THE EXPORT OF IRON AND STEEL.

THE subjoined table is designed to illustrate the development of the export trade of iron and steel from Great Britain to foreign countries. The diminutive character of this branch of commerce which prevailed in the early part of this century is easily explained. Iron was not then put to a variety of uses as is the case at present. There were no iron bridges constructed, nor was much iron required in any kind of building operation. In short, it is only necessary to remember that in the year 1814 the British Empire possessed but one steamboat; the first passenger train was not run until October, 1825. Again, our mining enterprise was even at the last-named date confined to comparatively a very small compass. The quantity of coals shipped from all ports of Great Britain, coastwise, to other ports of the kingdom, to Ireland, to the British colonies, and to all foreign countries, is shown, by official records, in the year 1819, to have been limited to 4,365,000 tons in all. The narrow limits of the iron trade were compassed by then existing circumstances. Nevertheless, the iron industry had attained even at the remotest period a development on a far larger scale than obtained in other countries. Looking to France, among other continental countries, it is shown that the production of iron, though fairly developed, did not keep pace with the daily increasing consumption. Official records in France show that from 1821 to 1830 the imports of foreign smelted iron amounted to 834,435 quintals, of which quantity 268,634 quintals had been received from the British Isles. In the following decade, 1831-1840, the imports are recorded as having been 1,329,636 quintals, and thereof, more than one-half, namely, 755,354 quintals, were of English origin, the remaining portion having been obtained from Belgium, Russia, and Sweden. During the two decades, *i.e.*, 1821-1840, France imported of hammered and malleable iron 1,263,561 quintals. The larger portion thereof likewise came from England, though at the close of the period —1840—there was a visible decline by reason of the development which home production had attained in France. The records tend to prove that from 1,435,000 quintals, the home production in 1825, had risen to 2,312,000 quintals in 1839. In addition to France and other European countries, the United States were more or less dependent on Great Britain for the supply of iron and steel. Though their mineral wealth was known at an early stage to be unsurpassed in magnitude, it has remained in a state of infancy until very recently. The exports from Great Britain, in the earlier part of this century, of unwrought steel found for the most part a market in the United States. The same may be said of various kinds of wrought and unwrought iron. The imports from England into the United States are summarised from the official records as follows :—

	Period. 1831-35. Tons.	Period. 1836-40. Tons.	Period. 1841-45. Tons.
Iron, all kinds	351,603 ..	446,720 ..	483,717
Steel, unwrought	11,023 ..	13,534 ..	12,986

These items convey an idea of the comparatively moderate demand from abroad. On the other hand, British enterprise was paving the way for the development of a magnificent future. From the single steamer which existed in the year 1814, a large fleet had been raised. Reversing the odd figure and turning to the year 1841, there were found to be registered 771 steam vessels measuring 87,928 tons, as belonging to the United Kingdom. In the same year, 1841, the network of British railways comprised 1261 miles, while in all France, Germany, Austria, Belgium, and other minor continental States, the entire mileage in operation was equal to about 1400 miles, with a population more than fourfold larger than England. On the other side of the Atlantic they had outstripped Europe. The United States possessed at the same date as above more than 3000 miles of railroad tracks—some of them constructed, to say the least, in a very primitive manner, but they answered their purpose. When railway enterprise was in its infancy the point of consideration was: would it be wiser to wait until the United States proved in a condition to make rails at home, or to import them from Great Britain? The manufacture of rails called for a large outlay; the United States lacked not only the capital, but, above all, the experience for manipulating the fabrication of iron. In absence of these *desiderata* it would have retarded the progress of the country in far too serious a manner. They could not stand still until the bantling attained maturity. Though things have undergone great changes since 1840-45, there is still much of the same feeling abroad, and every nerve is strained to arrive in the United States at a point, sooner or later, to render the supply of iron and steel rails independent of imports.

Looking back to the year 1840, it will be seen that the total export from Great Britain of wrought and unwrought iron and steel aggregated in that year 268,327 tons, while, already in 1855, the quantity so exported exceeded 1,000,000 tons. Taking first pig iron, there were shipped in 1821, 4484 tons; in 1831, 12,444 tons; in 1841, 85,867 tons. Thence the circle of our foreign clients largely widened. The shipments of pig iron had risen in 1851 to 201,264 tons, in 1861 to 388,004 tons, in 1871 to 1,057,458, and in 1881 to 1,480,196 tons. To sum up, pig iron, the export of which in the quinquennial period of 1841-5 averaged annually 102,362 tons, has risen to an average annual export of 1,114,185 tons in the period 1876 to 1880, while the average is exceeded in 1881 by 370,000 tons. These figures cannot be contemplated with indifference when it is observed that the rise in other descriptions is not commensurate, but, as a matter of fact, exhibit more or less a serious decline. As a contrast to the foregoing, we point to the items comprised under the head of "Bar, Bolt, and other Iron." The period 1841-45 shows an average annual export of 198,653 tons; in the five years comprising 1876-80, the average has risen to 247,049 tons. The increase during forty years shows only a very small percentage indeed, when it is observed that the quantity of pig iron exported during the same period has augmented more than tenfold.

The distribution of exports of pig iron occurs in the following manner:—In 1869, the year when the volume of shipments began to increase, Germany and the Lowlands took about 300 tons in the aggregate; Italy, Spain, and other countries, together about 100; the United States, 130; France, 100; Australia and Canada together about 100; say, total, 710,000 tons. The year that followed, 1870, exhibited but little variation. But from 1871 down to 1881 the shipments of pig iron have enormously increased. In lieu of 300 tons, as shown above, Germany, Holland, and Belgium have taken on the average in rough numbers nearly 600 tons annually; the United States have taken during the ten years referred to, roundly, 1200 tons; and the Russians have likewise largely increased their former quota.

While this expansion has taken place in regard to pig iron, the European countries have gradually reduced their purchases in bars, rods, and bolts. Of these descriptions a falling off, varying from 40 to 50 per cent., has taken place in the quantities shipped to Russia, Germany, Holland, and other countries during the last three years, 1879-81, when compared with the shipments of 1876-78; Italy is excepted from the rule. The United States, on the other hand, have somewhat increased; and, finally, the loss on the side of foreign countries is recouped through increased exports to Canada, Australasia, and British India. The aggregate shipments to these colonies show a total of more than 500,000 tons of rod and bar iron during the six years ending 1881.

We proceed now to consider the shipments of rails. Both the year 1880 and 1881 exhibit a marked increase in the total quantities shipped; but the improvement thus shown does not make up for the deficiencies which occur in the four preceding years. The increase in the quantities shipped in 1880-81 is solely due to the larger takings of the colonies, and this is further supported by the revival in the demand from the United States. How long the demand from the latter country will continue is a moot question. The outlet for railway iron has undergone a radical change, and the English rails have been replaced by foreign makes. More than one country passes by our market and draws supplies elsewhere. Russia, who some years ago was a very large customer, has recently taken only small lots of rails. Nevertheless, it seems Russia has been faithful to England, inasmuch as the official tables of imports of that country show that the quantities received agree, as near as possible, with the returns of exports on our side. The changes which have been wrought in the distribution of exports of railroad iron find an illustration in the following summary, comparing the last three years' shipments with those of former periods :—

Shipments of Railroad Iron to the following Sections of Countries. Number of Tons.

	European countries.	United States.	Other American countries.	British possessions.	Various other countries.
	Tons.	Tons.	Tons.	Tons.	Tons.
1860	114,600	138,000	27,900	159,000	14,000
1864	143,800	108,800	42,100	94,026	19,500
1869	373,200	299,200	42,500	142,600	30,000
1874	337,400	94,400	116,000	196,300	29,000
1879	116,900	43,600	62,000	212,800	28,000
1880	63,100	221,100	67,600	324,100	12,000
1881	73,300	294,400	43,800	303,300	100,000

Here again, it will be observed, the shipments to British colonies have tended to make up for the deficiencies of other markets.

The export trade in tin-plates depends to fully three-

Iron, 1801—1881.—The quantities of Iron and Steel exported from Great Britain. Official Returns.

	Old iron for re-manufacture.	Pig and puddled.	Bar, bolt, and rod.	Railroad of all kinds.	Hoops, sheets, boiler plates, &c.	Wrought and manufactured.	Castings.	Wire.	Tinned plates.	Steel unwrought.	Steel manufactured.
	Tons.	Tons.	Tons.	Tons.	Tons.		Tons.	Tons.	Tons.	Tons.	Tons.
1801—05	—	10,443	24,692	—	—		—	—	—	—	—
1806—10	—	8,862*	18,462*	—	—		—	—	—	—	—
1811—15	—	4,539*	46,887*	—	—		—	—	—	—	—
1816—20	—	11,710	157,888	—	—		31,469	—	—	2,916	—
1821—25	—	22,032	152,020	—	—		27,707	—	—	2,661	—
1826—30	—	42,451	245,708	—	—		35,510	—	—	3,470	—
1831—35	—	107,859	385,893		—		64,093	—	—	8,425	—
1836—40	—	220,082	610,519				67,928	—	—	14,949	—
1841—45	23,797	511,811	993,265		332,403		87,517	8,437	—	22,761	—
1846—50	41,155	814,647	1,596,607		489,145		103,503	13,188	—	43,855	—
1851—55	82,394	1,360,548	2,887,715		738,921		286,448	33,619	—	85,388	—
1856—60	91,550	1,801,297	1,471,826	2,335,152	505,017	631,271	379,694	57,091	—	117,527	—
1861—65	57,436	2,288,438	1,433,269	2,064,895	582,629	536,664	383,004	87,310	255,022	126,946	25,354
1866—70	585,864	3,083,106	1,553,791	3,609,482	812,108	1,069,181		111,819	434,844	166,984	46,084
1871—75	372,423	5,254,609	1,484,550	4,040,277	982,315	1,291,843		168,098	619,645	184,874	55,983
1876—80	557,122	5,570,923	1,235,244	2,509,879	1,060,854	1,285,758		235,691	855,745	174,318	58,646
Average last five years.	111,424	1,114,185	247,049	501,976	212,171	257,152		47,138	171,149	34,863	11,729
1881	124,115	1,480,196	294,757	820,671	305,497	291,934		75,118	242,448	167,422	16,178

* Incomplete; records destroyed by fire.

Machinery, Metalware, &c., 1821—1881.—The values of Exports of Machinery and Ironwork.—Official Returns.

	Millwork and machinery.		Implements and tools.	Telegraph wire and apparatus.	Hardware and cutlery.	Fire-arms.	Carriages and railway trucks.
	Steam engines.	Other machinery.					
	£	£	£	£	£	£	£
1821—25	—	615,430	—	—	6,679,436	—	—
1826—30	—	1,154,193	—	—	6,748,043	—	—
1831—35	—	845,203	—	—	7,838,564	—	—
1836—40	—	2,699,339	—	—	8,407,385	—	—
1841—45	—	3,500,705	—	—	9,130,054	1,103,070	318,269
1846—50	1,567,750	3,373,144	—	—	11,225,465	1,462,842	313,536
1851—55	2,650,373	5,929,160	—	—	16,011,867	1,051,417	598,145
1856—60	5,197,267	12,571,329	—	1,601,048	18,621,297	1,589,219	995,850
1861—65	8,047,851	14,688,626	1,382,331	1,219,695	16,972,803	3,719,792	1,866,294
1866—70	9,300,769	15,508,507	1,452,951	4,293,802	18,076,123	2,877,653	1,695,045
1871—75	13,473,635	29,563,008	1,969,616	7,569,600	22,702,133	2,891,596	1,817,824
1876—80	11,350,461	26,623,504	1,982,834	6,608,490	16,668,126	1,402,820	1,276,088
Average last five years ...	2,270,092	5,324,701	396,567	1,321,698	3,333,625	280,564	255,217
1881	3,186,550	6,757,063	No returns	1,974,266	3,859,340	317,538	225,940

fourths in extent on the purchases made by the United States. The trade in that country of canned fruit, vegetables, oysters, lobsters, &c., has assumed such enormous dimensions, that the demand for tin-plates for packing purposes has increased from year to year.

We come now to the exports of cast and wrought and all manufactured goods. This branch of the iron trade does not afford a satisfactory outlook in so far as the old, well-established markets are concerned. The deficiency in shipments is of a very serious character, as shown by the following summary of shipments during the last twelve years to some of our principal markets. For the sake of comparison, and distinguishing the increase or decrease, the twelve years have been divided into two groups, comprising 1870-75 and 1876-81 :—

Statement showing the Quantities of Iron, Cast, Wrought, or otherwise Manufactured, Exported as below during 12 *years.*

	United States.	Russia.	Germany.	Holland	Canada.	British India.	Australasia.
	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.
1870-75 ..	84,200	130,900	131,600	66,000	109,100	152,000	152,500
1876-81 ..	46,800	64,900	69,600	59,500	69,500	249,500	357,500
Increase ..	—	—	—	—	—	97,500	205,000
Decrease ..	37,400	66,000	62,000	6,500	39,600	—	—

Thus we have an increase of about 300,000 tons in shipments to the colonies as an off-set against the losses inflicted by foreign competition in old-established markets. But this is not all—this competition is not confined to markets abroad; but it makes itself felt in our own isles.

It will be remembered that Mr. Gladstone, in a speech before the electors at Leeds, called a noble lord to order for having made the assertion that a railway station at York had been constructed out of Belgian iron. It would be idle here to inquire whether the railway station was constructed at York or elsewhere within the limits of the United Kingdom. Belgian iron is and has been imported during recent years for building purposes. That is an undisputable fact. The Customs House Returns show that between 1876 and 1880 the United Kingdom has imported, in yearly increasing quantities, 229,000 tons of manufactured iron and steel from Belgium. The returns give no details of these imports; but, on official authority, the following statement has been made :—"In 1876 the export from Belgium amounted to 16,310 tons, and in 1877 to 25,887 tons. The latter included 18,000 tons merchant girders, about 1500 tons plates, and 1900 tons iron rails." On these shipments a Belgian contemporary—the *Revue Industrielle*—remarked at the time that, while the facts were most remarkable. it gave satisfactory evidence of the commercial activity and the intelligence of the Belgian metallurgists in bringing their products to the highest point of perfection. It was further remarked that Belgian manufacturers were enabled to purchase pig iron in England, pay freight and charges thereon, and re-deliver the same iron manufactured into beams and girders in the most central part of England at lower prices than it can be made by English firms on the spot. The author of the article went on to say :—"Many persons will remember that, when Belgium began to establish business relations with England, serious doubts were entertained whether these relations would be lasting, or acquire any real importance. Other and older men, in carrying their memories back to the period of the great struggle between free trade and protection—the prophecies of those who saw Belgium crushed by the British giant—Belgium inundated with English produce, compelled to close her factories, and her workmen reduced to beggary — all these prophecies have been often published at the time. Nevertheless, Belgium has been enabled to develope commercial relations, increase the outlet of her produce, and strengthen her position as a manufacturing country; and the truth is, Belgium has resisted better than England the crisis through which they have both been passing."

TENDERS.

ERDINGTON SEWERS.

E. Pritchard, engineer, Westminster, S.W., and Birmingham.

Contract No. 2.—Cast Iron Pipes and Special Castings.

	£	s.	d.
Stacey, Davis and Co., Derby	2890	0	0
Butterley Iron Company, Alfreton..	2446	0	0
Cochrane and Co., Derby	2159	6	0
J. and S. Roberts, West Bromwich—accepted	2055	0	0
C. E. Firmstone and Bros., Stourbridge—not accepted in consequence of failure to compete in stipulated time	2015	0	0
Staveley Iron Company, Staveley—informal			

ST. HELENS.

For new cooperage, washing premises, loading and unloading stages, and pavings, at the Brewery, St. Helens, for Messrs. Greenall, Whitley, and Co. Messrs. Davison, Inskipp, and Mackenzie, architects, 62, Leadenhall-street, London, E.C. Quantities by Messrs. Curtis and Sons.

	£	s.	d.
J. Latham, St. Helens	4864	0	0
J. Whittaker, St. Helens	4720	0	0
G. Harris and Son, St. Helens	4580	0	0
W. Harrison, St. Helens—accepted	4364	5	6

The Utilisation of Tramways at Night.—We recently heard a suggestion with regard to utilising the now very complete system of tramways in the Manchester district for the conveyance during the night-time of goods from the numerous mills in the neighbourhood to the warehouses in the city. We have not heard that the suggestion has yet taken any practical form, but it is worth mentioning as a proposal which might be of great practical utility. At present large quantities of goods are conveyed by road to the warehouses, as this is found more convenient than by entailing the unloading and reloading necessary for transit by rail; and the suggestion is that the tram lines which now connect nearly all the neighbouring manufacturing districts with Manchester might have sidings run out to the mills and warehouses, and that at night, after the passenger traffic has terminated, loaded wagons could be brought on to them and conveyed either by horse or steam power to their respective destinations. So far as the capabilities of the tram lines for this work are concerned, there can be no doubt that they are laid down in a sufficiently substantial manner to carry this class of traffic.

THE CHEMICAL SOCIETY.

THE UNIT OF WEIGHT AND MODE OF CONSTITUTION OF COMPOUNDS.

At the meeting of the Chemical Society, February 2nd, Dr. Odling delivered a lecture on "The Unit Weight and Mode of Constitution of Compounds." The lecturer said that it had been found useful to occasionally bring forward various points of chemical doctrine, upon which there were differences of opinion, to be discussed by the Society. Three questions were proposed: (1) Is there any satisfactory evidence deducible of the existence of two distinct forms of chemical combination — atomic and molecular? (2) Is the determination of the vapour density of a body alone sufficient to determine the weight of the chemical molecule? (3) In the case of an element forming two or more distinct series of compounds, *e.g.*, ferrous and ferric salts, is the transition from one series to another necessarily connected with the addition or subtraction of an even number of hydrogenoid atoms? He would, however, limit himself to the first of these questions; at the same time the three questions were so closely associated with one another that in discussing the first it was difficult to know where to begin. The answer to this question, "Is there any satisfactory evidence deducible of the existence of two distinct forms of chemical combination?" depends materially on the view we take of the properties called in text books "valency," or "atomicity," and before discussing the question, it is important to have a clear idea of what these words "valency" and "atomicity" really mean. It is necessary, too, to start with some propositions which must be taken for granted. These propositions are, first, that in all chemical changes, those kinds of matter which we commonly call elementary do not suffer decomposition; secondly, that the atomic weights of the elements as received are correct, *i.e.*, that they do really express with great exactitude the relative weights of the atoms of the individual elements. If we accept these two propositions, it follows that hydrogen can be replaced atom for atom by other elements, not only by the halogens, but by alkali metals, &c. Hydrogen is, it may be remarked, an element of unique character; not only can it be replaced by the elements of the widely different classes represented by chlorine and sodium, but it is the terminal of the series of paraffins $Cn\,H_{2n}$, $C_3\,H_6$, $C_2\,H_4\,H_2$. The third proposition which must be taken for granted is that the groups of elements $C_2\,H_5\,C\,H_3$ behave as elements, and that these radicals, ethyl, methyl, &c., do not suffer decomposition in many chemical reactions.

Now as to valency or atomicity, accepting the received atomic weights of the elements, it is certain that there are at least four distinct types of hydrogen compounds represented by $Cl\,H$, $O\,H_2$, $N\,H_3$, $C\,H_4$. The recognition of these types and their relations to each other as types was one of the most important and best assured advances made in theoretical chemistry. When we compare the formula of water with that of hydrochloric acid, we find that there is twice as much hydrogen combined with one atom of oxygen as there is combined with one atom of chlorine, and in a great many other instances we find that we can replace two atoms of chlorine by one atom of oxygen, so that we get an idea of the exchangeable value of these elements; and we say that one atom of oxygen is worth two of chlorine, or is bivalent; similarly nitrogen is said to be trivalent. The meaning attached to the word valency is simply one of interchangeability, just as we say a penny is worth two halfpennies or four farthings. The question next arises, Is the valency of an element fixed or variable? If the word be defined as above it is absolutely certain that the valency varies. Thus tin may be bivalent $Sn\,Cl_2$, or tetravalent $Sn\,Cl_4$. Accordingly elements have been classed as monads, dyads, triads, &c. The lecturer objected most strongly to the word atomicity; he could not conceive of one atom being more atomic than another. He could understand the atomicity of a molecule or the equivalency of an atom, but not the atomicity of an atom; the expression seemed to him complete nonsense. He next considered the possibility of assigning a fixed limit to this valency or adicity of an atom, and concluded that the adicity was not absolutely fixed, but was fixed in relation to certain elements, *e.g.*, C never combines with more than four atoms of H; O never with more than two atoms of H, &c. The adicity of an element, when combined with two or more elements, is usually higher than when combined with only one, *e.g.*, $N\,H_3$, $N\,H_4\,Cl$. The term capacity of saturation may be used as a synonym for adicity, if care be taken to distinguish it from other kinds of saturation, such as an acid with an alkali, &c. Adicity is, however, quite distinct from combining force; the latter is indicated by the amount of heat evolved in the combination.

The lecturer then proceeded to criticise a statement commonly found in text books, that chemical combinations suppress altogether the properties of the combining bodies. The reverse of this statement is probably true. To take the case commonly given of the combination of copper and sulphur when heated, this is good as far as it goes, but there are numerous instances, as Cl I, S Se, &c. &c., where the original properties and characters of the combining elements do not completely disappear. The real statement is that the original properties of the elements disappear more or less, and least when the combination is weak and attended with the evolution of a slight amount of heat, and in every case some properties are left which can be recognised. So with reference to the question of atomic and molecular combination; as atomic combination does not necessarily produce change, it does not differ in this respect from what is usually called molecular combination. The lecturer then referred to an important difference in the adicity of chlorine and oxygen; chlorine can combine with methyl or ethyl singly; oxygen can combine with both and hold them together in one molecule. The recognition of this fundamental difference between chlorine and oxygen, this formation of double oxides as opposed to single chlorides marks an epoch in scientific chemistry.

