigs in which the quantity of phosphorus is estimated at as high as 4½ per cent. have been blown. These, treated by Mr. Gilchrist with an extra proportion of lime, have made slabs and billets deemed by that inventor to be in no way inferior to those resulting from the use of pigs with 3 per cent. of phosphorus. Arrangements have been made for completely testing all the slabs and billets. Eighteen firms are now receiving lots of from two or three to five tons apiece. Treated in the ordinary iron mill, these slabs will be rolled out as if they were piles made of puddled iron or scrap, and the sheet or strip, or what-not, will be experimented with by the stampers, the tin-plate makers, the tube makers, and the rest. Upon the reports of the testing firms will largely depend the adoption of the basic Bessemer process in districts where common pigs are abundant but high qualities of hematite pigs scarce.

LITERATURE.

A Treatise on Rivers and Canals: Relating to the Control and Improvement of Rivers, and the Design, Construction, and Development of Canals. By LEVESON F. VERNON-HARCOURT, M.A., M.I.C.E. Text and Plates. Clarendon Press Series. Oxford, at the Clarendon Press. 1882.

THE author of this work is well known as one of the few engineers who have paid special attention to the difficult problems involved in the hydraulics of rivers, estuaries, harbours, and canals, and his book, though not voluminous, contains a great deal of information on river and canal engineering generally, and particularly on those points which present themselves as amongst the difficulties in practical river and canal operations. The first volume contains eighteen chapters, illustrated by twenty woodcuts, and by the twenty-one plates which constitutes the second volume. Elementary hydrodynamics occupy very little space, the author's intention being apparently to describe the works of hydraulic engineering and their results, supposing a knowledge of theoretic hydraulics to be possessed by the reader, though, of course, some reference to the principles on which these works were based is involved in the discussions, though they are brief, of the questions

referred to above. Premising then that the book was not intended to be an elementary treatise on its subjects, it may be admitted that it is a valuable addition to its literature, but at the same time it must be remarked that some of the works described and discussed as examples are extremely briefly treated. The book seems to have originated in a course of lectures delivered at the Chatham School of Military Engineering, and it is, perhaps, as complete as books having their origin in lectures generally are. Its contents may be indicated by giving the titles of the chapters. Chapter I. is entitled "Physical Characteristics;" II., "Measurement of Discharge;" III., "Rivers and Canals;" IV., "Dredging Machines and Appliances;" V., "Fascine Work, Piles and Cofferdams;" VI., "Foundations;" VII. and VIII., "Works for affording a Passage from one Level to another;" IX., "Weirs;" X., "Various Works on Rivers and Canals;" XI., "History of Inland Canals;" XII., "Ship Canals;" XIII., "Floods of Rivers and the means of Mitigating their Effects;" XIV., XV., XVI., and XVII., "Improvements of Tidal Rivers;" XVIII., "Improvement of the Mouths of Tideless Rivers." In Chapter I. the variations of rainfall, evaporation, and percolation, effects of forests and permeable and impermeable strata on discharge and floods, available rainfall and divergence of currents are briefly treated. In the latter part the statement is made that "a very slight impediment, such as a fallen tree or harder ground at one bank, will direct the main current against the opposite bank, which if composed of soft materials is gradually washed away, so that the course of the river is by degrees altered." This statement is true in effect, but it is not an accurate statement, as harder ground on one bank does not necessarily deflect a current, but the current will wear away the softer bank fastest, and so the form of the channel and the direction of the current are thus altered. In the second chapter the methods and apparatus for the measurement of the mean velocity, and thereby discharge, are described, and the relative values of the different forms of floats and current meters are briefly but clearly defined. In the third chapter the variable flow of rivers, and the necessary observations of the rise and fall and form of channel, which must be studied before commencing any improvement works, are dwelt upon, as well as some of the works which may be carried out with certain views. In the next chapter different forms of dredgers are very briefly treated, the brevity not being compensated for by the number and clearness of the illustration, as nothing is given as to the cost and quantity of work which the different machines and apparatus will do under different conditions. In the next chapter various forms of foundations are described, and in the seventh various forms of lock-gates and caissons are described and discussed with reference to strains, strength, and economy. In the eighth chapter various methods of raising barges up inclines on trucks, and by means of lifts such as the Anderton canal lift, described in THE ENGINEER of the 21st of August, 1880, are described. Weirs of various form as well as their relative values under different applications are described, and in the tenth chapter various forms of dams and swing lift, bascule, and traversing bridges are also briefly described, most of the information concerning them being obtainable from the illustrations; many of the great continental dams, such as that of the Furens reservoir, receiving equally brief treatment, although these are amongst the most instructive examples of work of this kind. A footnote refers the reader to the Annales des Ponts et Chaussées for more information on the subject, but we may refer them for an account of this and other continental dams to THE ENGINEER of the 13th of August, 1867, p. 312. We may also refer to the account of the design and proportions of the Settons reservoir in THE ENGINEER, 13th August, 1875, pp. 107-110. In the twelfth chapter the greatest canal works of the world are briefly described, comments and hints running in an easily assimilated manner with the descriptions which include the latest works. In chapters thirteen to eighteen there is a great deal of information comprising the results of extended experience compressed into a comparatively small space, but the author's style of writing is clear and always to the point, so that the reader is often surprised at the number of hints gathered from a single page. A large part of the descriptive matter is compiled from the "Proceedings of the Institution of Civil Engineers," and the "Annales des Ponts et Chaussées," and the references to the originals are very numerous, so that the reader who requires special information will find Mr. Vernon Harcourt's book valuable as a reference guide, and this is assisted by the large number of illustrations. The book is well got up, and may be recommended to all interested in its subjects.

The Coal and Iron Industries of the United Kingdom. By RICHARD MEADE, Assistant-Keeper of the Mining Records. London: Crosby Lockwood and Co. 1882.

THIS is one of those books that other writers make books from. It contains texts and the facts and figures for the subject matter of a library on mining and manufacturing industries, progress, and wealth. To review it would be much like reviewing a dictionary of the English language by a well accredited authority, for Mr. Meade is a painstaking, careful author on subjects the facts and figures on which he has in his keeping. We must content ourselves, therefore by merely saying what the book contains, and this is almost given in the secondary part of the title, namely, "a description of the coal-fields, and of the principal seams of coal, with returns of their produce and its distribution and analyses of special varieties; also an account of the occurrence of iron ores in veins or seams; analyses of each variety; and a history of the rise and progress of pig iron manufacture since the year 1740, exhibiting the economics introduced in the blast furnaces for its production and improvement." The book is illustrated by maps of the coal-fields and ironstone deposits of the United Kingdom. We might make numerous extracts of great statistical interest, but once to begin this would be to force upon ourselves the difficulty of knowing when to stop. Amongst the deductions from the figures it is satisfactory to note that the conclusion is warranted that at the present rate of production and increase there is coal enough left at a workable depth to last over 900 years. We must not, however, extract, but refer our readers to the book, which is one which must find a place on the shelves of all interested in coal and iron production, and in the iron, steel, and other metallurgical industries.

ELECTRICAL ACCUMULATORS OR SECONDARY BATTERIES.

BY PROFESSOR OLIVER J. LODGE, D.Sc.

NO. IV.

So far we have investigated the amount of chemical action in a Faure cell, when a given current is passed through it; but though this is important it is by no means all that we want to know, for the same chemical action exactly will go on in every cell through which the same current is driven, and the chemical work which a given current can do is, therefore, essentially unlimited. But, of course, the more cells we have in series, the more driving power—or electromotive force—do we require to send the current through them; and the chemical work that can be done by a given current generator is determined, therefore, by its available electromotive force and current strength conjointly. In this respect chemical work is precisely in the condition of every other form of work, and, in fact, it cannot be otherwise.

Consider now, as our source of current, a dynamo-machine driven with the horse-power P. Of this power some is wasted in friction and in churning the air; another portion is spent in warming the exciting magnets and armature, while the remainder, which we will call p, is available for maintaining the current through the external circuit. What fraction p is of P depends upon the perfection of the dynamo, and indeed the ratio $\frac{p}{P}$ may be called its efficiency. We may perhaps surmise that a probable value for this ratio is as much as $\frac{3}{4}$, but it is not likely to be more. To measure p we have only to measure the electromotive force in volts between the terminals of the dynamo and the currents in Ampères which it is at the same time producing in the whole outer circuit, multiply the two together and divide by 746. We will, therefore, take p as a known quantity.

Now take N Faure cells and arrange them, n in series and m abreast, so that they are equivalent to n cells, each m times the size of a single one. Of course $m\,n = N$. Let the resistance of each cell with its connecting wire be r ohms—the resistance of the leading cables need hardly be taken into account if they are thick enough to keep cool—then the resistance of the combination of cells is $\frac{n\,r}{m}$ ohms.

To drive a current of C Ampères through this resistance would require an electromotive force $\frac{n\,r}{m}$ C volts, which we may write $n\,r\,c$, if we put c for the current passing through each of the m series of cells. But this electromotive force is not enough to maintain the current for more than an instant; for directly the cells begin to charge they each exert an opposition force e, which must be overcome. This opposition e may or may not vary during charging, but it probably does not vary very much after the first hour or so, and it may be considered as not far off $2\frac{1}{2}$ volts. It can be measured by connecting an electrometer to the terminals of a charged cell momentarily disconnected from the charging circuit. No time must be lost in taking this measure, or its value will diminish, and if the cell is short-circuited it falls off rapidly—probably because of the consumption of the hydrogen alloyed with the lead. It is its maximum value which is active in opposing the charging current, and this it is which we agree to call e in volts. The whole set of cells will offer an opposition force $n\,e$ volts.

If the cells are not uniform we must determine the *average* values of e and r, but there is every possible reason for turning out the cells from the manufactory as uniform as they can possibly be made, and afterward keeping them uniform by subjecting them to precisely similar treatment. Hence the practice of replenishing the power of a working battery by occasionally adding an instalment of fresh cells is not to be approved on a large scale, unless it is carried on with regularity, a fresh one being put on at one end and a comparatively worn-out one simultaneously taken off at the other by some automatic time-keeper.

It is well known in ordinary voltaic batteries that if any of the cells are different from the others in any way, we get all the disadvantages which such difference may cause, and scarcely any of the advantages; in other words, one extra good cell in a series of poor ones is lost, and its effect swamped; while a single bad one among good ones chokes the lot. It is only like the links of a chain after all. Any difference—whether in size, or weight of lead, or closeness of plates, or time of charging, or of standing, or of discharging, or any temporary short circuiting of one cell more than of others—if it can produce harm it will, but if it tries to do good it can't. Hence every difference should be avoided.

Well, we were going to write down the E M F necessary to force the current C through each of the m series into which we have supposed our cells to be arranged while charging, and it is

$$E = n\,e + n\,r\,c$$

the first term overcomes the opposition electromotive forces, the second drives the current against the given resistance.

The whole energy expended per second is proportional to E and to the whole strength of current C, or $m\,c$, and is

$$E\,C = m\,n\,e\,c + m\,n\,r\,c^2$$

The first term represents the useful work done, or the energy expended in overcoming chemical affinities, and in storing the current; or at least it represents this on the hypothesis that all the chemical substances decomposed assist the storage by being ready to recombine and drive the current back again whenever called upon to do so, and not before. If the cells are allowed to evolve gas while charging, or to stand a long time after charging, these conditions are not fulfilled, and some of the $m\,n\,e\,c$ is lost. Hence in saying that $m\,n\,e\,c$ represents the useful work, one means that it does so under the most favourable circumstances, or that it represents its maximum value.

The second term $m\,n\,r\,c^2$ is certainly all wasted and goes to warm the cells. The proportion between the waste and the useful is therefore $\frac{r\,c}{e}$; and this shows the great desirability of keeping the charging current c weak, as well as for having the cells large and of low resistance. The horse-power available as current we have supposed to be p, and $p = \frac{E\,C}{746}$; hence we may write the foregoing equation thus (remembering that $m\,n = N$):—

$$N\,c = \frac{746\,p}{e + r\,c}.$$

This represents the total amount of chemical action going on in all the cells put together, for the current c is passing through each, and chemical action proportional to c is going on in each, therefore the total chemical action is $N\,c$. Looking at what $N\,c$ is equal to, we observe that p is fixed and e is beyond our control; so again we perceive that the only way of getting the most effect at the least cost is to keep $r\,c$ small. Now the resistance of a large Faure cell and connections need not exceed, I suppose, ·002 of an ohm, and the charging current sent through it may be kept as low as 4 or 5 Ampères if desired; hence, as the value of e is 2·5 about, it is quite possible to make $r\,c$ almost wholly negligible compared with e. We shall thus get out of the given horse-power the greatest amount of chemical action per second that we possibly can, viz.:—

$$N\,c = 746\,\frac{p}{e}$$

$$= 300\,p \text{ say.}$$

The equations of last week, expressing the amount of total decomposition on both sides of a Faure cell when a given current is passed through it, may be now modified to express the decomposition produced in a whole set of similar cells arranged economically and subjected to the utilised horse-power p for T hours, by simply writing in those equations $300\,p\,T$ instead of C T.

As far as here appears, the number of cells does not signify, for if more cells are used, less will be done in each, and conversely. But we have just seen how important it is to keep c small, that is, to charge with a very low strength of current; hence the more cells charged at once the better. It seems difficult to use too many. The limit in series is reached when $n\,e$ is nearly equal to the highest possible electromotive force of the shunt dynamo—that is, the number n must not exceed two-fifths of the maximum electromotive force available, expressed in volts. But it may be nearly as great as this with advantage. There seems no limit to m, the number of cells that may be joined up in multiple arc, and apparently the more the better. But the "lead" wires and the armature of the dynamo must be of very low resistance, or they will get heated if m is very large, even though c, the current through each set of cells, is small. Edison's bar armatures seem just the thing therefore, or some of those machines which are made for electro-plating purposes. The wire on the field magnets should be very long, so as to magnetise them strongly without shunting off too strong a current, even though it is driven with the highest available electromotive force.

The highest available electromotive force is the difference of potential between the terminals of the shunt dynamo when they are disconnected from the external circuit, so that the whole of the current produced in the armature passes through the field magnets. There must be some connection between the resistance of the wire on the field magnets, and on the armature, and the number of cells which will give the most economical result, though it is not a relation that is obvious to common sense; but it can no doubt be worked out if we set to it, and I will try next week. Meanwhile let us put in a convenient practical form part of the result of this week's article, viz., that if the best arrangement is adopted in every way, no waste being allowed, and no secondary or useless chemical action permitted, the total amount of any substance of "atomic weight" w and atomicity k that can be decomposed or liberated, as the case may be, by p horse-power utilised as current in any number of cells, each of maximum electromotive force e, is

$$\frac{746\,p}{e} \cdot \frac{w}{12000\,k} \text{ pounds per hour.}$$

which becomes for Faure cells, whose e is $2\frac{1}{2}$ volts

$$\frac{p}{40} \cdot \frac{w}{k} \text{ pounds per hour.}$$

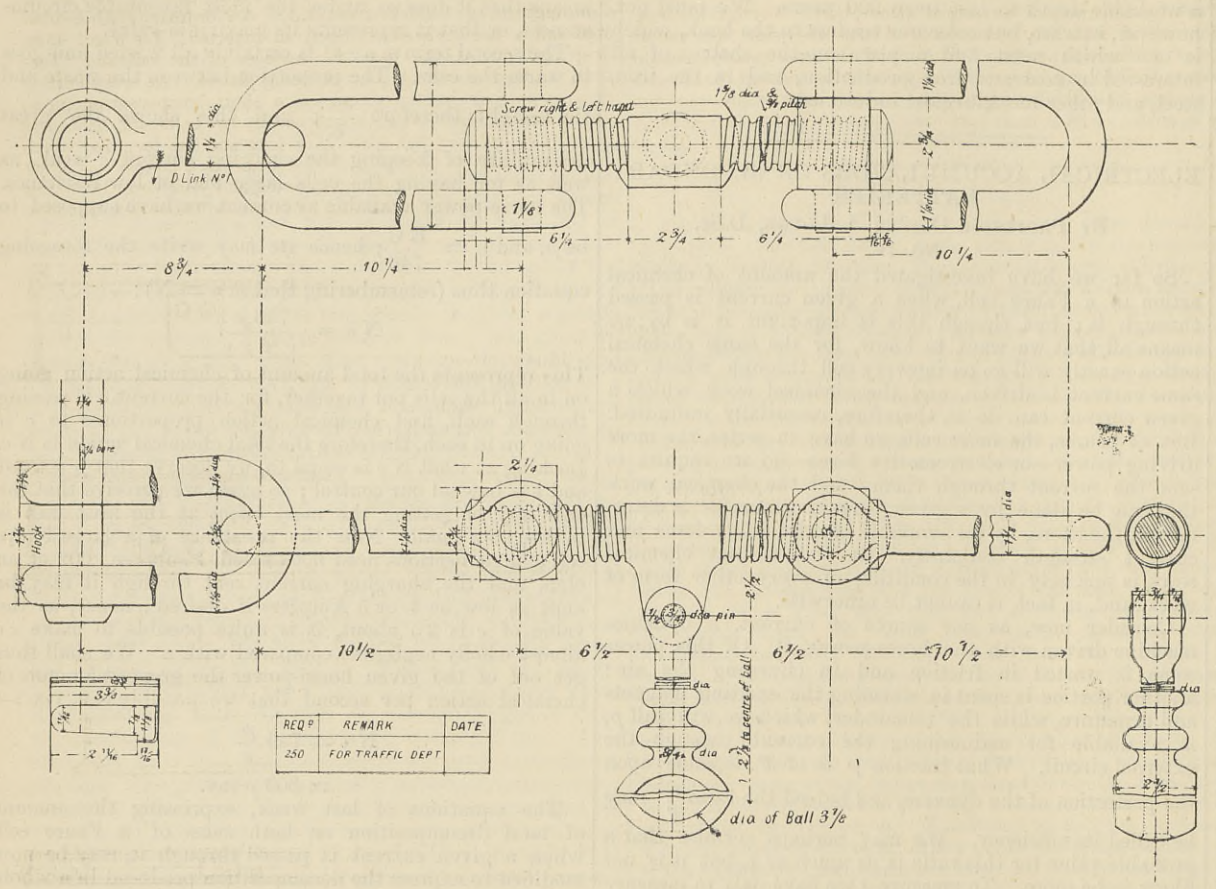
For instance, 2·8 p pounds of litharge can be peroxidised, and also reduced, per hour, by the horse-power p applied to this purpose and to nothing else. Of minium the amounts are 2·1 p reduced, and 4·2 p peroxidised; that is, 6·3 p pounds of minium may be acted on altogether under the most favourable circumstances. Thus, if 5-horse power are utilised as current, 31·5 lb. may be acted on in an hour, or a ton in 71 hours. To form 120 cells, each containing 28 lb. of minium properly distributed between the two plates, cannot take less than T hours, where $6{\cdot}3\,p\,T = 28 \times 120$; which for $p = 5$ gives $T = 106$. But if the cells contain 14 lb. of minium on each plate they will take longer, viz., at the very least $\frac{800}{p}$ hours.

Liverpool. O. J. L.

ELECTRIC RAILWAY.—An electric railway has been opened between Amsterdam and a park near that city. Messrs. Siemens and Halske are the engineers.

LAUNCH AT BARROW.—On Saturday a new steamer was launched from the yard of Messrs. Caird and Purdie, Barrow, of the following dimensions:—Length, 245ft.; breadth, 34ft.; depth of hold, 17ft.; gross tonnage, 1500 tons. The new vessel, which has been built to the order of Mr. Ware, of Cardiff, was named the Countess Evelyne, and is intended for the general cargo trade.

SCREW COUPLINGS, GREAT INDIAN PENINSULA RAILWAY.



CONTRACTS OPEN.

SCREW COUPLINGS, GREAT INDIAN PENINSULA RAILWAY.

THE Great Indian Peninsula Railway Company asks for tenders for railway couplings, as per accompanying engraving. The couplings must be made of the best quality of materials and workmanship, and in accordance with the drawings, which may be seen at the office of Mr. George Berkley, the consulting engineer, 57, Charing-cross, and the contract must be completely executed to his satisfaction. They are to be made of the best quality of tough Yorkshire cable iron, to be obtained from one of the following makers, viz.:—Lowmoor, Bowling, S. T. Cooper, Taylor Bros., Monkbridge, or Farnley, which must be capable of bearing the following tests, viz.:—Samples, selected promiscuously from the bulk by the inspector, must be capable of bearing at least 12 tons per square inch without permanent set, and 23 tons per square inch before fracture. It must also stretch at least 2½in. in an original length of 12in. before fracture. Pieces bent when cold and when heated to a dull red heat must be capable of bending double without fracture. All fractures must show the iron to be the best tough fibrous quality. Two complete couplings of each kind, taken promiscuously from the bulk, must be tested to destruction, as will be directed by the consulting engineer. The testing and all incidental expenses connected therewith will have to be defrayed by the contractor. The screws must be turned with a right-hand semicircular thread at one end, and a left-hand one at the other, and the nuts must be cut to fit them. The pins and gudgeons of the nuts must be turned and the eyes drilled. Great care must be taken to insure all the welds being sound. The iron must be plainly stamped with the maker's name at both ends of each bar, and the contractor must, if required, show the consulting engineer or his representative the invoice for it. The links, &c., must be stamped with the initials G. I. P. R., and the trade-mark or initials of the works or owner of the works where they are forged. The whole of the chains excepting the turned parts must be painted with two coats of black varnish, the first coat being put on hot. If any of the work shall, within thirty days after coming into the possession of the company's storekeeper at Bombay, be found defective, the company, on the certificate in writing to their agent in India by their locomotive superintendent there that such defect arises from inferiority of material or workmanship, or from imperfect protection or other fault on the contractor's part, are to be at liberty to remedy the defect, and the contractor shall pay to the company such an amount as the consulting engineer shall certify to be the fair cost of the work which, in his opinion, has arisen from the default of the contractor, notwithstanding any superintendence, inspection, approval, or certificate previously given in England, or any advance made by the company to the contractor as herein provided on account thereof.

