

THE INSTITUTION OF MECHANICAL ENGINEERS.

On Thursday evening last the spring meeting of this Institution commenced in the hall of the Institution of Civil Engineers.

ON RIVETTING, WITH SPECIAL REFERENCE TO SHIPWORK.

After referring to the importance of securing proportions in rivetted joints, the author remarks that various simple formulæ have been given for this purpose for the ordinary cases where two plates of equal thickness are joined by one or two rows of rivets.

ON RESULTS OF EXPERIMENTS ON RIVETTED JOINTS MADE FOR THE INSTITUTION OF MECHANICAL ENGINEERS.

The author was asked by the Council and the Committee on Rivetting to place before the members of the Institution, in the form of a paper, a statement of the general results of a series of experiments bearing on the strength of rivetted joints.

RIVETTED JOINTS.—TABLE I.

Series I.—General Mean Results.—Tenacity of Steel Boiler Plates. Specimens pulled from Pins.

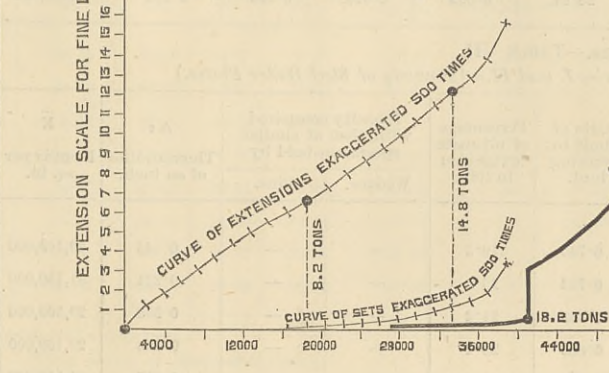
Table with 8 columns: Test No., Dimensions (Breadth, Thickness, Area), Limit of Elasticity, Breaking load, Ratio of limit to breaking load, Ultimate extension.

Tables I. to IX. give the results of the preliminary experiments—Series I. to Va.—above referred to on the tenacity of the plates.

proportion of carbon in these plates, according to analysis at Landore, was about 0.18 per cent. Tables II. and V., which correspond to each other for Series I. and II., give the results of detailed observations as to the elasticity of the material.

Tables III. and VI. contain the results—for Series I. and II.—of very detailed observations made as to the elasticity of the material under test. A simple apparatus* was attached to the specimen, which measured the extension, permanent or temporary, between points 10in. apart.

shows, in illustration of this matter, the observations on a 10in. length of No. 272—Table III.—a specimen of average tenacity and elasticity, in which set began extremely early. Here the set curve distinctly commences



at a load of 8.21 tons per square inch. Out of the twenty-four specimens for which this point was determined, it occurred in five cases at less than 9 tons per square inch.

RIVETTED JOINTS.—TABLE II. Series I.—Mean Ultimate Extension of Specimens.—Steel Boiler Plate.—Pulled from Pins.

Table with 9 columns: Test No., Nominal dimensions (Breadth, Thickness), Final permanent extensions (In 2 1/2 in. at fracture, In 10 in. total length, In 7 1/2 in. not including fracture), Tenacity.

to be proportionate, it will be about 47 per cent. of the breaking load. If, lastly, it be taken—as it practically is always for commercial purposes—as the point where the material “breaks down” —the point given in column 3 of the Tables, and A, Fig. 1—it is not reached until 68 per cent. of the breaking load.

RIVETTED JOINTS.—TABLE III. Series I.—Mean Elasticity of Specimens.—Steel Boiler Plate.—Specimens pulled from Pins.

Table with 11 columns: Test No., Nominal Dimensions (Breadth, Thickness), I. Permanent Set began, II. Uniform Extension ended, III. Steelyard dropped, IV. Broke, Ratio I/III, Ratio II/III, Ratio I/IV, Delta, E.

very low point of commencement of permanent set is not at all peculiar to mild steel, but is probably more or less characteristic of ductile materials. In five bars of a very

* A later apparatus, similar in principle, is illustrated in THE ENGINEER of Feb. 25, 1881.

firm quality of wrought iron recently examined by the author the extension ceased to be uniform at 14.28 tons per square inch in mean, while permanent set was visible at, and steadily increased from, a load of 7.28 tons per

RIVETTED JOINTS.—TABLE IV. Series II.—General Mean Results.—Tenacity of Steel Boiler Plates. Specimens pulled in Wedge Grips.

Table with 8 columns: Test No., Dimensions (Breadth, Thickness, Area), Limit of elasticity, Breaking load, Ratio of limit to breaking load, Ultimate extension.

square inch in the average. In one case the commencement of set occurred distinctly as early as 3.57 tons per square inch. It will be seen from Fig. 1 that up to a certain point the observed extensions lie all upon one

straight line with very great exactness; after that point—which in the diagram is reached at 14.78 tons per square inch—the line begins to curve upwards. This fact was equally distinct in all the other specimens.

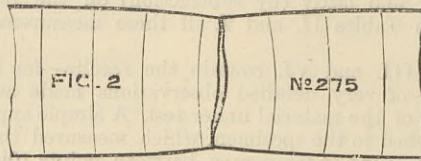
RIVETTED JOINTS.—TABLE V. Series II.—Ultimate Mean Extension of Specimens.—Steel Boiler Plate.—Specimens pulled in Wedge Grips.

Table with 10 columns: Test No., Nominal dimensions (Breadth, Thickness), Final permanent extensions (In 2 1/2 in. at fracture, In total length of 10 in, In 7 1/2 in. excluding fracture), Tenacity.

limit of elasticity, it is the point where the material breaks down that is referred to. Tables III. and VI. further give some of the most important ratios in detail, and in the last column give the modulus of elasticity of the material, where it was determined. The figures in

the column headed $\Delta \epsilon$ are however, the author believes, practically more convenient than the modulus of elasticity. Here $\Delta \epsilon$ may be called the specific extension of the material. It is the actual average extension of the specimen in a length of 10in., measured in thousandths of an inch, for a stress of 1000 lb. per square inch. To obtain the actual extension of any piece of the same material under any load, it is only necessary to multiply the specific extension—which as a small figure is easily remembered—by the load in thousands of pounds per square inch, and by the length in inches, and to divide by ten. The quantity itself has been obtained by calculating the mean in each case of—generally—two or more series of observations of the extensions, up to some point as closely as possible approaching that given in column 2. The values of the modulus of elasticity— E —are obtained from those of the specific extension, the latter of course being the only quantity directly resulting from observation. Arithmetically it can easily be seen that E is equal to 10,000,000 divided by the specific extension. The mean values given for E are the values corresponding to the mean specific extensions, and are therefore slightly different from the arithmetical mean of the figures in the columns for E . A summary of the principal results of the first six tables was given in a table marked VII., which we need not give.

of diameter of bolster—amounting to $\frac{1}{16}$ in. in each case—has no definite effect in such thin plates as these. In another matter the results have a still more practical interest in view of past and future experiments. The specimens, as has been pointed out, varied in width from 2in. to 8in.—quite room enough for the effect of width, if there were any, to show itself. An examination of the results shows, however, that there is practically no differ-



ence worth mentioning between the narrow and the broad specimens. The real cause of the increase of strength due to the drilling of holes in a ductile material is not difficult to understand, when the actual fracture of the material is examined. In Figs. 2, 3, and 4 are shown the forms taken by lines scribed originally parallel to each other on the specimen, at right angles to the direction of the pull. In Figs. 2 and 3, which show the fracture of two of the speci-

RIVETTED JOINTS.—TABLE VI.

Series II.—Mean Elasticity of Specimens.—(Steel Boiler Plates.—Specimens pulled in Wedge Grips.)

Test No.	Nominal dimensions.		I. Permanent Set began.	II. Uniform extension ended.	III. Steelyard dropped.	IV. Broke.	Ratio. I. III.	Ratio. II. III.	Ratio. I. IV.	$\Delta \epsilon$ Thousandths of an inch.	E Pounds per sq. in.
	Breadth.	Thickness.									
273	1 3/4	1/4	Tons per sq. in. 11.50	Tons per sq. in. 13.23	Tons per sq. in. 24.01	Tons per sq. in. 31.04	0.479	0.551	0.370	0.365	27,400,000
274	4	1/4	9.12	11.86	19.66	29.39	0.464	0.603	0.310	0.316	31,640,000
	Mean, 1/2 in. plate		10.31	12.54	21.83	30.21	0.472	0.574	0.341	0.353	28,330,000
275	2	3/8	9.87	10.06	17.93	29.33	0.550	0.561	0.336	0.345	28,980,000
276	3 1/2	3/8	9.44	15.16	19.00	27.38	0.497	0.798	0.245	0.319	31,350,000
	Mean 3/8 in. plate.		9.76	11.33	18.20	28.84	0.536	0.623	0.338	0.338	30,590,000

RIVETTED JOINTS.—TABLE VII.

Summary and Comparison of Mean Results, Series I. and II.—(Tenacity of Steel Boiler Plates.)

Test No.	Nominal dimensions.		Limit drop of steelyard.	Breaking load.	Ratio of limit to breaking load.	Percentage of ultimate extension in 10in.	Tenacity compared with that of similar specimens held by		$\Delta \epsilon$ Thousandths of an inch.	E Pounds per sq. in.
	Breadth.	Thickness.					Wedges.	Pins.		
268 to 273	1 3/4	1/4	22.65	30.35	0.745	19.3	—	—	0.343	29,160,000
269 to 274	4	1/4	21.75	30.07	0.722	23.1	—	—	0.321	31,150,000
	Mean for 1/2 in. plate.		22.20	30.21	0.733	21.2	—	—	0.338	29,590,000
270 to 275	2	3/8	17.82	28.58	0.623	25.1	—	—	0.343	29,160,000
271 to 276	3 1/2	3/8	17.99	28.59	0.629	24.6	—	—	0.317	31,550,000
	Mean for 3/8 in. plate.		17.90	28.59	0.626	24.8	—	—	0.332	30,120,000
272-1 to 4	2 3/4	1/2	17.14	28.96	0.594	24.8	—	—	0.367	27,250,000
	Mean of all plates, 1/2, 3/8, and 1/4 = 28 in all		19.63	29.34	0.669	23.3	0.989	1.011	0.339	29,500,000

RIVETTED JOINTS.—TABLE VIII.

Series III.—General Mean Results. (Tenacity of Rivet Steel.)

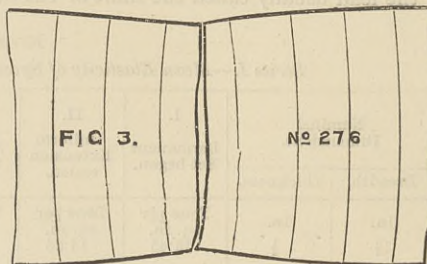
Test No.	Dimensions.			Limit of elasticity.	Breaking load (on original area.)	Ratio of limit to breaking load	Ultimate extension in 10in.
	Original diameter of bar.	Diameter as tested.	Area.				
277	1 1/4	0.508	0.202	Tons per sq. in. 20.00	Tons per sq. in. 29.17	per cent. 68.6	per cent. 20.9
278	1 3/8	0.618	0.300	20.65	30.73	67.2	19.9
279	1 1/2	0.798	0.500	21.29	27.46	77.5	23.3
	Mean of 9 specimens.			20.65	29.12	71.0	21.4

The result of experiments on the tenacity of the rivet steel—Series III.—are given in Tables VIII., IX., and X., which are arranged precisely as those already examined. From column 1 of Table X. it will be seen that no permanent set could be detected below 15.6 tons per square inch—a very much higher average than with the plates. The limit of elasticity is also somewhat higher than before. The specific extension was very uniform, its mean value being 0.326, which gives a mean value of the modulus of elasticity of 30,670,000 lb. per square inch.

Table XI. gives the results of six experiments on the shearing resistance of the rivet steel, of which the last table gave the tenacity and other properties.

The results of the experiments in Series V. and Va are given in Tables XII. to XV. These experiments had a three-fold object—(1) to examine the effect of drilling and punching holes in the material; (2) to find out how far such results were affected by the width of the specimen; and (3) to see if the strength of the punched holes was affected by the size of the die as compared with the punch. The second point is of special importance in enabling conclusions to be drawn as to how far the results obtained from experiments on narrow joints may be safely applied to the broad joints of actual practice. The result of making a hole in a specimen is to localise the extension altogether to the immediate neighbourhood of the hole; and this virtual shortening of the length of the specimen is accompanied, in a ductile material, by a very considerable increase in its tenacity—that is, in the tenacity of the remaining part of the material—unless the mode of formation of the hole has been such as to injure the material in any way. This is shown very distinctly in the experiments. In two other matters these experiments give interesting results. First, the very considerable difference

of diameter of bolster—amounting to $\frac{1}{16}$ in. in each case—has no definite effect in such thin plates as these. In another matter the results have a still more practical interest in view of past and future experiments. The specimens, as has been pointed out, varied in width from 2in. to 8in.—quite room enough for the effect of width, if there were any, to show itself. An examination of the results shows, however, that there is practically no differ-



commonly assumed to be, but is much greater at the centre than at the sides. When the two fractured halves are brought together afterwards, they touch at the sides and are quite wide apart in the middle, as can be seen from Fig. 3. But in the specimens with holes in them, the flow is in some points exactly reversed. The greatest extension occurs, of course, along the centre lines of the holes; between the holes, therefore, the cross lines become convex to the fracture, and the curvature of the lines diminishes instead of increasing as the actual fractured section is reached. From the straightness of the cross lines close to the fracture, in Fig. 4, it will be seen that the stress must have been as nearly as possible uniformly distributed over

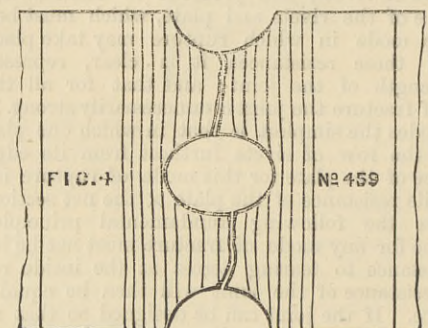
the metal between the holes. Table XV. shows the result of tests of six strips which were carefully annealed after machining. They show a diminution of tenacity of 3.3 per cent. in the one case, and 3.6 per cent. in the other. The ultimate extension was also diminished by just 2 per cent. in each case.

SHEARING RESISTANCE OF RIVET STEEL.—TABLE XI.

Series IV.—General Results.

Original Diameter of Bar. (Nominal.)	Tested Diameter.	Shearing Load.	Tenacity of same material.	Ratio of Shearing to Tensile Resistance.
In.	In.	Tons per sq. in.	Tons per sq. in.	Per cent.
1 1/2	1.000	24.35	27.46	88.7
1 3/8	0.621	26.63	30.73	86.7
1 1/2	0.622	23.41	29.17	80.3
	Mean ..	24.80	29.12	85.2

The first experiments made on actual rivetted joints were those of Series VI., of which the results are given in Tables XVI., XVII., and XVIII. Series VI. consisted of twelve joints with two rivets each, proportioned in pairs to break by tearing and shearing respectively; and all in 3/8 in. plate. Four specimens were made with 1/2 in., four with 3/4 in., and four with 1 in. rivets; and two out of each four with narrow, and two with wide pitch. The proportions



of these joints were not intended to be those of practice but such as should give to some extent limiting values to the resistances of the plate to tearing and of the rivets to shearing and to pressure. The actual results of the tests are given in Table XVII. The last three columns of Table XVII. show the proportionate strength of the joints. The first four are weak, as might be expected. Nos. 381 and 382 give the best results, the joint having 55 per cent. of the strength of the solid plate, and Nos. 383 and 384 are nearly as good.

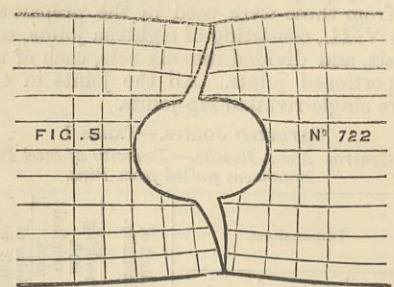
RIVETTED JOINTS.—TABLE XIII.

Series V.—Mean Tenacity of Plates used.

Test No.	Dimensions.			Limit of Elasticity.	Breaking Load.	Ratio of Limit to Breaking Load.	Per cent. of Extension in 10 in.	No. of Corresponding Specimens in Series V.
	Breadth.	Thick-ness.	Area.					
368-2	0.975	0.260	0.253	Tons per sq. in. 22.09	Tons per sq. in. 34.50	0.640	23.6	322 & 3
368	0.975	0.259	0.252	22.65	34.33	0.660	24.8	325 & 4
369	0.977	0.357	0.349	19.19	31.42	0.611	29.8	326 & 7
369	0.976	0.363	0.352	19.27	31.49	0.612	22.5	329 & 8

The results of the experiments in Series VII. on margin and pitch will be found in Tables XIX. to XXI. This series consisted of six joints only, of different proportions. All the joints broke by shearing the rivets.

The last set of rivetted joint specimens tested—series VIII.—consisted of eighteen rivetted joints, all of the single rivetted lap type, each with seven rivets. Table XXII. gives the mean dimensions for each set of three of the joints, as well as the actual ratios of shearing and



bearing areas to tearing area. Table XXIII. gives the general results of the experiments, which will be dealt with immediately. Table XXIV. gives the tenacity of ten strips cut from the 3/8 and three from the 1/2 in. plate, with other particulars as to the material. Table XXV., lastly, gives the shearing and tensile resistance of the rivet steel used in series VIII. The results obtained by breaking the joints are given in Table XXIII., which is arranged on the same general plan as Tables XVII. and XX.

The graduated experiments of series VIII. allow very clear deductions to be made as to the best proportions for certain important types of rivetted joint. The strongest proportions are those of Nos. 656 and 657. The difference between them is not very great at first sight, but is in reality more than may appear. The joints of 656 owe their great resistance entirely to the excess tensile stress which they sustained; and without further experience it is not possible to count on always obtaining such a great excess, far higher than is indicated by the other experiments. Moreover the close pitch makes the joint an expensive one, and the deficiency in plate area is in almost all cases a deficiency in the wrong

RIVET STEEL.—TABLE X.
Series III.—Mean Elasticity of Specimens.

Test No.	Original Diameter of Bar.	I. Permanent Set began.	II. Uniform Extension ends.	III. Steelyard Dropped.	IV. Broke.	Ratio I/III	Ratio II/III	Ratio I/IV	Δε Thousandths of an inch.	E Pounds per sq. inch.
277	In. 1 1/8	Tons per sq. in. 16.65	Tons per sq. in. 16.38	Tons per sq. in. 19.78	Tons per sq. in. 29.08	0.811	0.828	0.552	0.326	30,670,000
278	1 1/8	15.89	17.63	20.65	30.73	0.769	0.854	0.517	0.325	30,770,000
279	1 1/8	14.80	16.12	21.09	27.73	0.702	0.764	0.534	0.326	30,675,000
Mean of 7 complete experiments.		15.63	16.84	20.53	29.40	0.762	0.821	0.533	0.325	30,670,000

STEEL BOILER PLATE, WITH PUNCHED AND DRILLED HOLES.—TABLE XII.
Series V.—General Mean Results.

Test No.	Description.	Mean Thickness of Plate.	Mean Pitch of Holes.	Mean Diameter of Holes.	Tenacity in Tons per square inch net section.				Mean Tenacity.	Tenacity as compared with that of	
					Widths as under:—					Solid plate.	Drilled plate.
						Two inches.	Four inches.	Six inches.	Eight inches.		
322 to 323	In. 1/4 plate, drilled holes	0.262	2.00	0.940	37.02	37.92	39.72	38.00	38.17	1.107	1.000
324	1/4 plate, 3/8 punch, 3/4 die	0.259	2.00	.912-.876	35.65	35.41	34.38	34.71	35.04	1.000	0.918
325	" " 3/8 die	0.250	2.00	.892-.871	36.21	33.72	33.38	34.46	34.44	1.025	0.902
Mean					35.93	34.56	33.88	34.58	34.74	1.012	0.910
326 to 327	3/8 plate, drilled, hole	0.365	2.00	0.930	35.67	35.07	34.68	35.20	35.15	1.119	1.000
328	3/8 plate, 3/8 punch, 1 die	0.363	2.01	.908-.890	33.48	34.60	33.36	34.21	33.91	1.073	0.965
329	" " 1 1/8 die	0.360	2.02	.945-.875	35.19	34.24	33.74	34.34	34.38	1.096	0.978
Mean					34.33	34.42	33.55	34.27	34.14	1.034	0.971

RIVETTED JOINTS.—TABLE XIV.
Series Va.—General Results.—Second Series with Punched and Drilled Holes.

Test Number.	Description. Dimensions in inches.	Mean thickness of plate.	Mean pitch of holes.	Mean diameter of holes.	Tenacity in tons per square inch. Widths as under:—				Mean tenacity. Tons per sq. in.	Tenacity as compared with	
					2in.	4in.	6in.	8in.		Solid plate	Drilled holes
454 to 455	1/4 plate, drilled holes.	In. 0.266	In. 1.99	In. 0.929	33.33	32.50	32.47	30.77	32.26	1.112	1.000
456-1 to 4	1/4 plate, 3/8 punch, 3/4 die	0.263	2.00	.869-.912	29.28	31.12	30.92	31.55	30.72	1.059	
457-1 to 4	" " 3/8 die	0.263	1.99	.889-.904	30.92	29.67	30.30	33.23	31.03	1.070	
Mean					30.10	30.39	30.62	32.39	30.87	1.064	0.957
458 to 459	3/8 plate, drilled holes	0.380	1.98	0.933	32.45	31.55	32.01	32.00	32.00	1.108	1.000
460-1 to 4	3/8 plate, 3/8 punch, 1 die.	0.378	2.00	.867-.981	30.40	30.28	30.80	31.36	30.71	1.064	0.960
461-1 to 4	" " 1 1/8 die	0.378	2.00	.870-.931	31.36	30.08	29.37	30.61	30.35	1.051	0.948
Mean					30.88	30.18	30.08	30.98	30.53	1.058	0.954

RIVETTED JOINTS.—TABLE XVI.
Measurements of Series VI.—(First Series of Rivetted Joints.)

Test No.	Original No. in series.	Nominal Dimensions.	Dimensions by actual measurement.			Dimensions assumed correct.			Size to which holes were drilled.	Joint intended to break by	Ratio of shearing to tearing area.	Ratio of bearing to tearing area.
			A. (width)	B. (lap)	C. (thickness)	D. (Diameter of Rivet)	E. (margin)	P.				
377	1	In. 1/4 plate, 3/8 rivets	In. 1.76	In. 1.80	In. 0.370	In. 0.5	In. 0.625	In. 0.875	0.531	Tearing	1.76	1.56
378	1	" "	1.73	1.86	0.369	"	"	"	"	"	"	"
379	4	" "	1.99	1.91	0.365	"	"	1.00	"	Shearing	"	"
380	4	" "	2.01	1.83	0.367	"	"	"	"	"	1.29	1.13
381	2	3/8 plate, 3/8 rivets	3.00	2.86	0.379	0.75	1.000	1.50	0.781	Tearing	1.76	1.09
382	2	" "	2.99	2.82	0.378	"	"	"	"	"	"	"
383	5	" "	3.98	2.87	0.377	"	"	2.00	"	Shearing	1.06	0.65
384	5	" "	3.96	2.79	0.375	"	"	"	"	"	"	"
385	3	3/8 plate, 1 rivets	4.51	3.67	0.387	1.00	1.25	2.25	1.03	Tearing	1.78	0.84
386	3	" "	4.50	3.68	0.382	"	"	"	"	"	"	"
387	6	" "	6.01	3.65	0.386	"	"	3.00	"	Shearing	1.09	0.52
388	6	" "	6.01	3.60	0.388	"	"	"	"	"	"	"

RIVETTED JOINTS.—TABLE XVII.
Series VI.—General Mean Results.—(First Series of Rivetted Joints.)

Test No.	Tearing area.	Tensile stress when joint broke.	Shearing area.	Shearing stress when joint broke.	Bearing area.	Bearing pressure when joint broke.	Joint intended to break by	Broke by	Breaking load per inch breadth of		Proportional strength of joint.
									Joint.	Solid plate.	
377	sq. in. 0.252	Tons per sq. in. 29.94	sq. in. 0.444	Tons per sq. in. 16.96	sq. in. 0.392	Tons per sq. in. 19.19	Tearing	Tearing	Tons. 4.32	Tons. 11.07	39.3
379	0.344	29.16	0.444	22.53	0.389	25.71	Shearing	Tearing	5.00	10.97	45.6
381	0.543	34.40	0.958	19.51	0.591	31.63	Tearing	Tearing	6.23	11.34	55.0
383	0.901	25.83	0.958	24.31	0.587	39.64	Shearing	Shearing	5.87	11.27	52.1
385	0.940	29.54	1.67	16.63	0.793	35.01	Tearing	Shearing	6.16	11.52	53.5
Mean	1.527	18.90	1.67	17.29	0.798	36.18	Shearing	Shearing	4.80	11.60	41.6

It has been assumed in these calculations that the rivet actually filled up the hole which had been drilled for it.

direction. It is therefore clear that No. 657 is by far the best type of joint among those tested, and it can hardly be expected under any circumstances to obtain a single rivetted lap joint which has an average of more than 61 per cent. of the strength of the solid plate. In 657 the ratio of rivet to plate area—see Table XXII.—was 1.47:1, and of bearing to plate area, 0.82:1. Calling then the pitch of a single rivetted lap joint p , the diameter of the rivet holes d , and the thickness of plate t , we obtain for the equations connecting these three quantities,

$$1.47(p-d)t = \frac{\pi}{4}d^2$$

and

$$0.82(p-d)t = dt$$

worked out, this gives at once

$$p = 2.22d,$$

$$d = 2.27t;$$

which may be at once rounded off to

$$\text{pitch} = 2.25 \text{ diameter of hole,}$$

$$\text{diameter of hole} = 2.25 \text{ thickness of plate,}$$

which would thus represent the proportions—supposing they could conveniently be used—of a single rivetted lap joint—with steel plates and rivets, of maximum strength. The joints in 657 already had a small excess of plate area;

and this "rounding off" of the figures would give a little more. For boilers it would probably be advisable to increase the ratio of pitch to diameter of hole, to 2.3 or 2.4. The diameter of the rivet will be about $\frac{1}{3}$ less than the diameter of the hole. Although only one type of joint—single rivetted lap with drilled holes—was tested, the experiments enable some inferences to be drawn respecting

RIVETTED JOINTS.—TABLE XV.

Series Va.—Mean Tenacity of Plates used.

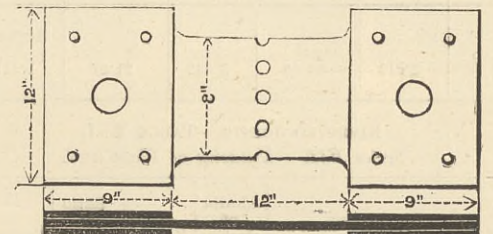
Test numbers	464 to 572	465 to 574
Dimensions	Breadth in inches 0.937	0.998
	Thickness in inches 0.269	0.333
	Area in square inches 0.268	0.332
Limit of elasticity—tons per square inch	20.21	18.66
Breaking load—tons per square inch	29.00	28.87
Ratio of limit to breaking load	0.697	0.647
Percentage of elongation in 4in.	29.1	28.6

RIVETTED JOINTS.—TABLE XVIII.

Series VI.—Tenacity of Plates used.

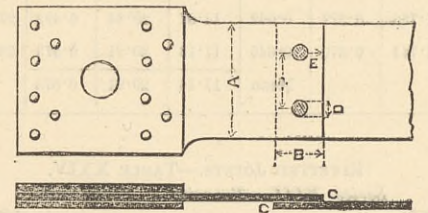
Test Nos.	462 to 473-4
Dimensions	Breadth in inches 1.704
	Thickness in inches 0.378
	Area in square inches 0.644
Limit of elasticity—Tons per square inch	18.47
Breaking load—Tons per square inch	29.07
Ratio of limit to breaking load	0.616
Per cent. of extension, 3 in 4in. and 2 in 6in.	26.96

others. With the wider pitch of double rivetted joints, the excess tenacity of the plate will be much less, and with chain rivetted joints of ordinary proportions it will altogether disappear. For the latter it will not be safe to



Sketch of widest specimen, Tables XII. and XIV. The rest similarly arranged.

assume a greater tensile stress than the ordinary resistance of the material. For butt joints, on the other hand, if they have double cover-plates, the shearing resistance of the rivets will approach much more nearly the shearing



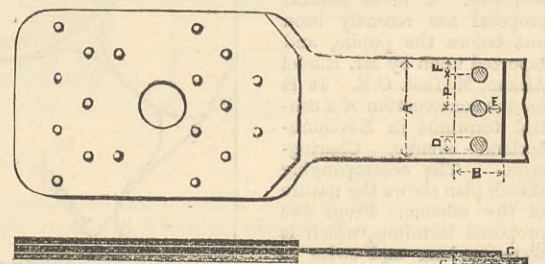
Sketch showing the dimensions corresponding to the reference letters at head of columns, Table XVI. Two rivets in all cases.

resistance of the steel out of which they have been made; and even in a double-rivetted lap joint the shearing resistance per square inch should be somewhat greater than in

RIVETTED JOINTS.—TABLE XIX.

Measurements of Series VII.—(Rivetted Joints varied for pitch and margin.)

Test No.	Original No.	A. (width)	B. (lap)	C. (thickness)	Nominal Dimensions.		Diameter of drilled holes (nominal)	Ratio of Shearing to Tearing area	Ratio of Bearing to Tearing area
					E. margin	P.			
431	2	In. 4.807	In. 2.82	Mean In. 0.366	In. 1.00	In. 1.61	0.781	1.59	0.95
432	1	4.810	2.63	0.378	0.875	"	"	1.54	0.95
433	3	4.806	2.36	0.386	0.75	"	"	1.51	0.95
434	4	5.000	2.33	0.372	0.75	1.70	"	1.45	0.88
435	5	5.135	2.31	0.377	0.75	1.78	"	1.37	0.84
436	6	5.597	2.31	0.368	0.75	2.00	"	1.20	0.72



Form of specimen, Table XIX. All specimens have the same diameter and number of rivets. Nos. 431, 432, and 433 have the same pitch, but differing margins; Nos. 434, 435, and 436 have the same margin but differing pitches. In all cases $F = 0.80$; and nominal diameter of rivet is 0.75.

RIVETTED JOINTS.—TABLE XX.

Series VII.—General Mean Results.—Joints varied for Margin and Pitch.

Test numbers	431 to 433	434 to 436
Tearing area, square inches	0.928	1.079
Tensile stress when joint broke, pounds per square inch	76,360	64,20
Shearing area, square inches	34.09	28.67
Shearing stress when joint broke, pounds per square inch	1.437	1.437
Bearing area, square inches	40,300	47,870
Bearing pressure when joint broke, pounds per square inch	22.01	21.37
Bearing pressure when joint broke, tons per square inch. (Joint broke by shearing.)	0.883	0.873
Breaking load, per inch run—joint, tons.	35.83	35.18
Ditto—solid plate, tons	6.58	5.87
Proportional strength of joint, per cent.	11.3	11.1
	58.43	52.7

a single rivetted one, on account of the greater stiffness given to the plates by the broad lap. If we take a double-

rivetted lap joint—of the materials used in the experiments—to be equally likely to break either way when the tensile stress is 31.5 tons per square inch, the shearing stress 23.0 tons per square inch, and the bearing pressure 40 tons per square inch, we should get for proportions of uniform—and maximum—strength

$$p = 3.54 d$$

$$d = 2.21 t,$$

and if the plate had a natural tenacity of 29.5 tons per square inch, such a joint would have a strength equal to nearly 77 per cent. of that of the solid plate. The effect

of substituting punched for drilled holes can be estimated from the results given in Tables XII. and XIV. The excess of tensile resistance over that of the untouched plate is reduced to about 6 per cent.

The joints experimented on were all made of $\frac{3}{8}$ in. plate. The author pointed out that he had confined himself entirely to a statement and discussion of his own results, without comparing them with those of others. The recent memoir published by the Board of Trade contains results which agree in every important respect with those here described, so far as they cover the same ground.

RIVETTED JOINTS.—TABLE XXIII.

Series VIII.—General Results.—Third Series of Rivetted Joints.

Test number.	Tearing area.	Tensile stress when joint broke.	Shearing area.	Shearing stress when joint broke.	Bearing area.	Bearing pressure when joint broke.	Proportion of breaking load at which visible slip occurred.	Joint broke by	Breaking load per inch breadth of		Proportional strength of joint. Solid plate.
									Joint.	Solid plate.	
652-1 to 3	Sq. in. 2.337	Tons per sq. in. 31.36	Sq. in. 3.417	Tons per sq. in. 21.46	Sq. in. 2.209	Tons per sq. in. 33.17	19.3	Shearing	Tons. 6.46	Tons. 11.73	Per cent. 55.1
653-1 to 3	2.320	32.60	4.064	18.61	2.402	31.49	25.2	Two by shearing one tearing	6.41	11.70	54.8
654-1 to 3	2.270	30.99	3.080	22.84	2.103	33.46	21.9	Shearing	6.45	11.76	54.9
655-1 to 3	2.572	29.54	3.440	22.08	2.137	35.56	20.4	Shearing	6.22	11.32	54.9
656-1 to 3	1.956	36.13	3.371	20.96	2.156	32.78	27.0	Two by tearing, one by shearing	6.76	11.52	58.6
657-1 to 3	2.347	32.56	3.452	22.09	1.924	39.71	27.0	Shearing	6.19	10.18	60.8
657-2	2.212	34.03	3.442	21.87	1.811	41.56	24.0	Shearing	6.11	9.59	63.7

RIVETTED JOINTS.—TABLE XXI.

Series VII.—Tenacity of Plate used.

Test No.	Dimensions.			Limits of elastic Drop of steel-yard.	Breaking load.	Ratio of limit to breaking load.	Extension in 4 in. and 6 in.
	Breadth.	Thick-ness.	Area.				
463-1	2.002	0.382	0.765	Tons per sq. in. 17.62	Tons per sq. in. 29.82	0.951	23.2
463-2	1.998	0.368	0.735	19.13	30.06	0.636	28.4
473-3	1.756	0.377	0.662	14.67	29.84	0.492	27.5 (in 6 in.)
473-4	1.744	0.370	0.645	17.13	29.91	0.573	28.0 (in 6 in.)
			Mean	17.14	29.91	0.573	

RIVETTED JOINTS.—TABLE XXII.