The lecturer then considered the subject of chemical formulæ. It is the bounden duty of every formula to express clearly the number of atoms of each kind of elementary matter which enters into the constitution of the molecule of the substance. A formula may do much more than this. If we attempt to express too much by a complex formula we may veil the number of atoms contained in it. This difficulty may be avoided by using two formulæ—a synoptic formula giving the number of atoms present, and a complex formula, perhaps covering half a page, giving the constitution of the molecule. But between the purely synoptic formula and the very elaborate formula there are others, contracted formulæ, which labour under the disadvantage, as a rule, of being one-sided, and so create a false impression as to the nature of the substance. Thus, for instance, to take the formula of sulphuric acid, $H_2\,S\,O_4$, this suggests that all the oxygen is united to the S, $(H\,O)_2\,S\,O_2$ suggests that two atoms of hydroxyl exist in the molecule; then, again, we might write the formula $H\,S\,O_3\,O\,H$ or $H_2O\,S\,O_3$. All of these are justifiable, and each might be useful to explain certain reactions of sulphuric acid; but to use one only creates a false impression. The only plan is to use them variously and capriciously, according to the reaction to be explained. Again, ethylacetate may be written

$$\left.\begin{array}{l}\left.\begin{array}{l}H_3\,C\\H_2\,C\end{array}\right\}\\\left.\begin{array}{l}O\;\;C\\H_3\,C\end{array}\right\}\end{array}\right\}O \qquad \text{or condensed} \qquad \left.\begin{array}{l}H_5\,C_2\\H_3\,C_2O\end{array}\right\}O$$

$$\text{or } H_5\,C_2\,O\,C_2\,H_3\,O, \text{ or } H_5\,C_2\,C_2\,H_3\,O_2.$$

Now each of these two latter formulæ is a partial formula; each represents a one-sided view; it is justifiable if you use both, but unfair if you use only one.

We now come to the question as to the existence or non-existence of two distinct classes of compounds, one in which the atoms are combined directly or indirectly with each other, and the other in which a group of atoms is combined as an integer with some other group of atoms without any atomic connection by so-called molecular combination. These two modes of combination are essentially distinct. The question is not one of degree. Are there any facts to support this theory that one set of compounds is formed in one way, another set in a different way? Take the case of the sulphates. Starting with $S\,O_3$ we can replace one at O by $H\,O_2$ and obtain $S\,O_2\,(H\,O)_2$ or $H_2\,S\,O_4$; replacing a second atom we get $S\,O\,(H\,O)_4$ or $H_4\,S\,O_5$ glacial sulphuric acid, a perfectly definite body corresponding to a definite class of sulphates, *e.g.*, $H_2\,Mg\,S\,O_5$, $Zn_2\,S\,O_5$, &c.; by replacing the third atom of O we get $S\,(H\,O)_6$ or $H_6\,S\,O_6$. This corresponds to a class of salts, gypsum, $H_4\,Ca\,S\,O_6$, &c. These are admitted without dispute to be atomic compounds. Are we to stop here? We may write the above compounds thus, $H_2\,S\,O_4$, $H_2\,S\,O_4\,H_2\,O$, $H_2\,S\,O_4\,2\,H_2\,O$. If we measure the heat evolved in the formation of the two latter compounds it is for $H_2\,S\,O_4 + H_2\,O$ 6·272, $H_2\,S\,O_4 + 2\,H_2\,O$ 3·092; but if we now take the compound $H_2\,S\,O_4 + 3\,H_2\,O$ we have heat evolved = 1·744, so we can have $H_2\,S\,O_4\,4\,H_2\,O$. Where are we to draw the line between atomic and molecular combination, and why? It comes to this—all compounds which you can explain on your views of atomicity are atomic, and all that you cannot thus explain are molecular. Similarly with phosphates, arsenates, &c.; in all these compounds it is impossible to lay one's finger on any distinction as regards chemical behaviour between the compounds called atomic and those usually called molecular.

Two points remain to be mentioned. The first is the relationship between alteration of adicity and two series (ous and ic) of compounds. Tin is usually said to be dyad in stannous compounds, and a tetrad in stannic compounds, but in a compound like $Sn\,Cl_2\,Am\,Cl$ is not tin, really a tetrad

$$Sn\left\{\begin{array}{l}Cl\\Cl\\Cl\\NH_4\end{array}\right.$$

and yet it is a stannous compound, and gives a black precipitate, with $H_2\,S$; so that valency does not necessarily go with the series. The second point is that an objection may be urged, as, for example, in ammonium chloride—the lecturer stated above that here N was a pentad, the addition of the chlorine having caused the N to assume the pentadic character—it may be said, why should you not suppose that it is the chlorine which has altered its valency, and that the compound should be written

$$N\left\{\begin{array}{l}H\\\left.\begin{array}{l}H\\H\\H\end{array}\right\}Cl\,?\end{array}\right.$$

There is something to be said for this view, but on the whole the balance of the evidence is in favour of nitrogen being a pentad.

In conclusion, the lecturer stated that his principal object was to direct the attention of chemists, and especially of young chemists, to the question, Is there or is there not any evidence derived from the properties, the decompositions, or the relative stabilities of substances to warrant us in believing that two classes of compounds exist—one class in which there is interatomic connection alone, and another in which the connection is molecular?

The Chairman said that at that late hour it was hardly possible to discuss the thoughtful and able address to which the Fellows had just listened. On his own behalf, he might say that he had for some time past given much thought to the question as to how far certain theories were statements of facts, and he had come to the conclusion that it would be better to get rid of such phrases as molecular combination, &c., which were not statements of facts. Such phrases seemed like the blinkers on a horse—only to shut out certain objects which we could not explain. It was better to refer to the unknown as unknown, and not give some fine scientific name to a reaction which we did not understand. The mind was only too ready to become satisfied with such a name, and to accept the word as giving some account of the fact, and thus the motive for investigation is diminished, and the progress of knowledge hindered. He was inclined, too, to dispense with new words for old things, and he would prefer to use the old word "vame" instead of adicity or valency. It was undesirable, too, to class elements as monads, dyads, &c., as their value varied under different conditions. Iodine, for instance, was usually called a monad. It was certainly not in its most stable compounds. It was a pentad or heptad. Only in the unstable H I was it a monad.

Dr. Armstrong said that, according to L. Mezer, there was reason to believe that some of the non-metallic elements behaved in different ways, *e.g.*, the halogens when combined with metals behaved as monads, with the non-metals as polyads, so that there might be two different methods of combination; for instance, in ammonia chloride, the N might be combined with the three atoms of H as in ammonia, and the H Cl add itself on by the affinity of the nitrogen for the chlorine

$$H\,Cl - N\left\{\begin{array}{l}H\\H\\H\end{array}\right.$$

Again, that the compound $Sn\,Cl_2\,Am\,Cl$ gave a black precipitate with sulphuretted hydrogen seemed to him no proof that the compound was a stannous salt. It might be stannic and be decomposed by the sulphuretted hydrogen.

Dr. Frankland must express his admiration of the excellent and logical discourse of Dr. Odling, but must confess that he was somewhat taken at a disadvantage by the ingenious title under which the lecturer had concealed the real subject of his lecture. He thought the term "atomicity" had something to be said for it; it lends itself too readily to the English language. As regards the gradation between atomic compounds and those usually called molecular, it must be remembered that in all departments of nature it was difficult to fix the limit as between plants and animals. As regards the very ingenious and forcible instances of the continued elimination of heat by the union of sulphuric acid and water, he would ask where are we to stop? He had carried the experiments down to moistening a piece of blotting paper with pure water, and surely that was not a case of atomic combination, yet a certain amount of heat was evolved. He would protest, too, against the capricious use of formulæ; it was difficult enough for students to follow the constitution of substances when the formulæ were on a uniform plan, and surely—though his contention might be unscientific—it would be doubly difficult if the formulæ were constantly changing.

Dr. Odling said that though it would be easier for a student to use one form of partial formulæ, he would take only a one-sided view of the substance; and surely it was worth the trouble to look at a substance from all sides, rather than have a false impression by looking at it from one side only. As regards the question of gradation, he had pointed out that the difference between atomic and molecular compounds was one not of degree, but that the compounds must be quite distinct, and ought to show different reactions. As to the stannous chloride, he would take another example which was still more clear, the compound $Fe_2\,Cl_4\,K\,Cl$, which was green and was evidently a ferrous salt, and yet the iron was there in the same condition as regards valency as in $Fe_2\,Cl_6$.

A Cleveland Railway.—The half-yearly meeting of the Cleveland Extension Mineral Railway Company was held on Monday in London. It will be remembered that this company was formed some years since for the opening out of a hitherto undeveloped portion of the Cleveland iron district, by means of a railway extending from Kilton to the Whitby Valley line, near Castleton. On account of the unpropitious state of the trade, practical operations were indefinitely postponed. In the meantime an action was brought against Joseph Dodds, M.P., and others, who had been promoters, for alleged false representations in the prospectus. This action, however, was dismissed with costs as no case against the defendants could be made out. The chairman, Mr. James Goodson, now reports that a commencement is about to be made with the work.

LETTERS TO THE EDITOR.

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

ENGINEERS IN SOUTH AUSTRALIA.

SIR,—I cannot but think it fair that those intending coming out here in search of Government engineering occupation should be made aware of some of the leading advantages and disadvantages to be met with, especially as so little is yet known in England of Australia, and especially South Australia.

These features are: The climate—which is very delightful in autumn, winter, and spring, there being no Indian rainy season, with lengthened periods of rainfall, the rains coming generally in March and April. A slight frost is often experienced in winter, and disappears with the morning sun. Camping out is pleasant and healthy at any time for anyone in even moderate health. The summer is hot—hot enough to be called a hot season—with frequent and sudden changes in temperature, which are very trying to weak people; but not so much as the cold east winter wind. The greatest change in temperature was 40 deg. in two hours, and I have worked in the field with the thermometer at 172 deg. in the sun, and 115 deg. in the shade; yet withal the heat is a dry heat, and therefore not so uncomfortable as a damp heat.

The cost of living is considerably dearer than in England, house rent being about £10 per room. Meat is cheaper; fruit about as dear, when bought in shops; clothes dearer; and servants much dearer.

The country in the hills and on the Murray is fairly picturesque, the foliage being chiefly the Australian gum; but in the plains and up north the scenery is wild and very desert-like, water being very scarce—tanks and dams being relied upon as a water supply, most rivers only running in winter when fed by the rains.

The railway department is all under the engineer-in-chief, and is subdivided into different offices, each having its own manager or head. The drawing-office in the Construction Department is extremely badly managed as regards the conduct of the work and its distribution in its various branches, chiefly caused by the want of direct supervision of the senior officers of the department, all the work having to go through the hands of a chief draughtsman; and quite one-third of the money spent in the office could be saved by means of an efficient superintendence. The capabilities of the individual draughtsmen are lost to sight and wasted, unless they choose to force themselves before the engineer-in-chief.

To anyone satisfied with a humdrum, monotonous, everyday life, and who will not be too sensitive to petty discomforts, the life of a draughtsman would suit, the hours being easy and the work decidedly light; but to those who have any ambition and sense of independence, a short stay in the office might be beneficial; but a long one would make one unfit for good work after leaving the office. There is no service in the proper sense of the term, so that there is nothing to depend upon. The salaries in the office are high in proportion to the work done.

In the field the life is that of a camp, and when water is to be had it is very pleasant; but when one has to go for days carrying one's water supply—as a friend of mine did lately, while surveying for a railway across two hundred miles of woodless and waterless land—then the toils and hardships of an explorer take away all the pleasure of the ordinary surveyor's camp.

Adelaide, January 19th. FORTITER ET FIDELITES.

WIND PRESSURE.

SIR,—In reply to the letter of your correspondent on wind pressure, in last Friday's issue, the explanation of the formula $\left(\frac{v}{20}\right)^2$ will be found in Mr. Hawksley's paper, published in THE ENGINEER of September 30th, 1881. $\left(\frac{v}{20}\right)^2$ is twice the head of pressure due to the velocity v obtained from a column of water by substituting the weight of a cubic foot of air for a cubic foot of water. The hypothesis is that the motion of the column is not affected by the impact. The theory of the subject will be found in Rankine's "Applied Mechanics," Art. 648—"Pressure of a Jet against a Fixed Surface." In this article the pressure of a jet of water, striking a fixed plane at right angles to it, is found from an isosceles triangle having each of its equal sides equal to the velocity of the water, and parallel to its direction before and after impact. It is assumed that the velocity before and after impact remains the same, the friction of the surface being neglected. The third side of the triangle is the deviating force exerted by the plane in deflecting the jet at right angles to its original direction. Resolving this force into its components at right angles and parallel to the plane, the former component or pressure at right angles to the plane is $= \frac{S\,Q\,v}{g}(1 - \cos.\ \beta)$ but β the angle of deflection is 90 deg., and Q being equal to Av (A is the sectional area of jet), the pressure is $= \frac{S\,A\,v^2}{g}$. $S = {\cdot}0765$ — the weight of a cubic foot of air (substituting air for water) and $g = 32{\cdot}2$, $A = 1$ square foot, therefore $\frac{{\cdot}0765 \times v^2}{g} = \left(\frac{v}{20}\right)^2$ nearly. This can be proved by experiment both for water and air. In the case of air it can be proved by calculating the pressure by this formula, the velocity being given by the cup anemometer, and comparing the result with the pressure given by a pressure anemometer. Dr. Hutton's experiment gives somewhat less than the pressure by this formula.

In the report of the Committee on Wind Pressure, published in THE ENGINEER, August 26th, 1881, this empirical formula is given $\frac{v^2}{100} = P$, where v is the run of wind in miles in one hour, and P is the maximum pressure recorded in that hour.

The formula given in "Buchan's Meteorology" $\frac{v^2}{200} = P$ where v is velocity in miles per hour at the instant in which the pressure P takes place, agrees very closely with $\left(\frac{v}{20}\right)^2$ in which v is expressed in feet per second. The two formulæ $\frac{v^2}{100}$ and $\frac{v^2}{200}$ cannot be compared, because v in $\frac{v^2}{100} = P$ is the mean velocity during the hour in which P is the maximum pressure. The velocity at the time P takes place is much greater than v.

The committee consider the exceptionally high pressures at Bidston Observatory to be caused by the conformation of the ground. Mr. Hawksley, in his paper, doubts the accuracy of the instruments in observatories generally, and considers them often improperly placed. I think this last consideration may account for a good deal. If a strong wind is blowing at right angles to a block of buildings there is a greater hydrostatic pressure on the one side of the buildings than on the other, so that the velocity of the wind blowing over the roof and round the ends of the building is much increased, and an anemometer placed in this current would give a much greater pressure than the wall of the building is subjected to. I think, therefore, that unless the anemometers in observatories are at a considerable height above the ground and in a perfectly open place, their indications are not reliable. A. R.

Greenock, February 27th.

THE CHANNEL TUNNEL.

SIR,—In your article of last week you quoted fairly the figures I mentioned in my speech at Dover, as representing the air necessary to work railway traffic by the Beaumont air locomotives, but a little further explanation is required. I stated that ¼ lb. of coal would suffice to take one ton one mile by my system on a railway, to which statement I adhere. As you point out, the result obtained with one of my tramway engines in daily operation at Stratford and Leytonstone are that thirteen tons were taken twenty-four miles, on anything but a straight and level line, for 5 cwt. of coal, corresponding to 1·77 lb. of coal per ton mile. This was with a high-pressure engine and a cold boiler feed. A saving of 33 per cent. could hardly be considered excessive if proper arrangements be substituted for condensing the steam and warming the feed-water, thus reducing the coal consumption at the depôt to 1·15 lb., but as the compressing engine was standing under full steam a quarter of its time, this would certainly be further reduced one-third, say to ·77 lb., as representing the coal consumption per ton per mile on an ordinary tramway worked continuously with proper compressing machinery. My experience, and I fancy that of most tramway engineers, goes to prove that the resistance on a railway is but one-third that of a tramway, which brings the figures down to my statement. I further say that superior results will be obtained from larger compressors, those at Stratford delivering only 3ft. of air per minute at 1000 lb. pressure.

FRED. BEAUMONT.

3, Victoria-street, Westminster Abbey, S.W., 27th February.

[Our correspondent forgets that the speed at which trains must be worked through the Channel tunnel will be about five times as great as that attained on the tramway, with a corresponding augmentation of resistance.—ED. E.]

SIR,—In your article on the Channel tunnel in your issue of the 17th ult., you mention the Faure accumulator. The net useful effect from a given dead weight already very nearly approaches the figure given by you when you say should wonderful improvements be made in the Faure battery. I have always regarded the Faure accumulator as a most valuable means of storing electric energy for industrial purposes, and from the figures you give as to the power required to take a train through the proposed Channel tunnel in half an hour, I can state from my own experience that the trains could be worked through the tunnel in the half-hour with a dead weight of Faure's accumulators less than the weight of an ordinary express passenger steam locomotive tender. The change of accumulator trucks could be made with the same ease that the change of engine is effected on the underground railways. I therefore maintain that as far as working the trains through the tunnels go, the recent results obtained from the Faure accumulator prove it can be done at a sufficiently low cost per train mile to make the undertaking feasible in its future working as far as the locomotion goes. RADCLIFFE WARD.

7, Northumberland-street, W.C., March 2nd.

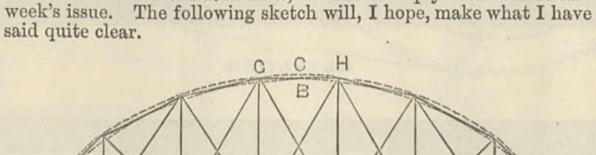
VACUUM BRAKES ON THE MIDLAND RAILWAY.

SIR,—I wrote a few months ago about one of my mates being suspended for running past Normanton with the automatic vacuum brake, caused by having the ejector shut off to get steam, and having no vacuum to stop with. I see by the papers the London and North-Western have been trying a Gresham automatic vacuum brake on our line a short time ago. Well, if it is no better than the Clayton's they will be no better off than having the chain brake and the piece of string; it will be like jumping out of the frying-pan into the fire. This brake of ours has been altered many times it is true, but never improved; the fact is, Sir, it takes too much steam to work it, and when done, you have only got one step. Now, Sir, I will just describe the working of it. First of all the small ejector has always to be kept at work to keep a constant vacuum of, say, 15in.; it will do that with not more than eight coaches on, but over that number the big ejector has to be used. Suppose an express train with fifteen on and 15in. of vacuum throughout running at fifty miles an hour. We find the signals on; the air valve is opened; the vacuum destroyed; on goes the brake, and with that train on there is no such thing as regulating it; all the power goes at once. Well, the signals are taken off as soon as the brake has got on, but we cannot get the brakes off many a time until we have been brought nearly to a stand, and the big ejector roaring out all the time, and the regulator wide open, and the steam gauge gone down 30 lb. or 40 lb.; when the brakes are released then the small ejector is shut off to get the engine up in steam, and the vacuum you had gradually dies away; then we are running without brake. Now there are thousands of miles run like this, nothing to depend on but steam brake for engine and tender. This is the time when some of us will get into trouble some day, trying our best to keep steam and keep time with the train and no brake power, and something crops up and we want it. There are no vacuum gauges in the vans, so when we are running no one can tell whether there is any vacuum, except they are on the engine to see the gauge. There is an air valve in the van, and the brake is supposed to be tested before starting from a terminus, so a vacuum is raised for that purpose, and then, as I say, with a heavy train it is allowed to die away to get steam. For stopping trains, when we do not stop above a minute at a station, and the brake has not had time to leak off, as it is well-known it does leak off in about two minutes, no one would credit the quantity of steam that is used with blowing the brakes off, particularly if it is a long train. I contend this, that the small ejector constantly blowing is very much against the engine's getting steam, and that is the reason it is shut off, and as soon as it is shut off the steam gauge begins to move up. It is time there was something done in the matter, but no one dare speak if there is a delay through any defect in the brake. We all try to get it hushed up and not to report it, for if we do an inspector comes to see us, and if we say anything for ourselves he begins to go red in the neck, and say what he can do and what he will do for you, but he never takes hold and shows us how to do. A MIDLAND DRIVER.

1st March.

BOWSTRING GIRDERS.

SIR,—I did not read Mr. Buckwell's letter, which appeared in THE ENGINEER of the 17th inst., in time to reply to it before last week's issue. The following sketch will, I hope, make what I have said quite clear.



In this figure the full lines represent a bowstring girder with an uneven number of bays. The dotted lines represent two parabolic curves, the upper one D C E passing through the points of intersection of the various members with the top flange; and the lower one passing through the centre of the middle bay of the top flange, or the point B. It will be seen at once that the bay of the top flange G H is a tangent to the curve, and the points G and H cannot therefore be in the curve.

The modification of the formulæ given in my letter of the 31st ult. to make them applicable to a bowstring with an uneven number of bays, is to substitute the dimension A C for the "depth of girder at centre, or distance apart of the top and bottom flanges there," which is A B. CHARLES LEAN.

Palace-chambers, 9, Bridge-street, Westminster, S.W., February 28th.

COLD AIR MACHINES.

SIR,—May I claim your indulgence to state that the formula in my last letter is of course only applicable to saturated air. I thought this was sufficiently obvious from the connection in which it was given, and, indeed, from the construction of the formula itself; but perhaps it would have been better had I mentioned it.

116, Fenchurch-street, London, T. B. LIGHTFOOT.

February 25th.

THE ELECTRIC LIGHT AT THE MANSION HOUSE.

PROBABLY no one has done more to make the electric light a practical success than Mr. R. E. Crompton. He has been the successful pioneer in several new fields, such as the adapting the light to mining operations, &c. One of his latest and one of his best installations is that at the Mansion House. The space at his command was somewhat cramped, and restrictions as to motive power had to be considered in his arrangements. We illustrate these arrangements on page 158. A 16-horse power gas engine by Messrs. Crossley is used to supply the power required to drive the dynamo machines, and we believe there is plenty of power in reserve to drive an extra circuit when required. Of the dynamos there are four, one of which, however, is used only in a case of emergency. The type employed is that of a vertical Bürgin constructed by Messrs. Crompton and Co., as shown in Fig. 1. The engine, dynamo machines, and countershafting are arranged in a space 29ft. by 9ft. 9in., partly filled with stone pillars, one of which indeed had to be bored out in order to admit a part of the engine. Figs. 2 and 3 show a plan and elevation of these arrangements. Two of the dynamo machines, marked A and B, drive Crompton arc lights in the Egyptian Hall. Three lamps in series are supplied by each machine. The third machine C supplies the current for the Swan lamps in the saloon, while D is the spare machine. In order to counteract the pulsation of the gas engine affecting the steadiness of the Swan lamps, a small fly-wheel 2ft. in diameter is fixed on the spindle of the C machine, which has been found extremely effective, and the lights in the saloon are perfectly steady. We understand similar fly-wheels are to be fixed to the other machines, as there is a continual oscillation of current to the extent of some four or five Ampères, which, however, is not noticeable in the arc lights unless they are specially watched.

