ON THE FRICTION OF SHAFTS OR JOURNALS THOROUGHLY LUBRICATED.

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IN a number of THE ENGINEER near the beginning of the present year, there appeared a leading article, entitled "What is Friction?" in which attention was drawn to the new and unexpected light thrown upon this subject by recent experiments, especially those of the Institution of Mechanical Engineers. Having watched this course of experiments from the first, I may, perhaps, venture on endeavouring to supply some sort of answer to the question. Undoubtedly it will not be complete, probably it may be in some respects capable of improvement, but it will at any rate supply a "working hypothesis," which answers fairly to the facts as they stand at present, and may serve as a guide in the progress of further inquiry. The question will at least gain by the clear setting forth of the actual laws which, as a matter of experiment, have been found to govern the phenomena. I shall not at the present moment attempt to deal with the question of friction proper, or friction between dry surfaces, on which further experiment is still urgently needed. Nor shall I attempt to deal with what may be termed "oily" or "moist" friction, as in ordinary lubrication; but shall content myself with examining the only case that is in a fair condition to be approached by theory, namely, that where the supply of the lubricant is practically unlimited, and the lubrication is therefore complete.

This is, perhaps, the most important part of the whole subject of friction, at least as regards practice;* and it is that to which the recent experiments have chiefly been directed. It is covered especially by the "oil bath" experiments of Mr. Tower, detailed in the recent report of the Institution of Mechanical Engineers—"Proceedings" 1883, p. 632—and also by the earlier experiments of Professor Thurston. These agree very closely in their main results, and the laws educed may be formulated as follows:—(1) The coefficient of friction is extremely low, amounting in many cases to 0·001 only, or a mere fraction of the lowest results previously recorded, not merely for dry, but for wet or oily surfaces. (2) The coefficient of friction for moderate pressures and speeds varies approximately as the reciprocal of the pressure. In other words, the actual frictional resistance per surface unit is approximately constant, and therefore if the load is doubled the coefficient of friction —which is the ratio of the resistance to the load—is halved. In dry friction, on the other hand, it is the coefficient which is constant, and therefore the resistance varies directly as the load. (3) As a consequence of the above, the frictional resistance, with constant pressure, varies as the area of contact. In dry friction it is independent of the area. (4) As the velocity of rubbing increases, say, from 10ft. to 100ft. per second, the frictional resistance—and therefore the coefficient of friction, the load being constant—diminishes also; but at 100ft. per second, or thereabouts, a change takes place, and thenceforward the resistance increases as the square root of the velocity increases. (5) As a consequence of the above, the resistance at and near 100ft. per minute is approximately constant, or independent of the velocity. (6) A rise in temperature—within moderate limits—has a marked effect in lowering the coefficient of friction; the coefficient varying approximately in the inverse proportion to the temperature above freezing point of water.

With regard to the evidence for these laws, No. 1 is proved by simple inspection of the tables given in Mr. Tower's report. Thus with olive oil, at 520 lb. pressure per square inch, the coefficient of friction was ·0008 at 157ft. per minute, ·001 at 209ft. per minute, and ·0015 at 419ft. per minute. With lard oil, the coefficient of friction was practically the same as with olive oil. With mineral grease it was ·0010 at 157ft. per minute, but had risen to ·0018 at 419ft. per minute. Sperm oil would not carry 520 lb. per square inch at all; but with 415 lb. the coefficient was ·0015 at 157ft. per minute, and ·0021 at 419ft. per minute. With rape oil the coefficient was again practically the same as with olive oil, and with mineral oil it was only slightly higher, being—with 520 lb. per square inch—·00123 at 157ft. per minute, and ·00178 at 419ft. per minute. The two latter oils, however, stood a somewhat higher pressure, mineral oil taking as high as 625 lb. per square inch nominal load. It must, of course, be remembered that the exceedingly low values thus found for the coefficient of friction are due to the fact enunciated in the second law, viz., that the resistance of friction is independent of the pressure; consequently when the pressure is high, the coefficient becomes necessarily low. For instance, at the lowest pressure of 100 lb. per square inch, and at the highest speed of 419ft. per minute, the coefficient of friction with olive oil and lard oil, instead of being 0·001, as with the higher pressures, was about ·008, while with mineral grease it was ·014. Even these figures, however, are much below the values usually given for the coefficient of friction in lubricated bearings, which in Morin's experiments varied from ·05 to ·09.

We may now proceed to the evidence for the second law —that of the constancy of frictional resistance. This is also shown by a glance at the tables, in which the nominal frictional resistance, as well as the coefficient, is given. The former quantity is found by multiplying the coefficient of resistance by the nominal load per square inch—in other words, by the total load on the bearing divided by its horizontal section in square inches. In this case the journal was 6in. long and 4in. in diameter, so that the nominal load was obtained by dividing the total load by 24. A few instances may again be given. With olive oil, at 209ft. per minute, and with loads varying from 100 lb. to 520 lb. per square inch, the nominal frictional resistance varied between ·512 lb. and ·607 lb. At 419ft. per minute, it varied between ·736 lb. and ·870 lb. With lard oil, under the same conditions, the resistance, at 209ft. per minute, varied between ·47 lb. and ·58 lb.; and at 419ft. per minute, between ·779 lb. and 810 lb. Similar variations occurred with the other lubricants. The differences, considering the necessary difficulties in the observation of such small quantities, are not large, and, what is still more important, they are altogether irregular, their highest values being sometimes at one end of the series, sometimes at the other, and sometimes in the middle. On the whole, it is clear that the law must be admitted as correct for all ordinary pressures and speeds. At the very high pressures carried by the mineral oil and the rape oil, the frictional resistance showed a decided increase; and therefore something like an approximation to the conditions hitherto supposed to be normal ones appeared to hold in those cases.

The third law—that the frictional resistance varies as the area—is merely a deduction from the second, and therefore needs no illustration.

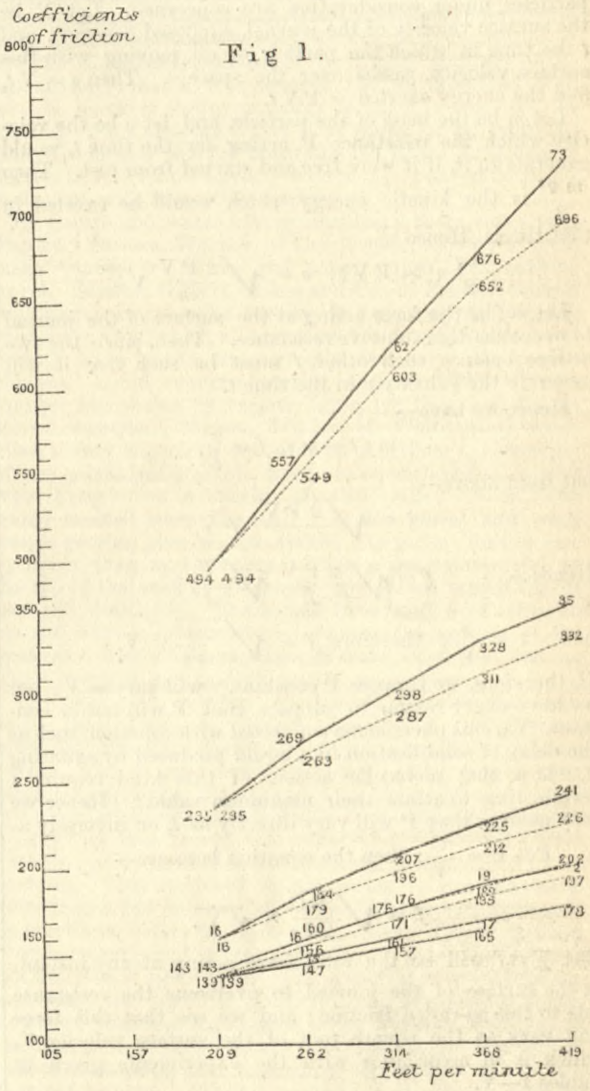
The fourth law—the variation of friction with velocity —is of a more complicated character, and requires further examination. With regard to the first part of the law, namely, that for speeds up to, say, 100ft. per minute, the coefficient of friction is less at higher speeds, we have unluckily no complete figures to refer to. Professor Kimball found that with a wrought iron shaft in a cast iron bearing, an increase of speed from 6ft. to 110ft. per minute caused a fall of 70 per cent. in the coefficient of friction. In another case, with lower pressures, an increase from 1ft. to 100ft. per minute gave a fall in the coefficient from 0·15 to 0·05, or by 67 per cent., which is a result agreeing closely with the former. Professor Thurston found in some cases similar results, while in others the friction appeared to increase with the speed continuously from the commencement. On the whole, however, he comes to the conclusion that the friction does diminish with increase of velocity up to about 100ft. per minute; but the actual figures on which this conclusion is based are not given in detail. Mr. Tower's experiments unfortunately do not begin before 105ft. per minute, and therefore furnish no information as to lower speeds. Between 105ft. and 159ft. per minute his figures show in all cases a decided rise in the friction. On the whole, while the fact of the decrease at low speeds may be admitted, there is nothing to enable us to define its nature or laws; and a comprehensive set of experiments, embracing all speeds from the highest to the lowest, is thus a desideratum of the future.

We now come to the question of the rise in the coefficient of friction, when the speed exceeds the value of 100ft. or 150ft. per minute; and here our data are clear and precise. Professor Thurston, indeed, fails here again to give us detailed figures; and he infers that the increase varies as the 5th root of the velocity. This assertion is disproved, however, by the elaborate experiments of the Institution of Mechanical Engineers, which show quite conclusively that the variation is as the square root of the velocity. To prove this I have taken the first table in their report, that for olive oil, and assuming the speed of 209ft. per minute as the basis—since we are here quite beyond the influence of the supposed change which takes place at 100ft. per minute, or thereabouts—have calculated the coefficients of friction for the remainder of the speeds given, assuming the variation to be as the square root of the speed. The calculated and observed values are placed below each other for comparison in Table I. It will be seen that the two sets of figures agree very closely, and that the differences are sometimes on one side, sometimes on the other, which is the best proof of their being due merely to errors of observation. The only exception is in the last column, relating to the highest speed of 471ft. per minute; here the observed values are throughout higher, and sometimes decidedly higher, than the calculated. Of course, at such high speeds the difficulty of accurate observation becomes greater; in fact, where the very small quantities which had to be observed are considered —the variations in the position of the pointer, from which the coefficients were deduced, being merely $\frac{1}{30}$in. to $\frac{1}{10}$in. —it may well excite surprise that the differences between calculation and experiment are not far larger.

To show that the result is not due to any peculiarity in the lubricant employed, or in the circumstances of one particular set of experiments, I have given in Tables III. to V. similar results for other lubricants, viz., lard oil, sperm oil, mineral oil, and mineral grease. It will be seen that with lard oil—Table II.—the agreement between calculation and experiment is very good at the higher pressures, but that the calculated fall regularly below the observed at the lower pressures—a fact which is also visible, though not so great an extent, with olive oil. With sperm oil—Table III.—the pressure could not be carried as high as 520 lb. per square inch, as the bearing began to seize. The highest pressure is thus 415 lb., and at this the calculated values are throughout higher than the observed. At 310 lb. the observed coefficients are so low as to suggest some error in the experiments. At 205 lb. the two are almost exactly in accordance, but below this the opposite prevails, and at 100 lb.—as in the case of lard oil—the difference at high speeds is considerable. With mineral oil, which is usually looked on as an inferior lubricant to the two former, the results are perhaps the most regular of any. The coefficient of friction itself, it should be observed, is slightly higher than with olive oil at the highest pressure, but is equal, or even lower, at moderate pressures; whilst the agreement between observation and calculation, even up to the highest speeds, is very close and satisfactory. To exhibit this more clearly, the figures have been plotted, as per accompanying Fig. 1, and curves drawn through the points. It is difficult for any one, looking at this diagram, to avoid the conclusion that, to a very close approximation at least, the law which expresses the variation of friction with speed is that of the square root. Lastly, mineral grease, as shown by Table V., shows practically the same law of behaviour. The absolute values of the coefficient of friction are, indeed, higher; on the other hand, the lubricant is able to support a pressure of 625 lb. per square inch, which was beyond the power of any of the oils tried; and at this high pressure the coefficient of friction was well-nigh as low as any recorded. The variations between the observed and calculated results, as regards changes in speed, are also very slight, except at the lowest pressures as before. On the whole, the results go very far to confirm the wisdom of those railway engineers who have retained the use of grease for their vehicles in preference to oil, especially for cases where high bearing pressures are to be expected.

We have thus established the fourth law with which we started, viz., that the coefficient of friction increases with the velocity, and at a rate which is, approximately at least, the same as the square root of that velocity. The fifth law—that the coefficient is nearly constant at about 100ft. per minute—is a mere deduction from what has preceded. The sixth—the variation of friction with temperature—has been noticed as to its general results by Professor Thurston and others, and is brought out strikingly by Table IX. of the Institution of Mechanical Engineers' experiments, giving the coefficients of friction observed with a bath of lard oil, with a fixed load of 100 lb. per square inch, but with speeds varying from 105ft. to 471ft. per minute, and temperatures varying from 120 deg. to 60 deg. Fah.

The actual law under which the variation takes place has not been previously stated, so far as I am aware. It is, however, shown very clearly by Table VI., in which Table IX., mentioned just above, is reproduced, with an addition of figures given by calculation. The true law is masked in the original table by the fact that the temperatures are given on the Fahrenheit, not the Centigrade scale. When the latter is substituted, it is at once seen that the figures expressing the coefficients of friction are approximately in the inverse proportion of those represent-



ing the temperature. On calculating the coefficients by this hypothesis, the figures given in the table, below those observed, were obtained. It will be seen that in the bulk of the table the two coincide very closely indeed. In the two last columns—419ft. and 471ft. per minute—the calculated figures fall decidedly below the observed. This, it will be seen, was also the case with the calculations on the subject of velocity, and this tends to strengthen the suspicion that at these very high speeds the apparatus, owing to vibration or some other cause, may have given results which were somewhat too high. At 60 deg., on the other hand, the calculated figures are decidedly higher than the observed, even in the last two columns, though the difference in some cases is not large. But on the whole the agreement of the observations with the calculations is sufficient to prove that the law of the coefficient varying inversely as the temperature is at least approximately correct.

Certain theoretical conclusions as to the nature of friction, in the case of lubricated surfaces, may perhaps be deduced from these results. In the first place, it is evident that the phenomena are altogether different from those that obtain in the case of "dry friction," when two unlubricated surfaces are in contact with each other. Hence we may assume that, in the present case, the surface of the journal and bearing are divided from each other by a film of oil sufficiently thick to prevent their coming in contact; that this film is divided into two rings, one adhering to the moving journal, the other to the stationary bearing; and that the resistances, here called by the name of friction, are really those which occur at the bounding surface where these two rings meet each other. This is, in fact, the conclusion to which engineers have generally come from practical experience; and it is confirmed by a curious fact which occurred in the course of Mr. Tower's experiments. It was found that when a small hole was drilled down from above, through the brass bearing on which the load rested, the oil rose in this hole, and could not be kept from

* There seems to be an impression that this complete lubrication is impossible in practice. There seems, however, no reason whatever why this should be the case, and at any rate it forms the ideal state of things to which we should try to approach as closely as possible.

doing so, except by the application of a very great pressure —more than 200 lb. per square inch in that particular case. This proves the existence, at the point of greatest pressure between journal and bearing, of a film of oil capable of sustaining that pressure, and of being slowly squeezed out by it where an opening presented itself. It is clear that this film cannot be wholly at rest, but must be recruited from the oil bath below through the action of the rotating journal; otherwise the film would almost immediately have been squeezed out, and thus the whole of the journal would have become dry and would have seized.

We are, therefore justified in assuming that there is, in the case of a completely lubricated journal, such as we are considering, a film of oil adhering to the outside of the journal, and another film adhering to the inside of the bearing. These two films are constantly sliding or shearing one past the other at the surface speed, whatever that may be, of the journal.

It is natural, therefore, to attribute the so-called friction to the adhesion or shearing resistance which is known to exist to some extent in all fluids, even water, but which is much higher in the case of a heavy oil, such as is used for lubricating. We may treat this adhesion as being merely a cohesive attraction between the stationary and moving particles of the oil,* an attraction which is considerable at small distances, but diminishes rapidly to nothing as the distance increases.

Suppose P to be the mean value of this cohesive resistance, and that it lasts while the moving particle of oil is traversing a distance s. Then $P s$ is the amount of energy expended in overcoming this resistance, so far as the two particles under consideration are concerned. Let V be the surface velocity of the journal, supposed constant, and t the time in which the particle of oil, moving with this surface velocity, passes over the space s. Then $s = V t$, and the energy exerted $= P V t$.

Let m be the mass of the particle, and let v be the velocity which the resistance P, acting for the time t, would generate in it, if it were free and started from rest. Then $\frac{m v^2}{2}$ is the kinetic energy which would be exerted in that time. Hence

$$\frac{m}{2} v^2 = P V t; \quad v = \sqrt{\frac{2 P V}{m}} \sqrt{t}.$$

Let $m f$ be the force acting at the surface of the journal to overcome this cohesive resistance. Then, since the two actions balance each other, f must be such that it will generate the velocity v in the time t.

Hence we have—

$$m f t = m v, \quad f = \frac{v}{t},$$

but from above—

$$v = \sqrt{\frac{2 P V}{m}} \sqrt{t}.$$

Hence—
$$f = \sqrt{\frac{2 P V}{m}} \sqrt{\frac{1}{t}},$$

but $t = \frac{s}{V}$; therefore $f = \sqrt{\frac{2 P}{m s}} \times V.$

If, therefore, we suppose P constant, f will vary as V; but we have every reason to suppose that P will not be constant. Various phenomena connected with cohesion, such as the delay of solidification in a liquid produced by agitating it, show that molecular actions of this kind require a certain time to attain their maximum value.† Hence we may assume that P will vary directly as t, or inversely as V. Put $P = \frac{C}{V}$; then the equation becomes—

$$f = \sqrt{\frac{2 C}{M s}} \times \sqrt{V}.$$

But $\sum m f$ will be the total force acting at any instant, at the surface of the journal, to overcome the resistance due to this so-called friction; and we see that this force will vary as the square root of the surface velocity V, which is in accordance with the experiments given in Tables I—V.

It is easily seen that this theory is also in complete accordance with the laws laid down from experiment at the beginning of this paper. We may take these in order. (1) The coefficient of friction is very much lower than in ordinary or dry friction. This is to be expected, because the shearing resistance of such a liquid as oil is also very low. The value of this adhesion might be perhaps determined by calculation from these results; but this would certainly need to be checked by direct experiment. (2) The actual frictional resistance per unit of surface is independent of the pressure. This agrees with the hypothesis; for fluid being incompressible, the external pressure will not draw the stationary and moving particles nearer to each other, or cause any alteration in the energy needed for separating them. (3) The resistance varies as the area in contact, independently of the pressure. Since it arises from the adhesion between the moving and stationary films, which adhesion will go on all over the separating surface, this will obviously be true. (6) The fact of the decrease of the coefficient of friction in inverse proportion to the rise in temperature may at first sight seem difficult to reconcile with this theory. It might be supposed that the expansion of the liquid with increasing temperature was the cause of the variation. But as the coefficient of expansion is a very small quantity, it seems impossible that, if this were the cause, the coefficient should vary inversely as the temperature, *e.g.*, that if the temperature be doubled the effect should be halved. We must have recourse, therefore, to the fundamental conception of temperature, as given us by the mechanical theory of heat—namely, that it represents the amplitude of the molecular vibrations, or, for vibrations of the same period, the mean velocity of the vibrating particle. As the time of such vibrations is exceedingly short, a great number of them will occur during the period in which the moving particle of oil is traversing the space s, and during which the stationary particle is supposed to act upon it. Let O A represent the time t of this action, set off along the axis of x, and draw from each point ordinates to represent the distance between the stationary and moving particles at that instant. Let P Q represent the locus of these ordinates on the supposition that the particles have no vibratory motion. Then if we knew the law of force, we could calculate from this diagram the energy expended by the stationary particle, on the assumption that there is no vibration. But, as a matter of fact, there is vibration, and the true form of the locus will be the wavy line $P\,a\,b\,c\,d$. In other words, there will be continual and very rapid changes in the distance between the two particles. But, as we have seen, the force between them requires time to develope its maximum power under any change of circumstances. Consequently this kind of oscillation will practically tend to diminish the magnitude of the force acting as a resistance between the particles, and approximately in the inverse ratio of the amplitude or velocity of vibration. But if the resistance is diminished, the force required to overcome the resistance will be diminished in the same proportion. In other words, this force will vary inversely as the temperature, which by experiment it is found to do.

FIG 2

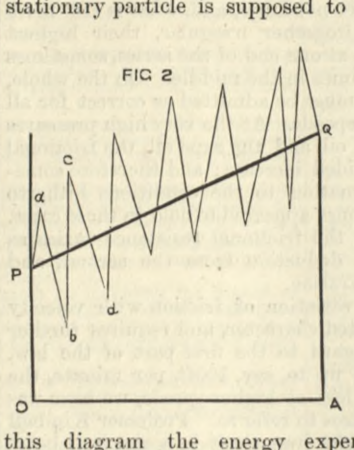


TABLE I.—*Bath of Olive Oil, Temperature* 90 *deg. Fah.*

Nominal load lb. per sq. in.	Coefficients of friction, for speeds as below (feet per minute).	209ft.	262ft.	314ft.	366ft.	419ft.	471ft.
520	Observed	·0010	·0012	·0013	·0014	·0015	·0017
	Calculated	·0010	·00118	·00123	·00132	·00141	·00150
468	Observed	·0013	·0014	·0015	·0017	·0018	·002
	Calculated	·0013	·00145	·00159	·00172	·00184	·00195
415	Observed	·0014	·0015	·0017	·0019	·0021	·0024
	Calculated	·0014	·00157	·00172	·00185	·00198	·0[illegible]210
363	Observed	·0016	·0017	·0019	·0020	·0022	·0025
	Calculated	·0016	·00179	·00196	·00212	·00226	·00240
310	Observed	·0017	·0019	·0021	·0022	·0024	·0027
	Calculated	·0017	·00190	·00208	·00225	·00240	·00255
258	Observed	·0020	·0023	·0025	·0026	·0029	·0031
	Calculated	·0020	·00224	·00245	·00265	·00283	·003[illegible]0
205	Observed	·0025	·0028	·0030	·0033	·0036	·0040
	Calculated	·0025	·00276	·00306	·00331	·00353	·00375
153	Observed	·0035	·0040	·0044	·0047	·0050	·0057
	Calculated	·0035	·00387	·00429	·00463	·00495	·00525
100	Observed	·0055	·0063	·0069	·0077	·0082	·0089
	Calculated	·0055	·00611	·00674	·00728	·00778	·00825

TABLE II.—*Bath of Lard Oil, Temperature* 90 *deg. Fah.*

Nominal load lb. per sq. in.	Coefficients of friction for speeds as below (feet per minute).	209ft.	262ft.	314ft.	366ft.	419ft.	471ft.
520	Observed	·0010	·0011	·0013	·0015	·0015	·0017
	Calculated	·0010	·00118	·00123	·00132	·00141	·00150
415	Observed	·0014	·0015	·0016	·0018	·0019	·0021
	Calculated	·0014	·00157	·00172	·00185	·00198	·00210
310	Observed	·0017	·002	·0022	·0025	·0026	·0029
	Calculated	·0017	·00190	·00208	·00225	·00240	·00255
205	Observed	·0023	·0028	·0031	·0034	·0039	·0042
	Calculated	·0023	·00257	·00282	·00304	·00325	·00345
153	Observed	·0032	·0037	·0041	·005	·0051	·0052
	Calculated	·0032	·00357	·00392	·00423	·00453	·00480
100	Observed	·0050	·006	·0067	·0076	·0081	·009
	Calculated	·0050	·00555	·00612	·00661	·00707	·00750

TABLE III.—*Bath of Sperm Oil, Temperature* 90 *deg. Fah.*

Nominal load lb. per sq. in.	Coefficients of friction for speeds as below (feet per minute).	209ft.	262ft.	314ft.	366ft.	419ft.	471ft.
415	Observed	·0017	·0018	·0019	·002	·0021	·0021
	Calculated	·0017	·00190	·00208	·00225	·00246	·00255
310	Observed	·0012	·0014	·0016	·0017	·0018	·0019
	Calculated	·0012	·00134	·00147	·00159	·00170	·00180
205	Observed	·0018	·0021	·0023	·0024	·0025	·0027
	Calculated	·0018	·00201	·00220	·00238	·00255	·00270
153	Observed	·0023	·0028	·0030	·0033	·0[illegible]35	·0037
	Calculated	·0023	·00257	·00282	·00304	·00325	·0[illegible]345
100	Observed	·0038	·0044	·0051	·0057	·0061	·0064
	Calculated	·0038	·00425	·00465	·00503	·00537	·00570

It might be suggested that another cause would still further diminish the resistance at high temperatures. It will be observed that the ordinate of the wavy line $P\,a\,b\,c\,d$ becomes greater than A Q before a is reached; and as A Q is supposed to be the limit of distance, beyond which the two particles do not act on each other, it follows that this action will cease at an earlier and earlier period, as the temperature becomes higher, and will, therefore, be less in amount. But when we consider the enormous rapidity of the vibrations of heat, it is clear that at any ordinary speeds this effect will be quite imperceptible.

Another objection may be alluded to, namely, that if the force between the two particles acts to retard the motion of the shaft when they are receding from each other, it will act equally to accelerate it when they are approaching each other; and thus the net effect will be *nil*. But it must be remembered that the moving particle is not rigidly fixed to the shaft, but is easily separable from it; hence the effect of the attraction, when the two are approaching, will probably be almost entirely to draw the moving particle further from the shaft and nearer to the stationary particle. It will not appear, therefore, as a force accelerating the shaft as a whole; whereas the resistance to separation must ultimately be overcome by the external force tending to turn the shaft.

TABLE IV.—*Bath of Mineral Oil, Temperature* 90 *deg. Fah.*

Nominal load, lb. per sq. in.	Coefficients of friction for speeds as below (feet per minute)	209ft.	262ft.	314ft.	366ft.	419ft.
lb.						
625	Observed	·00139	·00147	·00157	·00165	
	Calculated	·00139	·00156	·00171	·00185	
520	Observed	·001[illegible]9	·0015	·00161	·0017	·00178
	Calculated	·00139	·00156	·00171	·00185	·00198
415	Observed	·00143	·0016	·00176	·0019	·002
	Calculated	·00143	·00159	·00176	·00189	·00202
310	Observed	·0016	·00184	·00207	·00225	·00241
	Calculated	·0016	·00179	·00196	·00212	·00226
205	Observed	·00235	·00269	·00298	·00328	·0035
	Calculated	·00235	·00263	·00287	·00311	·00332
100	Observed	·00494	·00557	·0062	·00676	·0073
	Calculated	·00494	·00539	·00603	·00652	·00696

TABLE V.—*Bath of Mineral Grease, Temperature* 90 *deg. Fah.*

Nominal load lb. per sq. in.	Coefficients of friction for speeds as below (feet per minute).	209ft.	262ft.	314ft.	366ft.	419ft.	471ft.
625	Observed	·0012	·0014	·0014	·0016	·0018	·002
	Calculated	.0012	.00134	·00147	·00159	·00170	·00180
520	Observed	·0016	·0018	·0019	·002	·0021	·0022
	Calculated	·0016	·00179	·00196	.00212	·00226	·00240
415	Observed	·0019	·0021	·0023	·0025	·0026	·0027
	Calculated	·0019	·00212	·00233	.00251	·00269	·00285
310	Observed	·0026	·0029	·0032	·0035	·0038	·004
	Calculated	·0026	·00287	·00318	·003[illegible]4	·00368	·00390
205	Observed	·0040	·0047	·0053	·0058	·0062	·0066
	Calculated	·0040	·0047	·00490	·00529	·00565	·006[illegible]0
153	Observed	·0048	.0057	·0065	·0071	·0077	·0083
	Calculated	·00[illegible]8	·00537	·00588	·00635	·00679	·0072

TABLE VI.—*Variation of Friction with Temperature.*

Temperature. Cent.	Temperature. Fah.	Coefficients of friction for speeds as below (feet per minute).	105ft.	157ft.	209ft.	262ft.	314ft.	366ft.	419ft.	471ft.
48·9	120	Obsd.	·0024	·0029	·0035	·0040	·0044	·0047	·0051	·0054
43·4	110	Obsd.	·0026	·0032	·0039	·0044	·005	·0055	·0059	·0064
		Calcd.	·00271	·00327	·00394	·00448	·00496	·00530	·00575	·00610
37·8	100	Obsd.	·0029	·0037	·0045	·0051	·0058	·0065	·0071	·0077
		Calcd.	·00311	·00375	·00453	·00516	·00569	·00608	·00660	·00699
32·2	90	Obsd.	·0034	·0043	·0052	·0060	·0069	·0077	·0085	·0093
		Calcd.	·00364	·00439	·00532	·00608	·00668	·00714	·00775	·00820
26·7	80	Obsd.	·0040	·0052	·0063	·0073	·0083	·0093	·0102	·0112
		Calcd.	·00440	·00531	·00641	·00732	·00806	·00861	·00934	·00989
21·1	70	Obsd.	·0048	·0065	·008	·0092	·0103	·0115	·0124	·0133
		Calcd.	·00556	·00672	·00811	·00928	·01012	·01089	·01182	·01252
25·6	60	Obsd.	·0059	·0084	·0103	·0119	·0130	·0140	·0148	·0156
		Calcd.	·00752	·00909	·01110	·01252	·01379	·01473	·01599	·01693

There is still one fact as to friction, of those stated at the beginning, which we have not considered, namely, that at low speeds the coefficient does not increase, but, on the contrary, diminishes with increasing velocity. This, indeed, is not so clearly proved as the others; but admitting its truth, it must obviously be due to some other cause than that hitherto treated of. This may, perhaps, be found in the fact that each particle of oil in passing from the edge to the centre of the bearing, passes from a region where the pressure is low to a region where it is high. This high pressure will act to drive back the oil as it advances, and a certain amount of force will be required to overcome it. Thus let s be the length of the particle's path, from edge to centre of bearing; and let the pressure in this space vary from 0 to P. Then, if we assume that the pressure increases uniformly from edge to centre, the pressure when the particle has traversed a distance s will be $\frac{P}{S} s$, and this will have to be overcome through the distance ds. Hence the total energy expended by the pressure in resisting the advance of the particle of oil will be represented by the integral of $\frac{P}{S} s\,ds$ between O and S, or will be $= \frac{P S}{2}$. Let V be the velocity of the shaft, as before, and v be the velocity with which the particle of oil arrives at the centre; then $m \frac{V^2 - v^2}{2} = \frac{P S}{2}$.

Now this diminution of the velocity of the particle of oil will cause it to slip through a certain distance along the shaft in the opposite direction to the motion, and thus produce a certain amount of energy retarding the rotation. This energy will be proportional to the distance slipped, and therefore to $V - v$; but from above,

$$V - v = \frac{P S}{m} \times \frac{1}{V + v}.$$

Thus, this energy will be inversely proportional to the velocity of rotation nearly—since v will not be very different from V. It will therefore be considerable at low velocities, but will rapidly diminish, and at high velocities will be inappreciable in comparison with the adhesive resistance already considered. This is in accordance with observation.

It may, perhaps, be allowable to hope that the theory thus developed may be considered as supported, by its

* It is here assumed that there is no regular or continuous gradation from the stationary to the moving layer, the one being attached to the bearing, and the other to the shaft.

† Of course this need not imply that the force is actually a function of time, but that the molecules take a certain time to arrange themselves so as to produce their maximum effect.

agreement with experiment, sufficiently to be at least worth using as a working hypothesis in future investigations of this important question.

WALTER R. BROWNE.

MISCELLANEOUS MACHINERY AT THE ROYAL AGRICULTURAL SHOW AT SHREWSBURY.

AMONGST the machinery not referred to in our last impression was much modern milling plant. The construction of this class of machinery has already become an important industry in this country, although there is yet a considerable quantity imported from America. The reason for this does not seem at first sight obvious, neither is it wholly explained on investigation. An American machine may be seen, with a legend as long as a local time-table intended to show how that particular wonder in mechanical art is hedged in by the protecting arm of the American Patent-office, by the side of a similar English machine which does not boast and probably cannot lay claim to any such official protection. This importation will probably diminish as the English millers grow more accustomed to high milling requirements, and make it worth the while of the manufacturers of such excellent machinery as that shown by Messrs. Hind and Lund, Messrs. Thos. Robinson and Son, and others, to construct machines of the kind. We do not suggest that there is not great credit due to the American milling machinists for the completeness with which they have considered every point in the history of a grain of wheat from the time it reaches a milling establishment to the time that it is in the bakehouse, for it must be admitted that they have not only done this, but have provided machinery in accordance with this complete study. This, however, does not make it any the more necessary that we should import American machinery; but there is no doubt that some of those milling engineers who are doing this at present will cease to do so when further experience in this comparatively new trade has more definitely shown what are likely to be permanent requirements. The process of selection and survival of the fittest is markedly observable in the history of the modern roller milling plant with the refinements in the division of the milling process into so many parts, which came into existence almost suddenly in this country. The Milling Exhibition of 1881, in London, forms a prominent mark in the history of this modern radical change in a very old industry and its appliances. The roller mill and its accessories had at that date gained some hold even in this country, and enterprising milling engineers and millers had looked upon the new comer as one that was no mere visitor, but one that had come to stay. Yet, in the three years which have followed that exhibition changes have occurred, and with them millers have in increasing numbers adopted the new system. The gravitation of the milling trade of the country, which with steam power had for some time been drifting from the small millers into the hands of those with larger capital, is being wonderfully hastened by the new system, which requires still more capital. High-class flour is more than ever in demand, and, except perhaps in London and a few country places, people will have it, with the result that country millers have to buy the high-class flour from others. This obtains in most parts of England, though not equally in all parts, as, for instance, in Suffolk and Norfolk, where the good quality of the wheat still enables the local millers to satisfy requirements; but even in these counties the windmills which used to be seen at every turn are decreasing in number, and as they fall out of repair are not being renewed. Some of the processes through which wheat is now passed would have seemed absurd in the eyes of our forefathers. The machines which have for some time been considered essential, such as smutters, dusters, cleaners and separators, add much to the capital required to stock a mill, while the grain washers and dryers help again in this direction. Yet now that washing the grain is practised, and it is seen that even after passing through the separator much dirt is removed in the process, it is recognised that to clean grain before eating it is as necessary as cleaning any other edible. The millers have been led to do it not so much from this consideration as from the desire to produce white flour, which is now understood to mean in great measure clean flour. Amongst a large quantity of milling machinery exhibited by Messrs. J. Walworth and Co., Bradford, was a grain washer for washing foreign wheats, and capable of cleaning from ten to twenty sacks per hour.