Measurements of Series VIII.—Third Series of Rivetted Joints.

Test number.	Total breadth	Diameter of drilled holes.	Pitch of holes.	Thickness of plate.	Ratio of shearing of tearing area.	Ratio of bearing to tearing area.
652-1 to 3	11.34	0.79	1.62	0.400	1.46	0.94
653-1 to 3	11.84	0.86	1.68	0.399	1.75	1.03
654-1 to 3	10.90	0.75	1.56	0.401	1.36	0.93
655-1 to 3	12.20	0.78	1.74	0.386	1.34	0.83
656-1 to 3	10.45	0.78	1.49	0.393	1.72	1.10
657-1 to 3	12.32	0.79	1.77	0.347	1.47	0.82

RIVETTED JOINTS.—TABLE XXIV.

Series VIII.—Tenacity of Plates used.

Test No.	652 to 657
Dimensions	Breadth, inch 1.700
	Thickness, inch 0.385
	Area, square inch 0.675
Limit of elasticity, tons per square inch	17.60
Breaking load, tons per square inch	29.33
Ratio of limit to breaking load	0.600
Percentage of final extension	44.1
	In total length of 10 in., per cent. 23.2

The numbers of these specimens correspond with the numbers of the plates in Series VIII. (see last two tables) from which they were cut.

RIVETTED JOINTS.—TABLE XXV.

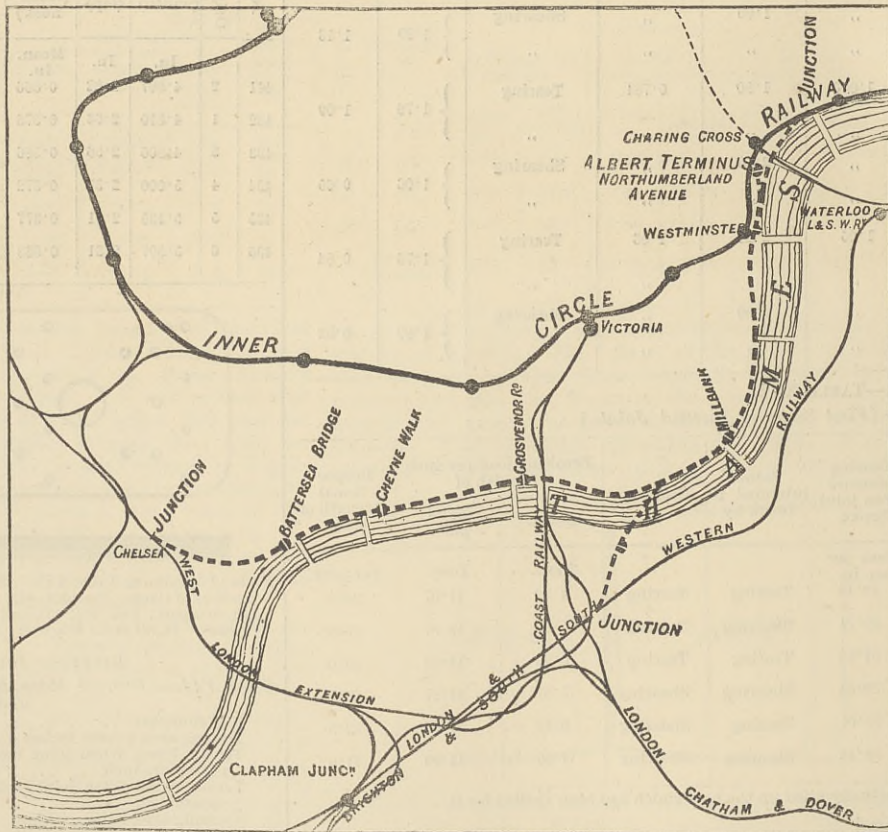
Series VIII.—Shearing Resistance of Rivet Steel used.

Test No.	728
Original diameter of bar (nominal), inch	$\frac{3}{8}$
Tested diameter, inch	0.621
Shearing load	Pounds per square inch 58,980
	Tons per square inch 26.33

All these specimens showed signs of passing a limit of elasticity at points varying from 58 per cent. to 85 per cent. (mean 70.3 per cent.) of their breaking load.
A piece cut from the same bar and tested for tenacity had its limit at 18.62 tons per square inch, and broke at 29.03 tons per square inch. The ratio of shearing to tensile resistance is, therefore, in this case $\frac{26.33}{29.03}$, or nearly 91 per cent.

A CENTRAL RAILWAY STATION FOR LONDON.

SOME years ago it was proposed in this journal that a grand central railway terminus should be made on the site in the Strand now occupied by the New Law Courts. At that time the site had been cleared, but those in authority were divided in opinion as to whether the Law Courts should or should not be built upon it. The Law Courts came, however, and a splendid opportunity was lost. A more modest proposal has recently been put before the public, and reported upon by Mr. Russel Aitken, M. Inst. C.E. It is for the construction of a central terminus in Northumberland-avenue, Charing-cross. The accompanying sketch plan shows the nature of the scheme. From the proposed terminus, which is to be as long and twice as wide as Cannon-street Station, the proposed railway would pass in tunnel underneath the gardens of the National Club, &c., to Bridge-street, Westminster, where some offices and houses would have to be underpinned or be taken down and rebuilt. It would then pass between Westminster Abbey and the Houses of Parliament, under the site of the Law Courts, which are shortly to be demolished. After this, the railway would be carried under the new boulevard, which was decided on by the Metropolitan Board of Works in 1875, and which will extend from the Houses of Parliament to the Vauxhall Bridge-road. After passing under the Vauxhall Bridge-road the railway would rise alongside the Embankment, and then cross the Thames by a skew bridge, having four spans of 230ft. each, to the Surrey side, where it would run for some distance through some vacant land belonging to the Southwark and Vauxhall Waterworks Company, joining the South-Western at the point where the London, Chatham,



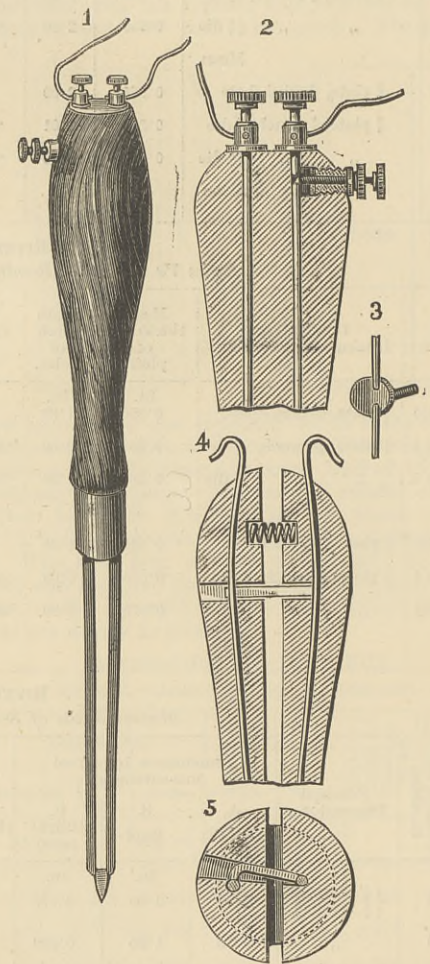
and Dover Railway crosses over it. By joining at this point no interference with the working of the Nine Elms Goods Station, or with the engine sheds, would take place; in fact, the engine and carriage sidings would be as available for working the new terminus as for Waterloo. The length of new railway from the junction of the London and South-Western Railway at Battersea to the proposed new terminus would be 2.3 miles, so that the distance between Clapham Junction and the terminus would be a little shorter than it now is to Waterloo. Thus the terminus could be reached by trains from Clapham in as short a time as

Waterloo. There would be two stations, one at Millbank and one at Westminster. The London and North-Western and other companies are owners of the West London and the West London Extension Railways, so that trains from Willesden Junction could run on it to the proposed terminus, and there are two routes by which this can be done. The total length from Willesden by this line would be 8.4 miles, as compared with 7.4 miles as proposed by the Mid-London Railway, but the route now proposed will be an easier line to work. The whole scheme seems to have been well thought out and deserves attention.

SOLDERING BY ELECTRICITY.

THE accompanying engraving shows an ingenious application of electricity. It is a soldering iron heated by an electric current, and capable, the *Scientific American* says, of melting all kinds of solders, such as gold and silver solder, which have heretofore required a blowpipe to melt them. It may also be used for the more fusible solders employed in making tin ware. Now that the electric current is distributed so generally and is used for all manner of purposes, it seems quite practicable to employ it for soldering.

Figs. 1, 2, and 3 show one form of electric soldering iron, Fig. 1 being a perspective view, Fig. 2 a section showing the switch for controlling the current, and Fig. 3 a detail view of the switch button. Figs. 4 and 5 are views of a modified form of the device. In Figs. 1 and 2 the electric conductors extend through and project beyond the handle, and embrace a piece of platinum or other material offering sufficient resistance to the



passage of the electric current to become heated more or less according to the strength of the current. One of the conductors is separated near the upper end of the handle, and bridged by a button made partly of electrical conducting material and partly of insulating material, so that by turning the button the circuit may be completed or broken as circumstances may require. The device shown in Figs. 4 and 5 is on the same general principle, the only difference being that the handle is split lengthwise and the two portions are pressed apart by a spring. When apart to their fullest extent a hook attached to one of the conductors touches the other conductor and short circuits the current in the handle. When the two halves of the handle are pressed together the current passes through the refractory point.

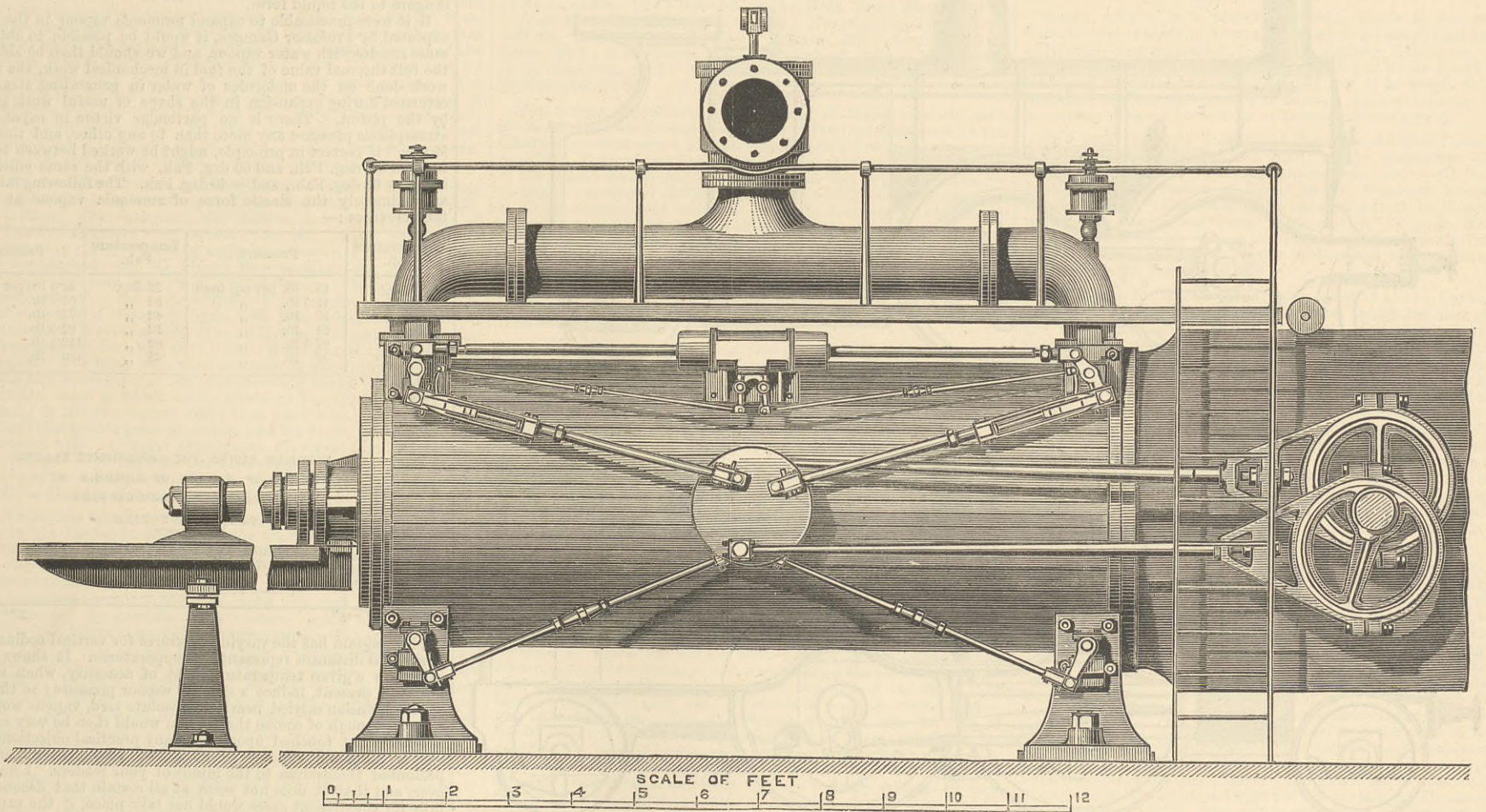
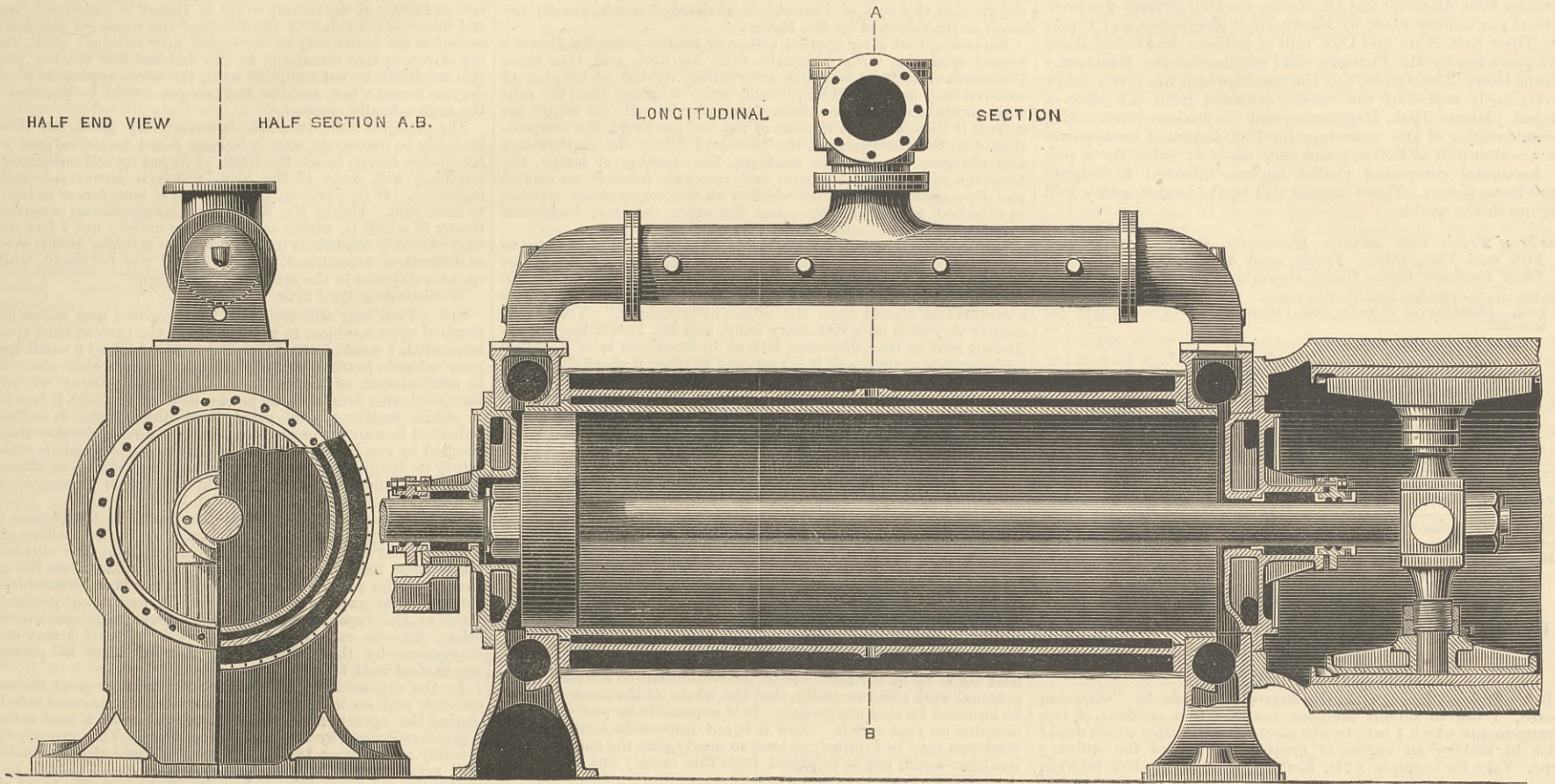
The invention was recently patented by Mr. C. E. Ball, of Philadelphia, Pa.

NAVAL ENGINEER APPOINTMENTS.—The following appointments have been made at the Admiralty:—John R. Harvey, chief engineer, to the *Pembroke*, vice Wyllie; and Joseph Wyllie, engineer, to the *Flora*, for *Ascension*, vice Forster; Richard W. Topp, chief engineer, to the *Asia*, additional, for service in the *Active*; Nicholas D. Chambers, chief engineer, to the *Ruby*, vice Nibbs; and John T. Morgan, chief engineer, to the *Pembroke*, additional, for service in the *Linnet*, vice Chambers.

MILD STEEL IN THE WORKSHOPS.—The occasional failure of steel plates in boiler and other work, is generally attributed to want of sufficient information on the part of the workmen. To prevent, as far as practicable, the possibility of failure in steel plates, caused by deficient information as to the proper method of treating this material, the Steel Company of Scotland has published and directs the attention of the users of the steel to the following rules:—(1) *Welding*: In welding mild steel plates, it is not necessary to heat them to the same high temperature as in the case of iron. Instead of a 'welding heat,' a bright yellow heat is sufficient; and if flux is required, it need only be three parts clean sand to one part common salt, moistened, and thrown on the parts in the fire. We recommend that the weld be of the V form, in preference to the lap, and that it be treated in the usual way—that is, lightly hammered on the V part. After the weld is made, and while the heat is good, the parts near and on either side of the weld should also be lightly hammered. In making the weld, the fuel used should be free from sulphur, otherwise red shortness may result. (2) *Flanging*: In flanging, care should be taken in the local heating that the parts are not overheated, and that no hammering or work is put upon them while at a black heat; further, it would be well if work could be continuous until each flange is completed, or, if the plate has to be laid aside before it is finished, it should be protected from chills, if it is not convenient to keep it warm. (3) *Annealing*: After completing either welding or flanging, the whole piece should be heated to a cherry-red heat, and slowly cooled. (4) *Orders*: In ordering steel plates, care should be taken to state the purpose for which they are to be used, especially in cases where they are required to weld and flange.

CORLISS MILL ENGINE FOR 1000 INDICATED HORSE POWER.

CONSTRUCTED BY MESSRS. HICK, HARGREAVES AND CO., ENGINEERS, BOLTON, FOR MESSRS. DANIEL ILLINGWORTH AND SONS, WHETLEY SPINNING MILLS, BRADFORD.



We illustrate above and on page 212, one of the largest Corliss engines ever constructed. It is of the single cylinder, horizontal, condensing, type, with one cylinder 40in. diameter, and 10ft. stroke, and makes forty-five revolutions per minute, corresponding to a piston speed of 900ft. per minute. At mid stroke the velocity of the piston is 1402ft. per minute nearly, and its energy

cylinder is bolted directly to the end of the massive cast iron frame, and the piston coupled direct to the crank by the steel piston rod and crosshead and the connecting rod. The connecting rod is 28ft. long centre to centre, and 12in. diameter at the middle. The crank shaft is made of forged Bolton steel, and is 21in. diameter at the part where the fly-wheel is carried. The fly driving wheel is 35ft. in diameter, and grooved for twenty-seven ropes, which transmit the power direct to the various line shafts in the mill. The rope grooves are made on Hick, Hargreaves and Co.'s standard pattern of deep groove, and the wheel, which is built-up, is constructed on their improved plan with separate arms and boss, and twelve segments in the rim with joints planed to the true angle by a special machine designed and made by themselves. The weight of the fly-wheel is about 60 tons. The condensing apparatus is arranged below, so that there is complete drainage from the cylinder to the condenser. The air pump, which is 36in. diameter and 2ft. 6in. stroke, is a vertical pump worked by wrought iron plate levers and two side links, shown by dotted lines, from the main crosshead. The engine is fenced off by neat railing, and a platform with access from one side is fitted round the top of the cylinder for getting conveniently to the valve spindles and lubricators. The above engraving, which is a side elevation of the cylinder, shows the valve gear complete. There are two central disc plates worked by separate excentrics, which give separate motion to the steam and exhaust valves. The excentrics are mounted on a small cross shaft, which is driven by a line shaft and gear wheels. The piston rod passes out at the back end of the cylinder and is carried by a shoe slide and guide bar, as shown more fully in

the detailed sectional elevation through the cylinder, showing also the covers and jackets in section. The cylinder, made in four pieces, is built up on Mr. W. Inglis's patent arrangement, with separate liner and steam jacket casing and separate end valve chambers. This arrangement simplifies the castings and secures good and sound ones. The liner has face joints, which are carefully scraped up to bed truly to the end valve chambers. The crosshead slides are each 3ft. 3in. long and

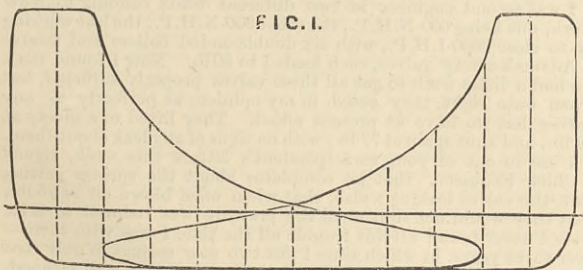
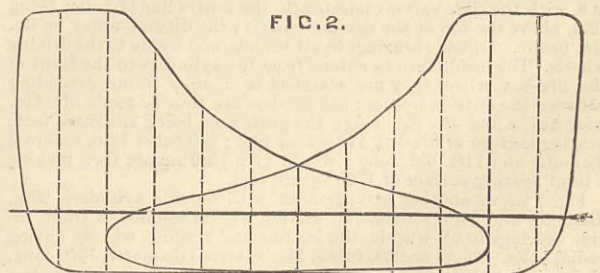


FIG. 1.
DIAM OF CYLINDER = 40"
STROKE = 10ft
REVS = 41
SCALE OF DIACRAMS 40 LBS. = 1 INCH

in foot pounds amounts to about 8.6 times its weight. The cylinder is steam jacketted on the body and ends, and is fitted with Corliss valves and Inglis and Spencer's automatic Corliss valve expansion gear. Referring to the general drawing of the engine, it will be seen that the



1ft. 3in. wide. The engine was started last year, and has worked beautifully from the first, without heating of bearings or trouble of any kind, and it gives most uniform and steady turning. It is worked now at forty-one revolutions per minute or only 820ft. piston speed, but will be worked regularly at the intended 900ft. piston speed per minute when the spinning machinery is adapted for the increase which the four extra revolutions per

minute of the engine will give; the load driven is over 1000-horse power, the steam pressure being 50 lb. to 55 lb., which however will be increased when the existing boilers, which are old come to be replaced by new. Indicator diagrams from the engines are given on page 309. The engine is very economical in steam consumption, but no special trials or tests have been made with it. An exactly similar engine, but of smaller size, with a cylinder 30in. diameter and 8ft. stroke, working at forty-five revolutions per minute, made by Messrs. Hick, Hargreaves, and Co. for Sir Titus Salt, Sons, and Co's. mill at Saltaire, was tested about two years ago by Mr. Fletcher, chief engineer of the Manchester Steam Users' Association, and the results which are given below pretty fairly represent the results obtained from this class of engine. Messrs. Hick, Hargreaves, and Co. are now constructing a single engine of the same type for 1800 indicated horse-power for a cotton mill at Bolton; and they have an order for a pair of horizontal compound Corliss engines intended to indicate 3000-horse power. These engines will be the largest cotton mill engines in the world.

Result of Trials with Saltaire Horizontal Engine on February 14th and 15th, 1878. Trials made by Mr. L. E. Fletcher, Chief Engineer Steam Users' Association, Manchester.

Engine single-cylinder, with Corliss valves. Inglis and Spencer's valve gear. Diameter of cylinder, 30in.; stroke, 8ft.; 45 revolutions per minute.

No. of trials.	Total I.H.P.	Mean boiler pressure.	Mean pressure on piston at beginning of stroke.	Mean loss between boiler pressure and cylinder.	Mean average pressure on piston.	Water per I.H.P. per hour.	Coal per I.H.P. per hour.
Trial No. 1.	301.89	46.6	44.11	2.53	21.23	18.373	2.699
Trial No. 2.	309.66	47.63	44.45	3.18	21.67	17.599	2.561
Means ..	305.775	47.115	44.28	2.855	21.45	17.986	2.630

LETTERS TO THE EDITOR.

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

HIGH-SPEED LOCOMOTIVES.

SIR,—In accordance with the suggestion made by "Running Board," I beg to submit for your consideration outlines of two arrangements which I believe will meet the difficulties which would arise in making an engine of great power and of the ordinary type. Take for example a 7ft. coupled, with the fire-box between

which, if allowed to pass uncontradicted, may perhaps injure the interests of the company I represent. Mr. Bower claims that the cost of his compressed and carburetted coal gas when applied to a lamp for lighting a railway carriage is only one tenth of a penny per hour, as against one farthing per hour per light of equal intensity when supplied with oil gas on the Pintsch system. The former part of the statement may be correct, but the latter part of it is certainly not so, practical experience having indisputably shown that the cost of Pintsch's is, curiously enough, exactly the same as that claimed by Mr. Bower.

Supposing that after another fifteen or twenty years Mr. Bower's second system is more fortunate than his first, and that some thousands of railway carriages are running lighted on his plan of carbureting, no one will be probably more delighted than the railway companies who have been fortunate enough to adopt his system if they find that the cost of the coal gas itself, the compression of it, the carbureting, the labour of filling the carburetters and charging the carriage receivers, the cleaning of lamps, the breakage of glasses, all repairs and renewals, interest on capital and depreciation on all plant whether at the compressing stations or attached to the carriages, and the other necessary incidental expenses amount to only one farthing per hour.

While writing on this subject it is well to notice that in order to avoid the difficulty of the carbureting material depositing in the pipes, Mr. Bower appears to place his light close to the hydrocarbon which is to enrich it, in fact he says "the gas passes through a carburetter placed upon the object to be lighted." This might answer very well on a stationary lamp, and Mr. Bower has an unlimited field in that direction, but as hydrocarbon is of a highly inflammable nature, and it is proposed to place it above the lights, the result of a collision might prove somewhat unpleasant to the passengers. It was not very long ago that I noticed in THE ENGINEER an account of an accident which happened on the Erie Railway, in which several persons were killed owing to the catching fire of the lamp oil.

W. B. RICKMAN.
Pintsch's Patent Lighting Company, Limited, Metropolitan-chambers, New Broad-street, London, April 28th.

THE ZERO MOTOR.

SIR,—No doubt the article which appeared last week in your columns on the zero motor will have been perused with interest by many of your readers. The subject is attractive and even of some importance. Will you permit me to make a few remarks on it?

You reasoning is logical and clear, and on the data you have given the zero motor ought to work, provided the serious practical difficulties to which you refer be got over. But you obviously assume as the conditions of success: First, that the whole of the heat taken up by the ammonia in the boiler shall be converted into external work; and secondly, that the whole of the ammonia shall be liquefied by that conversion. It is impossible to put any other meaning on your article. Now it is not impossible that the first condition may be fulfilled, at least so nearly that the success of the machine would not be impaired from this cause; but it is quite

the performance of work a considerable quantity of the ammonia he uses. Whether he can or cannot make a zero motor, depends entirely on the proportion which the ammonia unliquefied will bear to that liquefied. The whole must be liquefied to make the cycle complete. But on the one hand, liquefaction is effected by the expansion of the gas in the performance of work, and on the other it is liquefied by doing work on it and compressing it. The relation which the two processes bear to each other will determine the success or failure of the motor, so far as theory is concerned, because as I have said, I think it possible that the whole of the heat absorbed in the boiler may be converted into external work, excepting of course that remaining in the residual low tension gas. If this condition be not complied with, the whole apparatus would by degrees become hot, and less and less gas would be liquefied until the engine finally stopped.

The practical difficulties are, however, very great, and it would probably be necessary, merely to keep down boiler surface within reasonable limits, to use fire heat. I do not myself anticipate that anything will come of the idea, which is, however, beautifully ingenious. It is, however, just the kind of *ignis fatuus* to lure men to their ruin. Unlike Mr. Keely, Mr. Gamgee has an invention the theory of which is, within certain limits sound; but I feel certain that the only conditions under which the machine could work are so difficult of attainment, that it would not be worth while to spend a sixpence in the attempt to get them.

S.
Westminster, April 27th.

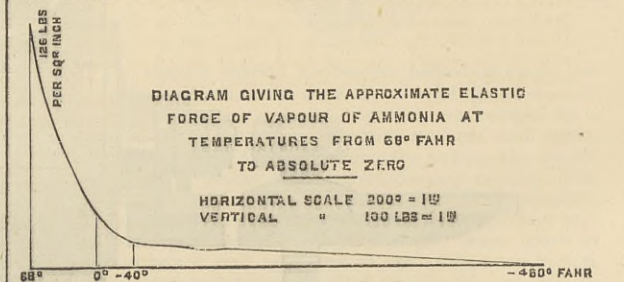
SIR,—Your very able article on this proposed new motor having touched upon a subject in which I am at the present time specially interested, I would feel obliged if you could afford a small space in your valuable journal for some considerations which occur to me in continuation of that article. Though at present we are not furnished with details of the precise method by which it is expected to obtain motive power, yet I think the scheme is sufficiently indicated to warrant us in going at least one step further than was reached by you last week, and to enable us to predict with certainty its complete failure, in so far as it consists of an attempt to produce continuous motive power by the use of ammonia vapour in a closed cycle without rejection of heat.

Whether the conversion from the liquid to the gaseous form, and the energy of pressure, is caused by the acquisition of heat derived from the combustion of fuel, or from the surrounding atmosphere itself, is, of course, of little moment so far as the theory of the process is concerned. What is to be considered is, can ammonia vapour, which behaves in expanding precisely the same as the vapours of other well-known fluids—such as water, ether, &c.—be expanded to the liquid form—if I may use the expression—by the simple abstraction of heat in performing mechanical work?

In the expansion of a vapour, no matter how great the ratio of volume, and no matter what proportion is condensed into liquid during the operation, there must always remain a final volume at a pressure defined by the final temperature. This vapour, though sensibly at the same temperature as the liquid already condensed, still retains its latent heat of vaporisation; and though by large expansion the pressure can be reduced theoretically to an almost imperceptible amount, yet, unless some cooler body be provided capable of acquiring its latent heat, it is quite impossible to convert it again to the liquid form.

If it were practicable to expand ammonia vapour in the manner expected by Professor Gamgee, it would be possible to obtain the same results with water vapour, and we should then be able to get the full thermal value of the fuel in mechanical work, the internal work done on the molecules of water in generating steam being returned during expansion in the shape of useful work given off by the piston. There is no particular virtue in expanding to atmospheric pressure any more than to any other, and the "Zero Motor," if correct in principle, might be worked between temperatures of 68 deg. Fah. and 60 deg. Fah. with the same efficiency as between 68 deg. Fah., and — 40 deg. Fah. The following table gives approximately the elastic force of ammonia vapour at various temperatures:—

Temperature Fah.	Pressure.	Temperature Fah.	Pressure.
40 deg.	15 lb. per sq. inch	22 deg.	47.5 lb. per sq. inch
32 "	15.5 lb. "	32 "	60 lb. "
22 "	17 lb. "	42 "	75 lb. "
12 "	21 lb. "	52 "	92.5 lb. "
0 "	27.5 lb. "	62 "	112.5 lb. "
12 "	37 lb. "	68 "	126 lb. "



The diagram has the varying pressures for vertical ordinates, the horizontal distances representing temperatures. It shows graphically how a given temperature must of necessity, when sufficient liquid is present, induce a definite vapour pressure; so that, even were expansion carried nearly to absolute zero, vapour would still remain, though of course the tension would then be very small.

I have not touched upon the many practical objections to the use of ammonia vapour, as no doubt they will already have presented themselves to the minds of your readers. I may, however, add that it does not seem at all certain that decomposition into its constituent gases would not take place, if the vapour was worked in a closed cycle in contact with metals. The liquid changes into the solid form at 103 deg. below zero Fah.

Dartford Ironworks, Dartford, Kent, T. B. LIGHTFOOT.
April 26th.

SAFETY VALVES.

SIR,—Seeing a good deal of correspondence in your valuable paper on the Adams's safety valve, I think that it will not be out of place for me to give you my little experience of them.

I was second engineer in two different boats running to New York, one being 600-N.H.P., the other 900-N.H.P., the last working up to close 3000-I.H.P., with six double-ended boilers and twelve f Adams's safety valves, each loaded to 80 lb. Now I found that we had a little work to get all these valves properly adjusted, but when once right, they acted, in my opinion, as perfectly as any valves that we have at present afloat. They lifted to a nicety at 80 lb., and shut again at 77 lb., with no signs of any leak about them.

I see in one of your correspondent's letters this week, signed "Chief Engineer," that he complains about the springs getting soft, the valves leaking; also, that when once blown off at 75 lb., that they would not shut until the pressure was reduced to 62 lb. Now I never found all this trouble all the time I was with them—over three years, in which time I put two new springs in only that had softened a little; but I always had the valves well cleaned, springs painted, and gear overhauled once a month, which I think should be done to all safety valves if possible to insure their proper working.

I think that "Chief Engineer" finds fault in the wrong place when he condemns the valves. I think that if he had paid more attention to the water in his boilers, and kept them clean and free from mud, his safety valves would have been free from dirt—which alone kept them from working properly—he would then have had more success with them.