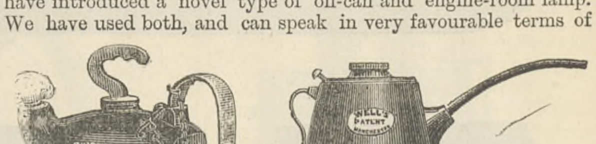
The engine makes 136 revolutions per minute, with an 8ft. fly-wheel driving by a strap S—see the plan, page 158—on to a 3ft. pulley on the countershaft, giving 362 revolutions of the countershaft. The dynamos are driven by the straps S^1 on 2ft. 3in. pulleys off the countershafting, and have for the A and B machines 7in. pulleys, and C and D 6in. pulleys. This gives 1296 revolutions and 1512 revolutions per minute respectively.

If we assume, as is nearly the case, that machines A and B revolving 1600 times per minute have an E.M.F. of 300 volts, and that the E.M.F. is proportional to the revolutions, we get an E.M.F. for 1300 revolutions = to 244 volts. The resistance of the external circuit is about 8 ohms, whilst that of the machine is 3·7 ohms, so that the current through the lamps is—using formula, when C = current, E = electromotive force, and R = external resistance, and r = internal resistance. $C = \frac{E}{R + r} = \frac{244}{8 + 3{\cdot}7}$ = nearly 21 Ampères. According to the action of the engine, as we have said these figures will vary somewhat, we give them as approximate. Similar calculations show that the current through the Swan lamp is between 1 and 1·5 Ampères. The Swan lamps are of the newest pattern and specially selected, and have been giving extremely good results. They have a very even resistance, about 32 ohms hot, and hence give almost exactly equal amounts of light.

The dynamos are fixed on a planed cast iron bed-plate with grooves to take the holding-down bolts, to permit the setting back the machines to tighten the straps when necessary. By this means Mr. Crompton is able to use cement jointed bands, thereby avoiding any little irregularity due to joints passing over the pulleys. The vertical dynamos are used partly to obtain room and partly to prevent distortion of the magnetic field by the action of the iron bed-plate. Fig. 4 shows the arrangement of the circuits. The six arc lamps in the Egyptian Hall have the alternate lamps on separate circuits. The Swan pendants in the saloon are arranged in compound parallel arc, and the two circuits, each taking three electroliers, are led back to the switches, so that if it should be found convenient to place them on separate circuits it can be at any time done without altering the wires as already laid. It is also arranged that one electrolier out of three in a circuit, or two out of four in the two circuits, can be switched off independently of the others; This is effected by leading a separate return from the electroliers C D to the switches. The switches C D are shown with these circuits disconnected. The central switch is for breaking the entire circuit and for connecting in the current meter when required without breaking the circuit. The pendants for hanging up the arc lamps are shown in Fig. 5, and those for the incandescent lamps we shall illustrate in another impression, when from a comparison of the designs which have yet appeared, it will be seen that the electric light, as well as gas, gives plenty of room for ingenuity in the design of internal fittings.

WELLS' OIL-CANS AND LAMPS.

MESSRS. A. C. WELLS AND CO., Market-street, Manchester, have introduced a novel type of oil-can and engine-room lamp. We have used both, and can speak in very favourable terms of



them. They are made of malleable cast iron, and will not break even when very roughly used. The oil-can spouts are of brass, very stout, and the cans are fitted with valves, so that leakage cannot take place. The lamp is a great advance on the ordinary engine-room lamp, both in shape and solidity. The small accompanying cuts illustrate both very clearly.

WHITEHAVEN WET DOCK.—This dock, which for a considerable time has been undergoing repairs at the entrance which gave way, will, in all probability, be opened for traffic in about a fortnight. The gates have been swung, and a dredger is at work clearing away the accumulated *débris*. There is reason to believe that a very fair trade will be done at this dock.

ACCIDENTS IN MINES.—The North Derbyshire miners are holding meetings with regard to the frequency of colliery fatalities. At a meeting held at Unstone, on Wednesday, it was resolved—"That the miners assembled at this meeting desire to call the serious attention of her Majesty's Government to the terrible and alarming explosions which are destroying so many valuable lives and causing fearful misery among the mining population; and we do respectfully ask her Majesty's Government to amend the law relating to mines by passing measures which will prevent the recurrence of these terrible holocausts in our mines." It was further resolved to forward the resolution to the press and the Home Secretary

ELECTRIC LIGHTING PLANT IN THE MANSION HOUSE.

MESSRS. R. E. CROMPTON AND CO., LONDON, ENGINEERS.

(*For description see page* 153.)

VERTICAL DYNAMO MACHINE

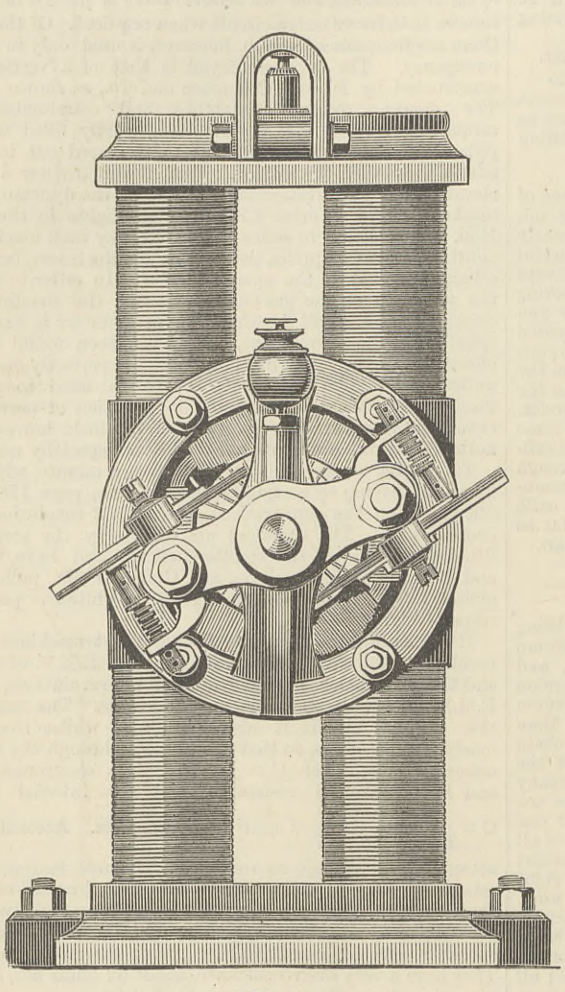


Fig. 1.

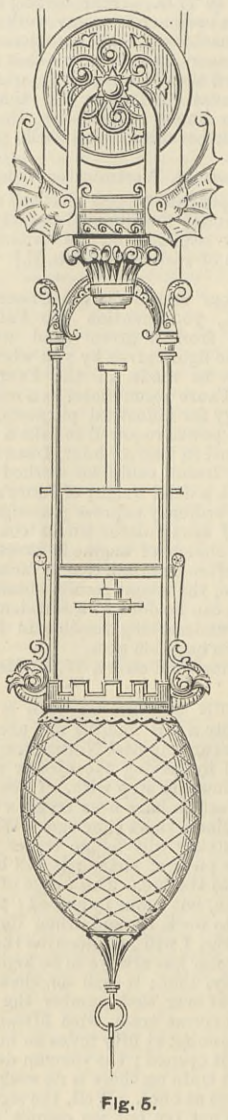


Fig. 5.

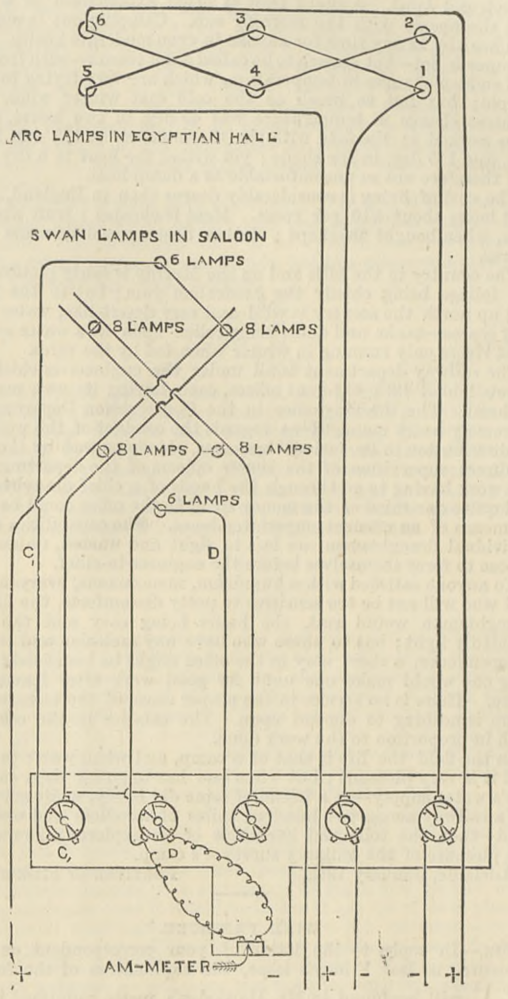
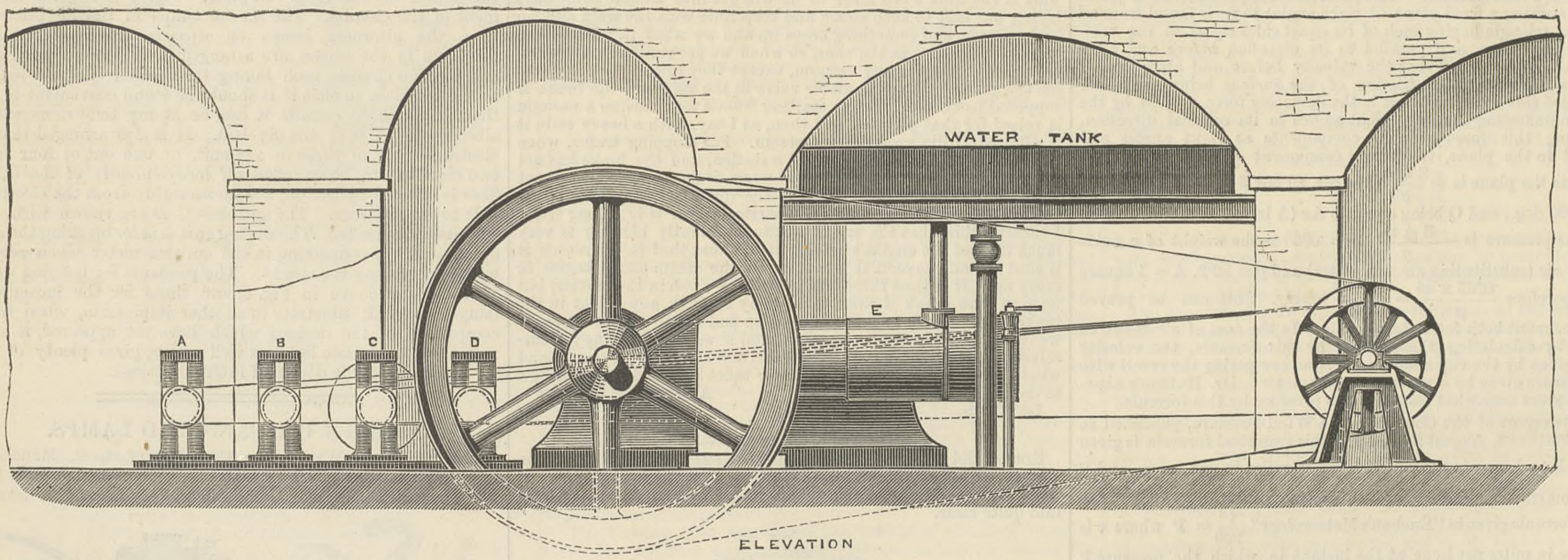
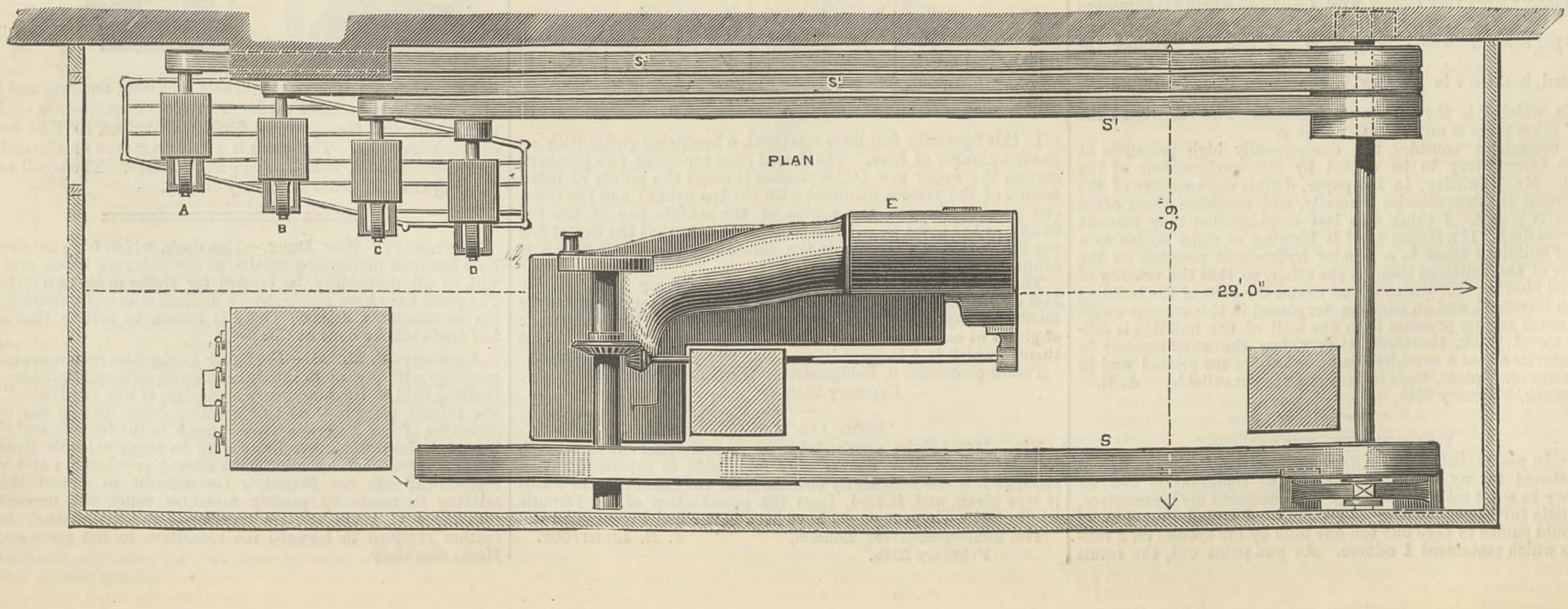


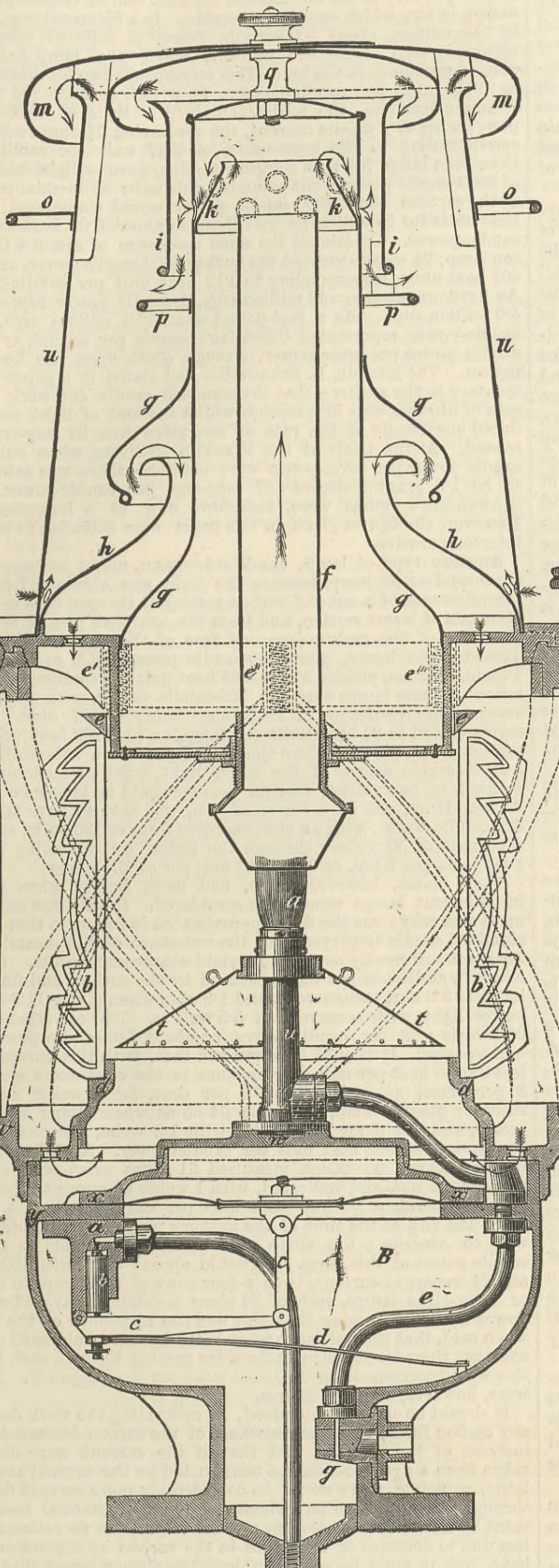
Fig. 4.



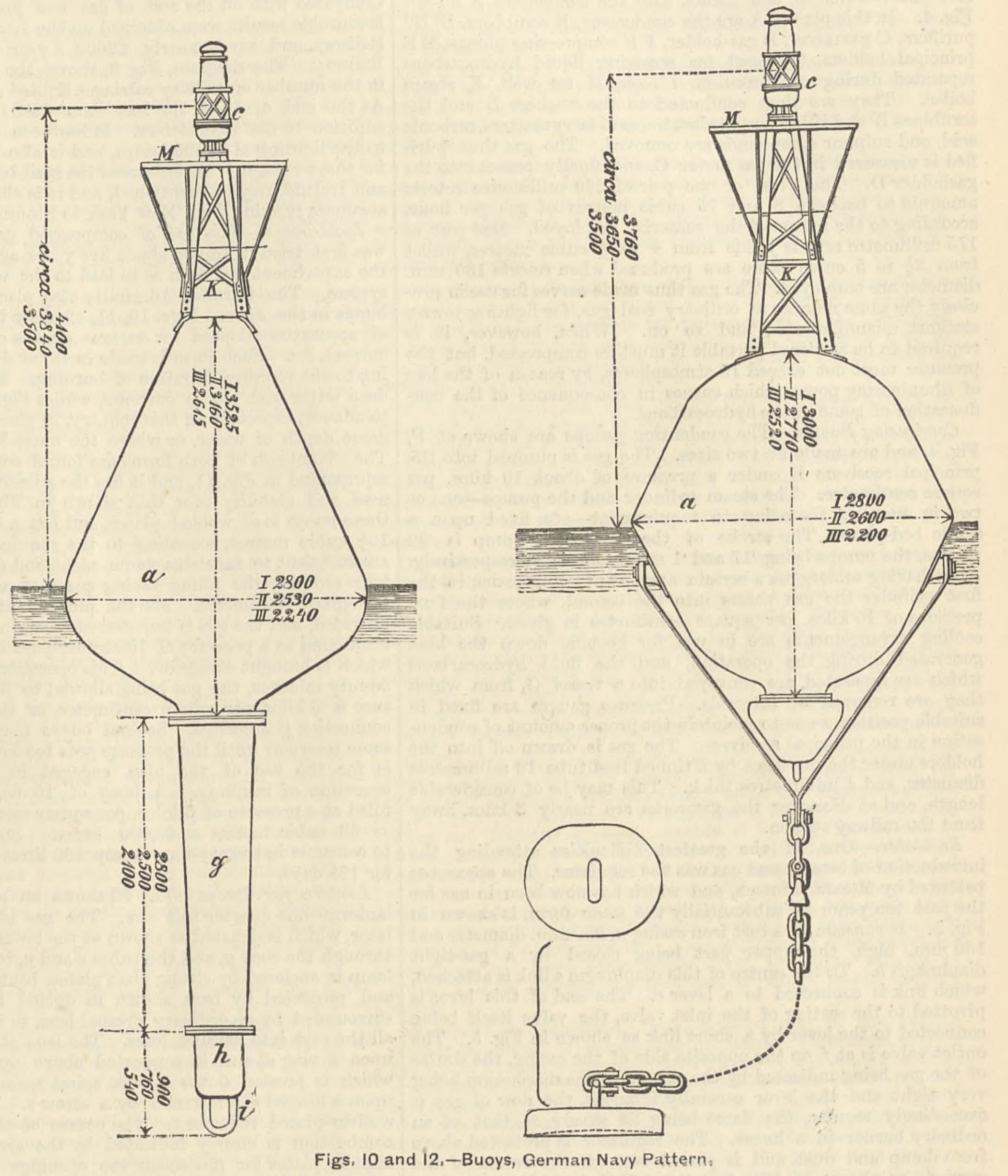
ELEVATION



PINTSCH'S SYSTEM OF LIGHTING RAILWAY CARRIAGES AND BUOYS.



Buoy Lamp, Lantern and Regulator.



Figs. 10 and 12.—Buoys, German Navy Pattern.