Mr. W. Gardener, of Gloucester, exhibited a number of machines, amongst which was a new three-high roller mill, arranged so that the feed roll can be stopped instantaneously, and so as to work on two different kinds of middlings at the same time. The mill is driven by one belt, and the gearing runs in oil, the frame being made so that the rolls can be taken out without taking the frame to pieces or taking the wheels off. The rolls are separately adjustable, though all are simultaneously separated by one lever attached to a double excentric. He also exhibited one of Odell's eight-roller mills, with some recent improvements, made especially to meet the requirements of small mills, with a capacity of from twenty to seventy sacks per twenty-four hours. Of mills of this small size there are large numbers, and as the owners must adopt, at least in some measure, the new system, mills of this kind will no doubt be extensively required. It contains four pairs of 7in. by 14in. rolls, all of which are driven with one belt from the power shaft, each pair provided with an independent hopper and feed mechanism. Each pair of rolls is provided with separate adjustments for setting and tramming them, and all four pairs may be simultaneously spread apart, and the feed cut off by one movement of a hand lever. By means of one adjustable tightener pulley, the machine can be instantly stopped or started without disturbing the driving belt.

Messrs. Robinson and Son, Rochdale, exhibit some fine new machines, characterised by the good style of design and good work which marks their machinery for other purposes. To some of these machines we shall return on another occasion.

Mr. C. Hopkinson, of Retford, exhibited some good milling machinery at work, but his attendant seeing us make a note, jumped to the conclusion that we wanted to copy the roller mill (a good simple two roller mill for middlings or bran, and fitted with a very simple form of adjustment, stop feed, and means of instantaneously separating the rollers); and refused to be communicative, and not seeing Mr. Hopkinson afterwards, we gathered nothing about his machinery except what was visible.

Mr. J. Harrison Carter exhibited a large number of machines, including his disintegrators, and some well designed roller mills made by Messrs. E. R. and F. Turner, of Ipswich.

Messrs. Hind and Lund exhibited some well designed and excellently well finished machinery, including a new purifier specially made to deal with coarse semolina, the features of which, however, we could not describe without drawings.

It is a noteworthy fact that nearly all the chilled rollers used in roller mills made by English manufacturers are bought from American founders. It is said that satisfactory rolls cannot be made in this country. Surely this ought not to be the case, and even if it has hitherto been so, it ought to pay some of those who are experienced in chilled roll making to turn their attention to this matter, seeing that roller mills are so rapidly gaining favour.

The usually extensive show of grinding mills by Messrs. E. R. and F. Turner was this year very small, in consequence of the double fees now charged by the Society for these mills; but as small stone grinding mills are even yet used a good deal for grist work, and as the Society at one time gave prizes for mills of this kind, and as metal mills for gristing work are admitted as agricultural machines, Messrs. Turner feel much aggrieved by the action of the Society. They observe that if stone mills are to be classed as non-agricultural, there are many other things, including large compound engines, which should be similarly classed.

The Willesden Waterproof Paper and Canvas Company had a fine display. In a recent impression we fully described the process employed by this company. It will be enough to say here that copper is dissolved in liquid ammonia. The paper, canvas, &c., is passed through the solution, and dried in a steam-heated chamber, and so rendered waterproof. Special methods of forming roofs and buildings have been designed to meet the demands made by waterproof paper on the constructive ability of the company, and with very great ingenuity and success. Their exhibits included a large hay barn, 45ft. by 22ft.; a silo roof, 30ft. by 10ft., in three sections, on rails; a light adjustable rick cover, 24ft. by 12ft., suspended between two poles; various houses, pipes, and other articles too numerous to mention. The strength and waterproof qualities of the material were illustrated by a small overshot water-wheel, with buckets of Willesden paper.

Several specimens of silos were shown by different makers. One by Messrs. J. and F. Howard, of Bedford, seemed to be very successful. The principal feature in it is that the cut grass is not pressed down by anything but its own weight. The cover of the silo is rendered air-tight by a water-seal round the edge of the lid or roof.

A somewhat interesting competition was carried out with machines for filling silos. The competitors were Messrs. Crowley, Richmond and Chandler, Burlingham, Bust, Maynard, Albaret, Carson and Toone, and Lister. The principle of all the machines is the same. The grass or other material to be converted into ensilage is cut up by revolving knives—chaff cutters, in fact—and the cut grass is then delivered automatically into a cart, bags, or the silo pit. All the competitors used rotary knives. The difference between the various machines lay in the mode of elevating the cut stuff. The most powerful and expensive machine shown was that of M. Albaret, of Liancourt, Ratigny, Oise, France. In this a large cast iron fly-wheel is mounted with four curved knives, taking the place of spokes, and a number of vanes about 7in. square. The whole is enclosed in a box. The stuff is fed up to the knives by an endless web in a trough and proper feed rollers and a pressing block; a long delivery spout elevator is fixed to one end of the box, which box plays the part of a fan case. The current of air caused by the vanes as the cutters revolve, blows the cut stuff through the delivery spout, which is set to stand at a considerable height from the ground. The machine shown by Messrs. Carson and Toone delivers the cut stuff at the bottom of the rotary knife case on to a travelling web elevator. Richmond and Chandler's machine delivers at the bottom on to a horizontal endless web, which conveys it to a web elevator running in a trough. Messrs. Bust's knife wheel is fitted with fan blades, which deliver on much the same principle as that of Albaret's machine. Lister's machine is a similar combination of chaff-cutter and fans. It is not necessary to describe any of the machines minutely, as the judges did not consider that any of the competitors had produced just what was wanted, their award posted in the showyard running, "We have carefully tried the whole of the machines entered in this competition; we have not found any single machine that completely meets the conditions under which the prize was offered, viz., for an efficient machine for cutting and elevating materials to be preserved in silos. We consider, however, that Messrs. Richmond and Chandler's machine is deserving of high commendation for the efficiency of its arrangements for cutting materials." Some hard things have been said of the judges for withholding the prize. We confess, however, that our sympathies are with the judges. They were painstaking and fair to the last degree. The breaking down or choking of the machine did not disqualify it. The exhibitors might repair or re-adjust it as much as they pleased, and then come up for trial again. As a matter of fact, nearly all the machines broke down in some way. In one, some of the vanes were broken off, in another the delivery elevator was choked, and so on. We refrain from mentioning names. All the machines were more or less susceptible of improvement. They represent what can be done by ingenuity groping in the dark for want of experience. They were first attempts, and while as first attempts they were satisfactory and successful, there was not perhaps one which would really meet the wants of the farmer. The evidence of want of skill in dealing with a new material in a new way was apparent. On the whole, the knives did the cutting very well. The chaff-cutter is not a new thing, and because concerning cutting there was plenty of experience available, errors in proportion, or in shape of knives, or in strengths of parts were not visible; they did not exist; but this cannot be said of the delivery arrangements. It is a new thing to pass tons of cut grass through a fan. One machine, for example, cut up and delivered a ton of wet grass in 7 minutes 6 seconds. No one quite knows what is the proper shape of blade, or its right area, or curvature, or strength. Several blades were bent during trial. Indeed, hardly a single machine came out of the competition scatheless. Those who used elevators did not quite know what size to make them or how fast to run them. It is surprising that the results obtained were as good as they were. One competitor put in a machine that had never been tried until it came up for competition. The blowing principle seems to be right, but it wants development. The system of testing was as follows:—One of Messrs. Aveling and Porter's 6-horse power crane engines supplied the power. An integrating dynamometer was interposed between the engine and the machine to be tested, which was supplied with 1 ton of cut rye and the same weight respectively of green oats, tares, and gorse. Machines which did well with one material sometimes failed completely with the others. The integrating dynamometer showed the force expended. We may here point out that this dynamometer has not been cleaned or overhauled for several years, and is by no means in good order. Nothing, indeed, but the practised skill and experience of Mr. Courtney, Messrs. Easton and Anderson's representative, enabled good results to be obtained with it; and we should not like to pledge ourselves for the minute accuracy of its indications. As a comparative test it answered well enough, however, being probably as much in error for one machine as for another. But it is much to be regretted that a great and wealthy body like the Royal Agricultural Society should follow a penny-wise-and-pound-foolish policy in dealing with its testing machinery.

Of pumps and water lifting machinery there was a poor display. Messrs. Warner, of Cripplegate, showed a great many pumps for horse and other power, but nothing novel. Messrs. Gilbert Gilkes and Co., of Kendal, showed centrifugal pumps and a turbine in action, apparently the very same with which all shows of the Royal Agricultural Society have made us perfectly familiar. Of garden engines, liquid manure pumps, and such-like a large number was shown by various firms, but they call for no special mention. Messrs. Wilder, of Wallingford, exhibited a very ingenious set of well machinery, consisting of two galvanised buckets, fixed one at each end of a wire rope, hung over a species of clip pulley in an iron frame erected over the well. A belt wheel and very simple gearing give motion to the clip pulley, first in one direction, then in the other. As each bucket rises full to the top of the well it is caught by a hook, which tilts it over and empties it. The bucket in turning over comes in contact with a lever, which reverses the motion of the machine. The whole machine is very ingenious, and no doubt it would be found efficient in many places.

Railways and railway appliances, suitable for farm work, were shown by Messrs. Decauville and Fowler, while Mr. Fleeming Jenken sent one span of his telpher system, and a good working model. The single span could not, of course, be worked, but the model attracted a great deal of attention, and would have attracted more but for the fact that power was supplied by a 20-cell Grove battery, quite unsuitable for the work it was called on to perform. This rendered it impossible to run the model more than a few minutes at a time, lest the battery should be run down before the showyard closed. Telpherage has been so recently and fully described in our pages that we need not describe it again here. The invention is in its infancy, and may yet perform great things. We cannot think, however, that the high-speed motor adopted, hung below the line, in a situation where it is liable to get dirt spilled into it in loading and unloading the buckets is the best that can be used. What is wanted is a disc motor, running at a slow speed, say 600 revolutions per minute, instead of the Ayrton and Perry motor, which is not well adapted for this particular kind of work.

A feature of novelty was this year introduced by the Society, in the water supply of the Show ground, by the adoption, for the first time, of the Norton's "Abyssinian" tube well system. The quantity of water needed was 15,000 gallons per hour, to obtain which Messrs. Legrand and Sutcliff, of London, furnished eight 3in. "Abyssinian" tube wells. These were driven 20ft. apart, about 21ft. deep, and connected by branch pieces to one 5in. cast iron main or receiver, with a central 6in. outlet, to which was attached the suction pipe of a steam pump, which forced the water up into a tank about 800 yards distant, thence to be distributed in the usual way by hydrants throughout the grounds. An abundant supply of beautifully clear, cool water was thus secured.

TENDERS.

STRATFORD-ON-AVON SEWERAGE WORKS.

E. PRITCHARD, M.I.C.E., engineer, London and Birmingham. Contract No. 2.—For the manufacture and erection in Stratford of gas engines and pumps.

Name.	Amount. £	s.	d.	Engines.	Pumps.
Coalbrookdale Company.	1918	0	0	2 of 6-H.P. Otto	ram
Piercy and Co., B'ham	1660	0	0	,,	reciprocating
,,	1620	0	0	3 of 6-H.P. Clerk	,,
,,	1400	0	0	3 of 8-H.P. Otto	centrifugal
Causer and Co., Soho	1327	0	0	3 of 6.H.P. Otto	reciprocating
Glenfield Co., Kilmarnock	1291	0	0	,,	,,
,,	1271	0	0	3 of 6.H.P. Clerk	,,
Crossley Bross., Man.	1276	0	0	3 of 6-H.P. Otto	centrifugal
,,	1149	15	0	,,	ram
Tangye Bros., B'ham	1216	0	0	,,	centrifugal
,,	1066	10	0	4 of 4-H.P. Robson	,,
Pratchitt, Carlisle	1180	0	0	3 of 6-H.P. Otto or Clerk	ram
*Ball and Horton, Stratford-on-Avon	1062	17	0	2 of 6-H.P. Otto	centrifugal

* Accepted.

GERMAN REGULATIONS AS TO THE CONSTRUCTION OF IRON BRIDGES.

AT a meeting of the German Association of Architects and Engineers held in October, 1881, the question of normal regulations for the delivery of iron structures for bridges and buildings was discussed. The subject was then referred to the Saxony Association, for the drawing up of a series of regulations on the subject. The matter has since that time been under consideration, and during last autumn the work projected was accomplished.

In the scheme drawn up—signed by Messrs. Centner, Ehrhardt, Fränkel, and Fritzsche—the question of bridge construction has been treated in a comprehensive manner; less attention having apparently been given to that portion of the subject which refers to building work. The following is a summary of the principal features of the scheme in question, given in detail by the *Wochenblatt für Architekten und Ingenieure.*

I. Technical basis of construction: (A) *Intrinsic weight of the structure;* (B) *Alterable vertical load.*—(*a*) In railway bridges this is represented by a train consisting of three of the heaviest locomotives in prospective use, and an unlimited number of loaded goods trucks. (*b*) The traffic on road bridges consists of foot passengers and carriages. For main girders of bridges, of about $65\frac{1}{2}$ft. span, concentrated loads upon one or two axles are more unfavourable than the burden of a crowd, but in larger bridges the latter is the most unfavourable. This last-named pressure can as a rule be estimated at about 82 lb. per square foot, but in cases of a compact crowd the pressure may be as high as 114 lb. per square foot. The prospective burden of carriages has to be estimated according to the probable character of the vehicles and the description of roadway; the portion of the roadway not covered with vehicles being supposed to be filled with a crowd. In some cases regard must be paid to a probable load of street locomotives. (*c*) In buildings the movable burden of the floors, burden of snow on the roof and wind pressure. (*C*) *Horizontal forces.*—(*a*) The wind pressure acting horizontally may be estimated for the loaded bridge at $30\frac{3}{4}$ lb. per square foot, and for the unloaded bridge at $51\frac{1}{4}$ lb. per square foot, or, in a specially exposed situation, even at $57\frac{1}{4}$ lb. per square foot. (*b*) In curved railway bridges the effect of the centrifugal force for the maximum speed of the trains has to be taken into consideration. (*D*) *Allowable requirements of the material used in the construction.*—The employment of the formulæ founded on Wöhler's tests* is suggested, but the following strengths are mentioned as maximum requirements:—Welded iron, 7·625 tons per square inch; steel, 11·5 tons per square inch. Wide flanged welded iron I girders—where the width of the flanges exceeds that of the German normal profile—even if they have only to support a fixed load, should not be required to stand a test of above 5 tons per square inch in tension. In calculations affecting rivets there should not be more strength claimed than about 3·75 tons per square inch of rivet section. Cast iron should be required to stand tests for extension of 1·625 tons per square inch, and for pressure of 4·75 tons per square inch.

II. Preparation of contract drawings and calculations.—*III. The preparation of working drawings.*—The drawings and calculations on which a contract is based are, as a rule, prepared by the building authorities, and when the adjudication takes place the contractor receives attested copies. If these are—apart from the general plan—on the scale of one-twenty-fifth to one-twentieth of the natural size for entire main girders, and one-tenth the natural size for the details, no further working drawings are required. Any defects arising in the work are not to be excused on the ground of want of clearness or imperfections in the drawings. Any changes suggested by the contractor are to be notified within a given period. When special working drawings have to be prepared by the contractor, they are to be submitted in duplicate to the building authorities within a given time after the adjudication. Any purchases of materials or other steps taken before the approval of these working drawings are at the contractor's risk. The calculations as to weight are in most cases prepared by the authorities and annexed to the contract. If they are in accordance with the dimensions shown in the drawings no further calculations of weight are required, but the contractor is bound to examine them. Should approximate weights only have been given, the contractor is bound to send in within a given time in duplicate an exact calculation of weights. The following standards of weight are to be taken as a basis:—Cast iron, $452\frac{3}{8}$ lb. per cubic foot; wrought iron, $486\frac{1}{4}$ lb. per cubic foot; steel and ingot iron, $490\frac{5}{8}$ lb. per cubic foot.

IV. Selection, quality, and testing of the materials.—(*a*) The bearing portions of the structure, such as the main girders, cross girders, and intermediate girders, as well as all portions which are liable to deflection, are in general to be made of wrought iron. It is recommended in bridge building to use wrought iron instead of cast iron columns. As to the use of mild steels, caution is advised in the present conditions of methods of manufacture. (*b*) The definition of the quality of the material of the construction must be governed by its working capabilities. (*c*) The wrought iron used must at least possess the qualities specified in the conditions of classification issued in May, 1881, by the Association of German Ironworks. As to mild steel and ingot iron, tests can hardly be specified on account of the insufficiency of experience relating to them. The cast iron portions must be cleanly made of grey soft iron in the prescribed dimensions. They must contain neither blisters, holes, fissures, nor any other defects. The minimum strength must be—against tension 7 tons per square inch; compression, 38 tons per square inch. Cast iron columns and supports are tested up to double the burden for which they are constructed. The minimum thickness of metal for cast iron columns is $\frac{3}{8}$in.

V. Cleaning and painting.—Previous to the separate parts being put together—plates, bars, &c.—the rust and hammer slag are to be removed from the iron. The mode of cleaning is left to the contractor's option, but he must give notice of what it is, and is responsible in the instance of chemical cleaning for any subsequent rusting arising from want of care in the removal of the acids used. The cleaned portions are to be coated with a varnish of boiling hot linseed oil, which must be thin and quick in drying. Until dried, the portions thus coated must be properly sheltered. The building authorities are at liberty to arrange for a provisional acceptance when the rivetting is completed, after which the grounding of the parts may be effected with a protecting ground paint. For this purpose a varnish of linseed oil with red lead is recommended, but the operation must not take place during damp weather in the open air. This provisional acceptance is not any agreement on the part of the building authorities as to the correctness of the measurements or the number of pieces in the construction. The larger portions are only to be grounded on the building site after revision. After the iron portions are in position, all the joints are to be carefully filled up, at the surfaces of contact, with a putty composed of white lead and linseed oil varnish, and a grounding of red lead is to be applied to the heads of the rivets driven in on the building site. Besides, all spaces between portions of the construction where water might accumulate have to be carefully filled up with asphalt. The entire construction subsequently receives from the building authorities a second coat of oil paint. Should the zincing—galvanising—of any portions be prescribed, it should be effected by a strictly uniform coating. The portions thus treated should be capable of being bent until they break without the zincing, *i.e.*, what is incorrectly called galvanising in this country, becoming detached. The coating of zinc must be as free as possible from lead.

VI. The manufacture and putting together o, the separate parts.—All the parts of the construction must exactly correspond with the drawings and fulfil the following conditions:—(*a*) The portions fastened with rivets or screws must fit closely together. (*b*) All iron portions must be rolled or forged out of one piece of iron, and not be formed by the welding together of separate pieces. Any exceptions have to be specified. (*c*) Angles and bending are to be avoided as far as possible. (*d*) The rivet holes must correspond as to diameter and position with the drawings. The holes which are drilled at the building site should be about $\frac{1}{25}$ of an inch narrower than the diameter of the rivet requires, so that a good fit is ensured after its being enlarged. (*e*) All screw holes and rivet holes are to be carefully drilled. (*f*) Where several holes meet each other in the parts to be united, a horizontal dislocation of not more than 5 per cent. of the diameter of the hole is allowable. The holes must, however, be made perfectly equal with the rimer, and not by filing on one side. Rivet bolts of proportionately large size must be used in holes thus enlarged. (*g*) The rivets are to be inserted at a bright red-heat—after being carefully freed from scales—into the duly cleared rivet holes in such a manner that they are quite firm after the head is completed. (*h*) After the rivetting, it is to be tested whether the rivets are quite firm. All that are not firm or do not correspond with the above-named conditions are to be removed and replaced by others. No further driving is under any circumstances to be permitted in the cold state. In the putting together of the parts, care is to be taken that none of them is forced into a one-sided tension. Should any portions become distorted in the rivetting, the connections must be loosed and the faults carefully remedied.

VII. Extent of completion in the workshops.—In all parts not to be rivetted in the factory, provisional screw bolts must be inserted. Rivetting upon the building site is to be confined to the smallest possible extent, and, therefore, the completion of all possible parts of the work at the factory is recommended.

VII. Suspension of the execution and acceptance of the work in the workshop.—The building authorities have the right of constant or occasional skilled supervision of work in the workshops, and the necessary appliances and force for tests and examinations must be furnished to them, or obtained by them at the contractor's expense. All portions not according to the prescribed regulations, or otherwise unserviceable, are to be marked in such a manner that their subsequent employment in the structure may be recognised. The examination of the iron material and the control of the execution in the workshop does not prevent the rejection of the work delivered, during or after the erection of the structure, if defects show themselves.

IX. The mode of ascertaining the weight.—For the purpose of computation all parts of the structure should, if possible, be weighed, but when this is impracticable, a certain number of objects selected by the building committee should be officially weighed for the purpose of obtaining reliable indications regarding the total weight of the structure. The computation then takes place according to the agreed prices on the basis of the total weight as ascertained, if the latter does not exceed the original computed weight by more than 3 per cent. If the excess of weight is more than 3 per cent., the contractor is only paid for 3 per cent. extra. Any shortness in weight is deducted. Portions of a structure which are more than 5 per cent. above the estimated weight, or more than 2 per cent. under it, can be at once rejected.

X. The stonework of bridges.—The bed stones are delivered to the contractor in the correct position of altitude, and the middle line of the bridge construction is marked on the pillars in a distinct manner. The contractor is supposed to ascertain by his own measurements, before the erection begins, the exact dimensions, and to control the same according to the drawings, reporting any differences to the building authorities, and awaiting their decision; otherwise the contractor is liable for any ultimate difficulties. The contractor is specially bound to carry out the correct and exact placing in position of the main girders. The masons' and stone-dressers' work in connection with the final works is looked after by the building authorities, who likewise provide the necessary materials.

XI. The erection on the site.—The methods to be employed in the erection of the ironwork and of the scaffolding are generally left to the judgment of the contractor, but the building authorities have the right in letting out the contract to stipulate for a certain mode of erection. The machinery for hoisting and other appliances have to be supplied by the contractor at his own expense. As the erection of scaffolding, &c., is subject to local regulations, the building authorities are to give the contractor in the conditions for delivery all available information, and plans, &c., bearing on this point, as also upon the question of land and water transport for materials, &c. Plans of the scaffolding—scale 1 : 100—are to be submitted within a given time after the adjudication—by the building authorities to the local officials for examination and approval. Those parts of the masonry on which the bed-plates are to be placed should be put at the disposal of the contractor a given time before the date fixed for the completion of the ironwork. Should the masonry not be ready, the contractor must be apprised of the altered circumstances, but any compensation under this head must be a stipulation of the contract. The officials charged with the supervision of the erection are authorised to satisfy themselves in any way they wish as to the quality of binding materials not yet tested. A repetition of tests for strength already carried out in the workshops can only be ordered by the building authorities in special cases. The contractor is bound to follow the instructions of these officials within three days, but has the right of appeal to the building committee. In urgent cases the officials have the right to order the suspension of the work, but if it is found on appeal to the building authorities that such a course was not justified, the contractor is entitled to compensation for any injury he has sustained, and the period of suspension is added to the time originally fixed for the execution of the work.

XII. The testing and acceptance of the completed work: (a) super-elevation of girders.—Truss and lattice girders, &c., are laid with a camber, which is computed upon the principle that after the work is finished and the load has produced its natural effect, there should remain a camber equalling half the bending which would have been produced by a similar moving load.

(b) Tests for load.—These vary according to the purposes of the structure. Railway bridges are tested by a train being placed on each of the lines. This train consists of three of the heaviest goods engines available, the first with the chimney in front and the two others with the chimneys in opposite direction to each other, and loaded goods trucks of the heaviest description in use upon the railway in question. These trains are placed upon that portion of the bridge which corresponds with the greatest momentum, and the amount of deflection after six hours is measured in the centre of the main girders and at the main piers. The train is then removed and the amount of permanent deflection of the girders is ascertained. Finally the bridge is crossed at the maximum speed allowed upon the line, and the amount of transitory and permanent deflection is ascertained. For testing road bridges a testing weight is brought upon the roadway and the foot-paths, where it is left for twenty-four hours. A row of the heaviest loaded vehicles which have been provided for in the construction of the bridge is driven step by step over it, and is then allowed to rest half an hour upon it. In both cases the transitory and permanent deflection of the main girders is ascertained, as previously explained. The marching of men in time, as well as the rapid driving of vehicles over the bridge, are not excluded, but must be provided for in the conditions for the construction. The most unfavourable combination of the burdens of the separate openings is produced with continuous girders. A small permanent deflection after the removal of the first trial load cannot be attributed to any defect in the construction if no permanent deformation of the separate parts of the work can be proved. Further trials should, however, not produce any further deflection. The measured elastic deflection with fixed and moving loads must not in any case exceed the computation by 15 per cent. Any differences in temperature which may have intervened should be regarded in such tests. All defects which are rendered visible by the tests, and which can be traced to faulty execution or to the materials used, are to be remedied by the contractor within a period fixed by the building authorities. The tests for burden are carried out at the expense of the building authorities. The examination of the work with a view to its acceptance as a whole should take place within a given period of its completion. The contractor remains answerable for a certain period as to the normal condition and the good and proper execution of the work. It is suggested that a year is a suitable period.

* See THE ENGINEER, August 11th, 1883.

CRUISER FOR THE SOUTH AUSTRALIAN GOVERNMENT.

THE South Australian colonies have now attained to such a degree of importance that their respective Governments, with the consent of the Colonial-office, are taking steps to provide for the defence of their own coasts. The commerce of the antipodean colonies has prompted the colonists not to rely entirely upon the mother country. Another incentive to the formation of defensive forces has arisen in the shape of a strong public feeling against France, owing to the attitude she maintains on the convict question. Prominent colonial politicians now repeatedly declare that the people of Australia are desirous of being able to protect their shores from whatever direction the foe may come. They do not hide the fact that the only enemy to their peace is France, and, in the formation of a colonial fleet, the feeling of self-assertion has been a leading factor. Only two or three months ago, two useful gunboats were delivered to the South Australian Government by the eminent Newcastle firm of Sir W. G. Armstrong, Mitchell, and Co. These were the Albert and Victoria, both vessels calculated to be of good service in coast and harbour defence. A few weeks ago, there were launched at the Low Walker shipyard of the same firm two gunboats for the Government of Queensland. A further step in the same direction has now been taken by the construction of the Protector, a heavily armed cruiser, for the South Australian Government. This war vessel recently underwent her speed and gun firing trials off the mouth of the Tyne. She is a vessel of the small cruiser type, having scarcely a thousand tons displacement. Her dimensions are as follows:—Length, 180ft.; breadth of beam, 30ft.; depth, 16ft.; mean draught of water, 12ft. 6in. She is schooner rigged, with topsail forward, and forward she has a hurricane deck. The vessel is subdivided into numerous water-tight compartments, while her magazine, engines, and rudder head are all well below water line. She is constructed of steel; and along the water line has in addition a streak of steel plating an inch thick. On deck there is a conning tower, in which is placed steam steering gear, and also telegraph tubes by which the captain can control the vessel entirely from this shelter. Her armaments constitute her the most formidable vessel of her size afloat. Forward, and projecting over the hurricane deck, she carries an 8in. 12-ton gun, while astern she has a 6in. gun, and on each broadside two more 6in. guns. The broadside guns are placed on sponsons which afford room for a large amount of training. The 8in. gun in the bows has about 15 deg. of training, and the 6in. in the stern has almost all-round fire. In addition to these powerful guns, she carries five Gatlings of the Accles improved feeder type. This little weapon is worked in a very simple manner by a single gunner. The elevation and direction of the gun is decided by means of a wooden lever which the gunner holds under his left arm, and the crank is turned by the right hand. In an instant the direction or elevation of the gun can be altered, while, by simply turning the crank at his will, the gunner can fire single shots or volleys over any range up to 2000 yards. In 2·6 seconds no less than 104 shots can be fired, and no less than 1200 shots have been fired in one minute by this handy Gatling. All the guns, including the Gatlings, have been manufactured by Messrs. Sir W. G. Armstrong, Mitchell, and Co., and it need hardly be said that they display admirable workmanship. Each of them is provided with a steel shield, $1\frac{1}{4}$in. thick, for the protection of the gunner. Indeed, the Protector is provided with all that is requisite for a war vessel of her type. She left the ordnance works at an early hour and proceeded down the river for Shields. During the trial, she was manned by a crew supplied by the builders; but her own crew, a fine body of men, sixty in number, were also present to render assistance. She steamed well out until she had gained sufficient sea room for gun firing. The testing of her various weapons was then gone through, and gave the most complete satisfaction in every respect. With regard to the vessel's speed, over a four hours' run she attained a mean speed of 14·15 knots, and as she was built to run 14 knots, the result was highly satisfactory. The vessel is provided with twin screws, which are driven by horizontal direct-acting engines. The machinery worked smoothly throughout, and an indicated horse-power of about 1600 was obtained.

HAVING introduced the modern system of roller milling in his Woodside mill, Mr. J. F. Milner determined to have the best light, and has now adopted electric lighting. The mill is run day and night. The installation consists of one Crompton-Burgin compound self-regulating dynamo machine and about ninety Swan 20-candle lamps. It is also intended that there shall be an arc lamp on each side of the mill, for loading purposes; these will be of the Crompton-Crabbe double differential type of 2000-candle power. The machine is placed on the top floor, where it is driven by a small separate engine, which, although intended to drive the hoist, answers for driving the generator, as it can always be kept running if desired. The generator is driven by a countershaft, at a speed of 1400 revolutions per minute. The loss by fire in corn mills has increased from £42,000 in 1877 to £154,000 in 1883; but the adoption of the electric light will, it is believed, be a great step towards reducing this risk and the present high insurance rates. The work has been carried out under the superintendence of Mr. J. T. Baron, on behalf of Mr. Wilson Hartnell, Leeds.

to know how Mr. Gibson and the other gentleman will settle between them how both their lifts is each better at all points than the other.

Being, then, a dispassionate individual, with at least a modicum of engineering knowledge and some aptitude in hydraulics, I cannot help smiling, even to the degree of broad grins, when I read the lucubrations of those who claim that their lifts are economical or the reverse. They actually fail to see that there can be no question about economy, though there be some about the thing termed net efficiency, the nature of which they seem not to comprehend—yet to the smaller tyros of engineering it ought to be known—that thing which for obscure yet perchance wise purposes, has been hidden even from Mr. Gibson, namely, that so long as a given weight has to be lifted by a given weight of water under a given pressure, the quantity of water that must be used is as fixed and unalterable, as is the appetite of lions for lambs, or the desires of builders to put streets on end. If a lift is mounted on the top of a ram, the only loss of efficiency will lie in the friction of the leather collars, that of the water in the pipes, and the loss of sufficient *vis viva* at each end, and such a lift made must have a higher efficiency or do more useful work than a rope lift such as that of the American Elevator Company.

But the true way to economise is to reduce the load to be lifted, and that can be done by making folks descend in the lift as well as go up in it. It is by no means to be supposed that all the people who go up in lifts stay up. A few may, peradventure, walk down stairs, but I understand that in New York no one who goes up in a lift ever comes down save in a lift, unless, indeed, he fall out of window or be dropped down a fire-escape. Now, this being the case, it is clear that the whole work to be done need but consist, not in lifting folk up, but in overcoming the friction and inertia of the moving parts; and a few gallons of water might be made to work very large lifts. Let us suppose that on the existing system 75 per cent. of all the water used is employed in lifting people, and 25 per cent. in overcoming friction. A properly made lift, for 100 gallons used by the normal elevator, would need but 25 gallons. I am quite prepared to hear it said that the thing can't be done, yet when the sayers see one at work they will exclaim:—"There is nothing new in it." For the present they must take my *ipse dixit* that it can be done. That all the work of the descending weight of heavy parties; men with whom gravity does not play, but makes a serious business of its duties; of light parties, children, dogs, &c., may be used up to raise a corresponding load of humanity or dog flesh, and this may even be done with a single lift, but better with two.

I have no patents, nor intention to take out patents, knowing by experience the futility and life-wasting powers thereof, but any man of moderate inventive skill can solve the problem if he will. The true balanced lifts will be so much better than any other that those who have not got them will turn, even with loathing, from the works of the American Elevator Company, Messrs. "Economiser," and Smith and Stevens, and Waygood and Co., and others too numerous to name, and will fly multivious to the makers of the new lifts, beseeching them to make them new elevators which will set the water companies and all their works at defiance; and lest I should be much plagued and troubled by those desirous to know how such lifts can be made, I take to myself the name of one long since defunct, but in his time well versed in hydraulic lore, and the inventor of much-that-is-to-this-day-and-will-be-alway valued in waterworks, and places where there are presses, and so sign myself,

July 21st. JOSEPH BRAMAH.

SIR,—We had hoped that we should not again be obliged to trespass upon your kindness, but must ask a small measure of indulgence as a consequence of the communications appearing in your last issue.

The senior Mr. Otis is in London, on his way to the Continent. Although our president was in New York at the time of the erection of the "Mills Building," the necessities of a very large business made it necessary for each individual in the office to assume the direction of his own field of labour. Our president was therefore not acquainted with the circumstances attending the fixing of the lifts in the Mills Building. Happily Mr. Otis was specially in charge of that particular building, and we have placed before him the letter of your correspondent "F. M. E." We have the honour to embody his reply to our inquiry. It is as follows:—

London, July 23rd, 1884.

W. A. Gibson, Esq., President.

My dear Sir,—I have read the letter in THE ENGINEER of 18th inst., and am happy to be able to explain the occurrence referred to fully.

You were in New York at the time, and you will remember that Mr. Mills required the plans to be prepared, the old buildings to be demolished, and the new building, which was to be fire-proof and nine stories in height, to be erected within the space of one year, so that the new building should be ready for occupancy on the 1st of May, 1882. The architect had only twenty-three days for the preparation of plans and specifications, and for the procurement of estimates for the erection of the new building.

When the old buildings had been taken down, and foundations were being prepared for the new one, it was found that the site was a marshy bed. Many thousands of piles had to be driven to carry the walls of the building, and there was a delay of about six weeks at the very outset of the work.