J. H. W.
Saltney, Cheshire, April 27th.

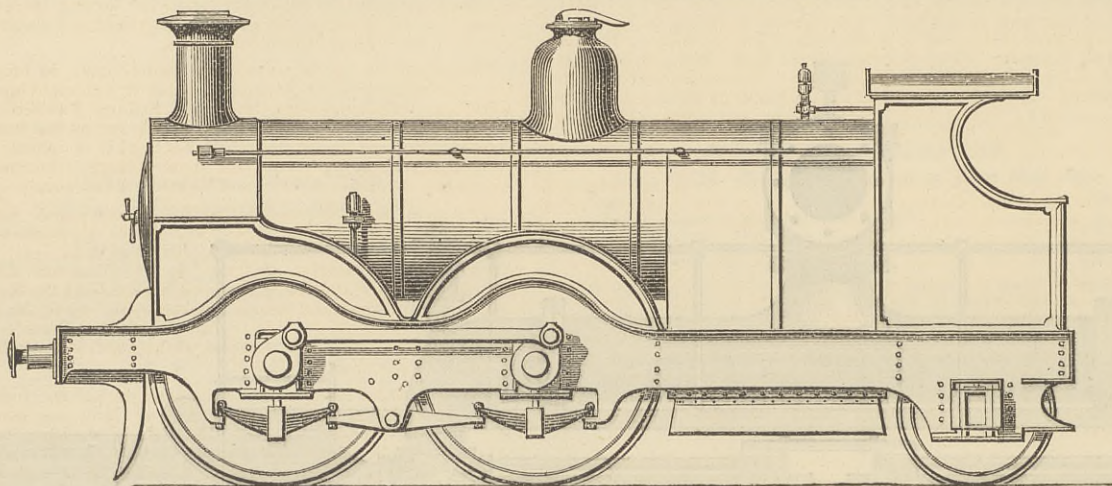


FIG. 1

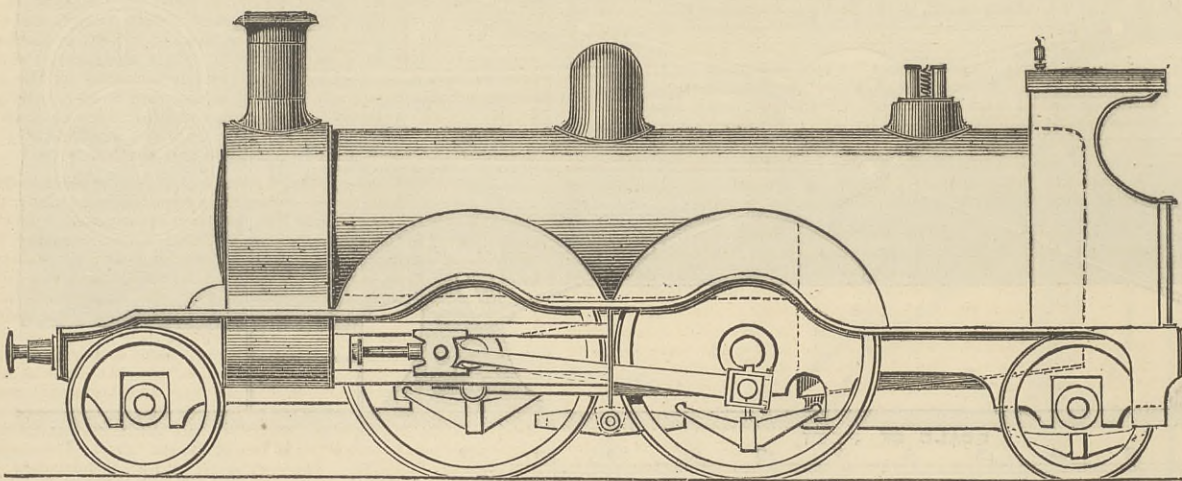


FIG. 2

The driving and trailing axles—I think every one will admit that a single engine is out of the field; the diameter of boiler is limited to 4ft. 4in., and the width of fire-box to 3ft. 6in., so that the coupled wheels would have to be about 10ft. 6in. apart to obtain the requisite grate area. This would be bad for the side rods.

With an arrangement shown by Fig. 1, these difficulties are overcome. The driving wheels are 6ft. 6in. diameter, the leading wheels coupled, inside cylinders 20in. diameter and 22in. stroke, inclined 1 in 8, with the slide valves underneath, the centre line of boiler being 12in. above the top of the driving wheels; the diameter may be 4ft. 6in. inside. Outside bearings to all wheels, and inside to the driving wheels. The inside frames extend from the cylinders to the front of the fire-box, where they are attached to a cross frame extending between the outside frames; the fire-box can thus be made 5ft. 6in. wide inside and 5ft. 6in. long; the grate area being 29 square feet; heating surface of fire-box 140 square feet; 300 tubes 1 1/2 in. external diameter and 11ft. 6in. long; would give 1580 square feet, making a total heating surface of 1720 square feet.

Fig. 2 shows another arrangement with outside cylinders 20in. diameter and 24in. stroke, 7ft. driving wheels coupled in front, inside bearings to all wheels, the leading and trailing wheels having radial axles. There are 200 tubes, 2in. external diameter, 13ft. long, giving about 1300 square feet of heating surface. The inside fire-box is 7ft. long, heating surface 134 square feet, making a total of 1435 square feet; the grate area being 23 square feet.

7th April. E. L. PEARCE.

LIGHTING RAILWAY CARRIAGES.

SIR,—I notice in THE ENGINEER of the 22nd inst., a statement contained in a letter written by Mr. A. S. Bower, of St. Neots,

certain that the latter condition cannot be fulfilled by the expansion of the gas in the performance of work alone, for no matter to what extent expansion is carried, and no matter how great the cold, so long as it does not touch absolute zero, complete condensation cannot take place. There will remain in the cylinder at the end of each stroke liquid ammonia, and gaseous ammonia of a very low tension it is true. The gaseous ammonia represents so much loss, for it must be dealt with in some way. It may be expelled into the atmosphere by the return stroke of the piston, in which case additional quantities of liquid ammonia must be supplied from time to time, and as it is rather expensive this could not prove economical; or it may be discharged into another cylinder and compressed therein, rendered liquid, and returned to the boiler; but this compression will represent a loss of power. What the loss would be in practice it is of course impossible to say, but I may assume that one-tenth of the ammonia remains uncondensed, and it will not be too much to assume further that at least one-fifth of the power of the engine will be required to recondense it. There is, as you have pointed out, some uncertainty as to the pressure at which liquefaction takes place at 62 deg.; probably 120 lb. would suffice, but no difficulty need be anticipated in effecting liquefaction by compression alone. It follows that even the circumstance that complete liquefaction cannot possibly be effected need not prove an insurmountable obstacle in Mr. Gamgee's way. The condensing pump would be nearly analogous to the air pump of a steam engine, which is employed to withdraw vapour that cannot be liquefied for just the same reason that the whole of the ammonia cannot be liquefied.

This is just the point at which Mr. Gamgee has, I understand, arrived. In his ice-making machine he liquefies by expansion in

RAILWAY MATTERS.

THE Government of New South Wales have reduced the cost of carriage for agricultural and dairy produce.

THE work on the Emory-Savona Railway, British Columbia, is being pushed on with all speed. Two thousand white and three thousand Chinese labourers have been engaged by the contractors for the opening season.

THE first section of the Eastern Railway of Western Australia was recently opened for traffic. A loan for £100,000, for the construction of the next section of the line had, at date of last mail, been proposed and well received.

THE report of the directors of the Dunaberg and Witepsk Railway Company, Limited, shows that this company has shared in the general depression which has, during the past year, so materially affected similar undertakings in Russia.

THE railways of New South Wales show a net return for 1880 of half a million, after paying all working expenses. This pays 4½ per cent. on capital invested on all lines now open for traffic. The Albury station, to which the line is now open, is 386 miles from Sydney, and along that route there are 64 stations.

It is reported that the Russian Government will make an experiment in working railways by the State, by taking over the Charkov and Nicolaiev Railway, three-fourths of whose stock it has always owned. Russia has long been a railway proprietor—usually part proprietor—but has not heretofore worked any railroad by Government officials.

THE *Hungarian Post* of the 25th inst. states that the contract for the completion of the whole of the Pesth-Semlin Railway, together with the branch lines, was signed on the 24th at the Ministry of Communications. The cost of the work, 24,000,000 florins, will be covered by the issue of Five per cent. Rente, which will be taken up by the Rothschild group.

THE proposals of the New South Wales Minister of Public Works involve an expenditure of £8,750,000, chiefly upon railways for connecting the northern and southern lines, extending the existing trunk lines, and constructing new railways, the Bills for which are now before the Legislative Assembly, which is, the *Colonies and India* says, generally favourable to the Ministerial proposals.

At a meeting of the Committee for arranging the Stephenson Centenary celebration in June, held at Newcastle-on-Tyne, on Saturday last, the following outline of a programme for the day was agreed upon:—A procession of locomotives of past and present dates, from the Central Station, Newcastle, to Wylam or Street-house, the birth place of Stephenson; a representative procession of all the principal trades and public bodies in the Tyneside district, including the members of the Northumberland and Durham Miners' Association, through the streets of Newcastle to the Town Moor, where a public demonstration will be held; the day's proceedings closing with a banquet in the Assembly Rooms and a display of fireworks in the Leazes-park.

ABOUT 250 tons of bracings, ties, and gussets, to be used in the strengthening of a bridge on the route of the Madras Railway Company, over the Cheyair River, are being made by Messrs. Carter, Ford, and Co., James Bridge Ironworks. The piles are not maintaining their original position in the river, and the bracings are to be thrown between each two columns to give them that support which the engineers find they need. Round the top of the columns, which are 6ft. diameter, belts of iron 2ft. 4½in. deep by ½in. thick are being fastened by gussets to the main girders. The present is the first lot of a larger contract which is expected in connection with the same and some other bridges on the same railway. At the same works two main road bridges for the Grand Junction Canal Company, to be erected on their new branch canal from West Drayton to Slough, are being made.

GENERAL HUTCHINSON, on behalf of the Board of Trade, made an inspection of the Stoke tramway line and plant on Friday last, April 22nd. The chairman, Mr. Beattie, and several members of the board of directors were present; also Mr. Lyman, architect to the company; Mr. Vignolles, engineer; Messrs. Phillips, contractors for the line; and Mr. Henry Merryweather, and Mr. Wardle, on behalf of Messrs. Merryweather and Sons, and Messrs. Manning, Wardle, and Co., the constructors of the engines. The engines tried were two of Merryweather's, with 7½in. cylinders, and two of Manning and Wardle's, with 8½in. cylinders. General Hutchinson walked over the line, and then rode over it on each engine with car attached. The trials were very successfully carried out—especially taking into consideration the exceptionally heavy and continuous gradients, some of which are as severe as 1 in 16, and others 1 in 18 and 1 in 20—the engines doing their work with perfect ease, and without perceptible noise or smoke, and the traffic being in no way interfered with. General Hutchinson expressed himself as being very pleased with both the line and engines, and stated he should be happy to report favourably to the Board of Trade upon the whole, so that the line could at once commence to work.

An offer has been made this week of a slight traffic rate concession to the hardware section of the traders of Birmingham and South Staffordshire by the railway companies. It is a proposal to alter the classification of hollow-ware and hardware generally, whereby, if the manufacturers will themselves undertake "risk," the rate will be reduced some 20 per cent. upon the rate which included risk accepted by carriers. The traders regard the offer very lightly, for it leaves them still in a worse position than they once occupied by the extent of the risk. There is misconception in some quarters about the traffic rates by railway on iron from the Birmingham district to London and the other ports. Those now charged are within the legal maximum. But the ironmasters have cause of complaint of differential charges which are against them in their competition at Liverpool with the ironmasters of Middlesbrough who can get to that port at less than is charged to the South Staffordshire trade, though Wolverhampton is only half the distance it is from Middlesbrough to Liverpool. The ironmasters of North Staffordshire and those also of South Staffordshire have cause of complaint again in the circumstance that it costs 10d. per ton more to bring a ton of mineral from North Staffordshire to South Staffordshire, some forty miles, than it costs to bring minerals from Northampton to South Staffordshire, a distance of seventy miles.

A NUMBER of railway projects is attracting attention in India now that the Government seem disposed to encourage the development of Indian resources by private enterprise, which was so strongly insisted upon in Major Baring's Budget Minute. The first scheme to take this form will probably be the Calcutta, Jessore, and Koolna Railway. Among the terms of the concession will be one, it is believed, requiring the company to complete the railway by 1886, and another guaranteeing 4 per cent. interest while the line is under construction, the money so advanced to be paid out of the first earnings above 4 per cent. Another project is that of a railway westward from Calcutta to join the Central Provinces system and substitute a direct line to Bombay for the present roundabout journey via Allahabad. Three routes are proposed for this line:—The first would start from Calcutta and pass through Midnapore and Sambalpur. This, however, would involve bridging the large rivers Damoodah and Roonparani, and it is more likely that one of the other two schemes now before the Government will be selected. One of these proposes a line to start from the Burrakur Station, on the East Indian Railway, and proceeding westward, via Ranche and through the wild country to the west of Chota Nagpore, to join the Central Provinces State Railway at Bilaspur. The third, and what appears in, says a correspondent of the *Times*, every respect the best plan is to start from Burrakur and to proceed in a south-westerly direction to Raipore, where it would join the State Railway. Among the other advantages a branch could easily be carried to Cuttack, thus opening up the large province of Orissa.

NOTES AND MEMORANDA.

ACCORDING to M. Gruber, the ingestion of borax is found to increase the decomposition of albumen in the animal organism.

CANADA now produces 40,000,000 bushels of wheat, and a total of 170,000,000 bushels of all crops, or about 42½ bushels per inhabitant.

M. ZULKOWSKY proposes to make starch perfectly soluble in water by heating it to 190 deg. Cent. along with glycerine. This process is most successful with potato starch, less so with wheat starch, and very difficult with rice starch.

At the Royal Observatory, Greenwich, the duration of registered bright sunshine in the week ending the 16th inst. was 17'0 hours—against 20'2 hours at Glynde-place, Lewes—the sun being above the horizon during 95'8 hours; the recorded duration of sunshine was, therefore, equal to 18 per cent. of its possible duration.

THE population of Switzerland on the night of November 30th, as given in the official returns, amounted to 2,831,787. In 1870 it amounted to 2,655,001; in 1860, to 2,510,794; in 1850, to 2,390,116. Hence in the first of these three decennial periods—1850-60—the yearly increase was 11,219; in the second, 14,494; in the third, 17,679.

A LEIPSIK journal gives a simple method of toughening glass, which, it asserts, will prevent lamp chimneys, tumblers, and like articles from cracking. The articles are put into a pot filled with cold water, to which some common table salt has been added. The water is well boiled over a fire, and then allowed to cool slowly. When the articles are taken out and washed, they will, so it is said—we have not tried it—be found to resist sudden changes of temperature.

M. BLONDEAU gives the following receipt for purifying and bleaching sponges:—The sponges are first washed in tepid water, and then in a solution of hydrochloric acid—5 cubic centimetres = 0'3 cubic inches, to 1 litre = 1½ pints—which frees the pores from carbonate of lime. To bleach them, they are immersed for twenty-four hours in a solution composed of five parts of hydrochloric acid to 100 of water, with the addition of six pints of hyposulphate of soda. In this way sponges may be bleached more effectually and rapidly than with sulphurous acid.

PARIS is well provided with water, the daily supply averaging 324,000 cubic metres, which for a population of 2,000,000, gives more than 150 litres per head daily. This is divided between the public and private service. The private service consists of: Supply to houses (47,000), 95,000 cubic metres; public establishments, 23,000 cubic metres; fountains, 9000 cubic metres; or a total of 127,000 cubic metres. The public service comprehends: Flooding the sewers and gutters, for which 139,000 cubic metres are required; and watering, requiring 58,000 cubic metres; total, 197,000 cubic metres.

ACCORDING to the Registrar-General's return of births and deaths in London and 19 other large English towns for the week ended April 16th, the annual rate of mortality averaged 22'9 per 1000 of their aggregate population. The rates of mortality in the several towns, ranged in order from the lowest, were as follow: Brighton, 14'8; Leicester, 15'1; Norwich, 18'1; Hull, 19'4; Bristol, 19'7; Plymouth, 20'0; Birmingham, 20'3; Newcastle-on-Tyne, 20'6; Salford, 21'0; Bradford, 22'6; Oldham, 22'7; London, 23'0; Leeds, 23'4; Nottingham, 23'5; Sunderland, 24'1; Manchester 24'5; Sheffield, 24'7; Wolverhampton, 25'8; Liverpool, 27'8; Portsmouth, 28'3.

THE marine department of the Board of Trade specially calls attention to the following conclusions of the Commissioners on the spontaneous combustion of coal:—That with a view to guard against explosion, free and continuous egress to the open air, independently of the hatchways, should be provided for the explosive gases by means of a system of surface ventilation, which would be effective in all circumstances of weather. That the breakage of coal in its transport from the pit to the ship's hold, the shipment of pyritic coal in a wet condition, and especially ventilation through the body of coal cargoes, conduce to spontaneous combustion even though the coal may not be unfit for conveyance on long voyages. That when coal is being carried on long voyages the temperature in the various portions of the cargo should be tested periodically by thermometer and registered in the log.

As the result of a series of experiments with the object of determining the value of a combustible gas by its flame length, Mr. Lewis T. Wright has formulated the following laws:—(1) That the flame length of a combustible gas is proportional to the consumption. (2) That the flame-length is the distance travelled by a gas in obtaining oxygen for its consumption. (3) That the flame lengths of different gases are proportional to the relative amounts of oxygen required for their combustion. The last remains to be proved, and he has been led to experiment on simple gases such as hydrogen, carbonic oxide, and sulphuretted hydrogen, with the object of determining their specific flame lengths; but these gases give flames offering great difficulties in measurement. The flames given by coal gas under suitable and easily obtained conditions offer no difficulty. He has not been able at present to obtain very satisfactory results with the above mentioned three simple gases.

At a meeting of the Royal Society, Edinburgh, March 21, a paper was read by Mr. C. A. Stevenson, B.Sc., on the earthquake of November 28, 1880, in Scotland and Ireland. The main conclusions at which the author arrived were the following:—The centre of the disturbance was at a point some thirteen miles south-west of Fladda, in the continuation of the line of the fault that lies along the great Glen which stretches in a south-westerly direction from Inverness. The disturbance was felt over an area of 19,000 square miles, extending as far east as Blair Athole, as far north as the Butt of Lewis, and as far south as Armagh in Ireland. The undulation was everywhere of an up-and-down character; its breadth was estimated at 1100ft. and its velocity seemed to vary from 3'75 to 7'75 miles per minute, having a mean value of 6'75 over the sea and 4'68 over the land. The accompanying rumbling was not heard at all the stations, and appeared to have been best heard where but little soil covered the hard dense substratum of rock. The disturbance was felt better over the older rocks. Noises were not heard outside a radius of 38 miles from the centre, except in the north of Ireland, where, however, it was suggested that the noise was due to the indirect action of the earthquake in causing a secondary local disturbance.

In the recent edition of Prof. Hull's book on the coal-fields of Great Britain, he observes that the South Wales coal-field is, after that of the Clyde Basin, the largest field in Britain, and contains almost as great a vertical thickness of strata as any coal-field in the world, amounting to upwards of 10,000ft. Of this total depth, only 120ft. are pure coal. "As the lowest coal-bed must have at one time been exposed to air or water for the growth of the plants which formed the coal in their decay, the South Wales coal-field testifies to a subsidence of the earth sufficient to have brought some of the highest Alps to the sea level. The time required for so great a transformation, if gradually accomplished, is estimated by Mr. Hull as 640,000 years. It is only, however, to a depth of 4000ft. that, having regard to the increased heat of the earth as we descend, coal can be won; but, even with this limitation, the supply left in the veins of the district is sufficient to supply consumption at its present rate for 1800 years." It might be asked whether it is absolutely necessary to assume the subsidences such as Prof. Hull refers to, or whether it is not as likely that the process of mountain building continued some time in the Alps after the vegetable growth represented by the early beds of coal; and thus, perhaps, the pushing up to form a mountain has been accompanied by pushing down by orthogonal thrusts to form valleys, and thus the relative change of sea level be only half that assumed by Prof. Hull.

MISCELLANEA.

EACH immigrant landed at Sydney costs the Government from £15 to £16.

WE are informed that the Silicate Paint Company has received the highest award at the Melbourne Exhibition for its class manufactures.

IN a paper recently read before the Society of Arts it was stated that petroleum abounds in South-West Ontario, and is largely distributed over the western peninsula.

THE Anchor Tube Company, Gas-street, Birmingham, is informed that a first-class award has been made at Melbourne for its collection of wrought iron tubes and fittings.

AT the usual fortnightly meeting of the Liverpool Engineering Society on the 13th inst., a paper by Mr. G. C. Thompson "On the Application of Natural Forces to the Production of Motive Power," was read.

THE address of the new Society of German Mechanical Engineers just organised in Berlin, beginning with 140 members, from all parts of Germany, is No. 80, Linden-strasse, Berlin, W. Mr. F. C. Glaser is treasurer.

THE Phosphor Bronze Company, Limited, of Summer-street, Southwark, London, S.E., has been, we are informed, awarded the highest prize, and also a silver medal for the collection of phosphor bronze specimens at the Melbourne Exhibition.

THE Rustless and General Iron Company, Messrs. James E. and Samuel Spencer, 3, Queen-street Place, Cannon-street, have secured a First Prize at the Melbourne Exhibition—the highest award—for their anti-corrodo tubes and fittings, coated by Barff's rustless process.

M. DAUBIGNY, electrical engineer in Paris, has sent to the Municipal Council a petition asking for authority to establish on the top of the Colonne de Juillet a large electric lamp fed by a magneto-electric machine of fifty horse-power. This enormous light is to be diffused by a large reflector of special construction.

THE Cunard steamship *Catalonia*, of about 5000 tons, is expected to be launched in a few weeks, and will be ready for service in the summer. To meet the large and increasing Transatlantic business of the company, contracts have been entered into for the construction of three additional steamships of great size and power, to be delivered early next year.

THE Italian Government has placed with the Leeds firm of machine makers, Messrs. Greenwood and Co., a very extensive order for machinery, which comprises the entire plant of a new factory of arms which has been established by that Government at Terni. The machinery will include apparatus for the manufacture of the Veterey gun, as well as rifles.

THE Wellington Commissioners, Salop, have recently purchased the water supply works of the Wellington Water Company for £12,000, by private treaty, and have instructed Mr. Thos. S. Stooke to prepare the necessary plans for largely increasing the storage on the Wrekin, and an entire system of new mains throughout the town with necessary filter beds.

GREAT efforts, it is stated, are being made to increase the German export trade to Australia, which it is thought has received additional encouragement from the Sydney Exhibition, where German wares were extensively displayed, and as the freight from Hamburg to Sydney is only 25s. per ton, it is hoped that the statistical reports for 1881 will show a marked increase in the Australian demand for articles of German manufacture.

THE usual monthly meeting of the Meteorological Society was held on Wednesday, the 20th inst., at the Institution of Civil Engineers, when the following papers were read:—(1) "On the Frequency and Duration of Rain," by Dr. Wladimir Köppen, of Hamburg; (2) "Results of Experiments made at the Kew Observatory with Bogen's and George's Barometers," by G. M. Whipple, B.Sc., F.R.A.S.; (3) "On a Discussion of Mr. Eaton's Table of the Barometric Height at London with regard to Periodicity," by G. M. Whipple, B.Sc., F.R.A.S.

THE entries for space in the implement yard at the forthcoming show of the Royal Agricultural Society at Derby are now closed, and the result issued. In all, 12,715ft. of shedding have been taken, as against 9781ft. last year at Carlisle, 22,903ft. at Kilburn in 1879, 15,796ft. at Bristol in 1878, 15,556ft. at Liverpool in 1877, and 14,682ft. at Birmingham in 1876. The shedding is divided as follows, as compared with the past two years:—Ordinary shedding, 9138ft. this year, as against 6662ft. in 1880, and 16,000ft. in 1879; machinery in motion, 2102ft., as against 2060ft. in 1880, and 4863ft. in 1879; side shedding, 1511ft., as against 1059ft. at Carlisle last year, and 2220ft. at Kilburn in 1879. Since the London show the price for space has been very considerably increased by the society for the purpose of reducing the size of the yard to more manageable limits. Each exhibitor has been also confined to a maximum space of 150ft., and to the exhibition of only one machine of a kind. When this is remembered, the entries this year are large.

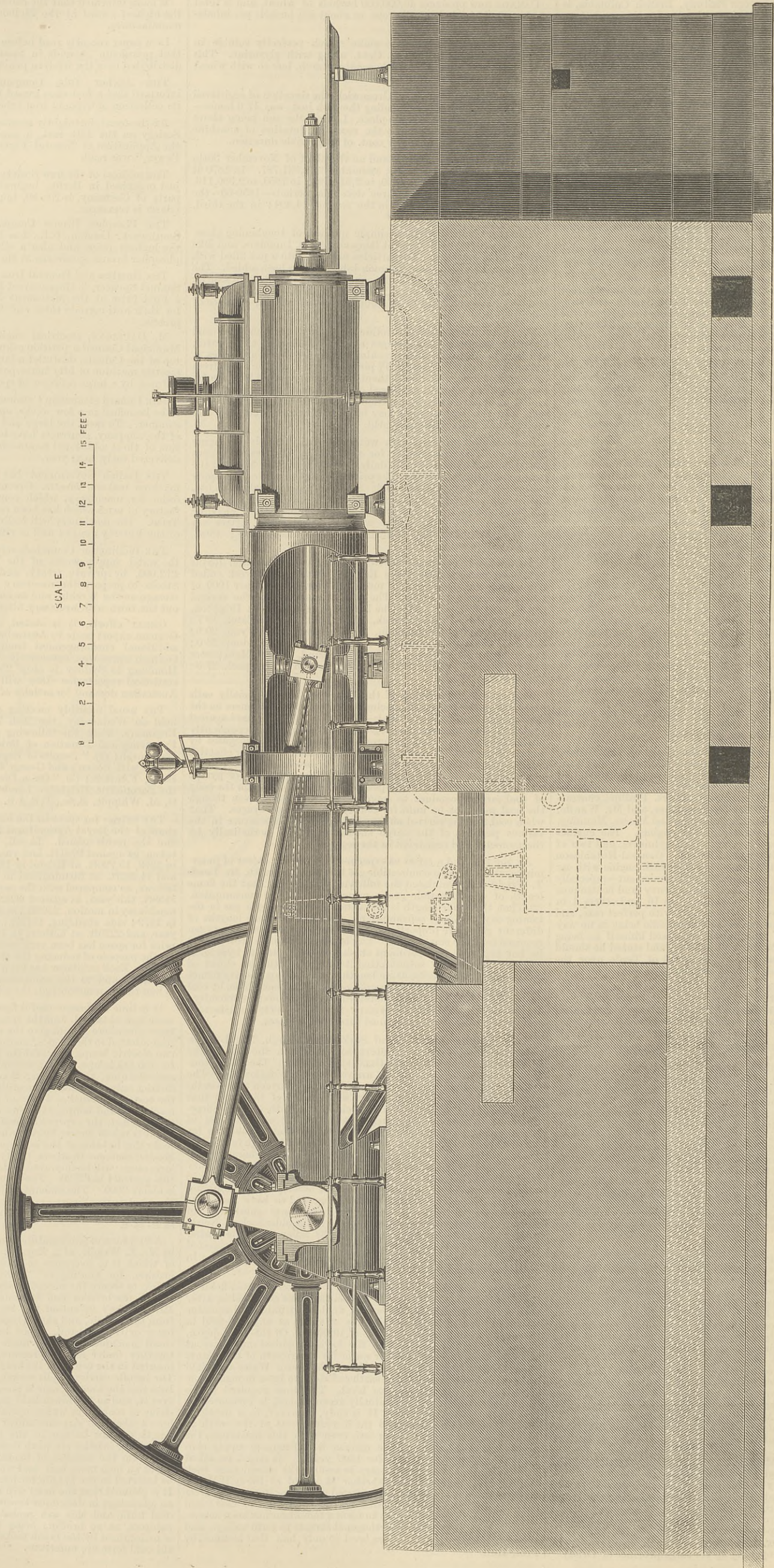
It is time that some useful figures on the cost of electric lighting were now obtained, and the successful experiment in the city and those elsewhere should give the necessary information. In the district allotted to the Anglo-American Electric Light Company, thirty-two electric lamps, at a cost for the year of £1410, are substituted for 150 gas lamps, costing annually about £650, including lighting and cleaning, thus making the cost of the experiment in this district only £700 above the ordinary outlay for gas; but deducting the cost—estimated at £750—of providing and fixing the electric machinery and lamps, and removing the same at the expiration of the contract, the expense as near as possible is the same as for gas, but it is not of course known whether the company would continue to do the lighting at the same price. In the district assigned to Messrs. Siemens Brothers, thirty-two electric lamps—including six large ones—will be employed in lieu of 138 gas lamps. The amount of this contract is £3720. The sum saved by non-consumption of gas is about £600. The amount estimated for providing and removing the electric machinery and lamps at the expiration of the contract is £1450, so that the cost compared with gas is, for one year, about as 16 to 6.

A NEW form of paint and distemper brush and handle has been made by Mr. E. Wright, of 2, Royal Exchange-buildings, E.C., the object of which is to overcome the necessity, experienced with ordinary brushes, for binding or "bridling" the long hairs of a new brush, to secure the necessary stiffness, and to prevent the spreading of the bristles and splashing of the paint. According to Mr. Wright's invention the knot of hair is made up separately from the handle, and the bristles are firmly secured in a narrow brass or copper band, about half-an-inch wide. By means of a small machine or press, made for the purpose, they are bound together under severe pressure, a metal core or centre being inserted in the centre of the knot, so that the hairs cannot get loose. The handle carries a split socket, made of thin pressed sheet brass. Into this the knot of hair is inserted, and a gripping ring is pushed over it, and so the brush held tightly. It requires no bridling of string or soaking in water, operations alone costing a painter one hour's labour, or sixpence added to the expense of the brush. The length of hair in use in the new brush can be regulated with ease as the bristles are worn down. There is more elasticity in the hair from the absence of bridling. The painter gets the use of about an inch more hair, and when it is worn out a new knot can be inserted in the handle for less than the cost of a common brush. It is claimed that the hairs will not come out, which is particularly an advantage in distemper brushes. The brush is made also in an oval form, and this will probably be most highly appreciated by painters, as no bridling being used, the oval form of the brush is maintained by the brush socket, and the practical advantages of the oval form are numerous.

CORLISS MILL ENGINE, 1000 INDICATED HORSE POWER.

CONSTRUCTED BY MESSRS. HICK, HARGREAVES AND CO., ENGINEERS, BOLTON, FOR MESSRS. DANIEL ILLINGWORTH AND SONS, WHEATLEY SPINNING MILLS, BRADFORD.

(For description see page 309.)



FOREIGN AGENTS FOR THE SALE OF THE ENGINEER.

PARIS.—Madame BOYVEAU, Rue de la Banque.
BERLIN.—ASHER and Co., 5, Unter den Linden.
VIENNA.—Messrs. GEROLD and Co., Booksellers.
LEIPZIG.—A. TWIETMEYER, Bookseller.
NEW YORK.—THE WILLMER and ROGERS NEWS COMPANY, 31, Beekman-Street.

TO CORRESPONDENTS.

** In order to avoid trouble and confusion, we find it necessary to inform correspondents that letters of inquiry addressed to the public, and intended for insertion in this column, must, in all cases, be accompanied by a large envelope legibly directed by the writer to himself, and bearing a 2d. postage stamp, in order that answers received by us may be forwarded to their destination. No notice will be taken of communications which do not comply with these instructions.
** We cannot undertake to return drawings or manuscripts; we must therefore request correspondents to keep copies.
** All letters intended for insertion in THE ENGINEER, or containing questions, must be accompanied by the name and address of the writer, not necessarily for publication, but as a proof of good faith. No notice whatever will be taken of anonymous communications.

L. L. (Southsea).—Have not found it yet. Next week.
G. W. W.—A book by S. Hellyer is published by Mr. Batsford, Holborn.
X.—We know no more of the material at present than is contained in the paragraph referred to.
J. F. (St. Rollox).—It is quite impossible to make anything out of the absurd description which you have quoted. No such log sawing machine as that which you construct from it has been made in America to the knowledge of the London representative of one of the largest American makers of heavy wood-working machinery.
TITTON.—The interposition of a feed-water heater between the condenser and the engine will not injure the vacuum unless the heater tubes leak air. If your belt is already as wide as it ought to be, then you must use two to take off the increased power. But one belt will be best, and you may use a belt 3/4" wide if it is properly made. Perhaps your present belt will be found large enough on trial.

ETCHING IN STEEL.

(To the Editor of The Engineer.)

Sir,—I should be much obliged if any of your correspondents could kindly tell me by what process etching can be done on steel. What I wish to do is to put maker's names on steel articles; and to paint each article separately with Brunswick black and then eat with acid, would take too long and be too expensive. I should therefore be glad to know of any cheap and easy method.
A. R.
Edinburgh, April 26th.

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

MEETINGS NEXT WEEK.

THE INSTITUTION OF CIVIL ENGINEERS.—Tuesday, May 3rd, at 8 p.m.: Paper to be discussed, "The Relative Value of Upland and Tidal Waters in Producing Scour," by Mr. Walter R. Browne, M. Inst. C.E.

SOCIETY OF ENGINEERS.—Monday, May 2nd, at 7.30 p.m.: A paper will be read on "Floating Docks—the Depositing Dock, and the Double Power Dock," by Mr. John Standfield, the leading features of which are as follows:—Varying conditions under which docks are required. Special feature of the depositing dock. Method of working. Depositing vessels on fixed staging along the shore. Advantages of the system. Special feature of the double power dock. Method of working. Its self-docking powers, not possessed by any other form of dock. Advantages.

THE IRON AND STEEL INSTITUTE.—The Institution will meet at 10 a.m. on Wednesday, Thursday, and Friday, the 4th, 5th, and 6th of May, in the hall of the Institution of Civil Engineers, Westminster. The following papers, or a selection of them, will be read and discussed:—"On the Results of Experiments Relative to Corrosion in Iron and Steel," by Mr. William Parker, of Lloyd's Registry, London. "On the Manufacture of Armour Plates," by Mr. Alexander Wilson, of Sheffield. "On the Manufacture of Steel and Steel Plates in Russia," by Mr. Sergius Kern, St. Petersburg. "On the Use of Steel for Shipbuilding," by Mr. William Denny, Dumbarton. "On some Physical Properties of Cast Iron," by Mr. Charles Markham, Stavoley. "On the Desulphurisation of Iron," by M. Rollet, St. Chamond, France. "On Iron and Steel Permanent Way," by Mr. R. Price Williams, London. "On Hydraulic Appliances for the Bessemer Process," by Mr. Michael Scott, London. "On the Manufacture of Bessemer Steel and Steel Rails in America," by Captain Jones, Edgar Thomson Steel Works, Pittsburg, U.S.A. "On a New Form of Bessemer Crane," by Mr. Thos. Wrightson, Stockton-on-Tees.