The screws must be covered with white lead and tallow, and be protected by matting and bound round with wire.

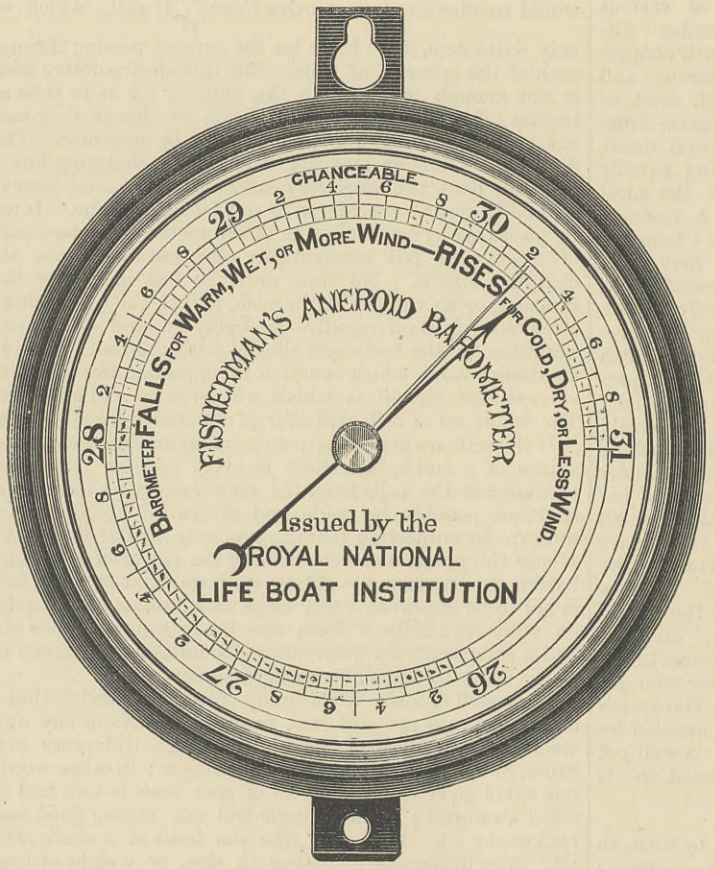
Tenders, addressed to Mr. Thos. R. Watt, must be sent in to 3, New Broad-street, E.C., before twelve noon on the 30th inst.

THE FISHERMAN'S ANEROID BAROMETER.

IT is now more than twenty years since the National Lifeboat Institution undertook to supply first-class barometers to its lifeboat stations and to some other places. The result has been most encouraging in every way :—First, the coast population of those places have numerously watched the indications of the barometers with the aid of the daily registered chart usually attached to them ; and secondly, they have come to the determination at most places to be guided in their business movements by the indications of the barometers. By means of these barometers and their timely warnings the National Lifeboat Institution has no doubt contributed to the saving of the lives of a large number of fishermen. The Institution has now taken another important step in this matter by offering to supply an aneroid barometer to owners or masters of fishing vessels at a small cost, which, considering that it is of a superior and trustworthy character, must make this useful instrument a welcome addition to every decked fishing boats' equipment.

The value of the weather warnings of an aneroid or a mercurial barometer cannot be disputed. Mr. Birkbeck, M.P., in suggesting that the Institution might take this step, stated that it had come to his knowledge that during the fearful gales of last winter, when so many fishing vessels were lost, those of them which had aneroids on board were, by observing previously their indications, saved from peril, while many which did not possess them were lost, involving the loss of scores of valuable lives. It will thus be seen what beneficial results are likely to accrue to life and property if this fresh important step of the Institution is appreciated and encouraged by the owners of fishing vessels. At present it is notorious that small fishing craft hardly ever carry with them an aneroid, and thus when in mid ocean they are without the most hopeful means of forecasting the disasters which so often overtake them when gales of wind suddenly spring up. It may be mentioned that the National Lifeboat Institution has spared no effort to obtain a good instrument, and one that will not easily get out of order on board fishing smacks, or require repairing at frequent intervals. In short, if taken ordinary care of, one of these aneroids may confidently be expected to do its work for many years.

We illustrate below the fisherman's aneroid barometer as issued by the National Lifeboat Institution, and made by Messrs. Negretti and Zambra. Its dial or face, which is enamelled, is five inches in diameter, being half an inch larger than the ordinary



full-sized aneroid ; and the case is bronzed to prevent corrosion. It is made with loops to fix it firmly in its place ; the glass covering the dial is ¼in. in thickness, so that it will not easily be broken. The dial reads from 26in. to 30in., and is very clearly divided to the one-twentieth of an inch. The vacuum chamber is composed of corrugated German silver, which is much more durable than brass, and is 3in. in diameter. The chain connecting the gear with the hands is made of fine steel.

THE NIEDERBAUM SWING BRIDGE AT HAMBURGH.

No. I.

OUR able contemporary, *Zeitschrift des Vereines Deutscher Ingenieure*, is publishing a series of articles descriptive of a new swing bridge of considerable dimensions, worked by hydraulic power. This bridge will be found well worth the attention of engineers in this country, and we propose in this and succeeding articles to give such particulars concerning it, condensed from the pages of our contemporary, as will make its construction clear to our readers.

This bridge was rendered necessary in order to accommodate the large and increasing traffic between the railway stations and the quays—traffic which was previously carried through narrow and winding streets, and by a circuitous route round the Binnerhafen or inner harbour. To effect the improvement it was needful to pass a bridge across the narrow entrance connecting the inner with the outer harbour. This must of course be an opening bridge of some kind ; and as, in the case of such large traffic, the time occupied in opening and closing became of importance, it was resolved to adopt hydraulic mechanism. But the space available was too contracted to allow of the installation of a steam engine, with or without accumulators, on the common

FIG. 1

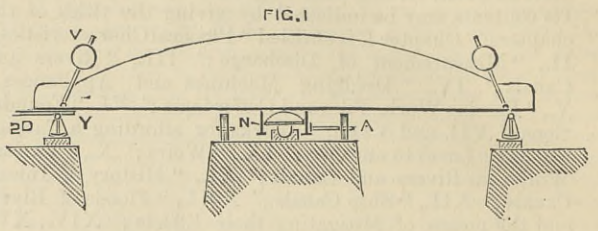


FIG. 2

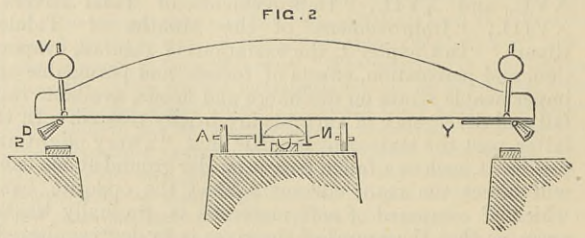
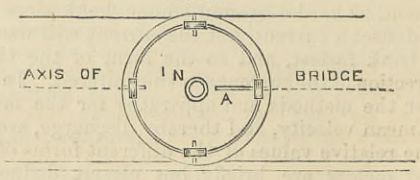


FIG. 3



English system, and the only resource was the water in the street mains, which had there a pressure of about 40 lb. per square inch. Under these conditions the bridge was begun in 1878 and completed in 1880. It consists of two fixed spans each of 22·1 metres, and of a two-leaved swing bridge in the centre, each leaf having a clear span of 13·5 metres, and the total length being 36 metres. The breadth of the roadway is 6·3 metres, the width from centre to centre of main girders 7·27 metres, and on either side, supported on brackets, is a footway having a width of 18m. The roadway consists of asphalte laid on concrete, and carried on buckled plates, and the footways are of the same material. All three spans have main girders of parabolic form, 1·7 metres apart. The construction was rendered difficult by two facts, one that the depth available for the girders did not exceed 7 metres, and the other that the bridge was designed to be subsequently available for a line of railway worked by heavy goods engines.

With regard to the opening arrangements, it was preferred that the bridge must be opened and closed by swinging through an arc of 180 deg. in the same direction, instead of through an arc of 90 deg. and back again, as usual. By choosing the proper moment, the bridge can then always be opened just in front of an advancing vessel and closed just behind it, so that there is a considerable saving of time. In addition to this, the following conditions were laid down in the specification :—(1) The bridge must be workable by hand as well as hydraulic power. (2) The hydraulic power is to be regularly used, but the hand-power must be readily and quickly applicable in case of any accident to the former. (3) The whole of the mechanism must be placed on the piers, either of the fixed or moving spans, and must not project under the main girders, except for a small distance just at the end. (4) A system which would turn the bridge continuously through 180 deg.—as described above—would be preferred. (5) When the bridge is closed the two ends must be supported at the same level, and the distribution of the weight may be taken at about 186 tons on the central pier, and about 56 on each of the side piers. The latter might, however, be diminished, if found convenient. (6) The turning must be as easy and rapid as possible, and must be actuated from one point only for the hydraulic gear, and not more than two for the hand gear. The speed at the ends of the bridge is not, however, to exceed 7 metres per second. (7) The consumption of water is unimportant as compared with rapid motion. The contractor had to state the time which his bridge would take to open, both by hydraulic gear and by hand gear worked by two men, and severe penalties, after the usual German plan, were annexed in case of failure. This, or some other cause, seems to have had an unfavourable effect on the competition, for only one satisfactory tender was sent in, that of Herr Volthering, of Sudenburg, Magdeburg. His design, which went beyond the specification in providing that the bridge could be made to turn in either direction, was accepted with some modifications, both for the bridge itself and for the turning gear. The latter only, as shown in the illustrations, will be treated of here.

The general principle is as follows :—When closed the bridge rests in the middle on the central pivot N—Fig. 1 above—and at the ends are two "pendulum" bearings D_2. In this condition its total weight loaded is 607 tons, unloaded 299 tons. The load on each of the end bearings is 50 or 28 tons, leaving 407 or 187 tons respectively on the pivot. To open the bridge the ends are raised about 5 mm. by means of the four lever arrangements V, the bearings d_2 are swung down, and the bolts y withdrawn. The ends are then depressed again by the levers, until the bridge bears on the pivot and on the four wheels A—Fig. 2 above. These wheels are fixed to the bridge, and roll on a circular roller path upon the centre pier—Fig. 3 above. Only one of them, A—Fig. 3—has solid bearings, those of the others being carried on springs. When the bridge has made its semi-revolution, the bolt is shot, the ends raised by the levers, and the pendulum bearings swung up again. The ends are then lowered again until they rest on the bearings, and the bridge is again fit for traffic. It will be seen that we have here several highly novel conditions involving some ingenious engineering work, and well worth notice.

THE RAINBAND SPECTROSCOPE.

IN the earlier days of the spectroscope, at the time of the drawing of Angström's maps of the lines of the solar spectrum, it was discovered that certain variable bands were sometimes present, and further research proved some of these not to be inherently due to the light of the sun, but to the amount of excess of vapour of water in the atmosphere of the earth. Professor Piazzi Smith noticed the rainband to be a special feature in the spectrum at Palermo before and after a sirocco in 1872. Next, in July, 1875, he noticed that the rainband in the spectrum presaged disastrous floods, although the barometer was high. Thenceforth he gave further attention to the subject, publishing the results in "The Edinburgh Astronomical Observations," the Scottish Meteorological Society's *Journal*, N. S., and in *Nature*. More recently, Mr. J. Rand Capron, F.R.A.S., has published information and experiments on the subject in *Symon's Monthly Meteorological Magazine*. The spectroscope has a special advantage over the barometer in this matter, because the barometer does not indicate the amount of surplus moisture in the air, and the rainband in the spectroscope does it directly.

The actual discoverer of the true nature of the rainband was Janssen, the French physicist, who in 1864-66 tried various experiments, the first series of which, made upon a high mountain, proved to him that the variable bands of the spectrum were due to the atmosphere of the earth. In his 1866 experiments he employed a tube 118ft. long, the property of the Gas Company of Paris, and filled it with steam, means being also adopted to prevent the steam from condensing into visible form. The ends of the tube were closed with strong pieces of plate glass. When he then spectroscopically examined a brilliant gas flame through his long cylinder of vapour of water, the rainband was found to have been thus artificially produced in the orange part of the spectrum. Janssen next, by means of an ordinary spectroscope of five prisms, resolved the rainband into a series of lines, which he mapped.

The rainband spectroscope is an instrument which has recently been specially constructed by Mr. John Browning, the optician, for the purpose of affording indications whether rain is likely to fall within the next four or five hours, the whole apparatus being also sufficiently portable to be carried in the pocket. It is all contained in a little cylindrical leather case between 4in. and 5in. in length. The principle on which the indications of the instrument depend is, that when the air is laden with invisible vapour of water, in that condition in which it is on the point of turning into rain, various darkened bands appear in the spectrum, one of them stretching towards the red end of the spectrum from the double line D in the yellow of the solar spectrum being specially prominent. In fact, in using the pocket instrument, this band is all the observer looks for.

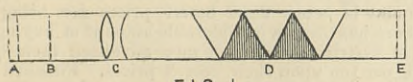


FIG. 1.

Fig. 1 shows the principle of the instrument. In this cut, A is a piece of plane glass to keep the dirt out of the tube A E. The slit of the spectroscope is in the position denoted by the dotted line B. An achromatic lens is placed at C. D is the compound prism of a direct-vision spectroscope, consisting of two prisms of flint glass denoted by shading, and three of crown glass which are unshaded in the diagram; these five prisms are cemented together with Canada balsam. E is a piece of plane glass as the eye-piece end of the spectroscope.

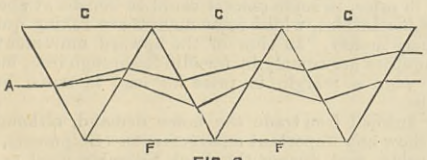


FIG 2

The principle of the direct-vision compound prism, by the use of which the awkward angular form of many spectroscopes is avoided, and all the optical apparatus permitted to be placed in a straight tube, is illustrated in Fig. 2. The ray of white light A enters the first prism C, and is deflected and decomposed into its constituent colours or wave-lengths; the first flint glass prism F disperses it still more. On passing from a dense medium to the less dense crown glass prism which follows, the dispersion of the ray is reduced, but again increased by the second flint glass prism. By the last crown glass prism the dispersion is somewhat reduced, but the light escapes from the outer surface in the axial direction of the compound prism.

Mr. Browning's instrument has two adjustments, one of a telescopic nature to obtain the focus; the other is made by turning the milled rim of a brass disc, whereby the width of the slit of the rainband spectroscope is varied. Fig. 3 shows the solar spectrum, with some of the finer lines omitted, as seen

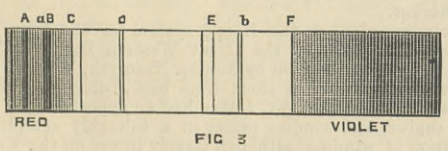


FIG 3

when the spectroscope is directed to a pure bright sky. The double line D in the yellow part of the spectrum is always specially prominent, and is due to vapour of sodium in the atmosphere of the sun. Fig. 3 contains no rainband. Fig. 4 contains the rainband to the left of the double D line; it also

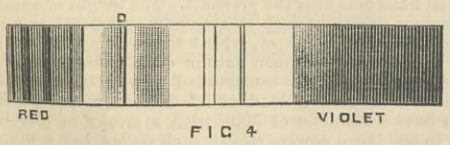


FIG 4

contains sunbands. The shaded band touching and to the left of D is what the observer has to search for with the rainband spectroscope. It takes a little experience with the instrument to be able to see it, since it is faint at the best. Faulty adjustment of the instrument will prevent its being seen; on some days it is not present, but this indicates that a downpour of rain is probably not imminent.

In using the rainband spectroscope, it is directed to an illuminated cloud from 20 deg. to 40 deg. above the horizon, and preferably in the direction from which the wind is blowing. A cloud thus low down is best, because the spectator then examines a greater thickness of terrestrial atmosphere. Vertical observations are of little use, no rainband of large size being then visible unless a deluge is pending. The slit of the spectroscope should be adjusted to small aperture, only just wide enough to abolish horizontal hair-like lines across the whole length of the spectrum from red to violet; these horizontal lines are due to exceedingly minute particles of dust obstructing the aperture of the slit at places. The adjustment is best made in the first instance upon the brightest part of the sky; afterwards the spectroscope can be turned in the direction in which rainband observations are to be taken. About nine o'clock in the morning, when the sun is neither high nor low, is a good time for observing. When an observation is too low, too close down to the horizon, a false band due to earth moisture sometimes appears. The instrument is found to be more sure in its prognostications in summer than in winter, because in summer an excess of vapour of water in the air is more liable to fall quickly in the form of rain. When the rain begins, the rainband often declines in intensity. Rainbands are usually weak during cold winds and cold fogs, and strong during warm winds and warm mists. When using the instrument the red end of the spectrum should always be kept to the left. When the rainband is present, the Fraunhofer lines of the spectrum are usually less sharp and clear than when it is absent, however carefully the focussing may be done; hence the appearance of these lines is a guide when making rainband observations. The justly celebrated optician who constructs this instrument is also a good poetical critic, so he will probably appreciate the following lines varied from "The Hunting of the Snark":—

> The rainband when absent is known by the taste,
> Which is noisy and mellow yet crisp;
> It tastes like a coat which is tight in the waist,
> With a flavour of Will-o-the-Wisp.
>
> But O, beamish Browning, beware of the day
> When the rainband is faint to the view,
> For your tubular spectrum will vanish for aye,
> And you will go after it too.

The handy little rainband spectroscope can be used for other purposes than ascertaining the aqueous state of the atmosphere. By placing the coloured leaves of flowers in front of the instrument, and allowing the light to shine through them, absorption bands are produced in the spectrum. Various green leaves give different kinds of absorption bands, all due to chlorophyll, but chlorophyll not in the same condition, hence the bands do not appear in the same places in the spectrum. The principal Fraunhofer lines from A to H are shown by means of this spectroscope. When colour is imparted to the flame of a spirit lamp, by means of beads of melted salts sustained in the flame by a loop of platinum wire, coloured lines are revealed in the spectroscope; the yellow sodium line comes out strongly when common salt is ignited in the flame. The late Professor Zöllner, of Leipsic, observed the spectrum of lightning with this small instrument; in lightning the blue nitrogen line is brightest, while the red line of hydrogen is also present; a continuous spectrum containing all the prismatic colours is also seen during lightning. The experienced observer can use the instrument for detecting certain adulterations in liquids, such, for instance, as logwood in port wine. With an induction coil the rainband spectroscope will show the bright lines of the spectra of the different metals and gases.

If optical methods were to be adopted for doubling the illumination of the rainband spectrum of the instrument now under notice, at the expense of halving the width of the spectrum, or of enlarging the size of the instrument, it would be an advantage which would be appreciated by observers unskilled in detecting the amplitude of the rainband it reveals. The rainband spectroscope is already too large for the waistcoat pocket, so a moderate increase in its size would not interfere appreciably with its portability in a coat pocket.

PORTABLE ENGINES FOR ELECTRIC LIGHT WORK.