The contract for the elevators was signed in July, and the work was pushed forward and was ready for erection in the building in the January or February following. The work was put up while the building was yet incomplete and not in a condition to receive it. On the first day of May, 1882, when the building was to be ready for occupancy, all the lower portions of the building were in an unfinished and chaotic state: the five upper floors only were completed, and the tenants entered upon possession, and, of course, the elevators were obliged to be in working order. They were started on the 30th of April. It may be easily imagined that with the enclosures to the shaft in an unfinished state it was difficult to run the elevators with safety.

You know that it is usual to provide resting blocks for the cars at the level of the lower landing, and that the cars remain at that point during the night; and you know, of course, that the purpose of this is to prevent any settling of the car during the night below the point at which it is designed to stop, and thus to prevent any opening of the valves by the automatic arrangements. These resting blocks were provided for the cars when they were started, but owing to the unfinished state of the building a pit was left underneath one of the cars, which served as a passage way for workmen from the ground level to the cellars, and workmen were constantly using this passage way while going backward and forward in the discharge of their duties. These workmen were busy night and day during the closing months, and some of them unwarrantably removed the resting blocks, which were intended to prevent the settling of the car during the night.

On the evening preceding the day upon which the occurrence referred to by "F. M. E." took place, the pumps were stopped before the elevators discontinued running, and in running the elevators to complete their service for that day, the water was entirely drained out of the upper tank. During the night, the car to which "F. M. E." refers settled a little owing to the absence of the resting blocks, and just enough to open the valve as though for the lifting of the car. The car did not rise because the water had been exhausted from the upper tank, and consequently no pressure was exerted upon the piston. In the course of the night, the valve being open, the water, little by little, and owing to the operation of perfectly natural causes, was drained out from below the piston, thus taking away the cushion of water, which would have been there had the arrangements made by us been uninterfered with, and leaving the cylinder below the piston empty.

The next morning the engineer, ignorant of what had taken place, and making no examination, started his pumps for the day, and water was rapidly delivered into the upper tank. This water found its way naturally to the cylinders of the several elevators, and when the water reached the piston of the elevator to which your correspondent refers, its weight caused the piston to descend, and there being no water below the piston, it descended to the bottom of the cylinder, and the car naturally went to the top of the shaft. The delicate cabinetwork at the top of the car was slightly injured by coming in contact with the overhead sheave beams, and at the same instant the safety fixtures came into operation and locked the car firmly at that point—so firmly, indeed, that it was with difficulty that it could be disengaged. Of course, everything was carefully examined, but I have stated all the damage that occurred. The car did not fall, as stated by "F. M. E.," and the safety fixtures performed exactly the service that they were designed to perform. No one was hurt, because no one was in the car; and if any one had been in the car, he could not have been injured. If "F. M. E." was upon the spot, as he says, he evidently took no pains to ascertain the truth as to the matter, and was content to take the statement of an irresponsible party. If the persons on the staff of the Northern Pacific Railroad Company and the Oregon Railway and Navigation Company will testify to the truth of the statement, as given by "F. M. E.," I suggest that you procure their affidavits to that fact, and that you volunteer to pay their expenses in getting them, as I see you have proposed to do in your letter to THE ENGINEER.

"F. M. E." must go further than this to find a valid ground for unfavourable criticism of the "Standard" hydraulic elevator, and I imagine that you could get no more favourable and unqualified approval of the "Standard" hydraulic elevator than from Mr. D. O. Mills, the owner of the "Mills Building." He has had to pay the expenses of working and maintenance since the finishing of his building, and I have no doubt will speak strongly.

The elevators in that building should really never have been started until the building was finished, and the building was not finished fully until four months after May 1st, 1882.—Yours very truly,

(Signed) CHARLES R. OTIS.

We add nothing to this letter—it speaks for itself. Those who are determined not to be pleased will be obliged to cast discredit upon its author. Those who are fair-minded will see nothing in the occurrence to which your correspondent refers to discredit any statement we have made. We cannot, more distinctly than we have done, challenge the closest investigation and severest scrutiny.

We make no reply to the letter in your last of Messrs. Smith and Stevens. We note your own remark, indicating that it is easy for this correspondence to go too far. We again offer facility for fair criticism, and unless something appears in your paper to call for further remark from us, we will not ask your further indulgence until the receipt of the affidavits from New York, for which we have sent. When these shall have arrived, we will ask your permission to submit a few of them to your readers.

American Elevator Company, WM. AUG. GIBSON,
38, Old Jewry, July 23rd. President.

PROSPECTS OF YOUNG ENGINEERS.

SIR,—I was much interested by the letter appearing in your last week's issue, signed "Unemployed." The writer thus signing himself being well aware of the difficulty usually attendant on finding new employment, suggests the formation of a Central Registry Office for engineers. This would no doubt be of great service if properly carried on. The students of the Institution of Civil Engineers have recently endeavoured with some little success to fill this want amongst themselves, and in March last a "Representative Committee" was formed from out of their body having certain duties, amongst others, being the finding of employment for those students out of work; the scheme being that students knowing of vacancies should at once communicate with the hon. sec., Mr. F. W. Stokes, 25, Great George-street, Westminster, who would immediately advise any one who, having sent in his name as wanting work, was in his opinion likely to suit the post. This idea is working well, and already no less than five vacancies have been filled in this way; but some little difficulty is experienced through the students not sending notice of vacancies. This will no doubt be remedied when the work becomes better known. The object is such a good one that it deserves the hearty support of all connected with the profession, and anyone sending information of vacancies in the various branches of the profession suitable for "students" will, I feel sure, receive the hearty thanks of the committee, who have at present several names of those desirous of employment on their books. EMPLOYED.

July 22nd.

THE CRYSTAL PALACE EXHIBITION.

SIR,—We think that exhibitors in the machinery department have more to complain of than in any other, as not one in two hundred visitors find their way to it—query if one in five hundred. The main entrance to it is blocked by a high pile of pipes, which the public do not approach or walk round. If they did, they would see a most unattractive passage with a blank wall on one side. The entrance at the north end is also most uninviting. People who go on purpose to find our exhibit come away without seeing it.

We have saleable items, and have a salesman there, and have been at considerable expense; and the result has been a sale of about £1 sterling. If the entrance to the machinery department had been attractive, we should have been content to have taken our risk with the other exhibitors.

We believe the great majority of exhibitors in this class are thoroughly disgusted with the management. EXHIBITORS.

July 15th.

INDIA-RUBBER AIR PUMP VALVES.

SIR,—In the memoir of Edward Humphrys which appears in the "Proceedings" of the Institution of Civil Engineers, xxvii. 592, session 1867-8, it is stated that Humphrys was the introducer of the india-rubber disc valves for air pumps. May I ask if any of your readers can fix the date of their introduction? In a patent taken out by him in 1848—No. 12,010—he claims the use of air pump valves of thin elastic metal. These have recently been brought out as a novelty; but Humphrys does not seem to have thought of using a single piece of metal, his valve consisting of a series of strips arranged radially. Where was Edward Humphrys born? Some accounts say "near Penzance" and others at Bristol.

July 19th. R. B. P.

STRESS DIAGRAMS.

SIR,—I am afraid it is impossible for me to answer the inquiries of "C. S.," in the letter published in your last issue, without going into the complete theory of the disintegration of bridge and roof trusses. R. H. GRAHAM.

Greenwich, July 23rd.

THE MILFORD ROUTE TO IRELAND.

SIR,—I have occasionally to make the long and wearisome journey between Milford and London, and have for some time been looking forward to the shortening of the distance by the opening of the Severn tunnel. But the years come and go and there seems no prospect of a completion. Can you give any information on the subject? If so you would much oblige. T. N. H.

Waterford, July 20th.

[The tunnel is being constructed by Mr. T. A. Walker, of Westminster, and will, it is expected, be ready to be opened for traffic about the 1st July, 1885.—ED. E.]

SELLING STEAM BY WEIGHT.

THE following extracts are taken from a paper read by Mr. Charles E. Emery, Ph.D., of the New York Steam Company, at the May meeting of the American Society of Mechanical Engineers, at Pittsburg, Pa.:—

"We commenced selling steam in February, 1883, at a specified price per 1000 kals, explaining that a "kal" was equivalent to a pound of water evaporated into steam, and thereby solved the problem for our special purposes. . . . The word "kal" is, of course, based on caloric, a relic of the material theory of heat, and like "calorimeter" from the same source, is designed to represent a measure of heat; each pound of water at a certain pressure taking up a definite quantity of heat. The short word kal, spelled as it is with a k, need not be confounded with the French *calorie*, or thermal unit.

The pressure at which the pound of water is evaporated is not of great practical importance. The number of thermal units derived from the fuel with a temperature of feed of 100 deg. is less than 3 per cent. greater when evaporated at 70 lb. pressure than when evaporation takes place at atmospheric pressure. . . .

It will be observed that the charges for heating are based on the ordinary steam-fitter's method, using the capacity of the buildings, instead of the area and thickness of walls, area of windows and roof, extent of ventilation, &c. These rules are founded upon investigations of the cost of heating a large number of business buildings in the city of New York, under actual practical conditions. The variation in cost between different buildings of similar construction and exposure were found to be very great, due doubtless to differences in apparatus and management, and made useless any elaborate system based on calculating the number of thermal units passing through window-glass or walls of different kinds and thicknesses. These rules, when applied of course with good judgment, simply give prices for which business buildings of the kind described should be heated satisfactorily during the ordinary business hours of an average heating season, say ten hours per day for 200 days in the year. With care the work can be done more cheaply, but when the steam is used from a district system where pressure is maintained continuously, janitors and porters will use the same prodigally by leaving it on day and night, or by neglecting to shut off radiators so as to properly graduate the heat to the demand, thereby increasing the cost in some cases very materially. . . .

The New York Steam Company.—Rules to be observed in making estimates by the Division of Steam Supply:—Offers, estimates, and contracts may be made for a stated price, but must in every case contain a reservation of the right to apply meters, as given in the regulations. Regular meter rate to be 60 cents per 1000 kals. In contracts for considerable amounts, 50 cents per 1000 kals will answer when the consumption can be accurately ascertained.

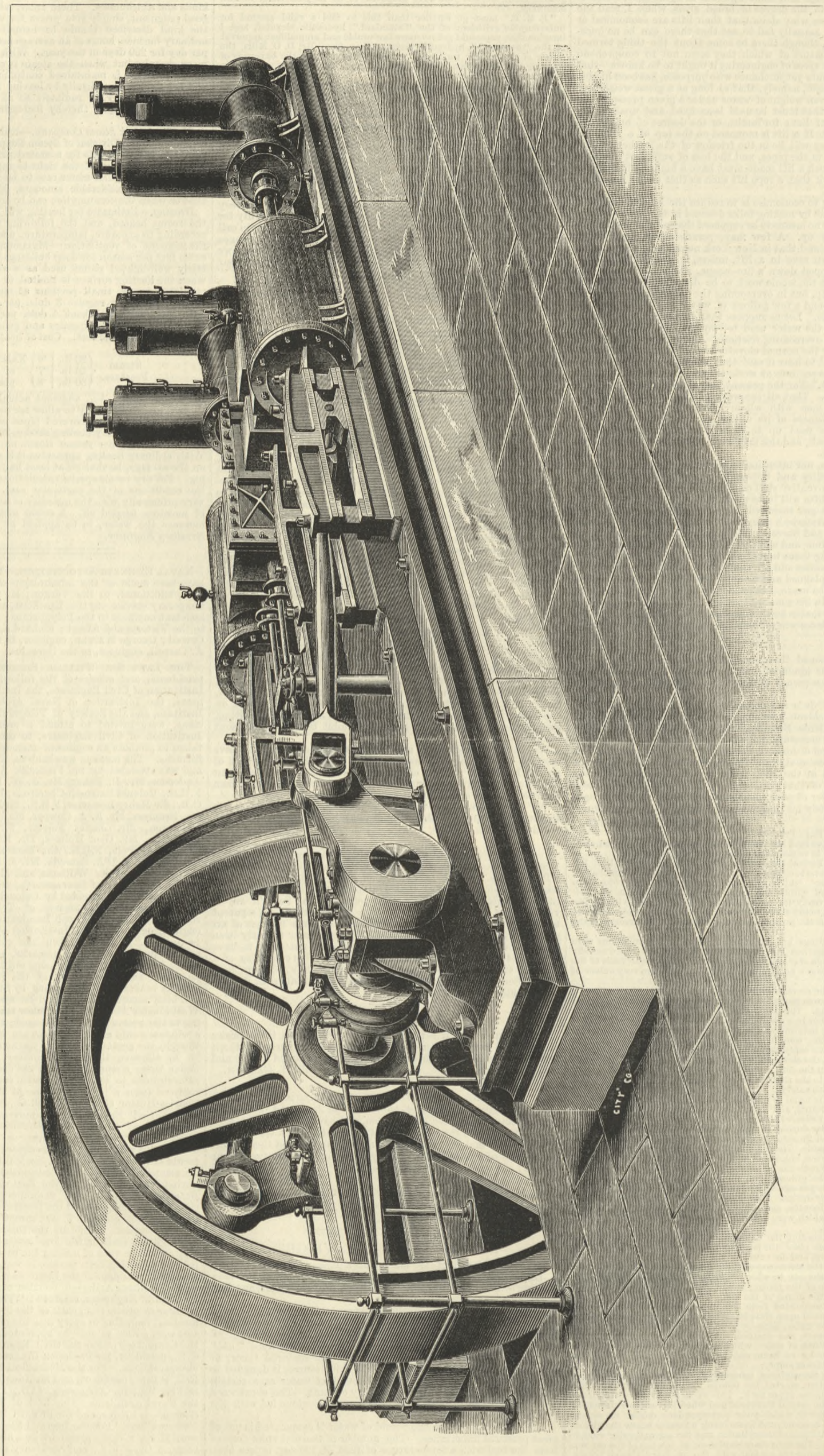
Heating.—Estimates for heating will be based on the capacity of the rooms heated, and the following rates, varied by judgment, according to exposure, temperature, and use of the rooms, and of the amount of ventilation:—Maximum rate, 2·50 dols. per 1000 cubic feet per season for deep buildings with minimum exposure, or fairly well-lighted rooms used as workshops for manual labour, when the heating surface is limited or so divided that it can be regulated to use small portions at once. Office buildings, well-lighted, generally require 3 dols. per 1000 cubic feet; buildings with large windows about 4 dols. per thousand cubic feet; and those with unusual exposure and good ventilation 4·50 dols. to 5 dols. per 1000 cubic feet. Cost of heating estimated from heating surface:—

Steam Pressure.	20 lb.	·6	Kals per square foot of heating surface per hour.
	40 lb.	·7	
	80 lb.	·8	

For steam tables, &c., augment actual surface of table and uncovered pipes reasonably to allow for fuel, cover, moisture carried off, &c. Charge for uncovered pipes in basements full time, day and night. Ordinary heating season, 200 days of ten hours. Allow about five days per season steam on one-fifth surface all night. With ordinary heating apparatus it is supposed the radiators will, on the average, be shut off at least half the time allowed for heating. For dry rooms special calculations are necessary, founded on the conditions of the particular case. The steam required will vary principally with the quantity of air circulated and the weight of moisture carried off. A steam meter, or some arrangement to measure the water, to be applied in every case of this kind.—*Sanitary Engineer.*

NAVAL ENGINEER APPOINTMENTS.—The following appointments have been made at the Admiralty:—J. Y. Mayston, chief engineer, additional, to the Vernon; H. R. Marsden, engineer—for temporary service—to the Excellent, additional, for the Skylark, assistant engineer to the Polyphemus; William J. Mabb, engineer, to the Victoria and Albert; Richard J. W. Earl, engineer, to the Orwell; George M'Ewan, engineer, to the Cambridge; and Henry A. Carroll, engineer, to the Hercules.

THE LATE SIR WILLIAM SIEMENS.—The Councils, past-presidents, and officers of the following societies, namely:—The Institution of Civil Engineers, the Institution of Mechanical Engineers, the Institution of Naval Architects, the Iron and Steel Institute, and the Society of Telegraph Engineers and of Electricians, were invited to attend a meeting in the theatre of the Institution of Civil Engineers, to consider what steps should be taken to promote an engineers' memorial to the late Sir William Siemens. The meeting was held on Thursday, the 28th of June, and was attended by Sir Frederick Abel, C.B., F.R.S., Mr. W. Anderson, Mr. B. Baker, Mr. J. W. Barry, Mr. J. F. Bateman, F.R.S., Colonel Bateman-Champain, R.E., Sir J. W. Bazalgette, C.B., Sir Henry Bessemer, F.R.S., Sir Frederick Bramwell, F.R.S., Mr. Brunlees, Mr. E. A. Cowper, Mr. T. R. Crampton, Mr. R. E. Crompton, Mr. James Forrest, Sir Charles Hutton Gregory, K.C.M.G., Mr. Geo. Holmes, Dr. Hopkinson, F.R.S., Mr. J. S. Jeans, Dr. Pole, F.R.S., the Earl of Ravensworth, Mr. M. F. Roberts, Mr. J. D'A. Samuda, Mr. J. I. Thornycroft, Mr. F. H. Webb, Mr. R. Price Williams, and Mr. Edward Woods. On the motion of the Earl of Ravensworth, president of the Institution of Naval Architects, seconded by Colonel Bateman-Champain, R.E., past-president of the Society of Telegraph Engineers, it was resolved: "That Sir Joseph Bazalgette, as president of the senior engineering society—the Institution of Civil Engineers—be asked to preside." Having taken the chair, Sir Joseph Bazalgette offered some explanatory remarks, pointing out that a general desire had been expressed among engineers that a memorial should be raised as a recognition of the great merits and important services rendered to engineering by Sir William Siemens; that it had been ascertained it would be agreeable to the authorities of Westminster Abbey that a window should be erected in that building to the memory of the deceased; that possibly the cost of such a window would amount to between £700 and £800; that it was thought the greatest tribute to the memory of the deceased would be by allowing the largest number of contributors; and that, under those circumstances, it was deemed advisable to limit the subscriptions to one guinea each, such subscriptions only to be received from a member of one of the five societies named. Sir Charles Hutton Gregory, K.C.M.G., past-president of the Institution of Civil Engineers, then moved, and Mr. Edward Woods, vice-president of the same Institution, seconded, the following resolution: "That this meeting is of opinion that it is very desirable to commemorate the distinguished character and attainments of their late colleague, Sir William Siemens, by erecting to his memory a window in Westminster Abbey." The proposition having been supported by the Earl of Ravensworth and Colonel Bateman-Champain, was unanimously agreed to. Mr. E. A. Cowper, past-president of the Institution of Mechanical Engineers, then proposed, and Mr. T. R. Crampton, member of Council of the same institution, seconded, the following resolution: "That the subscriptions shall, in the first instance, be limited to one guinea each, with the view of making the basis as wide as possible." This resolution having been passed, it was, on the motion of Mr. Bateman, past-president of the Institution of Civil Engineers, seconded by Mr. William Anderson, member of Council of the Institution of Mechanical Engineers, resolved: "That an Executive Committee of three members from each of the five societies represented at the meeting, including in every case the president—five to be a quorum and with power to act—be appointed." That the following form the Committee:—For the Civil Engineers: Sir J. W. Bazalgette, C.B., president, Sir Frederick Bramwell, F.R.S., and Mr. Woods, vice-presidents. For the Mechanical Engineers: Mr. I. Lowthian Bell, F.R.S., president, and Sir Joseph Whitworth, Bart., F.R.S., and Sir William Armstrong, C.B., F.R.S., past-presidents. For the Naval Architects: The Earl of Ravensworth, president, Mr. Samuda, treasurer, and Sir Edward Reed, K.C.B., F.R.S., M.P., vice-president. For the Iron and Steel Institute: Mr. B. Samuelson, M.P., F.R.S., president, and his Grace the Duke of Devonshire, K.G., F.R.S., and Sir Henry Bessemer, F.R.S., senior past-presidents. For the Telegraph Engineers: Professor W. G. Adams, F.R.S., president, and Sir William Thomson, F.R.S., and Sir Frederick Abel, C.B., F.R.S., past-presidents. Also that Mr. James Forrest, secretary of the Institution of Civil Engineers, be requested to act as honorary secretary and treasurer. The thanks of the meeting were then, on the motion of Sir Henry Bessemer, F.R.S., seconded by Mr. Samuda, given to Sir Joseph Bazalgette for his services in the chair.



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J. T.—*There is no special book on the compound steam engine. All modern works on the steam engine deal with the compound engine. Rankine "On the Steam Engine," and Rigg's treatise "On the Steam Engine," will supply what you want.*

W. H. S.—*Turndown chimneys are quite well known. The curious thing about the whole matter is that no one thought any chimney-lifter was wanted for portable engines until the other day. The use of a long chimney is a remarkable example of the vitality of that which is not the fittest.*

G. H.—(1) *You can compress air up to a pressure of about a ton on the square inch with suitable stage pumps. Roughly speaking, about* 150 *cubic feet of air at atmospheric pressure would then be contained in a space of one cubic foot.* (2) *You can fill a balloon at any speed you please. It is only a question of the size of pipes.*

ENQUIRER.—*There can be no stress in one part of the tie-rod which has not an equivalent resistance on the part of that to which it is attached. The stress would not be the same on the incli-ed part of the tie as on the central horizontal part. The digest on this subject given in Molesworth's "Pocket-book of Engineering Formulæ" will afford you the means of answering your question numerically.*

A. O.—*There has been too much vague writing about tidal power. If you will work out and send us an estimate of the cost of plant, &c., to give out* 300-*horse power of useful effect for ten hours per day, we will find a place for it in our columns. Our own conviction is that the interest on the capital spent would far exceed the cost of fuel for an engine of the same power, to say nothing of repairs and maintenance, and the effect of gales.*

CHIMNEY-LIFTERS.

(*To the Editor of The Engineer.*)

SIR,—In your report of the implements at the Royal Show, you state that the chimney-lifter exhibited by Barford and Perkins, and awarded a silver medal, is their invention and patented by them. I now beg to inform you that it is my invention and my patent. Messrs. Barford and Perkins are the licencees and manufacturers. JOHN T. SMITH.

Peakirk, Market Deeping, July 22nd.

DISPOSAL OF TOWN'S REFUSE.

(*To the Editor of The Engineer.*)

SIR,—Would you kindly allow me to inquire, through the medium of your columns, as to the best and most economical means of disposing of about 100 tons per week of town's refuse? Farmers in the neighbourhood do not care to take it, and any process described must be capable of being worked without skilled labour, and also must not cause any offensive smells. Has retorting the refuse been tried; if so where, and with what results? ALPHA.

July 24th.

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DEATHS.

On the 16th July, killed in the accident on the Manchester and Sheffield Railway, MASSEY BROMLEY, M.A. Oxon, C.E., of No. 5, Westminster-chambers, Victoria-street, London, eldest son of the Rev. T. Bromley, of St. Mary's, Leamington, aged 37 years.

THE ENGINEER.

JULY 25, 1884.

THE PENISTONE RAILWAY ACCIDENT.

A DISASTROUS accident occurred near Penistone, on the Manchester, Sheffield, and Lincolnshire Railway, on Wednesday week. The exact site of the calamity is close to Bullhouse Colliery. The train, consisting of nine coaches and a horse-box, left Manchester for London at 12.30, and was due at King's-cross at 5.20. The range of hills separating Manchester from Sheffield was safely surmounted, the Woodhead Tunnel was traversed, and the train, then on a falling gradient, was travelling at a speed variously estimated at 37½ miles and 60 miles an hour, when the crank axle of the four-coupled bogie engine broke. The engine and tender and the horse-box remained on the road, but the coupling between the horse-box and the next vehicle broke. The train then left the track. Some of the coaches ran down the embankment, while others fell over a bridge into the road beneath. Nineteen passengers were killed on the spot, or died within an hour or two, and others have since succumbed to their injuries. We add with special regret that Mr. Massey Bromley was among those slain. He was the last man extricated from the wreck. The coach in which he had been travelling had fallen into the highway. He appeared to have been killed without pain by a blow on the head. None of his limbs were broken; nor did he bear any marks save a bruise on the side of his face and on the temple. Thus died at the age of thirty-seven a talented member of our profession. He entered the works of the Great Eastern Railway Company at Stratford about the year 1869 as a pupil of Mr. Johnson; and passed through the shops, the running sheds, and the drawing-office. In 1872 and 1873 he was employed by the company in inspecting engines built by the Avonside Engine Company. In 1873 he was appointed foreman of running shed repairs. He was works manager under Mr. W. Adams at Stratford from 1874 to 1878, and locomotive superintendent of the line from 1878 to 1881, when he resigned. While locomotive superintendent he designed and built many engines, in which he endeavoured, with some success, to combine the best features of American and English practice. He was interred at Leamington, his native town, on Tuesday. Mr. Bromley had been for some time in partnership, as consulting engineer, with Mr. Wilson, in Victoria-street.

In another page will be found a plan of the locality where the accident occurred. The line here is curved to a radius of half a mile, and, as we have said, the train was running down an incline of 1 in 124. The distance from Manchester to London by this route is 203 miles. The time allowed for running it is but 4 hours 50 min., giving an average velocity, if we deduct twenty minutes in all for stops, of 45 miles an hour. But the ascent from Manchester to Woodhead is made at much less speed than this, and the pace from Woodhead Tunnel to Sheffield is of necessity high. There is therefore every reason to believe that the train was running at something like sixty miles an hour when the crank axle gave way. The speed was not a cause of the accident, but the coaches ran further after they left the line than they would have done had the speed been less. The greater the speed the greater the necessity that a train should be fitted with a really good brake. As a coroner's inquest and a Board of Trade inquiry are both in progress, we are bound to reserve all expression of opinion concerning the cause of the accident; but we are not precluded from commenting on facts perfectly patent to every engineer, or from pointing out the direction which, in our opinion, the inquiry should take. The engine, tender, and horse-box kept on the road, and ran a long distance after the coupling parted, as will be seen from the plan on page 64. We give there an enlarged view of one of the rails, showing certain marks on it. Why did the train run off the track? The answer seems to be that it was all torn up behind the tender. The injured engine as it advanced met with a good sound road, which it and the tender destroyed as they traversed it, leaving nothing in the shape of rails for the carriages to run on. At Bullhouse is a siding to the colliery. The tender or engine got on the check rail of this siding, tipped it up at one end, and the other was then forced into the tender tank. Which broke first, the coupling rod or the crank axle? It is known that when crank axles break the coupling rods usually give way, for obvious reasons; but it is not quite clear that this was the order of events in this case. As regards the crank axle, we think it best to quote Mr. Sacré's own words. Mr. Sacré is locomotive superintendent of the Manchester, Sheffield, and Lincolnshire Railway, and no one is more qualified to speak with authority on the subject. He said:—"The engine referred to was built under my instructions, and I have seen it since. On Wednesday last I saw it standing on the line after the accident. I arrived shortly before five o'clock, and it had been left there till I came. I at once inspected it, and found the right outside web of the crank axle broken. The outside crank arm of the driving wheel was wrenched off, retaining a piece of the side rod, and the other end attached to the trailing crank was missing. I gave instructions for the removal of the engine after carefully packing up the driving wheels. After that I found the check rail through the bottom tank of the tender. I had that removed, and then examined the horse-box, which was next to the tender. I found it in perfect order. I ordered the engine to Sheffield with the horse-box, where it has since remained. On my arrival at the scene of the accident I examined the road, and found six distinct marks on the north side rail running west of the signal-box. The marks were 18ft. apart, exactly the circumference of the tread of the wheel. The road was in perfect order at that point and up to it, but after that the marks became more intensified. Some chairs were broken. A check crossing was dragged out, and all the chairs that held the check rail broken. I then counted six rails, each 30ft. long, with the road very little disturbed, after which the line was torn up altogether and the rails removed. I instructed Mr. Dallas to take careful measurements of all marks and distances, together with a sketch of the wreck, and he did so. I remained until the road on both sides had been made good again. The down line had not been damaged. I examined the crank side carefully, and found it distinctly separated." The marks on the rail mentioned by Mr. Sacré will be found on our plan, but we understand they are not 18ft. apart, but the distances given in our plan. Mr. Sacré then gave evidence concerning the regular examination of the crank, a process too familiar no doubt to most of our readers to demand explanation here.

The train was fitted with Smith's simple or non-automatic brake, and it behaved precisely as was to be expected. The moment the driver found there was something wrong, he applied it. The instant afterwards it came off again, the vacuum being destroyed very probably by an injury to the pipes on the tender. We have here a potent and valuable illustration of the difference between the automatic and non-automatic system. Had this train been fitted with the Westinghouse brake, for example, the wheels would have been held fast, and the chances are ten thousand to one that none of the coaches would have run down the embankment, and that not a life would have been lost. It has been proved over and over again that even when a train is off the rails and running over the sleepers, the locking of the wheels is of simply incalculable value. The vacuum brake in this case probably did more harm than good. It may, indeed, have caused the breakage of the coupling between the horse-box and the train, which would have caused no mischief, but the reverse, had the brake been automatic. It remains to be seen whether the important lesson thus taught will or will not be taken to heart by railway companies. For ourselves, we regard the Penistone accident as the death-blow of the non-automatic system.

ALTERATIONS IN AMERICAN PATENT LAW.

A SERIOUS attempt has been made to induce the United States Legislature to follow the example set them by our own Government, and alter the patent law of its country. The proposed imitation goes no farther, however, than is defined by the single word alteration. In all else the action is the reverse of our own. With all its defects, still as a whole our new Patent Act is perhaps an improvement upon that which it replaces; and if there are shortcomings in some of its provisions, they but serve to prove that with whatever care an Act may be framed, it resembles after all a new machine, and defects become apparent when either is put in operation which the keenest foresight could scarcely have anticipated, but which ought to be amended when discovered.

Before the English Patent Act of 1883 was enacted, the disparity between the protection afforded to inventors in this country and in the States was a fruitful source of reproach to us. It seems, however, that this state of things is in course of reversal; quick following on our concessions to inventors, comes news of restrictions being proposed and likely to be imposed upon them in America. Coming too as they are at a time when the United States is entering on the fevered period of the presidential nomination, it will be interesting to watch the struggle between the brain power of inventors and that of the numerically smaller class of moneyed men. It would be deplorable were money to carry the day, and the poor inventor find himself so bound by restrictions, and the process for the assertion of his rights so expensive, that a great reduction in the number of inventions brought out would be the immediate result. Should capital overcome brains, and the American patent laws be so altered as virtually to vest all the inventive power of the nation in the hands of the wealthier classes, a great evil will be wrought. Material progress there is already unduly hindered by the influence of a comparatively small number of millionaires, who rule the railroads, the telegraphs, the sale of land, the steamship and the Government systems with a rod of iron, guiding and directing charges, tariffs, and commercial operations to their own personal advantage, irrespective of the national progress. Up to the present one system had escaped these monarchs of gold; inventors enjoyed a favourable patent law, one whose operation, though partaking of the imperfection common to all human devices, yet still encouraged invention to such an extent that it is idle to deny that the nation enjoys the benefits of numerous contrivances which, if not of great individual magnitude, are extremely serviceable collectively in a new country, and help to develope its industrial resources. The smaller inventions protected under the old American patent laws were rapidly produced, tested, and developed there, and formed a lucrative branch of export, notably to ourselves. Novelties poured in upon us, and their retail forms a regular branch of British trade, especially in small matters of household appliances.

It is needless to say that agitation is being made in the States against the proposed changes in the patent laws, and our clever contemporary, the *Scientific American*, in commenting on this subject, refers to what it describes as "a most remarkable oration on the re-organisation of the Patent-office, by the Honourable Orville H. Platt, Senator, from Connecticut, and chairman of the Committee on Patents." "We," says our contemporary, "look upon this discourse as one of the most able, eloquent, and profound expositions ever pronounced concerning the nature of patents and the marvellous influence upon the country exercised by new inventions." We have carefully studied what we presume is a fair report of the essence of Mr. Platt's speech; and though we are of opinion that he would have made it of more value had he noticed some of those collateral influences which operate on the utility of inventions, still, as a speech having for its text a particular branch of the subject under notice, namely, the protection afforded an inventor by the law of the land, it was an able and fairly reasoned discourse. Mr. Platt began at the origin of the American patent system at the date of the first Patent Act passed in that country, 1836, and, quoting data from Government archives since then, he showed the gradual unfolding of the patent system, dwelling upon the deep interest taken by that generation in new inventions and industries. He told his audience that he thought the passage of the patent law of 1836 an epoch in the history of American development the most important, from the declaration of independence till the war of the rebellion. We quote the following passages from Mr. Platt's speech:—"We have had fifty years of progress, fifty years of inventions applied to the every-day wants of life, fifty years of patent encouragement, and fifty years of a development in wealth and resources little short of miraculous, and this progress has only been made possible by the inventions of its citizens." In another place Mr. Platt observes:—"No purely agricultural, pastoral people ever achieved any high standing amongst the nations of the earth. It is only when the brain evolves, and the cunning hand fashions labour-saving machines, that a nation begins to throb with new energy and life, and expands with a new growth. It is only when thought wrings from nature her untold secret resources that solid wealth and strength are accumulated by a people." Mr. Platt pointed out to his audience with much truth that almost every item in common daily use represents one or more inventions; that one invention is but the stepping-stone to another in social progress, and reminded it that eight-tenths of American manufacturing depended upon patented processes. He also strengthened his arguments by some useful as well as suggestive statistics. For example, according to his figures the United States make a million sewing machines yearly, and these do as much work as would formerly have required 12,000,000 women to execute by hand labour, and a single shoe manufactory in Massachusetts turns out as much work as would employ 30,000 Parisian bootmakers. A man cleaning cotton by hand could only do 4 lb. a day; a Whitney gin cleans 4000 lb. a day. Mr. Platt goes on to show how one invention originates another, and cites numerous figures and data of an interesting and instructive kind, showing the influence invention, when encouraged by legal protection, exercises on the well-being of a nation; and he accentuates his arguments by directing reflection to what the state of the American nation would become if forbidden to make further use of any article resulting from the brain of an inventor.