CHEMICAL SOCIETY.—Thursday, May 5th, at 8 p.m.: Ballot for the election of Fellows. "On the Action of Humic Acid on Atmospheric Nitrogen," by Mr. E. W. Prevost. "On the Active and Inactive Amylamines," by Mr. R. T. Plimpton. "On the Products of the Action of Alkalies on Ethyl-β-Ethylaceto Succinate," by Mr. L. D. Thorne. "On the Action of Sodium Alcohols on Fumaric Ether," by Mr. T. Purdie.

SOCIETY OF ARTS.—Monday, May 2nd, at 8 p.m.: Cantor Lectures, "The Art of Lace-making," by Mr. Alan S. Cole. Lecture III.—Frings. Twisted thread-work in England in the fifteenth century. Early designs for plaited and twisted threads. Italian, Flemish, French, and English pillow lace. Laces of primitive design. Wednesday, May 4th, at 8 p.m.: Ordinary meeting, "Buying and Selling; its Nature and its Tools," by Professor Bonamy Price, M.A. Lord Alfred S. Churchill will preside.

THE ENGINEER.

APRIL 29, 1881.

ENGINEERS IN THE NAVY.

In dealing with the Navy Estimates for the present financial year, we spoke freely and fully concerning the position of engineers in ships of war. It will be remem-

bered that in the debate which followed Mr. Trevelyan's statement, Sir Edward Reed and others, advocated the claims of the naval engineers to higher pay and a better position, and pointed out that the working of the present system was not satisfactory, and that a radical change might be introduced with advantage. Our contemporary the Pall Mall Gazette, using what we said as a text, but going somewhat beyond it, published an article sharply criticising the modern naval engineer. The Hampshire Telegraph, which has long and ably advocated the claims of these officers, re-published in its own columns the Pall Mall Gazette article. Thereupon certain naval engineers have, it seems, fallen foul of the Hampshire Telegraph, and rated it soundly for venturing to insert the Pall Mall Gazette article without condemning it. The Hampshire Telegraph immediately published a leader—which will be found in its impression for April the 16th—in which it excuses itself and passes on the blame to us. "The engineers themselves," says our contemporary, "should be the last to deprecate the most searching criticism, and just as that criticism is weak or unjust, the stronger should be their ground of satisfaction. If nothing more discouraging to them can be brought forward than the rhetorical rakings of THE ENGINEER, then the battle is half won already." The words "rakings" in the preceding passage is probably a misprint for "ravings." "Rhetorical ravings" is a good phrase, and more forcible than "rhetorical rakings," which is perhaps a thought too vague to be impressive. We are quite content to take all the responsibility of writing an article which has indirectly got a respectable journal into trouble, and we do not think our contemporary has done anything for which it need apologise to the naval engineers.

When summed up, what does all we have said amount to? This, that engineers in the Navy are dissatisfied with their pay and their position, and that the younger men are so far from being competent or willing to discharge the duties of engineers, that each ship has to carry a large staff of engine-room artificers mainly if not altogether to do work which would otherwise be left undone. If this statement be not true it admits of contradiction, and our correspondence columns are open for the publication of that contradiction. We asserted besides that many engineers in the Navy wore kid gloves in the engine-room, and thought more of keeping their uniforms clean than of anything else when they were there; and dozens of engineers in the Navy—the older men, be it observed—will admit that this statement is quite true in the spirit if not in the letter. We repeat here that the whole system now adopted of supplying the Navy with engineers is defective, and that sooner or later it will cause a great deal of trouble, and not improbably disaster. We have not space—nor would any good purpose be served if we had—to go over old ground and repeating fully the story of the Naval engineers from the beginning; but we may summarise its phases. When marine engines were first put into war-ships they were only auxiliary, and they were regarded by seamen, not without justice, as an unmitigated nuisance. They spoiled the sailing of a ship, and they gave her instead, the power of crawling about the sea at 5 knots an hour in a calm. The men in charge of the engines were not "officers and gentlemen"—they were just hard-working, competent artisans, mostly from Scotland; and it is only doing them justice to say that they always kept their machinery and boilers in good order, although they were much vexed and harassed by captains and first lieutenants. As matters progressed, however, the engine-room became more and more important, and a superior class of men began to find their way into it; they began to ask for more pay than their predecessors had, and they got it, and a higher social position and they got that; but they did not get just what they wanted. The naval engineer will insist on looking on his business as a profession, and it is nothing of the kind. We have written to advocate the claims of the naval engineer. We have pointed out that successive Governments placed him in a false position. They made an officer of him, but they did not give him money enough to support his rank; and the naval officers could not meet him on terms of social equality. We said that being an officer he ought to have more pay; but we urged that, as regards the last point, the Government could do nothing. The engineers must work their own way up to the required social status. We believed that the system of having officers in the engine-room would be found to work fairly well after a time; and that as captains began to recognise the importance of the functions of the machinery on board the ships they commanded, they would get on better with the engineers. Unfortunately what we hoped for did not come to pass; the engineers as a class remained very discontented, making continual appeals for justice to Parliament and the country. Two courses were open to the Government; the one was at once to reduce the management of marine engines and boilers in the Navy to its proper place; to pension off the larger number of the malcontents, and to put on board in their stead men who could and would work, and could put forward no claims to be regarded as officers and gentlemen. Each ship would then carry one superintendent engineer, who would be a man of education, an officer and a gentleman; under him would be a certain number of foremen, or "watch engineers," and the responsible head of each watch would draw high pay and enjoy certain privileges. These watch engineers must be good workmen, and under them would be an efficient staff of hands, competent to drive a marine engine, and make such repairs and adjustments as can be done without the aid of a factory. The plan adopted by the Government was to regard the care of marine engines as a profession, and to put men into it who would have education enough to take the same social position as a captain. But very few people looked on the work to be done as professional work. Men of education, refinement, and high engineering attainments did not crowd into the Navy. In one word, the Government could not get the men it wanted. Then it undertook to educate the rising generation to suit; hence the Naval Engineers' Training College. But a good many men, not quite up to the

Government standard, did enter the Navy, quite prepared to take the Admiralty at their word, and regard their position as professional. It has been found practically impossible to get over this difficulty in any way save one—namely, the appointment of engine-room artificers, and these men do the work while the engineers look on. When the new and highly-trained men come out of college and go on board ship the same plan will have to be retained; and instead of each ship carrying a crew of artificers, "watch engineers," and a superintending engineer over all, who would fill a position akin to that of a locomotive superintendent in some respects, she will carry a crew of artificers, and half-a-dozen or more superintending engineers, who will be just as dissatisfied with their position as the present generation, only for a different reason. These men, if they have brains and a good education, will find in a very short period that they are wasting their lives and their opportunities. There is absolutely no opening for the display of talent or ability in the engine-room of a man-of-war; and the pay will always be small and the chances of promotion still smaller.

A great deal of ignorance exists as to the nature of the work done by the naval engineer. While ashore in harbour, he has little to do save keep his engines clean. This is done by the artificers and stokers; engineers do not clean engines. When under steam, little or nothing has to be performed save attending to lubrication. This is done by special hands—"greasers," or by the artificers, or even, as we have known in some ships, by stokers—not by engineers. In port, after a voyage, adjustments have to be made—brasses let together, for example. This is done by the artificers. Boilers have to be cleaned; that is done by the stokers. Glands have to be packed; artificers' work again. In a word, nothing but purely mechanical duties have to be executed by any one; and the sending to sea in our ships of war of men highly educated in theory is a great mistake, as will be found out some day. The most thorough knowledge of thermodynamics will not enable a man so to let brasses together that the bearing will not heat. Nothing that he can learn in the way of mathematics will teach a man how to replace a broken propeller with a new one. It is argued that theoretical education will not prevent a man from acquiring handicraft skill. This may be true, but it is more than probable that it is not true; and that a student who spends much time over his books will not be a good workman. But let us take it for granted that it is quite true. What then? The object of the Government seems to be to get their work well done in the first place, and in the second to make the engineers in the Navy contented. Now, we assert without hesitation that the more highly they are educated the less contented they will be. The duties to be performed are to the last degree uncongenial to a studious or an energetic and able man. There is no opening, no scope, for the exercise of his acquired brain power; and the remuneration he will receive will be quite incommensurate with his education.

If in saying all this we vex naval engineers, we regret the fact; but we have in this matter nothing whatever to do with individuals. We speak only of a class. Unless the nature of the duties to be performed on board a ship could be entirely altered, engineering in the Navy cannot become a profession. To put men highly trained in theory or even in general practice into an engine-room is like putting a racer to draw a sand cart. A false estimate has been attached to the value of the work done by the naval engineer, and it has wrought a great deal of harm. There is this wide difference between the position of an engineer in the mercantile marine and in the Navy, that the former always has possibilities before him, while the man in the Navy has none. A young engineer in the mercantile marine, who is well educated, of good address, competent, and energetic, is certain sooner or later, if he has a little interest, to get something to do on shore very much better than he has had at sea. For example, there are superintending engineerships to be filled now and then worth from £300 to as much as £2000 a year. He feels that his theoretical education may at any moment be of use to him, for he cannot tell when he will be called upon to design machines; and he has much to stimulate him to do his best. The naval engineer, on the contrary, must have the pleasant consciousness that if he were to live to the age of three score years and ten he would never be called on to design a pair of marine engines, and that to all intents and purposes his education has been wasted. In the mercantile marine a man has chances; in the Navy he has none. Nominally there are a few berths open which are worth having; but by the time the engineer sees a prospect of becoming superintendent of machinery in a dockyard let us say, he will have forgotten all the theory he ever learned. Finally, it may be urged, that what we have said of naval engineers in general would apply to the superintending engineer of whom we have spoken in particular; but it would not. These gentlemen ought to be men of high attainments. With steam machinery operating continually under their eyes, they would have enormous opportunities of observation. They could detect faults and weaknesses, and would be competent to make suggestions and prepare designs and specifications not only of screw engines, but all kinds of machinery. The ventilation of ships, the working of guns, and a hundred other matters would all come under their notice, and could all be pondered and dealt with to advantage by a good intellect, thoroughly well trained. There is no work analogous to this done on board our men-of-war now, nor is it possible that it can be done while the existing system remains in operation.

BRIGHTON BEACH.

SINCE our last article on this subject was in print we have obtained particulars of the works in progress. The importance of these works, as relating to one of the most difficult questions with which engineers in their varied experiences have to deal, will justify our fuller reference to them. As we remarked in our last

article, there is such an element of uncertainty as to the action of tidal currents and their effect upon foreshores, that it almost precludes decisive action in the attempt to withstand their effects; and no subject probably has more exercised the ingenuity of engineers than the best method of dealing with travelling beach. The extraordinary accumulation on the Chesil Bank between the mainland and Portland has long been a subject of discussion; and the reasons why such accumulations become so localised for many years, and then, without apparent cause, suddenly disappear and commence re-formation on a different part of the coast, have long baffled all inquiry. On no coast-line of which we have information have such changes been more often repeated than on the southern shores of our own country. That they have been so is doubtless due to the peculiar circumstances of the situation. A channel commencing, as the English Channel does, in the narrow opening between Dover and Calais, and gradually widening until its full debouchment into the Atlantic, naturally gives rise to an almost infinite variety of currents producing constant changes; these being multiplied almost indefinitely by the number of combinations resulting from shifts of wind during the alternation of tides. That the authorities of the different towns situated on the south coast have therefore ever since their foundation been actively engaged in staying the inroads of the sea upon their frontage can be no matter of surprise; and those of Brighton possessing a more extended line of foreshore than any other town similarly situated have been placed in a position of great difficulty. That they have battled so successfully with it as they hitherto have done, says much for their activity and the quality of the advice upon which they have acted. Old residents in the town can recollect the time when no road at all—practicable for wheel traffic—fronted between Middle-street and West street, and the fine drive which now extends for nearly three miles in front of the town has bit by bit been won from the sea. For many years prior to the commencement of defensive works the water had had the mastery, and the old fishing village of the middle of the last century had been gradually disappearing. Even now, at low water there can be distinguished the remains of an ancient fort which stood in front of Brill's baths, and it was not until about twenty years ago, we think, that the road in front of the old circular bath, which then encroached upon the frontage of the town, was made passable for vehicular traffic during the high winds which then drove the sea completely across the road at that point. It must be fully sixty years, we should say, since the government of the town took in hand the imposing sea wall which defends the Marine Parade; and ever since the success of that work became established the town has been yearly adding similar works of defence to its sea frontage. The instance of Brighton is therefore one which we may well cite as affording a case illustrative of the subject under our consideration; and recent circumstances affecting it make it one well worthy the fullest consideration by engineers, and the more so because, as we have so repeatedly pointed out, they demonstrate the necessity of Imperial control to establish a concurrent system of working.

Details furnished by the *Brighton Herald* will enable us more fully than we have hitherto done to lay before our readers the character of the works now in progress from Mr. Ellice-Clark's design and under his supervision. We mentioned in our last article on this subject that it appeared to us that the new groynes now under construction were to be laid at an angle with the shore, so as to avoid the tendency to cutting out the beach on their lee-side. We now learn that that angle has been fixed at 80 deg. in an easterly direction from the shore line. We pointed out when first discussing the proposal so to construct them, that this deflection might possibly fail to retain the travelling beach, as a return wash might be created along the weather face of the groynes and carry the beach with it. We have recently learned, however—though no mention of the fact appears in the article in the *Brighton Herald* to which we have referred—that it is Mr. Ellice-Clark's intention to construct a curved head to these groynes. This, we should say, would have the effect of stopping the return wash, and would cause an extensive lodgment of beach along the weather face. But although we consider such a result to be probable, we are by no means disposed to depart from the proposition we put forward that it might be desirable to stay the two easternmost groynes at the existing normal line and level of the beach. Even although we have been given to understand that it is not proposed to carry these groynes very far beyond it, we hold that, as nothing could be lost by stopping them as we propose, and much might be gained, it would be desirable to follow such a plan by way of experiment; for we consider that were it successful it would do much to prevent the injury we foresee in the future to the Brighton section of the beach. It is precisely in the control of such matters that we perceive the desirability of legislative interference. Having only their immediate interest to consider, the Hove authorities look only to the accumulation of shingle on their own foreshore. An imperial dictum could say that the plan we have suggested should and must be followed, for it would sacrifice no interest and might preserve one.

The two groynes now in course of being built will, be each about 280ft. in length, having a width at their base of 15ft. 9in., and an average top width of 5ft. 3in. The concrete blocks, of which about 30,000 will be required, will weigh from 2 cwt. to 3 cwt. each. These are moulded to form segments of an arch, which it is presumed will give much greater resisting power. We confess that we do not see that this result will be obtained. The power of such works to resist the force of wave action is mainly, indeed almost entirely, dependent upon weight. The arch form given to the mass can have no effect unless it has an abutment upon which to deliver its thrust, and the proposed method of construction constitutes simply an arch within itself without any such abutment. If the force of wave impact were always in a descending direc-

tion, the arch form might distribute thrust; but much of the destructive force of the sea is due to the tendency to reaction in an upward direction. We have before alluded to the plan adopted of dowelling or keying the blocks together by cement dowels, and this appears to be a judicious provision; but at the same time the number of these blocks and the tendency to disruption might, we think, have been greatly reduced, had the blocks employed, instead of weighing only two or three hundredweight, been of two or three tons each. With the modern machinery so readily available for moving heavy weights, the latter could be placed in position quite as easily as the smaller ones. The facing blocks are composed of five parts of shingle, one part of cement, and two of sand, and the hearting blocks of twelve parts of shingle and one of cement. Sea water has alone been used to incorporate the shingle and cement, and Mr. Ellice-Clark has directed that the minimum of water shall be used, his theory being, in the words of the *Brighton Herald*, "That, as the whole of the water must evaporate in time, the greater the bulk of water used the less solid must the masonry be when the process of evaporation has ceased; and so small, in fact, is the quantity of water used, that the concrete before it is poured into the moulds has not sufficient moisture to hold the component parts together, but they adhere and harden as they dry." It will be of interest to learn how far this course proves to be successful. In our own experience with cement work when salt water has been used we have found it impossible to prevent extensive efflorescence of the salt, which has continued for many months after work with it has been completed. Then, again, every engineer practised in concrete work knows that the most perfect system of incorporation employed does not prevent some admixture of air. It was this cause which largely led to the abandonment of the high "tip" in laying concrete foundations. Air was taken into the material during the shoot and locked in by the fall, and it was found preferable to gently deposit the material and hand stir it thoroughly when laying to set free any air mixed with it. Now, the process of only using enough water to "set free" the cement multiplies, in our opinion, the chance of air being largely mixed with the cement; and if this remain in in any quantity, it will give rise to decomposition of the salt within the work tending to the decay of the cement, and at all events will greatly retard its thorough hardening.

Great care appears to have been exercised in the obtaining Portland cement of the best quality; this is being supplied by Messrs. Bazley, White, and Co., from their Mersey Works. A sample taken from it, after having been allowed to dry upon a floor for fourteen days, is required to pass through perforations numbering 6000 to the square inch, leaving a residue of only 20 per cent. Its weight is fixed at 112 lb. to the imperial bushel, and the tensile strain it has to bear is 420 lb. to the square inch. Preparatory to the test, a figure 8 is cast in a gun-metal mould, the crossing section of the figures being exactly 1in. square. This is placed in water for six days, and after being allowed one day for drying, is then tested, the weight on the machine being gradually added by the employment of single buckshot until the full strain is attained. Some of the sections tested, although of the same cement, yielded at a far lower strain than others, and below the minimum fixed, causing the rejection of the whole consignment. The cause was ascertained to be the different temperature of the atmosphere when the cement was mixed. The *Brighton Herald* states that "the strongest cement which had been supplied was the weakest when mixed at a low temperature; and, consequently, the state of the atmosphere is now added as a column to the register kept of the works in progress." It occurs to us that it would not be difficult, if the facts be as are above stated, to mix the cement within a building kept at the temperature which may have been found to yield the best results; for it is undoubtedly of importance that the strength of the cement should be as uniformly preserved throughout the work as is possible. Unless this be so, should after-failure occur in any portion of it, it will be difficult to decide whether it arose from insufficient strength in design at the point of such failure or from weakness in the local material. The contract for these groynes have been taken by Messrs. Cheesman and Co., of Brighton, at £2200 each, so that we were not far out in our estimate of their cost, which we put at about £2000 each. We find that the dangers we mentioned as arising from land springs below the beach have been foreseen, and that they have proved more abundant in volume than had been anticipated, so that the contractors have had heavy pumping work to overcome them. Mr. Ellice-Clark, in order to get his foundations below their influence, had estimated a depth of 27ft. below the esplanade level at which he could get his footings on to the chalk below the beach; but it is stated that as yet shingle only had been met with. We are in a state of uncertainty, therefore, as to whether the works, as far as they have progressed, are founded on rock or on shingle. Of course to bed such works on sand when it is exposed to the action of moving water would be a fatal error, though there can be no better foundation than sand in dry situations; but we scarcely think good large shingle would be open to the same objections, always supposing it to be so placed that it could not possibly be exposed to percussive wave action. We even hold that were such shingle treated with a grouting of liquid cement and well punned, it might prove to be as good a foundation as the rock or chalk itself for the inshore end of the works.

We must conclude by a reference to a statement made by the *Brighton Herald* that THE ENGINEER made an attack upon the authorities of Brighton and Hove. In treating of a subject of such wide-spread interest as the defence of our foreshore, it would be impossible to refrain from comment upon what we deem to be an improper policy, which, selfish in its action, is affording a dangerous precedent in all similar instances. But while we have done so, we have not failed to point out that we considered such action to have been almost enforced by the culpable neglect of the Imperial Government to provide for such cases. We think, how-

ever, that in spite of the absence of Imperial supervision and control, it would have been the wiser and more correct course if the authorities of two towns which are, owing to their contiguity, practically one, had called in advice which should have been independent of any particular local interest, and which might have recommended some system of concurrent working which should have preserved the interests of both towns.

RAILWAY COAL RATES.

THE Corporation of Middlesbrough has taken a very practical step in the direction of obtaining redress for alleged excessive charges for the carriage of household coals in its district. It has obtained from several collieries in the Durham coalfield statements of the actual charges for the conveyance of coal for household and manufacturing purposes to several towns on the North-Eastern Railway; and without giving all the figures, it may be said that when these charges are divided by the distance in miles to the respective towns, there are some singular discrepancies to be found. For instance, coal carried from a colliery near Ferry Hill is charged over twopence per ton per mile to Middlesbrough, whilst the charge is only a fraction more than a halfpenny per ton per mile; the charge for coal for gas-making purposes being only about half the former of these two rates. Again, coal for household purposes is charged about three-fifths of a penny per ton per mile from an Auckland colliery to Hull, whilst the charge from the same colliery to West Hartlepool is three halfpence per ton per mile. For a little over twenty-six miles to West Hartlepool, 3s. 3½d. per ton is charged for carriage, whilst for the seventy-four miles of the distance to Hull after twenty-six are taken from it, the charge is only 1s. 8½d. Of course in making these charges it needs to be borne in mind that for the longer distance a lower mileage charge may be profitable, and in regard to the charge for manufacturing coals it must be assumed that the quantities needed are larger than are those for household purposes; but even when these facts are borne in mind it must be acknowledged that there is an apparent disparity; and it is notable that the disparity is remarkably in favour of the town of Hull, which has been charging the railway company concerned—the North-Eastern—with having imposed heavy charges on it, and with favouring ports in Durham. It does not seem that in the matter of the charges for household coal that this is the case, however; indeed the facts prove the very opposite. But it is evident that where there are discrepancies such as those of which the above are examples, the whole scale of charges on railways needs revision, and that by the companies themselves in their own interest. It cannot be expected that the charges in this country should be as low as in countries like the United States, where the cost of railway construction is so much less; but it is evident that there is need in some instances for reduced charges to make things equal, and that these reductions should be made at once. The policy of the railway companies should be to develop all the trades, and this can be best done by low charges. It is possible that in the cases referred to the inequalities may have arisen from the fact that the North-Eastern system is an amalgamation of lines; that these lines had in some instances varying rates of carriage charges; and that the variations may have continued after the amalgamation. But it is evident that when the separate parts are all welded into one company, the charges should be in harmony one with another; and it may be that in the future Parliament may make it a feature of amalgamation Acts that the lowest of the charges of the companies to be united shall apply to the whole.

CHESTERFIELD AND THE STEPHENSON CENTENARY.

CHESTERFIELD, "the City of the Crooked Spire," has the honour of being the burying-ground of George Stephenson, the great engineer. Its people are not slow to remind the world of the fact, and they have perpetuated his memory in a Stephenson Memorial Hall, which is practically beneficial for the inhabitants who are fond of seeing themselves in public meeting assembled. As the centenary of Stephenson is on the 9th of June, the Chesterfield folks are anxious to do something to mark the occasion. A public meeting, presided over by the mayor, was accordingly held, and it is rather interesting to notice what a modern Town Council—as represented by its mayor and members—regards as "respecting the memory of the great man." A fair idea is obtained by the specific proposals made at the meeting. The mayor was exceedingly sorry the attendance was not large. "As they had met, however, he thought they might discuss the subject." Strange he had no particular scheme of his own to offer; a variety of suggestions had been made to him. It had been suggested that a special service should be held at Trinity Church, where Stephenson was buried; that *immortelles* be placed on his grave; and that the church should remain open during the day, so that all persons visiting Chesterfield might be able to visit the grave of the great engineer. A gala for the young people had also been thought of, as well as the characteristically English idea of a dinner, the mayor cautiously adding that they might join for dining purposes with the engineers. Alderman Wood thought "it would be very disrespectful of the town where his remains now lie, if they allowed the opportunity to pass unnoticed," and he moved a resolution "to celebrate," which was carried. Alderman Wood suggested that Mr. Markham—the shrewd head of the Staveley Company—who occupies the house and grounds where Stephenson lived so long, might open the grounds that day to the public, and the worthy alderman gently suggested a straightforward scheme, which would be the most practical plan of all, to clear off the debt on the Stephenson Memorial Hall. Councillor Higginbottom had only to remind the meeting that the debt amounted to £4000, to have that suggestion instantaneously shelved. Ultimately everybody approved of what the mayor and Alderman Wood suggested—barring the debt idea—and a committee was appointed to carry out details. The mayor, responding to a vote of thanks, said he had the honour of a personal acquaintance with Stephenson when he was at Chesterfield, both when he lived at Wingerworth and Tapton. He—the mayor—had spent many pleasant evenings with him, and found him a most genial man. "He could amuse himself with a child as well as with a philosopher." And if he was here to-day he could no doubt amuse himself uncommonly well with the Chesterfield Town Council, and its public meetings. Chesterfield does its best to make itself a show-place over Stephenson, but for one man who asks to look at the grave of the great engineer, which can be looked at without trouble, a hundred struggle to see that architectural abortion, the twisted spire.

THE SUGGESTED NATIONAL SLIDING SCALE FOR MINERS.

THE national Conference of miners' representatives which was held last week at Birmingham having decided to adopt a sliding scale as the best means of preventing strikes and lock-outs, it may not be without interest to note that it was stated at the Conference alluded to, which represented about 195,000 miners,

that at the present time there are about 180,000 miners working in mines on regulations of some kind or scale; but many of them, it was stated, are so dissatisfied with their working, that they are about to give notice to have things put on a different basis. The North of England miners being amongst the number, it was resolved that all the associations or bodies of men which are bound by a sliding scale should forward a copy of such scale and the regulations attached to it to Mr. Macdonald, M.P., with a view to his suggesting the basis of some scale or method of payment which would be more satisfactory to the miners employed. Another resolution was agreed to, to the effect that the Conference thought that accountants ought not to be bound to secrecy, but should be allowed to give some details to the representatives of the men, to show and convince them that the work had been satisfactorily got through.

LITERATURE.

Lessons in Elementary Mechanics, Introductory to the Study of Physical Science. Designed for the Use of Schools and of Candidates for the London Matriculation and other Examinations, with Numerous Exercises. By PHILIP MAGNUS, B.Sc., B.A. Seventh edition, enlarged. Longmans, Green, and Co. London: 1881.

MR. MAGNUS differs from many writers on mechanics in that he endeavours, for the most part successfully, to make what he has to say quite easily understood. Old treatises on mechanics dealt solely with what were known as the mechanical powers, such as the lever, the pulley, and the inclined plane; but the modern writer on mechanics is bound to deal with the theory of the forces involved in the operation of mechanical laws. His range is enlarged, and he has to treat of subjects which are in many ways perplexing, in such a manner that he shall enlighten instead of confusing the student. This is no easy task; and just at present it is very difficult indeed to write a good and small treatise on mechanics. We say just at present, because the minds of those who teach science are apparently in a transition state. Much that has been hitherto taught dogmatically is now put forward with hesitation. The fact that motion is but a relative term, and that there is no such thing as rest, begins to be recognised. The idea involved in the phrase "potential energy" is being gradually rejected; and the truth that there are agencies at work which play an important part in the earth's economy, although they are in a sense extrinsic, begins to be taught in somewhat an intelligible form. It is possible that before the present century has passed away, books will have been written in which the meanings of such words as force, energy, and work, will be clearly and accurately set forth; but just now the man who ventures to write of these things as he thinks of them, is but too likely to be called heterodox. Mr. Magnus has succeeded very fairly in steering a middle course; and without adopting any views new or startling, he has not failed in making some things, heretofore puzzling to the student, very plain. We may cite as an example his method of dealing with motion. In his introduction he first, in simple language, calls attention to the apparent phenomena of motion. Having done this, he insists on the universality of motion, and goes on, "We thus see that bodies themselves and their molecules are constantly in motion or tending to move; that absolute rest nowhere exists; and that what we call rest, which is really rest relatively to us, can be analysed into counteracted tendencies to motion. As motion is thus universally present, we are sensible of what it is without being able to define it. It does not admit of explanation, for there is no condition in which matter exists that is simpler or more elementary." We might take some exception to the words "tending to move," but our author has in another place, where he uses them, explained that he is not dealing with the causes supposed to produce the movements indicated or the tendencies named. This is to say, that he uses the phrase in a conventional sense for convenience, and with this limitation there can be no objection to it. Mr. Magnus is, we think, the first writer of books like that before us who has had the courage to refuse to give a definition of motion. We are all sensible of it, he points out, but none can explain what it is; "for there is no condition in which matter exists that is simpler or more elementary." These are pregnant words, and deserve to be graven on the mind of the student. Although we cannot define what motion is—for to say that when a body goes from one place to another it moves, is no explanation at all—it is quite certain that on it the universe depends for its existence. According to the theory which disputes the existence of matter, motion is everything, and if motion ceased, there would be nothing. On the theory which admits the existence of matter, without motion all matter would become inert, dead. At absolute zero, for instance, we should have neither gases nor liquids; chemical affinities would cease to exist; life would be unknown; change would cease to take place. In writing this we assume, of course, that all motion would cease as well as that of heat. This is not strictly true, for it is quite possible that extinct suns are now moving in space, although their temperature may be that of absolute zero. We have no cause, however, to conclude that the temperature of space is absolute zero, or -461 deg., and there is good reason to think that it is higher. But this is beside the question. To the world as it exists motion is everything, and we pay Mr. Magnus almost as high a compliment as we can pay him when we say that he deals with motion in a very straightforward, intelligible way; and that writing, as he does, for students who are to be supposed to know little or nothing about it, he has employed illustrations of his meaning which, if not always novel, are at all events well used, apt, and sufficient for their purpose.

So far, we have dealt only with our author's introduction. It is in introductions to such works that we find the main clue to the writer's thoughts. The body of the book must be made up of more or less cut-and-dry matter. Thus, for example, we have in this volume:—"Motion may be uniform or variable. When uniform, equal spaces are described in equal times and the velocity is constant. In variable motion the velocity constantly changes. In

measuring velocity certain units of time and space are adopted. The unit of time is everywhere one second; the unit of length is one foot in England, but is different in different countries." Much the same thing has been written a hundred times before, and the most that it is possible to say of Mr. Magnus's way of writing it, and much more of the same sort, is that he uses simple, readily understood language. A large portion of the book is devoted to statements of mechanical and physical laws, and, on the whole, we can speak of these statements and the illustrations and explanations which accompany them with unqualified praise.

We regret to see that Mr. Magnus has not been able to keep himself quite clear of the vice common to nearly all writers on mechanics up to a recent date. He will insist on regarding energy as an entity apart from motion. Thus he writes:—"But matter is not deprived of energy even when at rest. There exists in so-called inert matter a tendency to put forth energy, and this energy is called potential energy." Now this statement cannot be too strongly contradicted. The words "potential energy" have long since been given up by every competent writer on the subjects of motion and energy, and in their stead we have Thomson's "Energy of Position," which is not quite the same thing. There does not exist a single scrap of evidence to prove that energy can have existence apart from motion. The old illustration of the bullet projected upwards, parting with its kinetic energy, and acquiring instead potential energy, is used of course. It is high time that such things were cleared out of our text-books. No one knows what gravity is, but there is excellent reason to believe that it is in itself a mode of motion, like all other so-called forces. The work done in lifting a stone, or projecting a bullet upwards, is done on gravity and not on the bullet, which is as inert in the matter as is the piston in a steam cylinder. It is not necessary to attempt to define the cause of gravity. We may teach the student that the kinetic energy expended in lifting a weight modifies gravity in some way consistent with the laws of the conservation of energy; and that gravity can give back this energy again when the stone falls. But to assert that there is intrinsic energy in the bullet when it is 1000ft. above the surface of the earth which was not in it when it was on the ground, is simply absurd—just as absurd, in fact, as the old statement that nature abhorred a vacuum.

We are pleased to find that, unlike some writers, Mr. Magnus recognises the truth that there is no true loss of energy, although kinetic energy apparently disappears, when two bodies come into contact under certain conditions. "If we suppose two bodies, the masses of which are 10lb. and 4lb., to be moving in the same direction with velocities of 8ft. and 15ft. respectively, then kinetic energy before impact is $\frac{10 \times 8^2 + 4 \times 15^2}{2 \times 32} = 24 \frac{1}{2}$, while after impact it is $\frac{10 + 4}{64} \times 10^2 = 21 \frac{1}{4}$, while 10 is the

common velocity after impact. Thus there is an apparent loss of kinetic energy. If the two bodies are moving in opposite directions, or if an inelastic body in motion strike a similar body at rest, there will be a still greater loss of kinetic energy. In all these cases, however, the energy that is lost by impact reappears in the heat generated by the blow." This supports the general theorem that it is impossible for any interaction of a system of moving bodies to either increase or diminish the energy of that system. In other words, the quantity of motion in the system must remain the same, no matter what takes place, until additional motion is withdrawn from the system or imparted to it by some extrinsic agency, the kinetic energy, apparently lost, under certain conditions being merely transformed into some other mode of motion, such as heat.

But Mr. Magnus is seldom content with making one statement which is accurately true without supplementing it by another, which is extremely doubtful. Thus, for example, he tells us again the old, and we had believed exploded myth, that the sun's energy converted into coal and stored up there for thousands of millions of years, is ready to be re-developed at any moment we please to burn that coal. As a matter of fact, the energy represented by the coal is small. The work done during combustion is not due to the coal, but mainly to the energy of the oxygen gas which combines with the carbon, and which has its molecular motion converted into heat motion. Precisely how this occurs no one knows, but that it does occur is apparently quite certain.

We have devoted a great deal of space to a very small book, because we regard small books of this kind as playing a very important part indeed in the teaching of physical science. Mr. Magnus has done his work so thoroughly well for the most part, that it is peculiarly aggravating that he should have in two or three instances seemingly lost all grasp of the tendency of modern thought, and repeated statements which, however common in books written twenty years ago, are now seldom met with. The sun and coal myth, for example, we thought was dead and buried long since. A book which has reached seven editions is pretty certain to reach an eighth. May we hope that in that eighth edition Mr. Magnus will bring up his work to the latest development of thought on physical science, and that he will wholly and bravely strike off the remainder of the chains from which he is manifestly willing to get free.