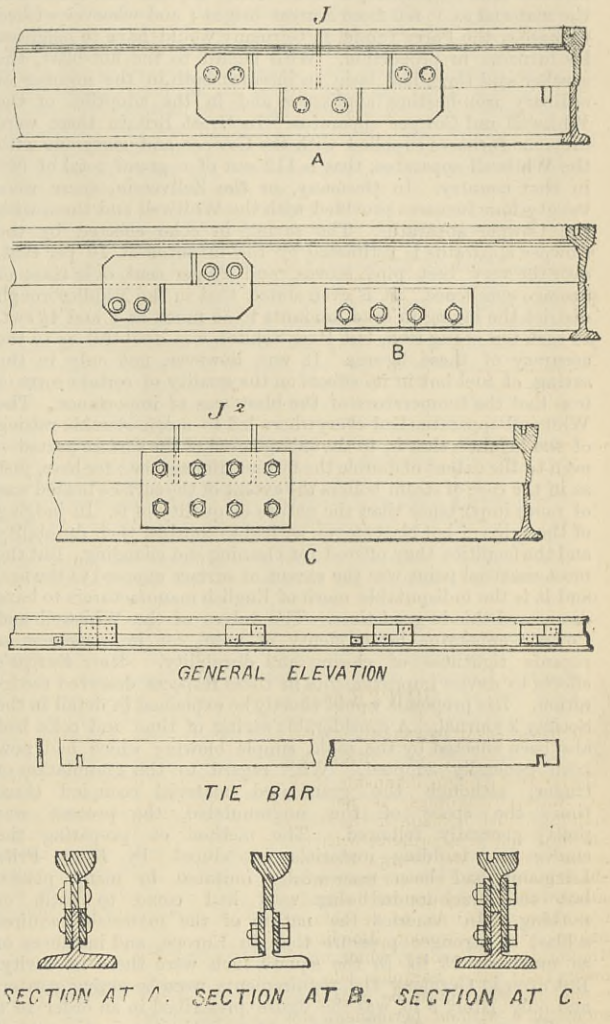
WE illustrate on page 454 one of the two 16-horse power engines, by Messrs. Marshall, Sons, and Co., of Gainsborough, used for driving dynamo machines during the recent exhibition at the Crystal Palace. These engines embody all the latest improvements. They have each two cylinders 9½in. diameter and 12in. stroke, and they are fitted with patent automatic expansion gear worked by Hartnell's governor. The fly-wheels are 6ft. in diameter and 9½in. wide on the face. The travelling wheels are of wrought iron, with wrought iron fore carriage.

These engines worked remarkably well on a small consumption of fuel during the time the exhibition was open, and in every respect maintain the high reputation of the firm.

H.M.S. CORDELIA.—One of her Majesty's new steam frigates was tried on Friday for a six hours' full power steaming trial. She left the wharf at Portsmouth Dockyard punctually at 8.30 a.m.; at quarter past nine she commenced at full power, the indicator diagrams showing 2400·65 indicated horse-power. At quarter to twelve, Portland Headland was seen at the distance, when the ship was turned round to return into Portsmouth Harbour. The last, or twelfth half-hour, the engines were found to indicate 2400·03 horses, with a mean number of revolutions of 105·59, and mean indicated horse-power for the six hours of 2423·53 horses, showing remarkable regularity of working throughout the six hours' trial. Boiler pressure was maintained at 60 lb., and vacuum 26·66 mean of both condensers. Speed of ship 14¼ knots. There were no hot bearings or hitch of any kind during the trial, which was considered most satisfactory. A similar vessel—the Candia—was tried a few months ago, also built of steel, at Portsmouth, with duplicate engines, both vessels being supplied with their machinery by Messrs. J. and G. Rennie, of London, the contract power in each case being 2800 horses. A somewhat similar vessel, but 10ft. longer, is being built at Portsmouth Dockyard, called the Calliopi, and a sister vessel, the Calypso, at Chatham Dockyard. The engines are making by Messrs. Rennie, of similar type to the Cordelia, but each of 3000 horses. Messrs. Rennie have also completed the machinery of Starling, Stork, and Raven, each of 360 indicated horse-power, now nearly completed at Chatham, the Starling having been built, and the other two waiting for an official trial, which is expected to take place next week. H.M. Alerto, paddle-wheel ship, for river service, has also been recently completed at Chatham by Messrs. Rennie with oscillating cylinders, two to each feathering paddle-wheel, and of a mean indicated horse-power of 494·91 with 39 revolutions. The Messrs. Rennie have also in the course of this year despatched a very complete set of dredging plant for the port of Buenos Ayres, consisting of one double screw dredger, with engines of 250-indicated horse power, to dredge up at the rate of 500 tons of soil per hour from a depth of 32ft. A smaller dredger of 100-I.H.P., to dredge up 230 tons from a depth of 24ft., and five screw steam hopper barges, each to contain 350 tons of excavated soil. All these vessels are fitted with compound engines, and the machinery is of the most approved construction with all the latest improvements.

CUNNINGHAM'S MOVABLE TRAM RAIL.

THE accompanying engravings illustrate a form of tramway permanent way which has been brought out by Mr. R. S. Cunningham, of Cannon-street, E.C. An ordinary bulb-headed steel rail is used, sustained upon an inverted "Tee-iron," 4½in. deep and 6in. at the base, the surfaces of the rail and "Tee-iron," at their points of contact, being planed. At every 96ft.—or at every four lengths of rail—is a short compensating piece, about 6in. in length, which is fastened by two bolts, and held in its place by an ordinary fish-plate, 12in. long and 6in. deep, and which is also attached to the rail and "Tee-iron" by a double row of six bolts and nuts. By simply unscrewing and removing the four or six top bolts, the compensating piece can be taken out, and then



two lengths of rail moved from left to right, and two lengths from right to left; this will enable the step or hook split fish-plates to be disengaged, as may be necessary, and the rail or rails lifted up and replaced in a short time and so as not to interfere either with the general public or with the road pavement. Where the compensating pieces occur, ordinary cast iron surface boxes, with lids, are placed, in order that, when it is desired to unscrew the fish-plates, for the purpose of changing a rail or otherwise, this can be readily done without interfering with or taking up the road. It is claimed for this system that it is low in first cost as well as offering the facility above described for renewals without interruption to traffic.

THE GERMAN IRON MANUFACTURERS' ASSOCIATION.

IN the Tonhalle at Düsseldorf, where the British Iron and Steel Institute held their last autumn meeting but one, the Society of German Iron Manufacturers have recently met for their spring session. About 300 members were in attendance, and the proceedings were conducted under the presidency of Herr C. Lueg, who will be remembered by many of our readers as the chairman of the committee under whose management the Düsseldorf Exhibition of 1880 achieved so much success. In opening the meeting Herr Lueg mentioned that the number of members had increased since the last meeting from 432 to 472, the additions including a number of Englishmen, and others from Austria and France, as well as Germany. The organ of the Society, "Eisen und Stahl," which had hitherto been issued only once a month, would shortly be published more frequently. The chairman further mentioned that the Mining School at Bochum, in which the Association took great interest, had been placed under the management of Herr Becker, formerly of the Osnabrück Iron and Steel Works.

The assembly then proceeded to the principal business of the meeting, which was to hear the results arrived at by the five gentlemen who had been appointed to report upon the present condition of the German iron manufacture. The gentlemen in question were all practically engaged as managers of large works, and many of their observations, which consisted of comparisons between the condition of the manufacture in Germany and England, cannot fail to be of interest in this country. Herr Schlink, the first speaker, said that it was of the first importance for the German manufacturers to be able to compete successfully with the English in pig iron. In spite of the most strenuous efforts on the part of the blast furnace technicians of Germany, they had not yet been able to do this, but the reason of their failure was attributable to the force of circumstances of a politico-economical character. The stringent requirements with regard to the chemical quality of their produce compelled the German manufacturers to exercise the utmost care in the choice of their raw materials and in discovering and introducing the most improved and economical processes. The immense scale of production in England had led there to the enlarging the size of blast furnaces, both in height and width. The largest furnace in England was one at Ferryhill, which was 105ft. high, and had a capacity of 50,000 cubic feet, dimensions which, the speaker thought, were not economical. The largest capacity of any furnaces in Germany was not more than 14,000 English cubic feet. Next to the question of the dimensions of furnaces the most important was that of fuel. The question would soon arise whether it would any longer pay for smelting works to keep up their own coke ovens. The collieries had now begun to make great exertions to produce good

coke in large quantities, and it appeared likely that the advantages iron manufacturers had hitherto found in making coke would soon disappear. The loss they would suffer by the disappearance of this cheap or gratuitous source of heat might be made good by more effective means of closing furnace tops and by a more sparing use of steam. With regard to the Bürmann form of furnace, opposition to it had almost entirely ceased in Germany, and the open breasted furnaces had become rare. In England, owing to the great height of furnaces and the generally uniform quality of the raw materials to be treated, the Parry funnel had been almost universally adopted. In Germany this was not possible to anything like the same extent as in England. The pipe of the funnel it was usual, in England, to let down a considerable distance into the furnace, so as to secure a better distribution of the material as it fell from a great height; and whoever wished to employ the Parry funnel in Germany would have to heighten his furnaces in proportion. With regard to the hot-blast, the speaker said there had been an increase both in the number of ordinary iron-heating appliances and in the adoption of the Whitwell and Cowper apparatus. In Great Britain there were fifty-one furnaces supplied with the Cowper and sixty-one with the Whitwell apparatus, that is 112 out of a grand total of 968 in that country. In Germany, or the Zollverein, there were twenty-four furnaces provided with the Whitwell and three with the Cowper apparatus. The saving in coke effected by the Cowper apparatus is estimated by the inventor at 10 per cent. over the very best pipe stoves, and 20 per cent. over those of average excellence. It is even stated that in the Middlesbrough district the saving in coke amounts to as much as 4 and 4½ cwt. to each ton of pig iron, but Herr Schlink was doubtful as to the accuracy of these figures. It was, however, not only in the saving of fuel but in its effects on the quality of certain sorts of iron that the temperature of the blast was of importance. The Whitwell apparatus had everywhere led to a considerable raising of the height—that is, to the enlargement of the surface heated—even to the extent of double the former dimensions; for here, just as in the case of steam boilers the extent of the surface heated was of more importance than the nature or quality of it. In judging of the value of hot blast stoves, we had to consider their durability and the facilities they offered for cleaning and changing. But the most essential point was the extent of surface exposed to the fire, and it is the indisputable merit of English manufacturers to have discovered this in good time. The valves of the Whitwell and Cowper apparatus leave plenty of room for improvement as regards tightness of closing and durability. Herr Burgar's efforts to devise improvements in these respects deserved recognition. His proposals would shortly be explained in detail in the Society's journal. A considerable saving of time and coke had also been effected by the rapid simple blowing which had now been generally adopted. With regard to the granulation of cinder, although the granulated material occupied three times the space of the ungranulated, the process was pretty generally followed. The method of preparing the cinder for building materials introduced by Herr Fritz Lürmann had been successfully imitated in many places, but the much-lauded slag wool had come to little or nothing. In America the nature of the materials requires a blast of stronger pressure than in Europe, and instances of as much as 13 lb. to the square inch were there no rarity. But even in Germany the requirements were becoming greater, and only lately 9 lb. was the figure prescribed in an order to a machinery firm. The most important single item in the cost of the production of iron in Germany was the cost of carriage, and in this a great deal had yet to be done in that country. The speaker then referred to the speculative business in warrants at the Glasgow market. The influence of these speculations he said was most pernicious. The warrant system in its origin was intended, and was indeed well fitted, to be of immense benefit to the iron trade. As a matter of fact, however, it had in the course of time been so perverted from its original purpose as to have become a curse rather than a blessing. It had led to gigantic over-production. It had caused immense stores to be heaped up unnecessarily. It had fostered a wild reckless spirit of gambling, and now, like a nightmare, weighed down the iron manufacture throughout the world. This was another reason why the German trade should shake itself quite free of the English market.

The next speaker, Herr von Limbor, went into a number of figures showing how the market for British iron in Germany might be reduced in favour of the German manufacturers. At one time, he said, Germany produced more cast iron wares than any other country. Between 1830 and 1840 as much as 83 per cent. of the cast iron used in Prussia was of home production. Between 1840 and 1850 the demand for foundry iron in Germany increased enormously, and in fact to six times the quantity required ten years before. This was the time when the iron imports from Great Britain went up to a prodigious extent. Under this competition the German manufacture suffered greatly until four years ago, since which time the British imports had fallen off 12 per cent. Herr von Limbor attributed this decrease, in the first place, to the imposition of high duties that were now in force; but an additional cause, he thought, was to be found in the disappearance of the prejudice formerly entertained by German consumers themselves against the home produce. In the year 1877 a number of experiments were made as to the comparative merits of English iron and of the iron of Rhineland and Westphalia, and, according to the speaker, the result was conclusively to show the superior quality of the German article. Nevertheless fully 48 per cent. of the total quantity of iron used in Germany still continued to come from Great Britain. The cause of this, he said, was to be found chiefly in the high tariffs of the railways for the carriage of iron, coal, iron ore, and other minerals. To produce at home the quantity of iron they now imported would, he continued, keep twenty-four blast furnaces in constant operation, and would increase the earnings of the working classes employed in the manufacture by 7 million marks a year. With the German railway tariff that of Belgium compared very favourably. Thus a manufacturer who had a blast furnace at Liège could send over a distance of 111 kilometres—nearly seventy English miles—for 2f. 60c. what it costs the German manufacturer 4f. 25c. to send in his own country. Where there had been a reduced tariff introduced, as there had been in the case of coal on the line from Velver to Hamburg, there had been a very large increase in the traffic. If the Belgian tariff were adopted on German lines, the speaker said that the result would be completely to close the German market to Scotch pigs. It had been shown that Germany had sufficient iron ore of good quality within her own borders to last her for centuries to come. The quality of the ore indeed was so good that the prospects of the blast furnace industry in the future, if it only had fair play, were excellent. In conclusion, Herr von Limbor expressed his opinion that German furnaces could supply all the iron and iron of the quality required for casting. He pointed out, however, some defects which prevailed at German works, especially regarding the temperature and quantity of the hot blast, which, he said, ought to be remedied without delay.

Herr W. Tiemann then spoke of the puddled iron manufacture in Germany. Since the recent introduction of various improvements, including the Whitwell and Cowper apparatus, the quantity of puddled iron produced in Rhineland and Westphalia had gone up from 20,000 to 110,000 tons, and the quality had been greatly improved. It had little phosphorus and was rich in manganese, but the ore out of which it was manufactured had to be brought from a distance.

The next speaker, Herr Schilling, referring to spiegeleisen, said that both in quality and quantity the manufacture on the Rhine had of late undergone considerable improvement. The last of the five reporters, Herr Hilgenstock, spoke of the Thomas and Bessemer processes. Thomas iron, he said, did not require anything like the amount of furnace space for its production as the Bessemer iron did. He doubted whether furnaces of more than 100 tons daily production were advantageous. With regard to the relative cost of production of Thomas iron and of Bessemer iron, the speaker said that in Germany at the present price of the raw materials Thomas iron cost from 22s. to 23s. per ton less than Bessemer iron, as it required 8 cwt. of coke less, which represented 4s. to 5s., and cost 18s. less for ore and limestone; and this does not include the saving in wages and other incidental expenditure, which were all in favour of the Thomas process.

In the discussion which followed Herr von Limbor stated that no English iron of the make No. 1 came upon the German market. Herr Schlink added that there was, so far as he could ascertain, not a single furnace in Cleveland producing No. 1 quality. The quantity of this mark required in German foundries was exceedingly limited. Herr Massenez said that owing to the heterogeneous qualities of the various ores used in Germany the manufacture was at a great disadvantage as compared with England, where the quality was more uniform. In theoretical and scientific applications, however, he held that Germany was in advance of England. Herr Lürmann then spoke of his patent process, and said it had been well received in France and coolly in Belgium, while in America it had been imitated, and by some changes his patent had been evaded. It was determined that the discussion on the important subjects started at this sitting should be resumed at a future meeting of this society.

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

(From our own Correspondent.)

Some merchants who do a home business reported this afternoon in Birmingham that the end of the quarter and of the half-year having now practically arrived, some customers were refusing to accept deliveries of iron until after stock-taking is over; hence they were quieter. This postponement of deliveries, however, is rather the exception than the rule. Most buyers are still pressing makers for deliveries, and numbers of producers scarcely know how to meet consumers' demands with the required promptitude. Yet current business is mostly of a hand-to-mouth character, few makers being able to see far ahead. Sheet makers are the best situated in this matter. Certain of them announce two months' orders in hand. Firms who are thus favourably situated are firm in demanding better prices.

Inquiries by the galvanisers for sheets were again strong to-day, this week's Australian mail having brought some good orders for corrugated sheets. Prices, in the black, were—Up to 20 w.g., £8 to £8 5s. per ton; up to 24 w.g., £8 10s. to £8 15s.; and up to 27 w.g., £9 10s. to £10. For 28 w.g. "extras" were demanded. The "list" houses quoted—Sheets, ordinary, £9 to £9 10s.; best, £11 10s.; and best best, £14 10s. Charcoal sheets the same houses priced at £16 10s. to £17; and best charcoals £19 5s. per ton.

Boiler plates were without improvement on the week. Messrs. Wm. Barrows and Sons' prices for these are understood to remain at—Ordinary sorts, £9; best, £10; B.B., £11; and B.B.B., £12.

Tin-plate makers reported a moderate sale. Certain of the foreign markets are improving a little. Australia, however, rather than the United States, stands out in this connection. Vendors stated that the home market, in its present fluctuating state, required careful watching. East Worcestershire makers' prices were about 18s. 6d. to 19s. per box for charcoals delivered Liverpool, and 16s. to 17s. per box for coke sorts.

Small sections of merchant iron, such as gas strip, bedstead strip, nail rods, &c., were in brisk sale. There is much more doing in these sorts of finished iron than many people would imagine. The orders are mostly for the satisfaction of local necessities. Gas strip was about £6 5s.; bedstead strip, £6 15s. to £7; and hurdle bars, £6; and here and there even slightly less.

Hoop and common quality bar makers reported themselves with orders on their books ensuring full work for six weeks to come. The demand is alike of a home and foreign sort. Prices of such irons are the same as last week. "Marked" iron firms quoted best scrap bars £9, and double best £10. Plating bars were—ordinary sorts £8, and best £9 10s. Best turning bars were £11.

Merchant advices delivered this week from Melbourne make known that galvanised corrugated iron had not been marked by any particular demand since the previous despatch. When the mail left quotations, according to brand, ruled at £20 10s. to £22 and £22 5s., according to gauge. A parcel of fifty cases Gospel Oak had been quoted at a full price. At auction there had been sold a miscellaneous shipment—no brand—with all faults, realising for 5ft., £20; 6ft., £19; 7ft., £19 10s.; 8ft., £19 10s.; 9ft., £21 7s. 6d.; and 10ft., £21 15s. A shipment of G.C. iron, "rabbit brand," assorted, was reported at 5ft., 6ft., 7ft., 8ft., 9ft., and 10ft., £19 17s. 6d. per ton.

Bar and rod iron in the Melbourne market were saleable at £10 to £11. Black sheet iron was firm when the mail left. Assortments of Nos. 8 to 18 were quitted at £11 10s., while for Nos. 20 to 26 £13 10s. was required. Plates were dull, quotations ranging from £11 to £12. Hoops for trade purposes were offered at £11 to £12. Nos. 6, 7, and 8 drawn fencing wire in good request, sales being made at £13 5s., £13 10s., and £14 5s. Tin-plates were offered at 15 per cent. advance on invoice for good assortments. I.C. coke-plates were quoted at Melbourne at 20s. to 21s.

In Birmingham to-day, and in Wolverhampton yesterday, the steel question was a prominent topic; and there was less disposition by those best sheet and tin-plate firms who have been lately fairly good customers for Landore and other open-hearth slabs to buy forward.

The committee who have been conducting the basic experiments look to receive in about a fortnight the reports from the firms who are about to test the local slabs. If these reports should prove to be all that is looked for, there will then be an effort to inaugurate the Basic-Bessemer process in Staffordshire by a joint stock company, for it is assumed that the cost of an altogether new plant will be heavier than one capitalist is likely to incur.

The quarterly meetings are fixed to be held in Wolverhampton on July 12th, and Birmingham July 13th.

After the activity of the last few weeks pig iron has become quiet again. Foreign part-mine brands are quoted 47s. 6d. to 50s. delivered, but some Northampton sorts may still be had at 45s. The Frodingham—Derbyshire—brand was quoted to-day at 48s., but the price was rather prohibitive. Thorncliffe—South Yorkshire—pigs were firm at 60s. An offer of 1000 tons at slightly less was refused. The representative of the Tredegar Hematite Company reported that his principals required him to quote prices up 1s. on a fortnight back, and his price was therefore 66s. Some Lancashire hematites were to be had at 62s. 6d. Native pigs were unchanged in price on the week. The Spring Vale Furnaces Company quoted: Hydrates, £3 2s. 6d.; mine sorts, £2 12s. 6d.; and common, £2 2s. 6d. Actual selling prices, however, were rather under these figures.

Mr. Peter Samson, inspector to the Board of Trade, has made his report upon the boiler explosion which occurred at Messrs. Hill and Smith's iron fence making and forge ironworks, at Brierley Hill, in February last. The boiler, which was of the Cornish type, was, he states, bought fourteen years ago, and was used in connection with two Lancashire firing boilers. It was placed horizontally on cast iron columns immediately over one of the forge-heating furnaces. The great source of danger was the intense heat to which it was subjected by reason of its position. The average consumption of coal was about 47 lb. per hour on each square foot of the grate surface. In ordinary Cornish boilers with internal furnaces, the coal consumption is frequently as low as 8 lb., and seldom exceeds 14 lb. When the explosion took place it is estimated that the steam gauge resistered a pressure of 48 lb. per square inch. The boiler was under the inspection of the Boiler Insurance and Steam Power Co., of Manchester, but their repeated recommendation that the hydraulic test should be applied had been neglected. Mr. Samson remarks that owing to bad advice, or to the insurance being continued, the firm may have been misled as to the importance of the recommendation.