Let us now turn to the changes either already made or proposed to be made in the United States patent law, and to this part of our article we invite special attention from those of our readers contemplating taking out patents in that country. On the 21st of last January it was proposed in effect that the holder of patent rights for any invention could not sue anyone using his invention if such a one uses it only for his own behoof; nor could he prevent the continued use of such pirated article; and in any action which he may bring, the plaintiff is bound to give a bond to the clerk of the court, with approved surety, to pay all costs of attorney's fees that may be adjudged against him; and what is more singular, if he recover a less sum than 20 dols. damages from the defendant for using his invention for the purpose of sale, he cannot recover costs in the cause. Such a law would be greatly opposed to the interests of inventors of small things, as very frequently damages on them would not amount to so much as 20 dols. Although at first superficial sight permitting a person to use a patented article for his own private use might do no appreciable harm to an inventor, yet, owing to a want of exact definition of what constitutes private use, there is much room for extensive piracy. For example, suppose a man patents a valuable process in photography, according to one interpretation of the phrase, "own private use," it may mean that a man may, for his own amusement, take photographs for his own personal use. This could not do the inventor much damage; but, on the other hand, if he use the process in his business, selling the pictures made by it, it might be said he was not manufacturing and selling photographic apparatus including the thing patented, and go free, the patentee having no remedy.

By another Bill read the day after the one above noticed, by a vote of 114 against 6, it was enacted that the manufacturer and vendor of a pirated article were the only persons liable for damages, and the measure of the damages in case the article was made by the defendant for his own use and benefit, should be a licence fee, which, if not fixed under the patent sued upon, should be fixed in an action at law by a jury, which would in nine cases out of ten be a body altogether incompetent to value or estimate a reasonable licence fee. Our own new patent law renders the granting of licences compulsory, but under such conditions as very fairly protect the patentee. For section 22 provides that the Board of Trade may order the patentee to grant licences upon terms and conditions to be settled by them, only when it is proved to their satisfaction that "by reason of the default of the patentee to grant licences upon reasonable terms, in case the patent is not being worked in the United Kingdom, or that the reasonable requirements of the public cannot be supplied, or that any person is prevented from working or using to the best advantage any invention of which he is possessed." The operation of this clause depends on the sentence, "By reason of the default of the patentee to grant licences on reasonable terms."

A greater blow, however, directed against patents was a Bill introduced into Congress by the Hon. J. A. Anderson, having for its object the reduction of the duration of a patent from seventeen to five years—a change so great, that if it succeeded it would almost virtually destroy invention in the States altogether. It is idle for any one to propound the theory that inventing is an involuntary action of the mind, and, *pari passu*, that communication of the invention gratis to the world at large is also certain to ensue. Persons who argue thus can have little practical experience of the process of devising a contrivance to supply a given want. Such contrivance nearly always represents not one, but many ideas; even the simplest machine contains three or four parts, each of which has to fulfil a specific duty, and an inventor's first idea has nearly always to undergo a tedious process of dissection, alteration, and adaptation of parts involving much harassing thought, drawing, and model-making; and no one in this matter-of-fact age having brains enough to work out a promising invention will be so deficient in sense otherwise as to waste his mental powers and handicraft skill upon a scheme which, be it ever so good when complete, will possibly benefit the public and certainly yield him no return; and it may safely be asserted that if patent protection were done away with, further progress in industrial improvements and social comforts would be very slow indeed. If the United States Government try to create a free trade in invention, they will bring forward a serious obstacle to the material advancement of their nation.

BOILER EFFICIENCY.

A CORRESPONDENT, whose letter appeared in our last impression, referred to the difference between the quantity of heat utilised and that actually developed in the combustion of fuel in the furnaces of steam boilers. He repeated the statement so often made about the steam engine wasting nine-tenths of this heat, and about two-tenths of the heat passing away up the chimney; statements which are not true as they stand, but which are so far credited by those who are unable to check them, or see what was meant by their authors, that they are likely to do harm to the extent that they prepare the way for boiler improving enthusiasts to claim much greater savings as due to real improvements, perhaps, or maybe nostrums of at least doubtful utility than is possible under the most favourable conditions. Our correspondent expresses almost unbounded faith in the possibilities which may result from the use of water tubes—at least, he intends looking to these as the means of escape from the reproaches which have been heaped upon the steam engine as a heat user.

When leading men speak of the steam engine wasting nine-tenths of the heat energy supplied to it, they should guard against misconception by admitting from the first that a steam engine cannot be said to waste that heat which it must give up in consequence, not of its own defects, but in consequence of inherent defects in steam considered as a gas. Again, it is necessary to be more exact when dealing with this question as far as it relates to the boiler as a heat engine. The examples wherewithal to point a diatribe on the performances of a well tried apparatus should be from its best work and not from a general average, which includes the very bad performance of the indifferently constructed examples of that apparatus. For instance, it is not true that at the very outset of our operations towards the use of heat in a steam engine we throw away twice as much heat as we succeed in utilising in the steam engine. There are what we call losses which are as inevitable as is the loss of energy due to the necessity for using, say, a lever or a wheelbarrow which has weight, because one without it does not exist, and a steam engine or a boiler works under these abstract disadvantages; they cannot be called practical disadvantages, because the practice cannot be realised under other conditions; nor theoretical disadvantages, because real theory takes into consideration all practical conditions.

We may see what a moderately good boiler does with a pound of coal. The heat of combustion of 1 lb. of pure carbon burned to carbonic acid is 14,544 units, and will require for its combustion 2·666 lb. of oxygen. As we are not dealing with calorimeter experiments, we will assume that the oxygen is obtained from atmospheric air. Of this 12·2 lb. will provide the oxygen required. We shall then have $12·2 + 1 = 13·2$ lb. of gases heated by the 14,544 units, and shall therefore have as the highest possible temperature with air at 60 deg., and having a specific heat of 0·238, of $T = (460 + 60) + \frac{14,544}{13·2 \times ·238} = 5150$ deg. Now, if we assume that the heat of the escaping gases could be so far utilised as to fall to that of the feed-water, or say, 100 deg. or 560 absolute, we should then have as the greatest possible proportion of available heat, or heat which could under the most favourable and hitherto impracticable conditions be realised, only $\frac{5150 - 560}{5150} = ·891$; that is to say, with an absolutely perfect boiler, burning pure carbon to carbonic acid with air at 60 deg. Fah., and only enough to provide the oxygen necessary for chemical combination, there must be a loss of 11 per cent. But this is not waste. Now to follow this up, to see how far a good steam boiler deserves the character for wastefulness which it is so common to ascribe to it, we must take more numerical values. We must make out the worst case for the boiler, and so must credit the fuel with all it possesses in the form of heat. We have supposed the air to be at 60 deg. Fah., and must take the same temperature for the 1 lb. of carbon, or an absolute temperature of 520 deg. The specific heat of carbon being 0·25, it must be credited with $1 \times ·25 \times 520 = 130$ units; the air must be credited with $12·2 \times ·238 \times 520 = 1485$ units, and these quantities with the heat developed in combustion = 16,159 units, from which, however, must be deducted 32 units as the equivalent of the work done in displacing atmospheric air by products of combustion raised from 60 deg. to 100 deg., at which they are supposed to escape, or increased in volume from 149·8 cubic feet, to 161·3 cubic feet, which leaves us 16,127 units as the total quantity of heat available. This is sufficient to evaporate 16·69 lb. of water from and at 212 deg., but as the greatest possible quantity of the total heat realisable is 0·891, as above shown, the greatest possible evaporation from and at 212 deg. by 1 lb. of carbon, the heat required to evaporate 1 lb. of water at this temperature being 966 units, is $\frac{16,159 \times ·891 - 32}{966} =$ 14·87 lb.

Now what do we get, as compared with this, from a good boiler. Following Mr. W. Anderson's excellent lecture, delivered before the Institution of Civil Engineers last December, we may refer to the results obtained in the portable engine trials made under the Royal Agricultural Society, at Cardiff, in 1872, with a portable engine boiler, nominally of 8-horse power. To begin with, the coal used was not, of course, all carbon. It was a smokeless Welsh coal, containing 0·8497 lb. of carbon per pound; but it contained 0·0426 lb. of hydrogen, and as the heat developed in the combustion of 1 lb. of hydrogen is 4·265 times as much as by 1 lb. of carbon, we have to take this into our calculation; and inasmuch as the coal also contained 0·035 lb. of oxygen in combination with hydrogen, in the form of water, and will abstract its combining equivalent of hydrogen from the fuel, one-eighth of the weight of the hydrogen must be deducted. Thus, as the 14,544 units developed in the combustion of 1 lb. of carbon is equivalent to 15·06 lb. of water evaporated at 212 deg., we have, for 1 lb. of the above coal, the heat, expressed in pounds of water evaporated $= 15·06 \left\{0·8497 + 4·26\left(0·0426 - \frac{0·035}{8}\right)\right\}$ $= 15·24$ lb. of water from and at 212 deg., equivalent to 14,727 units of heat. The conditions of combustion in the furnace of a steam boiler being so different from those in a calorimeter, the quantity of air used vastly exceeds that used in the laboratory as represented by oxygen; and in the boiler we are now dealing with 50 per cent. more air was admitted than would be necessary to supply theoretically the oxygen required for perfect combustion. This makes 18 lb.—about 24 lb. is more commonly used—of air per lb. of coal, and consequently 19 lb. of gases would have to be heated by the 14,727 units available, and hence the maximum temperature obtainable above that of the atmosphere would be $\frac{14,727}{19 \times 0·238} = 3257$ deg., or 3777 absolute. The temperature of the smoke from this boiler was 849 deg. absolute, and hence the maximum duty of the obtainable heat would be $\frac{3777 \text{ deg.} - 849 \text{ deg.}}{3749 \text{ deg.}} = 0·7752$. The specific heat of coal is about the same as that of gases at constant pressure, or as above given, and hence the temperature of the air being 60 deg., the 18 lb. of air and 1 lb. coal took to the furnace, $19 \text{ lb.} \times 520 \times 0·238 = 2350$ units, which, with the heat of combustion = 14,727 units, gives a total of 17,078 units, from which must be deducted 422 units for the heat expended in displacing atmosphere, or 151 cubic feet, which leaves us as the total available energy of the 1 lb. of coal 16,656 units. The greatest possible quantity of work to be obtained from such a boiler would, then, be

$$\frac{17,078 \times \left(\frac{3777 - 849}{3777}\right) - 422}{966} = 13·27 \text{ lb.}$$

of water evaporated from and at 212 deg., or equal to 12,819 units. Now, the boiler actually evaporated 11·83 lb. of water per pound of coal, and hence the efficiency of this boiler was $\frac{11·83}{13·27} = 0·892$, or less than 11 per cent. below the greatest possible efficiency under perfect conditions.

The portable engine or locomotive type of steam boiler is thus very far from being the inefficient thing which on incomplete bases of calculation it is often said to be, and there is not after all a great deal of room for that increase in efficiency to which it is sometimes asserted we ought in some way to attain. It may certainly be said that the reproaches referred to by our correspondent are not deserved by good boilers, nor are the results obtainable by their use so very miserable. It may be necessary to remark that we are referring to good and not to cheap and bad boilers.

THE METROPOLITAN WATER SUPPLY.

IN view of the alarmist assertions with reference to the river-derived water supplied to London, which have recently revived in consequence of the cholera epidemic abroad, it is very reassuring to find that those who are really capable of giving an opinion on the subject do not share any of these arrogantly-expressed fears. The report for the month ending June 30th, by Mr. W. Crookes, F.R.S., Dr. W. Odling, F.R.S., and Dr. Meymott Tidy, F.C.S., contains some remarks on the character of the water supplied during the half of this year. In these six months they have examined no less than 1071 samples of the water drawn from the mains of the seven companies taking their supplies from the Thames and the Lea, and they have been able to register these, without exception, as clear, bright, efficiently filtered, and as colourless judged by the eye, while tested as to colour by more exact means, the results were equally satisfactory, as were also the whole of these samples, tested by the permanganate process, for organic matter and for dissolved oxygen. During the six months 106 samples of the water from the Thames and 42 from the New River and East London Companies' mains, were submitted to complete analysis. The mean results from all these samples from the Thames, exceptionally low for the season of the year, gave for January, ·118 part of organic carbon in 100,000 parts of water. The mean result for February was ·140 part; for March, ·165 part; for April, ·139 part; for May, ·104 part; and for June, ·114 part of organic carbon in 100,000 parts of the water; while the highest result furnished by any single sample examined during the last two months was ·129 part, equivalent to about a quarter of a grain of organic matter per gallon. Comment on these figures is unnecessary, the figures speak for themselves, though it may be as well to note that there is not the slightest evidence that this minutely small quantity of organic matter is in any way prejudicial to health, any more than would be the meal from one oat mixed in the water. The report to which we have referred concludes as follows:—"It was explained in the Report of the Royal Commission on Water Supply, that a minute proportion of organic matter, variable in amount with the season, is a normal constituent of river water; that there is no reason whatever to consider this proportion of natural organic matter as in any way prejudicial to health; and that there is absolutely no chemical evidence to indicate that the small proportion of organic matter present in the water supply of London is different, either in quantity or in kind, from the natural organic matter of the river, as met with, for instance, at Lechlade, 120 miles above the intake of the companies. Still, in view of the importance which is sometimes attached, though as we maintain unwarrantably, to the not inconsiderable variations in the always minute proportion of organic matter present in the London supply, it is satisfactory to note that at periods of summer heat and drought like the present, the natural agencies at work to keep down the proportion of organic matter existing in the water of the river are at their maximum of activity. It results in this way, that the water supply of London is at its best just at those seasons, like the present, when any failure in the quality of the supply might be considered likely to be of exceptionally serious import."

DEPTH OF SCOTTISH COAL MINES.

ONE of the most interesting features in the "Blue-book on Mines and Minerals," just issued, is a list of the mines under the Coal Mines Regulation Act in the district of Mr. Ralph Moore, one of the inspectors. It includes not only a bare list of the mines, as some of the returns do, but also interesting particulars relating to most of them. It will be of interest from this return to glance at the columns that relate to the depth of the mines, or of the shafts. These vary very greatly; for instance, Newhouse Colliery, near Motherwell, has a downcast shaft 70ft. deep only, the smaller upcast shaft being 66ft. Next in the list is Rosehall Colliery, near Coatbridge, the downcast of which is 810ft.; and confining the comparison to the downcast shaft, we find that one—that at the Dumbowie Colliery—is only 36ft. deep; whilst others go deeper, down to—in the case of the Boghead Colliery, near Bathgate—a depth of 2376ft. We have deeper examples in other districts; but there are, perhaps, not many districts where the variation is greater. The size of the shafts also varies—from 5ft. by 4ft. to 23ft. by 7ft.; and the number of the workmen employed also varies—one colliery having as few as eight persons employed below ground and two above; whilst another, and a more typical, has 253 persons below ground and thirty-nine above. We are aware that the comparison may be pushed too far, and that the question as to what a "colliery" is is one that is not exactly defined in all instances. But the presentation of a mass of facts, such as that in the list to which reference has been made, is valuable, because it better enables the distinction to be drawn, and because it will be the more readily seen that the needs of one of these small mines are very different, both as to ventilation, inspection, and other particulars from those of the larger mines. But it may also allow the deduction to be drawn that there is some reason in this great variation, and in the numbers of the mines in a district for a greater provision for inspection than there is. In a degree that variation holds in other mining districts, and the need that exists is for more full provision for inspection and for elasticity in rules, so as to meet the variations in sizes, &c., of the mines.

THE NEWHAVEN AND DIEPPE STEAMSHIP NORMANDY.

A STATEMENT has been widely circulated that the London, Brighton, and South Coast Railway Company's steamer broke down last week shortly after leaving Newhaven. The facts have been altogether perverted and exaggerated. What really happened was this:—About an hour before starting time, the small donkey engine which works the centrifugal pump for the condenser, was tried, and after running a short time it stopped working. The second engineer informed Mr. Shaw, the chief engineer, and they both overhauled the engine to discover what was wrong, and found that the piston was broken into several pieces. They therefore consulted together, and unwisely agreed to make the voyage with the ordinary jet condenser, with which these boats are fitted for emergencies. They found, however, after getting out of the harbour, that the engines would only run at about twenty-four revolutions per minute, and therefore she would not be able to make a fast trip, even if she went across all right, and after going out about two miles, they decided to return to the harbour, and another vessel was got ready to take her place. Mr. Stroudley had a new piston for this engine made of wrought iron, and the boat took her next turn in the usual way. The engines of the Normandy are compound inclined drag-link engines, working with a pressure of 110 lb.; the Normandy steams at about nineteen miles an hour, being one of the fastest ships in the Channel trade. Her sister, the Brittany, is perhaps a shade quicker, but not much.

LITERATURE.

Traité Pratique d'Analyses Chimiques et d'Essais Industriels. Par RAOUL JAGNEUX. 8vo. pp. 503. Paris, 1884.

THIS volume is, in the words of the author, not intended for the use of beginners, but is specially prepared for the use of those who may be actually engaged in the practice of metallurgical chemistry and assaying, and chiefly to present several new methods of analysis which have been devised and used partly by the author and partly by his father, M. Hautefeuille. The novelties of greatest interest are the use of metallic lead as a means of separating copper from its solutions, and the precipitation of copper, zinc, cobalt, nickel, and bismuth as oxalates, for which latter method the advantage is claimed that, as the precipitates are not viscous, and only volatile reagents are used, the washing of the precipitates requires much less time than is the case with the processes in general use. It is, of course, difficult from mere description to form a correct judgment upon new analytical methods which have, no doubt, approved themselves to the author in practice; but judging from the account given, they seem to be rather tedious, and there are no comparisons given with other methods to show their accuracy. Probably in most cases electrolytic separation, or volumetric determination by cyanide of potassium, which are fully noticed, will be preferred. Apart from these, however, there is much valuable matter in the book which gives schemes for the analysis of all the more important minerals and furnace products, with which the metallurgical chemist is likely to have to do. The author's strong point is evidently in the analysis of copper and nickel ores, the section relating to iron being somewhat deficient. For instance, none of the more expeditious methods of determining carbon and manganese in steel and iron are noticed. The reduction of sulphide of gold by calcination in a platinum crucible, as directed at p. 467, seems rather unsafe, as there might be difficulty in detaching the reduced gold from the platinum unless the heat was very carefully regulated. Probably most operators would use a porcelain crucible rather than risk damage to the platinum. The volume is, however, exceedingly suggestive, and the notices of metallurgical processes make it interesting, which, in connection with its low price, should make it acceptable to those who are interested in metallurgical chemistry.

Leitfaden zur Bergbaukunde. Von Dr. ALBERT SERLO. Fourth edition, revised and enlarged. 8vo., 2 vols., pp. 1509. Berlin: Julius Springer. 1884.

THE third edition of the useful and well-known text book on mining, published in 1878 by Dr. Serlo, now the head of the technical department for mines in the Prussian Ministry of Public Works, having been for some time out of print, a new edition, revised and enlarged, has been issued. The enlargement is very decided, the text having grown from 1146 to 1509 pages, and the illustrations from 687 in number to 822. The original form of the work, namely, the division into nine sections, has been preserved, and with it much of the former text, the new additions being made in the proper places, and is not, as is so often the case with new editions of popular works, bundled in as an irregular appendix at the end of each chapter. The chief additions have been made in the sections on deep boring, explosives, boring, drilling, and coal-cutting machines, hauling and winding, ventilation and pumping. The use of iron instead of timber in securing shafts and levels, which has come into practical existence since the date of the former edition, is also well illustrated. The author very properly devotes but a short space to the consideration of mineral deposits, that being a special subject of sufficient importance to command a literature of its own; but he also omits the subject of handling and dressing minerals at the surface, an omission which some readers may be inclined to regret, although perhaps, strictly speaking, this may be regarded as belonging more to metallurgy than to mining proper. Within the limits of the work, *i.e.*, the civil and mechanical engineering of mines, it is exceedingly full of matter, and replete with references to the literature of the subject, which have been brought down to as late a date as the beginning of October, 1883. The work being of such an encyclopædic character, it is unfortunate that the author has not given an index or supplied marginal references to the text; the pages being large and the type small, there is sometimes a difficulty in picking up the beginning of the paragraph when making a casual reference. There is, however, a very detailed table of contents to each volume, which to some extent replaces the desired index.

Tin Mining, Dressing, and Melting. By ARTHUR G. CHARLETON. 8vo., pp. 82. London: Spon. 1884.

THIS volume, though little more in bulk than a pamphlet, is well supplied with titles. On the back it is called "Tin Mining;" on the cover this is expanded to the title given above, and on the title page it is said to describe "the chief methods of mining, dressing, and smelting it—tin—abroad." After this latter promise it is somewhat disappointing to find that the text is confined to a brief and rather unsystematic account of Zinnwald, and Altenberg, and Abertham, in Bohemia, illustrated with a number of rough free-hand sketches which are dispersed over fourteen plates without the slightest regard to numerical order. Thus, Figs. 28, 10, and 13 are next each other in descending order on Plate VII.; Figs. 9 and 21 on Plate VIII.; Figs. 19 and 25 on Plate IX., and so on, throughout; and as there is not the least indication given in the so-called explanation of the Plates of where the figures are to be found, reading the book is a very tedious work. A good account of an ancient and decaying industry as tin mining in the Erzgebirge is, would doubtless be interesting to many persons in this country; and it is therefore to be regretted that the author has not strengthened his text by consulting the numerous published authorities on the subject, and more particularly Dr. Reyer's monograph on tin, published in 1881, in which the geological and historical characters of the districts are admirably delineated. The work has been very carelessly put together; thus the precipitate obtained when a solution of bismuth in hydrochloric acid is diluted with water is spoken of as chloride of bismuth instead of oxychloride, and in the first paragraph on page 1, we are told that out of 16,430 tons of tin, which represented as nearly as possible the average annual production of the world, England produces 7200 tons and Saxony 130 tons, while at p. 42 it is stated that, "Roughly speaking, Saxony produces annually about one-thirtieth of the amount of tin that is produced in Cornwall." Surely 130×30 is a very rough approximation to 7200. The author might also have told his readers that the estimated total given above refers to a period about a quarter of a century back, and that the production of the world is at the present time nearly three times as great.

A Treatise on Earthy and other Minerals and Mining. By D. C. DAVIES, F.G.S. 8vo., pp. 336. London: Crosby Lockwood and Co. 1884.

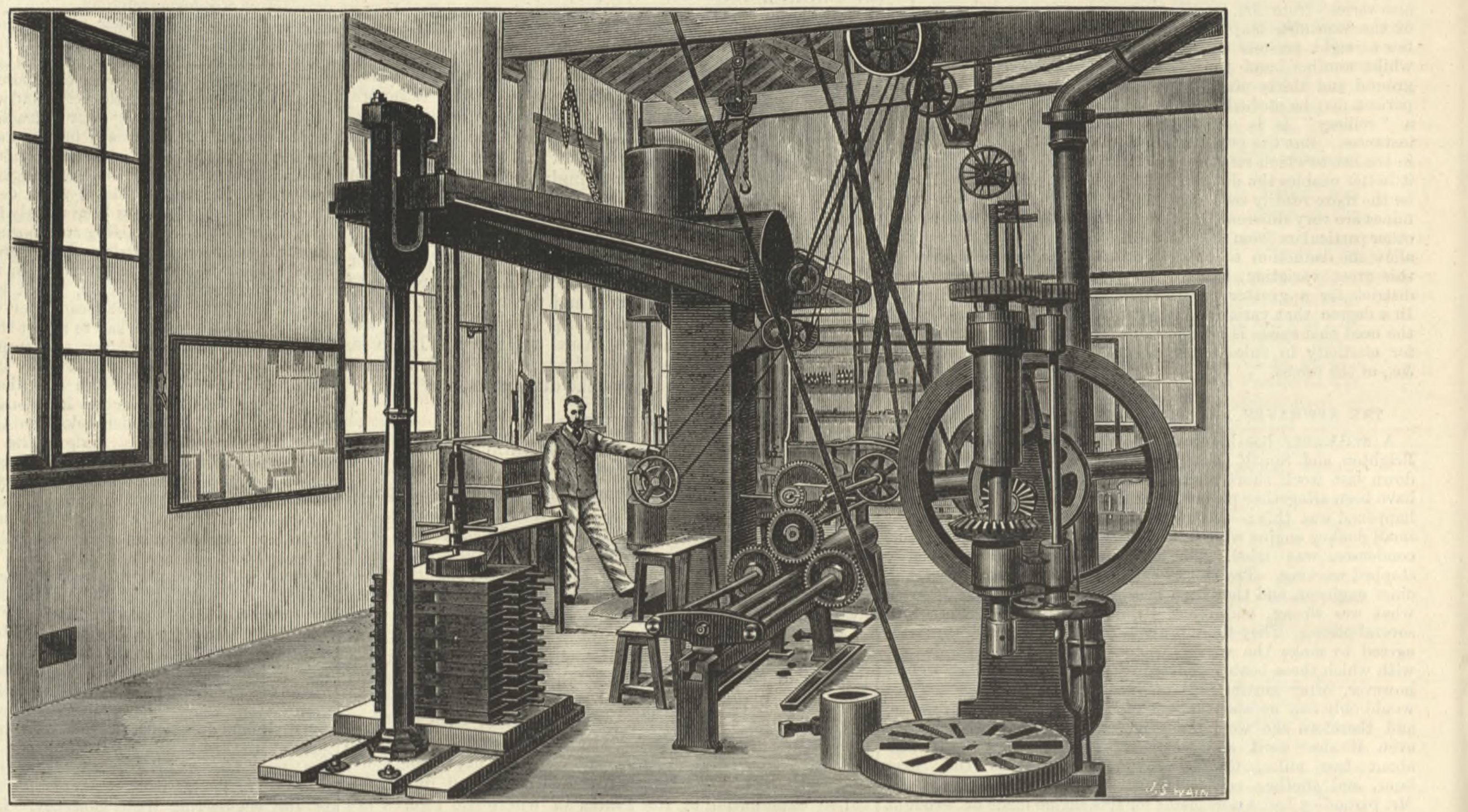
THIS work may be regarded as supplementary to that formerly published by the same author on "Metalliferous Minerals and Mining." It includes descriptions of the more important minerals, other than metallic ores, which are used in the arts. About one-fourth of the volume is devoted to the subject of phosphates, and this, which is by far the best part of the book, contains much interesting information, especially that concerning the little-known deposit of phosphorite lying on the top of the Bala limestone in the Berwyn Mountains in North Wales. This, which has been carefully studied by the author, is an irregular nodular bed, from 6in. to 18in. in thickness, extending for a considerable distance along the outcrop of the formation. At the Berwyn mine the average yield was at the rate of 2½ tons per fathom, of a phosphorite containing about 46 per cent. of phosphate of lime. The apatite deposits of Norway are also noticed in some detail, with figures, many of which are supplied from the author's own observation. There is also some account of the phosphates in the Lahn Valley, but here the author seems to have confused the schistose volcanic ashes—*Schalstein*—with the porphyry and basalt masses "usually crowned with a castle," which are of dissimilar ages. The phosphorite pits at Staffel are spoken of as yielding beautifully crystalline forms of apatite, but no mention is made of the special mineral of this locality, staffelite, a crystalline phosphorite containing carbonate of lime. Apart from the section on phosphates and some notices of Swedish mines, the volume is of small value. The author's design of giving a full and intelligent account of the minerals selected for description cannot be said to be realised, even approximately, as the descriptions are exceedingly careless. Thus, in the very beginning, the chemist's abstract term, silica, is credited with the physical properties of quartz, and immediately afterwards, in the description of rocks, quartz and the combined silica, of their constituent minerals, are considered as synonymous. In the same arbitrary fashion alumina and corundum are taken to be equivalent words, and then sapphire, ruby, spinel, topaz, emerald, beryl, and tourmaline are described as forms of corundum, while the analyses given in illustration are of the most quaintly inaccurate character. This part of the text might have been derived from some ancient mineralogical manuscript of, say, the middle of the last century, but it seems scarcely fair to put forth such matter as representing current knowledge on these subjects.

THE IRON TRADES EMPLOYERS ASSOCIATION.

THE annual general meeting of the members of the above Association was held yesterday—Thursday—at Halifax, and the general committee, in their report, which was presented and adopted, dealt with several important questions interesting to the trade generally. The marked events of the past year, the report pointed out, had been the increasing depression in the iron trades generally and the very sudden fall in the shipbuilding industry. This falling away of trade had, in many districts, been followed by reductions in the wages rates, which were becoming unusually high, and had reached a point which might probably have had much to do in bringing about a reaction that was particularly noticeable in those departments of the iron trades in which wages had been unduly forced up by exceptional conditions in the shipbuilding and marine engineering districts. In other engineering districts there were signs also that wages were tending backward to the rates in force before the recent period of activity had set in, which seemed, except in very special cases, to have disappeared for the present. Generally speaking, the committee had to report that no serious difficulties had arisen between workmen and employers in the districts where the Association had members; but there was one question which had occupied the attention of employers in the engineering trades all over the kingdom, and the dispute which had taken place in Sunderland upon the apprentice question, after a more protracted struggle in the engineering trade than had been known in any past time, had gained for employers and employed in all other industries a victory in which liberty of action on a most important point had been effectively vindicated and made secure. With regard to the important question of the rating of machinery by overseers of the poor, the committee reported that this was a matter which might at an early date become a question for legislative action. In some important districts much anxiety was felt in regard to the course pursued by overseers of the poor, in bringing tools, lathes, and light machinery generally within the schedule of property to be assessed for poor's rates, and in some places the subject was assuming a serious aspect. The theory upon which assessment committees and their officers were now proceeding in many places would throw an additional and very weighty burden upon industrial enterprise if not successfully resisted. The committee had, therefore, during the last few months given very close attention to the question in the interests of the members of the Association and of the engineering trade generally. In the Leeds and Manchester districts the leading firms had formed themselves into voluntary combinations for mutual assistance in resisting these attempts, and they had resolved to carry any such case to the final court of appeal before the House of Lords, should they find it necessary to do so. In the meantime, as nearly all our great national industries were thus threatened by an additional and very heavy burden which might be thrown upon the already over-weighted cost of production, conferences had been held, and occupiers of workshops and factories, railway companies and other great industrial corporations were likely to make common cause, by asking the Legislature to take such steps as would settle in clear terms, and make uniform in its action this vexed question of rating machinery, and would thus relieve employers from the harassing uncertainty to which they were exposed. The report next referred to the formation of local district branches on the Tyne and Wear in accordance with the request of the employers in the engineering trades of Newcastle-on-Tyne and of Sunderland. The successful working of the scheme of mutual insurance against claims made under the Employers' Liability Act was also dealt with, and as an illustration of how comparatively small are the risks in the engineering branches of trade, it is pointed out in the report that, notwithstanding the very low rates of insurance upon which the scheme had been originally based, it had been found possible to make a considerable reduction in the scale of charges, and they had still a revenue more than equal to the claims made upon the funds, and after discharging all demands for compensation and expenses of management, a balance upon the year's transactions remained in the hands of the Association.

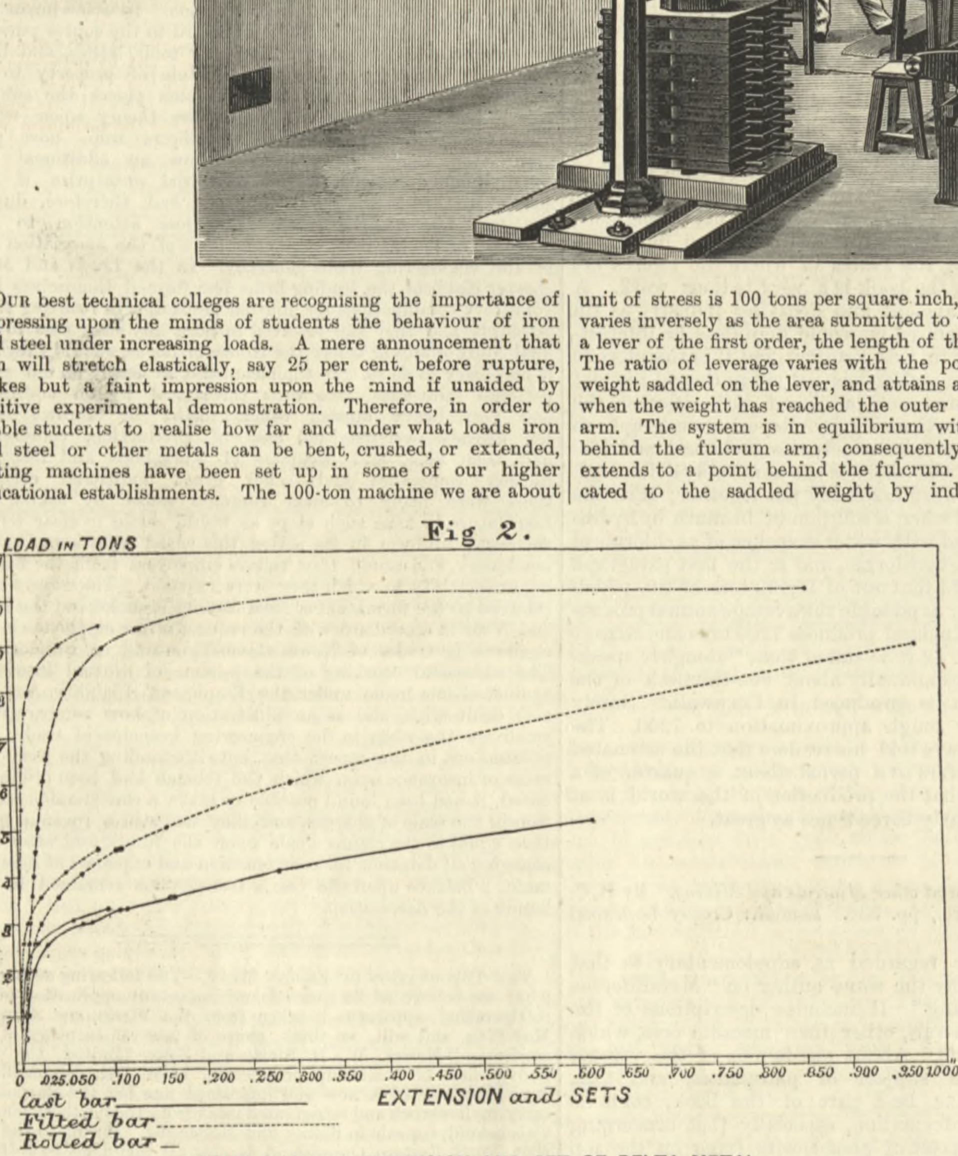
THE IMPORTATION OF FROZEN MEAT.—The following account of what we believe to be a novel and important application of air refrigerating apparatus is taken from the *Melbourne Argus* of May 27th, and will, we think, prove of interest to many of our readers:—"Messrs. W. H. Smith and Sons, Limited, the well-known firm of steamship proprietors, have with commendable enterprise started a new and important line for the purpose of carrying live stock and refrigerated meat from the northern ports of Queensland, for sale in Sidney and Melbourne. Owing to the fact that North-Eastern Queensland is now all taken up by settlers, who, as soon as possible, get the runs stocked with sheep for the sake of the more profitable wool, the cattle-producing stations are being annually pushed further into the new country in the interior; and the increasing difficulty of travelling live stock overland through the now settled districts and the great expense attending it, render the present enterprise imperative, as is evidenced by the present high prices of meat in Sydney. The s.s. You Yangs, which left this port for Queensland on Saturday, has, since her arrival at Melbourne a week ago, undergone a complete transformation. Three tiers of pens of a very substantial character have been erected in the hold, the 'tween-decks and the main deck, ranged along each side of the ship, with a wide passage-way between each row, giving ample room for the attendants to feed and water the stock. What was formerly the saloon on the main deck has been converted into the refrigerating chamber, and has been fitted with one of Lightfoot's patent cold-air machines, made by Siebe, Gorman and Co., of London. These machines are the latest development in this class of machinery, and are very compact and strong. The valves, which are the principal source of trouble with cold-air machines, are of novel construction, especially simple and strong. They consist of cylindrical slides, actuated by excentrics on the main shaft, and work as noiselessly and easily as the slide valve of a steam engine. At the trial on Saturday the machine worked very satisfactorily and smoothly, making no more noise than an ordinary steam engine, and quickly reduced the temperature to 40 deg. below zero. The thorough ventilation of the ship has been carefully attended to, and entirely novel means have been adopted to insure this end and the health and comfort of the live stock carried. This will be especially valuable in the hot climate of Northern Queensland, and keeping the holds at an even cool temperature must greatly benefit the health and condition of the live stock carried by preventing the sweating and wasting fever which usually occurs in the hold of a cattle ship. The air shaft is connected to a large funnel or uptake, in which is fitted a powerful ventilating fan or exhauster, driven by a small steam engine attached to it, which draws off all the heated and vitiated air, and keeps the current of pure, cool air constantly circulating through the ship even in bad weather when the hatches are battened down. Messrs. Hughes, Pye, and Rigby, of South Melbourne, supplied and fitted the ventilating and refrigerating apparatus. The ship as fitted is capable of carrying over 200 head of live stock and 100 tons of frozen meat or other perishable cargo, such as butter, milk, and other perishable cargo."