A STEAMSHIP REGISTER.—We have received from Messrs. Pile and Co., shipbuilders, &c., of Great St. Helens, a copy of their register of steamers for sale. This is a thick pamphlet, very full of useful information, and entirely unlike anything of the kind ever published before, in that it is very fully illustrated by lithographs, the drawings being for the most part longitudinal sections of ships. Many of these are folding plates. They save a great deal of description, and give an intending purchaser an accurate idea at once of what Messrs. Pile have to sell. The register is likely to prove specially interesting to yachtsmen, as it contains many illustrations of steam pleasure craft, and drawings of these show their internal arrangement very clearly. The whole pamphlet is exceedingly creditable to Messrs. Pile,

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

(From our own Correspondent.)

TO-DAY a slightly better tone pervaded the Birmingham Iron Trade 'Change, and that of Wolverhampton yesterday—Wednesday—than has characterised either market for the last few weeks. Men of prolonged experience expressed their conviction that the prices of iron have touched the lowest they are likely to reach for some time to come; and there was a little more disposition to invest money in iron and steel.

Partially manufactured steel was in favour by capitalists. One sale has just been effected of Landore blooms to an ironmaster here to the value of £15,000. A large portion of the metal may or may not have to be met again in the market by the Landore Company, according to circumstances as yet undeveloped.

Yesterday it became known that the Horsley Engineering Company, Tipton, has secured a contract for constructive work which will need 7000 tons in all of raw and rolled iron, including a good proportion of plates of dimensions some of which the ironmasters of Staffordshire have not hitherto produced in quantities.

Numerous offers to buy sheets were made to-day and yesterday by consumers of tank, of working-up sheets, and of galvanising and corrugating sheets. But the offers were at prices which makers could rarely accept. Few galvanisers would give more than £9 for lattens, at which they could not be bought. Inferior singles for working up were to be had at under £7, but galvanising singles alone were hard to buy at less than £7 10s. down to £7 5s. Doubles were often procurable at £8 for galvanising.

The galvanisers are in receipt of good orders, mainly from South America, and there was a class of galvanised corrugated roofing sheets made here which changed hands in Birmingham and Wolverhampton at £13, in bundles, of 24 w.g., delivered in Liverpool.

Plates are in better demand, but quotations, though slightly stronger upon the week, yet are low. Boiler plates keep in slow request. Offers for "Monmoor" sorts were refused yesterday at anything under £8 10s., and £8 was the minimum for "Wright" qualities.

A circular from the Earl of Dudley shows his lordship's new prices to be:—Flats, rounds, squares, half-rounds, ovals, convex and bevelled iron: lowest quality, £7 12s. 6d.; single best, £9; double best, £10 10s.; treble best, £12 10s. Rivet iron; single best, £10; double best, £11 10s.; treble best, £13 10s. Angle iron: lowest quality, £8 2s. 6d.; single best, £9 10s.; double best, £11; treble best, £13. T-iron: lowest quality, £8 12s. 6d.; single best, £10; double best, £11 10s.; treble best, £13 10s. Strips and hoops, 14 to 19 w.g., lowest quality, £8 2s. 6d.; single best, £9 10s.; double best, £11; treble best, £13; 20 w.g., 3in., lowest quality, £9 2s. 6d.; single best, £10 10s.; double best, £12; treble best, £14; 20 w.g., 3in., lowest quality, £10 2s. 6d.; single best, £11 10s.; double best, £13; treble best, £15.

To-day inquiries were renewed for hoops for baling in United States. Good tin-plates are in brisk request; and there are makers who are booked well ahead.

The pig trade keeps quiet; most consumers of forge kinds have good stocks, and are not buying, yet rates are kept up. They are generally from 1s. 3d. to 2s. 6d. higher, as to the less valuable sorts than they were this time last year. Yesterday and to-day there was a disposition to buy excellent hematite iron, and there were several offers to take 500 ton lots, if the vendors would accept £3 5s. for Tredegars. The offers were promptly rejected. Makers declined to consider any offer under £3 7s. 6d., and they reported a growing demand for their Bessemer qualities. Ordinary foundry iron was in a little better demand.

Coke was plentiful at, for washed descriptions of both Derbyshire and South Wales, 15s. per ton. Less money would not be accepted for other than unwashed kinds.

Coal was abundant at from 6s. 3d. to 7s. for forge, and 7s. to 8s. for furnace kinds. The pits are rarely busy.

As had been expected, the chairman of the Iron Trade Wages Board for Staffordshire and the Midlands—the Mayor of Birmingham—has decided that the ironworkers have no claim to the 6d. per ton higher wages which they sought at the last arbitration; but he has ordered that there shall be a minimum wage. This Mr. Chamberlain has fixed at 7s. 3d. per ton for puddling.

A good deal of machinery is leaving the Birmingham district, including ice-making machinery for the meat-carrying trade, and machinery for aerated water.

The striking growth in the demand for bicycles and tricycles is encouraging a much wider adoption of machinery this season than ever before, which is causing a good influx of orders to the shops where such machinery is turned out.

The increased amount of work which is being done at the local engineering shops and yards is, together with a spurt in the demand from other engineering districts, having a beneficial effect upon the business of general machine tool makers, causing a good demand for drilling machines, and lathes, chucks, presses, &c.

This week a valuable contract has been placed in Wolverhampton by the Admiralty, for the supply of shipping tackle.

The only first award of the Melbourne Exhibition jury for bellows, portable forges, iron hearths, and smiths' tools, has been secured by Messrs. Wm. Allday and Sons, of the Branstons-street Works, Birmingham.

NOTES FROM LANCASHIRE.

(From our own Correspondent.)

Manchester.—The probability of any material improvement in the iron trade of this district seems to be quite as remote as ever, and so far as the prospective requirements for raw material are concerned the very small amount of new work at present coming into the hands of consumers of iron does not afford much ground for encouragement. The iron market during the week has again been extremely flat, and buyers who have placed out inquiries appear to be holding back, in the hope of securing better terms than those now offered. A few sales have been reported, but these have been chiefly where sellers, anxious to realise, have been willing to book up to the end of the year at very low figures. Nominally, quoted rates are without alteration, but where prices are really tested by actual business decided weakness is evident, and any change that can be noted in the market is in the direction of an increased depression of values.

Lancashire makers of pig iron are still delivering a good deal of iron from their works on account of old contracts, but they report very few new orders coming in, and, as they have already got considerable stocks on hand, they are not very firm in prices where business can be done. The average prices now asked for delivery into the Manchester district, are 4s. for No. 4 forge, and 4s. for No. 3 foundry, less 2½ per cent. For Lincolnshire and Derbyshire brands, delivered into this district, about the same prices are asked, but I hear that iron is offered by needy holders at considerably under these figures. For Middlesbrough g.m.b.'s delivered equal to Manchester, about 46s. 4d. per ton, net cash, has been quoted during the past few days by merchants in this market.

For finished iron there is but a limited inquiry, and although one or two of the large local works are still kept busy on old orders, generally manufacturers are short of specifications, and to secure new business, concessions on late rates are necessary. For delivery into the Manchester district the average prices are about £5 12s. 6d. to £5 15s. for bars; £6 7s. 6d. to £6 12s. 6d. for hoops; £6 15s. for common plates; and about £7 10s. to £7 12s. 6d. for common sheets.

In the coal trade a falling off in the demand for round coals is generally reported throughout Lancashire, the requirements for house fire coals being less in consequence of the warmer weather, whilst common round coals are a drug in consequence of the

absence of demand for ironmaking and other manufacturing purposes. An easier tone is noticeable in prices, which at the pit mouth average about 8s. 6d. to 9s. for good house coals; 6s. 9d. to 7s. 6d. for seconds, and almost any price from 5s. upwards for the common classes of round coal. Engine fuel is steady in view of the probable scarcity of slack during the summer, and there is a tendency towards stiffness in this class of fuel. Burgy at the pit ranges from 4s. 6d. to 5s., and good slack from 4s. to 4s. 9d. per ton.

My notice last week of Messrs. Whitworth's new works at Openshaw may be followed this week by a brief description of another new engineering establishment, which is in course of construction on an extensive scale in this district. A short time back, the old works of Messrs. Collier and Co., the well-known tool makers of Manchester, were purchased by the London and North-Western Railway Company for the purpose of carrying out extensions on their line, and the above firm have now nearly completed the erection of new works, which lie in the very heart of Manchester.

As the speciality of Messrs. Collier's establishment is the manufacture of exceptionally heavy tools, this necessitates nearly the whole of their operations being carried out on the ground floor, and the chief portion of their new works consists of a large erecting shop, divided into four bays, measuring respectively 180ft. by 37ft., 200ft. by 50ft., 180ft. by 35ft., and 180ft. by 35ft. The three first bays or shops are devoted to heavy tools, and are fitted up with powerful travelling cranes, including three 15-ton and one 30-ton cranes, whilst there are about thirty massive planing machines, one of which has a bed 80ft. long, to plane 9ft. square. These machines are so arranged as to allow the greatest possible working room, the beds being set well back from the lines traversed by the cranes, and the tables only allowed to run underneath the crane, so that a continuous wide clear space can be secured when necessary. The fourth bay is occupied by the small machine shop, and in galleries above one portion of the building are the stores and the pattern shop, with light tools and machinery for wood-cutting. The smithy, as a precaution against fire, is placed outside and apart from the main building.

When I visited Messrs. Collier's Works they were in active operation, and there seemed to be no lack of orders in hand. The tools chiefly turned out by the firm belong to the heavy class employed in locomotive work and for marine engine building, and at the time of my visit there was in hand a large locomotive frame combined slotting and drilling machine, with three slotting heads and three drills, the bed being 33ft. long, 6ft. 6in. wide, and the whole weighing about fifty tons. This machine is being constructed to completely drill and slot the plates at one setting. There was also a number of duplex wheel lathes of specially strong construction, some of which had two and others four tool posts. Lathes, planing machines, and general tools of various kinds were also in hand, but these need no special mention.

One other item of interest which I may mention with regard to Messrs. Collier's new works is, that the firm are putting down special plant for manufacturing twist drills, and are thus laying themselves out for a branch of tool-making which English firms have hitherto, for some unaccountable reason, left to a very large extent in the hands of the Americans.

During the past week I came across a new tool for locomotive work, which is, perhaps, worth mentioning. Messrs. Kendall and Gent, tool makers, of Manchester, since taking over some time back the business of Messrs. Shaw, and Co., of Openshaw, have directed their attention more particularly to special tools for this description of work, and they are now just completing a special slotting machine for locomotive reversing shafts. In this machine the reversing shaft, with forged solid levers, is fixed and finished on the table at one setting.

The "long-wall" system of working mines was again under discussion at the meeting of the Manchester Geological Society on Tuesday, and one or two points which cropped up may be of interest. It was not claimed that the system could be worked more cheaply than other methods—in fact, it was admitted that in some cases it might cost more, but Mr. Lupton, one of the members, offered some very pertinent observations with regard to its superiority, as a safe method of working. If they took into consideration the question of liability to explosion, he thought there was abundant evidence to prove that long-wall wherever it could be adopted was much safer than pillar and stall. One great advantage of long-wall was that roads were maintained through the "goaf," there being no part of the mine which was not crossed and re-crossed by a series of air currents, so that there could not be an explosion in a long wall mine unless the negligence of the managers was excessive. Where, however, they left an unventilated goaf in a fiery mine they were sure to have a huge gas-holder which would be certain to destroy the pit in the event of an explosion. In some districts they found pits worked on the pillar and stall system, and headings driven into unexplored seams containing a vast amount of gas faster than the air current could be kept up to ventilate the cutting, and it was no wonder that a pit should explode under such a method of working. Then, as to firing shots, this dangerous practice in mining was rendered almost unnecessary in the long-wall system. Mr. Phillips also pointed out that shot firing in long-wall was reduced to a minimum, and said he could mention several collieries where a shot per month in blasting down coal was an exception, but where under any other system blasting on a large scale would be the rule. One great advantage of long-wall was that the source of gas generation was always exposed to the air current.

Barrow.—There is not much change to report in connection with the iron and steel trades of this district. A very fair business is being done, and inquiries are very well maintained, both from home and continental merchants. Deliveries are very heavy, and during the past few weeks there have been large shipments to the Continent, while on home account large parcels have been despatched. The American trade, which at one time promised to be very active this year, has not yet shown much vigour. It is known that large shipments have to be made to America, and that considerable parcels have already been made up, but up to the present the shipments in this direction have been small. Preparations are, however, being made for a heavy delivery, and several steamships have already been chartered for the purpose. I hear expressions of surprise all round that trade should be so good, and yet prices are so low, but, on the other hand, it seems to me that it is because prices are low that hematite is finding so good a market. It is evident that so long as this description of metal can be bought at a low price, comparatively speaking, there will be a good demand for it all round, and especially so for steel making purposes. There is nothing new in engineering to note, except that the date for launching the steamer, *City of Rome*, has been fixed for June 14th.

THE SHEFFIELD DISTRICT.

(From our own Correspondent.)

NEARLY 60,000 tons more coal reached London by rail last quarter than were forwarded during the corresponding period of last year; but in the local press it is pertinently pointed out that the Yorkshire collieries have not benefitted by the increase. The Masbro' Hall Collieries, which for nearly four years have been closed, are stated to be in a fair way of being re-opened. The water difficulty is said to have been got over by a shaft sunk at a lower level, and this, it is said, has induced Messrs. E. and J. Wells and Co., Limited, to contemplate re-opening the workings.

Another effort is being made to secure the amalgamation of the South and West Yorkshire Miners' Association. At a conference held in Barnsley, a committee was appointed to work out the details of amalgamation, and make the necessary arrangements for completing the federation. Barnsley will be the head-quarters of the combined body.

A serious item of news is the rejection of the sliding scale by Messrs. Newton, Chambers, and Co.'s workmen. Delegates repre-

senting the miners employed at the Thorncliffe, Tankersley, Rockingham and other pits have resolved rather to forfeit a recent advance of 5 per cent. rather than adopt the sliding scale. As the employers gave this advance on the understanding that the sliding scale arrangement would be carried out, they have now withdrawn it. This decision affects upwards of 1000 men.

Messrs. Turton Bros. and Matthews, steel file and spring makers, have been informed that the jurors' recommendation at Melbourne of a first award in respect of their exhibits has been confirmed by the Commissioners, who have also awarded the firm a gold medal for special merit. Messrs. Yates, Haywood, and Co., and the Rotherham Foundry Co., Limited, have succeeded for their stove plates, &c., in securing a first award at the Melbourne Exhibition, as they also did at Sydney. Messrs. Samuel Laycock and Sons, manufacturers of hair seating and curled hair, Sheffield, have also received advice that they have gained a first-class award for their exhibit at Melbourne.

The Sheffield Electro-Plating Company forwarded on Monday night to Hughenden Manor a silver casket, which was intended to be placed between the inner and outer coffins. The casket contained a recent likeness of the Earl of Beaconsfield. It is void of ornamentation, weighs 2 lb., and is 7in. high and 7in. wide. It was sent to the company to have the lid soldered, and that the casket might be silver-plated, and afterwards receive a heavy coating of nickel silver for preservation. On the lid was the following inscription:—"This casket contains a recent likeness of the late Right Hon. the Earl of Beaconsfield, April, 1881."

THE NORTH OF ENGLAND.

(From our own Correspondent.)

DEPRESSION was again the order of the day at the Cleveland iron market held at Middlesbrough on Tuesday. A week before those interested persuaded themselves that things were a little better, and firmness, and even an advance of 3d. per ton on pig iron was reported. This was, however, subsequently found to be merely a piece of self-deception. The advance was abandoned, and prices sank back to their previous level. The value of g.m.b. pig iron may now be considered to be 38s. per ton f.o.t., at maker's works, not only for prompt but even for delivery deferred to the end of the year. Warrants are one shilling more and forge quality one shilling less. The fact that merchants, at all events, are now willing to sell at present prices for several months ahead is portentous, as indicating that in the opinion of those best able to judge there is no prospect of a rise for some time to come.

Conna's stores have been increased during the week by 2263 tons, and now contain a total of 166,963 tons. At Glasgow the stock has attained to 548,798 tons. The shipments for the week from the Tees are 18,826 tons, which is not quite equal to the average of last month. As a proof of the general dullness of trade it may be mentioned that steamers which have made voyages to the Baltic are now actually returning in some cases in ballast. Such a thing has scarcely been known for years, as corn, hemp, tallow, timber, or potatoes were, hitherto, always to be had as freights.

The manufactured iron trade is decidedly steady. The returns for the quarter ending March 31st have been issued by Mr. Waterhouse. They show a slight fall in the average price realised as compared with the previous quarter, but not sufficient to bring about a reduction in wages, which still remain 7½ per cent. above the minimum of the year 1869. Two-thirds of the whole produce of the district consists of plates; only 2 per cent. rails, and the rest bars and angles. Since the stoppage of the Imperial Works the supply of manufactured iron in the northern district seems to be as nearly as possible equal to the demand, and therefore previous prices, although low, are maintained.

The shipyards are all in full swing, and gradually working down the stocks which had accumulated during the winter. There is also considerable demand for manufactured iron for bridge building purposes. The extremely absurd tests frequently specified stand seriously in the way of business. The effect of unreasonable tests is just the reverse of what those who are responsible for them intend. Instead of excluding all but the best and most reliable manufacturers, they exclude these and no others. Those firms who have the best reputation can always fill their books without running excessive risks; whilst new beginners, needy sellers, and those who do not understand what they are making themselves liable for, are usually ready to undertake anything which they are told by buyers they ought to be able to execute. "Fools rush in where angels fear to tread." Plates are now £6 2s. 6d. to £6 5s.; angles, £5 7s. 6d.; and bars, £5 10s.; f.o.t. Middlesbrough puddled bars may be had at £3 10s., and old rails at a shilling more. Coals are rather tending downwards, and in all probability will be sold ere long at as low price as ever.

The fifth meeting of the session was held on Monday evening at the Cleveland Institution of Engineers. An interesting paper was read by Mr. James Young, of Fencehouses, upon "Compressed Air Locomotive Engines for Underground Haulage." The president, Mr. E. W. Richards, occupied the chair. Mr. Young first described the various means of hauling wagons underground usually adopted, and then went on to consider his own improved system. Above ground he has a large compressing engine pumping into an air tank, whence pipes lead down the shaft and along the principal wagon ways. At intervals there are filling nozzles. He had seventeen or eighteen locomotives in the pit. These were simply cylindrical air tanks mounted upon four wheels, and furnished with a pair of cylinders and other usual working gear. The tank could be filled at the nozzles as often as required, and then was capable of pulling a considerable load for a considerable distance. The cost was stated to be 1½d. per ton per mile. In the discussion the paper was reviewed very favourably, the extreme simplicity of Mr. Young's engine being much commented on. The discussion was adjourned till the next meeting, when a paper will be read by Colonel Beaumont on his application of the same principle.

NOTES FROM SCOTLAND.

(From our own Correspondent.)

TAKING an average of years, it will be admitted that there is a fair amount of business being done in the iron trade, although it does not contrast favourably with that of twelve months ago, when large shipments were being despatched to the United States. Just now purchases of pig iron are, to a much greater extent than has been usual of late, designed for immediate consumption. Even at the moderate prices which now prevail, buyers cannot be got to accept iron in any quantity for storing, and this is particularly true of the foreign trade. By some this is attributed to an impression that prices will recede still further, and by others to the fact that over purchasing last year has turned out so unprofitable a business that those who engaged in it have learned by experience to be cautious. No doubt much may be said in support of either view, and it may be safe to add that the large stocks render consumers pretty certain of not being surprised by a sudden advance in rates, while the margin of profit is so small that they are in a manner compelled to work from hand-to-mouth. Those best acquainted with the pig iron trade in Glasgow affirm that the present lifeless condition of the market is likely to continue until one of two things happens, either a decline in prices, or a considerable reduction in the output. It is estimated that during the month of March about 30,000 tons more pig iron were made in Scotland than were disposed of, and although the quantity unsold in April has undoubtedly been less, stocks are increasing at a rate that appears quite without precedent in the history of the trade.

Business was done in the warrant market on Friday morning at 47s. 10d. to 47s. 7d. cash, and 47s. 10½d. to 47s. 8½d. one month, the afternoon quotations being 47s. 8d. and 47s. 9d. cash, and 47s. 9d. to 47s. 9½d. one month. On Monday the market was dull,

with business in the forenoon at 47s. 6d. to 47s. 7d. cash, and 47s. 8d. one month; and the prices in the afternoon were 47s. 7d. cash and 47s. 8d. one month. The market was a shade firmer on Tuesday, when transactions were effected at 47s. 6d. cash and 47s. 7½d. one month to 47s. 9½ cash and 47s. 10d. one month. Business was done on Monday at 47s. 9d. to 47s. 8d. cash, and 47s. 8½d. fourteen days. To-day—Thursday—the market was firm with a fair business up to 47s. 10d. cash, and 47s. 11½d. one month.

Makers' irons are quoted at the following rates f.o.b.:—Gartsherrie, No. 1, 58s.; No. 3, 50s.; Coltness, 58s. and 50s.; Langloan, 58s. 6d. and 50s.; Summerlee, 57s. and 49s. 6d.; Calder, 58s. and 50s.; Carnbroe, 54s. 6d. and 49s.; Clyde, 49s. 6d. and 47s.; Monkland, Quarter, and Govan, 49s. and 47s. each; Shotts, at Leith, 58s. 6d. and 51s.; Carron, at Grangemouth, 52s. 6d.—specially selected, 56s.—and 51s. 6d.; Kinneil, at Bo'ness, 48s. 6d. and 46s. 6d.; Glengarnock at Ardrrossan, 54s. 6d. and 49s. 6d.; Eglinton, 49s. and 47s.; Dalmellington, 49s. and 47s.

There is rather less doing in the foundries, but few complaints are heard regarding the condition of the manufactured iron trades generally.

A rather better coasting trade was done in coals in the course of the past week, but the foreign exports have fallen off to the extent of about 13,000 tons. But if we take the coasting and export trades together, they contrast favourably with those of the corresponding month of last year. Still there are great complaints from the different colliery districts as to want of employment. In the eastern mining districts trade is becoming livelier at the ports, especially those of Fife, where numerous cargoes are being loaded. The inland trade generally lacks vitality, except that steam coals are in good demand for consumption at home, as well as for shipment.

About 800 ship joiners have come out on strike in Glasgow for an advance of ½d. per hour. Their employers offered them ¾d. Many joiners are at present idle, owing to the backward state of the house-building trade.

WALES AND ADJOINING COUNTIES.

(From our own Correspondent.)

BRISK work has already begun on the Newport, Caerphilly, and Pontypridd Railway. The census returns show a great falling off in some of the largest colliery and iron districts as compared with the population of ten years ago, but if it had been taken three years ago the decrease would have been still greater. There is no doubt that of late the increase and improvement have been marked. The Rhondda Valley is expected to show a population of 40,000, or almost double that of the former census. Mr. Beith, who succeeded so admirably in the sinking of the Harris Deep Navigation Colliery, has been equally fortunate at the Tredegar pits, touching upon the celebrated Elluel vein a few days ago.

Some years ago the shaft was sunk, and a determined effort made to reach the coal, but unsuccessfully. A large number of colliery horses are to be dispersed by auction next week, owing to the exhaustion of the house coal seams of the Powell Gellygaer Company. The coal clearances from Cardiff last week to foreign ports amounted to 110,000 tons, those from Swansea 16,000 tons, and from Newport, Mon., 13,416 tons only. The exports of iron and steel from the whole district came to 5163 tons. Both trades are in a brisk state. As regards the coal trade, prices are quite as strong as they were last week, and may be said to be neither better nor any the worse than they have been for the last few weeks. Coalowners still find it difficult to conclude business without slight reductions, especially for secondary qualities. At Cardiff docks the business last week was very heavy, 48,000 tons being despatched on two days only. A large railway trade is being effected to between South Wales, Manchester, Birmingham, and Birkenhead, and it speaks well for railway management that the same coal wagons not infrequently run three times a week between Wales and Birkenhead.

The stoppage of Abernant Works and Gadlys Ironworks at Aberdare have greatly interfered with the progress of that once enterprising town, and I note that census returns show a decrease in population of 2184 souls. Nor can any improvement be expected there unless new industries are started, the coal measures being evidently on the wane in several collieries. Some degree of surprise has been expressed that Mr. Crawshaw does not adopt steel making. I think it is only a question of time. At present there is a moderate demand for iron rails, and the mill for merchant bar continues active. Probably as the stock of Welsh iron ore diminishes there may be a conversion of part of the plant to steel appliances. I see that last week one large mine pit was abandoned and the plates taken up.

Steel rails maintain their old prices, which range from £6 5s. to £6 15s. A good rail can, however, be secured at £6 12s. 6d. What will our ironmasters say to competition coming from Bilbao? I hear that pigs from Spain compete with ours in Germany, and there is an intention to compete on our own ground. If Spain can find a cheap coal that will suffice for coke it might be a paying speculation to bring the iron here, and leave the dross at Bilbao. Seeing that the ore from that quarter yields an average 50 per cent., one half the tonnage would be saved to begin with.

No less than fifty mills are idle in the tin-plate trade, and a good deal of difficulty may be anticipated from a large suspension amongst the buying world. I hear, too, of anything but an encouraging state of things in the neighbourhood of Swansea, though there may be a rallying movement, as prices are getting firmer than they have been, and stocks getting low.

Mr. Douthwaite, mining engineer at Merthyr Vale, and one of Mr. Nixon's most esteemed agents, died suddenly at his residence on Monday. He had materially assisted in laying out the colliery, which is one of the largest and best in the district.

There has been a dispute at Penygraig Colliery, a claim of wages, involving the question whether Mr. Moses Rowland had power to give notice. The bench ruled that he had, and the case was dismissed.

The Railway Servants' Society have issued the results of their Cardiff programme adopted in October last. One of the principal features to be insisted upon is limitation of work to nine hours per day, or fifty-four per week, Sundays to be over-time. Old rails are becoming a drug in the market, buyers at a distance are only offering 42s. 6d. for them, delivered, and scrap iron will only fetch 41s. It is evident that the tendency towards steel is setting in strongly. A steel train was wrecked at Merthyr Vale, as it was thought irretrievably, lately, but was "restored" without the addition of an ounce of steel or iron. Had the train been iron it must have been broken up for the furnace.

SOUTH KENSINGTON MUSEUM.—EASTER WEEK, Free.—Visitors during the week ending April 23rd, 1881:—On Monday, Tuesday, and Saturday, from 10 a.m. to 10 p.m.; Museum, 28,336; mercantile marine, building materials, and other collections, 22,446. On Wednesday, Thursday, and Friday, from 10 a.m. till 6 p.m.; Museum, 5743; mercantile marine, building materials, and other collections, 6440. Total, 62,965. Average of corresponding week in former years, 48,059. Total from the opening of the Museum, 19,896,825.

SHIP LAUNCH.—On Saturday last Messrs. Edward Finch and Co., of Chepstow, launched from their yard an iron screw steamer, the *Crawshaw-Bailey*, built to the order of Captain E. J. Harley, Milton Villa, Penarth. Her dimensions are:—Length, 110ft.; breadth, 19ft.; depth of hold, 10ft. 2in.; classed 100 A 1 at Lloyd's, to carry 230 tons dead weight. She has compound surface condensing engines, with inverted vertical cylinders and of forty-five nominal horse-power, working with a boiler pressure of 85 lb. per square inch. They, Messrs. Finch, are now building three other steamers, and have upwards of 1500 tons of bridge and roof ironwork in their yard.

THE PATENT JOURNAL.

Condensed from the Journal of the Commissioners of Patents.

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

Applications for Letters Patent.

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

19th April, 1881.

- 1688. BOOTS AND SHOES, W. Beverley, Aberdeen.
- 1689. SPINNING FRAMES, J. Erskine, Strabane, Ireland.
- 1690. HEATING BATHS, W. G. and J. Sloane, Dublin.
- 1691. TRICYCLE, A. Wharton, Snettisham.
- 1692. REGISTERING DISTANCE TRAVELLED, W. Thompson, Hackney, and A. Morten, Harlesden.
- 1693. SEA SOUNDING, F. Engel.—(W. Becker, Hamburg.)
- 1694. SHUTTLES, J. Holding & E. Holding, Lancashire.
- 1695. CRUSHING MACHINERY, T. Dale, Kirkcaldy.
- 1696. TELEGRAPHY, S. Pitt.—(O. Lugo, U.S.)
- 1697. CLEANING WOOL, W. R. Lake.—(A. Clarke & H. A. Perham, Lowell, U.S.)
- 1698. MOTIVE POWER, G. W. von Nawrocki.—(R. Schults, Dirschau.)
- 1699. SIGNALING, J. Wetter.—(R. S. Jennings, U.S.)
- 1700. SHIPS, W. R. Lake.—(F. Rainey & T. Rogers, U.S.)
- 1701. WHEELS, W. R. Lake.—(R. N. Allen, U.S.)
- 1702. STOPPERING BOTTLES, C. G. Elers, London, and T. Rowan, Isle of Wight.
- 1703. RAILING BOXES, B. J. B. Mills.—(J. H. Swift, U.S.)
- 1704. REFINING CAMPHOR, G. Atkinson, London.
- 1705. DRILLING, H. F. Parsons, San Francisco, U.S.
- 1706. MECHANICAL MOVEMENT, A. Clark.—(J. Harris, U.S.)
- 1707. PNEUMATIC BELLS, J. Newton, Clerkenwell.
- 1708. BOAT PLUG, A. M. Clark.—(L. H. Raymond, U.S.)
- 1709. PULLEY BLOCKS, T. H. Ward & E. Howl, Tipton.

20th April, 1881.

- 1710. BALLOONS, G. E. Vaughan.—(A. Apraxine, Paris.)
- 1711. WEARING APPAREL, J. Ramsay, Glasgow.
- 1712. ODOMETRES, E. S. Ritchie, Massachusetts, U.S.
- 1713. GUMMING, J. Wetter, Westminster.—(L. P. Bourdier and J. F. Ellis, Toronto.)
- 1714. HEATING, &c., C. R. Stevens, Lewisham.
- 1715. STEERING, J. Hornblower & G. T. Dove, London.
- 1716. OBTAINING AMMONIA, J. Storer, Glasgow.
- 1717. ENGINES, A. C. Kirk, Glasgow.
- 1718. GASSING FIBRES, A. L. Dickens, Middleton, and C. Ogden, Heaton Norris.
- 1719. BENDING, &c., GLASS, D. & W. Thompson, Leeds.
- 1720. PRODUCTS RICH IN MAGNESIA, &c., A. M. Clark.—(J. B. M. P. Closson, Paris.)
- 1721. SODA, &c., A. M. Clark.—(J. B. M. Closson, Paris.)
- 1722. RING FRAMES, W. Lumb, Rochdale, and J. Smith, Higher Standings, Bagtsale, near Rochdale.
- 1723. EXPLODING GASES, W. Watson, Leeds.
- 1724. CONTROLLING SPEED OF ENGINES, W. R. Lake.—(O. B. Crane, T. M. Platts, and W. H. Homes, U.S.)
- 1725. COLOURING MATERIALS, J. Young, jun., Kelly.
- 1726. ELECTRICAL CALL OF SIGNAL, W. R. Lake.—(D. H. Rice and J. B. Currier, Lowell, U.S.)
- 1727. MAKING CASTINGS, R. Lavender, Talywain.
- 1728. BASES FOR ARTIFICIAL TEETH, A. M. Clark.—(J. Duchesne, Marseilles, France.)

21st April, 1881.

- 1729. CAPSULES, L. Gros, Albany-street, London.
 - 1730. WATCHES, H. A. Dufrené.—(M. Vuillemin, Paris.)
 - 1731. SULPHATE OF ALUMINA, A. A. Croll, London.
 - 1732. ENGINES, P. Jensen.—(A. A. Atterberg, Sweden.)
- 22nd April, 1881.
- 1733. STEAM ENGINES, O. Trossin, London.
 - 1734. CENTRIFUGAL MACHINES, B. H. Remmers.—(W. Angele, Berlin.)
 - 1735. COUPLINGS, J. M. Head.—(J. C. Davidson, India.)
 - 1736. GRINDING, M. Bauer.—(A. Cheron, Redon, France.)
 - 1737. NUT CRACKERS, L. A. Groth.—(M. Renz and A. Kaufmann, U.S.)
 - 1738. STEAM ENGINES, M. Bauer.—(L. Fournier, France.)
 - 1739. STIFFENERS, E. Alexander.—(L. C. Warner, U.S.)
 - 1740. UMBRELLAS, J. C. Mewburn.—(A. Gruyer, Paris.)
 - 1741. RAISING LIQUIDS, P. Jensen.—(M. Honigmann, Greenberg, near Aia-la-Chapelle, Germany.)
 - 1742. DRYING GRAIN, &c., C. E. T. Mew, Newport.
 - 1743. CLARIFYING, W. R. Lake.—(E. Welz, Breslau, and A. Rittner, Schweidnitz, Prussia.)
 - 1744. PREVENTING EXPLOSIONS, C. D. Abel.—(O. Bustin, Liège.)
 - 1745. BATTERIES, C. D. Abel.—(P. Jablockhoff, Paris.)
 - 1746. ROTARY ENGINES, J. Lyle, London.
 - 1747. CASTERS, W. R. Lake.—(A. F. Mauchain, Geneva.)

23rd April, 1881.

- 1748. ROLLING MILLS, C. Pieper.—(E. Daelen, Prussia.)
- 1749. BOILER TUBES, W. H. Wood, Cookley.
- 1750. STEEL, &c., I. Beardmore, Parkhead.
- 1751. ACTINOMETERS, &c., F. Hurter, Widnes.
- 1752. SCREW PROPELLERS, C. Jones, Liverpool.
- 1753. MAGAZINES, &c., W. E. Gedge.—(Messrs. Ludwig, Loewe and Company, Berlin.)
- 1754. PUMP VALVES, J. Wetter.—(J. Florentin, France.)
- 1755. GEAR, R. C. Christian and G. Coates, Dublin.
- 1756. WINDOW FASTENINGS, G. Walker, Birmingham.
- 1757. SAFETY VALVE PLUGS, A. M. Taylor, Lenzie.
- 1758. WIRE BRUSHES, G. W. von Nawrocki.—(C. Flemming, sen., Schönheide, Saxony.)
- 1759. REMOVING THE DEBRIS FROM TUNNELS, &c., C. D. Abel.—(E. Schrabetz, Vienna.)
- 1760. DRESSING WOUNDS, L. A. Groth.—(Dr. P. Koch, Neuffen.)
- 1761. COOKING VESSELS, M. von Zyka-Radvánszky, G. Leidman, and F. W. Scharrath, Berlin.
- 1762. ELECTRIC INSULATION, J. Fleming, Cambridge.
- 1763. GAS ENGINES, W. Watson, Leeds.
- 1764. COATING METALS, A. Gutensohn, London.
- 1765. ENGINES, E. Edwards, London.
- 1766. REEL FITTING, W. Hardy, Alnwick.
- 1767. DYES, F. A. Zimmermann.—(J. F. Holtz, Berlin.)
- 1768. MAGNESIA, &c., H. Wedekind.—(H. Havenschild, Berlin.)
- 1769. CONVEYING GASES FROM MINES, &c., W. and J. Morgan, Pontypridd.
- 1770. PRINTING TELEGRAPHS, W. J. Burnside, London.
- 1771. VALVE MOTIONS, D. Greig and M. Eyth, Leeds.