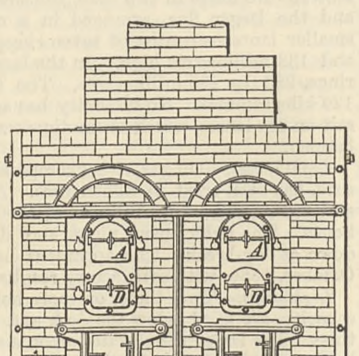


Fig. 1.—Elevation of Retort Battery.

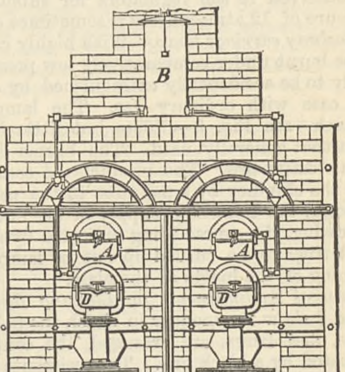


Fig. 3.—Back Elevation.

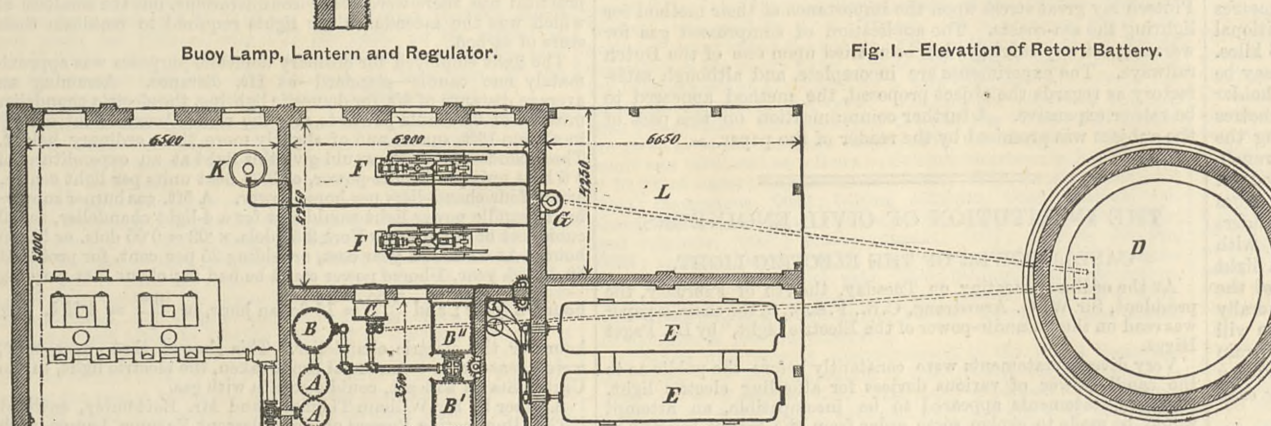


Fig. 4.—Plan of Gas Making, Compressing, and Purifying Plant.

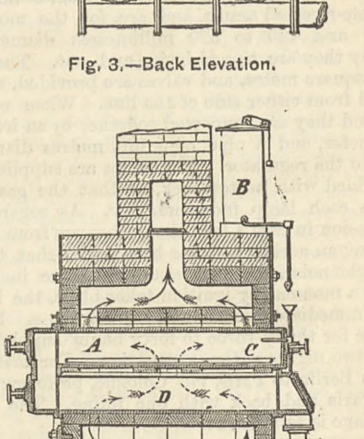


Fig. 2.—Section of Retort Battery.

ABOUT ten years ago Mr. Julius Pintsch, of Berlin, successfully introduced compressed oil gas for lighting purposes, and since that time it has become largely employed, especially in railway carriages. We have on previous occasions described parts of the apparatus for the system adopted by Mr. Pintsch, and in our impressions for the 23rd April and 7th May, 1880, gave an account of his works at Fuerstenwalde and of the extensive application of the system to the lighting of continental railway carriages. There were then about 6000 carriages fitted on the Continent and 1500 being fitted. Since then a very large number have been fitted, including the German Post-office vans, and only recently the Pintsch Patent Lighting Company, in London, completed the fitting of the 1000th carriage on English Railways. As the light remains by far the cheapest and the best yet adopted for railway carriage use, we take the opportunity of describing it more completely by information which we extract from an exhaustive paper read by the inventor at a recent meeting of the Society of German Engineers at Berlin. For our illustrations we are indebted to *Glaser's Annalen fuer Gewerbe und Bauwesen.*

Materials.—The material employed by preference is paraffine oil, which costs at Berlin 8½ marks per 100 kilos. Petroleum residues, raw petrolem, or naphtha may also be used, and, indeed, any kind of fluid or semi-fluid fatty matter. Paraffine oil, however, yields the largest quantity of gas, as compared with the above named substances.

Retorts.—Fig. 1 shows a front elevation, Fig. 2 a cross section, and Fig. 3 a back elevation of the retort adopted by Messrs. Pintsch. It produces a gas which is permanent, and is capable of operating even upon the most worthless fluid mineral, vegetable, and animal fatty substances. It will be understood that special precautions are necessary in the manufacture of gas which has to sustain great pressure. The gas must be perfect and must not be mixed with vapours which liquefy or condense to any great extent when pressure is applied. The retorts are, as will be seen, double, the oil being supplied to the upper division from the reservoir B through a small U-formed tube provided with a cock with a very fine screw adjustment. The oil is received in a sheet iron tray C, which is capable of easy removal for cleaning, where it is vaporised. The tray permits this operation to take place more gradually than it otherwise would, and also preserves the retort from the rapid wear which would result from the continual dropping of cold fluid upon the same place. The carbonaceous residue of the distillatory operation is deposited almost entirely upon the tray, which is withdrawn for cleaning. The volatile decomposition products pass by means of a connecting piece from the upper into the lower retort D, where the operation of conversion into gas is completed. Three sizes of retort are in use according to circumstances, namely, 260 by 260 millimetres, 175 by 175 millimetres, or 130 by 130 millimetres in cross section. The gas passes from the retorts into the receiver E, and thence into the condensers A A—see Fig. 4. In this plan A A are the condensers, B scrubbers, B^1 B^{11} purifiers, C gas meter, D gas-holder, F F compressing pumps, E E principal holders, G vessel for receiving liquid hydrocarbons separated during condensation, I cock, H tar well, K steam boiler. They are then conducted to the washers B and the scrubbers B^1 and B^{11}, where the last traces of tarry matters, carbonic acid, and sulphur compounds are removed. The gas thus purified is measured in the gas meter C, and finally passes into the gasholder D. The yield of one pair of 260 millimetre retorts amounts to between 8 and 15 cubic metres of gas per hour, according to the nature of the material employed. One pair of 175 millimetre retorts yields from 4 to 8 cubic metres, whilst from 3½ to 5 cubic metre are produced when retorts 130 mm. diameter are employed. The gas thus made serves for use in precisely the same manner as ordinary coal gas, for lighting towns, stations, manufactories, and so on. When, however, it is required to be rendered portable it must be compressed, but the pressure must not exceed 10 atmospheres, by reason of the loss of illuminating power which ensues in consequence of the condensation of some of the hydrocarbons.

Condensing Pumps.—The condensing pumps are shown at F, Fig. 4, and are made in two sizes. The gas is pumped into the principal receivers E under a pressure of about 10 kilos. per square centimetre. The steam cylinder and the pumps—one or two in number according to requirement—are fixed upon a single bed-plate. The stroke of the large sized pump is ·32 metres, the pumps being ·17 and ·1 metres diameter respectively. After having undergone a certain amount of compression in the first cylinder the gas passes into the second, where the final pressure of 10 kilos. per square centimetre is given. Suitable cooling arrangements are in use for keeping down the heat generated during the operation, and the fluid hydrocarbons which are separated are conveyed into a vessel G, from which they are removed at intervals. Pressure gauges are fixed in suitable position, so as to maintain the proper amount of condensation in the principal receivers. The gas is drawn off into the holders under the carriages by a tinned lead tube 16 millimetres diameter, and 4 millimetres thick. This may be of considerable length, and at Hanover the gasworks are nearly 3 kilos. away from the railway station.

Regulator.—One of the greatest difficulties attending the introduction of compressed gas was the regulator. The apparatus patented by Messrs. Pintsch, and which has now been in use for the past ten years in substantially the same form, is shown in Fig. 5. It consists of a cast iron casing *a*, 250 mm. diameter and 160 mm. high, the upper part being closed by a gas-tight diaphragm *b*. To the centre of this diaphragm a link is attached, which link is connected to a lever *c*. The end of this lever is pivotted to the seating of the inlet valve, the valve itself being connected to the lever by a short link as shown in Fig. 5. The outlet valve is at *f* on the opposite side of the casing, the course of the gas being indicated by the arrows. The diaphragm being very tight and the lever carefully balanced, the flow of gas is exceedingly regular, the flame being as steady as that of an ordinary burner in a house. The regulator is protected above from damp and dust, and is placed beneath the frame of the carriage, as shown in Fig. 6. Over 7000 have been fitted on various lines of railway. The same principles of construction are observed in the regulators for submarine lighting, where a pressure of 12 atmospheres is sometimes employed.

Railway carriage lamp.—With highly carbonised gas requiring to be burnt under comparatively low pressure the flame is more likely to be accidentally extinguished by currents of air than is the case with ordinary gas. The lamp adopted by Messrs. Pintsch—see Fig. 8—differs but little in external appearance from that generally used. The burner is of the fish-tail kind, with steatite tips. The products of combustion are carried off into the chimney by a flat tube in the centre of the enamelled reflector, the necessary supply of air entering through holes in the casing, the course being indicated by arrows. A joint allows the burner to be turned up out of lamp so as to facilitate the cleaning of the inside of the glass.

General Arrangements for Lighting Railway Carriages.—Figs. 6 and 7 show the manner in which the holders, regulator, supply pipes, and lamps are arranged, the course of the pipes being indicated by a black line. The recipients or holders, one or more according to the number of burners, are placed beneath the underframe. They are of sheet iron, 5 millimetres thick, with double-rivetted seams, and are, for the most part, 1·85 metres long and 420 to 520 millimetres diameter. For additional safety they are tinned inside and out. The pressure is 6 kilos. per square metre, and valves are provided, so that they may be filled from either side of the line. When more than one holder is used they are connected together by an iron pipe 7 millimetres diameter, and a pipe of 5 millimetres diameter conveying the gas to the regulator. The lamps are supplied by a short branch, provided with a stop-cock, so that the gas may be turned off from each lamp independently. As regards the danger from explosion in case a leak should happen from injury to the holders during an accident, it has been found that the gas escapes with a slight noise, and even should it come in contact with a light only a momentary ignition takes place, the high pressure of the gas immediately extinguishing the flame. Provision is generally made for thirty-three to forty hours' supply, so that a train will run two nights without attention. For instance, the mail train from Berlin to Paris, *viâ* Cologne, performs the double journey to Paris and back with one filling. The equipment for each carriage is as follows:—

No. of burners.	No. of holders.	Diameter in mm.	Capacity in litres.
6	2	520	380
5	2	470	310
4	2	420	250
3	1	520	380
2	1	420	250
1	1	318	140

In special cases, as, for instance, in large saloon carriages, or in the Imperial mail, where gas is also used for warming purposes, four holders, each 520 millimetres diameter, were found necessary for each carriage. Gas has also been applied to lighting the head lamps of locomotives, the holder being placed under the tender, on the tool box, or in the case of tank engines on the locomotive itself. The lamps are connected with the supply pipe by a short india-rubber tube. The lamp for use on the foot-plate is provided with a perforated shield, which only permits rays of lights to be thrown on the pressure gauge, the fire-door and the coals, everything else being dark, so as not to prevent a good look-out being kept.

Relative Cost.—Even on short lines where the consumption is relatively small, it would seem that the system of oil-gas lighting is economical. It appears from a report by Herr Kahl, chief locomotive superintendent in the Berlin and Hamburg Railway, that during the year 1880-81, 22,556 cubic metres of gas were consumed, the cost of which was 48 pfennig per cubic metre. Compared with oil the cost of gas was just one-fifth. Similar favourable results were obtained on the Lowei, Silesia and Mark Railway, and saves nearly £2000 a year on the Metropolitan Railway. The diagram, Fig. 9, shows the progressive increase in the number of railway carriages lighted on Pintsch's system. At the end of 1880, no less than 6800 had been fitted, in addition to the locomotives. It has been applied with success to the lighting of signal lamps, and is also used on board ship for short voyages. As instances the mail boats between England and Ireland may be mentioned, and it is also in use on a line of steamers running from New York to Stonington.

Light-buoys.—The use of compressed gas for lighting buoys was first tried in Russia about five years ago, and the success of the experiment was such as to lead to the wide adoption of the system. The German Admiralty also placed two experimental buoys in the Jade. Figs. 10, 11, 12 show three different forms of apparatus adapted for various depths of water, strength of current, &c. Each form is made in three different sizes, according to the required duration of burning. Fig. 10 is adapted for deep water with gentle currents, whilst Fig. 12 has been found to answer, especially in this country, in places where there is no great depth of water, or where the water-level is very variable. The advantages of both forms are found combined in the buoy represented in Fig. 11, and it has the advantages of great cheapness and stability over that shown in Fig. 12. The body of these buoys is of welded plates, and has a capacity of 5, 7, and 10½ cubic metres, according to the requirements. These sizes are sufficient to furnish a flame night and day for two, three, or four months, the filling taking place at a pressure of 6 kilos. per square centimetre. For the purpose of re-filling a valve is provided, and the gas is transferred from a reservoir, where it is condensed to a pressure of 10 atmospheres on board the tender which is brought alongside. This operation takes from five to twenty minutes, the gas being allowed to flow in until the pressure is 6 kilos. per square centimetre, or thereabouts, when the connection is detached. Several buoys may be filled from the same reservoir until the pressure gets too low. The platform M is for the use of the men engaged in superintending the operation of re-filling. A buoy of 10 cubic metres capacity, filled at a pressure of 6 kilos. per square metre, will hold $10 \times 6 = 60$ cubic metres = 60,000 litres. Supposing the burner to consume in twenty-four hours 480 litres the supply will last for 125 days.

Lantern for Buoys.—Fig. 13 shows an enlarged view of the lantern—one quarter full size. The gas issues from the regulator, which is situated as shown at the lower part of the lantern, through the cock *g*, and the tubes *e* and *u*, to the burner *a*. The lamp is enclosed by strong glass plates, bent into a circular form and protected by bars shown in dotted lines. The flame is surrounded by an ordinary Fresnel lens, so arranged as to direct all the rays into parallel lines. The lens at its lower part rests upon a ring *d*, and is supported above by a triangular ring *e*, which is pressed down by six spiral springs e^1, e^{11}, e^{111}, &c., upon a hinged cap fastened by a screw *s*. Below the burner is a silver-plated reflector *t*. The course of the air for supporting combustion is clearly indicated by the arrows, *o* and *p* being annular plates for protecting the openings beneath which they are placed from wind or water. The products of combustion pass off through the chimney as shown by the arrows. These lanterns are made in two sizes, the smaller having three burners and the larger five, arranged in a circle. The lenses of the smaller lanterns consist of seven rings 188 millimetres diameter and 188 millimetres high. In the larger pattern there are nine rings, 283 by 265 millimetres. The lanterns weigh from 50 to 120 kilogrammes. No difficulty has arisen from the deposit of salt on the lenses, which at one time was feared would frequently happen.

Lighthouses.—Oil gas, either compressed or under normal pressure, has been tried in lighthouses. At Pillau the holders are situated on shore at a distance of 1000 metres from the lighthouse. The light burns night and day, the gas being turned down at day-break. The apparatus has been in operation since October, 1880, with satisfactory results.

Lightships.—Two, three, or more holders of 6½ cubic metres capacity, are fixed below the deck and connected together by a tube. The lantern is elevated upon a suitable framework. The holders are filled periodically in the same manner as buoys are replenished. The lantern burns night and day without attention; a crew on board the lightship is therefore unnecessary. Messrs. Pintsch lay great stress upon the importance of their method for lighting the sea-coasts. The application of compressed gas for warming railway carriages has been tried upon one of the Dutch railways. The experiments are incomplete, and although satisfactory as regards the object proposed, the method appeared to be rather expensive. A further communication on this part of the subject was promised by the reader of the paper.

THE INSTITUTION OF CIVIL ENGINEERS.

CANDLE-POWER OF THE ELECTRIC LIGHT.

At the ordinary meeting on Tuesday, the 7th of February, the president, Sir W. G. Armstrong, C.B., F.R.S., in the chair, a paper was read on the "Candle-power of the Electric Light," by Dr. Paget Higgs.

Very diverse statements were constantly before the public as to the candle-power of various devices for affording electric light. As these statements appeared to be incompatible, an attempt would be made to evolve some order from the figures relating to the electric light. The most salient point for a unit of comparison was the number of heat units represented by electrical measurement, as in ratio with the candle-power measured optically. But at the outset a difficulty, or rather an uncertainty, was experienced; this referred, however, only to arc lights, of which there were two systems of measurement—one with the carbons on the same axis, the other with the axis of one of the carbons forming a very acute angle with the axis of the other carbon, so that the glowing crater of one carbon formed a reflector to the point of the other. In the latter case, considering the light of the former as unity, the light might be about 1·66 time stronger as measured. This had been pointed out by Mr. Douglass, M. Inst. C.E., in a report to the Trinity House. Another source of discrepancy was the want of knowledge of the specific heat of the vapour of the electric arc, and of its temperature; if one were known the other could be determined. Taking the ratio of units of heat represented per candle-power, the subsequent figures would show a large margin of economy for arc lighting over incandescent lighting. This would of course be true of the arc considered only as a furnace producing a greater heat in a smaller space than by incandescence; and it appeared to the author to be true for another reason. Whatever might be the specific heat of the vapour of the electric arc, it was certain that over the given resistance of the arc, as compared with an equal resistance of the incandescent lamp, the mass of the arc, measured by the molecules it contained was far less than that of the solid carbon.

Supposing a light of 1000-candle power, measured with the carbons on the same axis, produced with 4·5 ohms resistance and 10 webers of current, there would be represented 108 gramme-degrees of heat, or nearly 0·1 gramme degree per candle-power per second. This was deducible from the figures given by the Brush system. It did not include the heat due to consumption of carbon in air, which was inconsiderable. In a Siemens lamp, tested by the author, about 3000-candle power of diffused beam was obtained with 36 webers current, when the lamp had one ohm of resistance in the arc. This corresponded to 335 heat units, or 0·112 unit per candle-power. In a Serrin lamp fed from a Gramme machine, the author obtained a light of 3600-candle power with 45·7 webers current, the arc having 1¼ ohm resistance, corresponding to 624 heat units, or 0·17 unit per candle. A Crompton lamp, fed by a Burgin machine, gave a light said to be of 4000-candle power; but assuming this to be of bi-axial position of the carbons, about 2000-candle power would correspond to 180 heat units for 16 webers on 2·93 ohms, or about 0·09 heat unit per candle-power. On (about) the same resistance of arc n a Crompton lamp, 24 webers yielded the author 3600-candle power, or about 403 heat units, corresponding to 0·12 heat unit per candle-power. As 1 gramme-degree=42 million ergs, 1-candle power represented 4·9 million ergs. As a foot-pound was 13·56 million ergs, each candle-power represented 0·364 foot-pounds per second, or 1511-candle power per horse-power, a rough check upon the foregoing figures. The late Mr. L. Schwendler had stated in a paper—fragmentary to the author—that the standard candle did work at the rate of 610 meg-ergs in a second, whilst the unit of light was produced electrically at the rate of not more than 20 meg-ergs in a second. At the trials at the Franklin Institute, when only 380-candle power per horse-power were obtained, there was estimated to be 1·6 gramme-degree=67 meg-ergs per candle-power. Mr. Schwendler's figures were, therefore, now at a long discount. However, the figures given in this paper were intended to be only intercomparative.

Another type of lamp, the Werdermann, might be termed an arc-incandescent lamp, because the light was obtained from the incandescence of a cone of carbon resting at its apex on a negative electrode of larger section, and from the arc that played between the sides of the carbon-cone and face of the negative electrode. Ten of these lamps, giving 40-candle power light, each burning 4·5mm. carbons, yielded about 0·88 heat unit per candle-power. A series of these lamps averaged 306-candle power, with 50 webers current, the resistance of each lamp being 0·1337 ohm. This corresponded to 80 heat units per lamp, or to 0·262 heat unit per candle-power. Thus, where the small light was a sub-multiple to a considerable degree of the larger light, want of economy commenced to be evident, and an average could no longer be taken. A Joel lamp, one of a series of ten, was said to have afforded 320-candle power, with an electromotive force of 130 volts, sending a current of 50 webers through the series, corresponding to 156 heat units per lamp, or 0·49 heat unit per candle-power.

These notes, however crude, had more weight when purely incandescent lamps came to be considered. In this case measurement was easy; for the light approximated in colour to that of the standard candle employed, and the resistance of the incandescent fibre was sufficiently constant to yield concordant results. One of Maxim's earliest lamps was measured by the author, and found to indicate 3·6 ohms when cold, and 1·9 ohm when giving 11·5-candle power light, with a current of 5·5 webers. This corresponded to 0·83 heat unit per candle-power, or about 140-candle power per horse-power. It should be remarked that, with this current, the loss due to heat per unit of resistance in the conductors would be 3 per cent., as against the 0·1 per cent. for a weber current. Another Maxim lamp, of about 64 ohms when giving 50-candle power, and 116 ohms when cold, with 1·3 weber current, would correspond to 0·52 heat unit per candle-power. An Edison lamp in the author's possession measured 61 ohms when cold, and 33 ohms when hot, and indicated, with 1 weber of current, 11-candle power, equivalent to 0·73 heat unit per candle-power. A Swan lamp had not, at the time of the author's measurements, found its way to America; but there were several statements as to the candle-power of this lamp. It would appear that with 160 volts and 24 webers of current, twenty-four rows of two lamps in series, or forty-eight lamps, each of 84 ohms resistance, gave 48-candle power each. Assuming that this was the resistance of the lamp when cold, that the resistance when incandescent would be 33 ohms, and that there would then be 2 webers passing through each lamp, this would correspond to 0·66 heat unit per candle-power. These were, however, assumed figures.