The offer of the masters in the Birmingham nut and bolt trade has been accepted. The time given for decision was till the 21st instant. The opinion of the operatives has been taken by ballot, and the result declared on Monday showed a majority in favour of acceptance rather than a strike. The masters grant an increase of 1d. per gross of square and hexagon head, round neck sorts of sizes ¼, $\frac{5}{16}$, and ⅜; and of 1d. per gross of swagged bolts, cup, cheese, countersunk, and American heads, round or square necks, of sizes ¼, $\frac{5}{16}$, ⅜, $\frac{7}{16}$, and ½.

The operative chain makers in the Halesowen and Rowley districts, whose determination I wrote of last week, have now given the formal fourteen days' notice to leave unless wages are again paid according to the March 4s. "list." The action affects about 1000 men.

The decision of the Queen's Bench Division, which overrules the county-court judgment of Sir Rupert Kettle touching contracting out of the Employer's Liability Act, is affording great satisfaction to the iron and coalmasters hereabouts; nor are the majority of operatives much less gratified. Certainly Earl Dudley's colliers would have had much cause to regret any enactment that would have operated against the continuance of the arrangement by which their employer doubled any sum they themselves subscribed for relief purposes—an arrangement which wholly merits the commendation it received as well from Mr. Justice Field and Mr. Justice Cave as from Sir Rupert Kettle. Negotiations which had been suspended by Sir Rupert's judgment are now being resumed. Several ironmasters are not unprepared to meet their workpeople in some feasible scheme of assurance that will obviate the interposition of the law courts in the event of accidents embraced within the terms of the Liability Act.

NOTES FROM LANCASHIRE.

(From our own Correspondent.)

Manchester.—A decidedly stronger tone is maintained throughout the iron market here, and although any material advance in prices is still being followed only to a limited extent by buyers, where business is being done better prices are being realised. Recently there has been a considerable amount of buying, and the low sellers of district brands have now advanced their quotations fully 1s. 6d. per ton upon their recent prices. Finished iron also shows a tendency to stiffen, makers as a rule asking about 2s. 6d. per ton more than they were willing to take a few weeks back.

There was a firm market at Manchester on Tuesday as far as prices were concerned. Lancashire makers of pig iron, who have been doing better during the week than for some time past, are holding for 45s. to 46s. less 2½ for forge and foundry delivered equal to Manchester, but for anything like large sales find these prices difficult to obtain. Lincolnshire is now being quoted at 46s. to 47s. less 2½ delivered here, and at these figures sales, to a limited extent, are being made, but the bulk of the business, which has apparently pretty well filled makers' books for the present, has been done at prices a little under the above. Derbyshire iron is very irregular in price, in some cases it could be bought at about 1s. per ton over Lincolnshire, whilst some makers are asking quite 2s. 6d. per ton more money. In view of the upward movement in local brands inquiries are coming in for Middlesbrough iron, but there is still too wide a margin in price to lead to much business of importance.

In the finished iron trade the home demand, although better, does not show any important enlargements. Shipments, however, are increasing, and during the week tolerably good orders have been given out for bars and sheets for America, and for sheets for Russia, whilst there are indications of a revival in trade with the colonies. In hoops the chief business at present is in special descriptions suitable for hooping casks, and of these tolerably large shipments are being made to the United States. Baling hoops are only in limited demand, American inquiries not yet coming into the market, whilst the Egyptian trade is completely checked by the present unsettled state of affairs. For delivery equal to Manchester or Liverpool the minimum quotations are now about £6 7s. 6d. to £6 10s. for bars, £8 to £8 5s. for sheets, and £6 15s. to £6 17s. 6d. for hoops.

Engineers generally continue fairly well supplied with orders, and where complaints are made it is chiefly that, although trade is better so far as the quantity of work is concerned, there is no very appreciable slackening off in the keenness of competition, and very low prices have still to be taken. The last report of the Moulders' Society is only moderate in tone, trade being only returned as good in exceptional cases, and caution is urged upon the men with reference to any movement with regard to wages.

Fair inquiries for fireproof work for mill construction are reported in the market.

The winding plant on the Köepe system for the Avon Colliery, near Maesteg, owned by the Great Western Railway Company, which has been constructed by Messrs. Nasmyth, Wilson, and Co., and to which I referred a short time back, being now practically ready for starting at the pit, I have had an opportunity of inspecting the engines and winding pulley in a tolerably complete form. This system of winding, although largely in use on the Continent, has in England up to the present been adopted at only one other colliery—the Bestwood, near Nottingham—where, I understand, it is giving great satisfaction. The chief feature is the introduction of a balance or really an endless winding rope, intersected at equal distances by the pair of cages, and running over a pair of pulleys of equal diameter fixed respectively on the crank shaft of the engine and on the head gear over the pit shaft. The weight of winding rope on the engines, which in deep mining now so general is an important item, is thus got rid of, whilst the heavy winding drum is replaced by a pulley of much lighter construction. The engines for the Avon Colliery are constructed to wind from a depth of 500 yards and to raise a load of 52 cwt. 32ft. per second; the cylinders have a diameter of 30in. with a stroke of 5ft. 6in., and work up to 600-horse power, whilst each pulley has a diameter of 18ft. The engines are supplied with double-acting balanced slide valves, and I noticed a special feature in the introduction of relief valves, fitted with springs, so arranged in the steam ports, that, when acting, the steam escapes directly into exhaust ports, thus avoiding any outside pipe connections. The ordinary arrangement of the engines has been somewhat interfered with by the necessity of providing a temporary winding drum to be used during the sinking operations at the colliery. In order to provide this drum the pulley on

the crank-shaft has been constructed in two parts to form the sides of the drum, which will be carried in the centre. When the sinking operations are completed the drum will be removed and the two halves of the pulley brought together, the winding rope passing through a groove which will be formed in the centre, whilst a broad flange on each side of the pulley will provide for a brake to be applied either by a 12in. steam cylinder or by hand-power. In the Köepe system, however, the application of the brake is seldom required, as there is the dead weight of the load to be lifted constantly against the engines. The temporary requirements necessitating the introduction of a drum have also rendered necessary a more massive and longer crank shaft, and the engines are more spread out than they would otherwise be, whilst the winding pulley is much heavier than would ordinarily be required. In this case the crank shaft has a length of 18ft. 9in., and a diameter of 16½in., whilst the winding pulley weighs something like 14 tons, but under ordinary circumstances the engines would not carry a crank shaft of more than 13ft. in length, and 14½in. diameter, which would enable them to sit more compactly together, and a wrought iron pulley weighing not more than 12 tons would be sufficient.

In connection with the Köepe system at the Bestwood collieries, Messrs. Nasmyth, Wilson, and Co. have introduced a special arrangement for enabling coal to be wound from the upcast shaft with exhaust fan ventilation, in addition to the usual winding from the downcast. This has been effected by covering in the shaft with a circular iron casing extending from the pit mouth up to nearly the top of the head gear, a distance of 48ft. Into this casing circular tunnels are run on either side, and these are fitted with air-tight doors at their outside ends and at the entrance to the casing. The empty tubs are run into the tunnel on one side, and the outside door being closed, are then passed through the second door to the cage inside the casing, and the loaded tubs are discharged from the cage into the tunnel on the opposite side in similar manner. By this means the loss of ventilation is confined to the limited area of the tunnel on either side as each operation of loading or unloading is performed, and the arrangement enables an addition to the output of from 500 to 600 tons per day. The circular shape of the casing and tunnels admits of a lighter construction than would otherwise have to be adopted, light plates bound with ordinary T-iron being found of quite sufficient strength. For any necessary repairs of the cages provision is made for the removal of a portion of the shaft casing, and the inlet and outlet tunnels are placed on a gradient of 1 in 80 right through so as to facilitate the running in and out of the tubs.

Electric lighting is making progress here. I have already referred to its successful introduction, on the Edison principle, at the engineering works of Messrs. Mather and Platt. Another important step in the same direction is now being carried out by the complete lighting of the Manchester Royal Exchange, and the extensive restaurants, dining-rooms, &c., underneath, by electricity. In the Exchange itself the lighting is being carried out by the British Electric Lighting Company, under the charge of Mr. J. M. Emmerson, of Stockport. The large central hall is being lighted by nine arc lights, of 6000-candle power, and the side corridors and offices by 210 incandescent lamps. The main entrance is also lighted by three arc lights. A Gramme machine, driven by a 25-horse power engine, is used. The dining-rooms and restaurants have been lighted on the Siemens alternating system, with Swan incandescent lamps, by Messrs. Gooch and Hüne, of London and Manchester. Here there are at present 154 lamps in one circuit in operation, and in the winter months this number will be increased to 210; but by the introduction of Faure accumulators, it is contemplated making the billiard and smoke rooms independent of the main lighting circuit, which is supplied from one large dynamo driven by a 12-horse Crossley gas engine. I may add that the same company has laid down in the Severn tunnel twelve lamps on the south side with a circuit of about a mile and a-half, and on the north side they are preparing to lay down forty lamps over a circuit of four miles. The circuits are so arranged that any light can be put out and the current switched on to a motor to work up to about 1-horse power, without interfering with other portions of the system.

The coal trade is very quiet and stocks are accumulating, notwithstanding a very general restriction of the output. Prices are irregular, and seem to be governed more by what buyers are prepared to offer than by the nominal rates quoted by sellers. At the pit mouth prices average about 8s. to 8s. 6d. for best coals; 6s. to 6s. 9d. for seconds; 4s. 9d. to 5s. 6d. for common; 4s. 3d. to 4s. 9d. for burgy; 3s. 3d. to 3s. 9d. for good slack; and 2s. 9d. to 3s. for common. Shipping is very dull and steam coal is offered at Liverpool and Garston at 6s. 6d. to 7s. per ton.

Barrow.—The satisfactory position which the hematite pig iron market has occupied during the past week or two has been the means of steadying the market a good deal. The amount of new business done has not been large; but this is owing to the smelters having a good supply of orders on hand and a desire for higher values before they contract for orders of any magnitude. The inquiry which I noted had increased continues to improve, and shows the disposition there is amongst users to place orders. American buyers are coming more freely into the market, and before long the orders from this quarter are likely to show a decided increase. Deliveries of metal are being made in large quantities. These have been held back as long as possible, in the hope that rates would be lower; but freights have continued high, owing to the scarcity of getting return cargoes, and double those of any preceding shipping season. Prices have again advanced. No. 1 Bessemer, is quoted at 56s.; No. 2, 55s.; No. 3, 54s.; inferior qualities from 50s., f.o.b., three months delivery at West Coast ports. Makers doing business firmly refuse to sell for deliveries extending over three months, and in some instances are asking prices much above those quoted.

In the steel trade there is nothing new to note. Makers are steadily employed, and prices are firm. The mills are in full work, while the demand for all round samples is well maintained. Iron ore in steady request and prices are firm. At several of the mines large contracts have been made. Other industries well employed. Shipping fairly active.

The Sandscale Iron Mining Company has just discovered a rich bed of iron ore of large dimensions on its royalty in Furness which borders on the Duddon estuary. The new find is close to the port of Barrow, and in close proximity to the Furness Railway. The effect on the shares of the company by the new find has been to more than double their marketable value. The presence of iron ore in large quantities in the Duddon estuary has long been thought probable, and the new find would appear to point to the truth of the statement.

It is satisfactory to note that the iron trade of West Cumberland has considerably improved during the past few weeks. The Lonsdale Iron Company is relighting two of its furnaces. The Distington Iron Company, which has been effecting very considerable alterations and improvements in the whole of its plant, is pushing the work forward in order to have three furnaces in blast.

THE SHEFFIELD DISTRICT.

(From our own Correspondent.)

THE Yorkshire and Derbyshire May coal traffic by railway to London shows a slight increase in quantity, but prices are stated to have been exceptionally low and unremunerative. The total weight was 506,378 tons, of which the Midland Railway Company had 166,738 tons; the London and North-Western, 109,682 tons; the Great Western, 82,362 tons; the Great Northern, 86,087 tons; the Great Eastern, 57,091 tons; other lines, 3418 tons. In April the quantity sent was 492,615 tons, and in March 493,541 tons.

The Holmes Colliery, of which I have repeatedly written, is still in the market. Anybody with £14,500 to spare can have a complete colliery which was valued last September at £134,000. A number of gentlemen, who desire to form a new company, will only give £10,000. The Holmes Colliery at one time employed nearly 1000 hands, and paid dividends amounting to 150 per cent., one year's dividend alone being 80 per cent. There is no selling colliery property at present.

Lead mining in the neighbouring county of Derby is not a profitable business in these days. The Eyam Mining Company has sold during the year 284 tons, as compared with 142 tons last year, but the average price this year was about £1 15s. 3d. per ton less than was realised in the previous year, and the total amount realised has not been sufficient to pay miners' wages. The piping times of peace mean no dividends for lead mine owners.

In the armour-plate, rail, and ship-plate departments there is continued activity. Rails are also more freely ordered for foreign parts. At home the prices are very small, yet even at these rates there is keen competition for orders. Messrs. Wilson, Cammell and Co., Limited, of Dronfield Steel Works, will close their works sometime in the autumn. Unfinished orders will be completed at the works of Messrs. Charles Cammell and Co., at Sheffield, or at Penistone. All the machinery will be removed to Workington.

The cutlery, general hardware, and engineering departments are very brisk, the latter particularly so, except in the case of specialities for collieries, for which there is very little demand. Files, saws, sheep-shears, and similar goods in request, and in electro-plating departments four leading firms report that they are in receipt of important orders for Australian and several other colonial markets.

Latest quotations for Mortomley coal are—hand-picked brands, 15s. per ton; main coal, 12s. 1d.; seconds and nuts, 9s. 2d.

Mr. Benjamin Nicholson, of the Shoreham Steel Works, Sheffield, has forwarded to the Technical Exhibition, to be held at Bradford next week, a collection of tools for building and other purposes. The case contains excellent specimens of Sheffield workmanship, and is creditable to the firm.

THE NORTH OF ENGLAND.

(From our own Correspondent.)

THE Cleveland iron market, held at Middlesbrough on Tuesday last, was well attended, and the general tone was steady, with a tendency towards firmness. The usual conference of ironmasters was held before 'Change. Some of them were in favour even of advancing quotations, in the belief that consumers would give more than present prices. It was decided, however, by the majority that it would be desirable to let well alone for the present. Makers' quotations for prompt f.o.b. deliveries of No. 3 must still be taken to be 43s. 6d. per ton. Merchants' prices are 1½d. per ton less. Warrants are not much in demand, and what did change hands were sold at 43s. 3d.

Business between merchants and makers continues to be of a somewhat strained character. The former prefer to draw upon the warrant stores, in order to supply their customers. Consequently Messrs. Connal and Co. have now only 126,437 tons of Cleveland iron in stock, as compared with 190,000 tons a few months ago. The quantity which has been removed during the week is no less than 39,366 tons. The stocks of iron generally are likely to be considerably diminished by the end of the month, notwithstanding that shipments have only been moderate so far.

The manufactured iron trade continues steady. The firmness in Glasgow pig iron market, which is taken by so many consumers as a guide to the probable course of prices, has no doubt some effect in producing this result. At any rate the contracts for manufactured iron made during the past week have far exceeded the quantities run off. Plates are now quoted at from £6 15s. to £7 f.o.b. Middlesbrough, according to quantity and specification. Bars and angles are quoted at £6 5s.

The engineering and ironfounding works are well employed and are receiving plenty of inquiries, but prices are said not to be remunerative.

The steel trade is very flat. The last contract made by Messrs. Bolckow, Vaughan, and Co. was at £4 17s. 6d. at works.

Mr. Charles Smith, a partner in the firm of Messrs. T. Richardson and Son, and also general manager of their works at Hartlepool, was unfortunately drowned while bathing in Lake Lucerne a week or ten days since. Mr. Smith was a Scotchman, and stood extremely well as a marine engineer. He was also very highly esteemed by a large circle of personal friends, and his loss will not easily be repaired. He was in Switzerland on a tour for a few weeks in order to obtain a little relaxation from business.

The whole of the men and boys employed at the Cowper Colliery, belonging to the Earl of Durham, have received notice to leave. It is popularly supposed that this is owing to some dispute as to the royalty, but it is more likely to be simply the result of the extreme depression with which the Northern coal trade has long been contending.

The Board of Arbitration for the North of England iron trade held a meeting at Darlington on Monday last. In view of the fact that several of the recent decisions of the Board, and especially the awards of the last arbitrator, Sir J. W. Pease, have been repudiated by the workmen, and that they have at their meetings repeatedly declared their want of confidence in the Board, and have refused to support their own delegates, their chief officials have declined to move in any way, unless they have some assurance that their future efforts will not similarly be frustrated. The employers also say that they will no longer devote their valuable time to the services of the Board unless they are certain that the decisions thereof will be respected. Acting under these views, it was unanimously agreed on Monday last that a ballot should be taken at all the works connected with the trade, to ascertain whether the ironworkers desire a continuance of the Board of Arbitration, and agree for the future to be bound by its decisions. This ballot will be taken on Saturday next, and the Board of Arbitration will be continued or not according to the result. At the meeting on Monday a vote of thanks to Sir J. W. Pease for his award was carried; but it is noteworthy that Mr. Cullen, operatives' vice-president of the Board, positively refused to second the proposal. It may be added that Mr. Cullen is not an ironworker proper, and it is thought by many that this circumstance should be a disqualification and not a qualification for his holding a post at the Board at all. The ironworkers must, however, settle this point for themselves. At any rate it is clear that he is one of those who think that an arbitrator, although doing his work gratis, is not entitled to thanks except from those who may be perfectly satisfied with his award.

The position of general manager of the Stockton Malleable Ironworks, vacant by the death of Mr. Chas. Hill, has been offered to, and accepted by, Mr. Robert Stephenson, of Middlesbrough. Mr. Stephenson is a native of Tyneside, but has lived for many years in Middlesbrough as an iron merchant and broker, and has also been the local representative for the sale of the products of the Stockton Malleable Iron Company. Mr. Stephenson has a high reputation as a man of business, and the appointment seems to have given general satisfaction.

The tenders for the construction of the new bridge across the river Tees at Stockton were examined on Monday last. None of them, however, were accepted, because they all exceeded by far the amount which the bridge committee have at their disposal for paying the cost of the bridge. It was decided to refer the designs of the bridge back to the engineer, with a view to reduction of the cost.

NOTES FROM SCOTLAND.

(From our own Correspondent.)

THE Glasgow warrant market has been exceedingly active during the greater part of the week, and a large speculative business has been done. Prices advanced steadily until they reached 48s. 7d. on Friday forenoon, after which a slight drop took place in consequence, it is believed, of a number of purchasers selling in order to realise a profit on the advance which had taken place in the course of the week. This week has brought out a considerable number of outside purchasers, and the market has been further strengthened by the report with reference to shipments, which is very satisfactory, and compares most favourably with that of the corresponding week of 1881. Good consignments of pig iron have been made to the United States and to Canada, and larger shipments than usual are also taking place to Russia. The deliveries of pig iron into Connal's stores have been inconsiderable, and it is understood that makers' stocks continue slightly to decrease. Some brokers estimate that up till date the average production this year has been 30,728 tons less than in the corresponding period of last year, while there has been an average increase in the consumption of 3100 tons per week, or a total of 71,300 tons. From the same source we have a calculation to the effect that the reduction in stocks, including those with makers and in warrant stores, amounts to 43,317 tons. It is probable that the latter figures may be a shade full, but there can be no doubt that the pig iron trade is at present in a very hopeful state.

Business was done in the warrant market on Friday forenoon at from 48s. 5½d. to 48s. 7d. cash, and from 48s. 7½d. to 48s. 9d. one month, the afternoon quotations being 48s. 6d. to 48s. 2½d. cash, and from 48s. 8d. to 48s. 4½d. one month. On Monday forenoon business was done at from 48s. 3d. to 48s. 3½d., and down to 48s. 1d. cash, and from 48s. 5½d. to 48s. 3½d. one month; in the afternoon the quotations were 48s. 1d. to 47s. 11d. cash. On Tuesday morning the market was firmer, with business at 48s. to 48s. 1½d. cash, whilst in the afternoon the tone was quiet, with transactions at 48s. 6½d. to 48s. 2½d. cash, and 48s. 4d. to 48s. 5d. one month. A fair business done on Wednesday up to 48s. 5d. cash, and 48s. 7d. one month. To-day—Thursday—business was done for 48s. 7½d. cash, to 48s. 3d. cash, and 48s. 5d. one month.

In consequence of the activity in the warrant market and the large business being done in makers' iron, the prices of the latter again show a general increase, and are as follows:—Gartsherrie, f.o.b. at Glasgow, per ton, No. 1, 59s. 6d.; No. 3, 54s.; Coltness, 60s. and 55s. 6d.; Langloan, 60s. and 55s. 6d.; Summerlee, 58s. and 51s. 6d.; Calder, 57s. 6d. and 51s. 6d.; Carnbroe, 52s. 6d. and 49s.; Clyde, 52s. and 49s. 6d.; Monkland, 49s. 6d. and 48s.; Quarter, do. do.; Govan, at Broomielaw, 49s. 6d. and 48s.; Shotts, at Leith, 60s. and 55s. 6d.; Carron, at Grangemouth, 49s. 6d. (specially selected, 52s.) and 48s. 6d.; Kinneil, at Boness, 48s. and 47s.; Glengarnock, 52s. 6d. and 49s.; Eglinton, 49s. 6d. and 48s.; Dalmellington, 49s. 3d. and 48s. 3d.