TESTING LABORATORY, COOPER'S HILL ENGINEERING COLLEGE.



Our best technical colleges are recognising the importance of impressing upon the minds of students the behaviour of iron and steel under increasing loads. A mere announcement that iron will stretch elastically, say 25 per cent. before rupture, makes but a faint impression upon the mind if unaided by positive experimental demonstration. Therefore, in order to enable students to realise how far and under what loads iron and steel or other metals can be bent, crushed, or extended, testing machines have been set up in some of our higher educational establishments. The 100-ton machine we are about to describe is one of this class made by Buckton and Co., of Leeds, and erected during the course of last year in the laboratory of the Royal Indian Civil Engineering College, Cooper's Hill. Essentially its principle is the same as that of the single-lever 50-ton Wicksteed machine, whose place it takes, and which has been previously described in these columns, but in accessory qualities it embodies many improvements, suggested by Professor Unwin, which greatly distinguish it from the previous machine of lighter build and lower testing power.

Fig 2.



CURVE SHOWING EXTENSION AND SET OF DELTA METAL.

FIG.3.

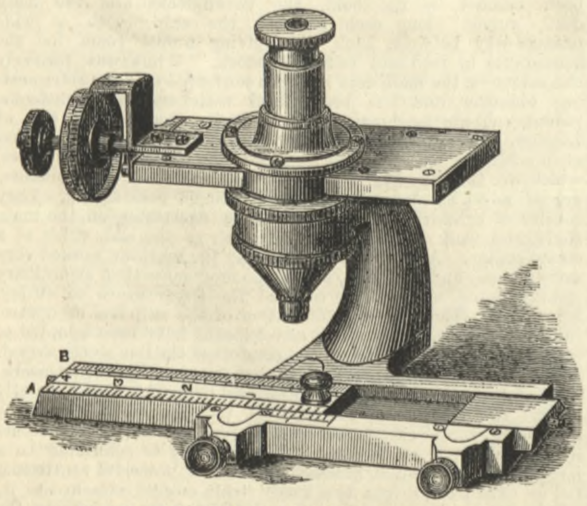


Fig. 3.—PROFESSOR UNWIN'S MICROMETER.

Fig. 1 is a general view of the new machine and the interior of the engineering laboratory. The machine has a maximum testing power of 100 tons. Hence, with inch bars the maximum unit of stress is 100 tons per square inch, and for other sections varies inversely as the area submitted to test. It is in principle a lever of the first order, the length of the short arm being 4in. The ratio of leverage varies with the position of the running weight saddled on the lever, and attains a maximum of 50 to 1 when the weight has reached the outer end of the long lever arm. The system is in equilibrium with the running weight behind the fulcrum arm; consequently the load graduation extends to a point behind the fulcrum. Motion is communicated to the saddled weight by indirect transmission to shafting from a prime motor Clerk gas engine, indistinctly visible in the background behind the drilling machine on the right of the figure, and by fast and loose pulleys and screw shaft to machine. The motion of the riding weight is started, stopped, or reversed by the fast and loose pulleys which can be worked by hand when a delicate movement is necessary. Motion is conveyed to the compressor plunger by a somewhat similar arrangement, clearly shown in the centre of the illustration. The necessary counterpressure is produced by the action of this horizontal plunger upon a ram in a vertical cylinder of cast steel, fitted to the frame and contained below floor in the line of specimen under test. The plunger acts upon the ram through an intermediate hydraulic seal or water piston which effects a steady and continuous increase of pressure. The maximum counterpressure attained is about 2 tons per square inch of ram area. The machine has two knife edges, each 22in. long; one used as a fulcrum, the other for the suspension of the shackles. The shackle-joints are somewhat novel, consisting of a rounded end fitting into a halved semispherical cup or socket, a type of joint which seemed to us very elastic and apt to relieve any oblique twists or local strains. The diameter of the pump plunger is about 3¼in., that of the ram about 9in.

Diagram, Fig. 2, gives the plotted results of a series of actual experiments upon three small bars of Delta metal 0·62in. diameter and 8in. length, made and kindly furnished to us by Professor Unwin. There are two curves to each bar, one for permanent set, the other for total extension, the intercept between them showing the elastic extension. These curves appear exceptionally regular and continuous, bearing in this respect a close resemblance to a steam expansion curve. It would appear from the diagram that Professor Unwin prefers to enlarge the scale of extensions rather than the scale of loads, an expedient which, in our opinion, tends to bring out in relief the salient features of the test. Apart from a slight deviation in the curve of the cast bar, the diagram exhibits no break-down or line where extension continues unaccompanied by increase of load. Another pleasing characteristic of the curves is the approximate constancy of the elastic extension, the greatest variation in this respect being exhibited by the cast specimen.

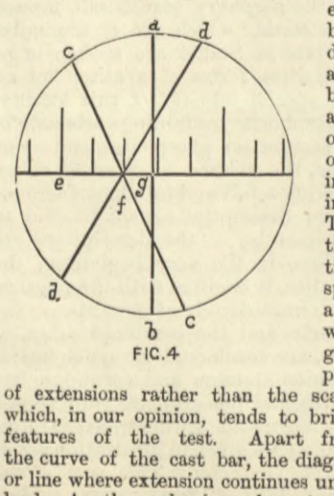
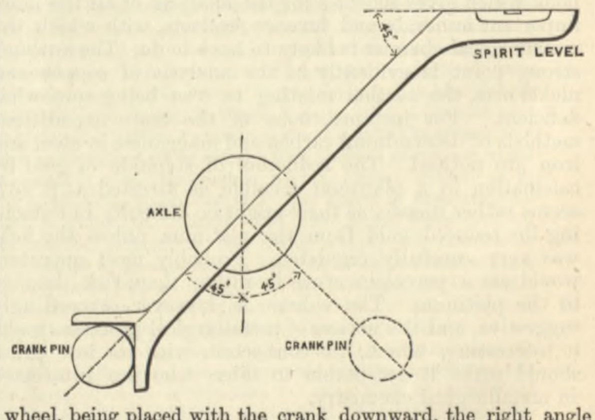


FIG.4

Fig. 3 is an illustration of the micrometer with which Professor Unwin took the extensions plotted in Fig. 2. The measurements are first approximately taken by drawing out the graduated scale, and then minute differences are determined by using the circular vernier in the following way:—The double scale A B, Fig. 3, is first set by touch to the distance between two polished steel pins fixed on the bar, and this distance is read off provisionally on scale A, divided into tenths, and subdivided by a vernier into hundredths of an inch. Practically, within the limits of elasticity, only the nearest one-tenth is required. Having read the extension on scale A within one-tenth of an inch, the operator next looks through the microscope at the magnified scale B, divided into tenths of an inch to agree with the first division on A. Each of these tenths is subdivided into five parts, or to one-fiftieth of an inch. Thus the field of view presented to the eye is similar to diagram, Fig. 4, where *a b* is a fixed cobweb coincident with the vernier zero of scale A. The lines *c c d d* represent crossed cobwebs displaced by turning the graduated head of the micrometer screw. When the crossed cobwebs coincide with *a b*, the graduated head is at zero. Two turns of the head move the cobwebs one small division of scale B, and as the circumference is divided into hundredths, it reads within one-ten-thousandth of an inch. Up to the limit of elasticity the scale A requires to be read only once. Beyond this limit the stretch is so great that the readings to hundredths on scale A are sufficiently accurate. This adaptation of the micrometer as an end measure is certainly ingenious, and more likely, we should think, to give correct results than the plan of following the extension on the vertical scale of a cathetometer.

TESTING CRANK PINS.

In the Missouri Pacific shops, St. Louis, they employ, according to the *Railroad Gazette*, a very neat device for testing the angle of crank pins. It often happens that after an engine has been running some time the axle becomes twisted, and consequently the crank pins are no longer at 90 deg. apart, though originally correctly set in a quartering machine. The little tool, shown in the engraving, enables the accuracy of the pins to be tested. The

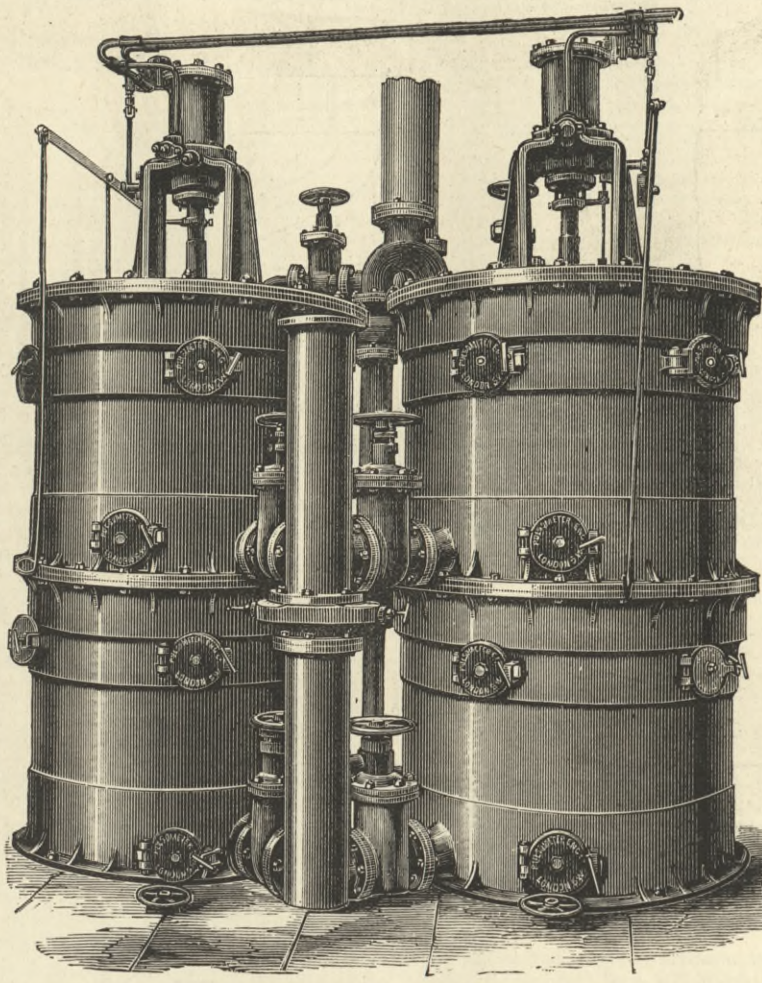


wheel, being placed with the crank downward, the right angle fork at the lower end of the gauge is put on the crank pin, and the inclined face is brought into a line with the centre of the axle. The instrument being clamped to the wheel, the latter is turned until the bubble in the spirit level stands central. It is obvious then that the line joining the centres of the crank pin and axle is inclined at an angle of 45 deg. with the vertical central line of the axle. The instrument is now unclamped and set on the other crank pin. If the bubble in the spirit level again stands central, it is evident that the line joining the centres of this crank pin and the axle is also at an angle of 45 deg. from the vertical; and that the sum of these angles being 90 deg., the crank pins are correctly at right angles to one another. If the bubble stands away from the axle, the crank pins are less than 90 deg. apart, and if the angle between them is too great the bubble will stand towards the axle.

South Kensington Museum.—Visitors during the week ending July 19th, 1884:—On Monday, Tuesday, and Saturday, free, from 10 a.m. to 10 p.m., Museum, 10,591; mercantile marine, Indian section, and other collections, 3945. On Wednesday, Thursday, and Friday, admission 6d., from 10 a.m. to 6 p.m., Museum, 1745; mercantile marine, Indian section, and other collections, 160. Total, 16,441. Average of corresponding week in former years 18,071. Total from the opening of the Museum, 21,202,468.

THE THAMES FILTER.

CONSTRUCTED BY THE PULSOMETER ENGINEERING COMPANY



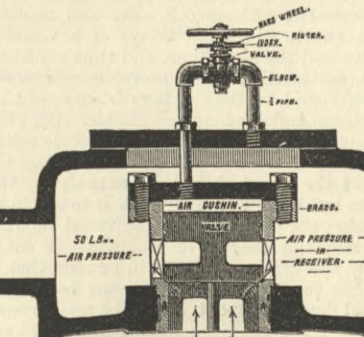
FOR many years the rapid filtration of large quantities of dirty or muddy water presented a problem which no one seemed able to solve. The rapid extension of the use of steam boilers, and of water for various industrial and other purposes, and for the transmission of power—as, for instance, by the London Hydraulic Power Company—has, however, forced engineers to take the matter up, with the result that it has now for some time been overcome. The Pulsometer Engineering Company has applied its "Thames" filters to numerous purposes, and its success has led to its use for filtering water from the tidal part of the Thames for boiler and manufacturing purposes by proprietors who thus save large sums by being able to dispense with water from the waterworks companies, and by proprietors of steamboats and tugs, who have found, it need hardly be said, great economy and saving of time result from the use of filtered water.

Some time since we gave a description of the "Thames" filter, which makes it unnecessary to describe the construction now; but our object here is to draw attention to the fine set of these filters which has been erected and in operation now for some time in the works of the London Hydraulic Power Company, as above referred to. The object of this company is to supply water at a pressure of about 700 lb. per square inch over a large area at each side of the river Thames, commencing at Blackfriars Bridge and extending to near the Tower. Already several miles of mains have been laid, many consumers have machinery connected to them; and the company has recently issued circulars announcing proposed extensions. The whole of the water pumped into these mains, and that used in the boilers, is taken from a sump in the river close to Blackfriars Bridge, and is cleansed in the two large filters shown in our illustration. Each of the four filters is designed to pass 2500 gallons per hour, and to deliver the water bright and clear, and sufficiently purified to permit of its use in boilers, baths, pumps, presses, and lifts, without any prejudicial action, and of its passage at slow speed through long pipes without depositing any sediment.

The construction of the filters is essentially the same as that we described in THE ENGINEER, 21st September, 1883. There are four filters at Blackfriars, two in each of the columns shown. The material employed to separate the solid matter from the water, is sponge strongly compressed between two perforated plates, one of which forms the upper surface of a piston. The water enters each filter near the bottom, and rising through the layer of sponge, escapes at the top, the tanks for the muddy and clean water having a difference of level of about 5ft. to provide the necessary pressure. At the end of a time varying from twelve to twenty-four hours, according to the state of the river, the filter is cleaned, all its accumulated mud being entirely washed out, and the sponge returned to its original state of purity. To effect this the inlet valve is closed, and a waste valve near to it is opened, thus allowing a certain quantity of the clean water to flow back in the opposite direction to that in which it had already passed through the filter. While this water is flowing, an action like that of washing a sponge by hand is obtained by alternately raising and lowering the piston, allowing the sponge to expand to about twice the bulk it occupies when at work, and then compressing it. The motive power for this is high-pressure water acting in the small hydraulic cylinder shown at the top of each pair of filters. This is provided with a simple distributing valve by which the motion is reversed at the end of each stroke, and the piston kept in motion for the ten to twenty minutes during which the cleaning is continued. The cylinders of the filters are lined with gun-metal, and the pistons lagged with wooden strips, so that they will not stick even if left unmoved for days. The sponge lasts for a long time, and the annual expense of maintenance of this material is merely nominal. The filtration is in this set of filters supplemented by filtration through charcoal, an addition which was introduced to guard against the results of a peculiar stain which now and then in certain conditions of the Thames is difficult to remove, although all solid particles are apparently taken out. The filter is arranged so that this secondary filtration need not be done, and when the Thames is not in the condition referred to, the water appears as bright before as after passing the charcoal. This is the only installation in which the charcoal is used. The filtering installation at the General Hydraulic Power Company's works has already been in operation several months with uniform success, and proves that the system is applicable, not only on a small, but also on a very large scale.

AIR COMPRESSING ENGINES.

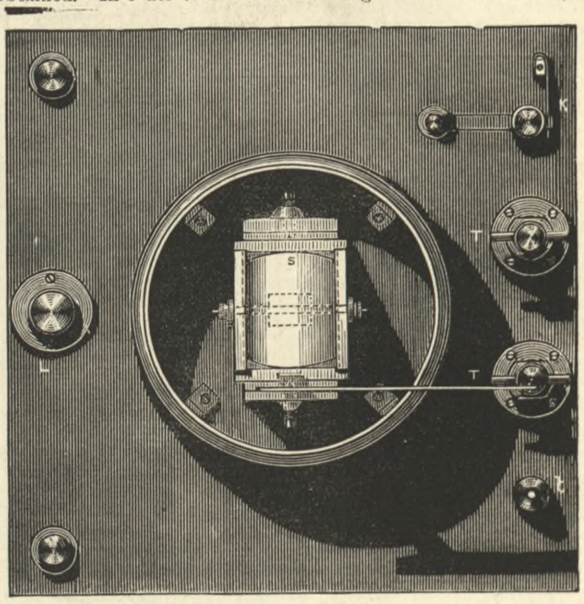
THE pair of air compressing engines of which, in this week's number we give an engraving, were constructed by Messrs. R. Bradley and Co., engineers, Wakefield, for the purpose of supplying compressed air for the underground hauling, pumping engines, and coal-cutting machines, at the large and extensive collieries belonging to Messrs. Pope and Pearson, Normanton. The engines are horizontal, the cylinders being 24in. diameter, with a stroke of 6ft., fitted with cut-off valve and graduated indicator plate which can be altered whilst the engines are at work, and a heavy fly-wheel for the purpose of preserving a regular motion. The want that has always been felt in air compressing engines is the long stroke, by means of which the usual waste of air, which is one of the disadvantages of the short stroke engine, is avoided. It will be noticed from the engraving that the pistons of the air cylinders are connected with the steam cylinder piston rods by means of a coupling wrought iron slide block. The air cylinders are 25½in. internal diameter, with vertical cast iron towers attached, in which are placed the outlet and inlet valves. The inlet valves are a modification of the ordinary construction; the outlet valves have been specially designed by Mr. W. E. Garforth, mining engineer to the collieries, under whose superintendence the work, together with the construction of the new engine-house with arrangements for cooling the air, &c., has been carried out. It is shown by the annexed engraving of a valve and seat made of gun-metal, with an arrangement by which the compressed air acts as a cushion. The upper portion of the valve chamber is carried outside the main tower, and by means of a valve can be regulated at pleasure. It will be evident that the saving of wear and tear has been greatly reduced by the use of this valve. The indicator diagrams show that the power necessary to lift the valve is less than in the ordinary valve, besides other minor advantages which will be apparent to our readers. From the foregoing principle it will be seen that the compressors are on the principle which is known as the wet air



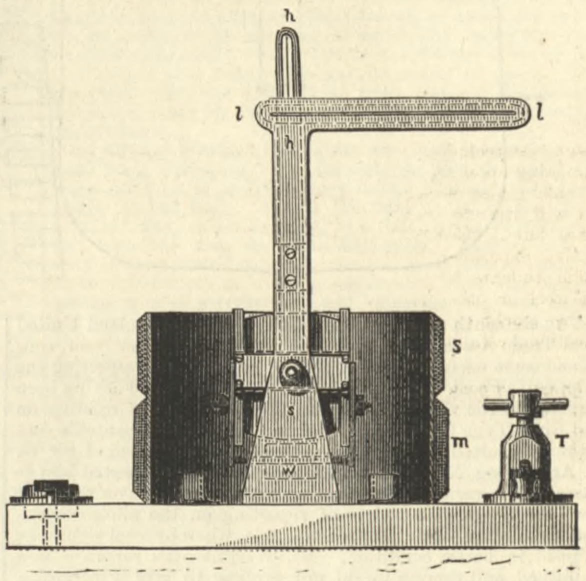
compressors. This kind of engine, although often used on the Continent, is seldom seen in England. The chief advantages claimed in these engines are the outlet valves, the arrangement for supplying the air cylinders with the necessary amount of water, and with the general arrangement, and specially the proportions of the towers and valves. It may be stated that the improvements have been designed from actual experience gained in working, and by numerous indications to ascertain the most suitable piston speeds, besides observations on the temperature required to reduce the heat of the air consequent on compression. It is now claimed that these engines are giving the maximum effect with a minimum consumption of fuel, and the cost of repairs, owing to the slow speed, is very considerably less than in the ordinary air compressors.

KAPP'S ELECTRIC ENERGY INDICATOR.

THE energy indicator, illustrated by the accompanying engravings, was exhibited at Professor Adams' *conversazione* at King's College on the 3rd inst. It consists of a coil of high resistance wire pivotted on horizontal centres, and capable of oscillating in a plane at right angles to the plane of the winding. This coil is inserted as a shunt between the main leads, and is therefore traversed by a current, the intensity of which is proportional to the electro-motive force between these leads. Another fixed coil *m* wound in a horizontal plane carries the main current and surrounds the shunt coil, as will be seen from our illustration. The tendency of the main current is to set the shunt coil so that its magnetic axis coincides with the axis of the main coil. This tendency is partly resisted by the weight *w*, which tries to keep the shunt coil in the position shown in the drawing. In consequence of the two forces acting at a right angle to each other, the coil takes an inclined position, and the geometrical tangent of the angle of inclination is a measure for the product of the shunt and main current, that is for the electrical energy flowing through the instrument. The shunt coil is provided with an index arm having a slot and fine wire *h h* stretched across it. This wire, when the index arm is deflected, moves in front of a fixed slot *l l*, and thereon indicates directly the tangent of the deflection. Thus an evenly divided scale is obtained. In order to increase the range of the instrument, a



second shunt coil S of nine times the resistance of the coil *s* is added. These two coils are coupled in series, but by depressing a key K the large coil can be short circuited. To avoid any magnetic effect from the coil S, one half of it is coiled one way and the other half the opposite way. T T are the terminals of



the main wire, *t* the terminal for one of the ends of the shunt wire, the other end being permanently soldered to one of the main terminals. A spirit level L serves to set the instrument horizontal. The energy indicator is made by Messrs. Crompton and Co. Chelmsford.

THE EXPRESS RAILWAY CHAIR.

THE railway chair illustrated in the accompanying engraving is now being tried on the Great Northern Railway, where we understand it has given satisfaction. On one side of the chair the jaw is shaped to fit the bottom of the rail, and has a plain smooth face; on the other side the jaw tapers towards one end, making the opening between the two jaws of wedge shape. On the face of this latter jaw there are some serrated projections or teeth which run in a vertical direction. These projections or teeth are inclined at such an angle that instead of tearing the key when being driven they tend to facilitate its

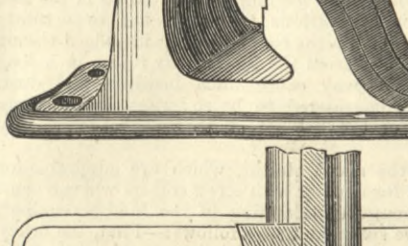


FIG. 1

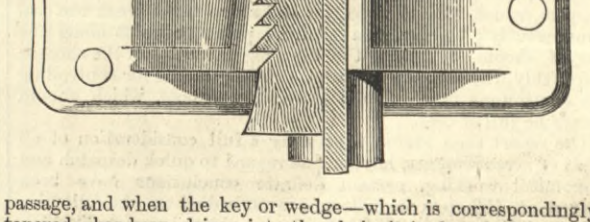
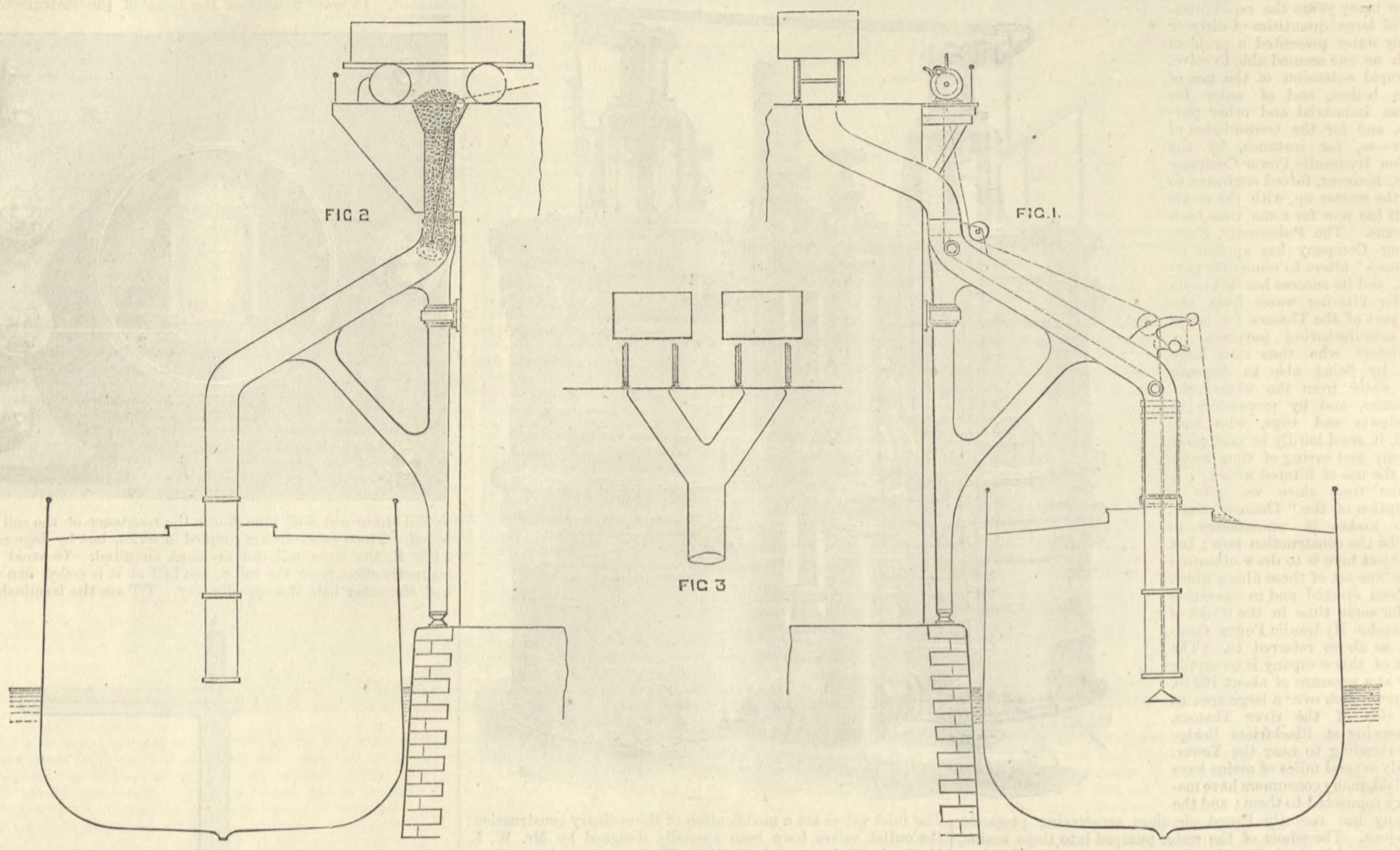


FIG. 2

passage, and when the key or wedge—which is correspondingly tapered—has been driven into the chair, it is found that these teeth have penetrated into the wood, or otherwise the wood has protruded into the notches; and as the faces of the teeth are at right angles to the web of the rail and drift way, they directly oppose any tendency of the key to slip back and fall out; whilst on the other hand, as the key is of taper shape, it cannot possibly pass through the chair in the opposite direction, therefore it remains permanently fixed in one position for a very considerable period. The chair is made by the Express Railway Chair Company, King-street, Leeds.

WESTMACOTT'S COAL SHIPPING MACHINERY.

MESSRS. SIR W. ARMSTRONG, MITCHELL & CO., NEWCASTLE-ON-TYNE, ENGINEERS.



THE sixteenth annual report of the North of England United Coal Trade Association, issued at the close of last year, contained some useful information and suggestions respecting the shipment of coal. The attention of the committee having been directed to the very imperfect methods at present existing on the River Tyne for shipping coal in good and merchantable condition, consulted Mr. Percy Westmacott, of the firm of Sir W. G. Armstrong, Mitchell, and Co., Limited, and requested him to examine the various staiths and shipping apparatus on the three northern rivers with a view of reporting on the whole subject, and suggesting some improved mode whereby coal would be shipped in better condition. Mr. Westmacott's report is now published, and though we do not propose to give it *in extenso*, we think some extracts from it will interest many of our readers, more especially as at the present time the subject is receiving increased attention in regard to the economical use of coal, and the prevention of a great deal of the reckless waste which has so long existed in the neighbourhood of our collieries.

It appears that all the principal shipping staiths in the counties of Northumberland and Durham are upon the gravitation system, and Mr. Westmacott divides them into two classes, viz., balance staiths and shoot staiths. These are not described in detail, as it is assumed that the members of the Association are acquainted with their construction and working; but it is broadly stated that the former admit of the least breakage of coal, and that the latter are capable of shipping the greatest quantity in a given time. Theoretically, to lower a truck of coals bodily from off the high-level rails into the hold of a vessel until the truck comes to rest close to the bottom of the vessel or upon the body of cargo coal, gives the least amount of breakage possible; but practically the system cannot be carried out, because, in the first place, the size of trucks prevents them as a rule from being lowered through the hatchways; secondly, the great distance in many cases through which the trucks would have to move in order to reach the extreme depth required to prevent an undue fall of coal is not attainable; thirdly, the loss of time which takes place in swinging the trucks out and in when rapid loading is essential, as in the case of screw colliers, is too serious; fourthly, the opportunity afforded in this class of staiths for careless or ill-judged timing in breaking out the coal from the trucks may result in a long fall for the coal, and may cause much breakage and dust. These objections are considered to be so serious as to entirely preclude all chance of the balance staith being made properly efficient.

With regard to the shoot staiths, which are admirable for quick despatch, and for dealing with screw colliers where a comparatively small amount of trimming in the hold is required, their defects may be summed up as follows:—First, the heavy amount of breakage and dust caused by the excessive fall of the coal from the bottom of the truck upon the receiving hopper; secondly, the generally defective construction of the receiving hoppers, which with their angles and sharp turns break the coal unnecessarily; thirdly, the fall from point to point along the line of shoots; fourthly, the tapering inwards of the shoots; and fifthly, the absence of proper arrangements for controlling the continuous flow of coal down the shoots, which should always be full of coal.

The report then states that after a full consideration of all kinds of arrangements, having due regard to quick despatch and economical working, certain definite conclusions have been arrived at. These conclusions are embodied in the following series of suggestions:—(1) It is considered inexpedient to attempt to adopt any plan in this district that is not based on the gravitation system. (2) Looking at the large amount of capital expended upon the present staiths, their rails, and their approaches, it would be most desirable in making any alterations or modifications to interfere as little as possible with the present structures. (3) It is desirable, if possible, to construct such a plan for saving the breakage of coal as shall be applicable, or can be attached, to all kinds of existing staiths. (4) It is observed that coal is not materially injured if it be allowed to gravitate in a continuous unbroken mass through a smooth shoot or spout tapering slightly outwards, and having no obstructions, sharp corners, or angles. (5) A cylindrical spout is considered to be the best form to adopt, and it should be capable of being extended from the receiving hopper on the rail level in an unbroken form right down to the bottom of the hold of a vessel. It should be so constructed that it can readily be shortened as the body of coal rises in the vessel, and as it would not be possible in all cases to make the spout of a straight form, the bends, where necessary, should be rounded to a good radius. (6) The spouts should be made to swing sideways, and may be carried by means of a jib or derrick, or some simple contrivance. (7) The receiving hopper should be made as shallow as practicable, with smooth sides and rounded corners. (8) In order to enable all the hatchways of a vessel to be filled with coal at one and the same time, and thus expedite the loading of steamships, the adoption of movable spouts, and hoppers which can be adjusted to the varying distances of hatchways in vessels, are recommended where practicable. (9) (This is considered the most important feature in the whole scheme.) The control of the flow of the coal into the hopper and through the whole length of the spout should be entirely in the hands of the man on the rail level, whose duty it is to see to the emptying of the trucks; the men on board the vessel should only have the power of stopping the flow of coal when it comes too fast upon them. By this arrangement it will be seen that if the man on the bank has proper and handy means for regulating the flow of the coal down the spout, he can be made responsible for keeping the coal in the receiving hopper always at such a level that all undue breakage from the fall of coal from the trucks may be avoided, and thus the present serious amount of breakage due to the careless emptying of the shoots can be abolished. (10) In order to save the first breakage of coal in filling the spout when commencing to load, a simple contrivance is introduced, consisting of a plug attached to a wire rope, which is let down by the attendant on the bank as the coal is run into the spout. As soon as the plug passes the bottom of the spout, it can be unhinged and the wire rope drawn up. (11) It is proposed to regulate the flow of coal through the spout by means of a flap or valve at the bottom of the spout, to which a wire rope will be attached, passing up to a winch or similar contrivance placed at a convenient position for the attendant on the high level. By means of a grip arrangement, acting only in one direction, the men in the vessel will be able to pull up the flap or valve and thus stop the flow of coal at any moment, but they will not be able to open it again. For the convenience of working and for the saving of hand labour and time, it is preferred to work all the motions about the spout by means of power, hydraulic by preference; for instance, the swinging of the jib, where a jib or derrick is required for carrying the spout, the raising and lowering of the telescope portion of the spout, and the regulating of the flap or valve at the bottom. It is important to be able to swing the end of the spout readily, because by so doing the attendant can move the spout from end to end of a long hatchway and assist the trimmers materially. The report is accompanied with outline sketches illustrating the application of a continuous spout to a side-tipping staith and to an end-tipping staith. These we reproduce above. Fig. 1 shows the method of carrying the flow of coal through a cylindrical spout from the rail level, and the means whereby the men on the deck of a vessel can stop the flow of coal at will. Fig. 2 illustrates the means of filling the spout on first charging, by means of a plug, as described in this report. Fig. 3 shows an arrangement for discharging from two lines of rails on an end-tipping staith. In both cases the spouts are shown attached to, and swung from, a crane. The whole arrangement, as will be seen, is exceedingly simple, and will doubtless be a great improvement upon the appliances at present in operation. It has been patented by Mr. Westmacott.