25th April, 1881.

- 1772. BOBBINS, J. H. Wilson and L. Wilson, Cornholme.
- 1773. SIGHTING RIFLES, R. Morris, Kent.
- 1774. TRICYCLES, T. Townsend, Coventry.
- 1775. MINERS' SAFETY LAMPS, J. Fyfe, Glasgow.
- 1776. VAPOUR GAS, H. Springmann.—(A. Baudt, Hamburg.)
- 1777. JOINTS OF PIPES, R. Punch, Middlesbrough.
- 1778. BLEACHING COTTON, W. Mather, Manchester.
- 1779. SHAPING MACHINES, T. Morgan.—(E. Balm, Charlottenburg, Germany.)
- 1780. DISTILLING, L. Lederer.—(C. Paulmann, Hanover.)
- 1781. CASTORS, A. Bell, Edinburgh.
- 1782. HOT-AIR ENGINES, P. Jensen.—(M. Honigmann, Greenberg, Germany.)
- 1783. MEASURING ELECTRIC CURRENTS, E. G. Brewer.—(T. A. Edison, Menlo Park, U.S.)
- 1784. GRINDING AGES, W. Knowles, Heckmondwike.
- 1785. CHURNS, H. Powell, Ruffin.
- 1786. SOLID FAT ACIDS, F. Wirth.—(A. Müller-Jacobs, Moscau, Russia.)
- 1787. DYNAMO-ELECTRIC MACHINES, A. M. Clark.—(H. J. Muller and A. Levet, U.S.)

Inventions Protected for Six Months on deposit of Complete Specifications.

- 1697. OPENING, &c., FIBROUS MATERIALS, W. R. Lake, Southampton-buildings, London.—A communication from A. Clark and H. C. Perham, Lowell, U.S.—19th April, 1881.
- 1701. WHEELS FOR RAILWAY WHEELS, W. R. Lake, Southampton-buildings, London.—A communication from R. N. Allen, Chicago, U.S.—19th April, 1881.
- 1705. DRILLING ROCKS, H. F. Parsons, California, U.S.—19th April, 1881.
- 1723. ELECTRICAL SIGNAL APPARATUS, W. R. Lake, London.—A communication from D. H. Rice and J. B. Currier, Lowell, U.S.—20th April, 1881.
- 1743. CLARIFYING APPARATUS, W. R. Lake, London.—A communication from E. Welz, Breslau, and A. Rittner, Schweidnitz, Germany.—22nd April, 1881.

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

- 1568. FEEDING STEAM BOILERS, G. Weir and J. Weir, Glasgow.—18th April, 1878.
- 1591. REVIVIFYING SPENT LIME, G. R. Hislop, Paisley, and W. Young, Clippens.—20th April, 1878.
- 1601. STOPPERING BOTTLES, F. B. Michell, Plymouth.—20th April, 1878.
- 1822. SEWING MACHINE TABLES, C. Pieper, Berlin.—7th May, 1878.
- 1637. INSPIRATORS, W. Morgan-Brown, London.—24th April, 1878.
- 1718. RAILWAY PROVISION CARRIAGES, W. d'A. Mann, Langham Hotel, London.—29th April, 1878.
- 1614. HORSESHOE NAILS, W. R. Lake, London.—22nd April, 1878.
- 1656. KILLING ANIMALS, R. Jones, Berkeley.—25th April, 1878.
- 1666. BLANKETS and BED COVERS, L. Slater, Manchester.—25th April, 1878.
- 1688. LAMPS, H. F. O. Timme, London.—26th April, 1878.
- 1644. RECORDING SOUNDS, T. A. Edison, Menlo Park, New Jersey, U.S.—24th April, 1878.

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

- 1435. SEPARATING COAL TAR PRODUCTS, C. Lowe and J. Gill, Manchester.—24th April, 1874.
- 1558. SQUIBS, &c., S. H. Daddow, St. Clair, U.S.—2nd May, 1874.
- 1373. ORDNANCE, E. Schultz, Paris.—21st April, 1874.
- 1429. LUBRICATING CYLINDERS, D. Jones, Millburn.—24th April, 1874.
- 1425. FIRE RESISTING MATERIALS, R. R. Horne, Glasgow.—24th April, 1874.
- 1516. TOBACCO, J. W. Gibson, Dundalk, and J. P. Kennedy and A. Prior, Cavan.—30th April, 1874.

Notices of Intention to Proceed with Applications.

Last day for filing opposition, 13th May, 1881.

- 5057. REGULATING THE PASSAGE OF ATMOSPHERIC AIR, &c., J. F. Hoyle, London.—4th December, 1880.
- 5087. SEPARATING THE FINE FROM THE COARSER PARTICLES OF MATERIALS, G. Wilson, Parliament-street, Westminster.—7th December, 1880.
- 5298. COMPRESSING, &c., GUNPOWDER, &c., J. James, Princess-street, Lambeth.—17th December, 1880.
- 5303. VENTILATING SEWERS and DRAINS, T. Rowan, Ryde, Isle of Wight.—17th December, 1880.
- 5306. PREVENTING WASTE OF WATER, T. H. Goodson, Chancery-lane, London.—A communication from H. E. T. Goodson.—17th December, 1880.
- 5316. LIFE BUOYS, J. Sample, Blyth.—18th December, 1880.
- 5321. CLEANING IMITATION CARVING ON WOOD, A. Guattari, London.—18th December, 1880.
- 5338. TYING BUNDLES OF CHIPS, M. Glover, Leeds.—20th December, 1880.
- 5340. TELEPHONE SIGNAL, W. Morgan-Brown, London.—Com. from G. H. Bliss, U.S.—20th December, 1880.
- 5345. BRANDING WOOD, J. Richmond and W. Whiting, Kirby-street, London.—21st December, 1880.
- 5357. BOXES, &c., P. Lawrence, Farringdon-road, London.—21st December, 1880.
- 5378. CHAFF-CUTTING MACHINES, C. T. Burgess, Brentwood.—22nd December, 1880.
- 5381. PRODUCING BARRELS, W. Morgan-Brown, London.—A communication from E. Holmes and B. Holmes, Buffalo, U.S.—22nd December, 1880.
- 5408. KILNS, E. E. Street, C.E., Clifton.—23rd December, 1880.
- 5424. MOULDING BRICKS, &c., H. Johnson and B. Stuart, Keymer Junction.—24th December, 1880.
- 5438. TREATING LIQUID, W. R. Lake, London.—Com. from P. Prévost, France.—24th December, 1880.
- 5439. ATTACHING DOOR KNOBS, H. Fayton, Birmingham, and W. S. Dackus, Balsall Heath.—24th December, 1880.
- 5457. REVOLVING FURNACE, B. J. B. Mills, London.—Com. from G. Duryee, U.S.—28th December, 1880.
- 5505. STEAM TRAPS, H. Lancaster, Pendleton.—31st December, 1880.
- 10. CHEMICAL PRINTING, A. M. Clark, London.—A communication from L. C. dit Christian and A. Liébert, Paris.—1st January, 1881.
- 15. ELEVATORS, W. Dover, Liverpool.—3rd January, 1881.

54. LEVER, &c., STEAM TRAPS, H. Lancaster, Pendleton, near Manchester.—5th January, 1881.

- 218. PRODUCING ELECTRIC LIGHT, J. E. H. Gordon, Dorling.—17th January, 1881.
- 374. DRAWING ON STONE, W. Wise, London.—Com. from F. Martini and Co., Switzerland.—27th January, 1881.
- 557. DRAW-OFF TAPS, J. Davidson, Auchmill, Scotland.—9th February, 1881.
- 1336. FINISHING, &c., PILLS, J. G. F. Richardson, Leicester.—25th March, 1881.
- 1349. RABBIT, &c., TRAP, T. Douglas, Wire Bridge, N.B.—26th March, 1881.
- 1496. PREVENTING "RACING" IN MARINE ENGINES, T. Mudd, Hartlepool.—6th April, 1881.
- 1498. CABINETS, &c., R. Kerr, Paisley, N.B.—6th April, 1881.
- 1543. ELECTRIC LAMPS, St. G. L. Fox, Grosvenor-gardens, London.—8th April, 1881.
- 1599. LACING HOOKS, W. R. Lake, London.—Com. from M. Bray, Newton, U.S.—12th April, 1881.

Last day for filing opposition, 17th May, 1881.

- 5248. BATS FOR LAWN TENNIS, S. W. Trimmings, London.—14th December, 1880.
- 5330. STEAM ENGINES, J. Humphry, Barrow-in-Furness, and D. Joy, Amerley.—20th December, 1880.
- 5355. CONVERTER LININGS, H. Wedekind, London.—Com. from H. Bollinger, Milan.—21st December, 1880.
- 5366. COKE BREAKING, &c., MACHINES, W. F. Anderson, London, & G. Mant, Stratford.—22nd December, 1880.
- 5371. VALVES, COCKS, &c., J. D. Demans, Paris.—22nd December, 1880.
- 5374. TREATMENT OF MINERAL PHOSPHATES, J. J. Knight, Widnes.—22nd December, 1880.
- 5376. PADLOCKS, A. Linley, London.—A communication from G. Cooper, Buenos Ayres.—22nd December, 1880.
- 5382. SPECTACLES, G. W. von Nawrocki, Berlin.—Com. from P. Goerz, Stuttgart.—22nd December, 1880.
- 5388. WIRE FENCING, J. Shaw, Sheffield.—22nd December, 1880.
- 5399. ROVING, &c., FRAMES, J. Farrar, Halifax.—23rd December, 1880.
- 5400. TRAVELLING TRUNKS, J. J. B. Toussaint, Paris.—23rd December, 1880.
- 5404. LOCKING, &c., SIGNAL LEVERS, M. C. Denne, Eastbourne, & T. J. Denne, Redhill.—23rd December, 1880.
- 5410. VELOCIPEDES, W. Hillmann, Coventry.—23rd December, 1880.
- 5411. METALLIC DOOR KNOBS, J. S. Edge, Yardley, and J. Deeley, Birmingham.—23rd December, 1880.
- 5412. ROTARY MACHINES, W. R. Lake, London.—Com. from A. Kaiser, Germany.—23rd December, 1880.
- 5413. METALLIC FRAMES, H. H. Andrew and W. Lockwood, Sheffield.—23rd December, 1880.
- 5415. WEIGHING MACHINES, W. R. Lake, London.—Com. from A. Kaiser, Germany.—23rd December, 1880.
- 5425. MINERS' SAFETY LAMPS, W. Crossley, Glasgow.—24th December, 1880.
- 5429. DERIVATIVES OF BENZOLE, J. A. Kendall, Dalston.—24th December, 1880.
- 5436. FURNACES, A. C. Wylie and T. Lockerbie, London.—24th December, 1880.
- 5437. TURNING, &c., METALS, J. Evans, Wolverhampton.—24th December, 1880.
- 5443. AIR COMPRESSING ENGINES, F. E. B. Beaumont, London, and D. Greig, Leeds.—27th December, 1880.
- 5444. PREVENTING ENGINES FROM LEAVING THE RAILS, W. R. Lake, London.—A communication from H. Ruelle, Paris.—27th December, 1880.
- 5516. PRODUCING DESIGNS, &c., on WOOD, A. Guattari, Chancery-lane, London.—31st December, 1880.
- 5. CENTRAL FIRE CARTRIDGES, F. Wirth, Germany.—Com. from G. Bloem.—1st January, 1881.
- 11. COMPRESSING AIR, F. Wirth, Germany.—A communication from F. Honigmann.—1st January, 1881.
- 30. REVOLVING OR SWIVELLING SEATS, &c., W. H. Blain, Liverpool.—4th January, 1881.
- 47. LASTING BOOTS AND SHOES, A. M. Clark, London.—Com. from S. B. Ellithorpe.—4th January, 1881.
- 48. GENERATING, &c., ELECTRICITY FOR LIGHTING and OTHER PURPOSES, W. R. Lake, London.—A communication from E. Eteve.—4th January, 1881.
- 52. AXLE-BOXES, C. D. Abel, London.—A communication from D. G. Labbé.—5th January, 1881.
- 88. BRECH-LOADING FIRE-ARMS, &c., A. M. Clark, London.—Com. from L. N. Valasse.—7th January, 1881.
- 91. CAP SPINNING, &c., APPARATUS, R. D. and W. H. Dawson, Hunslet, Leeds.—8th January, 1881.
- 109. LOWERING, &c., SHIPS' BOATS, J. H. Barry, Cannon-street, London.—8th January, 1880.
- 480. SHACKLES, &c., for POLE CHAINS, H. Bezer, St. John's-street, London.—4th February, 1881.
- 517. COMBINATION OF LETTER LOCKS, E. Allebos, Brussels.—7th February, 1881.
- 685. SECURING TIRES or RINGS to WHEELS, D. M. Yeomans, London.—17th February, 1881.
- 1225. COLOURING MATTERS, J. A. Dixon, Glasgow.—A communication from C. Rumpff.—21st March, 1881.
- 1365. LOOMS, E. Smethurst, Manchester.—28th March, 1881.
- 1423. FEEDING ROLLER MILLS, &c., J. H. Carter, Mark-lane, London.—31st March, 1881.
- 1425. SCREWS, &c., J. Mackintire, Tudor-street, London.—31st March, 1881.
- 1426. HARVESTING, &c., MACHINERY, J. Hornsby, J. Innocent, and G. T. Rutter, Grantham.—31st March, 1881.
- 1440. PREVENTING EXPLOSION OF BOILERS, B. Giles, Blackheath.—1st April, 1881.
- 1494. STRAM VALVES, &c., J. Gresham, Craven Iron-works, Salford.—6th April, 1881.
- 1529. LINE, CORD, &c., A. T. Lawson, Leeds.—A communication from J. Coulson.—7th April, 1881.
- 1549. RAISING A NAP ON WOVEN FABRICS, &c., J. Worrall, Ordsall, Salford.—8th April, 1881.
- 1655. COTTON GINS, A. M. Clark, London.—A communication from A. G. Jennings.—14th April, 1881.
- 1705. DRILLING HOLES IN ROCKS, &c., H. F. Parsons, San Francisco, U.S.—19th April, 1881.

Patents Sealed

(List of Letters Patent which passed the Great Seal on the 22nd April, 1881.)

- 4208. URINALS, H. Phillips, Albion-place, Heavitree.—15th October, 1880.
- 4322. FASTENERS FOR BOOTS, &c., J. F. Fryer, Nottingham.—23rd October, 1880.
- 4326. HORSESHOES, L. A. Groth, London.—23rd October, 1880.
- 4332. BRICKS and TILES, P. Bawden, Norland-square, London.—23rd October, 1880.
- 4335. ARTIFICIAL STONE, W. R. Lake, London.—23rd October, 1880.
- 4336. SPINNING MACHINE SPINDLES, &c., W. R. Lake, London.—23rd October, 1880.
- 4362. POTATO DIGGERS, J. Wallace, Glasgow.—26th October, 1880.
- 4372. PERMANENT WAY OF RAILWAYS, R. Punshon, Brighton.—26th October, 1880.
- 4373. STEERING APPARATUS, J. N. Holliday, Sunderland.—26th October, 1880.
- 4374. TABLE CLOTHS, S. Ogden, Manchester, and J. Western, Lancaster.—26th October, 1880.
- 4380. MOULDING, &c., AMBER, J. C. Mewburn, London.—27th October, 1880.
- 4388. ADJUSTABLE SEATS, &c., P. M. Justice, London.—27th October, 1880.
- 4398. GAS ENGINES, J. C. Rhodes, Blackpool, & W. Goodbrand & T. Holland, Manchester.—28th October, 1880.
- 4399. PACKING FOR PERMANENT WAY, F. Jackson and E. R. Austin, Manchester.—28th October, 1880.
- 4400. OBTAINING COLOURS ON COTTON, &c., T. Holliday, Huddersfield.—28th October, 1880.
- 4405. UTILISING RESIDUARY PRODUCTS, T. Holliday, Huddersfield.—28th October, 1880.
- 4421. PRIME MOVERS, G. Wilkinson, Manchester.—29th October, 1880.
- 4425. PULP FROM WOODY FIBRES, &c., J. Chase, Orange, U.S.—29th October, 1880.
- 4433. CONVERTING REFUSE INTO GAS, &c., B. J. B. Mills, London.—30th October, 1880.
- 4454. APPLYING COMPOUND SYSTEM TO LOCOMOTIVES, J. A. Thompson, London.—1st November, 1880.
- 4468. FURNACES, W. Black, South Shields, and T. Larkin, East Jarrow.—2nd November, 1880.
- 4486. BOOTS and SHOES, &c., J. Sharp and S. Austin, Bradford.—3rd November, 1880.
- 4513. SUBSTITUTE FOR LEATHER, O. Wolff, Dresden.—4th November, 1810.
- 4523. BRECH-LOADING FIRE-ARMS, T. Nordenfelt, London.—4th November, 1880.
- 4544. FURNACES, &c., H. H. Lake, London.—5th November, 1880.
- 4548. SEPARATING IRON FROM ANIMAL CHARCOAL, &c., D. MacEachran, Greenock.—6th November, 1880.
- 4583. VACUUM BRAKE APPARATUS, J. Gresham, Salford.—6th November, 1880.
- 4602. PRINTING FABRICS, J. Kerr and J. Hawarth, Church.—9th November, 1880.
- 4629. SHIP'S WINDLASSES, W. H. Harfield, Mansion House-buildings, London.—10th November, 1880.
- 4631. PUMPS, C. Chapman, Salford.—11th November, 1880.
- 4640. REGULATING, &c., the FLOW OF LIQUIDS, H. J. Haddan, Westminster.—11th November, 1880.
- 4693. EXTRACTING OILY, &c., MATTER FROM COTTON WASTE, &c., C. T. Basted, Lower Kennington-lane, Kennington.—13th November, 1880.
- 4721. SYRUPING, &c., AERATED LIQUIDS, W. A. Ross and F. Lockhart, Belfast.—16th November, 1880.
- 4729. LAMPS, S. Pitt, Sutton.—17th November, 1880.
- 4739. ELECTRIC BATTERIES, H. E. Newton, Chancery-lane, London.—17th November, 1880.
- 4844. TREATING DOLOMITE, W. R. Lake, Southampton-buildings, London.—22nd November, 1880.
- 4991. BATTERY or MACHINE GUNS, T. Nordenfelt, St. Swithin's-lane, London.—30th November, 1880.
- 5170. WEIGHING MACHINES, &c., W. B. Avery, Birmingham.—10th November, 1880.
- 5177. LAMPS, S. Pitt, Sutton.—10th December, 1880.
- 5343. WEIGHING MACHINES, &c., W. B. Avery, Birmingham.—20th December, 1880.
- 180. GAS ENGINES, W. Foulis, Glasgow.—14th January, 1881.
- 373. SHIP'S SLEEPING BERTHS, W. R. Lake, Southampton-buildings, London.—27th January, 1881.
- 395. PRESS, J. S. Sworder, Park-villas, Loughton.—29th January, 1881.
- 402. SHEEP SHEARS, P. Ashberry, Sheffield.—29th January, 1881.
- 497. ELECTRO-MAGNETIC INDUCTION MACHINES, H. Wilde, Manchester.—5th February, 1881.
- 543. STRINGING PIANOFORTES, H. H. Lake, Southampton-buildings, London.—8th February, 1881.
- 569. SILICIOUS PIG IRON, A. Crawford, Glasgow.—10th February, 1881.

- 615. TENTERING FABRICS, J. Ashworth, Rochdale.—14th February, 1881.
- 634. READING, &c., JACQUARD CARDS, B. Toone, Nottingham.—15th February, 1881.
- 639. PREPARING CARBON, &c., W. R. Lake, Southampton-buildings, London.—15th February, 1881.
- 667. RAILWAY POINT and SIGNAL APPARATUS, J. Saxby and J. S. Farmer, London.—16th February, 1881.
- 677. SEWING MACHINES, A. Anderson and G. Browning, Glasgow.—16th February, 1881.
- 696. WORKING RAILWAY BRAKES, C. W. Siemens, Westminster, and A. C. Boothby, Kirkcaldy.—17th February, 1881.
- 697. ROTATING SLIDE VALVES, P. Brotherhood, Compton-street, London.—17th February, 1881.
- 709. MAKING, &c., PIPES, J. W. Butler and M. Dale, Bridge-street, Westminster.—18th February, 1881.
- 721. LINING STEAM-ENGINE CYLINDERS, E. R. Allfrey, Deptford.—19th February, 1880.
- 741. INK, A. F. Stoddart, Bristol.—21st February, 1881.
- 756. KNITTED or LOOPED FABRICS, J. Booth, Ovenden, near Halifax.—22nd February, 1881.

(List of Letters Patent which passed the Great Seal on the 26th April, 1881.)

- 3193. LOOMS, R. Hindle and G. Greenwood, Blackburn.—4th August, 1880.
- 3683. JACQUARD APPARATUS, J. Bywater, C. Bedford, and T. Kershaw, Birstal.—10th September, 1880.
- 4112. NECK YOKES for HORSES, J. L. Babb, Greenland.—9th October, 1880.
- 4143. PURIFICATION OF GAS, H. Cockey and F. C. Cockey, Frome Selwood.—12th October, 1880.
- 4386. COWL, J. R. Dry, Oriental-street, London.—27th October, 1880.
- 4411. CISTERNS, U. Bromley, G. Crowe, and W. James, Chester.—28th October, 1880.
- 4419. GAS ENGINES, M. Benson, Chancery-lane, London.—29th October, 1880.
- 4424. VALVE GEAR, J. Crighton, R. Crighton, and P. Chell, Manchester.—29th October, 1880.
- 4432. VELOCIPEDES, W. Hillman, Coventry.—20th October, 1880.
- 4438. ARTIFICIAL FUEL, J. R. Lever, Swansea.—30th October, 1880.
- 4446. DENOTING TIME, R. H. Ridout, Battersea.—30th October, 1880.
- 4450. UNHAIRING SKINS, V. Lesage, Paris.—1st November, 1880.
- 4469. PRESERVING NATURAL FLOWERS, &c., E. C. H. Krueger, Glasgow.—2nd November, 1880.
- 4472. UTILISATION OF STEEL RAIL ENDS, C. Jones and J. D. Jones, Swansea.—2nd November, 1880.
- 4481. WIRE ROPES, F. W. Scott, Reddish, near Manchester.—3rd November, 1880.
- 4487. WATER SUPPLY APPARATUS, T. Kennedy, Kilmarnock.—3rd November, 1880.
- 4510. BREAKING STONES, D. Stratton, Edinburgh.—4th November, 1880.
- 4531. STEAM HOISTS, T. Archer, jun., Gateshead.—5th November, 1880.
- 4534. CHAMFERING THE ENDS OF LEATHER BELTING, J. M. J. Feckin, Germany.—5th November, 1880.
- 4616. COMPRESSED GUNPOWDER, E. L. Beckwith and T. B. Lightfoot, Dartford.—10th November, 1880.
- 4635. SELF-CLOSING COCKS, J. Barr, Kilmarnock.—11th November, 1880.
- 4718. CONDENSING or COOLING, J. H. Johnson, London.—16th November, 1880.

3324. IMPROVEMENTS IN DYNAMO-ELECTRIC, MAGNETO-ELECTRIC, AND ELECTRO-DYNAMIC MACHINES, C. G. Gümpel.—Dated 16th August, 1880.—(Not proceeded with.) 2d.

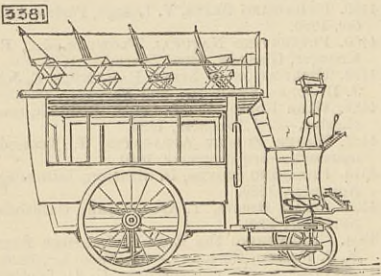
The inventor makes the rotating armature in the form of a hollow open-ended shell of magnetic material, of a shape approaching that of an ellipsoid, the middle being larger in diameter than the two ends. He notches the ends of the shell or divides them by projecting pins, which may be continued as ribs along the outer surface of the shell, forming divisions for the reception of the wire, which he winds thus:—Assuming there are four short magnetic fields, he arranges the wire on the shell in a number of divisions which is a multiple of four by any odd number. Take five for instance, then the number of divisions is twenty. The wire is wound forwards along No. 1 division, backwards along No. 6, forwards again along No. 11, backwards along No. 16, and thence again to No. 1, leaving free both ends of the wire so wound. Another wire is wound in a similar manner along Nos. 3, 8, 13, and 18; a third wire similarly along Nos. 5, 10, 15 and 20; a fourth wire similarly along Nos. 7, 12, 17 and 2; and a fifth wire similarly along Nos. 9, 14, 19 and 4; the ends of the wire being connected to plates of a commutator with brushes in usual manner. The inventor also describes two other methods of winding the wire.

3355. OBTAINING COLOURED PHOTOGRAPHIC PRINTS, F. H. Hallett.—Dated 18th August, 1880.—(Foid.) 2d.

This consists in obtaining coloured photographs by means of two impressions from the negative, the first being a weak impression in order to give the outline for guiding the application of the colouring, and the second, after the colours have been applied, being an impression of sufficient strength to give the clear drawing lights and shadows, and details of the picture.

3381. OMNIBUSES, &c., G. M. F. Molesworth.—Dated 20th August, 1880. 6d.

The entrance is made in the front part of the vehicle instead of at the back. By means of extending a platform like a tram-car platform, and by placing the front wheels close together underneath the steps leading to the platform space is gained for the platform for the entrance, and sufficient space also to build upon the platform a spiral staircase or steps, or to



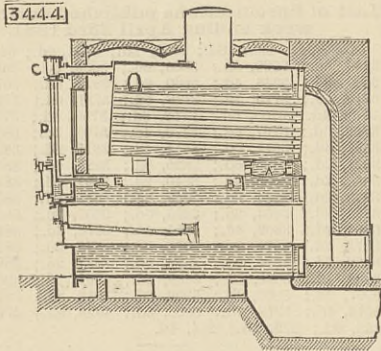
erect ladders, so that passengers may reach the roof with greater facility and safety than at present. The body of the vehicle is suspended by means of an iron bar or bent spring, and thereby the wheels can revolve or turn at any angle without locking, so that the omnibus will be enabled to turn round within a circle of a diameter of its own length.

3438. SECURING TELEGRAPH WIRES TO THEIR INSULATORS, A. E. Gilbert.—Dated 25th August, 1880.—(Foid.) 2d.

This consists in the construction and use of a bow-shaped fastener, clamp or clip, made preferably of malleable iron or malleable cast iron, having its free ends hooked or turned round so as to embrace or grip the line wire some inches in advance of and beyond the insulator, and pull it firmly into the groove on one side by the insertion of the strong hollow central breast or bow part of the clamp or clip into the groove of the insulator on the other side, the curve of the bow clamp or clip being such as to pull and slightly bend the telegraph wire on each side of the insulator towards or in a line through its centre, so that the tightness or strain of the tightening up of the wire thus effectually and automatically secures the wire and its clamp on or within the groove on each opposite side of the insulator.

3444. STEAM BOILERS, F. C. Glaser.—Dated 25th August, 1880.—(A communication from J. L. Piedboeur.) 6d.

This relates to steam boilers in which there are two or more compartments one above the other, and consists in providing in each such compartment a separate steam space instead of providing such steam space in the upper compartment alone. In the upper part of the lower compartment is fixed a cross partition B extending some distance down, thus forming a steam

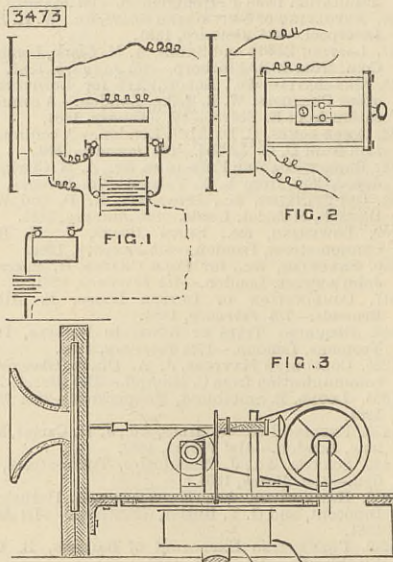


chamber, which occupies the greater part of the crown. This chamber communicates by a pipe D with the steam space of the upper compartment, the passage being governed by a valve C worked by a float E, so that when the pressure in the lower steam chamber is such as to depress the water level therein, the float E descending causes the valve C to open, allowing the steam to pass into the upper compartment, and the water level consequently to rise in the lower steam chamber. A is the communication for water between the two compartments of the boiler.

3473. IMPROVEMENTS IN APPARATUS FOR TRANSMITTING AND RECEIVING SIGNALS BY MEANS OF ELECTRICITY, A. F. St. George.—Dated 27th August, 1880. 10d.

Fig. 1 shows the arrangement of the apparatus for transmitting signals. A metallic bar is surrounded with an internal coil and an external coil of insulated wire with a vibrating diaphragm. The main line wire through which the current is transmitted round the external coil by transmitting apparatus is shown. The current then passing to earth by another wire or through a return wire. An adjustable resistance apparatus is placed in the circuit, or the transmitter may be placed in an independent or local circuit which influences the main line circuit by induction, so that signals produced in such local circuit by transmitter, induce like signals in circuit which are transmitted to receiving instrument, or, as shown in figure, the condenser may be so arranged that the current through the inner coil may be made to pass as desired to it, or through the adjustable resistance apparatus. The disturbing currents induced in the main line, and which it is desired to suppress, pass through the outer coil of receiving telephone, and induce corresponding currents in the inner coil. These induced currents in the inner coil pass in an opposite direction and are opposed to the currents passing through the outer coil. Another

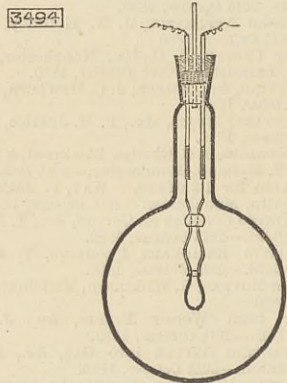
arrangement is to make the inner coil movable and separate from the outer one, so that it can be made to move lengthways along the metal bar or core within it, so that the inner coil may be withdrawn more or less from the inside of the outer one. This is shown in Fig. 2. Another part of the invention is an apparatus by means of which sonorous vibrations of the air produced by any sound are made to impinge upon the elements of a thermo-electric generator, so as to cause variations in the current, which are transmitted along the line by a transmitter. One kind of transmitter is a bar of carbon, one end of which is carried by a metal support of German silver or other suitable material, which forms one of the thermo-electric elements, to which is connected the circuit wire. The other end of the carbon bar rests in a cavity of a carbon block, capable of being heated by a lamp. Another part of the invention consists of an apparatus for producing vibra-



tions in a diaphragm by currents. Opposite to one of the poles of a magnetic bar the inventor fixes a metallic diaphragm, which is thus drawn towards the pole; these are so adjusted that between them can be arranged a wire or coil bent spirally, or backwards and forwards in a plane parallel to the diaphragm, the ends of the wire being connected with the circuit. When variations are produced by the transmission of signals in the electricity traversing the wire, they produce corresponding variations in the magnetism operating between the diaphragm and the pole, the field of which they traverse and affect, and corresponding vibrations are produced in the diaphragm. Another method of producing signals by vibration of a diaphragm is shown in Fig. 3.

3494. IMPROVEMENTS IN ELECTRIC LAMPS, &c., St. G. Lane Fox.—Dated 28th August, 1880. 6d.

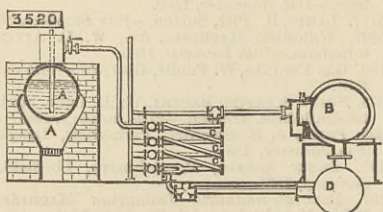
The Fig. shows the inventor's lamp on the incandescent principle. A is the lamp globe; a, the luminous bridge or burner made of vulcanised fibre which has been baked and then carbonised by heating to a white heat in benzole vapour; B a small block of porcelain between the ends of the bridge to keep them apart; E a pair of metallic clips through which the current passes, and which press against the outer surface of the said ends, and so form the electrical contact; these may be made of steel wire passed through and cemented to a block D of porcelain borax fused by a



blow pipe is a good cement for this purpose.) The upper ends of C have soldered to them short pieces of platinum wire E E, which enter the lower ends of and are fused into glass tubes F F, which latter are filled with mercury, so as to prevent leakage into the lamp; the mercury also forms the electrical communication between the luminous bridge and the outside of the globe. F F, and another tube H, which connects the globe with the apparatus by which the lamp is exhausted, pass through and fit tightly in holes in an india-rubber stopper G, which closes the neck of the globe; this latter is slightly tapered to prevent the stopper being forced in by the pressure of the atmosphere. The upper surface of the stopper is covered by a layer of mercury I to make the joint air-tight. To prevent the mercury being spilt, some marine glue is placed above as shown at J. The inventor then describes at length the mode of preparing his luminous bridge or burner, and the method of exhausting the lamp with his special apparatus, which is also described. The lamp having been thoroughly exhausted, a current is passed through it so as to render the burner incandescent, the pumping action (of the exhaustor) being continued as rapidly as possible. The incandescence and pumping must be continued until nothing more comes off, or for about two or three days, when the tube H is melted near the top of the lamp and the latter thereby sealed from the atmosphere.

3520. REVIVING AND RE-APPLYING SPENT STEAM IN STEAM ENGINES, H. A. Bonneville.—Dated 30th August, 1880.—(A communication from J. Belou.) 6d.