Most departments of the manufactured iron trade continue well employed. There is an extensive demand for castings. In the malleable branch, however, the inquiry for shipbuilding iron has become rather less pressing. So far the increase of prices in the pig iron departments has not affected the quotations of finished iron.

The operative engineers of Edinburgh and Leith have made a demand upon their employers for an advance of ½d. per hour in their wages and have declined to accept a compromise.

There is still a good business doing in the coal trade. Taking the business at the whole of the Scottish ports during the past week, we find that it has been considerably larger than that done in the preceding week and in the corresponding week of last year. The reductions noted in the preceding two weeks in the shipments, chiefly at Glasgow, are now believed to have been due to a want of vessels. There are very good orders to hand, and the prospects of the trade are altogether of a favourable character. An effort is being made to increase the price of coals in the West. Indeed, it is stated on the other hand that there is a likelihood of the coalmasters of Fife being obliged to renounce the slight advance in prices which they made some few weeks ago upon returning the reduction of 12½ per cent. to the miners.

WALES AND ADJOINING COUNTIES.

(From our own Correspondent.)

MESSRS. FAREBROTHER AND ELLIS, of London, have issued a preliminary notice respecting the sale of the whole of Plymouth Works and collieries. It is proposed to sell Plymouth, Pentrebach, and Duffryn Works; the collieries, which comprise an area of 2437 acres of various qualities of good steam coal, and the farms, cottages, &c., on the Merthyr estate. The impression in the locality is that something now may be done with the works.

The present time is good for labour, that being abundant and cheap. The great drawback, however, with the ironworks is that they are antiquated. Iron rails are now out of date, and the steel trade is not flourishing. I have heard of very low prices accepted for steel rails to keep works going. A competent valuer gives £60,000 as the value of the old iron and plant of Plymouth Works.

We are soon to see Cyfarthfa take its place again amongst busy steel works. The intention is to build four furnaces with all the latest arrangements. These with mills, &c., will employ from 1000 to 1500 men. Some time must necessarily elapse for the extensive plant to be made and put up.

I fancy the law courts have been a little hard upon the holders of the Coppee patent for coke making. An application has been made for prolongation of patent, and this was refused, because, in the period of seven years a few thousand pounds profit had been made. Had £30,000 or £40,000 been realised, one could understand it; but something under £12,000 is not much for the inventor after, possibly, years of study and investigation. I note this as the patent is getting into great favour here. It is quite in keeping with the new system of things—science *versus* manual labour. I hear that the manager in the Welsh district has improved upon the patent and secured his rights, and this is, for him, a fortunate occurrence.

An important trial of safety lamps took place at Llynypia, Rhondda Valley, this week. The results, which were of a most important nature, have been purposely withheld for a little while.

There is little to chronicle in connection with the ironworks. At the tin-plate works prices continue low, 16s. a box for ordinary coke being less frequently seen than 15s. 3d. Rhiwderrin Works Colliery are in liquidation; Messrs. Forester of Swansea and Grove of Ebbw Vale have the management. I note that some of the ironworks are amongst the sufferers—casualties that are unavoidable in the present peculiar condition of the tin-plate trade.

The anthracite trade of Swansea is flat, so, too, is the business of the new dock. Up to Saturday only one vessel has entered. On the whole the coal trade is fairly maintained, and prices show more tendency of upwards than downwards.

An important meeting of colliers' delegates, representing 20,000 men, was held at Aberdare, when after a great deal of discussion three important resolutions were carried—a vote of confidence in the representatives who had gained the amendment in the sliding scale, a resolution to form a defence fund by the payment of 6d. per collier throughout South Wales and Monmouthshire, and thirdly, a resolution to obtain, if possible, the concession to alter the educational standard at school for boys from the fifth to the fourth, so that boys may be able to work in their thirteenth year, according to the Mines Regulation Act. This intention of the colliers to have the fourth standard is regarded favourably by the public. The tendency of the School Board system is to send more clerks into the market than the demand justifies.

One of the tin-plate works that failed lately in the Swansea Valley is offering its first dividend of 1s. in the pound.

The Rhymney Ironworks directorate have issued their report for the financial year ending March 31st, by which it is shown that a profit of £20,457 has been made, but they do not recommend a dividend.

The "Earl of Chester Steamship Company," Cardiff, has been registered, capital £17,000.

A good cargo of rails has been cleared for Montreal from Cardiff, 2250 tons.

There is still a lurking desire amongst the colliers to get the minimum down to 7s. 3d. instead of 7s. 6d. I am afraid that troubles are brewing in the house coal trade.

THE PATENT JOURNAL.

Condensed from the Journal of the Commissioners of Patents.

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

Applications for Letters Patent.

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

13*th June*, 1882.

2765. Printing Machines, J. H. Johnson.—(*E. Anthony, New York, U.S.*)
2766. Coffins, S., J., and R. Turner, Lancaster.
2767. Grinding Mills, P. Justice.—(*M. Church, U.S.*)
2768. Railway Cars, P. Justice.—(*M. B. Church, U.S.*)
2769. Dynamo-electric Machines, J. Imray.—(*P. Jablochkoff, Paris.*)
2770. Vehicles, S. Pitt.—(*P. Herdic, Pennsylvania.*)
2771. Dynamo-electric Machines, J. Farquharson, London.
2772. Slabs of Plaster, R. W. Hitchins, London.
2773. Lawn Tennis Courts, A. R. Cobbett, London.
2774. Velocipedes, W. Dixon, Brighton.
2775. Bottles, D. C. Berthon, London.
2776. Carbons, F. H. Varley, London.
2777. Fusees, W. T. Evans, Manchester.
2778. Compressing Explosives, E. Hesketh, Dartford.
2779. Haymaking, J. C. Float, Maldon.
2780. Sensitive Paper, W. T. Morgan and R. L. Kidd, Greenwich.
2781. Electric Lighting, W. R. Lake.—(*C. Ferdinand de la Roche, Paris.*)
2782. Safety Lamps, W. Smethurst, Brynn.
2783. Dressing Stone, H. J. Haddan.—(*A. McDonald, Massachusetts, U.S.*)
2784. Paper, H. Haddan.—(*J. Korschilgen, Germany.*)
2785. Candles, G. W. von Nawrocki.—(*A. Mann and R. Jacobi, Germany.*)
2786. Measuring, &c., A. Clark.—(*E. Bourdon, Paris.*)

14*th June*, 1882.

2787. Transmitting Motive Power, A. Lafargue, London.
2788. Vehicles, E. Rayner, Liverpool.
2789. Supplying Air, J. Howden, Glasgow.
2790. Albums, A. Aron, London.
2791. Sieves, J. P. Lipps, Dresden.
2792. Watches, J. H. Godsell, Coventry.
2793. Generating Heat, &c., J. Teer, Salford.
2794. Boilers, C. Hulseberg, London.
2795. Looms, T. Knowles, Blackburn.
2796. Buoyant Speed Wheel, W. Teague, jun., Tincroft, Redruth.
2797. Belt, W. A. Barlow.—(*W. Teufel, Germany.*)
2798. Bottle Stands, F. Sibray and J. Hall, Sheffield.
2799. Spinning Fibres, S. Tweedale, Accrington.
2800. Card-setting Machines, H. Yates.—(*Stedman and Fuller, Lawrence, U.S.*)
2801. Furnaces, J. Proctor, Burnley.
2802. Printing Presses, J. Miller, Springburn.
2803. Dynamo-electric Machines, F. Willard, London.
2804. Electricity, W. R. Lake.—(*F. van Rysselberghe, Belgium.*)
2805. Producing Designs upon Metal, A. N. Hopkins, T. Baker, and T. W. Burt, Birmingham.
2806. Securing Glass, S. Deards, Harlow.
2807. Secondary Batteries, L. Epstein, London.
2808. Fluting Metal Rollers, J. Buchholz, London.
2809. Rotary Engines, J. and F. W. Brierley, London.
2810. Ratchet Braces, T. W. Cheesebrough, London.
2811. Lubricators, B. J. B. Mills.—(*O. H. Jewell, U.S.*)
2812. Facilitating the Travelling of Vehicles, W. R. Lake.—(*S. von Heinrich, Hungary.*)
2813. Shirts, D. P. Belknap, San Francisco, U.S.
2814. Metallic Bedsteads, T. Wilson, Birmingham.

15*th June*, 1882.

2815. Ventilating, &c., Air, A. B. Brown, Edinburgh.
2816. Filter Press, J. Simpson and E. W. Parnell, Liverpool.
2817. Burglar Alarms, J. Blomerley, Pendlebury.
2818. Secondary Batteries, J. S. Sellon, London.
2819. Advertisements, &c., P. M. Justice.—(*E. Brenta, Brussels.*)
2820. Iron, &c., J. Beasley, Handsworth.
2821. Straps, J. B. Brooks, Birmingham.
2822. Pontoon Deck-house, J. Littlejohn, Wallsend-on-Tyne.
2823. Electric Currents, C. Westphal, Berlin.
2824. Coffee, H. J. Haddan.—(*E. A. Grote, Germany.*)
2825. Dressing Lithographic Stones, H. J. Haddan.—(*C. G. Röder, Germany.*)
2826. Leaden Threadlike Fibre, F. J. Cheesbrough. *A. K. Eaton, Brooklyn, N.Y.*)
2827. Wire Ropes, F. C. Guilleaume, Germany.
2828. Attaching Knobs, E. H. Baxter, Birmingham.
2829. Flushing Drains, R. R. McKee, Kirkcaldy.
2830. Electro-motors, W. E. Ayrton and J. Perry, London.
2831. Music Stools, W. Morgan-Brown.—(*E. C. Toussaint, Switzerland.*)
2832. Flap Valves, E. Edwards.—(*E. Roche, France.*)
2833. Fire-arms, J. Robertson, London.
2834. Water-closets, A. M. Clark.—(*J. J. Frey, U.S.*)
2835. Soap, W. R. Lake.—(*J. Bankmann, Vienna.*)
2836. Nitric, &c., Compounds, W. R. Lake.—(*H. Gruson and A. Hellhoff, Germany.*)

16*th June*, 1882.

2837. Water Taps, G. Chisholm, sen., and G. Chisholm, jun., Stirling, N.B.
2838. Ring Spinning Machinery, G. Perkins, G. Wimpenny, and J. H. Evans, Manchester.
2839. Retaining Heat, C. P. D. Chittenden, Lee.
2840. Measurement, of Velocity, H. Shaw, Bristol.
2841. Steam Boilers, A. D. Barclay, Kilmarnock.
2842. Vessels, R. Atkin, Clapham.
2843. Heating Air, &c., L. McIntyre, Glasgow.
2844. Panels, &c., J. H. Browne, Cleobury Mortimer.
2845. Incandescent Lamps, A. Pfannkuche, London.
2846. Railway Brake, E. Foakes, Cardiff.
2847. Printing Machines, J. H. Johnson.—(*E. Anthony, New York.*)
2848. Engines, T. H. Ward, Tipton.
2849. Presses, J. H. Johnson.—(*P. D. and E. D. Brenot, Paris.*)
2850. Supplying &c., Water, J. H. Johnson.—(*A. Dumas, Paris.*)
2851. Furnaces, J. Mason, Eynsham Hall.
2852. Weaving, W., A., A., A., E., & J. Briggs, Whitworth, near Rochdale.
2853. Pipe Joints, J. H. Moore, Bournemouth.
2854. Vehicles, J. U. Burt, London.
2855. Adjusting Doors, S. A. Say, London.
2856. Air-testing, &c., Instruments, F. H. F. Engel.—(*W. Klinkerfues, Germany.*)

17*th June*, 1882.

2857. Injectors, A. H. Smith, Nottingham.
2858. Safety Saddle-bars, R. S. Garden, London.
2859. Sash-weight Attachments, H. C. Tucker, Peterborough.
2860. Tricycles, R. Neal, New Benwell.
2861. Storing, &c., Food, E. Edwards.—(*S. Schreiber, Hanover, Germany.*)
2862. Hydro-extractors, E. Edwards.—(*C. Brecheissen, Elbœuf, France.*)
2863. Checking Money, H. R. Landon and G. L. Dezille, London.
2864. Bleaching Fabrics, E. de Pass.—(*G. Davis, U.S.*)
2865. Wheels, H. A. Bonneville.—(*E. Meatyard, U.S.*)
2866. Apparatus to take up Slack Chain of Hoists, G. Allix, London.
2867. Gas Regulators, A. J. Boult.—(*P. Parsy, France.*)
2868. Cutting Stone, J. Thomas, Bangor.
2869. Ships' Rudders, M. Cotter, Glasgow.
2870. Caloric Engine, A. M. Clark.—(*J. Schweizer, Switzerland.*)
2871. Dynamo-electric Machines, J. Gordon, London.
2872. Distilling Spirit, J. T. Board, Bristol.
2872. Coke, &c., Bricks, G. E. Vaughan.—(*F. Lürmann, Germany.*)
2874. Umbrellas, R. B. Avery, Manchester.
2875. Gas Batteries, R. J. Gulcher, London.
2876 Soda, H. Gaskell, jun., and F. Hurter, Widnes.
2877. Ascertaining the Depth of Water, W. R. Lake.—(*L. G. C. de Nordeck, Paris.*)
2878. Valves, E. M. Simpson.—(*F. Weck, Berlin.*)

19*th June*, 1882.

2879. Printing Machines, J. H. Johnson.—(*E. Anthony and J. E. Harvey, New York.*)
2880. Sewing Machines, W. Fairweather, Manchester.
2881. Measuring, J. Scruby, Romford.
2882. Window-blind Apparatus, W. Laycock, Sheffield.
2883. Lubricating, E. Brydges.—(*F. Tovote, Germany.*)
2884. Preparing Colours, B. Grené, London.
2885. Dynamo-electric, &c., Machines, J. A. Berly.—(*F. V. Moquaire, Paris.*)
2886. Printing Machines, J. H. Johnson.—(*E. Anthony and J. E. Harvey, New York.*)
2887. Counting, &c., Apparatus, F. Petersen and J. H. R. Dinsmore, Liverpool.
2888. Capstans, &c., S. Baxter, London.
2889. Stages, C. D. Abel.—(*R. Gwinner, J. Kautsky, C. Dengg, and F. Roth, Vienna.*)
2890. Engines, &c., G. Allan & R. Dickinson, Sheffield.
2891. Corsets, &c., S. Dixon, Whitehill, Peterfield.
2892. Scrapers, J. G. Perkin and J. Scott, York.
2893. Fitting Teeth, E. Reading.—(*Dr. Buttner, U.S.*)
2894. Cloth, T. Isherwood, Westerly, U.S.
2895. Explosive Material, W. R. Lake.—(*F. J. Petry, Vienna, Austria.*)
2896. Shunts or Switches, C. T. Howard, U.S.
2897. Brakes, W. R. Lake.—(*J. Woods, Melbourne.*)
2898. Electric Lamps, A. Swan, Gateshead.
2899. Easing Strains, R. A. Ray, Great Grimsby.
2900. Promoting Combustion in Furnaces, A. M. Clark.—(*T. Brennan, W. G. Munn, W. J. Duncan, W. A. Meriwether, and C. G. Davidson, Louisville.*)
2901. Producing a Continuous Current of Air, E. Edwards.—(*E. Vigreux, France.*)
2902. Electric Meters, J. T. Sprague, Birmingham.

Inventions Protected for Six Months on Deposit of Complete Specifications.

2744. Dynamo-electric Machines, &c., J. Imray, London.—A communication from J. J. and T. J. McTighe, Pittsburgh, U.S.—10*th June*, 1882.
2765. Printing Machines, J. H. Johnson, London.—A communication from E. Anthony, New York, U.S.—13*th June*, 1882.
3770. Two-wheeled Vehicles, S. Pitt, Sutton.—A communication from P. Herdic, Philadelphia, U.S.—13*th June*, 1882.
2811. Lubricators, B. J. B. Mills, London.—A communication from G. H. Jewell, Chicago, U.S.—14*th June*, 1882.
2813. Shirts, D. P. Belknap, San Francisco.—14*th June*, 1882.
2847. Printing Machines, J. H. Johnson, London.—A communication from E. Anthony, New York.—16*th June*, 1882.

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

2346. Combing Wool, J. C. Walker, Shipley, near Leeds.—13*th June*, 1879.
2348. Corset Busks, A. Jacobson, Manchester.—13*th June*, 1879.
2384. Disconnecting Gear, J. Sample, Blyth.—16*th June*, 1879.
2519. Sliver Conductors, J. Barbour, Belfast.—23*rd June*, 1879.
2556. Grinding Mills, H. Simon, Manchester.—25*th June*, 1879.
2616. Coke Ovens, H. Simon, Manchester.—28*th June*, 1879.
2619. Sewing Machinery, A. Keats, Newcastle-under-Lyne.—28*th June*, 1879.
2828. Sulpho-acids of Rosaniline, C. D. Abel, London.—11*th July*, 1879.
2343. Ice, F. N. MacKay, Liverpool.—13*th June*, 1879.
2350. High-pressure Filters, J. J. Royle, Manchester.—13*th June*, 1879.
2353. Ice, W. A. Gorman and J. Walker, London.—13*th June*, 1879.
2358. Vessels, J. C. Browne, London.—14*th June*, 1879.
2403. Mixing Gases with Liquid Matters, A. B. de Podewils, Munich, Bavaria.—17*th June*, 1879.
2407. Covering for Rollers of Spinning Machinery, A. M. Clark, London.—17*th June*, 1879.
2359. Elastic Web or Cloth, J. Dean, Derby.—14*th June*, 1879.
2372. Velocipedes, W. H. Thompson, London.—14*th June*, 1879.
2391. Fluid Meters, R. H. Gould, London.—17*th June*, 1879.
2553. Liquid Meters, R. H. Gould, London.—25*th June*, 1879.
2624. Tanks, &c., I. Shone, Wrexham.—28*th June*, 1879.
2998. Lubricators, J. Dewrance and G. H. Wall, London.—23*rd July*, 1879.
2388. Ships, W. Coppin, London.—16*th June*, 1879.
2416. Boats, B. J. B. Mills, London.—18*th June*, 1879.
2429. Railway Buffers, J. W. Howard, London.—19*th June*, 1879.
2440. Hops, L. Naumann and C. Pohl, Plauen.—19*th June*, 1879.
2408. Window Screen, S. H. Sharp, Leeds.—18*th June*, 1879.
2434. Grinding Plate Glass, W. W. Pilkington, St. Helens.—19*th June*, 1879.
2523 Furnaces, J. Hampton, Loughborough.—24*th June*, 1879.
2749. Printing Fabrics, J. N. Wilson, Flixton.—5*th July*, 1879.

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

2216. Clippers, T. L. Phipps and W. Burman, Birmingham.—16*th June*, 1875.
2226. Ventilating Garments, J. R. W. Luck, London.—17*th June*, 1875.
2240. Fixing Telegraph Posts, J. Oppenheimer, Manchester.—18*th June*, 1875.
2210. Lock or Jam Nuts, J. F. Wiles, London.—16*th June*, 1875.
2341. Stop Motion Winding Doubling Frames, T. Unsworth, Manchester.—28*th June*, 1875.
2416. Multitubular Steam Boilers, B. J. B. Mills, London.—3*rd July*, 1875.

Notices of Intention to Proceed with Applications.

Last day for filing opposition 7*th July*, 1882.