AMERICAN NOTES.

(*From our own Correspondent.*)

THE demand for iron and steel has been declining slowly during the past six months, in all of the principal markets of the United States. Prices have exhibited but little variation during that period, excepting in steel rails. The competition has enforced a partial restriction of production, and at the present time upwards of half the producing capacity is temporarily idle, for the purpose of stock taking and repairs. There is but little inquiry for large lots of iron, and no interest manifested in the market. The heavy railway requirements which have been the mainstay of the American iron trade for many years have almost disappeared, and in their place a retail trade has sprung up, made up of orders for from 100 to 500 tons, chiefly for repairing purposes, side tracking, and the like. Steel rails are to be had at 30 dols. for fall and winter delivery, but at this very low price there is scarcely any demand. During the first six months of the year 1200 miles of road were laid. The productive capacity is equal to the requirements of 10,000 miles. Hence it is that prices are low. Rumours prevail of a suspension amongst the Bessemer rail mills, and of some sort of a combination by which a restriction can be agreed upon. It is not likely that this will be accomplished. The best situated Bessemer companies say that those that can run ought not to be asked to remain idle, to assist those not well situated. The western mills are charging from 33 dols. to 35 dols., but they have the advantage of lower freight rates in north-western markets. Some twenty odd roads are being constructed, running from ten to 100 miles in length. The prospects for railway building are fair, notwithstanding the present depression. The Presidential campaign is on hand, and this divides the attention of the people. The question of protective tariffs is the all-absorbing one in politics. There will be a bitter struggle on the part of revenue reformers for lower duties.

The crop outlook, according to the latest authentic advices, is exceedingly flattering. The railroads are looking forward to an enormous tonnage; the returns of sixty of our leading lines show an increase in gross and net earnings as compared to last year, but these returns are not always reliable; yet the general condition of our railway system is good.

The decision of the Supreme Court of the United States on the constitutionality of the greenback is giving rise to the organisation of the banking interests, for the purpose of taking such steps as will secure a judicial decision in conformity with the accepted opinions amongst financiers as to what constitutes money. This, with the coming tariff issue, will form abundant material to enable the politicians to drag the people this way and that.

No. 1 pig iron is selling at tidewater ports at 19.50 dols. to 20.50 dols.; No. 2 foundry, at 18 dols. to 19 dols.; gray forge, at from 16 dols. to 18 dols.; average, 17.50 dols.; Bessemer and spiegeleisen are dull; merchant iron is selling at 1¾c. to 2c. per lb.; ordinary boiler plate, 2¼c. An order of 10,000 tons of structural iron has been placed this week with the New Jersey Iron and Steel Company.

Our brokers are not hopeful of any activity in the iron trade this year. There are more mills and furnaces than there is any possibility of keeping engaged. The anthracite coal production for the first six months this year was 12,000,000 tons. It is expected that the production for the next six months will be 18,000,000 tons. The region can produce 40,000,000 tons this year. A combination of the companies controlling the region keeps prices at from 4.50 dols. to 5.50 dols. per ton. All of our chief coal-producing regions are busy, but wages are low, and strikes are threatened.

The commercial failures for the past six months show an increase over last year, and for the second quarter of the year the amount of liabilities is double that of the corresponding period last year. The reduction of the public debt for the fiscal year just closed was 101,000,000 dols., and for the preceding year, 138,000,000 dols. The Treasury has 205,000,000 dols. in gold coin and bullion.

Western Pennsylvania continues to be greatly excited over the development of natural gas fuel, and at the present time there are between thirty and forty wells being bored in and around Pittsburgh, each one of which is expected to yield an enormous flow of gas. Engineering and metallurgical enterprise have not yet determined the extent of the utilities to be derived from this new fuel, but there is much to be said in its favour, and very little to be said against it.

The lumber interests are suffering from an over production of lumber; too many logging camps, too active competition, and too narrow profits. There is a large accumulation of lumber in most of the leading markets, and the sentiment of the trade is in favour of some sort of restriction, but there seems to be but little probability of an agreement being reached.

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

(*From our own Correspondent.*)

Business does not improve with the advance of the quarter. On the contrary, some works have less to do now than a fortnight or three weeks ago. The mills are running irregularly all over South Staffordshire; at some places only very partial employment can be found. Merchants are buying iron cheaper than for many years past; yet they will only take limited parcels. The determination of the ironmasters to bring down wages affords them an additional excuse for standing off the market. What the issue of the wages question in the iron trade may be will depend in much part upon the ultimate result of the colliers' strike.

The demand for sheets has of late fallen off conspicuously. Hoops, too, are in limited call. Other districts rather than Staffordshire are taking most of the American orders for hoops, but these are not large. Galvanised orders for sheets are unusually restricted at present. Merchant singles remain mostly at £6 15s. to £7, and doubles at £7 10s.

"Woodford" sheets of 20 b.g. are quoted £8 5s.; 21 to 24 b.g., £9 15s.; 25 to 26 b.g., £11 5s.; and 28 b.g., £11 15s.; "Woodford Crown" close annealed sheets are, for 20 b.g., £9 10s.; 24 b.g., £11; 26 b.g., £12 10s.; and 28 b.g., £13. Best qualities are £11, £12 10s., £14, and £14 10s., according to the respective gauges. Double best are 30s. per ton additional, and treble best a still further 40s. per ton additional. Siemens-Martin steel sheets are quoted: £13 for 20 g., £14 10s. for 24 g., £16 for 26 g., and £16 10s. for 28 g. "Woodford charcoal" sheets are £16 for 20 g., £17 10s. for 24 g., £19 for 26 g., and £19 10s. for £28 g. These quotations include delivery at outports.

Plate makers complained to-day—Thursday—in Birmingham, of the competition from the North of England, South Yorkshire, North Staffordshire, and other outside districts. The mills of makers here are only in quiet operation. Tank plates are £7 10s. and on, and boiler plates £8 10s. easy.

Marked bars are £7 10s. to £7; common descriptions are £6 to £5 12s. 6d.; and in some cases even £5 10s. for hurdle manufacture. Gas tube and nail strip is down in some cases to £5 12s. 6d., though the more general quotation is £5 17s. 6d.. to £6. Best horseshoe bars are £7 10s.; fullered shoe bars are quoted £8, but common shoe bars are £6 10s. easy. Hinge strip is abundant at £7. Best angles are named at £8., but common sorts are £6 10s. down to £6 5s. Ordinary T-iron is £7 15s., and common £7 5s. per ton. Sash iron is £8 easy.

Excellent reports continue to reach me of the quality of the ingot iron, or steel, which is being turned out at Bilston upon the Thomas-Gilchrist process. Sample orders are being followed by orders of a trade size, and the material is being successfully rolled down into tank and safe plates, sheets, tube strip, &c. It has proved itself sufficiently good even for the manufacture of Galloway boiler tubes; and the book tests which samples of the metal have recently borne at the Swindon Works of the Great Western Railway Company are in every way satisfactory.

There is no inducement to native pig makers to increase the output. The demand is limited, and the competition of outside districts is increasing in severity. All-mine hot-blast pigs are 57s. 6d. to 55s., and part mines, 42s. 6d. Cinder pigs are 37s. 6d. to 35s. Hematites of Barrow and Tredegar makes cannot command more than 35s. delivered into this district for forge sorts. Derbyshires pigs are quoted 42s., but in one instance this afternoon 1000 tons changed hands at 41s. 3d. Welsh scrap iron was never offered so cheap as now. Even at 47s. 6d. to 48s. 9d. it is difficult to make sales. Manufacturing coal is easy on the basis of 7s. per ton for best forge sorts, and 6s. down to 5s. for common. Clay Cross and South Yorkshire furnace cokes are 15s. delivered.

The Rixon's Iron and Brick Company is now preparing the site for the new pig iron works which it has determined to erect at Wellingborough, Northamptonshire. Two furnaces will be put up, and the machinery used in their working will be that which formerly operated the three blast furnaces at Roughay, near Wednesbury, of Messrs. Adderbrooke. The sale of these latter furnaces was made to the new Wellingborough Company sometime back.

The standard quotations for iron roofing work are at present £12 10s. per ton and upwards on trucks in Staffordshire; and for iron rivetted girders £11 per ton and upwards. Galvanised shedding for agricultural purposes is quoted at £35 per 40ft. length. Galvanised wrought iron open cisterns to hold 100 gallons are quoted on the open market at about £9 9s. per half dozen; 125 gallon cisterns, about £11 14s. per half dozen; and 150 gallon cisterns about £12 18s. per half dozen.

The prospects of the ironworkers quietly acquiescing in the notice which the masters have given for a reduction in wages are not cheering. The workmen in the Brierley Hill district have given notice that they will oppose the step on the ground that the present state of trade does not warrant any reduction. Further, they declare that when the present rate of wages expires on August 23rd they will apply for an advance. It seems therefore probable that the ironmasters will have to lay their case before the arbitrator.

There appears every probability that the strike in the coal trade will end in favour of the masters. The optimistic tone of the men has considerably calmed down, and some of them are going in at the reduction. At the Clay Croft, Ramrod Hall, Warren's Hall, Saltwells, and Cradley Heath Collieries of Earl Dudley the men have gone in this week, and it is expected that others will speedily follow. The carrying-out of the threat of Mr. Fisher-Smith, that he would shut down the pits on Lord Dudley's domain, is also having its due effect. Several of the "royalty masters" on his lordship's coal-field, who hitherto have been paying the old rate, have now given fourteen days' notice of their intention to close the pits if the men do not accept the drop.

The export orders for hardwares continue flat, and this state of things is a matter of much disappointment. Neither the United States nor Canada is buying up to the average, while the cholera has added a fresh obstacle to the revival of trade with France, Spain, and the Mediterranean generally.

The iron wire drawers have been in the receipt of a larger number of orders of late, consequent upon the drop in prices which the reduction in the wages of the operatives allowed them to make. It is felt, however, that this increased business has not yet compensated for the sacrifice which producers were compelled to make so as to resist the encroachmente of the Westphalian firms.

The safe trade is dull, more especially in the export department; but considering the time of year, this is hardly surprising. Best goods are in pretty steady demand for home consumption, but export orders of large size are for inferior goods, and are much cut up. The Brazils, Peru, the West Indies, and Australia are the chief buyers.

The manufacturers of Kidderminster believe that if there were a new railway line between Wolverhampton and their town a means would be forthcoming of alleviating the present heavy railway freights. Some years ago an effort in this direction failed, but circumstances are now much altered. The proposal then was to construct a railway from Wolverhampton in connection with the London and North-Western Railway, through Kidderminster, and connected with the South Wales service. The Kidderminster Chamber of Commerce, at their half-yearly meeting on Wednesday, decided to discuss the subject afresh, and, if necessary, to formulate a new scheme. At present the town is served by the Great Western Railway Company.

NOTES FROM LANCASHIRE.

(*From our own Correspondent.*)

Manchester.—Business continues in a most depressed condition throughout all branches of the iron trade in this district, and that the only practicable solution of the difficulty with which makers have to contend, as I have pointed out in previous reports, is a reduction of the output, is at length being so completely realised that a number of the furnaces in the district are now being either blown out or damped down. Low prices, although they are known to have got to a point at which they not only leave makers no profit, but in many cases barely cover the cost of production, apparently offer no inducement to buyers to give out orders beyond their actually known requirements, which are very small, and as there is no prospect at present of any enlargement in the requirements of consumers, but indications rather of decreasing activity, makers, unless they are prepared to go on working for stock, have really no other alternative but to reduce a production which is already far in excess of the wants of the market.

There was only a very dull market at Manchester on Tuesday, with a despondent tone prevailing generally. The inquiry reported in all departments was extremely small, and the actual business done insignificant as regards weight. The prices ruling for both pig and finished iron are extremely low, in fact they are now so low that speculators, who have hitherto been disposed to bear, are beginning to check their operations in this direction; but for immediate delivery there are sellers at quite as low figures as ever. The steps which are being taken for reducing the output are no doubt having some effect, and the belief is entertained that this may produce a turning point in the market, which has evidently got down to about the very lowest possible point so far as prices are concerned. For pig iron delivered equal to Manchester prices average about 42s. to 42s. 6d. for Lancashire, 41s. 6d. to 42s. for Lincolnshire, and 42s. 6d. to 43s. for Derbyshire forge and foundry less 2½ per cent., but there is very little business being done at these figures.

The hematite trade continues exceedingly quiet, 55s. 6d. less 2½ is about an average quoted price for good foundry brands delivered into this district, but where there are any orders in the market there is a good deal of underselling to secure them.

In the manufactured iron trade business is extremely dull, and some of the local forges have hard work to keep going at all. For good qualities of local and North Staffordshire bars delivered into the Manchester district £5 15s. remains the quoted price, and there are makers who decline to entertain offers at under this figure; but the bulk of any business doing is on the basis of £5 12s. 6d., and buyers have very little difficulty in placing anything like good orders, with prompt specifications, at this figure, whilst for common bars £5 10s. is a price which is pretty fully talked of in the market.

Some fair locomotive orders have recently been given out in this district, and engineers have in most cases work in hand that will keep them fairly well employed for the next two or three months; but the general reports are that the orders running out are only being partially replaced, and that there is unquestionably a decided slackening tendency in trade.

The question of the Indian State Railway contracts, to which I referred in my "Notes" a few weeks back, and which has since been taken up by correspondents in the columns of The Engineer, continues a prominent matter of discussion in the trade generally; and that a reform of the system on which the contracts are given is urgently needed, is a point which is most strongly insisted upon on all sides. So hampered are these contracts with harassing and useless conditions, that Indian State railway work is only sought after as a last resort; and whilst the Indian Administration gains nothing, the work given out is robbed of any advantage to the firm that undertakes it. In addition to the contracts which the Government admit have been given out abroad, there are rumours that Indian State railway officials have recently been endeavouring to place on the Continent orders for 100,000 tons of rails, for delivery over long periods, which has caused a good deal of commotion in the trade, and I believe that some very strong efforts are in contemplation with the object of effecting some change in the Indian State Railway contract system, which shall place it on a more satisfactory footing as regards the engineering and iron trades of this country.

Various efforts have during the last few years been made to apply electricity as the motive power for the driving of tramway cars, but hitherto with no very great success. A further step in this direction has been made by Mr. W. H. Smith, of Halifax, who has introduced an arrangement for carrying the electricity along a specially constructed track between the ordinary rails; and for the purpose of fairly testing this arrangement, a full-sized experimental car has been constructed, which has undergone a series of successful trials on a short length of line specially laid down in a field adjoining the works of Messrs. Smith and Baker at Manchester. The principle of the invention is not altogether a new one, but the method by which it is worked out is not only new, but very simple and effective. The central track along which the electricity is conveyed consists of a copper tube in halves carried in chairs below the line of the pavement. From these tubes the electricity is collected by a specially constructed collector, and conveyed to a motor under the flooring of the car, which gives the driving power. The electricity is conveyed from the generating station to the central track by means of two copper wires, and after being collected by the car as it moves along the circuit, is completed by passing it to the wheels and thence to the ordinary tram lines in either side. There are a number of mechanical details which I have not space to enter into fully, but I may add that the car can be propelled with perfect ease at the rate of twelve miles per hour, and Mr. Smith calculates that with his system trams can be driven for 2d. per mile per car, and one very eminent electrician has expressed the opinion that it is the most practical method of applying electricity for tramway purposes that has yet been introduced. Certainly the trials that I had an opportunity of witnessing were in every way very successful; the car runs without noise, is started or stopped with the greatest ease, and the conductors carrying the electricity are so arranged that they are out of reach of any possible contact with traffic in the streets, while special arrangements are made for overcoming any difficulties which might arise from the blockage of the central track by dirt, stones, or other material.

In the coal trade business has been somewhat disturbed by the wages dispute in West Lancashire and the stoppage of a number of the pits during the past week; but the market has not been affected to any material extent. Supplies have continued plentiful and in excess of requirements, while all classes of fuel are still very small, and prices continue quite as low as ever; one or two attempts which were made, where pits were stopped, to secure an advance, having met with no success whatever. At the pit mouth prices remain at about 8s. 6d. to 9s. for best coals, 6s. 6d. to 7s. for seconds, 5s. to 6s. for common, 4s. 6d. to 5s. for burgy, 4s. to 4s. 3d. for best slack, and 3s. 6d. to 3s. 9d. for ordinary qualities.

Shipping has shown a fair amount of activity, and for good qualities of Lancashire steam coal delivered at the high level, Liverpool, or the Garston Docks sellers have been able to get about 7s. 3d. to 7s. 6d. per ton.

As I anticipated, the West Lancashire strike against a reduction of wages has not developed into any serious proportions, and after a short stoppage of the pits, the bulk of the men have gone in on the employers' terms. An isolated stoppage of the pits in one or two districts is threatened, but this is a course of procedure which will not be tolerated by the coalowners, and generally the strike is considered as practically at an end.

Barrow.—The hopes of a revival which were entertained by makers some weeks ago have been dispelled, and the hematite pig iron trade of the North Lancashire district has fallen back into the same inactive state which it occupied for so long a time. This week's market was badly attended, and the business doing is insufficient to keep works fairly, much less fully employed. On home account I cannot hear of any good contracts being booked, and I notice that the deliveries are unusually low. Foreign buyers are slow in placing out orders, and although prices are in their favour, they place little confidence in makers. Prices are unchanged from the last market, No. 1 Bessemer samples being offered at 47s. per ton net, No. 2 at 46s. 6d., and No. 3 at 46s. The weight of metal on hand is considerable, and although the output has been restricted, is not diminishing. The steel makers are but indifferently employed, and there is a scarcity of orders. Prices are unremunerative, rails selling as low as 90s. per ton net at works. Shipbuilding in a stagnant condition, with few signs of any improvement occurring. Iron ore selling slowly at from 9s. per ton and upwards. Coal and coke quiet. Shipping inactive, as freights are low.

THE SHEFFIELD DISTRICT.

(*From our own Correspondent.*)

The great question of the week has been the dreadful accident on the Manchester, Sheffield, and Lincolnshire Railway at Bullhouse, near Penistone, some 15½ miles from here. I have attended the inquest on both occasions, and the evidence seems clearly to point to a flaw in the crank axle of the engine, a flaw which could not be seen by the ordinary system of inspection. Before the last of the bodies had been brought out I was on the scene, and though some twenty-five years of press work has made me fairly familiar with railway disasters, I never saw so complete a wreck as the remains of the Manchester express on the 16th inst. Sir Edward Watkin, M.P., the chairman of the company, addressing the shareholders at the half-yearly meeting on the 23rd inst., stated that one of his colleagues, Mr. A. M. Watkin, had been suggesting for a long time that one of the best things for securing the safety of passengers and improving the dividends would be a general understanding to reduce those excessive speeds at which the trains ran. His—Mr. Watkin's—calculation was that they might perform the service of the country with the greatest regularity, and provide trains which on the average would be quite as fast as at present, by taking a uniform speed of 40 miles an hour, by reducing the stoppages, and by providing in all their efficiency continuous brakes and that communication between the guard and the driver now adopted all over the country. The question was one deserving earnest attention. At the same time he did not mean to say for a moment that the accident occurred from anything in the shape of excessive speed. The train was not one of their quickest trains; it was going at forty-five miles an hour, and the question of speed did not affect it; but looking at the question all round, and seeing how the lines were trying to outbid each other in the matter of speed, it must be admitted that there was a limit to safety in speed. They all knew that speed was attained at great cost, and he thought the suggestion made by Mr. Watkin was a valuable one, calling for consideration.

Sir Edward Watkin's figures are the most interesting items of local trade this week. The company, he says, is nearly £40,000 worse off than it ought to have been. This he attributed principally to bad trade. In the exertions to get traffic, the traffic obtained was, on an average, of a less paying description than had been the case for some half-years. Colliers will notice with interest that "owing to the increased price of coal," it cost them £3294 more in working expenses. They had carried six million tons of merchandise and minerals, the rate for which per ton in the corresponding half-year was 2s. 2d., but was this time a little less than 2s. 1¾d. Only a question of a farthing, no doubt, but on six million tons it made an enormous difference. Comparing the first half of 1875—a year when trade was apparently in a good condition—with the past half year, there was an increase in the Sheffield traffic of 47,000 tons, and a decrease in the amount obtained of £3000. Therefore, practically speaking, they had carried 40,000 more tons for £3000 less, and it meant that the rate per ton through the pressure of competition was so much less than on previous occasions.

On the Hull and Barnsley Railway, Sir Edward reminded his shareholders that the prospectus for the railway five years ago promised 8½ per cent. for the railway and 9 per cent. for the docks. The directors found they had spent a great deal more than the estimate, and they required about £2,000,000 to finish the undertaking. It was proposed a few months ago to issue £1,500,000 of preference stock. No one would take it up, and now they had managed to get into Parliament through the Standing Order being relaxed a Bill for the issue of £1,500,000 of No. 2 debenture stock. He could only say that he thought people would be unwise to have it. But it was important to note that the Standing Order had been relaxed, and he believed some great parliamentary irregularities had been committed.

The Manchester, Sheffield, and Lincolnshire Company burn 250,000 tons of coal during the year, and Sir Edward states it is now having coal 3d. per ton cheaper—a fact our friend the collier must consider with the other as to the increased cost for the past year. The Right Hon. Sir Richard Cross has been elected a member of the Board.

During this week we have had the National Union of Conservative Associations holding their annual Conference in Sheffield, and the various industrial processes of Sheffield, from cutlery making to armour-plate rolling or casting, have been freely shown to them.

THE NORTH OF ENGLAND.

(*From our own Correspondent.*)

There was but a scanty attendance at the Cleveland iron-market held at Middlesbrough on Tuesday last, and the tone was as dull and inactive as on the previous Tuesday. Merchants are strenuously endeavouring to force down makers' prices by offering small lots of No. 3 g.m.b. at 36s. 9d. and 36s. 10½d. per ton, and consumers continue to hold back their orders, buying only what they must have for immediate use. Nevertheless, producers remain obdurate, and will not take less than 37s. for No. 3, or 35s. 6d. for forge iron. Which party will have to yield eventually is doubtful, but makers threaten to reduce their output still further rather than accept lower rates.

The price of warrants has been reduced to 36s. 9d. per ton, but this does not attract buyers.

The stock of Cleveland pig iron in Messrs. Connal's store at Middlesbrough on Monday last was 56,926 tons, being a decrease of 650 tons for the week. At Glasgow they hold 588,036 tons.

Shipments are not quite up to the average, but are still highly satisfactory from a smelter's point of view, considering the gloomy state of affairs in all other directions. The quantity of pig iron sent from the Tees up to Monday last was 53,399 tons, being about 1000 tons less than during the corresponding period of last month, and about 8500 less than that of July, 1883.

There is nothing new to report relative to the finished iron trade. Only a limited business is being done, and at the same rates as have ruled for some time past. Considering that prices are as low as they are likely to be, it is not improbable that some improvement will take place before long. Meanwhile competition for such orders as are in the market is exceedingly keen. For average specifications, ship plates are £5 per ton, angles, £4 15s., and common bars, £5 2s. 6d., free on trucks at manufacturers' works—payment, cash 10th, less 2½ per cent.

Messrs. Bolckow, Vaughan and Co.'s mills and forges at Witton Park are still idle. There is only one blast furnace in blast, and it is said that even this will be blown out in a week's time.

Owing to the depression in trade, Messrs. Bell Bros. have given notice to about forty miners at their Skelton mines to terminate their engagements, and a further number will be paid off shortly unless some improvement takes place.

The Hull Chamber of Commerce and the Hull Corporation have both decided to petition Parliament in favour of the Hull and Barnsley Railway Company's Bill, asking for power to borrow an additional $1\frac{1}{2}$ millions to complete their railway and docks.

The value of hematite pig iron is now only from 9s. to 10s. per ton above Cleveland brands. This difference is just about equivalent to the extra cost of making steel by the basic as compared with the acid Bessemer process. It follows that, unless the present conditions alter, the two methods may be considered equally advantageous as regards economy of production. But it must not be forgotten that the products are not precisely the same. High carbon steels are more easily made with perfect regularity of temper by the acid process, and low carbon steels by the basic. The general appreciation of such facts is gradually sorting out for each material the specialities most suited for it. Thus, steel wire for telegraph cables, specified to bear as much as 70 tons per square inch, is coming to be most usually, because most readily, made from acid steel, whilst, on the other hand, thin gauge sheets for tin-plates are now being largely made in basic steel. In the latter case great tenacity is not necessary, whilst great ductility manifestly is.

Inventors often wonder why ironmasters are so averse to try new inventions and improved processes, and even disinterested persons have not unfrequently accused them of being guided by their Conservative instincts to a degree bordering on stupidity. The difficulties which, however, usually beset any deviation from the beaten track are well exemplified by what has recently taken place at the Bowesfield works. Nearly five years ago the company which owns them adopted a certain patent double puddling furnace invented by Messrs. Caddick and Lewis. It was said to work with diminished quantities of coal and fettling, and to produce better yields of iron and of superior quality. The tools used by the men were, however, a little longer and heavier than ordinary, and by mutual agreement an extra 3d. per ton was allowed them for this. For nine months no question was raised, but during the spring of 1880, when the "American boom" was at its height, the men, by collectively giving notice to leave, forced another 6d. per ton out of their employers, as well as an undertaking to submit to arbitration a further claim for 3d. per ton. The latter claim was investigated by a small committee of the Board of Arbitration. In view of the then probable state of trade and turbulent state of the ironworkers, the full claim was awarded, with consent of the Bowesfield Company, and the total rate of 1s. extra established. After a lapse of two years, the condition of trade having considerably altered in a downward direction, the company claimed relief by diminution of this extra allowance to their patent furnace puddlers, on the ground of certain alterations they had made rendering their work easier. These alterations were investigated by another committee, and decided to be of too trivial a character to deserve consideration. The rate therefore remained as before. Recently, another two years having elapsed, and profits having entirely disappeared, the Bowesfield Company again applied to the Standing Committee for a mitigation of the 1s. extra. For a third time the matter was investigated, and the two previous decisions were confirmed; not unanimously, however, for two out of the four employer members of the committee expressed views dissenting from the conclusion arrived at, though one of them was obliged to leave before the vote was taken. The Bowesfield Company state, however, that they cannot afford to continue to pay the extra, and that it is better for them to buy puddled bars than to continue to make them on such terms. Their forge has been standing the whole of the present week, and it is understood it is not likely to be re-started as far as the patent furnaces are concerned for some time. Such experiences account for the extreme unwillingness of ironmasters to adopt new inventions or improved processes.

NOTES FROM SCOTLAND.

(*From our own Correspondent.*)

THE Glasgow Fair Holidays began on Thursday, and all the public works in the city and the busy industrial localities surrounding it are closed. Business will be very generally suspended for nearly two weeks. The trade reports this week are necessarily brief. In the pig iron market, which was closed for two days, comparatively little business has been done. The fluctuations in the values of makers' iron and of warrants are of little importance. There are ninety-six furnaces in blast, as compared with 115 at this date last year. The stock of pig iron in Messrs. Connal and Co.'s stores is still decreasing, although not to a very large extent. For hematite the demand is quiet, but the stocks are smaller than they were twelve months ago.

The warrant market was shut from Thursday till Tuesday. Business was done on the latter day at 41s. 3d. to 41s. $2\frac{1}{2}$d. cash, and 41s. 5d., in the forenoon, and at 41s. 4d. fourteen days in the afternoon. The iron market was steady yesterday, with transactions at 41s. 3d. and 41s. $3\frac{1}{2}$d. cash and 41s. 5d. and 41s. $5\frac{1}{2}$d. one month. To-day—Thursday—the market was quiet, with business done at 41s. $3\frac{1}{2}$d. cash and 41s. $5\frac{1}{2}$d. one month.

The values of makers' iron, which show little alteration, are as follow:—Gartsherrie, f.o.b. at Glasgow, per ton, No. 1, 51s. 9d.; No. 3, 49s. 9d.; Coltness, 57s. 6d. and 51s.; Langloan, 53s. 6d. and 51s.; Summerlee, 50s. 6d. and 47s.; Calder, 52s. and 46s. 6d.; Carnbroe, 50s. 6d. and 46s. 6d.; Clyde, 48s. and 45s.; Monkland, 43s. 6d. and 40s. 3d.; Quarter, 42s. 6d. and 40s. 3d.; Govan, at Broomielaw, 42s. 6d. and 40s. 3d.; Shotts, at Leith, 51s. 6d. and 51s.; Carron, at Grangemouth, 48s. (specially selected, 54s.) and 47s. 6d.; Kinneil, at Bo'ness, 44s. and 43s.; Glengarnock, at Ardrossan, 50s. and 43s.; Eglinton, 44s. 6d. and 41s.; Dalmellington, 46s. 6d. and 42s. 6d.

The malleable iron and steel trades are quiet, and the quotations are nominally without change. In the last three weeks the shipments of iron and steel manufactures from Glasgow have embraced £38,630 worth of locomotives, £36,300 machinery, £12,300 sewing machines, £10,300 steel manufactures, and £135,300 iron goods of various descriptions.

The coal trade is fairly active for the season, but it is, of course, very quiet at present on account of the holidays. The foreign shipments from Glasgow, excluding supplies for the use of steamers, amounted to about 10,000 tons, of which 2172 tons went to San Francisco, 1820 for Canada, 940 for Russia, and smaller quantities for other places. The shipments at the other ports have recently been above the average. At Grangemouth 14,455 tons were despatched in the course of the week, but a very large proportion of this amount came by rail from the western mining districts; f.o.b. at Glasgow main and ell coals range from 6s. 3d. to 8s. 1d.; splint, 6s. 9d. to 7s. 3d.; and steam, 8s. to 8s. 6d. At Burntisland the shipping quotations are 6s. 6d., 6s. 9d., and 7s. f.o.b., according to the quality of the coals.

Two new pits are about to be sunk by Messrs. Merry and Cuninghame for the purpose of working the clayband seams of ironstone at Kilbirnie, in Ayrshire.

WALES & ADJOINING COUNTIES.

(*From our own Correspondent.*)

I HAVE never witnessed a more gratifying demonstration than was accorded to Mr. W. T. Lewis at Brecon on Tuesday, on his taking office as High Sheriff of Breconshire. The North of England and South Wales coal and iron industries were well represented, and the testimony to his great ability endorsed by men of the first practical standing, such as Sir George Elliott and Mr. Edward Williams, of Middlesbrough. Though in the thick of the Barry fight, when party feelings run high, both sides united in their respect. As stated in the address, which was superbly got up, to him in a great measure were due the tranquillity and prosperity of the coal valleys of South Wales; to him the Coalowners' Association of South Wales and Monmouthshire; the sliding scale, which has borne such excellent fruit; the Miners' Provident Fund, which has elicited the virtues of self-help and self-reliance, and various other movements of excellent character, which are blended in the social and industrial progress of South Wales.

It speaks well for the organisation of our industries that such a great number of leading spirits could be taken from docks, collieries, railways, in all directions; and yet the output, traffic, and shipping went on without a hitch. I should think nearly every colliery manager in Wales was there, from Pentyrch to the most remote of the Rhondda, and crowds again from the Monmouthshire districts.

I am glad to note some revival in the iron trade. The water supplies are now intact again, and Dowlais, which suffered most, now appears the most flourishing.

Large stocks of rails left the Welsh ports last week for America, and substantial cargoes of tin-plate are following.

The difficulty between the puddlers and tin-plate makers is coming to an end. The masters wanted 10 per cent. reduction; the men offered to accept 5. The latest offer is from the masters, who will consent to accept $7\frac{1}{2}$; so I expect that a few days will see the termination. Stocks are getting low, and as a result prices are advancing 3d. to 6d. per box. Re-starts of the Vernon, Briton Ferry, Penclawdd, Llantrissaint, and Lydbrook Works will be carried out at once.

The Cardiff Corporation Bill has been passed, and now we may expect the action of pick and shovel. The first essential is to get a good contractor for the waterworks. The Corporation will be fortunate in getting one as successful as Mr. Walker, whose Prince of Wales' Docks at Swansea and Bristol Channel Tunnel are amongst his great achievements in Wales. Another important movement will be to the front shortly—the construction of harbours of refuge in the Bristol Channel. The Mumbles, Swansea, and Lundy Island are named already.

The Aberdare, Merthyr, and Dowlais district of miners held their monthly meeting this week, and passed various measures of interest. One was in direct antagonism to the action of the Rhondda colliers, and amounted, in fact, to a condemnation of the course now taken by the Rhondda meeting in getting up a Burt and Bradlaugh demonstration. The opinion expressed by the Aberdare meeting was to the effect that no practical good came out of such demonstrations—a very common-place conclusion to arrive at during a time of such great pressure in coal-getting as the present. The Rhondda demonstration is going on peacefully.

At each of the docks good work has been done during the week. Best steam coal is in capital demand, and prices are firm. For seconds and house coal the demand is not so good.

The South Wales Institute of Engineers is enlarging its basis of membership. At one time no one was admitted a member who was not practically an engineer; now any one interested in the leading industries is invited, and there is every sign of this becoming an important institution.