This consists in causing the spent steam to pass successively through a greater or smaller number of injectors between the engine boiler and the driving

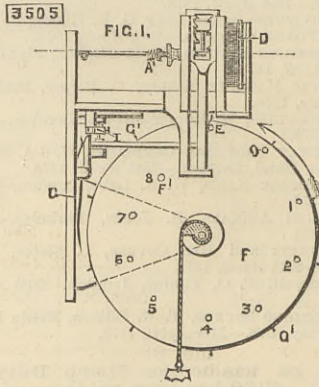


cylinders, acted upon separately by currents of steam under pressure, overheated or not, and acting upon one another, joined head and tail in such a manner that the first current having sucked the spent steam,

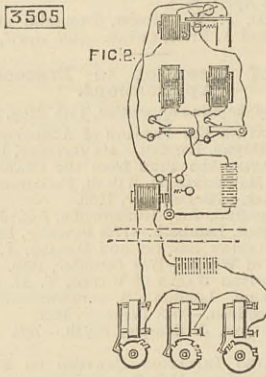
and having communicated to it a first degree of pressure, the second current in its turn sucks the product of the first, and imparts to it a second degree of pressure, and thus one after the other for the injectors following, until the product resulting from the mixture of the sucking steam with the sucked steam may have attained a sufficient pressure to be used as motive power by the engine. In the drawing A is the ordinary steam generator; B the ordinary steam cylinder; C C a series of injectors of any kind whatever, the ends of which are connected with each other, and arranged in some manner whatever, the one below receiving the spent steam of the engine, and sucked from a chamber D between the engine cylinder and the injector.

3505. ELECTRIC SIGNALLING TELEGRAPHS, &c., G. W. Clark.—Dated 28th August, 1880.—(A communication.) 10d.

The object of this invention is partly to transmit signals and partly to actuate indicators. Each station has mechanism for rapidly opening or closing the circuit, which act operates on the receiving instru-



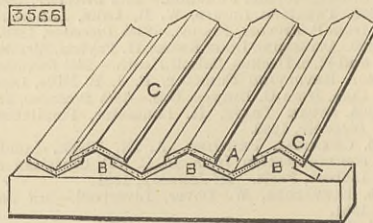
ment at another point. The indicator has the usual visual movable letters or figures. Fig. 1 shows a side elevation of the indicator. D is an electro-magnet with armature on lever A, which lever vibrates to or from the magnet. At the end of A is a pallet for engagement with escapement teeth C C on rack. The rack is mounted on vertical guides. The teeth are so proportioned to the pallet that on the release of a



tooth on one side a tooth on the opposite side is engaged, and so the fall is through a distance equal to that between two teeth. Thus the action of an armature of electro-magnet provides means to obtain a step-by-step motion and to obtain the movement necessary to indicate the different letters or figures. Fig. 2 shows the circuit connections for the form of apparatus preferred.

3566. COVERINGS FOR ROOFS, &c., J. H. Johnson.—Dated 2nd September, 1880.—(A communication from J. H. Tred.) 6d.

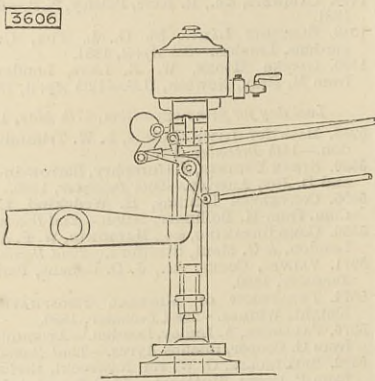
When the covering is made of wood, as shown in the drawing, it consists of V-shaped strips A, laid with the hollow side uppermost upon the framework of the roof, and resting upon angular supports B of a corre-



sponding form. The spaces between these strips are covered by other strips C of the same form, but inverted, so that their edges overlap the edges of the strips A.

3606. EXPANSION VALVE GEAR FOR ENGINES, A. J. Stevens.—Dated 4th September, 1880. 6d.

The object is to provide an automatic expansion gear worked by means of a governor which shall be specially applicable to large winding engines with double beat valves. This object is attained by allowing the lifters, instead of lifting the valve direct, to act through an intermediate bell-crank lever. On

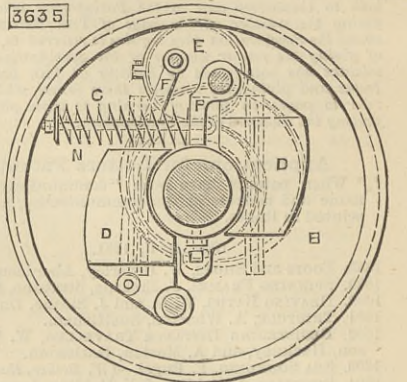


the frame which guides the valve spindle a spindle is carried on which there is a small eccentric; this eccentric is varied in position by means of a governor, and according to its position the lever will come into contact with it sooner or later, and the sooner it comes in contact with it the sooner will the steam be cut off in the cylinder.

3635. GOVERNORS FOR ENGINES, A. S. F. Robinson.—Dated 7th September, 1880. 6d.

A disc B is fastened to the crank shaft of the engine and has a flange which serves to partially encase the mechanism. Weights D are free to turn on studs fixed to the disc, and to the upper one is fixed an eccentric E coupled by a rod F with the lower weight. A spring G tends to draw the weights inwards and controls their centrifugal action. The strap of the eccentric E

is formed so as also to encircle the boss of the disc B, and at its lower end is a pin which enters a slide mounted on the outer side of the disc in guides. In the centre of the slide is a boss, through which the crank shaft passes, and the engine eccentric circles this boss. The upper weight has lugs to which a rod N is pin-jointed, and passes through the spring G,



which stands upon a platform P supported at one end by the stud on which the weight D turns, and at the other by a ledge on the boss of the disc.

3637. IMPROVEMENTS IN ELECTRIC LIGHTING, P. M. Justice.—Dated 7th September, 1880.—(A communication from H. C. Spalding.) 6d.

The object of the invention is to avoid shadows cast by buildings, &c. To obviate these the inventor employs groups of electric lights, erected on towers from 100ft. to 200ft. high, so that the light may be about 100ft. above the houses. These towers are arranged in triangular groups of not less than three towers, whereby the rays of light cast from one tower cross those cast by the others angularly. Each tower supports an electric light lantern consisting of a gallery or floor, surrounded by glass and enclosing the lights massed in a circular group, surrounding and external to the frame of the tower, so that it casts no shadow. That no light may be lost by upward radiation, each group is surmounted by a circular or conical reflector projecting beyond the groups. To protect the lantern and reflector from the weather, they are surmounted by a conical roof.

3640. JOURNAL BEARINGS AND ANTI-FRICTION COMPOSITIONS, A. M. Clark.—Dated 8th September, 1880.—(A communication from H. G. Farr and H. C. Copeland.)—(Not proceeded with.) 6d.

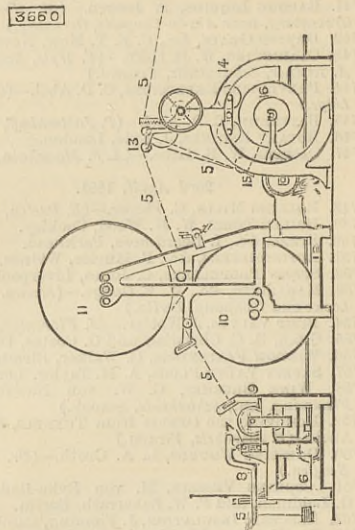
This consists, first, in a journal having a groove or grooves formed in its internal or bearing surface, said groove or grooves being inclined to the longitudinal axis of the said bearing; secondly, in an anti-friction composition composed of plumbago or graphite and shellac.

3646. HOLDERS FOR CIGARS AND CIGARETTES, H. J. Hadden.—Dated 8th September, 1880.—(A communication from P. Kurczyn.)—(Not proceeded with.) 4d.

Wire is bent in such form as to produce a spring, a lock, and a pair of gripping jaws, and so arranged that the jaws cannot be naturally spread open beyond a given point, neither can they be closed beyond a given point, consequently the strength of the spring will not be impaired, and when necessary to remove the butt of a cigar from the holder, it is accomplished by simply compressing the wire so as to open the jaws, and a fresh cigar replaced in like manner.

3660. MACHINERY FOR DRESSING AND BEAMING YARNS, W. W. Urquhart and J. Lindsay.—Dated 9th September, 1880. 6d.

According to one modification, parts are provided for separately dressing and drying two sets of yarns, which are afterwards beamed together or wound on one beam; the beaming apparatus occupies a central position, and the separate dressing and drying sections are arranged towards opposite ends. The several sections of the apparatus are made with distinct and detached frames designed to give the attendant workers convenient access to the various parts, instead of there being, as in many existing machines, one or more long unbroken framings involving loss of time in getting from one part to another. The framing



of the beaming section is specially arranged to facilitate the introduction and withdrawal of the trucks or barrows employed for conveying the beams to and from the machine. At each end of the machinery the yarns 5 drawn in the usual way from a bank or frame of bobbins are led to a dressing machine or frame 6, and therein passed between rollers 7, the lower one of which dips in a trough 8 of starch or other dressing material, and is next subjected to the action of a rotating brush 9. The yarns 5 on leaving the dressing frame 6 proceed either to a single large steam-heated drying cylinder, or to a pair 10 11 of such cylinders mounted one above the other on a separate framing 12. From the last drying cylinder 11 the yarns 5 are led at a considerable elevation to guide rollers 13 at the top of the beaming frame 14, the guide rollers 13 for the two sets of yarns from opposite ends of the machinery being near together, and the yarns 5 passing down between them to a single lower guide roller 15, to which last they proceed together to the beam 16.

3672. SURGICAL BANDAGES, J. H. de Bussey.—Dated 10th September, 1880.—(A communication from Dr. C. de Mooy.) 6d.

The bandages or splints are formed of split rattan of about 1/8 in. thickness, strung together with strong cord, and connected at the extremities with thinner cord. They are covered afterwards with white leather.

3679. ENVELOPES, N. Contopoulos.—Dated 10th September, 1880. 4d.

This consists of a sheet of paper folded into the shape of an envelope in such a manner that a small pocket or pouch is formed, into which a letter or other paper or document can be dropped, and from which

such letter or paper cannot be abstracted without opening the envelope.

3677. DOORS OF RAILWAY CARRIAGES, &c., J. H. Southwood.—Dated 10th September, 1880. 6d.

This consists in fitting or providing the doors of railway carriages and other carriages or vehicles with means or appliances for the reception of wet umbrellas, and for the exit of water dripping therefrom.

3691. APPARATUS FOR BINDING OR SECURING PAPER, &c., BY MEANS OF METAL STAPLES OR FASTENERS, G. W. McGill.—Dated 10th September, 1880. 10d.

A bed plate is furnished at its front end with a clenching anvil, and at its rear end with a pillar or pillars, in which is pivotted the rear end of a lever arm, the front end of which is provided with the mechanism for inserting the staples in the articles to be bound or secured, which mechanism, in connection with the anvil, clenches the staples in said articles.

3699. RING FRAMES FOR SPINNING AND DOUBLING COTTON, G. Young.—Dated 11th September, 1880.—(Not proceeded with.) 2d.

This relates to means for preventing the snarling of the yarn between the fluted rollers which give off the said yarn and the bobbins into which the same is being wound. It consists in stopping the revolution of the fluted rollers just before the spindles are stopped, and this may be effected by mounting the carrier wheel, which drives the said rollers, and which is driven by a wheel on the tin roller shaft upon one end of an arm or lever, the other end of which is conveniently pivotted on to the framing of the machine.

3700. SASH FASTENERS, W. Lea.—Dated 11th September, 1880.—(Not proceeded with.) 2d.

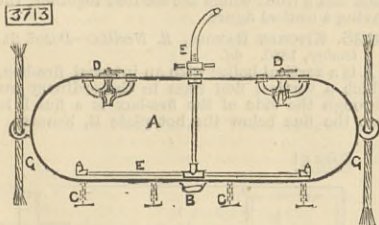
The lever for holding the two sashes together when the window is closed is formed in two parts, hinged together so that the outer end may be capable of turning upwards slightly, and when this lever is turned over so as to connect the two sashes, this hinged part turns up to pass over an inclined projection, and then drops down again beyond the end of this inclined projection, which thus becomes an effectual stop to prevent the return of this lever, and consequent release of the windows by any appliance passed up between the two sashes.

3707. JUTE FABRICS, &c., D. Donald.—Dated 11th September, 1880.—(Not proceeded with.) 2d.

The fabrics are submitted to the combing or teasing process in a tiger raising machine or in a cross raising machine, or to the action of both such machines, and thus a pile is combed or raised upon one or both sides or surfaces of the fabric, which pile surface renders such fabrics capable of receiving the most perfect impression in the subsequent printing process, or of receiving the colour in the dyeing process, or the pile is raised wholly or partially by hand tools.

3713. RAISING SUNKEN SHIPS, C. Huslett and J. G. Thomson.—Dated 11th September, 1880. 6d.

Pontoons A of the form shown in the drawing are employed and are weighted so as not to turn over, and at bottom have an opening B so as to put the interior in communication with the external water. These pontoons are lowered by means of chains previously



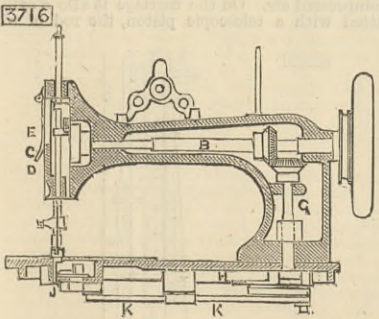
fastened to the sunken vessel, and which pass through eyes G so as to guide the pontoon in place, when they are secured by chains. Compressed air is then admitted through the hose E. D are cocks for permitting the escape of air from the pontoon.

3715. TRICYCLES, &c., S. Chatwood.—Dated 11th September, 1880. 6d.

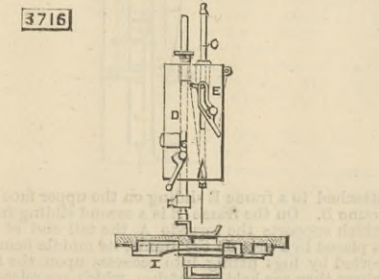
The tricycles are constructed with two main or driving wheels, and with a central steering wheel behind. The treadle cranks are formed upon the axle of the main wheels, and the rotary motion of the axle is imparted to the wheels through gearing, so that the main wheels may be rotated at a slower speed than the axle. The bosses of the main wheels have necks projecting inwards, and these are received into bearings at the ends of an arched or bow frame, which frame is in this way supported by the main wheels. From the centre of the arched or bow frame an arm projects to the rear, and it has at its end a socket which receives the stem of a fork in which the hinder or steering wheel is carried. The bow frame or its arm also carries the driver's seat. Upon the main axle on either side, just within the projecting necks of the main wheel bosses, a pair of pinions are arranged to slide along a feather upon the axle. These pinions are under the control of the rider, who can move them in or out along the axle.

3716. SEWING MACHINES, T. Chadwick, T. Sugden, and C. Shaw.—Dated 13th September, 1880. 8d.

This relates, first, to improved mechanism for sewing with a needle and shuttle, and consists of an ordinary disc on the driving shaft B fitted with a crank pin carrying a bowl working in a cam slot in a cross piece on the needle slide C. The ends of the cam piece on the needle slide work against ledges on the



box D which is secured to the head. A pin passes through the cam piece and needle slide, and works in a cam slot in a slack thread lever E having its fulcrum on the box D. On the driving shaft B is a bevel wheel gearing with a similar wheel on shaft G, on the lower end of which is a double cam and a crank pin, plate

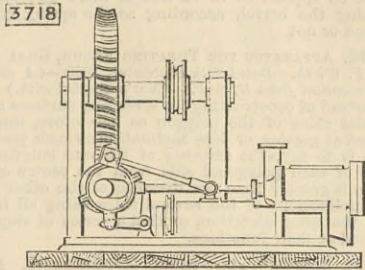


and pin. The double cam acts upon the end of a lever H, to which it imparts both end movement and an oscillating movement, so as to actuate the feed bar I,

which is made adjustable to give more or less lift. The shuttle race is circular, and in its centre the shaft J of the shuttle driver works, and is driven by a connecting-rod K from the shaft G. A second part of the invention consists in a combination of vertical needle and feeding mechanism with circular needle mechanism, to produce the "Lancashire sewing machine stitch;" and a third part consists in combining with parts of a Wilson machine, a rotary shuttle having the axis of its driver in a vertical position parallel to the needle slide.

3718. MOTIVE POWER ENGINES, W. Adair.—Dated 13th September, 1880. 6d.

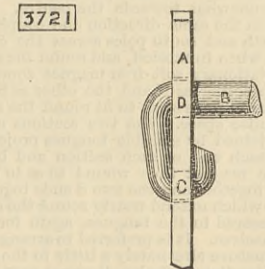
Two cylinders are employed, with the necessary valves for opening and closing the ports or passages leading to and from the said cylinders, and motion is given to the said valves at the required times, by means of gear operated by a single eccentric. The said eccentric is formed with a slot or opening therein, in such manner that the said eccentric may be moved into a position where the valves will be unacted upon or nearly so, or into positions where the said valves



will be so actuated as to cause the engine to move in one direction or the other. Motion is given to the said eccentric for starting, stopping, and reversing, by means of a disc, constructed or fitted with spiral or curved grooves or projections, working in combination with grooves or projections in or on the eccentric, or by means of bell-crank levers. The said eccentric receives a rotary motion, so as to actuate the valves by being connected to the crank shaft of the engine by slides or equivalent devices. The pistons, cylinders, crank shaft, connecting rods, and like parts of the engine are of any usual or desired construction, and motion is communicated from the crank shaft to, say, steering gear winches or the like, by means of worm, spur wheel, or other suitable gearing.

3721. METAL HURDLES, FENCING, AND GATES, W. Bailey.—Dated 13th September, 1880. 6d.

The drawing shows one method of joining the ends of horizontal round bars to uprights. A is the upright, and B the bar; through A holes D are



punched for the passage of the bar, and below them are other holes C for the return bend of the bar. The end of the bar is tapered and bent to a U form, when it is passed through the holes C and D, and the end clenched up as shown.

3723. PICKERS FOR LOOMS, S. D. Rhodes.—Dated 13th September, 1880. 4d.

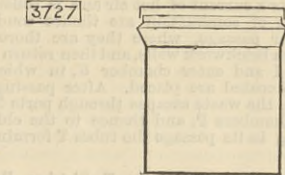
This consists in casting at one or both ends or sides a recess or hollow part, into which is introduced through a slot a piece of buffalo hide or other suitable material.

3724. PIANOFORTES, R. Howson.—Dated 13th September, 1880. 6d.

The vibration plank is arranged in proximity to and attached to the hitch pin plate. The belly bridge thus occupies the same position that it does in an ordinary pianoforte; but instead of resting on the belly itself, it rests on a vibration plank, which is bolted or screwed at intervals to the hitch pin plate, but overhangs the same all along its margin. The second part relates to a method of constructing the crescendo piano with a fixed sound-board, with which and the vibration plank are combined movable wedges, or interlocking or connecting pieces arranged intermediately, and so that the contact may be produced by such intermediate wedges or interlocking or connecting pieces, when they are actuated by means of the pedal or otherwise.

3727. METALLIC BOXES, CANS, &c., G. F. Griffin.—Dated 13th September, 1880. 6d.

This consists in the manufacture of improved metal boxes, cans, or other receptacles for holding alimentary and other substances by forming on the body of the receptacle a rib or ribs, projection or projections, tapering upward to receive and expand by a wedging



action under the force of a blow, the lid or cover of the box, and downward so as to give support against the cover when driven down. The drawing is a section through a can having a continuous rib or projection, the lid or cover being soldered on.

3730. MANUFACTURE OF GAS, &c., A. Pope.—Dated 13th September, 1880. 8d.

This consists essentially in the manufacture of gas from hydrocarbon fluid, alone or mixed with coal-gas, in an apparatus in which the vapour or mixture of gas and vapour from a heated retort passes into a second retort, in which it is caused to descend in contact with the heated surface thereof, and then to ascend through a central tube to pass into another retort, this process being continued through any number of retorts necessary for the conversion of the whole of the vapour into gas.

3732. BOXES FOR COTTON BALLS OF SEWING MACHINES, A. C. Henderson.—Dated 13th September, 1880.—(A communication from A. Henry.)—(Not proceeded with.) 4d.

The box consists of three parts, one of which is the lid, pierced with a small hole for the exit of the thread from the box, to the bottom of which, at the opposite end to which the thread is drawn, is soldered a conical tube which is intended to be placed on the ordinary spindle of the sewing machine.

3733. RAILWAY CARRIAGES, T. Hanway.—Dated 14th September, 1880.—(Not proceeded with.) 2d.

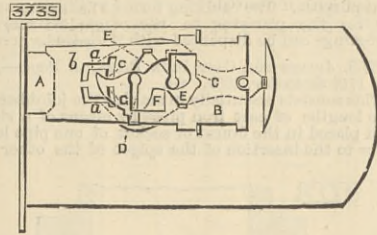
This consists in constructing the body of the carriage of a cylindrical or oval, or partly cylindrical, partly oval, or partly rectangular tube, the said tube being continuous from end to end of the carriage.

3734. APPLIANCES FOR SIGNALLING, A. M. Ritchie.—Dated 14th September, 1880. 6d.

This consists in the construction and use for signalling purposes of a ball or shape, made of two or more canvas-covered hoops or discs, arranged and fitted so as to be collapsible for stowage.

3735. LOCKS AND LATCHES, W. H. Saint Aubin.—Dated 14th September, 1880. 6d.

The locks are constructed so that the locking bolt can be locked with the key inserted the right or ordinary way up, whether the lock is used for the right or left hand, and also to render the lock difficult to pick. The latch bolt and follower being of ordinary construction are not shown in the drawing. A is the bolt head, B the tail of the bolt, C the tumbler, D two



separate keyholes, E key gratings formed through the tail of the bolt, and F clearance opening to allow the key to pass round through the gratings. a are horizontal racks through the tail of the bolt, and b is a cross slot joining the front ends of the racks, and c are recesses continued upwards and downwards for additional safety. When the lock is locked from either keyhole it can only be unlocked from the same one.

3736. ROLLING MILLS, G. W. von Nawrocki.—Dated 14th September, 1880.—(A communication from J. Schmidt.) 4d.

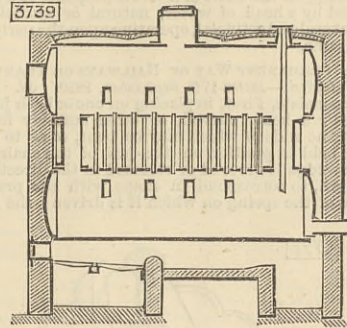
This relates to the cold rolling of wire or fine iron by means of small rollers with semi-hexagonal grooves, forming a hexagonal section.

3738. FLOATS FOR FISHING PURPOSES, G. J. Archer.—Dated 14th September, 1880.—(Not proceeded with.) 2d.

This consists first, in the application and use of luminous paint or material to a float; secondly, in lieu of caps, ordinarily used for adjusting the cap to the line, an india-rubber or other elastic band is placed round the shoulder of the float, the line passing between it and the float being thereby pinched or set in any desired position.

3739. STEAM BOILERS, W. R. Lake.—Dated 14th September, 1880.—(A communication from J. Prigardien.) 4d.

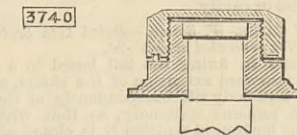
This consists in providing in addition to the ordinary connecting tubes a number of small tubes connecting the upper and lower water chambers, which small



tubes may be straight or curved, and which offer a large heating surface to the gases or products of combustion passing around or about them, thus absorbing the heat therefrom, and expediting the evaporation and circulation of the water.

3740. SAFETY NUTS FOR AXLES OF VEHICLES, &c., H. Anderson.—Dated 14th September, 1880. 6d.

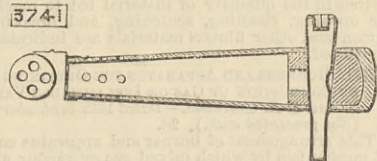
This consists in constructing a nut or washer in two parts and forming a screw thread upon the outer end



thereof, over which a screw cap or head is placed, firmly connecting the two parts of the nut or washer and holding them in position upon the end of the axle.

3741. MANUFACTURE OF TAPS FOR BEER, &c., E. Ludlow.—Dated 14th September, 1880. 6d.

This consists in making the body and inlet pipe of the tap or stop-cock from a solid drawn taper tube closed at one end, and the plug and outlet pipe from a



second and smaller solid drawn taper tube closed at one end, the said plug working liquid-tight in a cork filling piece or other packing material fixed in the body of the tap or in a metallic lining crossing the body of the tap.

3742. SECURING THE FASTENINGS OF THE PERMANENT WAY OF RAILWAYS, R. J. Hinton and S. W. Yockney.—Dated 14th September, 1880.—(Not proceeded with.) 2d.

This consists in making cast iron, wrought iron, or steel chairs or fastenings of ordinary or other form, with in addition to the holes for fastening the chairs to the sleepers, an additional hole or holes, or slot or slots, in the jaw or upper part of the chair, between which and the rail the key is fixed in position; through this hole a nail, spike, plug, or screw of iron, wood, or other material is driven into and attached to the wooden or other key, after the key is placed in position, by which it can be held and moved, tightened, and prevented from shifting or becoming loose, or shaking out of the chair or fastening until the key is required to be removed.

3743. MANUFACTURE OF SHELLS FOR ORDNANCE, C. D. Abel.—Dated 14th September, 1880.—(A communication from E. J. B. Delacourt.) 6d.

One part of this invention relates to the improved manufacture of shrapnel shells, or shells containing bullets or pellets. Rings or crowns of bullets are formed, the balls of each ring being joined together in casting, while the upper and under sides are flattened somewhat, so that a series of such rings can be firmly cemented together upon each other. Every alternate ring is by preference made of a somewhat smaller

diameter. A pile of such rings having been formed, this is placed centrally within the mould for the shell, and the body of the shell is then cast round the rings of bullets, which thus form an inner wall to the steel. Each ring of bullets may consist of two concentric sets of bullets.

3744. BICYCLES, TRICYCLES, &c., M. Webb.—Dated 14th September, 1880. 6d.

This consists of a slotted lever which is fixed under the treadles of the vehicle, and in one end of which revolves the axle upon which the driving or propelling wheel or wheels is or are mounted; the said axle being acted upon and caused to revolve partially at each thrust of the foot by means of a bevelled bar or finger working within the said slotted lever or bar.

3746. MATCH-BOXES, &c., J. Jacoby.—Dated 15th September, 1880.—(Not proceeded with.) 2d.

This relates to a box or apparatus for containing matches, and for delivering them one by one from the interior to the exterior of the box, as they are required for use.

3748. ANNEALING BOXES AND PANS, C. H. Onions.—Dated 15th September, 1880. 4d.

This consists in constructing them with a series of wrought iron chains or links imbedded in the cast iron in the process of casting, with the view of preventing the breaking or parting of the annealing boxes or pans during the operation of annealing from the action of the fire on the cast iron, and the wrought iron is to compensate and to hold together the boxes and pans, even should the heat cause the casting to crack or break the same.

3750. MANUFACTURE OF CARBOLIC ACID, &c., G. Wischin.—Dated 15th September, 1880.—(Not proceeded with.) 2d.

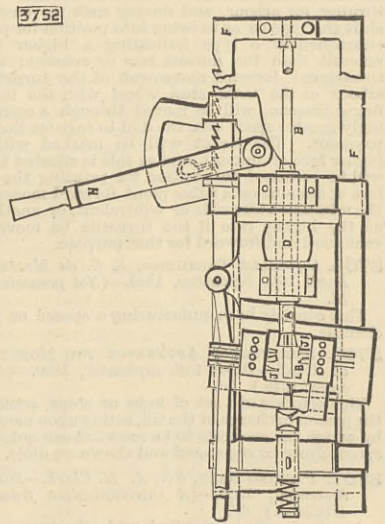
This consists in the substitution of carboic acid, or gases or vapours or liquids containing free or uncombined carbonic acid, or of the substitution of the bicarbonates of the alkalies for the mineral acids hitherto used for the economical treatment of alkaline solutions of carboic acid, crude or otherwise, or analogous phenols.

3751. STEAM ENGINES, R. Sutcliffe.—Dated 15th September, 1880.—(Not proceeded with.) 2d.

Connected with the condenser or condensers is an air pipe and tap or valve, so that when desirable to arrest the motion of the engine, the air tap will be opened and the steam then shut off, whereon the air enters the condenser by way of the pipe and at once destroys the vacuum, the engine being at once brought to a standstill.

3752. TURNING, BORING, GROOVING, &c., WOOD AND OTHER MATERIALS, L. Vallet.—Dated 15th September, 1880. 6d.

The object of the invention is to effect simultaneously the various actions required for forming internal and other bottle stoppers, bobbins, circular boxes and other articles, i.e., the internal and external turning, boring, grooving, cutting, and otherwise shaping wood and other materials. The machine consists of a hollow spindle A provided with saw cuts at its inner end so as to form a spring to hold the material B to be operated upon, which in the drawing is a piece of wood to be



made into stoppers. This spindle is rotated by the pulley D. A frame F carries the end of the material B, and can be moved forward by means of the pawl lever H, the pawl of which engages with teeth formed on the frame. Cutting tools J are mounted in a movable slide R. To turn the inside of any article the tool L is brought into operation.

3753. PRODUCING DESIGNS UPON CARRIAGE LAMPS, A. M. Clark.—Dated 15th September, 1880.—(A communication from D. Scottellari.)—(Not proceeded with.) 2d.

This relates principally to the production of armorial or heraldic devices, &c., in vitrified colours upon the lamps.

3754. COATING IRON WITH ZINC, &c., W. R. Lake.—Dated 15th September, 1880.—(A communication from J. B. Jones, H. W. Shepard, and R. Seaman.) 4d.

This comprises the use of a neutralising bath for preparing sheets to be coated after the usual pickling or cleaning operation has been performed, and previous to immersion in the metallic bath, for the purpose of decomposing the injurious ferric salts from the fibres of the iron, thereby removing an injurious and destructive element to the durability of the iron through deliquescence and exposure to moist atmospheres. It also comprises the use of a flux bath for the purpose of removing any oxidation or preventing its formation as the sheets or articles are passed into the metal bath, thereby rendering unnecessary the use of muriatic acid, and drying the same in an oven or otherwise, as now practised, to the great injury of the texture of the iron, and also the great deterioration of the metal from the admixture of iron resulting from the decomposition of that portion of the dried ferric salts remaining upon the surface. It further comprises a special alloy of zinc, tin, lead, and nickel, to be applied to the prepared articles as a metal bath.

3755. SPLINTS FOR SURGICAL PURPOSES, &c., H. Hides.—Dated 16th September, 1880. 4d.

This consists in manufacturing splints for surgical purposes of felt saturated with a hardening or stiffening solution and perforated.

3756. RAILWAYS AND ROLLING STOCK, J. Le Clair and J. de Rees.—Dated 16th September, 1880. 4d.

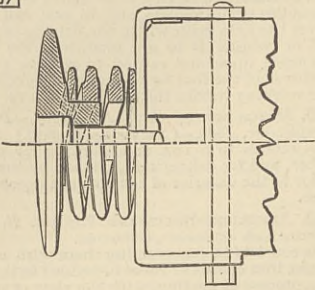
This relates to railways for fairs and public gardens, and consists of a portable railway, having the rails arranged as a down and up incline, or in a curve, together with a carriage allowed to travel thereon from one end, being the top of one incline, to the other, being the top of the other incline, by gravity, said carriage being so constructed that the body will revolve when travelling, or oscillate endways or sideways, and thus combine a swinging and gyratory motion, or one or the other motion simply.

3758. INCREASING THE EFFICIENCY OF STEAM USED IN COMPOUND ENGINES, E. A. Brydges.—Dated 16th September, 1880.—(A communication from S. N. Carvalho.)—(Not proceeded with.) 2d.

This consists in heating or superheating steam by means of hot water under pressure, water and steam combined, also under pressure, or high-pressure steam alone, at any convenient point between the generator and the place where the steam is used.

3757. BUFFERS FOR RAILWAY ROLLING STOCK, I. A. Timmis.—Dated 16th September, 1880. 6d.
The object of the invention is to lessen jarring, vibration, and wear in the working of railway carriages, to lessen the cost and increase the life of same, and to give greater security in the carriage of passengers, &c. The buffer head is made hollow in its centre and is

3757



held in position by a pin, which passes through the back plate, and is secured by a cotter. The back plate is fastened to the vehicle by bolts. Outside the hollow plunger is placed a spring, the dead blow of the buffer being taken up by the plunger coming in contact with the back plate or by the spring, or by both together. Modifications are shown.

3760. WHEELBARROWS, F. Wirth.—Dated 16th September, 1880.—(A communication from A. W. Pletsch.) 6d.

This consists, first, in constructing the wheelbarrow so that one of the wheels is freed from weight whilst the barrow is being loaded. There are two wheels arranged one in front of the other. Secondly, in arranging a brake which operates upon one of the wheels, and can be worked by the foot of the person using the barrow.

3762. FARE REGISTER, G. W. Warren.—Dated 16th September, 1880. 6d.

This relates to improvements on patent No. 2468, dated 20th June, 1878. In the "Uniform" type of instrument the issuing is effected by a continued movement of the miniature turnstile or its equivalent in the same direction as for registering and printing or marking. For this purpose the miniature turnstile arbour carries a wheel having a series of teeth at intervals only, and not entirely round its circumference, and each set of such teeth comes into gear with a pinion that operates the issuing gear when or immediately after a ticket has been registered and marked. The ticket is marked by type operated directly from the bent arm that is operated by the segments. In the "Union" type of instrument the issuing of tickets is or may be effected as in the "Uniform" instrument. But the instrument is so arranged that by a reverse movement of the miniature turnstile, or its equivalent, the main stud wheel will be caused to perform a reverse movement without turning its arbour, and during such movement will shift the type so as to bring into position for printing subsequently a type indicating a higher fare or amount than the normal fare or amount; then by subsequent forward movement of the turnstile the arbour of the main stud wheel with the indicator finger thereon, will be moved through a correspondingly greater space over the dial to register the fare or payment. The ticket will be marked with such higher fare or amount, and as this is effected the type will be returned to position for printing the normal fare or amount on a subsequent forward movement of the miniature turnstile or equivalent, or another fare at the higher rate if the turnstile be moved both backward and forward for that purpose.

3764. CHENILLE TRIMMINGS, S. G. de Montauzan.—Dated 16th September, 1880.—(Not proceeded with.) 2d.

This consists in manufacturing a spaced or plumed chenille.