646. Composition for Protecting Wood, &c., from Fire, H. H. Lake, London.—A communication from J. Wildi.—10*th February*, 1882.
652. Lifting Apparatus, J. Stainer, Heckmondwike.—10*th February*, 1882.
654. Linings for Vent Flues, T. Fraser, Aberdeen.—10*th February*, 1882.
672. Welding Metals, C. D. Abel, London.—A communication from J. Laffitte.—11*th February*, 1882.
673. Air Refrigerating Apparatus, T. B. Lightfoot, London.—11*th February*, 1882.
680. Slide Valves, D. Ashton, Sheffield.—11*th February*, 1882.
681. Door Hinges, J. W. Pitt, Liversedge.—11*th February*, 1882.
699. Looms, J. Hollingworth, Dobcross.—13*th February*, 1882.
715. Venetian Blinds, R. M. Chevalier, London.—14*th February*, 1882.
723. Regulating the Speed of Steam Engines, &c., G. B. Goodfellow and R. Matthews, Hyde.—15*th February*, 1882.
765. Vessels, &c., W. May, London.—16*th February*, 1882.
773. Knitting Machines, J. Poole, Bradford.—17*th February*, 1882.
786. Ventilators, &c., J. M. Lamb, South Hampstead.—18*th February*, 1882.
847. Sash Pulley, W. Meakin, London.—21*st February*, 1882.
848. Velocipedes, J. Humpage, Bristol.—21*st February*, 1882.
890. Testing Apparatus, W. C. De Wit, Amsterdam. Com. from C. D. Gäbler.—23*rd February*, 1882.
937. Corrugating Machines, V. B. Daelen, Berlin.—27*th February*, 1882.
963. Preventing Railway Accidents, C. N. Leroy, Paris.—28*th February*, 1882.
974. Fans, C. Cockson, Wigan.—28*th February*, 1882.
994. Gas-motor Engines, J. Fielding, Gloucester.—1*st March*, 1882.
1005. Boiler Tubes or Flues, W. H. Wood, Cookley.—2*nd March*, 1882.
1164. Protecting the Interior of Graves, J. Walters, Kingston.—10*th March*, 1882.
1229. Navigating Fluids, A. W. Lake, London.—A communication from T. Hyatt.—14*th March*, 1882.
1258. Treating Diseases of the Throat, &c., E. Châbot, London.—15*th March*, 1882.
1283. Placing Fog Signals in Position on Railways, J. Natt, London.—16*th March*, 1882.
1304. Thrashing Machines, T. and W. Nalder, Wantage.—17*th March*, 1882.
1477. Harvesting Machines, B. Samuelson and W. G. Manwaring, Banbury.—Partly a communication from C. W. Marsh.—27*th March*, 1882.
1734. Cleaning, &c., Tram-rails, J. Remfry, East Indies.—12*th April*, 1882.
2259. Transmitting, &c., Sounds, W. Barney, London.—13*th May*, 1882.
2336. Dynamo-electric Machines, T. J. Handford, London.—A communication from W. A. Stern and H. M. Byllesby.—18*th May*, 1882.
2340. Dynamo-electric Machine, C. W. Vincent, Holloway.—Partly a communication from W. B. F. Elphinstone.—18*th May*, 1882.
2348. Incandescent Electric Lamps, S. H. Emmens, London.—18*th May*, 1882.
2349. Electrical Apparatus, S. H. Emmens, London.—18*th May*, 1882.
2419. Electric Arc Lamps, W. H. Akester, Glasgow.—23*rd May*, 1882.

Last day for filing opposition, 11*th July*, 1882.

703. Gas Engines, C. T. Wordsworth, Leeds, and H. Lindley, Salford.—14*th February*, 1882.
707. Rolling Pamphlet Covers, W. P. Thompson, London.—A communication from E. L. Miller and W. H. Rohrer.—14*th February*, 1882.
726. Blocking the Fronts of Boots, S. Hudson, Belgrave.—15*th February*, 1882.
729. Folding Packing Cases, E. I. Billing, Cheltenham.—15*th February*, 1882.
743. Utilising Sewage, G. H. Gerson, Berlin.—15*th February*, 1882.
746. Ventilating Apparatus, T. F. Wintour, London.—16*th February*, 1882.
750. Transmitting Motion, W. Spence, London.—Com. from J. Coirarrd.—16*th February*, 1882.
758. Telegraph Instrument, F. J. Cheesbrough, Liverpool.—Com. from W. A. Shaw.—16*th February*, 1882.
768. Rails, &c., for Railways, H. T. Grainger, London.—17*th February*, 1882.
772. Lock-up Stands for Bottles, &c., J. Ridge, Sheffield.—17*th February*, 1882.
775. Photography, R. T. Wall, Longfleet.—17*th February*, 1882.
777. Tin, C. D. Abel, London.—A communication from Dr. H. A. Schulte.—17*th February*, 1882.
779. Pianofortes, E. Outram, Greetland.—17*th February*, 1882.
782. Winding Apparatus, W. T. Stubbs and J. Corrigan, Manchester.—17*th February*, 1882.
824. Driving, &c., Metallic Staples in Paper, W. R. Lake, London.—A communication from I. W. Heysinger.—20*th February*, 1882.
831. Electric Lamps, J. Rapieff, London.—21*st February*, 1882.
841. Circular Knitting Machines, J. W. Watts, Countesthorpe.—21*st February*, 1882.
845. Seats or Saddles of Bicycles, C. Edwards, Birmingham.—21*st February*, 1882.
864. Furnaces, J. H. Johnson, London.—A communication from the Société Nouvelle des Forges et Chantiers de la Mediterranée.—22*nd February*, 1882.
872. Electrodes, F. Des Vœux, London.—Com. from G. Cumming & C. M. Brinkerhoff.—23*rd February*, 1882.
892. Drying Sewage, J. H. Johnson, London.—Com. from E. Coignet.—23*rd February*, 1882.
942. Hair Clasps, F. L. R. Kopp, Hamburg.—27*th February*, 1882.
957. Spinal Support, G. E. Vaughan, London.—Com. from P. J. Le Belleguic.—27*th February*, 1882.
958. Cutting and Reeling Paper, W. W. Colley, London.—27*th February*, 1882.
993. Pocket Hanger for Hats, &c., A. M. Clark, London.—Com. from T. McDonald.—1*st March*, 1882.
998. Ring Spinning, &c., Frames, S. Brooks and A. Holden, Gorton.—2*nd March*, 1882.
1065. Blinds or Screens, J. Wetherilt, London.—6*th March*, 1882.
1080. Reels of Reaping Machines, A. M. Clark, London.—A communication from F. F. Kanne and L. Z. Rogers.—6*th March*, 1882.
1125. Suspending Beds, F. Lebacq, Bruxelles.—8*th March*, 1882.
1188. Drying, &c., Wheat, J. Walworth, Bradford.—11*th March*, 1882.
1255. Repeating Small-arm, F. J. Cheesbrough, Liverpool.—Com. from J. Nemetz.—15*th March*, 1882.
1288. Incandescent Lamps, J. B. Rogers, London.—16*th March*, 1882.
1362. Permanent Way, A. Riche, Brixton.—21*st March*, 1882.
1387. Valves, W. Teague, Illogan.—22*nd March*, 1882.
1409. Armour Plates, H. Reusch, Prussia.—23*rd March*, 1882.
1468. Fireproof, &c., Plates, C. D. Abel, London.—A communication from J. Nagel.—27*th March*, 1882.
1471. Metallic Packing, W. V. Ley, Liverpool.—27*th March*, 1882.
1618. Electric Lamp, J. B. Rogers, London.—3*rd April*, 1882.
1760. Dynamo Machines, J. B. Rogers, London.—13*th April*, 1882.
1982. Magazines, G. E. Vaughan, London.—A communication from J. Werndl.—27*th April*, 1882.
1999. Accumulating, &c., Electric Currents, J. B. Rogers, London.—27*th April*, 1882.
2087. Sponge Fishing Nets, H. J. Haddan, London—Com. from E. Arapian and L. Isaacs.—3*rd May*, 1882.
2136. Incandescent Lamps, J. Rapieff, London.—6*th May*, 1882.
2263. Secondary Batteries, A. Tribe, London.—13*th May*, 1882.
2352. Perambulators, J. Preston, Stratford-le-Bow.—18*th May*, 1882.
2391. Secondary Batteries, J. Pitkin, London.—20*th May*, 1882.
2394. Pianofortes, S. Peppler, London, and J. Carter, Southampton.—22*nd May*, 1882.
2412. Ground Marker, T. Green, Leeds.—22*nd May*, 1882.
2414. Insulating Materials, J. A. Fleming, Hampstead.—22*nd May*, 1882.
2420. Decorating Walls, &c., W. S. Morton, Edinburgh.—23*rd May*, 1882.
2423. Motors, W. P. Thompson, London.—A communication from S. Marcus.—23*rd May*, 1882.
2424. Steam and Hand Steering Engines, A. W. Pattie and G. W. Robertson, Glasgow.—23*rd May*, 1882.
2426. Bottling Apparatus, F. Foster, London.—23*rd May*, 1882.
2432. Incandescent Electric Lamps, G. G. André, Dorking.—23*rd May*, 1882.
2452. Electric Lamps, J. Wetter, New Wandsworth.—Com. from L. Nothomb.—24*th May*, 1882.
2471. Blue Colouring Matters, R. Meldola, Hackney Wick.—24*th May*, 1882.
2577. Washing and Rinsing Bottles, E. Lofts, Cherry-hinton.—31*st May*, 1882.
2630. Dynamo-electric Machines, A. J. Jarman, London.—5*th June*, 1882.
2662. Kilns, J. Davies, Kearsley Moor.—7*th June*, 1882.
2719 Coupling, &c., Apparatus, W. R. Lake, London.—Com. from E. H. Janney.—9*th June*, 1882.
2744. Dynamo-electric Machines, J. Imray, London.—Com. from J. J. and T. McTighe.—10*th June*, 1882.
2770. Two-wheeled Vehicles, S. Pitt, Sutton.—A communication from P. Herdic.—13*th June*, 1882.

Patents Sealed.

(*List of Letters Patent which passed the Great Seal on the* 16*th June*, 1882.)

5548. Vacuum Pumps, L. A. Groth, London.—19*th December*, 1881.
5551. Armatures, J. H. Johnson, London.—19*th December*, 1881.
5554. Fastening, &c., Window Sashes, B. C. Cross, Dewsbury.—19*th December*, 1881.
5595. Electric Calls for Telephones, &c., A. W. Lake, London.—21*st December*, 1881.
5626. Bleaching and Dyeing Yarns, &c., J. Auchinvole, Glasgow.—23*rd December*, 1881.
5628. Knitting Machines, L. A. Groth, London.—23*rd December*, 1881.
5702. Sockets or Holders for Lamps, J. W. Swan, Newcastle-on-Tyne.—28*th December*, 1881.
5731. Direct-acting Gas Furnaces, R. S. Casson, Brierley Hill.—30*th December*, 1881.
74. Motive-power, W. B. Tibbits, Clifton.—6*th January*, 1882.
103. Bottles, A. and I. Jacobs, London.—7*th January*, 1882.
271. Purifying Grain, &c., H. J. Haddan, London.—19*th January*, 1882.
273. Umbrellas, &c., H. J. Haddan, London.—19*th January*, 1882.
297. Galvanic Batteries, J. and A. J. Higgin, Manchester.—20*th January*, 1882.
324. Kitchen Ranges, H. M. Ashley, Knottingley.—23*rd January*, 1882.
573. Swells for Shuttle-boxes, W. Haythornthwaite, Blackburn.—6*th February*, 1882.
702. Blowing, &c., Apparatus, H. Wilson, Stockton-on-Tees.—13*th February*, 1882.
737. Furnaces, J. H. Johnson, London.—15*th February*, 1882.
858. Preventing, &c., Fires, K. and J. McLennan, and R. Owen, London.—22*nd February*, 1882.
1023. Indicating, &c., the Current of Electrical Generators, T. J. Handford, London.—3*rd March*, 1882.
1127. Treating Flesh and other Animal Matter, J. Imray, London.—8*th March*, 1882.
1139. Electric Machines, T. J. Handford, London.—9*th March*, 1882.
1142. Regulating Electric Machines, T. J. Handford, London.—9*th March*, 1882.
1191. Regulating Electric Machines, T. J. Handford, London.—11*th March*, 1882.
1249. Armatures, C. L. Levey and E. Lumley, London.—15*th March*, 1882.
1418. Weaving Looms, A. Rollason, Manchester.—24*th March*, 1882.
1561. Purifying Coal Gas, J. Walker, Leeds.—31*st March*, 1882.
1593. Gloves, H. Urwick, Wandsworth.—1*st April*, 1882.
1625. Recovering Lead, &c., from Furnace Fumes, E. A. Cowper and T. Sopwith, London.—4*th April*, 1882.
1675. Slide Valves, &c., D. Halpin, London.—6*th April*, 1882.
1933. Life-preserving Mattresses, A. A. Young, Boston, U.S.—22*nd April*, 1882.

(*List of Letters Patent which passed the Great Seal on the* 20*th June*, 1882.)

5587. Barbed Fence Wire, E. G. Brewer, London.—21*st December*, 1881.
5591. Clarifying Liquids, C. H. Roeckner, Newcastle-on-Tyne.—21*st December*, 1881.
5611. Rolling Mills, E. Edwards, London.—22*nd December*, 1881.
5622. Automatic Harmonica, W. P. Thompson, London.—23*rd December*, 1881.
5630. Musical Instruments, J. B. Hamilton, Greenwich.—23*rd December*, 1881.
5636. Watches, C. H. Errington, Coventry.—23*rd December*, 1881.
5639. Electrical Alarm Apparatus, D. S. Garau, London.—23*rd December*, 1881.
5640. Printing Machines, A. Godfrey, Clapton.—23*rd December*, 1881.
5646. Mechanical Musical Instruments, W. P. Thompson, London.—24*th December*, 1881.
5647. Steamships, &c., W. P. Thompson, London.—24*th December*, 1881.
5648. Cut Wire and Wrought Nails, J. Grimshaw, Leeds.—24*th December*, 1881.
5656. Working Electric Clocks, &c., E. G. Brewer, London.—24*th December*, 1881.
5658. Pickers, E. Hollingworth, Dobcross.—24*th December*, 1881.
5676. Blacking, &c., Leather, W. Morgan-Brown, London.—27*th December*, 1881.
5681. Dynamo-electric Machines, J. Richardson, Lincoln.—27*th December*, 1881.
5682. Velocipedes, J. White and J. Asbury, Coventry.—27*th December*, 1881.
5717. Brushes, W. Willeringhaus, London.—30*th December*, 1881.
5718. Wind Musical Instruments, W. P. Thompson, London.—30*th December*, 1881.
5726. Winding Machines, R. and T. Speight, Bradford.—30*th December*, 1881.
5733. Wind Musical Instruments, W. P. Thompson, London.—31*st December*, 1881.
389. Magazine Fire-arms, W. R. Lake, London.—26*th January*, 1882.
552. Knife-cleaning Machines, W. H. D. Jones, Brixton-rise.—4*th February*, 1882.
643. Appliances for Gas Burners, Hon. J. W. Plunkett, Dunstall Priory.—10*th February*, 1882.
955. Reducing and Parting Metals, F. Wirth, Frankfort-on-the-Maine.—27*th February*, 1882.
1158. Reservoir Pen-holders, G. R. Hughes and T. Carwardine, Hampstead.—10*th March*, 1882.

List of Specifications published during the week ending June 17th, 1882.

*313, 4d.; 2439, 4d.; 3865, 2d.; 4697, 6d.; 4823, 4d.; 4839, 6d.; 4901, 6d.; 4918, 8d.; 4926, 8d.; 4931, 6d.; 4933, 2d.; 4948, 1s.; 4849, 2d.; 4954, 6d.; 4962, 6d.; 4968, 6d.; 4972, 6d.; 4974, 4d.; 4980, 2s. 2d.; 4987, 2d.; 4989, 2d.; 4990, 2d.; 4991, 2d.; 4994, 2d.; 4995, 8d.; 4996, 4d.; 4998, 2d.; 4999, 8d.; 5000, 6d.; 5001, 2d.; 5002, 2d.; 5005, 6d.; 5006, 2d.; 5007, 2d.; 5008, 8d.; 5009, 8d.; 5011, 6d.; 5013, 2d.; 5014, 2d.; 5015, 6d.; 5017, 10d.; 5018, 8d.; 5019, 2d.; 5021, 6d.; 5023, 6d.; 5024, 6d.; 5026, 2d.; 5029, 6d.; 5030, 2d.; 5031, 6d.; 5032, 6d.; 5033, 2d.; 5034, 2d.; 5035, 6d.; 5036, 6d.; 5039, 2d.; 5040, 6d.; 5041, 2d.; 5042, 2d.; 5043, 2d.; 5044, 2d.; 5049, 2d.; 5047, 6d.; 5048, 6d.; 5049, 8d.; 5052, 2d.; 5054, 2d.; 5055, 2d.; 5056, 8d.; 5059, 6d.; 5061, 8d.; 5063, 2d.; 5066, 4d.; 5068, 2d.; 5069, 2d.;

5070, 6d.; 5071, 4d.; 5072, 8d.; 5073, 6d.; 5074, 2d.; 5076, 2d.; 5077. 2d.; 5078, 2d.; 5080, 6d.; 5081, 6d.; 5082, 2d.; 5085, 2d.; 5086, 6d.; 5088, 2d.; 5090, 6d.; 5101, 6d.; 5102, 6d.; 5107, 6d.; 5112, 6d.; 5114, 4d.; 5121, 6d.; 5125, 6d.; 5143, 8d.; 5207, 4d.; 5283, 4d.; 5296, 4d.; 5305, 6d.; 5621, 4d.; 249, 6d.; 1013, 6d.; 1190, 8d.; 1196, 6d.; 1224, 6d.; 1292, 4d.; 1300, 4d.; 1499, 6d.; 1552, 4d.

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

ABSTRACTS OF SPECIFICATIONS.

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

2439. PREPARATION AND APPLICATION OF MOSS PEAT, *F. Versmann, New Charlton.—2nd June*, 1881.—(*A communication from E. Meyer and Co., Brunswick.*) 4*d*.

This relates to the preparation for useful purposes of moss peat of the genus sphagnum.

3865. PENTAGRAPH MACHINES, *J. Hope, Providence, U.S.—6th September*, 1881.—(*Void.*) 2*d*.

The First part relates to the stylus or tracing point, which, instead of being permanently fixed to the tracer-carrier, is so attached thereto that it can be caused either to revolve merely upon its own axis, so as to mark a pointing, or to make a small circle, the diameter of which can be graduated or regulated as required. The object of the Second part is to make zigzag lines, and this part of the invention is attached to the main carriage of the machine.

4697. ELASTIC COTTON, *G. G. de Luna Byron, Brighton.—27th October*, 1881. 6*d*.

This relates to treating cotton fibres with superheated steam impregnated with such chemicals as alkalies, potash, alum, or other salts, for the purpose of rendering such cotton elastic.

4823. PHOTOGRAPHIC CAMERAS, *T. Bolas, Chiswick.—3rd November*, 1881.—(*Not proceeded with.*) 4*d*.

This relates to the general construction of the photographic camera.

4839. NUT-LOCKING DEVICE, *S. Danischewsky, Paris.—4th November*, 1881. 6*d*.

This invention relates to a nut-locking device in which spring catches or tongues cut out of a plate interposed between the nut and the piece which serves

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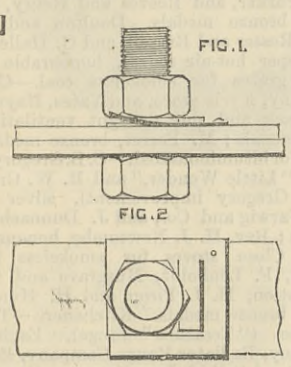

for its bearing or fulcrum, press against the nut with the object of preventing its unscrewing of itself, or shaking loose after having been screwed in place and suitably tightened up. The drawing shows the device with two spring catches or tongues.

4901. VELOCIPEDES, &c., *R. E. Phillips, Westminster.—9th November*, 1881. 6*d*.

This relates, First, to differential driving apparatus; and Secondly, to the method of carrying a lamp on the axle and within a wheel.

4918. RAISING SUNKEN VESSELS, &c., *J. Standfield and J. L. Clark, Westminster,—9th November*, 1881. 8*d*.

This consists, First, in the several forms of grippers and apparatus connected therewith, adapted for laying hold of sunken vessels, and for raising the same; Secondly, in the arrangement of dynamo-electric apparatus, for giving motion under water.

4926. DIGGING AND OTHER MACHINERY FOR CULTIVATING LAND, *T. C. Darby, Chelmsford.—10th November*, 1881. 8*d*.

This relates partly to the construction of digging machines with a series of narrow supporting wheels set upon an axis at short distances apart from one another, and with a series of digging tools radiating out from a shaft parallel with the axis of these wheels, and, as they revolve, entering into the spaces between the wheels.

4931. FLANGING OR BENDING OVER THE EDGES OF METAL PLATES, *J. Lyall, Govan.—10th November*, 1881. 6*d*.

This relates to the construction of apparatus for internal flanging of boiler and other plates, in which a roller or series of rollers fitted on a carrying piece are caused to revolve round a central axis, and to move forward in a direction parallel to their axial line while bearing on and pressing over the internal edge of the plates.

4933. APPARATUS FOR PRODUCING OPTICAL ILLUSIONS, *W. W. Baggally, Kensington.—10th November*, 1881.—(*Not proceeded with.*) 2*d*.

This relates to an apparatus whereby an object placed in a proper position with regard to the said apparatus will be reflected in such a manner that the image or reflection of the said object will be very clearly seen by a person looking into the said apparatus, whilst the object itself is invisible to him, thus producing special illusions of an interesting and amusing character.

4949. APPARATUS APPLICABLE TO WATER CISTERNS, &c., FOR ENSURING A SUPPLY OF WATER DURING FROST, *W. F. Padwick, Redhill.—11th November*, 1881.—(*Not proceeded with.*) 2*d*.

This relates to a heating apparatus applied to cisterns, &c., for maintaining the water above freezing point.

4954. APPARATUS FOR PRODUCING DOUBLE CROSSING MOTION FOR SELF-ACTING MULES FOR SPINNING AND DOUBLING, *A. Metcalf, Preston.—12th November*, 1881. 6*d*.