It should be clearly understood, in estimating the work done in any carbon focus, that the resistance of the carbon decreased with increase of temperature, and that if the current were directly taken from a dynamo-machine constructed on the mutual accumulation principle, there would be considerably more current flowing through the lamp than an estimate based on a potential measurement would allow. It was at present impossible to estimate the loss due to decrease of resistance in the carbon by expenditure of heat, but it must be considerable. The author hoped that from this it would appear in how far the incandescent light was theoretically more costly than the arc light—as about 6 to 1. But in practical use there were other considerations, not the smallest of which was the attendance arc lights required to maintain their store of carbon.

The light employed for ordinary domestic purposes was approximately one candle—standard—at 1ft. distance. Assuming an average distance of 8ft. for domestic lighting, the electric chandelier must be of 64-candle power to give the same "surface intensity," in a room 16ft. square and of slightly more than ordinary height. The incandescent lamp would give this light at an expenditure of 0·6 heat unit per candle-power, or 38·4 heat units per light centre, or say four chandeliers per horse-power. A 5ft. gas burner supplying 16 candle power light would cost for a 4-light chandelier, for 20 cubic feet of gas, in New York 2·50 dols. × ·02 = 0·05 dols. or 5c. an hour. At 40 dols. a year cost, or adding 25 per cent. for profit, at 50 dols. a year, 1-horse power could be had for about 300 working hours a year; and $\frac{5000}{300} = 16{\cdot}6$c. an hour, or $\frac{16{\cdot}6}{4} = 4{\cdot}15$ c. per hour for the electric chandelier. This showed that, even now, were a reasonable commercial profit taken, the electric light, in the United States at least, could compete with gas.

A paper by Sir William Thomson and Mr. Bottomley, entitled "The Illuminating Powers of Incandescent Vacuum Lamps, with Measured Potentials and Measured Currents," read at the last meeting of the British Association, contained a table from which a valuable law could be deduced, a law that the author first enunciated before the Institution in 1878. It was that the light in an electric system varied as the fourth power of the current whose resistance or potential was constant, or as the second power of the work in circuit. The value of the candle-power in heat units was higher than observed by the author. This was probably due to the method employed in measuring the light, which was more wasteful of the observed rays than that used by the author. Considering that in the measuring galvanometer, although a very accurate instrument, the deflections were merely proportional to the effect, the liability of error would be small; and that in the photometer used—an inaccurate instrument—the measurements varied with the second power of the distance, whilst the light under measurement varied with the fourth power of the current, the departures from agreement of the observed and estimated figures might be fully ascribed to errors of observation.

Naval Engineer Appointments.—The following appointments have been made at the Admiralty:—Robert Phillips, engineer, to the Duke of Wellington, additional, for the Medina, vice Monk; William F. Cole, engineer, to the Lord Warden, vice Fellows, the appointment of R. Phillips having been cancelled; Henry J. Walker, assistant-engineer, to the Nankin, additional, for service in the Majestic.

RAILWAY MATTERS.

THE ports of Quebec and Montreal are nearer to Europe by 430 and 250 miles respectively, and nearer Chicago, the great central grain depôt of the West, by 140 miles, than New York, and are better situated for the shipment of the products of the Western States.

THE longest railway in India is the East Indian with 1504 miles; next comes the great Indian Peninsular with 1275 miles. The Madras follows with 858 miles; the Sind, Punjaub, and Delhi with 663 miles; the South Indian with 645 miles; the Rajputana with 489 miles; and the Bombay, Baroda and Central India with 444 miles.

THE East Indian Railway cost 2,19,643rs. per mile; the Eastern Bengal, 2,08,935rs. per mile; the Great Indian Peninsular Railway, 1,95,945rs. per mile; the Bombay, Baroda and Central India, 1,86,582rs.; the Sind, Punjaub, and Delhi, 1,66,470rs.; the Oude and Rohilkund, 1,05,709rs.; the South Indian, 64,584rs.; and the Rajputana, 69,585rs.

AN article headed "Brakes and Professional Obstructives," and in which names are freely used, is published in the *Railway Review*, the gist of which is that the possession of patents for inventions by locomotive or carriage superintendents on some of the chief lines causes the chairman and directors of those lines to be misled, and prevents the adoption of the best and really efficient automatic continuous brakes.

THE first railway opened for traffic in India was the Great Indian Peninsular Railway, from Bombay to Tanna, in 1853. The East Indian opened twenty-three miles in 1854. The Madras railway followed in 1856. Then the Bombay, Baroda, and Central India in 1860. The Sind section of the Sind, Punjab, and Delhi line was opened in 1861. The Eastern Bengal opened forty-five miles for traffic in 1862. The Oude and Rohilkund opened forty-two miles in 1867.

THE drought is causing a great scarcity of water for domestic and industrial purposes in many parts of Switzerland. At Lausanne the public supplies are exhausted. The Lac de Bret, which furnishes the railway between Ouchy and Lausanne with water, is almost dry, and the train service cannot be continued. Unless there should be a heavy fall of snow before the spring, it is feared that the scarcity of water in the elevated districts will continue throughout the year.

To meet the expenses of the French public works estimates of 1883 the railway companies will be asked to reimburse 260,000,000f. of their debt. That operation supposes an agreement, and consequently, for the purpose of establishing such an agreement, an organisation of the right of purchase on a new basis, probably on that of the English conventions, which stipulate a right of purchase, but one only to be exercised at determined periods, every fifteen years, for example, so as not to create a permanent state of uncertainty in the economic *régime* of the railways by the menace of a purchase at any moment.

NEXT to the United States, Canada has the largest railway area in proportion to its population—one mile for every 690 inhabitants. With 5800 miles in course of construction, it holds the eighth place for total length of line, coming after France with its 13,000 miles. One of the largest and most valuable railways in the world, the Grand Trunk, extends from Quebec to Chicago, a distance of 1200 miles; the Intercolonial, from Halifax to Quebec, 720 miles; and the Occidental, from Quebec to Ottawa, 300 miles. From the ports of Quebec and Montreal several direct lines of railway to New York, Boston, Portland, St. John, N.B., and Halifax, keep up close communication with Europe, and the Great Western and other roads in Ontario connect with the Western States, Nevada and California.

ON the morning of the 22nd ult. (Wednesday) the first electric tram-car ever operated in this country, and, we believe, the first in the world, with the exception of some experiments made in France and Belgium last year with the same system, viz., Faure's accumulators, was run in the aggregate 2½ miles. The dead weight of the car was about 5¼ tons, the speed reached about 7 miles an hour, although the car was clumsily built, a bad fit on the rails, owing to the wheels having been constructed for a different pattern of tram rail than where the run took place. The experiment was successful, stopping and starting the car being effected with great promptitude. The trial took place on the Leytonstone branch of the North Metropolitan Tramways, on the private line leading to their works. The work is in the hands of Mr. Radcliffe Ward.

THE best-paying line in India is the East Indian, which earned in 1880 8·71 per cent. on a total capital of 33,03,98,294rs. The next best is the Eastern Bengal, which showed a net earning in 1880 of 7·67 per cent. on a capital of 3,31,68,524rs. The Bombay, Baroda and Central India shows last year a net profit of 5·72 per cent. on a capital of 8,28,42,480rs. The Sind, Punjaub, and Delhi showed a net profit of 5·24 per cent. on its capital of 11,04,52,484rs., but this favourable outturn was owing to exceptional military movements in 1880, consequent on the operations in Afghanistan. The Great Indian Peninsular earned 4·44 per cent. on a capital of 24,99,27,200rs. The South Indian showed a net profit of 2·23 per cent. on its capital of 4,16,72,963rs. The Madras Railway shows a net profit for 1880 of only 1·77 per cent. on its capital of 11,08,55,385rs. The average net profit of the broad-gauge railways for the year 1880 was 5·28 per cent. on their cost; of the narrow-gauge the result was a net profit of 2·65 per cent.

WRITING on the Spuyten Duyvil accident, a correspondent of the New York *Sun* says:—"In all the evidence given at the Spuyten Duyvil inquest there was none to show why those cars burned up so quickly. When a drawing-room or sleeping car is built, from 15 to 20 bushels of shavings from a planing machine are put into the space between the floor and the false floor. The floor timbers are 6in. by 9in., so there are 9in. of shavings trodden down hard by the men as they put them in before the upper floor is laid. Now it will at once be apparent why the Idlewild and Empire flashed up so quickly. In my opinion, if there had been no shavings, as stated, Mr. Wagner and some of the others might have been taken out alive, to say the least. The shavings were put in to deaden the noise and for warmth, by Mr. Wagner's orders." The *Railroad Gazette* says:—"We have no means of knowing certainly whether the spaces below the floors of the cars referred to were or were not filled with shavings; but we do know that it is a very common practice to use such material in that way. That it makes a car very much more combustible than it would be if the floor spaces were filled with some material which would not burn is plain, and therefore there is good reason for condemning and abandoning the practice."

THE report of Major Marindin on the recent fatal accident on the Great Northern Railway at Hornsey has been published. In his conclusion he says:—The lesson to be learnt from this fatal collision is that the whole system of fog signalling, in use generally throughout the kingdom, is a very weak point in railway working, and that the rules for working under the present system, weak as it is, require improvement. Even when fog signalmen are at their post, and are known by the drivers to be there, it must be remembered that in very thick fogs the fogman and his lamp are frequently invisible, and that therefore a driver does not get any positive intimation when a signal is off, such as he has when the signal lamp or arm is itself visible, but only a negative signal, on account of the non-explosion of two detonators, which may possibly have failed to explode, although upon the rail and intended to do so. The rule enjoining 'caution' when running in a fog should be rigidly enforced. The risk appreciable at all times during fogs becomes far greater when the fog is a sudden one, for in such a case there must be, under the present system, an interval of time when the signals are not protected by any fog signalmen. It is to be hoped that as a result of this collision a further trial may be given to inventions for the improvement of fog signalling.

NOTES AND MEMORANDA.

M. PLANTE has found that the process of "forming" the lead plates of his secondary batteries is hastened by heating the whole cell during charging to between 70 and 88 deg., when the opposing electromotive force is lessened, and the resistance very considerably so.

THE high tides which were common last week were predicted in Roberts' "Tide-table for 1882." According to this table the next period of high tides which may develope into overflow tides is from 1.49 p.m. of the 19th inst. to 4.13 a.m. of the 23rd. The probable depths on those days will be respectively 29ft. 3in. and 29ft. 8in. on the sill of the Shadwell lower entrance of the London Docks.

THE mean reading of the barometer at Greenwich last week was 30·23in.; the highest reading was 30·65in. on Monday morning, and the lowest 29·30in. at the end of the week. The mean temperature was 44·3 deg., 4·7 deg. above the average in the corresponding week of the twenty years ending 1868. The mean showed an excess on each day of the week; the warmest day was Saturday, when the mean was 49·1 deg., and 9·2 deg. above the average for the above period.

ACCORDING to a paper in the *Journal* of the Russian Chemical Society, by M. Kraevitch, the rarefaction of air in a vessel, as an incandescent lamp glass, may be carried by Mendeleef's pump, which appears to be a modified Sprengel pump, to 0·0002mm., the pressure of the vapours of mercury always remaining, and this at the ordinary temperature of a laboratory would not be less than 0·02mm. M. Kraevitch therefore doubts that Mr. Crookes has obtained so low a pressure as 0·00004mm.

THE new census returns show that in the commune of Naples there are 104,936 families and 489,334 individuals, showing an increase, since the year 1871, of 11,541 families, and an increase in the population of 40,999. The population of the following cities, as taken by the new census, is—Milan, 321,000; Rome, 300,292; Palermo, 244,955; Genoa, 179,491; Florence, 168,000; Venice, 130,698; Bologna, 122,884; Messina, 120,000; Catania, 101,000; Leghorn, 97,615; Ferrara, 77,008; Padua, 72,174; Verona, 68,741; Lucca, 68,116; Alessandria, 62,634; Brescia, 60,630; Bari, 60,575; Ravenna, 60,306. These figures compared with those of the former census show that the population of the above towns has augmented, while Ancona, Parma, Porto Maurizio, and Reggio d'Emilia have suffered a more or less sensible diminution.

AT a recent meeting of the Paris Academy of Sciences, a paper was read on the explosive wave, by M. Berthelot. It is not a sound-wave travelling with a velocity depending on the physical constitution of the medium, but a change of chemical constitution propagated. M. Berthelot recapitulates its properties. As to dependence of the velocity on the diameter, this becomes less and less as the increase of the diameter allows more freedom of motion to the molecules and diminishes friction. The total energy of the gas, at the moment of explosion, depends on its initial temperature and the heat liberated during combination. These two data determine the absolute temperature of the system, which, moreover, is proportional to the kinetic energy ($\frac{1}{2}mv^2$) of translation of the molecules. It follows that the velocity of translation is proportional to the square root of the ratio between the absolute temperature and the density of the gas referred to air.

THE discussion of the coal-near-London question has again cropped up. The discovery of Upper Devonian strata, both at Turnford and at Tottenham-court-road, in both cases dipping at high angles, lends not a little support to the view that a trough of carboniferous strata may exist between those two localities. Professor Prestwich, according to Professor J. W. Judd, would now recommend a boring "a mile or two north of Kentish Town, not directly north, but north-east or north-west, so as to avoid the hills—say about Edmonton on the one side, or near Edgware on the other." On the south side of London he would prefer to avoid the Lower Greensand, and would recommend a boring "just beyond its outcrop at Red Hill—somewhere between there and Horley." But he thinks that if coal-measures were found to extend beneath the Lower Greensand, means might be found to sink through the latter, by the new appliances of which the Belgian engineers have so largely availed themselves.

AT a recent meeting of the Royal Society, of Edinburgh, Sir William Thomson, in a paper on the thermodynamic acceleration of the earth's rotation, drew attention to a solar action which tends to accelerate the earth's rotation, or more strictly to diminish the retardation effect of the tides. From consideration of observed barometric changes at various stations all over the earth's surface, it is found that the well-known semi-diurnal barometric oscillation has its maxima, on an average, at 10 a.m. and at 10 p.m., and its minima at 4 p.m. and 4 a.m. This barometric oscillation must be due to the action of solar heat; and the line of crests, *i.e.* the axis of maximum pressure, so lies with respect to the line joining the earth's centre and the sun that the couple due to the sun's attraction upon the ellipsoidal mass of air acts in the direction of the earth's rotation, and therefore accelerates it. The energy of this acceleration is of course derived from the sun's heat, and hence the appropriateness of the name thermodynamic acceleration. Its value is estimated about one-tenth of the tidal retardation.

AT the meeting of the Chemical Society, on the 10th inst., a paper, "On the Chemical Examination of the Buxton Thermal Water," was read by J. C. Thresh. In a previous paper the author communicated the results of an examination of the sinter deposited by the above water, and in the present paper completes the examination of the spring by a very complete analysis of the saline constituents of the water. The flow per minute is not less than 101 gallons. The density of the water is ·99992; full details are given as to the methods employed in the analysis. The final result was tabulated as follows:—Calcium bicarbonate, 2·0014 parts in 10,000 of water; magnesium carbonate, ·8587; ferrous carbonate, ·0044; manganous, ·0040; barium sulphate, ·0069; calcium sulphate, ·0373; potassium sulphate, ·0888; sodium sulphate, ·1205; lead sulphate, ·0006; sodium nitrate, ·0037; calcium fluoride, ·0028; sodium chloride, ·4412; ammonium chloride, ·0003; magnesium chloride, ·1361: silicic acid, ·1356; lithium, trace; strontium, trace; phosphoric acid, trace; organic matter, ·0033; free CO_2, ·0287; free nitrogen, ·0272—total, 3·9015. The author also quoted the analyses of previous observers.

A PAPER was recently communicated to the Royal Society of Edinburgh "On the Diminution of Cast Iron at Various Temperatures," by W. J. Millar, C.E. His paper described:—(1) Experiments made by the author with cast iron showing that both large and small cold solid pieces floated in the molten metal, but that the larger pieces disappeared below the surface previous to their floating. (2) Statement of views expressed from time to time as to the phenomena attending cast iron at extreme temperatures, such as molten, white hot, solid, and finally cooled solid condition. (3) Conclusions drawn by the author from experiments which he had formerly made, viz., that the cause of floatation is buoyancy due to sudden expansion caused by the great heat of the surrounding molten mass. (4) Description of recent experiments made by the author from which he finds the above views are confirmed, and that on carefully measuring the solid before and after immersion it is found that sufficient expansion had occurred to give the necessary buoyancy, this expansion being equal to the original shrinkage. (5) From these and other experiments the author finds that the expansion is very rapid at first, and concludes from the fact that the floating pieces are comparatively little heated that a large part of the surrounding heat disappears in the form of work of extension. (6) Experiments were made with lead, type metal, steel, and bronze, from which it appears that the latter float like iron, but that the former do not float. (7) From some experiments made to determine whether any expansion took place with cast iron on setting it appears very doubtful if any such action exists, at least when the metal is free from air or gases. The experiments by Mr. Millar thus agree, and the conclusions appear to be the same as those of Mallet, as published in the "Proceedings" Royal Society, 1875.

MISCELLANEA.

A PROSPECTUS has been issued of a new company to be formed to take up the manufacture of the Buckett caloric engine and Holmes' Siren fog signals, with a capital of £100,000.

ON the evenings of the 28th ult. and 1st inst., lectures were delivered in the Central Exchange Art Gallery, on the "Present Position of Gas and Electricity as Illuminating Agents," by Mr. T. P. Barkas, F.G.S.

THE fifth part of "Art and Letters," conducted by Mr. J. Comyns Carr, is chiefly occupied with military studies and the Prince of Wales's Indian collection. The engravings, as in the former numbers, are generally excellent. The sixth part is just published.

THE Report of the Royal Commission for the Australian International Exhibition has just been published. It contains the report of the Commissioners and official representatives, correspondence, statement of the rise, progress, and present position of New South Wales and Victoria, regulations, list of awards, and various other papers.

PROF. HEIM, of Zurich, has visited Fettan, the village in the Grisons which is being swallowed up by the ancient moraine on which it is built. He ascribes the phenomenon to the movement of underground waters, and considers that the perils may be averted by certain engineering operations, which will probably be executed under his superintendence.

IN a paper read last week before the Yorkshire Society of Engineers and Surveyors by Mr. Styan, City Surveyor of York, "On York and its Public Works," it was stated that the drainage on both sides of the city was discharged into the river, in contravention of the Rivers Pollution Act, and that York possessed 26 miles of sewers unventilated; but it was also stated that the death-rate of the city averaged so low as only 19 per 1000 per annum.

DR. SPRENGEL has published in a pamphlet form a good deal of correspondence on the inventorship of the Sprengel mercury air pump, the object of the publication being to show that this most valuable invention is his and not Professor Bunsen's. This pamphlet seems almost unnecessary, for there are very few who attribute the pump to Professor Bunsen because he made an application of its principle and for a purpose used water instead of mercury. The name of the real inventor is so well known that the pump is very commonly referred to as a "Sprengel," and Professor Bunsen disclaims anything more than its application.

ON the 17th ult. a new dredger was tried in the Brunswick Dock Basin, Liverpool, made by Messrs. Priestman Brothers, Hull, for the Mersey Docks and Harbour Board, under the directions of Mr. G. F. Lyster, the engineer. This dredger is formed of a large self-filling and discharging scoop, capable of holding from 20 cwt. to 30 cwt., according to the nature of the material, and worked by engines designed to bring the two chains required under the control of one man, enabling him to work rapidly and with ease. At the trial the dredger worked in about 30ft. of water, and made more than a lift per minute, the "bucket" coming up quite full, giving an output of 70 tons per hour. Two or three of these machines placed on one large barge would form a dredger capable of giving a large output, the first cost of which would be very small.

A SINGULAR "accident" was inquired into by the Salford coroner last week. It seems that at Messrs. Whitham and Co.'s dye works a steam kettle had been rigged up out of an iron chest or box 2ft. wide by 2ft. 5in. deep, which had been previously used as a receiver of the exhaust steam from a high-pressure engine. This was connected with the boiler with a 1in. pipe, and charged with steam for the purpose of boiling water for the men's meals, but no safety valve was provided, and the result was that the steam kettle exploded, killing one man, and inflicting injuries on another, from which he is not likely to recover. Alderman W. H. Bailey, of Salford, who is the manufacturer of a patent steam kettle, was called to give evidence, and pointed out the dangerous and unsuitable character of the apparatus, which it appeared had been fitted up by a mechanic, without however the necessary practical knowledge. The coroner having commented on the carelessness which had been shown, the jury returned a verdict of accidental death.

FATALITIES in the London streets continue to increase. During the past thirteen years the numbers of deaths reported by the Registrar-General as due to horses and vehicles in the streets of the metropolis have almost steadily increased from 192 in 1869 to 252 in 1881. This latter number shows a considerable excess upon the number in any previous year, the nearest approach being 237 in 1878. If this heavy death toll upon passengers in the London thoroughfares be analysed with a view to distinguish the classes of vehicles which have most largely contributed to this slaughter, we find that 146, or considerably more than half, were due to vans, wagons, drays, and carts, 44 to omnibuses and tramcars, 31 to cabs, and 14 to carriages, while 13 were caused by horses. Perhaps the most noteworthy feature of these returns is the continually increasing fatality due to tramcars, more deaths being caused last year by tramcars than by omnibuses.