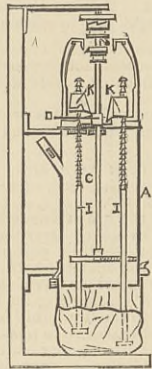
3766. REGISTERING APPARATUS FOR MONEY TILLS, G. Absell.—Dated 16th September, 1880.—(Not proceeded with.) 2d.

This consists of a set of keys or stops, actuated by the person in charge of the till, acting upon mechanism by which the amounts to be recorded can quickly and successively be registered and shown on dials.

3767. PACKING BRAN, &c., A. M. Clark.—Dated 16th September, 1880.—(A communication from W. L. Williams.) 6d.

A cylinder A is supplied with the bran or other material to be packed through a shoot at the upper end, and to the lower end of the cylinder the bag to receive the bran is secured. Within the cylinder revolves a shaft C carrying a cam L which acts upon

3767



loosely-fitting sleeves K mounted on the stamp shafts I, and having pivotted latches which the cam forces to engage with teeth on the upper end of the stamp shafts, which are thus raised, and when the cam has passed the stamps fall and compress the bran in the bag.

3768. TUBE STOPPER FOR STEAM BOILERS, A. M. Clark.—Dated 16th September, 1880.—(A communication from L. G. Jovet.)—(Not proceeded with.) 2d.

The stopper consists of a long rod having near its ends fixed collars, two discs of india-rubber, leather, or other flexible material, two other rigid and slightly cupped discs and nuts screwing on the threaded ends of the rod.

3770. COOLING OR WARMING MILK, E. Fitch.—Dated 17th September, 1880. 4d.

The apparatus consists of a pipe, or pipes, coiled in a helical form; one end of the said pipe or pipes forming the coil is passed through the coil ready for connecting to a cistern or other vessel containing either the hot or cold liquid or vapour it is desired to circulate through the milk, and the other end of the coil forms the outlet for the circulating liquid or vapour.

3771. MANUFACTURE OF WHITE LEAD, H. Koenig.—Dated 17th September, 1880.—(Not proceeded with.) 2d.

Strips of metallic lead are cut in such a way that they shall assume a helical, spiral, or other like form. These helices are suspended or otherwise suitably placed in a closed receptacle or chamber, and therein exposed to the action of moist air, acetic acid, vapour, and carbonic acid gas; these are introduced at a temperature of 150 deg. Fah., or thereabout, either separate or together.

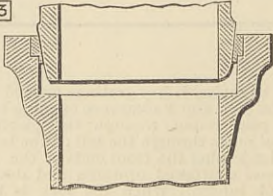
3772. IRON FRAMES AND PLANKING FOR COMPOSITE SHIPS, G. Allix.—Dated 17th September, 1880.—(Not proceeded with.) 2d.

This consists in making an inclined or single wedge-shaped projection from the two sides of the bottom web of the angled iron frame; the inside of the bottom web is slightly dished, so that the single wedge-shaped projection of one side is of the same depth as that at the other side, and also to lighten the frame without interfering with its strength. The projecting flange to which the back angle iron is secured is parallel on both its side faces, and it is proposed placing the back angle iron on the inner side face of this flange to enable the spaces between the single wedge-shaped surfaces of the angle frame to be caulked, the grooved portions of the planking having under-cut sides for that purpose. The caulking forms a filling up and so secures the planking to the angle frames, that fastenings can be dispensed with if desired.

3773. JOINTS FOR CAST IRON PIPES, J. Page.—Dated 17th September, 1880. 6d.

This consists essentially in making the joint between two lengths of cast iron pipes by means of a ring of lead placed in the faucet or socket of one pipe length prior to the insertion of the spigot of the other pipe

3773



length, the lead ring being of a shape to be forced into a form completely and tightly filling the joint space provided for it by the action of the spigot, which is of a tapered form, like that used in turned and bored joints.

3776. MACHINERY FOR PRINTING IN COLOURS, T. A. Middleton.—Dated 17th September, 1880.—(Not proceeded with.) 2d.

This relates to improvements on patent No. 2268, dated 30th May, 1876. The material is drawn forward by a pair of reciprocating grippers arranged on opposite sides of the machine, and connected by rods to cranks on the main driving shaft. The length of stroke of these cranks may be adjusted according to the amount of material to be drawn forward to correspond with the size of the printing surface employed. The reciprocating grippers deliver the material to a pair of stationary grippers, which hold it securely during the printing operation. The printing operation is effected by pressing the material on to the printing surface by means of pressing rollers.

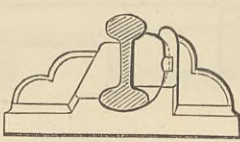
3777. PROPELLING VESSELS, H. Montgomerie.—Dated 17th September, 1880.—(Not proceeded with.) 2d.

Keyed upon the shaft of a screw propeller is a drum actuated by a head of water, natural or artificial, or both natural and artificial, operating upon the periphery of the same.

3778. PERMANENT WAY OF RAILWAYS OR TRAMWAYS, J. Holden.—Dated 17th September, 1880. 6d.

This consists, first, in placing on one or both jaws of the chair a bent, curved, or other suitably formed spring, the ends of which may be bent, so as to clasp and be held in position on the jaw of the chair; the key or wedge is grooved or recessed in the direction of its length, to correspond in shape with the pressing surface of the spring on which it is driven; the latter

3778



forms an elastic medium, whereby the key or wedge will become firmly pressed against the side of the rail, the said spring accommodating itself to the varying expansion or contraction of the key or wedge. The second part consists of a recess or cavity so formed on the inner face of one or both of the jaws of the chair, that the ends or entrance to the chair for the key or wedge will be of a less gauge or width than at the centre of the jaw, in such a manner that as the key or wedge is driven between the jaw of the chair and side of the rail it will swell and expand itself within the said recess or cavity.

3782. TILT CARTS, W. Bowen.—Dated 17th September, 1880.—(Not proceeded with.) 2d.

This consists in fixing the tail board to a frame formed by a rearward extension of the shafts, and in making the cart body tilt independently of the tail-board, which remains stationary, so that when the body is in the horizontal position it is closed at back by the tail-board, but when tilted it is unclosed, and its contents shot out beneath the tail-board.

3787. MACHINERY FOR OPENING, CLEANING, SCUTCHING, AND BREAKING UP COTTON, &c., R. Tatham and J. Taft.—Dated 18th September, 1880.—(Not proceeded with.) 2d.

This relates, first, to a method whereby the material is fed to a machine after being operated upon by a beater or equivalent apparatus to be delivered at two or more places simultaneously, and formed, if desired, into two or more laps; secondly, to apparatus by which irregularities in the quantity of material fed to machinery for opening, cleaning, scutching, and breaking up cotton and other fibrous materials are indicated and registered.

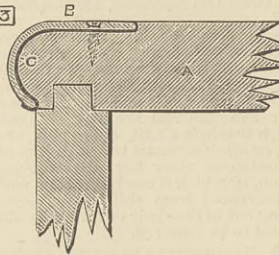
3791. BURNERS AND APPARATUS FOR OBTAINING LIGHT BY COMBUSTION OF GAS OR INFLAMMABLE VAPOURS, S. and S. R. Chatwood.—Dated 18th September, 1880.—(Not proceeded with.) 2d.

This arrangement of burner and apparatus consists of mechanism by which mixed gas or vapour and air contained under pressure is allowed to issue in a jet or stream, which is ignited and caused to traverse a gauze of platinum or other more refractory metal, or any alloy of the same, and so produce light.

3793. NOSINGS FOR STAIR TREADS, F. W. Hembry.—Dated 18th September, 1880. 4d.

A is the wooden stair tread, to which is applied the

3793



nosings B of vulcanised india-rubber, held in a sheet metal frame C, and secured to the tread by screws.

3794. SADDLE TREES, C. S. Cooling.—Dated 18th September, 1880.—(Not proceeded with.) 2d.

The belly of saddle trees are constructed of wood or other non-yielding material, and so arranged as to admit of the skirt of the saddle being brought over it.

3795. ATTACHING DOOR-KNOBS AND DOOR-HANDLES TO THEIR SPINDLES, E. Collins.—Dated 18th September, 1880.—(Not proceeded with.) 2d.

The ordinary knob and plane spindle are used. To the face of the knob centrally is made a semicircular recess with a hole in the centre; to the spindle at one or both ends is drilled a hole; this is then screwed, the spindle being placed in the square of the lock; the knob is then adjusted. A screw, specially provided, is passed through the hole in knob and into the spindle the desired distance, fitting itself in the semicircular recess.

3800. WATCHES AND CLOCKS, G. F. Böhme.—Dated 18th September, 1880.—(Not proceeded with.) 2d.

This consists in so connecting the main spring on to the barrel that when the spring is fully wound its power shall be applied in a direction more or less normal to the circumference of the barrel, and that as the spring unwinds the power shall be gradually applied more nearly in the circular direction of the barrel, whereby the power transmitted from the main spring to the train is equalised by causing the power to be so applied as to be less or more effectual for turning the barrel, according as the spring is fully wound or not.

3804. APPARATUS FOR TREATING FLOUR, GRAI &c., F. Wirth.—Dated 20th September, 1880.—(A communication from H. Seck.)—(Not proceeded with.) 2d.

Instead of constructing the screening surfaces as the regular sides of the polygon as heretofore, they are placed at greater or less inclination to such position, that is to say, the distance of the one longitudinal edge of each polygonal side from the centre of the drum is greater than the distance of the other edge, the inclinations of the several sides being all in one and the same direction, so that a series of steps are formed at their junctions.

3806. BUTTONS AND THEIR ATTACHMENTS, H. J. Haddon.—Dated 20th September, 1880.—(A communication from N. Fritzer.) 4d.

This consists in forming the button of any material with a conical-shaped shank combined with two metallic prongs depending therefrom; the attachment consists of a cup-like disc shaped to receive the button shank, perforated to receive the two prongs, and made with a groove or recess underneath, into which the button prongs, after being passed through the stuff, are clenched and lie.

3807. DRIVING BELT OR BAND, S. A. Dickens.—Dated 20th September, 1880.—(A communication from O. Dickens.) 6d.

This consists in the use of flat plaits or braids of esparto grass, cocconut, or other similar coarse fibre, set on edge and side by side, and laced or tied together by hempen cords or their equivalent, for the purpose of producing a compound fabric.

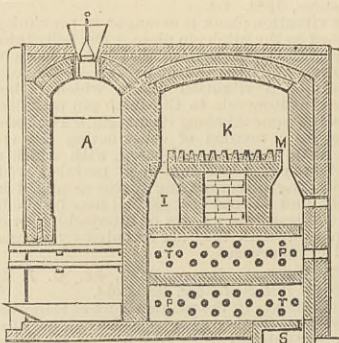
3808. DYNAMO MACHINES, F. G. Willatt.—Dated 20th September, 1880.—(Not proceeded with.) 2d.

An armature is cast in one solid piece having four or more, but preferably six blades, broad at the end and narrowing somewhat towards the centre. Each blade is wound in the same direction and coupled up so as to form north and south poles across the centre of the armature when in motion, and round the armature extends a stationary soft iron magnet composed of two parts, one acting as N and the other as S, and preferably circular in form so as to fit round the armature and economise space. The two sections of the magnet may be joined by suitable tongues projecting internally from each end of each section and bolted through, and the magnet then wound so as to bring the two N ends together and the two S ends together, and the facings which extend nearly round the armature are then secured to the tongues, again forming N and S in themselves. It is preferred to arrange the blades of the armature alternately a little to the right and left in the direction of its longitudinal axis upon the centre boss, so as to allow of a wire being intertwined amongst the blades without extending the breadth of the armature.

3811. PROTECTION OF IRON AND STEEL SURFACES, G. and A. S. Bover.—Dated 20th September, 1880. 6d.

This relates to the furnaces to perform the operations of oxidising and deoxidising the surfaces of iron and steel, and also the production of a protective coating by the combustion of hydrocarbons. The drawing shows the furnace employed. A are the producers for gasifying the fuel employed, and from which the

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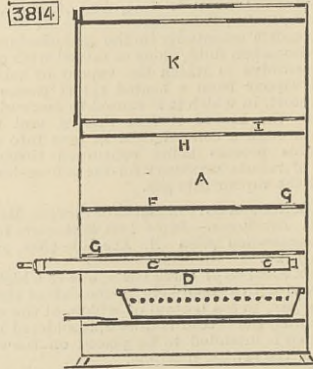


carbonic oxide passes along a conduit to an opening, where it meets a current of hot air and is consumed. The products of combustion are thence conducted along another passage, where they are thoroughly mixed by open brickwork walls, and then return along the passage I and enter chamber K, in which the articles to be coated are placed. After passing over these articles, the waste escapes through ports M into regenerator chambers P, and thence to the chimney flue S, heating in its passage the tubes T forming the regenerator.

3814. GAS OVENS FOR COOKING, T. Fletcher, F.C.S.—Dated 20th September, 1880. 4d.

The oven A is fitted in front with a hinged door, and is heated by the gas burner C placed beneath and outside the bottom of the oven in the space D, which is utilised for grilling or toasting. The bottom E of the

3814



oven as well as the shelf F have openings G for the passage of the heated air and products of combustion through the oven, which then pass through the opening H into the casing I, and thence to the top oven K, afterwards passing to the chimney flue.

3815. CLEANING AND POLISHING BOOTS AND SHOES, G. Mattison.—Dated 21st September, 1880.—(Not proceeded with.) 2d.

This consists in a stand or platform fitted with a hinged last or lasts, which can be adjustable in their sizes, or various sizes can be placed in position. The boot or shoe to be cleaned is placed on this platform with the last inside, and held in position by a clamp or otherwise. By throwing back the last on its hinge the foot with the boot on can be placed on the platform, and the cleaning then performed. A lever or its equivalent is arranged swivelling on a centre underneath the platform, and furnished with removable curved brushes, the distance between which can be adjusted to suit the size of the boot or shoe to be cleaned.

3817. CORKING OR STOPPERING BOTTLES, H. W. Beckton.—Dated 21st September, 1880.—(Not proceeded with.) 2d.

This consists in forming a plug of cork, wood, or other material, covered with cork, india-rubber, or other yielding substance, and of a wedge or conical form at its lower end to fit closely into a corresponding wedge or conical shaped neck of the bottle, in which position it is securely held by a wire passing round the neck of the bottle and over the plug or stopper; the ends of the wire are then twisted together as in the ordinary way of wiring.

3821. ACTUATING AND REGULATING CLOCKS, H. J. Haddon.—Dated 21st September, 1880.—(A communication from Dr. L. Mautner.)—(Not proceeded with.) 2d.

The apparatus consisting of electric, hydraulic, or pneumatic mechanism, is combined with an accurate pendulum clock, which may be placed inside a column for ordinary street use; said clock is supplied with air and water cylinders furnished with convenient inlet and outlet pipes, and also with rods and racks attached to the clock mechanism. The electric mechanism is in communication by wire with an observatory clock, and an assistant there makes electrical contact at stated times, and thereby moves the anchor of a regulating movement in the clock, and so controls the time of said clock. Water is allowed to pass into the water cylinders and the air compressed therein and within the air cylinders, their rods and racks are moved, and concurrently similar mechanism in other or subsidiary clocks placed in air and water communication with the air and water mechanism of the main clock.

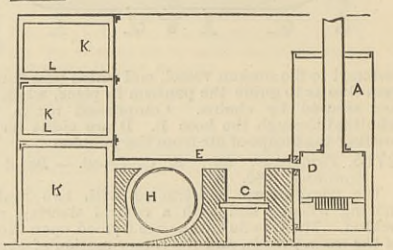
3823. BUTTONS, &c., J. Cadbury.—Dated 21st September, 1880. 6d.

In making a glove button a blank is used having the form of a nearly circular disc, with four equidistant and similar arms at its edge. These arms are nearly of a triangular shape, and when partially folded or closed upon the disc, form a nearly complete conical back to the disc, the ends of the arms not meeting but leaving an opening opposite the centre of the disc. The said disc constitutes the front of the button and the partially closed arms the backs. The extreme ends of the radial arms are doubled, so as to form at those points rounded eyes. Or the button may be made from two sheet metal blanks, so as to form a back and a front which are secured together, the back having a conical figure.

3825. KITCHEN RANGES, R. Neville.—Dated 21st September, 1880. 6d.

A is a vertical boiler with an internal fire-box, from which a vertical flue rises in the ordinary manner. Through the side of the fire-box is a flue D leading into the flue below the hot plate E, beneath which

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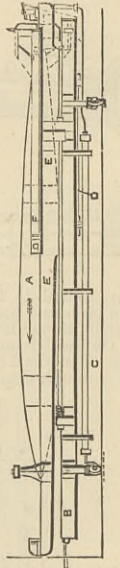


is a fire-grate. Beside the fire-grate is placed a horizontal cylindrical boiler H, round which the fire is made to pass through flues, which afterwards proceed to theovens K placed one over the other, round which they pass entirely, proceeding from one oven flue to the next through openings in the division plates L.

3826. LAUNCHING TORPEDOES, P. Brotherhood.—Dated 21st September, 1880. 6d.

This relates more particularly to apparatus for launching fish torpedoes, and has for its main objects, first, facilitating the placing of the torpedo on the apparatus; and, secondly, to effect the rapid propulsion of the torpedo through the ship's port, and simultaneously launching it, thus avoiding any exposure of the torpedo outside the ship until the moment of launching. For this purpose a frame B is pivoted at its forward end, and supported on a pair of front wheels, and a pair of hind wheels running on circular ways so as to be trained to various angles of direction. In this frame are fixed a number of receivers C in the form of strong tubes communicating by pipes with each other for holding a charge of compressed air. On the carriage is also a cylinder D fitted with a telescopic piston, the rod of which is

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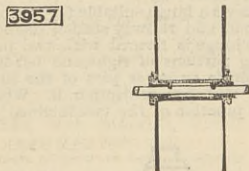


attached to a frame E sliding on the upper face of the frame B. On the frame E is a second sliding frame F which supports the torpedo A, the tail end of which is placed in a cage on the frame, its middle being supported by lugs fitting into recesses upon the frame, where they are held by catches, which are released by stops on the under frame when the upper frame and torpedo are projected forward. When in the backward position the upper frame E is retained by a catch at the rear end, which is withdrawn at the same

The top part has two apertures for the expulsion of air. The whole internal surface of the casing is provided with a series of steel bars placed at a distance of about 2 centimetres from the casing, these bars being preferably about 2 centimetres broad, 5 or 6 millimetres thick, and placed about 5 or 6 millimetres apart, so as to form a cylindrical grate inside the apparatus. These bars extend from one wall to the other, and are rigidly fixed by means of flanges provided at each end, and a small pin in their centre. At about a quarter of the height of the apparatus, and about parallel with the exit of the cylinder, is a shaft set in motion by a pulley and a belt; this shaft carries a cast iron drum which moves inside the apparatus, and is provided with a certain number of steel bars dovetailed into the cylindrical portion of the drum, and parallel with its axis.

3957. MANUFACTURE OF TOBACCO, E. J. Kennedy.—Dated 30th September, 1880. 6d.

This relates to the construction of apparatus for the purpose of combining the operations of spinning and rolling tobacco, or for rolling separately, and has also reference to improved means of treating and preparing tobacco rolls for sale. A sheath or tube is made corresponding in length with the width of the cradle of the spinning machine, which sheath is passed over the ordinary machine spindle, and around the interior of each end is formed a shoulder or ring provided with a spur or key, which catches in a groove formed in the machine spindle for the purpose of causing the sheath or tube to revolve with the machine spindle. Discs or metal plates are then slipped over the ends of the sheath or tube, abutting against rings or shoulders formed round the circumference of said ends, and leaving a small portion of the ends project-



ing through the discs, on which metal collars are secured. The drawing shows a longitudinal section of the reel. When the reel receives its proper quantity of tobacco it is removed and subjected to the second part of the invention, which consists of first driving in a peg to secure the end of the roll, and then wrapping a strip of cloth or other suitable material around the circumference of the roll, leaving a margin or flap all round over the ends of the roll, and outside this cloth are wound several coils of rope. One of the discs is now removed, and the margin or flap of the cloth turned over on the end of the roll and secured thereto by pegs. The roll is then turned upside down and the second disc removed, and the margin or flap of the cloth on this side treated as on the other end of the roll. The sheath or tube is then driven out, and the roll is ready for steaming or pressing.

4015. PRINTERS' METAL FURNITURE, P. M. Justice.—Dated 4th October, 1880.—(A communication from J. L. Chapin.) 6d.

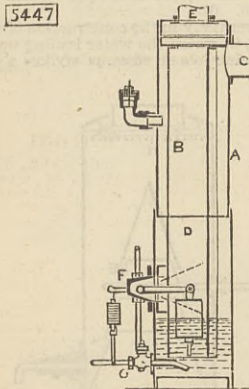
This consists in making printers' metal furniture of cast iron instead of type metal.

4453. TAR-INHALING CIGARS, &c., A. Rousseau.—Dated 1st November, 1880. 6d.

This consists of a tube shaped to represent a cigar, but perforated to allow the passage of air into the mouthpiece, through which it passes and becomes charged with tar or other medicaments, contained in the mouthpiece, before passing into the chest and bronchial tubes.

5447. PURIFYING STEAM, &c., J. F. Belleville.—Dated 28th December, 1880.—(Complete.) 6d.

This relates to an arrangement for purifying steam from particles of water and other suspended matters, and is effected by a continuously descending circular current between two concentric cylindrical walls, affording the steam a channel of large sectional area, in which it can flow always in the same direction and without sensible loss of pressure. It consists of a



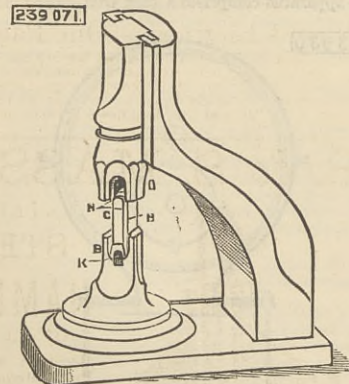
vertical cylinder A and an inner concentric cylinder B, the space between them being closed at top and along its entire height on the side of the steam inlet C, but open at the bottom and along its entire height at the side farthest from the steam entrance, the chamber D within the cylinder B leading to the steam outlet E. F is an automatic cleansing cock, and G a blow-off cock with a dipping pipe. A regulator of improved construction is used in combination with this apparatus, and serves to regulate the pressure and flow of the steam.

SELECTED AMERICAN PATENTS.

From the United States Patent Office Official Gazette.

239,071. MACHINE FOR WELDING LINKS, Henry C. Szink, Altoona, assignor of one-half to Lewis R. Paffenberger, same place.—Filed May 5th, 1880.

Claim.—In a machine for welding chain links, the

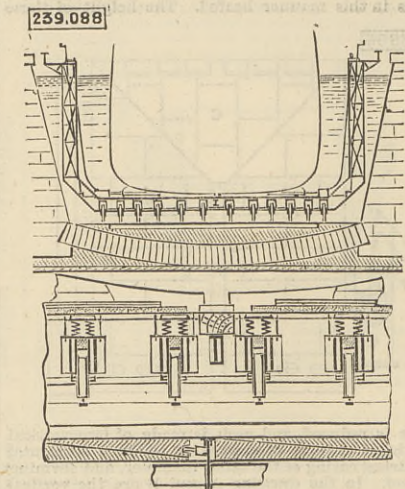


anvil B, recessed, as shown, and having the anvil die G resting in said recess and projecting upwardly above the horizontal face of the anvil B, the anvil die G being notched and recessed at K, rabbeted at H, and

grooved at H', in combination with the upper die section D, recessed at I and grooved at J, constructed and operating substantially as and for the purposes set forth.

239,088. SHIP RAILWAY CAR AND DRY DOCK, James B. Eads, St. Louis, Mo.—Filed July 12th, 1880.

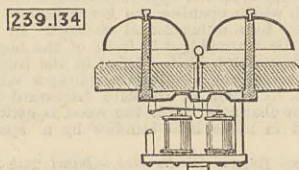
Brief.—A cradle provided with compound wedges working longitudinally under the keel and transversely beneath the bilge, and moved by the pressure of hydraulic jacks to force each wedge firmly home to their bearings while the vessel is afloat. The wedges are provided with pawls, which hold them securely in position. There is also combined with the cradle any necessary number of cars constructed with cross beams and provided with pedestals, stirrups, and springs, to afford a uniform support to the cradle. Claim.—(1) The combination of the wedges and the hydraulic jacks for setting the wedges up under the



keel and bilge of a vessel, substantially as herein described. (2) The combination of the wedges G J, jacks F F, and pawls L, substantially as and for the purposes set forth. (3) The combination, in a ship railway car, of the pedestals Q, springs N, cross bars U and V, and stirrups Q', substantially as and for the purposes set forth.

239,134. SIGNALLING APPARATUS FOR DISTRICT TELEPHONE SYSTEMS, George Lee Anders, Boston, Mass., assignor to American Bell Telephone Company, same place.—Filed August 7th, 1880. Patented in Canada January 21st, 1880; in Belgium, June 15th, 1880; in Spain, October 20th, 1880; in Italy, July 30th, 1880; and in England, May 12th, 1880.

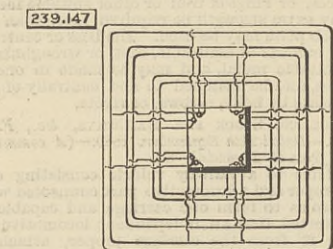
Claim.—In an electric circuit, two polarised electromagnets for operating signal bells, the armatures of



said magnets being normally held by springs or their equivalents at poles opposite in relation to each other, substantially as and for the purposes set forth.

239,147. SYSTEM OF ELECTRIC LIGHTING, Thomas A. Edison, Menlo Park, N.J.—Filed August 9th, 1880.

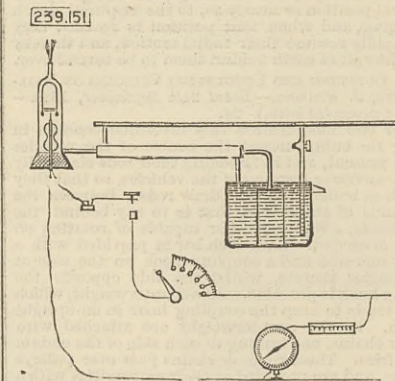
Claim.—(1) The method of laying the conductors in an electrical supply system, consisting in laying them in sets concentrically, as explained, each set being connected to the central station by several sets of branch conductors, and the various sets being connected to each other by several sets of coupler conductors, substantially as set forth.



conductors in an electrical supply system, consisting in laying them in sets concentrically, as explained, each set being connected to the central station by several sets of branch conductors, and the various sets being connected to each other by several sets of coupler conductors, substantially as set forth.

239,151. METHOD OF FORMING ENLARGED ENDS ON CARBON FILAMENTS, Thomas A. Edison, Menlo Park, N.J.—Filed November 24th, 1880.

Brief.—Heats by incandescence only the ends of the filaments in a hydrocarbon vapour. Claim.—(1) The method herein described of forming enlarged ends upon carbon conductors, consisting in forming an electrical circuit only through the portion desired to be enlarged, thereby heating the same in a vessel,

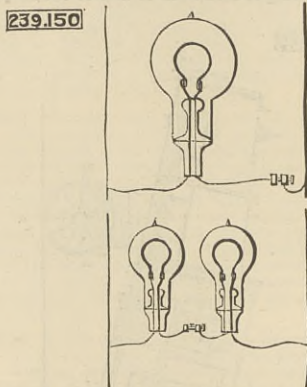


through which flows a stream of vapour from a carbon compound, substantially as set forth. (2) The combination of a receiving globe or chamber, means for passing therethrough a stream of vapour from a carbon compound, and means for forming an electrical circuit through any desired portion or portions of a carbon conductor within said globe or chamber, substantially as set forth.

239,150. ELECTRIC LAMP, Thomas A. Edison, Menlo Park, N.J.—Filed August 6th, 1880.

Claim.—(1) The combination, with one derived circuit, of a multiple arc system of two or more lamps, each of a fractional resistance and radiating surface of the resistance and radiating surface of the standard

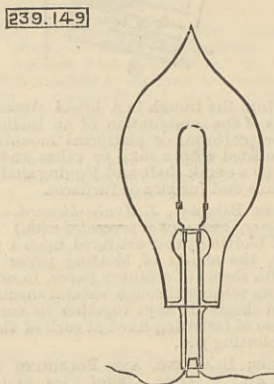
lamp of the system, the fraction being the number used, substantially as set forth. (2) The combination, with one socket or holder and one derived circuit, of one circuit controller and two or more lamps, each of



a fractional resistance and radiating surface of a standard lamp, substantially as set forth.

239,149. INCANDESCING ELECTRIC LAMP, Thomas A. Edison, Menlo Park, N.J.—Filed December 15th, 1880.

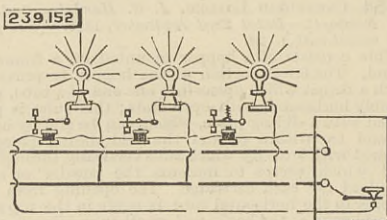
Claim.—(1) In an incandescing electric lamp, the supporting neck formed with a concavity at the point



where the leading wires pass through and are sealed therein, substantially as set forth. (2) The supporting neck formed with a solid glass projection, to and upon which the enclosing globe is supported and sealed, substantially as set forth.

239,152. SYSTEM OF ELECTRIC LIGHTING, Thomas A. Edison, Menlo Park, N.J.—Filed October 30th, 1880.

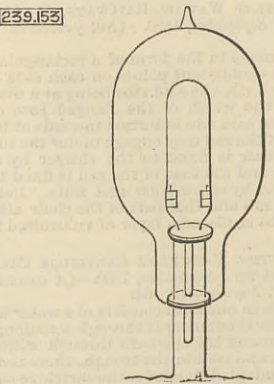
Claim.—The combination, with a main circuit and branch or multiple arc circuits, and translating devices in the latter, of a controlling circuit and devices therein controlling or governing the circuits through



the translating devices, and means in the controlling circuit for causing, at will, the controlling or governing devices therein to operate, substantially as set forth.

239,158. ELECTRIC LAMP, Thomas A. Edison, Menlo Park, N.J.—Filed August 27th, 1880.

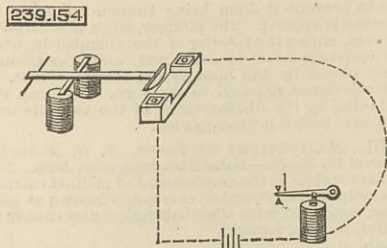
Claim.—(1) The combination, with the glass enclosing globe and incandescing conductor of an electric lamp, of a support hermetically sealed to the globe and supporting the carbons at a distance above the point of sealing, substantially as set forth. (2) The combina-



tion, with the conductors of an incandescing electric lamp, of a glass support, to which the conductors are sealed at two or more points, one near the clamps and one where the conductors enter the enclosing globe, so that the latter point is removed a little distance from the former, substantially as set forth.

239,154. RELAY FOR TELEGRAPHS, Thomas A. Edison, Menlo Park, N.J.—Filed December 14th, 1880.

Claim.—The combination, with a local circuit and instruments therein, of a flexible high resistance in

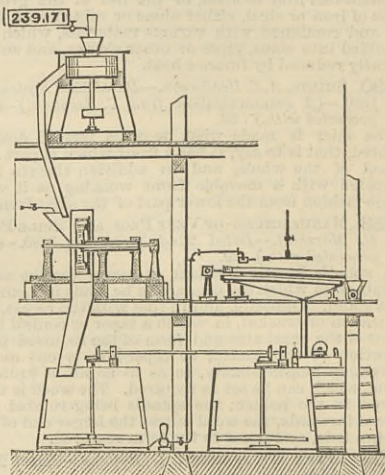


such circuit, and a metallic contact resting therein and controlled by the main circuit, substantially as and for the purpose described.

239,171. METHOD OF OBTAINING STARCH FROM GRAIN, Thomas A. Jebb and William T. Jebb, Buffalo, N.Y.—Filed February 5th, 1881.

Claim.—The herein-described method of obtaining starch from grain, which consists in first grinding the grain high with water, whereby the greater portion of the starch is loosened and carried onward with

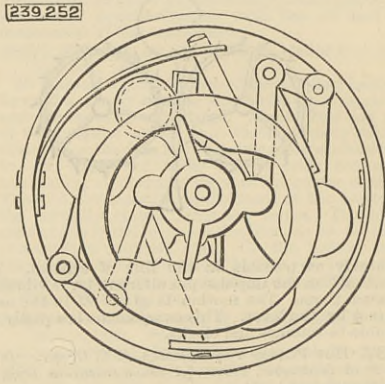
the water, while the bran and gluten are coarsely broken, then whipping or beating the wet ground grain, whereby any starch which still adheres to the fragments of gluten and bran is detached therefrom without pulverising the gluten and bran, and the whole is carried off with the water, and then sepa-



rating the gluten and bran from the water with which the starch is mixed by sifting, substantially as set forth.

239,252. STEAM ENGINE GOVERNOR, Edward Huber, Marion, Ohio.—Filed December 21st, 1880.

Claim.—In combination with the main shaft of an engine, the disc as described, the levers pivoted thereto and provided with governor weights, the



collar secured to the hub, which connects the lever with said collar, and said hub provided with friction arms having gibbs, the eccentric operated by said friction arms, and the arms for confining the gibbs to their seats, substantially as and for the purposes specified.

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INSTITUTION OF ENGINEERS AND SHIPBUILDERS IN SCOTLAND.—At the twenty-fourth annual meeting of this Institution, held in the offices, Bath-street, Glasgow, on Tuesday night last, the Institution's medal for the session 1879-80 was awarded to Mr. John Thomson for his paper "On the St. Petersburg Waterworks." The chairman asked the support of the members towards the establishment of a lectureship of Naval Architecture and Marine Engineering in the University of Glasgow. A discussion then took place on a paper by Mr. Andrew Jamieson "On the Technical Education of our Young Engineers, Shipbuilders, and Artisans." Mr. William Rowan, of Belfast, afterwards read a paper "On Pistons."

THE MILLING INDUSTRY IN MINNEAPOLIS.—It is stated that one of the leading mills in Minneapolis is being enlarged to a capacity of 4200 barrels daily. The daily output of the mills having a capacity of 1000 or more barrels a day is 15,650 barrels for seven mills. Nineteen other mills, ranging in capacity from 800 barrels each down to 75 barrels, give a grand total of 24,275 barrels.