This relates to the forming of the cops on the "self-acting mules" by a double action of the faller, a corresponding double action of the winding of the yarn on the spindle, whereby the yarn is crossed twice during such stretch of the mule instead of once.

4962. ILLUSTRATING OBJECTS FOR THE TEACHING OF READING, NOTATION, &c., *E. Sykes and C. G. Abbott, Huddersfield.—12th November*, 1881. 6*d*.

This relates to the employment of a series of revolving discs for the purposes of illustrating objects for the teaching of reading, &c.

4968. TRUNKS, BOXES, &c., *W. B. Worger and E. M. Richford, London.—12th November*, 1881. 6*d*.

This relates to a trunk, box, case, or bag fitted with drawers, shelves, trays, or partitions, and constructed with a recess below, above, or at either side of the said drawers shelves, trays, or partitions, in combination with a door or doors working on pivots running in grooves in the said recess or recesses, the said door or doors being received therein when opened.

4972. METALLIC FASTENERS, &c., *W. F. Lotz, London.—14th November*, 1881.—(*A communication from G. W. McGill, New York.*) 6*d*.

This consists in a fastener having two pointed penetrating shanks made of pin wire, and held together in separate parallel positions by a top piece, adapting the shanks to be forced simultaneously through the material to be bound or ticketted, each shank forcing a separate opening in the material for itself, and by reason of its pin-wire form forcing aside the fibres of the material in its entrance without cutting, tearing, or otherwise injuring the same.

4974. APPLIANCE FOR RESTING AND STEADYING THE ARM OF THE MARKSMAN WHEN FIRING A GUN OR RIFLE, *A. H. Atkinson, Worcester.—14th November*, 1881.—(*Not proceeded with.*) 4*d*.

This consists in connecting the hand with the lower portion of the upper arm by a strap ending in two loops, and made adjustable in length by means of a buckle.

4980. EMBROIDERING MACHINES, *A. M. Clark, London.—14th November*, 1881.—(*A communication from Terry and Millet, Lunéville, France.*) 2*s*. 2*d*.

The invention is based on the application to that class of embroidering machine in which the fabric stretched on a frame is shifted by a pantograph at each stitch made, of a combination of needles and shuttles—the needles being placed on one side of the fabric and the shuttles on the other—operating in the same manner as in sewing machines, that is to say, each needle being supplied with a continuous thread from a spool, and receiving alternate rectilinear motion to pass the threads through the fabric, and throw out a loop which is traversed by a shuttle carrying its own thread upon a spool contained within it.

4987. BOXES FOR HOLDING AND MEASURING RIBBONS, &c., *J. Beagarie, St. Neots.—15th November*, 1881.—(*Not proceeded with.*) 2*d*.

The rolls of ribbon are arranged in divisions or compartments in such manner that the ends can be readily passed through narrow openings in the front of the box, through which the ribbons are drawn, and cut off for retail purposes as required.

4989. COMBINED FASTENING AND TASSEL FOR UMBRELLAS, &c., *A. G. Aaron, London.—15th November*, 1881.—(*Not proceeded with.*) 2*d*.

This consists of a band or slip of cord, of elastic or non-elastic material, provided at one end with a button, stud, or one member of any suitable fastening device, and at its other end with a loop, eye, catch, or other member of the fastening device.

4990. MANUFACTURE OF INDIA-RUBBER, *I. Livermore, London.—15th November*, 1881. 2*d*.

This relates to the manufacture of "fine cut sheet rubber" of two or more colours, worked up so as to cause the colours to produce a marbled, mottled, or variegated appearance.

4991. LOCKETS, &c., *C. E. Solomon, Birmingham.—15th November*, 1881.—(*Not proceeded with.*) 2*d*.

This consists in substituting for the ordinary hinge or other joint between the pendant and the body of the locket, &c., a ball-and-socket joint.

4994. TREATMENT OF RESIDUES FROM SOAP FACTORIES, *H. J. Haddan, Kensington.—15th November*, 1881.—(*A communication from P. Py, Meurad, Algeria.*)—(*Not proceeded with.*) 2*d*.

This consists in first subjecting the residues to the action of a hydraulic press to extract the lye, after which the product is are moulded and dried, when it is used for building purposes.

4995. APPARATUS FOR MEASURING AND RECORDING THE SPEED OF VESSELS, &c., *C. E. Kelway and F. Dyer, London.—15th November*, 1881. 8*d*.

This invention relates to improved methods of constructing and arranging the rotating apparatus or log and the frame which carries it, as well as the support in which the frame is arranged, in such manner that the entire apparatus is simple and occupies little room, whilst it can be easily adjusted, either in the position in which it is set in operation and its indications recorded, or in that in which it is withdrawn into the ship and kept secure from injury until again required.

4996. MACHINERY FOR EFFECTING THE SEPARATION OF SOLID BODIES FROM EACH OTHER, &c., *H. J. Smith, Glasgow.—15th November*, 1881.—(*Not proceeded with.*) 4*d*.

The machine is constructed so that two circular or other shaped vessels, provided with inlets and outlets, which may be protected by filtering apparatus, rotated together about the same axis, and whose edges, flanged and so arranged as to obtain close and perfect contact, are brought together or separated during rotation.

4998. DRIVING BANDS, *M. H. Smith and F. Fleming, Halifax.—15th November*, 1881.—(*Not proceeded with.*) 2*d*.

The driving bands or rope belts are of a cross section about equal sides or square.

4999. SEWING MACHINES, *W. Morgan-Brown, London.—15th November*, 1881.—(*A communication from N. Wheeler, Bridgeport, U.S.*) 8*d*.

This relates to improvements on the Wheeler and Wilson machine; and consists partly in a four-motioned feeding device, having an overhanging toothed portion and fixed fulcrum projecting laterally from but one side thereof in the same direction as the said overhanging portion, combined with an arm of a rock shaft, which receives the said stud, the thickness of the said arm and the length of the said fulcrum being sufficient to firmly support the rear end of the feed bar by the fulcrum extended only from one side, and prevent the bar from twisting or turning.

5000. MERCURIAL AIR PUMPS, *C. H. Stearn, Newcastle-upon-Tyne.—15th November*, 1881. 6*d*.

This consists, First, in the combination with mercurial air pumps of an automatic feeding apparatus, whereby the fallen mercury utilised is repeatedly restored to its original elevated source; Secondly, in the combination in mercurial air pumps of a fall tube or fall tubes of less length than the barometric column, with the automatic feeding apparatus, the said fall tube or fall tubes being placed in communication with or enclosed in a tube or receptacle partially exhausted of its air by a mercurial air pump or other equivalent appliance.

5001. APPARATUS FOR FACILITATING THE STARTING OF TRAM CARS, &c., *H. B. White and B. Zieschang, London.—15th November*, 1881.—(*Not proceeded with.*) 2*d*.

This consists generally in applying the draught of the horses or motive power engines employed direct to the peripheries of one or more of the wheels of the vehicle.

5005. VELOCIPEDES, *E. J. Castle, London.—15th November*, 1881.—(*Not proceeded with.*) 2*d*.

This relates to tricycles, the chief object being to construct a machine of this description so that the driving or main wheel thereof may be directly operated by the feet of the rider, as in the case of a bicycle.

5007. MOTOR, *A. M. Clark, London.—15th November*, 1881.—(*A communication from J. Sutcliffe, sen., Huntsville, U.S.*)—(*Not proceeded with.*) 2*d*.

This consists of a tubular lever pivotted on the upper edge of a water tank, the inner or longer end of this lever terminating in a bulb or a hollow vessel, and the outer end connected by a connecting rod with a cog wheel engaging with a pinion on the driven shaft. This rod is connected by means of a second connecting rod with a pivotted box containing a weighted ball or its equivalent, which box is arranged above and attached at the end opposite the one with which the rod connects to a bellows having a flexible tube which leads to the tubular lever.

5008. MANUFACTURE OF CORRUGATED TUBES, *S. Fox, Leeds.—15th November*, 1881. 8*d*.

This consists in the use, for the purpose of bending corrugated metallic plates to the form of tubes, of a machine comprising a combination of three corrugated or grooved rolls, whereof two are main rolls and are arranged to act as gripping rolls, and the third roll is one with similar corrugations to those of the main or gripping rolls, and mounted in bearings on a movable carriage behind the main or gripping rolls, in such a manner that when in operation it so acts upon a corrugated plate under treatment as to form the same into a tube.

5009. MACHINERY FOR MOULDING AND CASTING STEEL, &c., *S. Fox and J. Whitley, Leeds.—15th November*, 1881. 8*d*.

This consists in a centrifugal machine for moulding or casting metal, of the use of a mould, comprising an internal cylinder, an external cylinder or jacket, and interposed refractory material, such mould being provided with ends, each having a liner, between which and the end itself refractory material is interposed.

5011. RAILWAYS AND TRAMWAYS, *J. Livesey, Westminster.—15th November*, 1881. 6*d*.

One part of the invention consists in the formation of a metal chair to be secured to an iron sleeper, only one bolt being required for fastening both the rail and chair to the sleeper, and the slacking of this bolt permitting the rail to be taken out or placed in posi-

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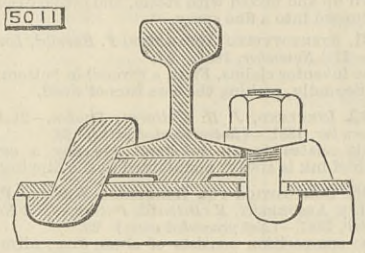

tion. The drawing is a section of the construction adopted in securing a flanged rail on the sleeper. Another improvement relates to the construction of a support for a tramway rail, which at the same time acts as a sleeper to carry the rail, and also as a rest or support for the pavement along the rail side, both vertically and laterally.

5013. LOOMS, *J. Thompson, Blackburn.—16th November*, 1881.—(*Not proceeded with.*) 2*d*.

The First part relates to an arrangement of apparatus which can be readily placed in or out of gear when required for the purpose of lifting the "taking-up catch" every alternate beat of the slay, so as to give a double thickness or solidity when beating or knocking up the headings or cross borders in woven fabrics. The Second part relates to the apparatus for letting off the yarn from the yarn beam, the object being to cause the strain or tension upon the yarn to be always the same, notwithstanding the diameter of the yarn beam decreases as the weaving proceeds.

5014. ENGINES FOR MULTIPLYING POWER, *C. Clowes, Stockbridge.—16th November*, 1881.—(*Not proceeded with.*) 2*d*.

This relates to mechanism for transmitting motion from one shaft to a second shaft, and thence to a third shaft, for the purpose of multiplying the motive power.

5015. COOLING AND REFRIGERATING APPARATUS, *J. F. Littleton, Battersea.—16th November*, 1881. 6*d*.

The invention refers to cooling and refrigerating machines in which a solution of ammonia, ether, or other like gas is evaporated in a generator by fire, steam, coil or otherwise. This gas, after passing through apparatus, such as an analyser, a rectifier,

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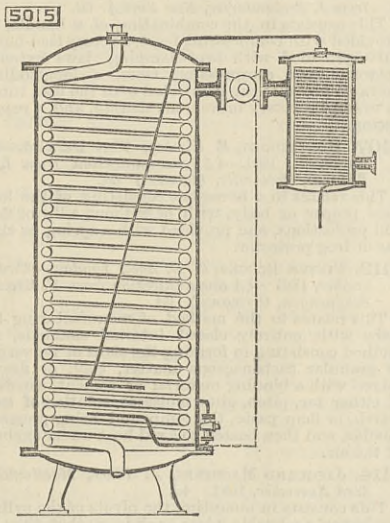

and a condenser, is collected in a receiver, from which it is allowed to flow into a cooler. The communication between the receiver and the cooler is formed so that the liquefied gas, before being allowed to expand in the cooler, is refrigerated by the gas which has previously expanded in the cooler. The drawing shows the manner in which an intensifier is applied to an ammonia machine.

5017. FIRE-ARM, *A. Dardelle, London.—16th November*, 1881. 10*d*.

This relates to a fire-arm or machine gun, so constructed and arranged as to allow of firing forward and during movement at any speed, the angle of fire constantly changing with the movement of the apparatus.

5018. GAS-COOKING APPARATUS, *W. T. Sugg, Westminster.—16th November*, 1881. 8*d*.

This relates to a means of reflecting on to the overlying surface required to be heated for culinary purposes the heat generated by gas-cooking stoves, and for limiting the supply of air to the burners.

5019. TORPEDO BOATS, *H. F. Phillips, Hammersmith.—16th November*, 1881.—(*Not proceeded with.*) 2*d*.

The object is to insure an even keel, by which means the resistance will be reduced, with a consequent increase in the speed of the boat.

5021. SUPPOSITORIES, *B. J. B. Mills, London.—16th November*, 1881.—(*A communication from E. A. Gibbs, New York.*) 6*d*.

This consists of a stoppered hollow suppository formed of butter, cocoa, or analogous material, and adapted to enclose and hold any desired medicament or nourishment, and to be hermetically sealed by heat.

5023. APPARATUS FOR CHARGING THE SYPHONS OF WATER-CLOSETS AND URINALS, &c., *T. G. Messenger, Loughborough.—16th November*, 1881. 6*d*.

This consists essentially in the charging of a syphon and bringing it into action by creating a head of water in an adjoining vessel in free communication with the syphon, said vessel being a receiver, which is of small sectional area compared with the cistern which contains it.

5024. MANUFACTURE OF BICARBONATE OF SODA, *E. Carey, H. Gaskell, jun., and F. Hurter, Widnes.—16th November*, 1881. 6*d*.

The invention consists in employing "salts," or that form of crystallised carbonate of soda which is obtained by "salting down," or, in other words, the evaporation by heat of the solution of soda named in specifications of patents Nos. 2939, 1879; 608, 1881; and 1161, 1881, the said alkaline solutions being first purified by the processes named in the said specifications.

5029. MANUFACTURE OF FELTS, &c., *W. L. Wise, Westminster.—16th November*, 1881.—(*A communication from A. Marthaus, Oschatz, and A. Polster, Dresden.*) 6*d*.

This consists in the method of producing felts and like products or articles from wool, hair, or fibrous material in one process and in a continuous manner by the use of machinery or apparatus, so arranged that the material under treatment is torn, reduced, divided, or separated, and formed into fleece upon a revolving apron by the air-evacuating action of an exhauster, after which such fleece is subjected to the condensing action of rotating rollers, to some of which an endwise reciprocating motion is imparted; and finally, the condensed fleece is subjected to the felting action of rotating rollers, whereof some have reciprocating endwise movement between endless cloth, while pressure, heat, and moisture are imparted to the fleece under treatment, so that the material fed to the machine at one end leaves the machine at the other end as a continuous condensed felt product.

5030. KNOBS FOR LOCKS, LATCHES, &c., *W. B. Shorland, Barton-on-Irwell.—17th November*, 1881.—(*Not proceeded with.*) 2*d*.

The invention consists in forming the bush shank or neck part of the knob or handle, which is to fit upon and be secured to the spindle, of strong metal, such as iron or steel, which is screwed or otherwise secured in a knob or handle of wood or other suitable material of any desired shape.

5031. APPARATUS EMPLOYED IN SPINNING AND DOUBLING COTTON, &c., *M. Dickie, jun., Stockport.—17th November*, 1881. 6*d*.

The principal feature of the invention is that whenever an end or thread breaks the bobbin or spool from which that end proceeds is immediately prevented from revolving, and no further delivery of that particular end or thread can take place until it is "pieced-up," and consequently no "roller-lap" can be formed, and the waste of yarn is thus materially lessened. A further advantage is that no other part of the machine is stopped, and hence a great economy of time and labour is effected.

5032. WORKING RAILWAY SIGNALS, &c., *S. Brear and A. Hudson, Bradford.—17th November*, 1881. 6*d*.

This consists in the use of electrical magnets placed near the top and bottom of signal posts, such magnets being connected by wires to the signal cabin.

5033. MANUFACTURE OF ARTIFICIAL MARBLE, *B. O'Neill, London.—17th November*, 1881. 2*d*.

Equal weights of Portland cement, blue lias cement, cinder or coke dust, and marble dust are mixed with water, in which is dissolved about 1 per cent. of borax. This mixture is run into moulds to give the desired shape.

5034. SOLES AND HEELS OF BOOTS AND SHOES, *F. Hocking, Liverpool.—17th November*, 1881.—(*Not proceeded with.*) 2*d*.

This consists in applying plugs of wood, cane, or other suitable material to the under or outside leather of the soles or heels of boots and shoes.

5035. APPARATUS FOR BOTTLING AERATED WATERS, *J. T. Hayes, Walthamstow.—17th November*, 1881. 6*d*.

This relates to improvements in apparatus used for filling the self-stoppering bottles, and in which the bottle is placed in a frame, turned over partially for filling, and completely turned over for the stopper to fall into the neck of the bottle, the pressure of the gas in the aërated water keeping the stopper pressed against the neck or outlet of the bottle, and securing the contents.

5036. APPARATUS FOR MIXING AND BURNING GAS, *J. A. B. Bennett, King's Heath, and B. P. Walker, Birmingham.—17th November*, 1881. 6*d*.

The drawing shows sectional elevation of the apparatus in one of the commonest forms. A is the nipple ready for connecting to any gas-pipe. The gas

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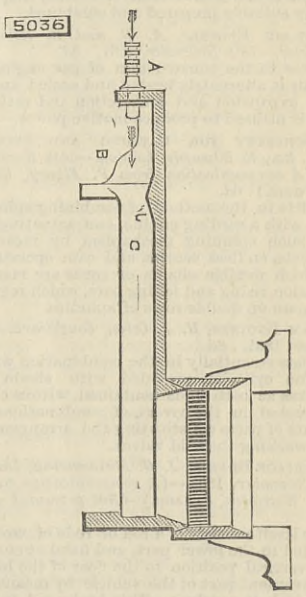


passes through the nipple in the direction of the arrow. The part B is quite open, so that air may freely enter the pipe C with the current of gas as it issues from the pipe A, where it is to some extent mixed with the gas. The cross-bar J stretches from side to side across the duct.

5039. APPARATUS FOR DISINFECTING WATER-CLOSETS, &c., *T. Beddoe, Bermondsey.—17th November*, 1881.—(*Not proceeded with.*) 2*d*.

This relates to the employment of an earthenware globe fitted with chemical compound for disinfecting. On one side of the globe is a pipe leading from the supply water pipe. On the other side is a smaller pipe which leads to the closet pan.

5040. STOVES AND FIREPLACES, *J. B. Petter, Yeovil.—17th November*, 1881. 6*d*.

The stove consists of a nautilus or shell-shaped hood which contains the fuel, gas, or oil used for obtaining heat, and the smoke and heated gases from which pass into the centre or axis of the shell, and are carried thence by one or more flues into the chimney, thus retaining the heat produced in the chamber from which externally a considerable amount of heat is obtained, as well as from the open fire direct in cases where fuel is used, or from the burners direct in cases where gas or oil is used.

5041. MANUFACTURE OF SET SQUARES, *J. Sims, Stoke Newington.—17th November*, 1881.—(*Not proceeded with.*) 2*d*.

The object is to avoid the warping, shrinking, and swelling to which the ordinary wooden set squares and angles as hitherto made are liable.

5042. LOCKS OR FASTENINGS, *G. H. Wildes, Lowndes-square.—17th November*, 1881.—(*Not proceeded with.*) 2*d*.

The object is to provide a spring lock or fastening which can be opened by simply pressing on a stud or button which may be placed in the knob or handle of the drawer, door, or the like, on which the lock or fastening is placed.

5043. WEIGHING MACHINES, *F. H. F. Engel, Hamburg.*—17*th November*, 1881.–(*A communication from J. F. W. Schultze, Hamburg.*)—(*Not proceeded with.*) 2*d.*

This relates to that class of weighing machines wherein the load bridge or platform is supported by levers used for transmitting the play of the bridge or platform to the weigh beam.

5044. CULTIVATION OF LAND, *R. C. Coulson, Stamford.*—17*th November*, 1881.—(*Not proceeded with.*) 2*d.*

This relates to means of simplifying and facilitating the operations of ploughing and harrowing.

5045. APPLIANCES FOR ACTUATING RAILWAY BRAKES, *J. McL. McMurtrie, Glasgow, and H. Smellie, Kilmarnock.*—17*th November*, 1881.—(*Not proceeded with.*) 2*d.*

This comprises a new combination of appliances consisting of an ordinary cylinder and piston connected by the piston rod and levers to the brake block and a new regulating valve operated by the driver or other attendant, and through which steam or compressed air is admitted to and exhausted from the cylinder.

5047. SMITHS' HEARTHS, &c., *A. Wilson, Handsworth.*—17*th November*, 1881. 6*d.*

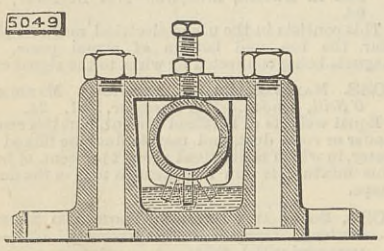
This refers to smiths' hearths and other like furnaces as are heated by the combustion of gaseous fuel, such as is produced by the imperfect combustion of coal and coke, in a chamber or generator which has a limited supply of air, the essential product of the said imperfect combustion being carbonic oxide.