A NEW steam digger is being made by Messrs. Proctor and Co., Stevenage. It is thus described by the *Mark Lane Express*:—"It consists of a 10-horse traction engine travelling on the land, with digging apparatus attached behind. Three forks, nearly resembling those of the Darby digger, take a breadth of 12ft., rotating at the speed of forty-five strokes of each fork per minute. The slices are turned over as in the Darby work, when the depth is sufficient, but broken and littered irregularly with much of the surface vegetation unburied where the digging is shallow. It may be assumed that, in the same soil, the tillage would precisely resemble that done by a Darby digger—excepting that the shorter spits or slices of earth do not fit very well where they meet. The feature is that there is no shifting of road wheels to convert the engine from road purposes to digging purposes; hence, work may be begun immediately upon entering a field. Another is that the weight is about half that of the Darby machine, but the breadth of work taken is only 12ft., against the Darby's 21ft. The price, too, is £600, as compared with the Darby £1000. By a spring arrangement the digging forks turn up of their own accord when the engine is backed, so as to lie flat upon the land instead of penetrating into it. The weight upon the main travelling wheels appears to differ very little from that upon the Darby wheels, per foot width of tire."

A REPORT to the Home Secretary by Mr. T. J. Richards, has been published, respecting the explosion on the 14th September, at the corn mill of Messrs. Fitton and Son, at Macclesfield. A large part of the mill at the north end was levelled to the ground, and the roof over a much larger area destroyed, and the engineman killed by the fall of part of the building. The damage was estimated at between £5000 and £6000. It appeared that some millstones had been running empty, and heated sufficiently to ignite the flour-dust diffused in the millstone cases, and this being transmitted along the passages to the stive-room by the continued ignition of dust, would cause an explosion of the flour-dust in the stive-room. Fires and explosions from these causes are much more common in America than this country; perhaps owing to the greater extent to which grain cleaning and stive separation have, until lately, been carried on in large American mills than in this country. To these explosions we have several times referred. Records of eighty-four serious fires which have occurred in corn mills since 1876, the origin of fifty-six being unknown. Insurance companies are alive to the extra risks incurred in corn milling, as is shown by the high rate of insurance charged for corn mills, namely, from 18s. to 20s. per cent. The risks involved in rice cleaning and milling are greater even than in corn milling. This seems to be indicated by the high rates of premiums charged by insurance companies, while some companies will not accept them at any rate.

PLANT AND APPARATUS FOR LIGHTING RAILWAY CARRIAGES, BUOYS, AND LIGHTSHIPS.

JULIUS PINTSCH, BERLIN, ENGINEER.

(*For description see page* 155.)

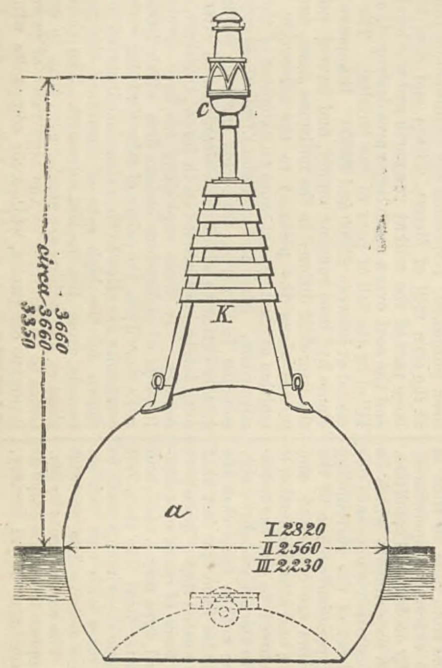


Fig. 11.—Gas Lighted Buoy, Trinity Pattern.

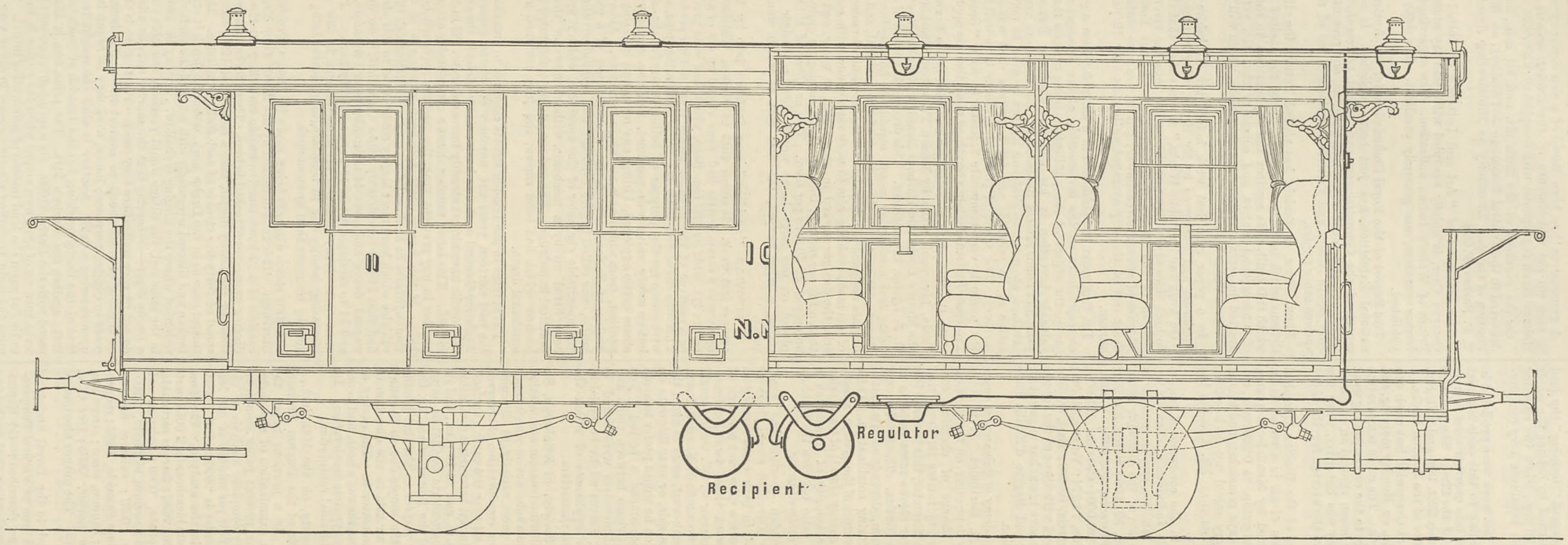


Fig. 6.—First-class Carriage Bergische Maerkisch Railway, Showing Fittings.

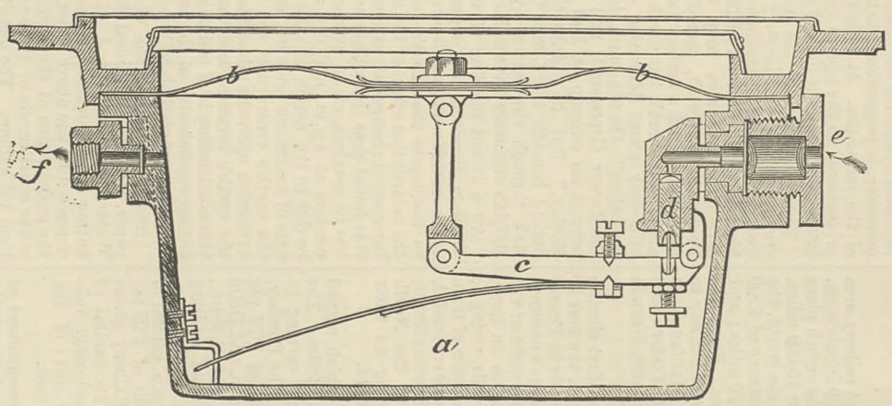


Fig. 5.—Gas Regulator and Reducing Valve.

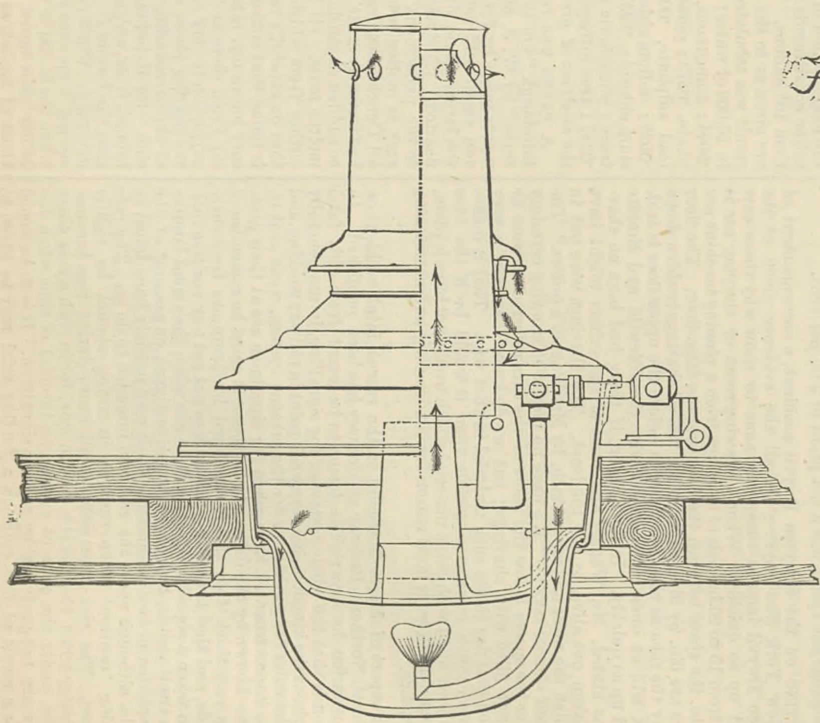


Fig. 8.—Railway Carriage Lamp.

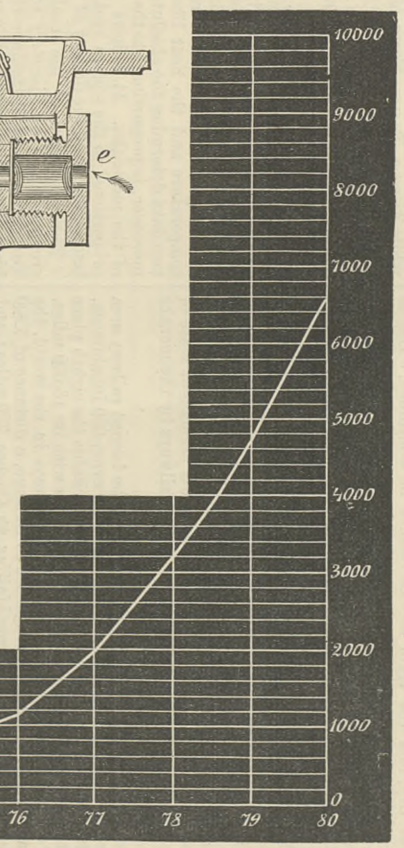


Fig. 9.—Progress of the System on Railways.

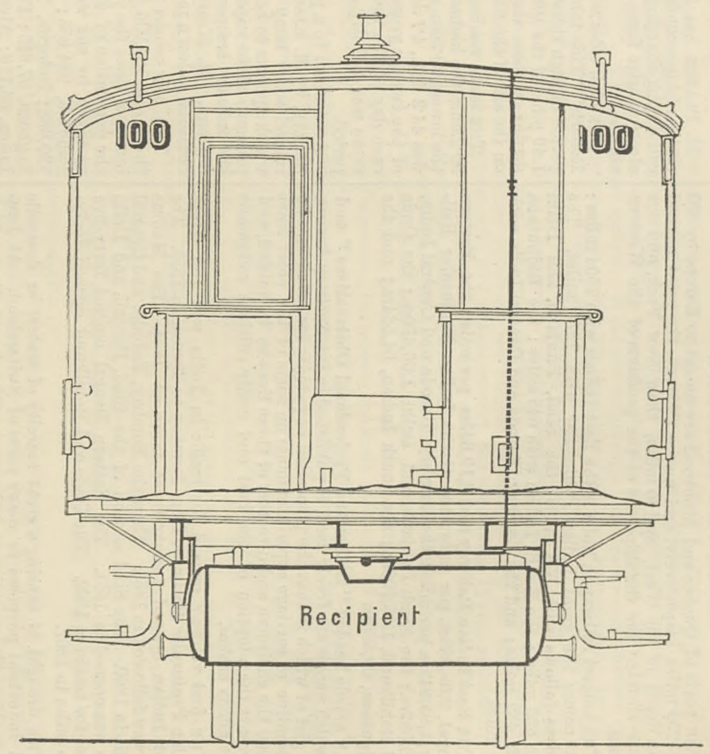


Fig. 7.—Section of Carriage, Showing Fittings.

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.*
LEIPSIC.—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* 1d. *postage stamp, in order that answers received by us may be forwarded to their destination. No notice will be taken of communications which do not comply with these instructions.*

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

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

J. A.—*We do not think your invention would possess any value in this country.*

ALPHA.—*Bone contains carbon, phosphate of lime, lime, nitrogen, and many other elements.*

A. AND W. (Birmingham).—*We do not find an article on the subject in* THE ENGINEER, No. 170, 3rd *April*, 1859. *We have no copies of that number for sale.*

W. F.—*We never recommend the machinery of particular makers. You must use your own judgment, or that of a consulting engineer, in making a selection among the numberless steam pumps competing for favour.*

MANY YEARS' SUBSCRIBER.—*Variations within reasonable limits; capacity of the intermediate receiver seems to have no practical effect on the working of a compound engine. You will get about as good results as can be had by making it equivalent to anything between one-half and the whole capacity of the high-pressure cylinder, assuming that steam is cut off at half or five-eighths stroke in the small cylinder.*

S. L.—*There is not, we believe, any complete work on hydraulic machinery. At present the various forms of cranes, rivetting, punching, and shearing machines, lifts and presses, are only properly described in scattered papers. You probably could not do better than to get the catalogues of one or two makers of hydraulic machinery, as affording good suggestive illustrations, and then get Box's "Practical Hydraulics," and Stone's "Simple Hydraulic Formulæ," both published by Messrs. E. and F. N. Spon.*

PHŒNIX.—*It is impossible to answer your query. No one can say whether a propeller of* 2*ft. pitch running at* 400 *revolutions, or one of* 4*ft. pitch running at* 200 *revolutions, will give the best result. An answer can only be given to such questions when all the conditions are known, such as the lines of the boat, the draught, the area of the screw, the kind of engine, and many other things too numerous to mention. Speaking broadly,* 200 *revolutions per minute is a better speed for a screw than* 400 *revolutions.*

J. S. L.—(1) *The quantity of coal used by a first-class steamer between Liverpool and New York depends, among other things, on the size of the steamer. Large ships, like the Servia, will burn* 5 *or* 6 *tons per hour.* (2) *You will find a full description of the needle gun in* THE ENGINEER *for July* 20*th*, 1866. *The first needle gun seems to have been patented by Mr. Sears on the* 11*th Jan.*, 1850. (3) *The longest tunnel in England is the Box Tunnel, on the Great Western Railway,* 3123 *yards; the Kilsby Tunnel, London and North-Western Railway, is* 2398 *yards; the Honiton Tunnel, London and South-Western Railway, is* 1350 *yards long.*

BUNSEN BURNER.—*All the air requisite for combustion cannot be mixed with the gas beforehand; air must be admitted elsewhere than through the burner. This being the case, you would have great difficulty in carrying your plan into practice. We advise you to use, say, twenty rose Bunsen burners, these burners to be set in a cast iron perforated plate with the delivery holes in the burners just above the top surface of the plate, the holes in the plate to be* $\frac{1}{8}$*in. more in diameter than the burner. The air necessary for combustion will enter through the holes in the plate and be intensely heated before touching the boiler—a matter of great importance—while complete combustion will be ensured. We shall be happy to give you further information if you want it.*

WOOLWICH INFANT.—(1) *The Milford Docks, Mr. J. M. Toler, Saltersford Hall, Holmes Chapel.* (2) *The strength of a solid wrought iron shaft may be found by the following formula:—*L = *length of lever in inches or radius of wheel at which force is applied.* F = *force applied in lbs.,* D *diameter of shaft in inches. Then* $D = \sqrt[3]{\frac{F\,L}{1700}}$ *and the strength as against torsion of a hollow shaft whose internal diameter is to the external diameter as* 4 *to* 10 *is* 1·26 *times the strength of a solid shaft of the same sectional area. If the relation of internal and external diameters is as* 5 *to* 10, *the strength is* 1·44 *times that of solid shaft; if* 6 *to* 10, *then it is* 1·7 *times; if* 7 *to* 10, *it is* 2·08*; if* 8 *to* 10, 2·74. (3) *It would take too much room here to go into the question of taking levels on the two sides of the Channel. See Baker's "Levelling and Surveying," or his "Mensuration," in Weale's Series; or Simms's "Marine Surveying," or "Marine Surveying," in Weale's Series; or Louis D'A. Jackson's "Aid to Survey Practice."*

LEATHER LINK BELTS.

(*To the Editor of The Engineer.*)

SIR,—In the issue of 24th inst., you speak of a "curious" belt as driving an exciter from No. 19 horizontal engine at the Electrical Exhibition. I have worked leather link belts nearly three years, and they have always given satisfaction. J. C.

Glasgow, February 25th.

BRASS SPRINGS.

(*To the Editor of The Engineer.*)

SIR,—Would you allow me to ask through your columns what is the best means of rendering brass wire springs elastic? The springs in question are spiral and of round section, so that they will not admit of being hammered. Is there any special make of brass suitable to this purpose? J. D. E.

London, February 27th.

THE TURBINE PROPELLER.

(*To the Editor of The Engineer.*)

SIR,—Permit me to correct an error in my letter of the 21st on the above subject. I called the absolute backward velocity of the water on leaving the propeller $\rho\, c$, and not $g\, c$, as your printer put it. This correction is necessary, as in the formula for the lift of the turbine g is used to signify, as usual, acceleration by gravity. GISBERT KAPP.

Grantham, February 28th.

SUBSCRIPTIONS.

THE ENGINEER *can be had, by order, from any newsagent in town or country at the various railway stations; or it can, if preferred, be supplied direct from the office on the following terms (paid in advance):—*

Half-yearly (including double numbers) .. .. .. £0 14s. 6d.
Yearly (including two double numbers) .. .. .. £1 9s. 0d.

If credit occur, an extra charge of two shillings and sixpence per annum will be made. THE ENGINEER *is registered for transmission abroad.*

Cloth cases for binding THE ENGINEER *Volume, price* 2s. 6d. *each.*

Many Volumes of THE ENGINEER *can be had price* 18s. *each.*

Foreign Subscriptions for Thin Paper Copies will, until further notice, be received at the rates given below:—Foreign Subscribers paying in advanc. at the published rates will receive THE ENGINEER *weekly and post-free Subscriptions sent by Post-office order must be accompanied by letter of advice to the Publisher. Thick Paper Copies may be had, if preferred, at increased rates.*

Remittance by Post-office Order. — Australia, Belgium, Brazil, British Columbia, British Guiana, Canada, Cape of Good Hope, Denmark, Egypt, France, Germany, Gibraltar, Italy, Malta, Natal, Netherlands, New Brunswick, Newfoundland, New South Wales, New Zealand, Portugal, Roumania, Switzerland, Tasmania, Turkey, United States, West Coast of Africa, West Indies, Cyprus, £1 16s. China, Japan, India, £2 0s. 6d.

Remittance by Bill in London. — Austria, Buenos Ayres, and Algeria, Greece, Ionian Islands, Norway, Panama, Peru, Russia, Spain, Sweden, Chili, £1 16s. Borneo, Ceylon, Java, and Singapore, £2 0s. 6d. Manilla, Mauritius, Sandwich Isles, £2 5s.

MEETINGS NEXT WEEK.

THE INSTITUTION OF CIVIL ENGINEERS.—Tuesday, March 7th, at 8 p.m.: Paper to be discussed, "Steel for Structures," by Mr. Ewing Matheson, M. Inst. C.E.

SOCIETY OF ENGINEERS.—Monday, March 6th, at 7.30 p.m.: A paper will be read entitled "Notes on Electric Light Engineering," by Mr. C. H. W. Biggs and Mr. W. Worby Beaumont. The leading feature is a discussion of some of the minor points which affect the successful arrangement of electric lighting plant, as the heating of the wires of dynamo machines, internal and external resistance, comparative resistance of various conductors, lamps in series, and in multiple arc, and calculations employed in arrangement of the lamps, &c.

SOCIETY OF ARTS.—Monday, March 6th, at 8 p.m.: Cantor Lectures, "Hydraulic Machinery," by Professor John Perry. Lecture I.—The hydraulic press. The nature of fluid pressure. Compressibility of water. The law of work in machines. Hydraulic jacks, punches, shears, and rivetting machines. Pressing machinery. The influence of friction. Bursting pressures. Wednesday, March 8th, at 8 p.m.: Fourteenth ordinary meeting, "Improvements in Gas Illuminations," by Professor A. Vernon Harcourt, F.R.S.. Dr. Odling, F.R.S., will preside. Thursday, March 9th, at 8 p.m.: Applied Chemistry and Physics Section, "Practical Hints on the Manufacture of Gelatine Emulsions and Plates for Photographic Purposes," by Mr. W. K. Burton. Mr. John Spiller, F.C.S., Vice-President of the Photographic Society of Great Britain, will preside.

THE ENGINEER.

MARCH 3, 1882.

THE WATER-METER QUESTION.

WE had not intended to add anything, for the present, to the remarks on "Meters or Rates" made in our issue of Feb. 10th, but since that article appeared some information has reached us, from a fresh quarter, so remarkable as to make it desirable that the subject should be reopened. The Civil Engineers' Club of Cleveland, U.S., have published a short but telling paper on "Water Waste and Water Meters," by Mr. M. W. Kingsley, Assistant Waterworks Engineer, whom we believe we may venture to claim as an Englishman, and as the son of a most distinguished Englishman, distinguished specially for his attention to questions of health. As the son of such a father, Mr. Kingsley is not likely to underrate the importance of giving to the inhabitants of cities no occasion to be niggardly in their use of water. Nevertheless, Mr. Kingsley is a decided, even an enthusiastic, advocate for the system of domestic supply by meter; and certainly, from the figures he gives, our Transatlantic cousins at least, require no encouragement to make a liberal use of the water provided for them. At the recent discussion before the Institution of Mechanical Engineers many hard things were said of the London water companies, because they permitted and allowed for the enormous consumption of 30 gallons per head per day. But Mr. Kingsley gives a list of the corresponding figures for ten American cities, which begins with Providence at 25 gallons, and ends with Detroit at 105, and Chicago at 119! As in other things, so in the use or abuse of water, our Western friends may claim to "whip creation." When we consider that 119 gallons mean about 19 cubic feet, we stand in amazement at the more than royal prodigality of bathing in which the average citizen of Chicago must indulge, if he at all does justice to his own opportunities. On the whole the average consumption in the ten cities alluded to is 64 gallons per head per day, while for seven towns of Great Britain, including London, it is 36. The reason of this enormous difference is not evident, but it seems to be partly due to the greater length and severity of the American winter. The wasteful and doubtful practice of allowing taps to trickle during a frost to prevent freezing of the pipes appears there to be universal, and this will probably account for a large part of the consumption. Experiments are given in the paper which show that a pipe even $\frac{1}{16}$in. diameter will discharge about 322,000 gallons per annum, if open constantly; and a pipe of $\frac{1}{4}$in. diameter nearly 40,000,000 gallons.