Some degree of astonishment was expressed in coal circles here this week that Mr. Wales, her Majesty's inspector for South Wales, had been prohibited by the Secretary of State from giving evidence in the House of Lords on the Barry Bill. The evidence of Mr. Wales was directly against the promoters.

PRICE OF STEEL.—In their half-yearly "Engineering Trades' Report," Messrs. Matheson and Grant say:—"Prices are very low, but have not continued to fall like those of iron. In the steel rail trade, so successful has been the combination of makers that prices have risen about 10s. a ton over those which ruled in December last. How long this combination will last depends as much on the continental makers as on those at home, but it is difficult to see how the larger steel-works can much longer endure without loss the small output. More attention is being given to the rolling of steel for miscellaneous purposes, and the variety of sections available to bridge-builders is increasing. The larger angle, tee, and channel sections are already as cheap in steel as in iron. Steel joists are being made in the North of England, and if what is now little more than an experiment succeeds, English steel joists may diminish considerably the import of Belgian iron joists, a large proportion of which are of the lowest possible quality."

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.

14th July, 1884.

10,143. SEA-GOING VESSELS, A. M. Clark.—(*J. L. Eshelman, Colorado.*)
10,144. MOSAIC WORK, W. R. Lake.—(*H. F. Belcher, New Jersey.*)
10,145. KNITTING MACHINERY, B. Kerr, Leicester.

15th July, 1884.

10,146. CUTTING MACHINES, A. Barron, Leicester.
10,147. FIBROUS MATERIAL, H. McE. Ward, Ballymacarrett.
10,148. SHIPS' DAVITS, J. W. Blake, Gosport.
10,149. SLAUGHTER and DE-HIDING of HIDED ANIMALS, J. Morris, Basingstoke.
10,150. PISTON VALVES, A. MacLaine, Belfast.
10,151. RATCHET BRACES, C. Schumacher, Germany.
10,152. SNAP MACHINE PRESSES, T. and H. T. Arrowsmith, Burslem.
10,153. WEAVING LOOMS, W. P. Thompson.—(*A. Dhondt and J. R. Bouy, France.*)
10,154. ELECTRICAL CURRENTS, W. P. Thompson.—(*P. H. Van der Weyde, New York.*)
10,155. LAUNCHING SHIPS' BOATS, T. A. Harper, Liverpool.
10,156. SAND GLASSES, J. Burgess, jun., Birmingham.
10,157. FASTENER for BOOTS, &c., T. Dixon, Leeds.
10,158. DRILLING COAL, &c., E. Gittins, near Stoke-on-Trent.
10,159. FASTENING GLOVES, &c., J. Smith, Stoke-upon-Trent.
10,160. FASTENING BOOTS, &c., J. Smith, Stoke-upon-Trent.
10,161. SECURING SHIPS' HATCHES, &c., J. W. Rockliffe and J. Greig, Sunderland.
10,162. RECEPTACLE for MATCHES, W. R. E. Alexander, London.
10,163. LOOKING GLASSES, C. Thompson, Isle of Wight.
10,164. FLOORING, S. Bivort, Belgium.
10,165. SLEEVE-HOLDERS, A. H. Reed.—(*E. Suhr and H. Kaufman, New York.*)
10,166. GLOVES, A. H. Reed.—(*R. F. Bartel, New York.*)
10,167. SALICYLIC ACID, J. Y. Johnson.—(*F. von Heyden, Germany.*)
10,168. FERRULES for HANDLES of FORKS, J. B. Jackson, Sheffield.
10,169. SMOOTHING, &c., SURFACES of PAINTED, &c., GOODS, S. J. J. Kelly and J. Akerman, London.
10,170. BRACELETS, &c., T. Morton, Birmingham.
10,171. STOPPERS for BOTTLES, J. Pritchett, Birmingham.
10,172. VOLTAIC BATTERIES, W. Boggett, London.
10,173. SENDING TRAPS for FLYING TARGETS, P. Marqua, Ohio, U.S.
10,174. CORNICE POLE, G. H. Reynolds, London.
10,175. ANTI-FRICTION BEARING for AXLES, &c., D. T. Lee, London.
10,176. METERS for MEASURING LIQUIDS, F. Walker, Arizona, U.S.
10,177. DRAW-BARS for RAILWAY VEHICLES, G. Wood, Belfast.
10,178. TRAP for CAPTURING ANIMALS ALIVE, T. Cank, near Preston.
10,179. PREVENTING the WITHDRAWAL of WATCHES from POCKETS, J. Morris, London.
10,180. VALVE GEAR, C. P. Holst, Amsterdam.
10,181. OVER-STITCH SEWING MACHINES, H. E. Newton.—(*O. R. V. Vechten, New York.*)
10,182. SOAP, C. L. Field, London.
10,183. STRAW NECKTIES, &c., A. E. Smith, London.
10,184. REGULATING SUPPLY of WATER, E. G. Colton.—(*M. Jones, Sicily.*)
10,185. INJECTING BOILER COMPOSITION, C. J. and W. T. Arnell, Isle of Wight.
10,186. OPERATING FANS, E. J. C. Fear, Bristol.
10,187. DRYING STOVES, P. Jensen.—(*J. Bonneaux, Nancy, France.*)
10,188. BREECH-LOADING SMALL-ARMS, J. Grainger, Acock's Green.
10,189. MOULDS for CASTING METALS, S. Siddaway, West Bromwich.
10,190. ELECTRIC TUGS, J. H. Barry, London.
10,191. PILLOWS, CUSHIONS, &c., W. R. Lake.—(*H. Weston, Philadelphia, U.S.*)
10,192. BUTTON-HOLE ATTACHMENT for SEWING MACHINES, W. R. Lake.—(*J. H. Palmer, Philadelphia.*)
10,193. LOADING and UNLOADING COAL CARGOES, G. Taylor, Penarth.
10,194. TREATING FIBRES, A. Wilkinson, London.
10,195. ENGINE GEARING, A. Greig, Leeds.
10,196. CIGARETTE MACHINES, E. Mavrogordato.—(*H. Pierrot-Minnot, St. Petersburg.*)
10,197. SELF-PROPELLING SUBMARINE BOATS, J. H. Blakesley, London.—*24th March*, 1884.
10,198. FURNACES, T. R. Crampton, London.
10,199. DRILLING MACHINES, W. Gilmer, Birkenhead.
10,200. FELTING HAT BODIES, &c., J. S. Taylor, Connecticut, U.S.)
10,201. CAPS, PRIMERS, &c., W. R. Lake.—(*P. Butler, Massachusetts, U.S.*)

16th July, 1884.

10,202. WEIGHING APPARATUS, J. Needham, Manchester.
10,203. HEATING FURNACES, J. W. Summers and T. Sharp, Staleybridge.
10,204. WIRE NETTING MACHINES, T. E. Bond and J. M. Garland, Birmingham.
10,205. KNIVES, G. A. Hardy, Lenton.
10,206. INCREASING the SPEED of VELOCIPEDES, W. R. Warner, Birmingham.
10,207. SECONDARY VOLTAIC BATTERIES, C. Moseley, Manchester.
10,208. EXTRACTING FAT from BONES, &c., F. Seltsam, Bavaria.
10,209. CURRY-COMBS, W. H. Tildesley, Willenhall.
10,210. GRINDING PREPARED LUMP SALT, L. O'Brien, Salford.
10,211. BI-CART WAGON, A. Stedman, Guildford.
10,212. HAND DRILLING MACHINES, W. Crick, Boston.
10,213. SHUTTLE MOTION for LOOMS, J. Belicard and M. J. Bianco, Manchester.
10,214. CLEANING, &c., FIBROUS MATERIALS, W. R. Lake.—(*A. Clarke and H. C. Perham, Massachusetts.*)
10,215. PROPELLING VEHICLES by ELECTRICITY, A. Reckenzaun, London.—*12th April*, 1884.
10,216. RAILWAY and other VEHICLES, E. G. Sheward, London.
10,217. PULLEYS, J. W. Heaps, Keighley.
10,218. STEAM BOILERS, G. H. Herbert, Rochdale.
10,219. DISCHARGING REFUSE, R. H. Holme and U. F. Arveschoug, Newcastle.
10,220. TAPS, P. A. Maignen, London.
10,221. WINDOW FRAMES and SASHES, R. Mason, Hemsworth.
10,222. LUGGAGE VALISES, J. A. Lamplugh, Birmingham.
10,223. BOOTS and SHOES, A. L. S. Leighs, London.
10,224. SEALING BOTTLES, H. Delin, Berlin.
10,225. WHEELS and AXLES, H. E. Winter, J. L. Merigot, and W. Frost, London.
10,226. CHANGING PICTURES in the MAGIC LANTERN, B. J. Edwards, London.
10,227. VELOCIPEDES, A. Kirby, Bedford.
10,228. LUBRICATING the SPINDLES of CAP SPINNING FRAMES, J. Dawson, Bradford.
10,229. REPEATING WATCHES and CLOCKS, W. R. Lake.—(*H. J. Loiret, Paris.*)
10,230. SHEET METAL SASH BARS, &c., W. H. Luther, Glasgow.
10,231. PYROMETER, J. B. Cox, Torquay.
10,232. CONTINUOUS-ACTING CENTRIFUGAL DRYING MACHINES, E. C. Roettger, Brunswick.
10,233. IMITATION WAX SEALS, J. Hodgson, London.
10,234. AUTOMATIC FEED WATER REGULATORS for STEAM BOILERS, J. H. Johnson.—(*P. A. Buisson, Paris.*)
10,235. GIVING VENT to CASKS when DRAWING LIQUIDS THEREFROM, W. Binns and J. Ellis, Isle of Wight.
10,236. RAISING and LOWERING COAL WAGONS, &c., G. Taylor, Penarth.
10,237. ELECTRIC and MAGNETIC METER, C. D. Abel.—(*La Société Maison Bréguet, Paris.*)
10,238. ELECTRIC SAFETY FUSE, R. E. Dunston, London.
10,239. PACKING CARTRIDGES in BOXES, W. R. Lake.—(*P. Butler, Lowell, U.S.*)
10,240. TREATING VEGETABLE MATERIAL for the MANUFACTURE of PAPER, A. Wilkinson, London.

17th July, 1884.

10,241. TWISTING and LAYING CORDS, &c., E. Whalley, Rochdale.
10,242. FASTENING BAG FRAMES, J. Holt, Willenhall, and J. B. Brooks, Birmingham.
10,243. CLEANING COTTONSEED from FIBRES, W. H. Stead, Liverpool.
10,244. SWING HORSES, &c., J. T. King.—(*R. E. Henry, Texas, U.S.*)
10,245. PRINTING MACHINES, &c., G. A. Wilson, Broad Green.
10,246. ROTARY APPARATUS for FOLDING PAPER, G. A. Wilson, Broad Green.
10,247. STOPPING or CLOSING BOTTLES, B. Harrison, Oldham.
10,248. CONSTRUCTING RAILWAY POINTS and SWITCHES, S. F. Sandiford, Old Trafford.
10,249. PROPELLING BICYCLES, &c., A. S. Bowley, Streatham.
10,250. ELEVATING, &c., BLACK-BOARDS in FRAMES, R. Whittaker, Skipton.
10,251. HATS, C. H. Wood, Sheffield.
10,252. ENAMELLED IRON CALLOTES, J. G. Watkinson, Birmingham.
10,253. WATER TAPS WORKING AUTOMATICALLY, G. Massey, Stalybridge.
10,254. CEMENT, G. F. Busbridge and J. H. Turvey, East Malling.
10,255. LUBRICATORS, J. D. Noble, Bristol.
10,256. FINISHING BOOTS and SHOES, &c., A. Archer, Dundee.
10,257. WEAVING LOOMS, J. E. Prestwich and J. Ward, Bolton.
10,258. BEATER for BLOWERS, J. Watkins and W. Brinkworth.
10,259. WHEELS of TRACTION ENGINES, W. C. Morton Birmingham.
10,260. LANTERN SLIDE, W. H. Bulpitt, Birmingham.
10,261. AUTOMATIC PIVOT for LOOKING GLASSES, E. and J. M. Verity and B. Banks, Leeds.
10,262. FORMING LETTERS on PAPER from a DISTANCE, M. T. Neale, London.
10,263. IMPROVING ROADS, J. F. Sang, London.
10,264. CORKING and STOPPERING BOTTLES, H. Agar, Surrey.
10,265. BEVERAGE for a TEMPERANCE DRINK, E. H. Wagner, Copenhagen.
10,266. DRINKING TROUGHS, G. Chaude, London.
10,267. PRECIPITATED PHOSPHATE of ALUMINA, &c., W. A. Hills, Saltney.
10,268. APPARATUS for VENTILATION of DRAINS, &c., E. Midgley, London.
10,269. APPARATUS for CUTTING the BRIMS of HATS, L. F. Marsh and H. Aylesbury, Bristol.
10,270. SPINDLE for DOOR HANDLES, W. Harrison, Sheffield.
10,271. FILTERS, J. Coulson and W. A. Todd, Stamford.
10,272. GREASE BOXES for MACHINERY, H. E. Newton.—(*W. S. Smith, Stein-on-the-Danube, Austria.*)
10,273. VELOCIPEDES, E. G. Mattilan, London.
10,274. GALVANIC APPARATUS, W. R. Lake.—(*J. Durien and Cie., Paris.*)
10,275. DISPOSAL of SEWAGE, &c., D. Nicoll, London.
10,276. MANUFACTURE of STARCH, B. H. Remmers.—(*L. von Wagner and A. Gillitzer, Austria.*)
10,277. WATER-HEATERS, J. Gale, Plymouth.
10,278. OVENS, J. B. Cox, Torquay.
10,279. RAILWAY CHAIRS, J. Mahoney, P. Doogan, and J. Mahoney, Leeds.
10,280. TAPS, F. B. Hill, London.
10,281. LOCK NUTS, W. J. Clapp, Nantyglo.
10,282. UMBRELLAS, H. Ellis and R Pawson, London.
10,283. MOTIVE-POWER WHEELS, A. E. Healey, London.

18th July, 1884.

10,284. SPOOL WINDING MACHINERY, D. Sykes and W. Mitchell, Huddersfield.
10,285. FOUNDRY LADLES with AUTOMATIC ACTION, J. Burrows, New Swindon.
10,286. FORMING COLLARS AROUND the MOUTHS of BOTTLES, &c., P. H. Senior, Leeds.
10,287. SMOKE and HOT-AIR CONDUCTOR, D. Raine, Over Darwen.
10,288. PLYERS, E. J. Hardman, J. Willcox, and H. Kendall, Birmingham.
10,289. FIRE-BARS, T. E. Caddy, Nottingham.
10,290. TRAVELLING CATHEAD HOIST APPARATUS, J. Formby and C. Keizer, Liverpool.
10,291. LOCKING MOTTIES or CHECKS to PIT CORVES, W. Caloe, Rotherham.
10,292. MALLEABLE IRON and STEEL, C. Thompson, Sunderland.
10,293. DESIGNS and DIES for EMBOSSING LEATHER, &c., W. R. Pullen, London.
10,294. PRODUCTION of DESIGNS for CALICO, &c., W. R. Pullen, London.
10,295. STAINED GLASS WORK, W. R. Pullen, London.
10,296. HAY RAKES, J. Holding, Farnworth, near Manchester.
10,297. STOPPING and STARTING TRAM-CARS, W. S. Holden, Southport.
10,298. MEDICAL ELECTRIC HAIR BRUSHES, W. S. Frost, J. L. Merigot, and G. C. C. Fein, London.
10,299. OBVIATING the RETURN of FOUL AIR in SEWERS, A. G. Rumley, Bristol.
10,300. PASSENGER VEHICLES, Baron W. A. von Bissing, London.
10,301. SUPPLYING DISINFECTANTS to WATER-CLOSETS, &c., G. Skudder, London.
10,302. INDICATING the QUANTITY of LIQUIDS CONTAINED in CASKS, &c., G. L. Miller, Liverpool.
10,303. CIGARETTE-MAKING MACHINES, O. Imray.—(*W. H. Emery, New York.*)
10,304. OBTAINING LIGHT, J. Kidd, London.
10,305. ELASTIC SEATING, A. J. Boult.—(*A. Buttner and L. Fink, Berlin.*)
10,306. STENCILLING in a QUICKER MANNER LETTERS, &c., R. Mausford, Bristol.
10,307. EMBROIDERING, J. J. Ebneter, Switzerland.
10,308. WAXING COMPOSITION, T. C. Smith, Maidenhead.
10,309. FITTINGS of SHIPS' HULLS, W. Rowden, Whitstable.
10,310. MATCH-BOXES, &c., F. Derry, Birmingham.
10,311. ROLLER BLIND FURNITURE, R. Hodges and J. J. Gaunt, Birmingham.
10,312. METALLIC NET-LIKE FABRICS, J. Wilkes.—(*H. Francis and T. Wilkes, Sydney.*)
13,313. SHIELDS, C. Scheuer, Vienna.
10,314. TABLE FOUNTAINS, H. Sainsbury, Walthamstow.
10,315. FURNITURE CASTORS, A. A. Daly and H. Sainsbury, London.
10,316. INDICATING the SPEED of LOCOMOTIVES, H. J. Haddan.—(*J. Décharnes, France.*)
10,317. WASHING BOTTLES, &c., F. Cuntz, Bohemia.

10,318. HANDLES, &c., of ELECTRO-MEDICAL APPARATUS, J. N. Aronson and C. B. Harness, London.
10,319. BEDSTEADS, W. R. Lake.—(*J. Goodwin, Lynn, Massachusetts, U.S.*)
10,320. TREATMENT of HIDES, &c., W. R. Lake.—(*M. Garnier, Paris.*)
10,321. SKIRTS of LADIES' HUNTING HABITS, W. B. Glover, London.
10,322. LIQUID DIFFUSER, F. Clark, London.
10,323. DYNAMO-ELECTRIC MACHINES, A. M. Clark.—(*E. B. Cutten, Kingsbridge, U.S.*)
10,324. HYDRAULIC PRESS for BALING COTTON, A. M. Clark.—(*C. Baumgarten, Schulenburg, U.S.*)
10,325. CORSETS, A. Ottenheimer, Stuttgart.
10,326. CABS, W. J. Brewer, London.

19th July, 1884.

10,327. CARRIAGE SPRINGS, J. Allen, London.
10,328. STOVES, W. Erck, Dublin.
10,329. ATTACHING CARRIAGE LAMPS to LAMP HOLDERS, W. Whiston, Birmingham.
10,330. GRAIN-BINDING HARVESTERS, J. O. O'Brien.—(*W. R. Baker and H. E. Pridmore, Chicago, U.S.*)
10,331. ECONOMICAL GAS STOVE, V. Mousel, Belgium.
10,332. CESSPOOL and FILTERING DEPOSIT REMOVAL PAN, D. P. Low, Glasgow.
10,333. STEAM TRAPS, C. Colderbank, Finland.
10,334. WASHING BATHS for PHOTOGRAPHIC PURPOSES, J. Sturrock, Dundee.
10,335. FURNACE GRATES, J. Burrell, Bristol.
10,336. SELF-ACTING REVOLVING COOKING STOVE, R. W. Brownhill, Birchfield.
10,337. SAVING LIFE, &c., by a HOUSEHOLD FIRE-ESCAPE, W. H. Adcock, Fazeley.
10,338. REGISTERING DISTANCES TRAVELLED by BICYCLES, &c., W. Whitstull, Aston.
10,339. RAZOR BLADES, E. E. Hewett.—(*J. Memmott, Worcester, U.S.*)
10,340. LOCKING BOLTS and NUTS, A. T. Allen and H. Cavill, Sheffield.
10,341. CARDING ENGINES, W. E. Heys.—(*R. Goodwin and W. W. Cook, St. Petersburg.*)
10,342. TELEPHONES, A. Hudson, Bradford.
10,343. CARDING MACHINES, W. Gawthorp, J. Reddihough, and S. Wade, Bradford.
10,344. UNICORN TOURING TRICYCLE, A. R. Brown, London.
10,345. COAL SCUTTLES, W. Hannaford, London.
10,346. INCREASING the SPEED of TREADLE SEWING MACHINES, C. Swain, Luton.
10,347. LUBRICATOR, F. G. Riley, London.
10,348. POMMEL PROTECTOR for LADIES' SADDLES, J. Smith, London.
10,349. FITTING SADDLES, &c., to VELOCIPEDES, J. K. Starley, London.
10,350. EVAPORATING LUBRICATOR, R. Thompson, Wellington-upon-Tyne, and T. Foster, Northumberland.
10,351. PRODUCTION of ELECTRICAL IMPULSES, &c., G. Downing.—(*W. F. C. M. McCarty, St. Petersburg.*)
10,352. TREATMENT of MATTES, &c., B. J. B. Mills.—(*P. Manhès, France.*)
10,353. PUNCHING MACHINERY, A. G. Brookes.—(*J. W. Bowers, Franklin, U.S.*)
10,354. PENCIL-HOLDER, H. J. Haddan.—(*K. Strössenreuther, Nürnberg.*)
10,355. LOCKS for EARRINGS, J. Wetter.—(*M. Kraus, Vienna.*)
10,356. STOPPER FASTENERS for SCENT BOTTLES, &c., R. A. Green, London.
10,357. REFRIGERATING APPARATUS, J. H. Johnson.—(*A. Nathanson, Paris.*)
10,358. FOLDING ARM CHAIRS, P. Jensen.—(*L. Vansteene and L. Cattrent, Brussels.*)
10,359. FOG SIGNALLING, W. Fox, Leeds, and A. Gledhill, Batley.
10,360. LADDERS, B. Ramsden, Leeds.
10,361. AIR PUMP or BLOWER, A. J. Boult.—(*A. D. Skelnutt, Kentucky, U.S.*)
10,362. GRINDING, &c., APPARATUS, R. Setz and J. Schweiter, Claus, Switzerland.
10,363. SCREW-DRIVERS, A. J. Boult.—(*C. H. Olson, Decatur, U.S.*)
10,364. CONVERTING RECIPROCATING RECTILINEAR MOTION into ROTARY MOTION, J. S. Wallace, Belfast.
10,365. FIRE-ARM, C. D. Abel.—(*C. Salvator and G. R. von Dormus, Vienna.*)
10,366. ELECTRIC METER, R. E. Dunston, London.
10,367. PURIFYING, &c., SUGAR, E. Langen, London.
10,368. SAFETY GEAR for STARTING LARGE FLY-WHEELS, &c., R. Matthews, Hyde.
10,369. HOLDING GAS and other GLOBES, &c., in POSITION, F. Cooper, London.
10,370. WASHING APPARATUS for PHOTOGRAPHIC NEGATIVES, C. Stortz, Hassocks-gate.
10,371. SEPARATING SMALL PARTICLES of IRON or STEEL from other MATERIALS, C. F. Hilder, London, and E. Scott, Newcastle-on-Tyne.
10,372. COUPLING, &c., the SHAFTS of TWIN-SCREW VESSELS, W. R. Lake.—(*E. Bauduin, Pola, Austria.*)
10,373. ELECTRIC FUSES and DETONATORS, P. Ward, Greenwich.
10,374. ELECTRIC FUSES and DETONATORS, P. Ward, Greenwich.
10,375. WHITEHEAD, H. G. Blyth, London.
10,376. SCARFS, P. Everitt, London.

21st July, 1884.

10,377. FURNACES, W. Goode, Nottingham.
10,378. RACK PULLEYS for BLINDS, D. Plumbley, Newport.
10,379. TAPS or COCKS, W. Thorburn, Liverpool.
10,380. LAND ANCHOR, G. Peake, Crewe.
10,381. CLAPPER for FORMING RIDGES, &c., S. Turner, Barrow Haven.
10,382. AUTOMATIC KILN, H. E. Brittin, Swindon.
10,383. AUTOMATICALLY PREVENTING UNDUE ACCELERATED MOTION in and STOPPING STEAM, &c., ENGINES, J. Binns, S. L. Chadwick, and T. Aspinall, near Rochdale.
10,384. FEEDING BOTTLES, W. H. Baines, Sheffield.
10,385. SPOOLS or BOBBINS, J. G. Wilson.—(*Sandberg Brothers, Freistadt, Germany.*)
10,386. JOINERS' PLANES, N. Ferencz, Austria.
10,387. MEDICINAL BEVERAGE, E. J. Fond, London.
10,388. BOOT-JACKS, G. B. Harkes, London.
10,389. CHAIN ROPES, W. T. H. Carman.—(*J. Becker, Londorf, Germany.*)
10,390. FOOTBALLS, W. Howard, London.
10,391. DIVIDING PEARLS, CORALS, &c., T. Groll, Frankfort-on-the-Maine.
10,392. COCKS and VALVES, B. J. Grimes, London.
10,393. VENTILATING APPARATUS, C. Lawrence and T. F. Wintour, London.
10,394. VENTILATING, &c., CONSERVATORIES, &c., C. Lawrence, London.
10,395. BRACES, T. Walker, Birmingham.
10,396. AXLE FRAMES, W. H. B. Vanes.—(*J. Niven, Uitenhage, Cape of Good Hope.*)
10,397. WHEELS, H. Ringwood and R. Holmes, London.
10,398. FURNACE FITTINGS, C. P. Kinnell and G. Rothnie, London.
10,399. HAYMAKING MACHINES, J. Jackson, Ripon.
10,400. NEUTRALISING the ACID in EXTRACT FIBRE, S. Law, Birstal, near Leeds.
10,401. TRAP for BEETLES, &c., A. Lamb, London.
10,402. BREAKWATERS or TURNWATERS, E. C. G. Thomas, London.
10,403. LOADING or UNLOADING VESSELS, T. E. Heath, Cardiff.
10,404. SEWING MACHINES, R. E. Sprott, Dromore.
10,405. STRAIGHT KNITTING MACHINES, E. de Pass.—(*La Société Verdier, Moreau et Compagnie, Paris.*)
10,406. PROPELLING VESSELS, J. Fernie, Philadelphia.
10,407. VESSEL for NAVIGATING SEAS, &c., J. Fernie, Philadelphia.
10,408. GARDEN ENGINES, E. Newton, Hitchin.
10,409. CUTTING and DRESSING RAGS, A. J. Boult.—(*L. Coburn and J. C. Coburn, Worcester, U.S., and C. F. Taylor, Springfield, U.S.*)
10,410. PERMANENT WAY of RAILWAYS, A. M. Clark.—(*A. N. D. Delffs, Bedford, U.S.*)
10,411. COMBINED POURING SPOUT and STOPPER, J. Mitchell, London.
10,412. TUBULAR KNITTING LOOMS, J. Imray.—(*La Société Poron frères, fils, et Mortier, France.*)
10,413. MILITARY WATER BOTTLE, W. de Wilde Cater, London.
10,414. STAITHS, S. Butler, London.
10,415. MILK CANS, A. J. Pinkerman, London.
10,416. CHAFF-CUTTING MACHINES, G. H. Innes, Hitchin, and J. W. Lee, Cambridge.
10,417. PREPARATION of NITRO-CHLORINE and BROMINE DERIVATIVES, A. M. Clark.—(*Wirth and Co., Frankfort-on-the-Main.*)
10,418. UTILISATION of CERTAIN WASTE PRODUCTS from the MANUFACTURE of SODA and CHLORINE, C. T. Richardson, Jarrow-on-Tyne.
10,419. BOTTLES, H. Codd, London.

ABSTRACTS OF SPECIFICATIONS.

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

5659. SEAL TRAPS FOR WASH BASINS, &c., *W. P. Thompson, Liverpool.—6th December*, 1883.—(*A communication from A. Edwards, New Jersey, U.S.*) 6d.

The objects are to prevent escape of gases, and to destroy vegetable organisms in the trap; and it consists in sealing the trap with mercury—the trap being of iron—so that in a short time a film of mercury is deposited on the walls of the trap. The trap has a removable bottom cap, which holds the mercury.

5660. BOOTS AND SHOES, *C. Sutton and W. Kirkland, Leicester.—6th December*, 1883. 6d.

Consists partly in the employment of heavy leather thinned down so as to be flexible in those parts which require to be elastic, and thick in those parts which have to be strong.

5661. GENERATING PRESSURE FOR WORKING ENGINES, *A. M. Clark, London.—6th December*, 1883.—(*A communication from J. A. Costa, Paris.*)—(*Not proceeded with.*) 4d.

This relates to an auxiliary pressure generator, with an internal furnace, leaving no outlet to the atmosphere, and which may serve to work engines operating by means of gaseous pressure, or for superheating the steam of steam boilers.

5663. ANCHORS, *J. Barton, Glasgow.—7th December*, 1883. 6d.

This relates to anchors with movable fluke pieces; and consists in forming these pieces with a projection, to work in a recess in the eye of the shank, whereby the movement is limited. Plates are bolted together, and secure the fluke piece in position in the eye. The fluke arms are of special form.

5665. ADDRESS LABELS, &c., *T. Humphreys and J. P. Milbourne, Manchester.—7th December*, 1883.—(*Not proceeded with.*) 2d.

A metal frame receives the labels, and has projections for securing it to a basket or box, so that it can only be removed when the lid is open.

5666. ROWLOCKS FOR BOATS, *E. Edwards, London.—7th December*, 1883.—(*A communication from L. M. Gautier, jun., France.*)—(*Not proceeded with.*) 2d.

This relates to a clamping device for securing rowlocks to receive the oars or sculls to boats.

5667. MOTIVE POWER ENGINES, *H. G. Hosmer, London.—7th December*, 1883. 6d.

This relates to an arrangement of two pendulums, each of which in turn, as it swings, causes the other to rise and then be released, whereby the proper length of swing is ensured. Pawls and ratchet wheels convert the reciprocating movement of the pendulums into rotary motion.

5668. ELECTRIC APPARATUS FOR OPERATING FOG SIGNALS ON RAILWAYS, &c., *G. W. von Nawrocki, Berlin.—7th December*, 1883.—(*A communication from Dreyse and Collenbusse, Sömmerda, Germany.*) 6d.

This relates to apparatus applicable for use either in connection with the ordinary railway signalling apparatus, or for firing torpedoes, a special cartridge being used in either case.

5669. MARINE ENGINES, *R. Wyllie, West Hartlepool.—7th December*, 1883. 6d.

The inventor claims, First, the arrangement of triple-expansion marine engines in which the low-pressure cylinder is placed between the high-pressure and intermediate cylinders; Secondly, the mode of arranging "fixed-link" valve gear (or valve gear with which the movement of the valve is mainly derived from the transverse or swinging movement of the excentric rod) in combination with other parts of marine engines.

5670. DYEING VEGETABLE AND ANIMAL SUBSTANCES, *W. R. Lake, London.—7th December*, 1883.—(*A communication from E. Crébassa and Baron P. C. Rogniat, France.*) 4d.

This relates to the use of a mordant composed of water, carbonate of soda, hypochlorite of lime, and—after preliminary solutions — dioxide of barium, whereby it is rendered unnecessary to heat the substance to be dyed for the purpose of removing the gummy matters.

5671. SAFETY SUSPENDERS FOR STIRRUP LEATHERS, *W. J. Bacon, Poole.—7th December*, 1883.—(*Not proceeded with.*) 2d.

This relates to a suspender, which, by an upward motion, as well as by motion lengthwise of the stirrup-bar, will release the stirrup leathers.

5672. BOILERS, KETTLES, &c., *R. Hannan, Glasgow.—8th December*, 1883.—(*Not proceeded with.*) 2d.

The bottom is of conical form extending up within the apex of the vessel, and from its apex a tube extends up through the lid, so that flames can pass right through the vessel.

5673. DOUBLE OR MANIFOLD POST CARDS, *H. A. Bonneville, London.—8th December*, 1883.—(*A communication from D. Cornilliac, Paris.*) 4d.

Relates to the manufacture of double or manifold post cards, with perforated or gummed edges, or with a flap, as in ordinary envelopes, proper for the transmission of correspondence, advertisements, patterns, prices current, or pamphlets.

5674. PAINT BRUSHES, *G. H. Nash, Birmingham.—8th December*, 1883. 6d.

An outer ferrule is provided with an interior projection or rim, the bottom of the ferrule being turned in, such ferrule being employed in combination with an expanded or turned-over metal core for securing the knot of bristles.

5676. MARINER'S COMPASS, *Sir W. Thomson, Glasgow.—8th December*, 1883. 10d.

This relates to improvements on previous patents Nos. 1339 and 4876 of 1876, and consists in substituting a totally reflecting prism instead of an ordinary mirror for taking bearings, the advantages being that it does not absorb so much light and allows of objects being seen more distinctly; and Secondly, the liability of the silvering coming off the mirror when exposed to dampness is avoided. The degree divisions of the card are printed so as to be read by the steerer, and are also inverted, so as to be read by the inverted method of using the mirror. The fore-and-aft magnets and 'thwartship magnets for correcting the semicircular error are placed in holes nearly through the centre of the binnacle. Receptacles are formed in the bottom of the bowl to hold quicklime.

5678. APPARATUS FOR WEIGHING OR INDICATING FORCE, STRENGTH OR STRAINS, *T. H. Ward, Tipton.—8th December*, 1883. 6d.

The object is to prevent injury arising from sudden strains or jerks in apparatus for weighing, &c., in which spring blades are acted upon in tension, so as to be straightened out. To one of the blades a frame is attached carrying a dial, axis, and pointer, the axis having a pinion gearing with a toothed quadrant turning on a pivot, but acted upon by a bearer so as to maintain it in a normal position, while a spring tends to move it therefrom. Under a sudden strain a pin connected to the other blade raises the bearer and allows the quadrant to turn on its pivot.

5677. GAS FURNACES, *F. Siemens, London.—8th December*, 1883. 6d.

This consists in so constructing and working a regenerating gas furnace in such a manner that the flame is made to move through it without contact with the materials in the furnace or with the roof or walls, the flame acting chiefly or entirely by radiation. The gas and air ports are placed at such height that the flame will pass clear of the objects to be heated.

5679. CRUSHING MINERALS, &c., *T. R. Jordan, London.—8th December*, 1883.—(*Not proceeded with.*) 2d.

This relates to improvements on patent No 4951, A.D. 1879, and it consists in forming the crushing chamber of two castings, and the bearings for the heater shaft in a separate casting, the shafts being hollow to admit air. To the outer extremities of the arms of each beater a ring of hard steel is fixed.

5680. ACCUMULATORS FOR STORING ELECTRICAL ENERGY, *J. Greenwood, Bacup, Lancashire.—8th December*, 1883.—(*Not proceeded with.*) 2d.