5048. RECOVERING RUBBER FROM RUBBER WASTE, *C. A. Day, Dalston Rise.*—17*th November*, 1881.—(*A communication from N. C. Mitchell, Philadelphia, U.S.*) 6*d.*

This consists in the mode of recovering rubber from rubber waste by first subjecting the mass of waste to the action of hydrocarbon vapour, and then by the action of strong sulphuric or muriatic acid heated at a high temperature.

5049. SELF-LUBRICATING BEARINGS FOR AXLES OR SHAFTS, *W. R. Lake, London.*—17*th November*, 1881.—(*A communication from P. Decauville, Paris.*) 8*d.*

This consists essentially in a lubricating bearing,



in which the lubrication is effected by capillary attraction and by suction caused by a vacuum through pieces of cane or reed dipping into oil placed below the axle or shaft to be lubricated.

5052. ELASTIC PACKING FOR GLAND AND OTHER JOINTS, *A. T. Gibson, Fleetwood.*—18*th November*, 1881.—(*Not proceeded with.*) 2*d.*

A mandril of any desired size is coated with india-rubber or other gum, and then a canvas or other woven fabric is laid volutewise over the rubber or gum with rubber or other gum between the layers, and it is subsequently vulcanised or baked, the mandril having been first withdrawn.

5054. FITTINGS AND FASTENINGS FOR SCARVES, &c., *G. Hopkins, Birmingham.*—18*th November*, 1881.—(*Not proceeded with.*) 2*d.*

This relates to the employment of a curved plate in which a hole is punched, into which the pointed pin enters.

5055. BRICKS, &c., *J. A. Davies, Ebbw Vale.*—18*th November*, 1881.–(*Not proceeded with.*) 2*d.*

This relates to the manufacture of bricks, &c., from slag and clay suitably prepared and combined.

5056. HOT-AIR ENGINES, *A. E. and H. Robinson, Manchester.*—18*th November*, 1881. 8*d.*

This relates to the construction of gas engines in which the air is alternately heated and cooled, and the consequent expansion and contraction and variation of pressure is utilised to produce motive power.

5059. MACHINERY FOR CARDING AND SPINNING COTTON, &c., *E. Edwards, London.*—18*th November*, 1881.—(*A communication from P. Fleury, Gonneville, France.*) 6*d.*

This consists in the method of combining spinning mechanism with a carding engine, and actuating and regulating such spinning mechanism by means of toothed wheels, endless screws, and cam operating a lever, by which flexible chains or cords are made to set in operation rising and falling bars, which regulate the cotton spun on double rows of spindles.

5061. STEAM ENGINES, *H. J. Coles, Southwark.*—19*th November*, 1881. 8*d.*

This consists essentially in the combination with a steam engine cylinder, provided with steam and exhaust valves at both ends contained within chambers constructed in the covers, of combinations and arrangements of parts constituting the arrangements of gear for working the said valves.

5063. CARRIAGE BRAKES, *J. G. Mainwaring, London.*—19*th November*, 1881.—(*A communication from J. Höfken, Westfalen, Prussia.*)—(*Not proceeded with.*) 2*d.*

The brake itself consists of a rod or rods of wood or metal serrated in the lower part, and fixed at one end in a nearly vertical position to the floor of the hinder or other convenient part of the vehicle by means of a bolt upon which it revolves. This brake rod is suitably connected to the brake handle.

5066. MACHINERY FOR SHAPING WOOD, *H. J. Haddan, Kensington.*—19*th November*, 1881.—(*A communication from A. Wenzel, Berlin.*) 4*d.*

This relates to the method of dressing many-sided blocks of wood, consisting essentially in moving a revolving cutter head up and down between piles of blocks held fast by plates and hand levers.

5068. LOOMS, *J. L. Stewart, Bradford.*—19*th November*, 1881.—(*Not proceeded with.*) 2*d.*

This relates to a combination of parts applied to "shedding" apparatus for operating and working the heals or heddles in looms employed in weaving, by which means a positive steady action is given in the upward and downward movement of the heals or heddles, and also a steady and easy action to the engine.

5069. BACKBONES OF BICYCLES, *E. S. Wilson, Egremont.*—19*th November*, 1881.—(*Not proceeded with.*) 2*d.*

This consists in the employment of two (or more) tubes, preferably oval or elliptical in section.

5072. CORN MILLS, &c., *E. Phillips, London.*—19*th November*, 1881. 8*d.*

This consists partly in the employment of a rotating part having a deep annular groove or grooves therein, the sides of which are roughened and formed angular or curved grinding surfaces.

5073. CUTTING AND PULPING TURNIPS, &c., *W. N. Nicholson and W. Mather, Newark-upon-Trent.*—19*th November*, 1881. 6*d.*

Instead of the usual flat disc, a hollow or convex conical disc is used, the knives being so arranged as to cut on the hollow side of the cone. There are arrangements for cutting the last piece in turnip cutters.

5074. TRICYCLES, &c., *G. D. Macdougald, Dundee.*—19*th November*, 1881.—(*Not proceeded with.*) 2*d.*

This relates to the general construction of the machine, the object being to render the propulsion and steering easy, and to decrease the friction in the moving parts.

5076. WINDING GEAR FOR MINES, *P. W. Pickup, Rishton, and J. Pilkington, Accrington.*—19*th November*, 1881.—(*Not proceeded with.*) 2*d.*

The object is to provide an efficient counterpoise to the winding ropes of engines used for raising men, coal, &c.

5077. METERS FOR WATER, &c., *H. H. Banyard, London.*—21*st November*, 1881.—(*A communication from W. Germutz, Vienna.*)—(*Not proceeded with.*) 2*d.*

The water or other liquid enters by the inlet channel, and through a mud reservoir and sieve into a ring channel, and from thence passes through oblique holes into the working room of the meter, and the said holes being bored in a uniform direction, a circular motion is imparted to the water, which actuates the turbine.

5078. DIFFUSING LIQUIDS IN THE FORM OF SPRAY FOR COOLING ROOMS, &c., *G. W. von Nawrocki, Berlin.*—21*st November*, 1881.—(*A communication from P. Lochmann, Schkenditz, Prussia.*)—(*Not proceeded with.*) 2*d.*

This relates to an apparatus in which the liquid is drawn up and mixed with steam, and while discharging turned into a fine spray.

5081. STEREOTYPING APPARATUS, *F. Harrild, London.*—21*st November*, 1881. 6*d.*

The inventor claims, First, a reversible bottom bar; and Secondly, making the core bars of wood.

5082. INKSTAND, *J. H. Kjellgren, Sweden.*—21*st November*, 1881.—(*Not proceeded with.*) 2*d.*

This relates to an inkstand whereby a certain depth of ink is always maintained in the dipping cup.

5085. COMPOSITION FOR RENDERING WRITING PAPER INK ABSORBENT, *E. Detmold, Putney.*—21*st November*, 1881.—(*Not proceeded with.*) 2*d.*

The composition consists of alum, 6 oz.; nitrate of silver, 5 grains; albumen, ½ oz.; distilled water, 1 quart.

5086. KNITTING MACHINES, *H. M. Mellor, Nottingham.*—21*st November*, 1881. 6*d.*

The thread layer is caused to lay its thread on to the dividing sinkers during the time that a previously partially-formed course of work is being completed upon the needles.

5088. FIRE-EXTINGUISHING APPARATUS, *R. C. Tucker, Liverpool-road.*—21*st November*, 1881.—(*Not proceeded with.*) 2*d.*

This relates to the employment of an apparatus at various suitable positions about a building, the apparatus being in connection with a pipe or main constantly charged with water or other fluid for extinguishing fire.

5090. BOTTLES FOR HOLDING AND TRANSPORTING MILK OR OTHER LIQUIDS, &c., *E. Edwards, London.*—21*st November*, 1881.—(*A communication from A. M. Hurel, Theillement, France.*) 6*d.*

This consists in the method of securing the cork in the vessel by means of a transverse hole through such cork, projecting lugs upon the neck of the vessel, and a cord or wire passed through the hole and beneath and round the lugs before its ends are tied or attached together.

5101. MECHANICAL HEELS FOR BOOTS AND SHOES, *A. Steenberg, Copenhagen.*—22*nd November*, 1881.—(*A communication from A. H. Christensen and G. Lund, Denmark,*) 6*d.*

The invention consists in making the bottom part of the heel movable, so that it may be easily turned round when worn on one side.

5102. LEAD AND CRAYON HOLDERS, *J. H. Johnson, London.*—22*nd November*, 1881.—(*A communication from J. Reckendorfer, New York.*) 6*d.*

This consists in the combination of a handle, a tip provided with compressing faces, a rotary lead-holding tube provided with lead-clamping jaws extending between said compressing faces, a longitudinally movable pressure cap connected with the lead tube, so as to impart rotary movement thereto, and a reacting spring.

5107. HORSESHOES, *E. Kimber, West Dulwich.*—22*nd November*, 1881.—(*A communication from L. H. Bellamy, Brockville, Canada*) 6*d.*

This relates to a horseshoe consisting of the horseshoe proper or body, with or without a lip or flange and projections, and provided with a spring or elastic bar or frog protector.

5112. FILTER BLOCKS, *C. D. Abel, London.*—23*rd November*, 1881.—(*A communication from F. Kleeman, Schönengen, Germany.*) 6*d.*

This relates to the method of manufacturing filter slabs with entirely closed internal channels, such method consisting in forming the slabs of pulverulent or granular carbonaceous matter, clay, or fire-clay mixed with a binding material or cement, consisting of either tar, pitch, glue, molasses, solution of sugar, starch, or flour paste, the compound being pressed in moulds, and then heated to a red heat under exclusion of the air.

5114. JACQUARD MACHINES, *A. Place, Macclesfield.*—23*rd November*, 1881. 4*d.*

This consists in mounting the pivots of the cylinder catches on a movable piece or slide, so that they may be moved to and fro in order to turn the cylinder either backwards or forwards as may be required, whilst the loom is at rest.

5121. FOLDING CHAIRS, *L. Field, Birmingham.*—23*rd November*, 1881. 6*d.*

This relates to the construction and combination of parts for collapsing the jointed arms of the chair on the folding up of the chair body, and for raising and supporting the jointed arms of the chair on the opening out or expanding of the chair body.

5125. SCREW SPANNERS, &c., *H. Waters, sen., and A. Vickerstaff, Birmingham.*—23*rd November*, 1881. 6*d.*

This relates principally to the construction of the internally and externally-screwed terminal part of the handle, the fixed internally-screwed tubular part of the handle, and their combination with other parts of the screw spanner or screw wrench.

5143. SMALL FIRE-ARMS, *T. W. and H. Webley, Birmingham.*—24*th November*, 1881. 8*d.*

This relates, First, to the method of constructing the lifter catch, by which the extractor of revolving small fire-arms is worked; Secondly, in the method of connecting and disconnecting the axis of the revolving cylindrical bolt of revolving small fire-arms to and from the block or the fixed barrel of the same; Thirdly, to the method of mounting the revolving cylinders; Fourthly, to the method of ejecting the cases of spent cartridges from breech-loading drop-down small-arms; and Fifthly, in actuating the hand lever of small-arms having concealed or internal hammers, by means of a coiled spring acting in front of the said lever.

5207. UTILISING WASTE OR SPENT LIME OF SOAP AND GAS WORKS, &c., *E. L. Ransome, San Francisco, U.S.*—29*th November*, 1881. 4*d.*

The invention consists in converting the waste material or product into bricks, tiles, building and paving blocks, pipes, and conductors or other articles, by subjecting it to great pressure in moulds or forms of the shape and structure required to produce the given article.

5283. MATERIALS FOR WASHING AND CLEANING, &c., *G. F. Redfern, London.*—2*nd December*, 1881.—(*A communication from H. Buczkowski, Vienna.*) 4*d.*

This consists in treating sheets or leaflets of paper or fibrous or textile material with a soap solution or soap emulsion.

5296. SULPHO-ACIDS, *F. Wirth, Frankfort.*—3*rd December*, 1881.—(*A communication from Kalle and Co., Biebrich, Germany.*) 4*d.*

This consists in the production of sulpho-acids by means of hydrate sulphuric acid in the presence of metaphosphoric acid.

5305. SADDLES FOR BICYCLES, &c., *C. R. B. Hamilton, Greenwich.*—5*th December*, 1881. 6*d.*

The bicycle or other velocipede is fitted with a saddle capable of rising and falling according to the movement of the rider.

5621. TREATING GASES, *F. Wirth, Frankfort.*—23*rd December*, 1881.—(*A communication from Dr. H. Roessler, Frankfort.*) 4*d.*

This consists in the method of producing sulphuric acid and sulphate of copper, and of rendering innocuous deleterious fumes by subjecting gases or fumes containing sulphurous or sulphuric acid while hot and in a fine state of subdivision to the action of oxidising liquids.

249. CLEANING BOOTS AND SHOES, *G. H. Ellis, London.*—18*th January*, 1882. 6*d.*

This relates to the construction of circular or annular brushes, and to the arrangement of the same in pairs back to back.

1013. MAKING LEAD TRAPS AND TUBES, &c., *A. M. Clark, London.*—2*nd March*, 1882.—(*A communication from E. W. Blatchford and C. F. Gates, Chicago.*) (*Complete.*) 6*d.*

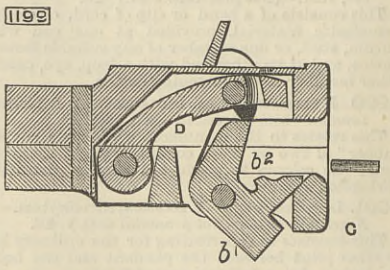
This consists in the construction of a two-plunger machine, said plungers being in line in one cylinder, and combined with a core which allows communication from one side of it to the other, so that when one of the plungers alone is moved the metal will be forced out through the annular orifice from both sides of the core.

1190. SCRAPING, STRIPPING, AND SHAVING CANE, &c., *W. R. Lake, London.*—11*th March*, 1882.—(*A communication from F. F. Raymond.*)—(*Complete.*) 8*d.*

The invention relates, First, to machines or devices for scraping and stripping rattan; and Secondly, to the shaving of the strips, whereby they are reduced to the necessary size.

1196. CAR COUPLINGS, *J. E. Carmalt, Scranton, U.S.*—11*th March*, 1882.—(*A communication from W. R. Thurber, Scranton, U.S.*)—(*Complete.*) 6*d.*

This consists, First, in the combination with the drawhead of a hinged latch and a pivotted angular lever having arms b^1 and b^2, and carrying the pin C, said arm b^2 being arranged at an acute angle to the



pin C; Secondly, in the combination with the drawhead, having the recess A^1 in its upper part, of the latch D hinged in the lower part of the drawhead, and pivotted angular lever conveying the pin, whereby the pivotted latch is adapted to operate within the drawhead, and is protected from the weather.

1224. SEWING AND MANUFACTURING FURNITURE TUFTS, &c., *G. Doolittle, Bridgeport, U.S.*—(*Complete.*) 6*d.*

The object is to provide a means for successfully manufacturing furniture tufts from strands of yarn or other suitable material, the peculiar form of which tuft forms part of the invention.

1292. TREATING AND AMELIORATING ALCOHOLS, &c., *H. A. Bonneville, London.*—17*th March*, 1882.—(*A communication from A. Ralu, jun., Paris.*)—(*Complete.*) 4*d.*

This relates to the treatment of alcohols and alcoholic liquors in a fermented state before distillation with glycerine, and matters of which it consists, and especially with fats or oils of cocoa, muscadine, cocoa nut, palm, or galam.

1300. EMBOSSED WALL PAPER, *A. M. Clark, London.*—17*th March*, 1882.—(*A communication from E. Leissner, New York.*)—(*Complete.*) 4*d.*

This consists in lining the paper to be embossed with a flexible backing, such as felt paper or blotting like paper, in then embossing said lined paper in proper manner, and in then filling the cavities in the back with a cement and covering the entire back afterwards with another paper.

1499. DISCHARGE APPARATUS FOR FIRE ENGINE HOSE PIPES, &c., *W. R. Lake, London.*—28*th March*, 1882. (*A communication from T. S. Mowell, Boston.*)—(*Complete.*) 6*d.*

This relates to discharge pipes for fire engine hose, and to the manner of packing the joints to render them watertight.

1552. MANUFACTURE OF SCREWS, BOLTS, &c., *W. R. Lake, London.*—30*th March*, 1882.—(*A communication from The American Screw Company, (Incorporated), Providence, U.S.*)—(*Complete.*) 4*d.*

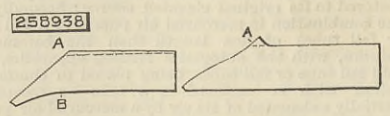
This consists of a screw, bolt, rivet, nail, or similar article having a steel core and a surrounding iron shell welded to the said core.

SELECTED AMERICAN PATENTS.

From the United States' Patent Office Official Gazette.

258,938. MANUFACTURE OF PLOUGHSHARES, *Lewis McKinniss, Decatur, Ill., assignor of one-half to Joseph S. Tait and Felix B. Tait, same place.*—*Filed* 15*th October*, 1881.

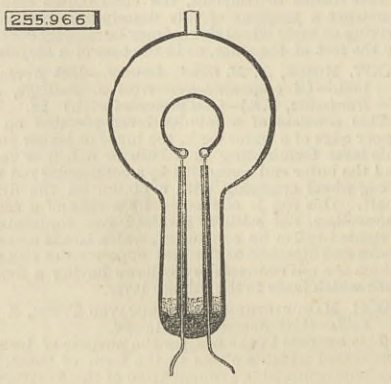
Claim.—The within-described method of manufac-



turing ploughshares, consisting in making the blank with a bold projection A at a point opposite the concave B, and then stoving down said projection, thereby widening and strengthening the share in the concave B, substantially as set forth.

258,966. INCANDESCENT LAMP, *Edward Weston, Newark, N.J., assignor to the United States Electric Lighting Company, New York, N.Y.*—*Filed* 12*th July*, 1881.

Claim.—An electric lamp consisting of a transparent,

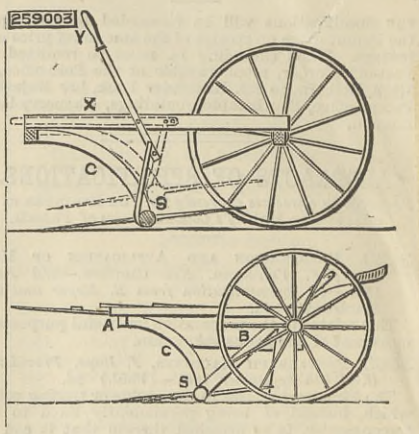


exhausted, and hermetically sealed receiver, surrounding a conductor capable of being rendered incan-

descent, and containing a small quantity of an air-absorbent substance, such as thorina, as and for the purpose set forth.

259,003. HORSE HAY RAKE, *Thomas W. Greene, Lansing, Mich.*—*Filed* 17*th October*, 1881.

Claim.—The combination, with the rake head S, pivotted draw bars C, and the bar B of the main frame,



of the hook A^1, pivotted to the lever A, the lever A pivotted to the bar B, and the fixed pin M adapted to lock the lever Y to the bar X when the rake is elevated, the whole being arranged and adapted to serve substantially as and for the purposes set forth.

SMOKE ABATEMENT EXHIBITION.—The following is the list of awards at this exhibition:—Open grates for bituminous coal.—Brown and Green, underfed grate, gold medal; Clark, Bunnett, and Co., Ingram's grate, with Wallsend and anthracite, and E. H. Shorland, Manchester ventilating grate, silver medals. E. R. Holland, underfed grate, H. E. Hoole, radiating and reflecting grate, Feetham and Co., basket dog grate, J. M. Stanley, hopper bottom fed grate, T. E. Parker, and Reeves and Henry, respirator grate, bronze medals. Doulton and Co., tile grate, Rosser and Russell, and G. Haller and Co., Koblhoper hot-air stoves, honourable mention. Open grates for smokeless coal.—Coalbrooke Company, Kyrle grate, and Yates, Haywood, and Co., back and side draught ventilating grate, silver medals; M. Perret, bronze medal. Close stoves for bituminous coal.—C. B. Gregory, J. Cornforth, "Little Wonder," and R. W. Crosthwaite (with Gregory improvement), silver medals; J. F. Farwig and Co., and J. Dunnachie, bronze medals; Rev. H. J. Newcombe, honourable mention. Close stoves for smokeless fuel.—W. Barton, F. Lönholdt, Musgrave and Co., slow combustion, H. J. Piron, and H. Hunt, Crown Jewel, bronze medals. Kitcheners.—T. J. Constantine ("Treasure" range), Eagle Range Company, Radiator Range Company, Brown and Green, and Falkirk Iron Company (Dr. Siemens's principles), silver medals; Newton, Chambers, and Co. (Thorncliffe range), W. Stobbs (anthracite range), and M. Feetham and Co., bronze medals.

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