Whatever the cause, it will hardly be denied that there is room for economy in the water consumption of American cities, and it is here that the meter system comes to the front. For by a second table, giving further particulars of the water supply in the ten selected towns, we learn that Providence, the most economical, has one meter for 2·3 services, and Fall River, which comes next, about the same; while Chicago has one for every 40 services only, and Detroit is practically without meters at all. These results cannot be accidental, and they go to support the view that domestic meters do have a most powerful effect in the suppression of waste. On the other hand, they cannot be said to show that the use of meters induces stinginess in the use of water; since Providence, which an American would call "the most metered city in the States," runs its consumption up to the very respectable figure of 25 gallons per head per day. Testimonies quoted in the paper, from Brooklyn, Baltimore, Philadelphia, and elsewhere, show that American engineers are alive to the enormous waste that is going on, and have quite made up their minds that the meter is the only remedy. In New York the decrease of pressure has become so serious that they have been compelled to resort to meters for all large supplies, and by doing so they reduced the consumption in a single hotel from 115,000 to 45,000 gallons per day. Nor does the system seem to work any hardship on the consumers. In many cases the amounts collected by meter fall short of those previously paid by rate, and in some cities, where the use of a meter is a matter of option, about 60 per cent. of the inhabitants are found to elect this mode of supply.

In the recent discussion, while much was said as to the systems and the meters used on the Continent, not a single allusion was made to American practice, so that this evidence is equally fresh and important. It will be observed that the district meter system, which we owe to Mr. Deacon, and of which the merits as a detector of waste are generally acknowledged, does not appear to be known in America. Their only idea for preventing waste is to fix a meter in every house, or nearly so. Now this proposal is met, both there and here, by two distinct objections, both urged by engineers of eminence—first, that it would tend to prevent the due use of water for purposes of health, and, secondly, that the expense would be far greater than the advantage would warrant. The first of these objections is met by the cases of Providence and Fall City, where the consumption, though controlled by meter, is still, according to European ideas, extravagant. Nor does any complaint seem to be made by the water companies of attempts to defraud by running the water too slow for the meter to register; although our Yankee friends are generally credited with being quite as quick and ready to take an advantage as Mr. Hawksley represented continental consumers to be. This objection moreover can in any case be disposed of by the simple expedient—which Mr. Kingsley also approves—of fixing a minimum rental. There remains then the question of expense. Now in this the Americans are clearly in a worse position than ourselves, since the pumping expenses would probably be a smaller fraction, if anything, of the total charges, while the cost of meters and fittings would be decidedly higher; and, in fact, the meters in use with them—the Washington, Ball, and Crown meters—appear to represent a cost of about £9 each as the average. We take it that an English meter maker would generally be very glad to take a contract at less than half that sum. Nevertheless, with this against them, we find American water engineers, like Mr. Kingsley, eager to promote the meter system; and urging that if the town of Cleveland had not spent about 19,000 dols. in meters, they would have had to spend ere this above 200,000 dols. in new pumping machinery and mains, to meet the growing demand of the city.

It is here, in fact, that the meter advocates have their strongest ground—a ground which they do not seem quite to have occupied as they might have done. The question is argued as if it only concerned the introduction of meters into a city like London, where the supply has long been complete, and where no immediate extension is looked for. Let us for a moment consider this case as put by Mr. Hawksley. He says that the total charge in London is about 7d. per thousand gallons, of which about $\frac{3}{4}$d. only is cost of pumping, which would alone be reduced by the water being economised. It is evident, however, that some other charges—such as that for filtration—would be equally affected; and we may fairly claim that a reduction in the consumption of 50 per cent.—which recent experience in Lambeth has shown to be quite practicable—would save the water companies $\frac{1}{2}$d. out of every 7d. they now receive, and thus enable them to make a reduction in their charges of, say, 7 per cent. Now a house containing six persons, at thirty gallons per head per day, will use about 66,000 gallons per annum, and should therefore be charged about £2 per annum for its water. It is clear that a reduction of 7 per cent. on this charge will not pay for the rent of a water meter; and so far Mr. Hawksley is perfectly justified. It is not worth while in England, and as a mere measure of economy, to employ water meters inside houses, except such as are very large, or require more than an ordinary domestic supply; and this is true even where the waste is so great as it confessedly is in London. But let us now suppose for a moment that London was yet waiting for its water supply, and that the question of how that supply should be paid for was now before Parliament. Then the advocates of the meter might fairly say, "If you go on the rating system, experience shows that you must provide thirty gallons per head per day; if on the meter system it will be fifteen gallons. In other words, your waterworks, which need only be sufficient for the proper supply of, say, three millions of people in the latter case, must in the former be arranged for the proper supply of six millions. Now the interest on capital—we are here following the figures given by the actual returns—will amount in the case of rating to more than 4d. out of a total of 7d. per thousand gallons. Hence the real saving by our system will be, not $\frac{1}{2}$d., but about $2\frac{1}{2}$d.; not 7 per cent., but 36 per cent.; and this will undoubtedly be sufficient to outweigh the cost of a very large number of meters, and yet leave a substantial balance on our side."

It will thus appear that in the case of new waterworks the advantages of a system which will ensure no more water being used than is actually wanted are beyond all dispute; and even in the case of existing waterworks, it must be remembered that population increases continually, and that the more economical the system the longer will the company defer that evil day, when the great expense of a fresh set of mains, and all the other concomitants of an enlarged supply, will have to be encountered. Impartial judges will probably decide, therefore, that careful and continual control by meter should be a duty imposed by authority on every water company, since the case of London is quite sufficient to show that they are not to be trusted to impose it on themselves. In what way that control may be most cheaply, and at the same time efficiently, exercised, is of course a question for experts. Much is to be said for the domestic meter system, which makes every householder a policeman over his own supply; but if the "district meter" system, or any other, can accomplish the same end, at any rate for small houses, without the expense and trouble which a house meter involves, the public at least will be quite contented to accept it as the solution of the problem.

STEAM ENGINE ECONOMY.

OUR readers will find on page 163 an extract from a very interesting report from the pen of Mr. Michael Longridge, M.A., Chief Engineer to the Engine, Boiler and Employers' Liability Insurance Company, Manchester. We cannot find space to reproduce the report *in extenso*, but we print the more essential portions. It will be remembered that in THE ENGINEER for February 25th and March 11th, 1881, we took exception to certain statements contained in a report prepared by Mr. Longridge on the performance of a tandem engine and boilers at Messrs. Nuttall and Sons, Oak Mill, Farnworth. This engine had in acketted cylinders, yet, according to Mr. Longridge, it worked with what appeared to be unparalleled economy; and we expressed our disbelief that under the stated conditions any steam engine could be made in which under 17 lb. of steam would develope an indicated horse-power. We were perfectly justified in expressing this doubt, because no record existed up to the date of Mr. Longridge's report of any performance even approaching that of Messrs. Nuttall's tandem compound engine. It was true that consumptions of 18 lb. of steam per horse per hour, or even a little less, had been met with in a few instances; but in these cases the cylinders were most carefully jacketted; and it seemed to be more likely that Mr. Longridge was led astray by an error in his indicator, or in his water-measuring apparatus, than that a very ordinary type of compound engine should perform with an unprecedented economy. Mr. Longridge has, it will be seen, checked the Farnworth experiments by a second series of trials made at Mr. Heyworth's weaving shed, Blackburn; and the results he has obtained in this latter case go far to confirm the accuracy of the conclusions he drew in the former case—that is to say, the Audley Hall engines required but 16·10 lb. of dry saturated steam per horse-power per hour, or 16·26 lb. of feed-water, the difference representing moisture in the steam.

Mr. Longridge's report is in many respects a masterly exposition of the action of steam in a cylinder, and we shall have more to say concerning it at another time. For the present we shall find quite enough matter for consideration in the extract from Mr. Longridge's report which we publish. Unless it is to be assumed that his indicator springs were wrong, that his assistants were incompetent, and his weights and measures inaccurate, we must conclude that his figures are correct; they are upheld by the results of the Farnworth experiments. It would be at once unfair to Mr. Longridge, and unjustifiable on other grounds, to express a doubt that what he says took place at Audley Hall did take place. Mr. Longridge, or any other experimenter, might make a mistake from want of caution in carrying out one experiment, but not in carrying out a second. We accept his figures then as conclusive, and find ourselves at once face to face with an apparently insoluble problem, namely, why are the engines at Audley Hall apparently among the most economical ever made? Leaving out the Farnworth engine, the only engines with which we can compare them are the Ditton engines provided with Mr. Cowper's "hot-pot," and the American engines of Mr. Leavitt, which are stated to have used but 16 lb. of steam per horse-power per hour. But in both these engines extraordinary pains are taken to keep not only cylinders, but the intermediate receiver hot. Now, in the Audley Hall engines we have no effort of this kind. The cylinders are jacketted only on the sides, and the same is said of the receiver. Why, then, should these engines be more economical than scores of other engines of the compound type indicated by Mr. Lavington Fletcher, Mr. Neil McDougall, and other boiler assurance companies' engineers? It seems to have fallen to the lot of Mr. Longridge to get hold of two phenomenal engines, the like of which his brother inspectors have never encountered. We accept the fact, but it is none the less remarkable. We regard his figures as being true; their truth makes them all the more astounding. It is not too much to say that Mr. Longridge renders a new departure in steam engineering essential; but unfortunately he has not shown us precisely in what direction we should go.

The peculiarity of the Audley Hall engine is not confined to its excessive economy resulting from apparently no adequate cause. A careful perusal of the table we have reproduced will supply us at once with another puzzle. The engine used more steam with the jackets in use than without them—what will Mr. Cowper say to this? The fairest comparison we can draw is between the feed-water per total horse-power per hour used on different days. We have explained what a total horse-power is in a recent impression, and need only remind our readers here that it means the total power exerted by the steam in overcoming back pressure as well as all other resistances. On the 25th of October no steam was admitted to any of the jackets; the feed-water amounted to 14·6 lb. On the following day steam was admitted to the low-pressure cylinder jacket, and the consumption of feed-water rose to 15·13 lb., or 0·53 lb. more. On the 27th of October the receiver jacket only was supplied with steam, the consumption of feed-water became 15·12 lb.; on the next day all the jackets were supplied with steam, when the consumption fell to 14·61 lb. On Monday, the 31st October, the high-pressure cylinder only had steam in the jacket; the consumption fell to 14·14 lb.; the next day none of the jackets had steam in them, the consumption of feed-water was 14·86 lb. On the 2nd of November, the last day of the trial, all the jackets were supplied with steam, and the consumption rose to 14·88 lb. It may be supposed that there was some difference in the power, pressure, and point of cut-off on the various days. There were differences, it is true; but so small as to be quite unimportant. Thus, the total ratio of expansion on the two last days was respectively 8·29 and 8·49; the pressure was the same within half-a-pound or so. It is as clear as anything can be that the jackets in this case either had no effect at all, or that they operated prejudicially. The only result tending to a contrary conclusion is that of the 31st of October, when the high-pressure cylinder alone was jacketted. The consumption of water was less on this day than on any other day by 0·46 lb. of water per horse per hour, an amount practically inappreciable in its effect on a coal bill. Turning to page 25 of Mr. Longridge's report, we find, "When all the jackets were in use the consumption was greater, but we must not conclude that steam jackets are therefore useless in all cases; for in the first place the sides only of the cylinders were jacketted, and in the second it is doubtful whether the whole surface jacketted was effective, for the heat furnished by the jackets was only 6 per cent. of the total quantity supplied, and as there were no air taps on the top there is no certainty that the jackets were filled with steam." It need hardly be pointed out that these words amount to nothing. If we suppose that the jackets were not filled with steam, then they would have produced no effect. Assuming that they were partly filled with steam, they did harm. It is reasonable to conclude that if they had been in full action they would have done either nothing at all or more harm than they did. The experiment, however, does not stand alone. It fully bears out the conclusions of many Liverpool engineers and shipowners, who hold, as the result of experiment, that jackets are of no value whatever, or that if they are of any service it is only when applied to the high-pressure cylinder alone. But we must not jump to the conclusion that because Mr. Longridge expresses doubts concerning the efficiency of the steam jackets they did not really act. On the contrary, he gives figures which show that they acted very well; and the fact that they did so, and yet did not effect any reduction in the consumption of fuel, but rather the reverse, is another of the remarkable features in the performance of the Audley Hall engine. To render the full import of Mr. Longridge's figures apparent we must offer a few words of explanation concerning the theory of the action of a jacket here.

When steam is admitted to an unjacketted cylinder it comes in contact with metal colder than itself, and a portion of the steam is condensed and heats up the cylinder. As the piston continues to move after the expansion valve has closed the steam falls in pressure, and at last has a less temperature than that of the cylinder which it had warmed up. Then the cylinder re-evaporates a portion of the water, and this in part restores the original loss. But as the re-evaporation always takes place at a lower pressure than that at which condensation occurs, there is invariably a loss of useful effect; the reproduced steam not being as efficient as that which was condensed. The object of the jacket is to prevent all cylinder condensation by keeping the cylinder uniformly hot. If the jacket be efficient very little water ought to be found at the end of the stroke in the cylinder; little condensation and small loss having taken place. The efficiency of the jacket will be measured by the comparative absence of water at the end of each stroke in the cylinder. Now, Mr. Longridge gives a very valuable table setting forth all the numerical results he obtained with the Audley Hall engine, and from this table we learn that with no steam in the jackets, on October 25th, the percentage of water in the small cylinder at the end of the stroke was 11, and in the large cylinder 33; in other words, one-third of all the steam passing through the engine was condensed in it. On the 28th of October steam was admitted to all the jackets, and we find that the percentage of water in the small cylinder was actually 15 instead of 11. But the percentage in the large cylinder was also 15. Thus then the jacket was so far efficient that no condensation whatever took place in the low-pressure cylinder; but, as we have seen, the engine was less economical, notwithstanding this fact, than when no jacketting took place. Of course the argument will be that the loss was transferred to the jackets, and that the water discharged from them was equivalent to that not deposited in the cylinder. Such an argument, however, has only to be named to be rejected. The weight of steam condensed in a jacket is always less than the weight of steam prevented from condensing in the engine. The loss by condensation with the steam in the jacket was reduced from one-third to one-sixth of the whole; and there was a very material increase in the average pressure in the large cylinder, and yet, as we have seen, there was a decided increase in the consumption of feed-water. How is this to be explained? Mr. Longridge does not attempt to explain it. The average effective pressure in the high-pressure cylinder on the 25th of October, without steam in jackets, was 44·95 lb., on the 28th of October, with steam in all jackets, it was 37·87 lb. The ratio of expansion on the first day was 8·27 times; on the 28th of October it was 9·82 times; but on the same days the effective pressures in the large cylinder were respectively 8·89 lb. and 11·20 lb., the back pressure in the first case being 3·76 lb., and in the second 3·95 lb. The indicated horse-power without steam in the jackets was 313·62, and on the 28th 313·78, or practically the same. Examining other figures we always arrive at the same result, namely, that admitting steam to the jackets powerfully retarded cylinder condensation. The percentages of water at the end of the stroke found in the small and large cylinders respectively on different days, with and without the jackets, are as follows: Small cylinder with jackets in use, 15, 8, 14; large cylinder with jacket, 23, 15, 16. Small cylinder with jacket not in use, 11, 15, 15, 11; large cylinder with jacket not in use, 33, 27, 33. These figures are very remarkable, and taken with the fact that the jackets on the first day, when they were all in use, discharged no less than 2987 lb. of water out of a total of 40,725 lb., go to show that they were kept well supplied with steam, notwithstanding Mr. Longridge's surmise to the contrary. The most remarkable fact of all, perhaps, is that when the high-pressure cylinder only was jacketted the percentage of water condensed in it at the end of the stroke was only 8; when the large cylinder also was jacketted the percentage was 15. Thus it would appear that, jacketting the low-pressure cylinder nearly doubled the condensation in the high-pressure cylinder. This certainly is a staggering proposition. Yet there is no escape from it; for on the 31st of October the ratio of expansion was 8·58, while on the 26th of October it was 8·78, or nearly the same. Indeed a glance at the table will show that the condensation in the small cylinder was apparently quite independent of the point of cut-off—another curious circumstance. Here we must for the present stop. We hope to resume the consideration of Mr. Longridge's figures next week. We may add that he has found Messrs. Donkins' system of testing so inaccurate that he has had to calculate a new coefficient for the discharge through notch boards.

AN UNCONSIDERED ASPECT OF THE CHANNEL TUNNEL QUESTION.

THE course of events in connection with the South-Eastern Railway Channel tunnel scheme does not run very smoothly. It will be remembered that one of the property rights which Sir Edward Watkin conveyed to the purchasers of the South-Eastern Railway tunnel works was the possession of three miles of foreshore. It would appear now that grave doubts exist as to whether Sir Edward Watkin had any such right to sell. In reply to questions put in the House on Monday night by Sir A. Gordon, Mr. Chamberlain stated that "It was necessary for the South-Eastern Railway Company to obtain leave of the Crown to deal with the foreshore. The South-Eastern Railway had gained no rights independent of the Crown, though they had set up a claim adverse to the Crown under a title by purchase, a claim which the Law Officers of the Crown would consider;" from which it would seem that the company may have sold that which it did not possess. On Tuesday night Lord E. Cecil asked for the names of the members of the committtee appointed to consider the Channel tunnel scheme. Mr. Childers, however, in reply, pointed out that the committee is not appointed to consider the Channel tunnel schemes generally, but only to make an exhaustive scientific investigation—without reference to the ulterior question of national expediency—into the practicability of effectually closing the projected tunnel. They are to ascertain whether it is certain beyond any reasonable doubt that, in the event of war, or apprehended war, the tunnel and its proposed approaches under the existing Acts of Parliament and the Bill now before Parliament can be rendered absolutely useless, and in what manner. They will consider and report what appliances, whether of destruction, of obstruction, of flooding, or of all combined, should be provided, including any work defending or commanding the exit, so that the use of the tunnel in every imaginable contingency may be beyond doubt denied to an enemy. The committee, as appointed, consisted of Sir A. Alison, head of the Intelligence Department, as chairman; Mr. Graves and another civil engineer. Since the committee was first appointed Mr. Barlow has been consulted as to one of the tunnel schemes, and his place on the committee will therefore be filled by another engineer, unconnected with either company. Only two civil engineers are thus to be appointed, but there are three military engineers, Major-General Gallwey, the Inspector-General of Fortifications; Sir Andrew Clarke, the present, and Sir John Stokes, the late Commandant of the School of Military Engineering; Colonel Alderson, Assistant-Director of Artillery; Colonel Majendie, Inspector of Explosives; and Professor Abel. The instructions to the committee will be laid on the table with the other papers. There is a point worth consideration which will, we trust, not be overlooked. According to the more earnest advocates of the scheme the tunnel can be made in five years, and at a cost of less than £1,000,000 sterling. It can also be worked by Beaumont's compressed air engines, with an expenditure for fuel comparatively small. Colonel Beaumont's estimate is, as will be seen from a letter in another page, ·25 of a pound of coal per ton per mile, or for a train of 200 tons, including engine, of 50 lb. per mile, or say one-half more only than is used by an ordinary locomotive. The ventilation difficulty would, of course, be got over under these circumstances; and the tunnel could not only be worked, but might be made to pay a good dividend. But if this should turn out to be the case, the Channel Tunnel Company will not be permitted to retain a monopoly. A second and third tunnel will be projected, and perhaps made in obedience to what seems to be a well-known law. A peculiarly analogous case is supplied by the Atlantic cable; when that was projected no one imagined that a rival scheme would ever be proposed; yet the cable had hardly been at work a year when another was suggested, and at this moment there is not one, but five cables uniting Europe with America. The gray chalk, to which Sir Edward Watkin attaches such value, is certainly competent to give room for more tunnels than one. Who is to say that more than one shall not be made? Who is to prove that two wealthy countries like England and France will not easily supply the money to make a second or even a third tunnel? Sir Edward Watkin may start from Dover; what is to prevent Sir John Hawkshaw from running his tunnel from Fan Bay? The distance from Dover to Boulogne is twenty-eight miles; from Folkestone to Boulogne, twenty-nine miles. If twenty miles can be made and worked it is possible that thirty miles can, and the service to Paris would be expedited by running trains direct to Boulogne from Dover. Even a rival line to Paris to compete with the Chemin de Fer du Nord might be called into existence. The construction of a second tunnel would materially alter the military aspect of the question for the worse. It may be urged that all this is a chimera, but with the example of the Atlantic cable before us it would be rash to assume anything of the kind. If we accept the statements of the advocates of the tunnel as true, then nothing is more likely than that a second tunnel will be made; and if the Committee of Enquiry does not bear this fact in mind a grave error will be committed.

SECONDARY BATTERIES.