The cells are charged while under a pressure of air proportionate to the quantity of current passed into them.

5681. COLOUR PRINTING, PRODUCING COLOURED PHOTOGRAPHS, &c., *W. R. Lake, London.—8th December*, 1883.—(*A communication from A. Bisson, Paris.*) 4d.

Colours are printed on one face of a transparent gelatine film, or of proofs obtained with carbon of photoglyptic engraving, or of proofs transferred to transparent supports, or of photographic or phototypic proofs obtained upon transparent supports. The transparent supports are formed by treating paper or vegetable parchment in a cold bath of benzine, resin, and linseed oil.

5682. MAGNETO AND DYNAMO-ELECTRIC MACHINES WITH CONTINUOUS CURRENTS, *A. de Meuron and H. Cuenod, Geneva.—8th December*, 1883. 6d.

The armature consists of a drum covered with wires placed longitudinally and parallel to the axis, the extremities being connected together through wires, forming a cord of the circumference of the base of the drum, and each measuring an even number of parts of the circumference. The field magnets form a polygon, having a number of sides equal to the number of armature coils. The pole pieces are placed within the spaces extending between the internal angles and the surface of the armature. The brushes are fixed in pivotted holders, whose axles are the centres from which the curves of the brushes are described.

5683. BREAKING CANNEL, COAL, COKE, &c., *J. Woodward, Manchester.—10th December*, 1883. 6d.

A plate with a serrated face is placed in a vertical position, and can be adjusted to and from a series of rollers one over the other and rotating in bearings, the rollers also being serrated. The distance from the plate to the rollers decreases from top to bottom, so that the coal fed in at top is gradually reduced.

5684. MANUFACTURE OF ROPE, *A. J. F. G. Telschow, London.—10th December*, 1883. 4d.

The object is to form ropes in such manner as to obviate excessively twisting the fibres. The strands are powdered with resin during their manufacture.

5685. SPRING MATTRESSES, *A. J. Boult, London.—(A communication from L. Leyx, France.)—(Not proceeded with.)* 2d.

A wooden box is strengthened at the angles by iron corner pieces, and in it cross bars are fixed and receive noiled metal springs at intervals, which are secured by leather straps with eyelets, forming a network at top.

5686. SADDLES FOR BICYCLES, *W. P. Thompson.—10th December*, 1883.—(*A communication from T. J. Kirkpatrick, Springfield, U.S.*) 6d.

Relates to the means for giving elasticity to the saddle.

5687. ROCK BORING APPARATUS, *J. T. Jones and J. H. Wild, Leeds.—10th December*, 1883. 6d.

The drills are of any form and worked by any suitable motive force, and a vessel or floating structure is employed, similar to that described in patent No. 5614, A.D. 1881. The object is to apply percussive drills to subaqueous rock boring, and for this purpose a tube is lowered from a vessel on to the rock and the drill is lowered therein, and has flexible tubes for working it and for supplying water to remove the *debris* from the bore hole.

5688. PUMP, *H. J. Haddan, London.—10th December*, 1883.—(*A communication from A. Reis, Belgium.*) 6d.

A fixed cylinder has within it a second cylinder, working like a piston and controlling the distribution of the fluid, and being actuated by a cam adapted to serve as a crank for working a ram piston in the second cylinder. By turning the pump partly round the action of the suction and discharge pipes can be reversed.

5689. LOOMS, *T. L. Daltry, Manchester.—10th December* 1883. 6d.

This relates to means for operating shafts or sections of warps in weaving, also to means for operating the drop boxes of a loom.

5691. BRUSH-MAKING MACHINES, *F. Wirth, Germany.—10th December*, 1883.—(*A communication from Bürsten and Pinselfabrik Donaueschingen Mez and Co., Germany.*) 1s. 2d.

This relates to the general construction of machinery whereby the successive operations of feeding single tufts of bristles, fibre, wire, &c., of proper size, from a container, drawing them into the brush stock, and cutting them off to the proper length, are automatically performed.

5692. TYPE-WRITING MACHINES, *H. H. Lake, London.—10th December*, 1883.—(*A communication from J. L. Young, New York.*) 6d.

This relates to a type-writer in which a wheel with raised letters on its face is caused to travel over the paper, and over which is mounted an index wheel, the two being connected by a bevel gear and moved together by an arm pivotted to the centre of the index wheel.

5694. SORTING OR SIFTING GREEN MALT, *F. Wirth, Germany.—10th December*, 1883.—(*A communication from G. Stein, Germany.*)—(*Not proceeded with.*) 2d.

The malt is passed over a vibrating screen with openings of such form that grains which have not sufficiently germinated can pass through them, and so be separated from the mass of malt which passes over the screen.

5695. PERAMBULATORS, *G. E. Webster, Nottingham.—10th December*, 1883. 6d.

The object is to enable perambulators to be used as rocking or stationary chairs and cots, and it consists in forming them so that the wheels can be readily removed and the springs serve as rockers or supports.

5700. FEEDING APPARATUS FOR THRASHING MACHINES, *R. R. Holben, Bartow, and S. Wilkerson, jun., Bassingbourn.—11th December*, 1883. 6d.

Consists partly in a drum feeder for thrashing machines, of the combination of a set of rigid tines and a set of oscillating or clearing tines working between or alongside of them, and receiving a positive oscillating motion from a crank or its equivalent.

5701. STEAM ENGINES, *T. E. Craven, Leeds.—11th December*, 1883.—(*A communication from G. W. Price, Baltimore.*)—(*Complete.*) 6d.

Refers to steam actuated valves, to a mode of actuating the same, and to a reversing attachment that may be combined therewith.

5702. FOOD COMPOUND, *E. J. T. Digby, London.—11th December*, 1883.—(*Not pooceeded with.*) 2d.

Carefully dried carobs are roasted for about twenty minutes, and when cool are ground. Cocoa nibs are then roasted, the shells or husks removed, and the nibs ground, the husks being then roasted and ground. The whole are mixed together, and sugar and butter added and flavoured to taste.

5704. ALARM WATCHES, *C. Masmejan, Switzerland.—11th December*, 1883.—(*Not proceeded with.*) 2d.

This consists in constructing alarm watches with keyless action with only a single barrel.

5705. MACHINES FOR PULPING TURNIPS, &c., *C. P. Davison, 11th December*, 1883.—(*Not proceeded with.*) 2d.

This consists in forming the cutting parts out of and constituting a portion of the disc or the barrel.

5706. SHEARS, *D. Ward and P. Ashberry, Sheffield.—11th December*, 1883.—(*Not proceeded with.*) 2d.

The object is to enable spring shears to have their blades readily separated for sharpening or renewal, and it consists in forming the shears in two parts separated at the bow, where each part is provided with interlocking indentations and projections.

5708. INSULATING ELECTRIC CONDUCTORS, *A. J. Boult, London.—11th December*, 1883.—(*A communication from J. B. Hyde, Brooklyn, N.Y., U.S.*) 4d.

This relates to a process for combining, under heat, mineral bitumen and coal pitch tar with mineral oil. Also to combining dry powdered "peaty" matters with resinous or bituminous substances, either separately or mixed, with a hydrocarbon fluid under heat.

5710. SHIELDS FOR ARTILLERY PURPOSES, &c., *R. H. Brandon, Paris.—11th December*, 1883.—(*A communication from Captain W. de Rohan, Paris.*)—(*Not proceeded with.*) 2d.

The object is to protect men serving field artillery from bullets and other small projectiles, and it consists in one or more sheets of metal erected in a perpendicular or slanting position in front of the gun.

5711. SEWING MACHINES, *H. Birch, Bristol.—11th December*, 1883. 6d.

The object is to trim the seam or cut away the edges of the fabric as the work progresses alongside of the seam, and at an uniform distance from it.

5714. ELECTRIC LIGHTING APPARATUS FOR SURGICAL OPERATIONS, &c., *A. M. Clark, London.—11th December*, 1883.—(*A communication from G. Trouvé, Paris.*) 8d.

An incandescent lamp is mounted in a casing provided with a reflector and lens, and connected by means of a ball-and-socket universal joint to a frontal plate, which is attached to the forehead by a suitable strap and buckle.

5715. COMBINED THICK COPYING AND WRITING PAPER, *F. Bardo, London.—11th December*, 1883.—(*Not proceeded with.*) 2d.

A mixture of zinc ferro-cyanide and zinc ferri-cyanide is added to the paper pulp for the purpose of fixing both the ferrous and ferric salts present in the ink to be afterwards used with the prepared paper.

5719. FORGING BOLTS, SCREWS, &c., *W. Horsfall, Leeds.—12th December*, 1883. 6d.

Consists partly in the combination with gripping dies between which the bar is grasped of a hollow or box-like tool which is to be advanced over the projecting end portion of said bar, and a plunger working through said hollow tool for upsetting or forcing up the iron to fill the same.

5720. PUDDLING AND OTHER FURNACES, *J. Lones, C. Vernon, E. Holden, and R. Bennett, Smethwick.—12th December*, 1883. 8d.

Relates to means whereby the air supplied to the furnace is highly heated by the waste heat of the furnace.

5721. GAS MOTOR ENGINES, *E. C. Mills, Manchester.—12th December*, 1883. 6d.

Relates partly to the admission valve opened by the gas pressure with or without the aid of a spring in combination with a recessed wheel or cam which keeps the valve closed excepting at the times when a charge is to be admitted to the cylinder.

5722. CARTRIDGE CASES FOR ORDNANCE, *C. D. Abel, London.—12th December*, 1883.—(*A communication from P. Boca, Paris.*)—(*Not proceeded with.*) 2d.

This relates to the manufacture of water-tight cartridge cases for ordnance of celluloid or analogous compounds.

5723. TREATING TIMBER WITH PRESERVATIVE FLUIDS, *S. B. Bolton, London.—12th December*, 1883. 4d.

After timber has been impregnated with either an oily solution of tar acids or with naphthaline, accompanied or not by tar acids, or with the distillates of heavy oils of tar obtained at temperatures above 500 deg. Fah., or with solutions of metallic salts with or without admixtures of tar acids, it is subjected to the action of heated creosote or other oily or bituminous body in closed vessels.

5725. LAMPS, *A. Rincklake, Germany.—13th December*, 1883.—(*Not proceeded with.*) 2d.

The objects are to prevent oil oozing through the plaster by which the socket to receive screw on the burner is secured to the oil reservoir; and also to prevent the oil escaping along the shaft employed to raise and lower the wick, and it consists in the employment of an elastic, impermeable packing.

5728. SEATS AND SLEEPING BERTHS OF RAILWAY CARRIAGES, *J. and F. H. W. Livesey, London.—13th December*, 1883. 6d.

Relates to an arrangement whereby the mattress, pillows, &c., can be folded into a box under them when not required.

5729. WORKING INGOTS OF STEEL, &c., *B. Walker, Leeds.—13th December*, 1883.—(*Not proceeded with.*) 2d.

Relates to the construction of a hydraulic apparatus for working the ingots.

5730. PRODUCING BROWN COLOURS OR DYES UPON TEXTILE FABRICS, &c., *J. C. Mewburn, London.—13th December*, 1883.—(*A communication from La Société P. Monnet and Co., St. Fons, France.*) 4d.

Consists in producing brown colours or dyes directly upon textile fabrics or other materials, by the direct oxidation upon such materials of aromatic diamines or their salts.

5731. MECHANICAL EXCAVATORS, *A. J. Boult, London.—13th December*, 1883.—(*A communication from G. Kervern, St. Nicholas de Redon, France.*)—(*Not proceeded with.*) 4d.

Relates to the construction of a machine in which two chains of buckets may be worked.

5733. GALVANIC BATTERIES, *F. H. Gossage, Widnes, Lancashire.—13th December*, 1883. 2d.

Relates to a battery having one electrode of iron and the other of zinc, both being immersed in a solution of caustic soda or caustic potash.

5734. DOOR HANDLES, *H. H. Lake, London.—13th December*, 1883.—(*A communication from C. E. Lacey, Calais.*)—(*Not proceeded with.*) 2d.

Relates to a means of attaching the door handle, so as to dispense with the employment of the small screw usually employed.

5735. EXPLOSIVES, *W. A. Barlow, London.—13th December*, 1883.—(*A communication from A. Gacon, Paris.*)—(*Not proceeded with.*) 2d.

The inventor takes 69 kilos. of powdered nitrate of potash, and intimately mixes the same with 19 kilos. of flour of sulphur, to which is to be added 12 kilos. of powdered ashes, those giving a greater percentage of soda or of potash being the best for the purpose. After thoroughly mixing these, there is introduced into the mixture 200 grammes of tannin dissolved in about 8 litres of water, and the same is triturated before being allowed to dry.

5737. ELECTRIC BATTERIES, *A. C. Henderson, London.—14th December*, 1883.—(*A communication from J. B. G. Vauzelle, Paris.*)—(*Not proceeded with.*) 2d.

The outer cylindrical vessel of copper is coated externally with gutta-percha, and has suspended centrally within it a serpentine strip of zinc, the exciting liquid being a sulphate of copper solution.

5738. Clocks, *G. W. von Nawrocki, Berlin.—14th December*, 1883.—(*A communication from P. Vielmetter, Berlin.*)—(*Not proceeded with.*) 2*d*.

Consists in the combination of a clock with a calendar, and the arrangement of a spring for actuating the alarum, in such manner that the alarum will sound for five minutes.

5741. Secondary Batteries, *J. S. Sellon, London.—14th December*, 1883. 6*d*.

Relates to various means for keeping the plates in shape and equidistant one from the other throughout the series by the use of strips of wood, insulite, porous clay, &c. Where the plates are subjected to a jolting action they are separated by layers of wood matting.

5742. Burning Oils, &c., for Heating Purposes, *L. Lefferts, New York.—14th December*, 1883.—(*Not proceeded with.*) 2*d*.

The object is to present the oil or other liquid hydrocarbons to the point or place of combustion in a very finely divided or atomised state, and mixed intimately with steam.

5743. Obtaining and Preparing from Peat Material for Making into Paper, Pasteboard, &c., *A. J. Boult, London.—14th December*, 1883.—(*A communication from A. Ubbelohde, Hanover.*—(*Not proceeded with.*) 2*d*.

Relates to the boiling of the peat and its treatment with carbonate of soda or potash and a mineral or vegetable acid.

5745. Umbrella Fasteners, *A. C. Henderson, London.—15th December*, 1883.—(*A communication from J. Roy, Paris.*)—(*Not proceeded with.*) 2*d*.

The object is to secure the folds of the silk when the umbrella is rolled up, and it comprises a clasp and hook-piece.

5748. Music Sheets for Mechanical Musical Instruments, *C. Pieper, Berlin.—15th December*, 1883.—*A communication from P. Ehrlich, Leipzic.*) 6*d*.

Consists partly in combination with valve levers of a mechanical musical instrument, of a circular rotating disc provided with parts adapted to depress the beaks of the levers in conformity with the notes to be produced.

5749. Carbons for Electric Lamps, *C. H. F. Müller, Hamburg.—15th December*, 1883.—(*Not proceeded with.*) 2*d*.

These are made of rattan, impregnated with a liquid which will increase its homogeneity, and then carbonised.

5750. Velocipedes, *J. White and J. Asbury, Coventry.—15th December*, 1883.—(*Not proceeded with.*) 2*d*.

The object is to prevent the vibration caused by the running of velocipede wheels over a rough road.

5753. Appliances for Packing Articles, *J. T. Staniland, London.—15th December*, 1883.—(*Not proceeded with.*) 2*d*.

Frames are provided in which the articles to be packed are suspended, and in such manner that contact cannot take place between the article packed and the package.

5755. Railways, *F. Schauman, Copenhagen.—15th December*, 1883.—(*Not proceeded with.*) 2*d*.

Relates to the construction of the chairs.

5756. Production of Aluminium, *G. B. de Overbeck, London.—15th December*, 1883.—(*A communication from H. Niewerth, Hanover.*) 2*d*.

The process consists in decomposing, by means of an electric current, a salt of the metal with an organic acid, or by similarly decomposing the chlorides in the nascent state.

5758. Raising or Hauling Heavy Bodies, *D. W. Sargent, London.—17th December*, 1883.—(*Not proceeded with.*) 2*d*.

Relates to an arrangement of levers.

5759. Secondary Electric Batteries, *A. C. Henderson, London.—17th December*, 1883.—(*A communication from N. Bassett, Paris.*) 6*d*.

The element is preferably composed of two plates of agglomerated carbon covered with natural peroxide of iron wrapped in blotting paper, and held together by string. These are placed without a diaphragm in a concentrated solution of protochloride of iron. The cells are coated with an insulating mastic composed of yellow wax, resin, paraffin, and pulverised colcothar.

5761. Production of Carbonate of Ammonia, *W. E. Gedge, London.—17th December*, 1883.—(*A communication from F. C. Glaser, Berlin.*) 2*d*.

Consists in subliming the carbonate of ammonia from a mixture of carbonate of soda or potash and sal-ammoniac or other salt of ammonia in the presence of an excess of carbonic acid obtained by the use of an alkaline bicarbonate or otherwise.

5762. Cyclometers, *J. Butcher, Boston, U.S.—17th December*, 1883. 6*d*.

Relates to the general arrangement of an instrument for recording the distance travelled by a vehicle.

5765. Indicating and Recording the Heat and Pressure of Fluid in Steam, Gas, or Air Engines, *T. H. Blamires, Huddersfield.—17th December*, 1883.—(*Not proceeded with.*) 2*d*.

The instruments comprise a pressure gauge and a thermometer working in conjunction with or separately from each other, and also in conjunction with or separately from a recording mechanism.

5766. Hansom and other Cabriolets, *C. A. Floyd, Eastbourne.—17th December*, 1883. 4*d*.

The roof is constructed in such manner that part of it can be moved into various positions so as to give more or less shelter to the passenger.

5767. Manufacture, &c., of Colouring Matters, *C. D. Abel, London.—17th December*, 1883.—(*A communication from the Farbwerke vormals Meister Lucius and Brüning, Germany.*) 4*d*.

This relates to the conversion of colouring matters belonging to the well-known series of azo-colouring matters, whether soluble or insoluble in water, into new compounds soluble in water, by combining such azo-colouring matters with the bisulphites of alkalies or other bases.

5769. Pianofortes, *R. Howson, Middlesbrough-on-Tees.—17th December*, 1883. 6*d*.

Relates to the arrangement of the sound board and bridge.

5771. Regulating the Flow of Gas, *H. H. Lake, London.—17th December*, 1883.—(*A communication from M. E. Braundbeck, Stockholm.*)—(*Not proceeded with.*) 2*d*.

Relates to the arrangement of a yielding partition which can be raised or lowered.

5775. Transmitters for Printing Telegraphs, *H. J. Allison, London.—18th December*, 1883.—(*A communication from S. D. Field, New York, U.S.*) 8*d*.

This relates, First, to a transmitter controlling a single circuit, which may contain a number of instruments; and Secondly, to a transmitter capable of controlling a large number of circuits, each of which may control a large number of instruments. To expedite the operation of printing, the printing magnet is provided with a relay, which permits only a momentary "flash" to pass through the helix of the printing magnet, thus avoiding the appreciable interval that usually occurs before the release of its armature and the consequent retardation of the platen and type wheel.

5784. Gas or Oil Motors, *L. A. Groth, London.—18th December*, 1883.—(*A communication from G. Daimler, Germany.*)—(*Not proceeded with.*) 2*d*.

Consists in a contrivance to press air mixed with combustibles (gas, steam, oil, &c.) in a confined heat-protected or not cooling space at the end of a cylinder, by means of a piston, so together and against the hot sides of the space that at the end of the piston stroke, by the effect of the compression, a spontaneous ignition, as it were, a pneumatic ignition, and quick combustion ensues throughout the whole mass of the mixture, and to employing the intensified tension thus obtained as moving power.

5780. Manufacture of Lactic Acid and the Lactates, &c., *A. G. Brookes, London.—18th December*, 1884.—(*A communication from T. S. Nowell, Boston.*) 4*d*.

Relates, First, to the manufacture of lactic acid and the lactates; and, Secondly, to the production of a mordant for fixing colours to animal and vegetable fibres, &c., in the process of dyeing, of which mordant the lactic acid formed by the described process of the first part constitutes the chief element.

5785. Regulating Apparatus for Turbines and Water Wheels, &c., *W. E. Wilson, Rathowen, Ireland.—18th December*, 1883—(*Not proceeded with.*) 2*d*.

Relates to an apparatus by which the speed of a turbine or water wheel is made to regulate the opening of the gates or gate thereof, so that when the speed becomes too great the opening is diminished, and when, on the other hand, the speed becomes too slow, the opening is increased.

5787. Apparatus for Equalising the Pressure upon Slide or other Valves, *E. Edwards, London.—18th December*, 1883.—(*A communication from A. Zalm, Rotterdam.*)—(*Not proceeded with.*) 2*d*.

Relates to the arrangement of springs.

5795. Mixing Hydrocarbons or Hydrocarbon Vapours with Superheated Steam and Air, and Burning same, *R. B. Avery, Washington, U.S.—18th December*, 1883.—(*Not proceeded with.*) 4*d*.

Relates to improvements in the process and to the construction of apparatus.

5798. Manufacture of Aluminum and Aluminum Alloys, *S. P. Wilding, London.—18th December*, 1883.—(*A communication from L. Grabau, Hanover.*)—(*Not proceeded with.*) 2*d*.

The object is to obtain aluminum from alumina or argillaceous earth, or from the fluor combinations of aluminum.

5799. Torpedoes, *C. A. McEvoy, London.—18th December*, 1883. 4*d*.

This relates to providing "spar" torpedoes with driving gear, and to mechanism for effecting their release from the spar when they come within striking distance.

5804. Gymnastic Apparatus, *M. R. Cobbett, Ewell.—19th December*, 1883.—(*A communication from F. Howcroft, New York.*)—(*Not proceeded with.*) 2*d*.

Consists in the application of a gripping lever or clutch brake, which occupies the position of a rowlock on a common outrigger, and is fixed firmly to the extremity of the arm, which takes the place of an outrigger in a boat.

5806. Apparatus for Communicating between Persons at any Distance from one another, *G. C. Gibbs, London.—19th December*, 1883.—(*Not proceeded with.*) 2*d*.

Relates to an apparatus by which persons may speak by signs, names, letters, or numbers.

5808. Printing with Metal Engravings Direct from the Cylinders of Rotary Web Printing Machines, *T. Shields, Bradford.—19th December*, 1883. 4*d*.

Consists in producing a composite curved printing surface suitable for rotary and other machines, consisting in part of a cast obtained by the *papier-maché* process of stereotyping, and in part of any kind of metallic printing surface suitable for printing by the letter-press method.

5811. Treatment of Hops in Brewing, *F. C. Glaser, Berlin.—19th December*, 1883.—(*A communication from A. Kempe, Moscow.*) 6*d*.

Consists in the treatment of the hops for brewing wherein a portion only of the hops is boiled with the wort in the first instance, the other portion thereof being charged into a closed vessel heated either directly or indirectly, and arranged in connection with a coil in a refrigerating tank in such manner as to keep up a continuous circulation of the liquid through the vessel and coil, whereby the whole of the aromatic constituents of the hops are retained in the extract, which, after cooling, is then added to the worts previously treated.

5812. Lamps and Lanterns, *J. Rogers, London.—19th December*, 1883.—(*Not proceeded with.*) 2*d*.

The object is to burn colza or other vegetable or animal oils, with a perfectly steady flame, without the use of a chimney glass.

5815. Controlling the Supply of Steam, Gas, or other Fluids, *F. A. Pocock and E. George, London, and R. Cook, Sheffield.—19th December*, 1883. 4*d*.

Relates to a combination of electro-magnets, and the apparatus described in patent No. 1217, of 1867, for regulating steam engines, or the currents produced by electric generators. There are no drawings.

5817. Metallic Wheels for Vehicles, &c., *J. Hodgkins, Warwick.—20th December*, 1883. 6*d*.

The object is to facilitate the removal and renewal of the rim or tire of wheels, and it consists in forming the wheels of a central boss fixed to the axle, two circular metallic discs, one flat and the other conical, forming the sides of the wheel, which are secured to the boss at one end, while their other ends receive a plain or flanged tire between them and are secured thereto by bolts. The bolts securing the discs to the boss, and also to the rim or tire, are separate for each plate, so that either one may be removed without disturbing the other.

5824. Metallic Plastering Surfaces, *A. M. Clark, London.—20th December*, 1883.—(*A communication from J. Stanley, New York.*) 6*d*.

Consists principally in corrugating or forming ribs in wire cloth, whereby the same is stiffened and made firmer, and whereby it may be secured to the joists by means of common staples.

5827. Production of Transfer Designs, *G. E. Lardeur, London.—21st December*, 1883. 4*d*.

Relates to the use of a composition consisting of rosin, colouring mixture, and turpentine.

5829. Miners' Safety Lamp, *F. W. Pittuck, Hebburn-on-Tyne.—21st December*, 1883.—(*Not proceeded with.*) 2*d*.

Relates to the general construction of the lamp.

5830. Manufacture of Electric Conductors, &c., *J. Kahn, London.—21st December*, 1883.—(*Not proceeded with.*) 2*d*.

The conducting material is deposited upon a rope or cord of vegetable fibre by electro deposition.

5835. Compounds for Insulating, Protecting, &c., *A. Muirhead, London.—22nd December*, 1883. 4*d*.

To enable the commoner kinds of gutta-percha to be employed in the preparation of an insulating compound, the gutta-percha is dissolved out of the raw gum by melted paraffin wax, or other suitable hydrocarbon, at a temperature not exceeding the boiling point of the hydrocarbon employed.

5840. Manufacture of Moulded Ornamental Articles in Imitation of Wood or other Carvings, *C. D. Abel, London.—22nd December*, 1883.—(*A communication from C. W. Radeke, Berlin.*) 4*d*.

Relates to the use for the production of moulded articles in imitation of wood and other carvings of a compound consisting of sawdust, resin, and a refractory material, such as slaked lime or infusorial earth, the said ingredients being mixed and used in a perfectly dry state.

5841. Desiccating Wood, *C. D. Abel, London.—22nd December*, 1883.—(*A communication from J. A. Koch, Galveston, Texas, U.S., and W. Herre, Berlin.*) 2*d*.

Consists in the method of desiccating wood by imbedding the same for a longer or shorter period in a hygroscopic substance, such as chloride of sodium, or of chloride of calcium, or mixtures of such substances.

5843. Secondary Batteries, *H. Woodward, London.—22nd December*, 1883.—(*Not proceeded with.*) 2*d*.

The electrodes consist of lead tubes filled with a suitable salt of lead and pierced with a number of holes. The tubes may then be flattened.

5845. Materials for Insulating Purposes, *J. L. Clark, London.—22nd December*, 1883. 4*d*.

That kind of "oxidised oil" which has been prepared by mixing a vegetable oil with bi-sulphide of carbon and chloride of sulphur, is preferably mixed with an oxidised oil prepared by being simply exposed to the atmosphere. This mixture is then incorporated with a bitumen and a small quantity of hydrocarbon oil, and with this the wires are covered in the usual way.

5847. Recovering and Obtaining Tin from Tinned Metallic Surfaces, *A. P. Price, London.—22nd December*, 1883. 2*d*.

The tin is recovered by electro-deposition in a solution of a caustic alkali, such as caustic soda.

5848. Fire-arms, &c., *H. F. Phillips, London.—22nd December*, 1883.—(*Not proceeded with.*) 2*d*.

Relates to hammerless breech-loading small-arms, and consists in means whereby the movement of the barrels in relation to the stocks that occurs in the act of opening or exposing the breech ends of the barrels is caused to effect cocking of the hammers.

5849. Manufacture of Alkalies and Alkaline Salts, *P. M. Justice, London.—22nd December*, 1883.—(*A communication from S. C. Thomas, Algiers.*—(*Not proceeded with.*) 2*d*.

Relates to the manufacture of soda and commercially available phosphates by means of phosphorus contained in phosphoric pig iron.

5876. Cold Drawing and Compressing Rods, Bars, and Shafting, *R. H. Brandon, Paris.—27th December*, 1883.—(*A communication from C. C. Billings.*) 8*d*.

Consists partly in a machine for drawing and compressing rods or bars, of the combination of a clutch or equivalent device to grasp and draw a rod or bar, a die, a die-seat, and bearing points or rolls to sustain the said seat, with means to adjust the said die-seat and die relatively to the line of the movement of the clutch.

5881. Producing Electric Currents, *A. M. Clark, London.—27th December*, 1883.—(*A communication from H. M. Paine, Newark, N.J., U.S.*)—(*Not proceeded with.*) 4*d*.

This relates to a magneto-electric generator possessing the dual property of accumulating electrical energy and discharging the same under conditions of "impact."

5886. Treating Zinc Ores, *F. C. Glaser, Berlin.—28th December*, 1883.—(*A communication from the firm of G. v. Kramsta'sche Erben and R. Weister, Germany.*) 6*d*.

Relates to the process for reducing zinc ores, especially calamine, silicious ore, Franklinite, as also zinc blende, under mixture with reducing material in a shaft furnace constructed in the form of a cupola furnace of circular or oval cross section, which is fed through a number of nozzles, arranged at one or different heights, with compressed, cold, or hot air, and then intercepting, in suitable chambers, the zinc oxide immediately resulting from the zinc vapours upon contact with the atmospheric air.

5894. Vessels or Apparatus Exposed to Corrosive Action, *J. Imray, London.—28th December*, 1883.—(*A communication from H. Egells, Berlin.*) 2*d*.

The vessels are constructed of hard alloy of lead, such as type metal, having lead fused on the exposed surfaces.

5915. Putting Designs upon Glass, &c, *W. H. Warren, London.—29th December*, 1883. 4*d*.

This relates to a method of repeating or duplicating designs upon glass or other material, so as to make exact copies at small cost.

SELECTED AMERICAN PATENTS.

From the United States' Patent Office Official Gazette.

300,400. Pump, *Wilbur L. Shepard, Hartford, Conn.—Filed November 19th*, 1883.

Claim.—The combination of the piston P, the cylinder Q, the tubular journals I and I[1], the waterways Y and Y[1], the valves W and W[1], the water-ways

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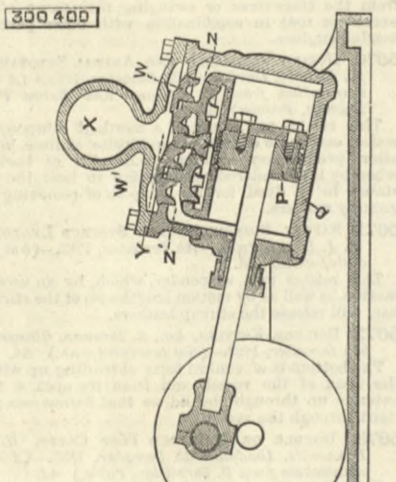

Z and Z[1], and the air-chamber X, all constructed and combined substantially as described, and operating together in an oscillating pump, substantially as explained in the specification.

300,404. Method of Utilising Old Rails, *Gottlieb A. Steiner, Allegheny City, Pa.—Filed February 7th*, 1884.

Claim.—The method of utilising old rails or rail ends in the manufacture of sheet or plate metals, which consists in cutting off one side of the flange, and then

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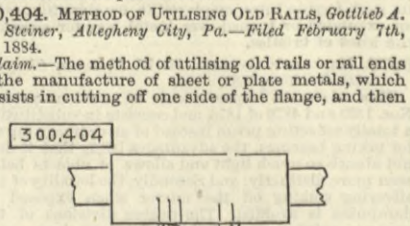

forcing the remaining side of the flange into the same plane as that of the web, and drawing out the rail to a plate of the desired gauge, substantially as and for the purposes described.

300,503. Friction Clutch, *William H. Rascoe, Plattsburg, N.Y.—Filed April 19th*, 1884.

Claim.—The combination, with a shaft, of the wheel A, provided with the recesses G in the sides of the opening for the shaft, the rollers H in the recesses, the plugs or blocks L, resting against the rollers, and the spring K, interposed between the blocks L and the

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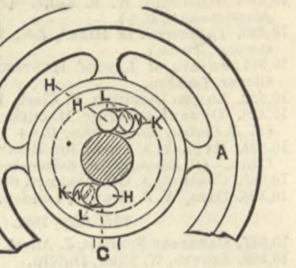

ends of the recesses, substantially as herein shown and described.

300,535. Dynamo-electric Machine, *Chas. J. Van Depoele, Chicago, Ill.—Filed October 19th*, 1883.

Claim.—(1) In a dynamo-electric machine, an armature provided with two sets of coils, one of said sets being arranged and connected so as to excite the field magnets and feed the external circuit, the other set being arranged and connected so as to react directly upon and to intensify the magnetism of said armature core, so as to strengthen the current produced in the coils connected to the working circuit, substantially as described. (2) In a dynamo-electric machine, an armature provided with two sets of coils, one set—the main—being in circuit with the field magnets of said dynamo and with the outside work, the other set—the auxiliary—being set apart and so connected as to impart to the armature core a higher degree of magnetism than that due to the action of the field magnets, thus strengthening the current produced in the main coils of said armature, substantially as set forth. (4) In a dynamo-electric machine, an armature provided with two or more sets of coils or circuits, one or more of said sets of coils being connected and arranged to do work outside of the armature, the remaining set of coils being utilised to directly energise said core to modify the current produced in the armature coils doing the outside work, substantially as

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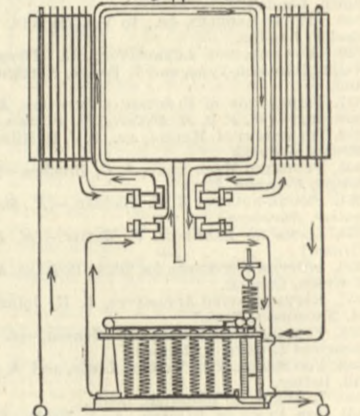

described. (5) In a dynamo-electric machine, an armature core carrying independent sets of coils arranged to be partly influenced by its field magnets and partly by an auxiliary circuit, including a portion of the coils wound thereon, in combination with a current-controller arranged in circuit with the coils acting directly on the armature, and adapted to regulate the flow of current in the said auxiliary circuit in order to regulate the production of current in the main coils of the armature, substantially as set forth. (8) In a dynamo-electric machine, the combination, with field magnets of such proportions compared with its armature that the former is incapable of bringing the latter up to its maximum efficiency, of the outside or working coils of its armature, and a set of coils disposed around said armature core, the sole office of which is to sur-excite the armature core by re-enforcing the action of the field magnets thereon to bring it up to its maximum, as set forth.

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