THERE seems to be no doubt that although the Faure secondary battery has not been applied practically in the many fields in which it was at one time expected it would be, a secondary battery has now been made and proved which will give all the advantages of a satisfactory accumulator of energy. A great flourish was made in this country with the results of the laboratory trials of the Faure battery, but not by M. Faure. Since then it has been tried for a practical purpose, lighting a train, but we do not find the experiment repeated; in the working field of electrical progress we hear nothing of it. We are not sure of everything about the new battery about to be brought out by a big electric lighting corporation; but we are credibly informed that internal resistance of the battery is exceedingly small, that it may be charged rapidly, will stand handling and comparatively rough carriage, and loses hardly any or no charge by standing. Its electro-motive force is about the same as the Faure, battery and it seems to have been tested on a practical scale. If this result has been attained we may once more begin to talk of the possibilities in transmitting power, and no doubt one of the earliest applications of these secondary batteries, next to their use as regulators, will be their use for driving tram-cars, and may be other railway carriages. Electric lighting in railway carriages will not perhaps be widely attempted, as the white light from oil gas is good, handy, and very much cheaper. Although a considerable part of a year has elapsed since the "box of electricity" was sent to Edinburgh, and two or three months since the experiments on the Brighton train, so little has been practically done with the Faure accumulator, that it is generally inferred that defects which cannot be satisfactorily removed have shown themselves. Although this is the case, however, the prospectus of a "Faure Electric Accumulator Company (Limited)" has been published. Its capital is not less than £1,000,000, in 80,000 ordinary shares of £10 each, and 200,000 deferred shares of £1 each. Subscriptions are invited for 40,000 of the former and 100,000 of the latter. The company is formed to acquire all the patents and processes now owned by the "Société la Force et la Lumière" for the United Kingdom, and it is admitted that the most important of these patents is Faure's secondary battery. A million sterling seems a large capital to work an invention, the practical utility of which remains to be proved, and until the battery has been put into more extended use, and practical proof afforded of its working value, it seems ridiculous to invite a subscription of £500,000 to make it. The chairman of the board of directors is Sir Arthur Otway, M.P. M. Camille Alphonse Faure, the inventor, is one of the consulting electrical engineers. The terms on which the rights of the vendors have been bought by the company are, it appears, that they are to receive £25,000 in cash, and £100,000 in fully-paid deferred shares, with a right to "a like proportion of deferred shares in any further issue of capital that may be made by the company." Secondary batteries may prove to be of vast commercial importance, but the figures in this case are not small.

THE HOURS OF RAILWAY SERVANTS.

The railway servants' agitation is extending to the Sheffield district. At Bridgehouses, Sheffield, a meeting has been held in furtherance of the nine hours' movement. Their programme is that which was initiated in 1880 by the Amalgamated Society of Railway Servants of England, Ireland, Scotland, and Wales. Briefly summarised, it amounts to this:—Nine hours to constitute a day's work for all grades in the service—excepting for signalmen, shunters, and pilotmen—all time worked after nine hours each day to be paid for as overtime, at the rate of time and a-quarter. For signalmen, shunters, and pilotmen, eight hours to be a day's work, and overtime beyond eight hours to reckon as time and a-quarter. For enginemen and firemen, mileage rates, where in vogue, to be fixed for 140 miles for passengers, and 110 miles for goods, or on branch lines the same to be equivalent to a day's work. Sunday work to be paid for at the rate of time and a-half to all grades. The goods yard to be closed at 1.30 p.m. on Saturday against the reception of traffic. These are the proposals of the men, which are meeting with very general favour outside Sheffield, but in the Sheffield district the preliminary meetings have been somewhat thinly attended, though resolutions have been carried approving the nine hours' movement, and agreeing to contribute one day's pay to support the proposal.

CONSTANT WATER SUPPLY.

Considerable progress has been made during the past two years in one of the most important questions of London water supply, namely, in the extension of constant service. Colonel Frank Bolton, the Metropolitan Water Examiner, states in his monthly report that all the companies are at present voluntarily moving in the matter under the provisions of the Metropolis Water Act, 1871, in some portion of their districts. The number of miles of streets containing mains constantly charged, and upon which hydrants for fire purposes could at once be fixed in each district of the metropolis, is 751¼, the different companies having as follows:—Kent, 85 miles; New River, 212; East London, 85; Southwark and Vauxhall, 117; West Middlesex, 82; Grand Junction, 36¼; Lambeth, 70; Chelsea, 64. The increase has thus been 11 miles by the New River Company, 4½ miles by the Southwark and Vauxhall, 12 miles by the West Middlesex, 4¾ by Grand Junction, and 8 by the Chelsea since December, 1879, or a total extension in about two years of 30¼ miles. On all these the companies are prepared to fix hydrants.

LEGAL INTELLIGENCE.

COURT OF SESSION, EDINBURGH.

(*Before* Lord M'Laren.)

February 1st.

UNITED TELEPHONE COMPANY *v.* MACLEAN.

The following judgment of Lord M'Laren, recently delivered in the above case in the Court of Session, will be read with interest:

In this case interdict is sought at the instance of the United Telephone Company against the infringement of two patents for telephonic instruments, the first being the original telephone invented by Mr. Graham-Bell, and patented in this country in the name of Mr. Morgan-Brown, the second being the transmitting instrument invented by Mr. Edison, and patented in his own name.

The title of the complainers to these patents is set forth in their statement of facts, and is not denied. The question is whether the instruments which, according to the evidence, were supplied by the respondent to a professional firm in Edinburgh constitute an infringement of the complainers' patents, or either of them. Specimens of the instruments sold by the respondents were produced at the trial, and their action explained. It is alleged that the respondent used Edison's transmitting instrument and Bell's receiving instrument. With respect to Bell's invention, the defence is that the patent was anticipated by the premature publication of the invention before the letters patent were taken out. With respect to Edison's patent, there are two defences—(1) an objection to the patent itself, founded on an alleged discrepancy between the provisional and the complete specifications; (2) a denial that the respondent's transmitting instrument involves the use of Edison's invention. I shall deal with the cases in the order of discovery, beginning with the invention of Mr. Bell.

The specification of William Morgan-Brown, in which this invention is described, is divided into various "plans," which contain respectively the descriptions of different instruments, or different variations of the same instrument, adapted for the transmission and reproduction of vocal sounds through the agency of the electric force. But the only instruments or modes of application of Bell's invention referred to at the trial were the instrument described in plan 4, and the two instruments or modes of application which are described in plan 5. These three variations of Mr. Bell's invention, as I shall call it (because it is not disputed that he is the first and true inventor of the telephone), are described with great clearness and fulness of detail in the evidence of Sir Frederick Bramwell, C.E. Under reference to this description, which I accept in all its particulars, I shall state as briefly as may be the essential parts of Mr. Bell's invention, and shall consider whether the invention is disclosed by the alleged anticipatory publication with such distinctness as would be necessary to enable a person of skill to make the instrument, and to put it into effective operation.

The essential parts of Bell's invention appear to be (1) a tympanum or circular plate of steel, or other metal susceptible of inductive action, for receiving the air pulses or undulations of speech; (2) the transmission in a closed circuit of electric undulations of the same order, induced by the vibration of this metal plate or tympanum; (3) the production of a repetition of the spoken sounds at the distant station or termination of the line wire by means of another metal tympanum, which, through "induction" or electric agency, is made to vibrate in the same manner as the first-mentioned tympanum, and thus to reproduce the vocal sounds in facsimile. All the witnesses are agreed that, under Bell's process, the transmission of the electric undulations along the wire is continuous. These undulations represent variations of the electric current corresponding to the variations of the elastic medium thrown into vibration by the voice, and like these they are continuous, because the electric force is transmitted from one station to the other in a closed circuit continuously, and without break or interruption; this is, in truth, the principle of Mr. Bell's invention —the transmission of undulatory electricity in a closed circuit. Prior to this invention, attempts had been made with partial success to reproduce musical sounds by different methods. By delicate mechanism, which it is unnecessary here to describe, the vibration of a tuning-fork or a musical string was made to alternately connect and disconnect two points in an electric circuit, and thus to send on a series of uniform and separate pulsations, by which a string tuned at the same pitch could be made to vibrate at the distant station. The most perfect modification of this process is that known as Reiss's invention, by which the sound was received on a drum of gold-beater's skin or membrane, carrying an armature or steel needle capable of inducing electric action in the line wire. By this means musical notes and vowel sounds were reproduced. It is clear, however, that by Reiss's method spoken discourse could not be conveyed from one station to another; and for this reason, that his instrument acted by transmitting a series of discontinuous electric impulses resulting from the alternate making and breaking of the circuit, and was therefore not adapted to the transmission of a continuous and variable series of undulations, such as are produced in articulate speech.

Mr. Bell discovered that electric undulations resembling those produced by speech could be transmitted through a closed circuit, and his specification (Morgan-Brown's) describes different instruments and modes of operation for producing this result in a manner which is admitted to be clear and intelligible. It is also established that telephones constructed according to Bell's method were extensively used and were of great utility.

I now come to the alleged anticipation of the invention through the publicity given to Bell's discovery by Sir William Thomson, in his address to the British Association delivered in August or September, 1876.

Sir William Thomson, in his evidence in this case, stated that he was present at the performance of Bell's experiments on the occasion of a visit to the International Exhibition at Philadelphia, and that he heard the instrument repeat the phrases of Hamlet's Soliloquy, which he quotes in his address. Mr. Bell, treating Sir William Thomson with the confidence accorded to a scientific visitor of distinction, had shown him his apparatus, explained to him the principle of his invention, and presented him with models or copies of his transmitting and receiving instruments. Sir William Thomson, in the passage of his address to the British Association, which has been reprinted from the newspaper called *Engineering*, of 15th September, 1876, gave an account of Bell's discovery, and he also exhibited models of Bell's transmitting and receiving instruments. The object of the learned lecturer, however, apparently was to describe results rather than processes; and although inferentially he may have given some indication of the methods employed, I am satisfied that his address does not contain such a description of Bell's process as would, even with the aid of the models, enable a skilled operator to produce a working telephone on the principle of the specification. Such is the opinion I have formed, construing the passage in Sir W. Thomson's address as I should construe a specification, after informing myself as to the state of scientific knowledge on this subject at the time, and with all the aid which I have been able to derive from the evidence as to the meaning of the terms of art used in the address and their application to the models.

It is plain that the invention had not been perfected—was, indeed, only in the experimental stage at the time when Mr. Bell explained his method to Sir William Thomson, and Sir William in his address did not profess to communicate anything more than he received from Bell. Mr. Cooke, a witness for the respondent, thinks that he could have made the instrument from Sir William Thomson's description. But then Mr. Cooke is an electrician of more than ordinary skill; and against his view I have to set the statement of another electrician of not inferior skill, who, with superior advantages to those of Mr. Cooke, tried to produce articulate sounds with Bell's instrument and failed. Besides I must say that Mr. Bell's experimental instrument, as published by Sir William Thomson—if the address is held to amount to publication —differed most materially from the instrument as patented. First, the transmitting tympanum of the experimental instrument consisted of a stretched membrane or drum, carrying a steel armature. All the witnesses are agreed that such a tympanum is open to serious objection, and that it will not give results satisfactory or comparable to those given by a metal transmitter, as described in the specification of the patented invention.

Secondly, the address does not state that the transmission of the electric force is to be made through a closed circuit, although this, as I have endeavoured to explain, is really the principle on which the successful working of the invention depends. It is true Sir William Thomson did not profess to describe any mechanical appliances for making and breaking the circuit; but it does not follow that his audience would draw the inference that the circuit was to be closed. He was not professing to give a full description of the mechanical appliances used by Bell. Nobody but Sir William Thomson and Bell himself knew that the transmission of the electric current was to be in a closed circuit, and yet the skilled operator, who is supposed to be able to work from Sir William Thomson's description, is left to find this out for himself. How was he to find it out, unless by the exercise of inventive talent; by, in short, re-discovering the principle of Bell's invention?

Thirdly, the plate, or the tympanum of the model-receiving instrument exhibited by Sir William Thomson, instead of being attached to the transmitting case by its circumference, so as to imitate the form of a drum, was attached by a screw at one point only, as shown in Fig. 11 of the respondent's print of prior publications. While thus attached, it stood inclined at an angle to the mouth of the case, like the lid of a box slightly raised. In this position the plate would vibrate in the manner of the tongue of a tuning fork, and not in the manner of a tympanum. According to all the evidence, such a receiving instrument would not repeat articulate speech.

This brings me to the decisive part of Sir William Thomson's evidence. This gentleman, himself the most eminent electrician in the United Kingdom, possessed of the instruments furnished by Mr. Bell, and instructed by Bell as to their principle and mode of application, was unable to make them work so as to reproduce articulate speech. He was most anxious to exhibit them in effective operation at the meeting of the British Association, and after trying them with batteries of different degrees of strength, and with every variation that his experience suggested, his experiments entirely failed and he was obliged to admit his inability to exhibit the telephone in operation. The respondent suggests that if the tympanum or lid had been less rigidly attached by its screw, it would have closed down under the attraction of the electro-magnetic force, and would then have acted as a closed tympanum capable of transmitting articulate speech. To this there are several answers. First, this is a suggestion easily made, after the principle of the closed tympanum had been made public through Bell's specification. Secondly, Sir William Thomson's lecture, with the relative model, disclosed a receiving instrument with an open and not a closed tympanum. Confessedly such an instrument would not reproduce articulate speech, and if the specification had given no more information on this head than is given by the model, I should have held the patent void, as not sufficiently disclosing the manner of performance of the invention. Thirdly, as to the suggestion that a skilled operator would have found out the mode of operation when he came to use the instrument, I may observe that, according to patent law, an invention is not sufficiently described if experiment be requisite to enable a skilled operator to discover the mode of working it; and, after being told by Sir William Thomson that his scientific knowledge, aided by personal communication with the inventor, did not lead him to infer that the tympanum should be kept down in order to the production of the desired result, I cannot for a moment suppose that this inference is one that should be drawn by an ordinary workman working by the description contained in Sir William Thomson's address.

I shall say nothing as to the other ublications contained in the respondent's print. The last in the order of dates was published after the date of the patent. The other publications are less specific than Sir William Thomson's address, and were founded on by the respondent's counsel rather as evidence of the state of scientific knowledge at the time, and in aid of Sir William Thomson's address, than as independent disclosures of the inven tion.

(2) I pass to Edison's patent: and first, as to the objection founded on the discrepancy between the provisional and the complete specifications. The complete specification describes various telephonic instruments, and, amongst others, an instrument known as the phonograph, which records the undulations of a vibrating diaphragm or tympanum, by indenting a series of dots on a cylinder, covered with tinfoil, and made to revolve rapidly by clockwork. In the reverse or complementary action of the instrument, the sounds may be reproduced with more or less distinctness, by giving to another diaphragm the motion resulting from a steel point vibrating in contact with the series of indentations. The description will be found in the paragraph commencing at page 11, line 5, of Mr. Edison's specification. The invention includes two processes—first, the recording of the sounds on a sheet of tinfoil; secondly, the reproduction of the sound by means of mechanism set in motion by the indentations on the tinfoil. It is said that the provisional specification discloses only the first of these two processes; and that the patent is void, because in the complete specification the reproduction as well as the recording of the sound is claimed. This is an extremely critical objection, and I do not think that it is well founded. The provisional specification states—pages 1 and 2—"Portions of the apparatus are interchangeably available in transmitting or recording;" and two lines further down the word "recording" is explained to mean making a record of the atmospheric sound waves, or of the electric waves or pulsations corresponding thereto or resulting therefrom. Now, keeping in view that in the telephonic art the words "transmitting" and "transmitter" are technical terms applicable to the part of the instrument by which the speaker's voice is made to set the electric wire in motion, I think that the expression "interchangeably available in transmitting or recording" is for the purpose of a provisional specification a sufficient indication of the functions of the phonograph. In the application of the instrument to the purpose of recording, the sound waves are laid down on the cylinder by the steel point attached to the tympanum, and vibrating with it. But by the same apparatus the action of transmitting may be produced, the indentations on the cylinder in this case acting on the steel point and causing the tympanum to vibrate, and thus to transmit electric undulations to a line wire. The words "interchangeably available" may be open to criticism, but they indicate an instrument in which the same mechanism may be used either for recording a message or for transmitting one which has been recorded.

(3) There remains for consideration the question of the identity of the respondent's transmitting instrument with the transmitting instrument described in Edison's specification—a question of some difficulty, though I have ultimately formed a clear opinion regarding it. In the Bell telephone the electric undulations set up in the line wire were comparatively weak, and the echo or reproduction of the voice at the distant or receiving station was correspondingly faint, so faint that the telephone could only be used within moderate distances. Mr. Edison's efforts were directed to the discovery of a method by which the waves of sound should operate more powerfully on the electric current, and this he effected by a process which is described by electricians as the method of "varying the resistance" to the electric current in the course of its transmission through a closed circuit. This was accomplished by making a joint in the circuit near to the transmitter, so that the current should at this point pass from one surface to another surface in contact with it under pressure. According to Mr. Edison, one of the two surfaces in contact ought to be a semi-conductor; and plumbago and some other forms of carbon are indicated as the most suitable materials for the purpose. According to his description, the variations of pressure between the surfaces, consequent on the vibrations coming from the tympanum, induce variations in the electric current proportionate to, but greatly exceeding in magnitude, the variations which would be induced by the direct action of the air waves according to Bell's method. According to Edison's theory, his process is in the strictest sense a mode of working in a closed circuit, because the carbon surface, although mechanically disunited from the platinum or other surface on which it presses, is nevertheless in electrical contact with that surface. There is therefore no making and breaking of the electric circuit as in the earlier tentative methods, but a continuous current of undulatory electricity, the number and form of the waves being determined by the changes of pressure upon the carbon surface.

In the first form of apparatus figured in the specification, the semi-conducting interposed substance—technically termed the tension regulator—is silk fibre mixed with plumbago. This is pressed by a screw against a platinum plate, which again is in contact with the tympanum, and the elasticity of the tympanum and of the silk fibre admits of that degree of play between the two surfaces which is requisite for the transmission of the variations of pressure produced by the vibrations of the tympanum when acted on by the voice.

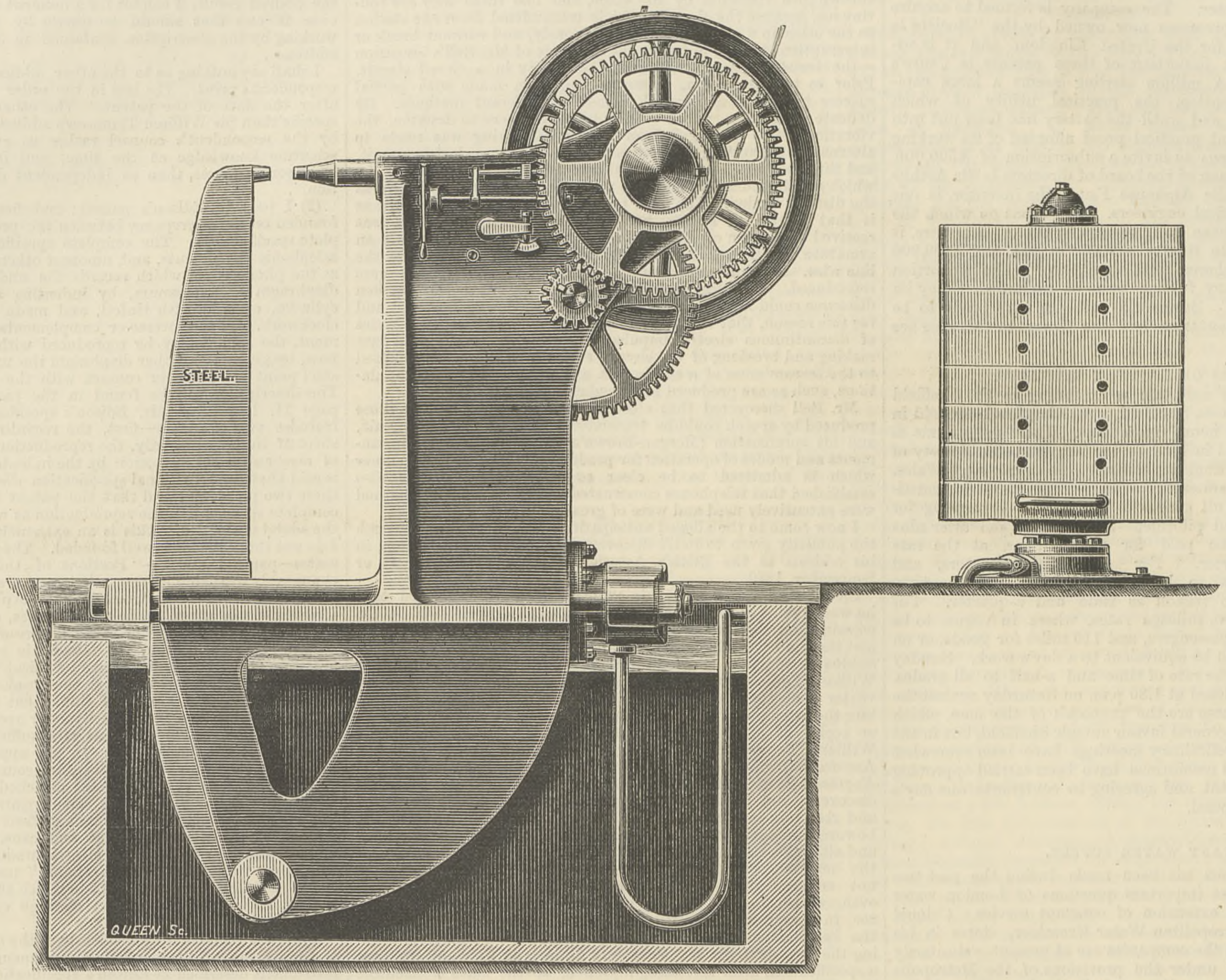
In a passage near the top of page 6 the inventor describes an alternative mode—on which the complainers place reliance—wherein he professes to make use of a variable resistance—*i.e.*, to the electric current—resulting from greater or less intimacy of surface contact, such as would result from a disc covered with plumbago placed adjacent to a diaphragm also covered with plumbago or other semi-conducting material. It is not stated in direct terms how this form of tension regulator is to be connected with the transmitting instrument; but, in fair construction, I think it must be held that it is to be introduced in the place of the silk fibre, and to be kept in contact with the diaphragm by pressure, just as the fibre regulator would be.

Other modes of maintaining the contact are described in subsequent parts of the specification, in one of which the pressure of a spring is employed.

It does not appear that any of the mechanical combinations described in the specification ever came into commercial use, probably because, as may happen in the history of even the most original and valuable inventions, these were immediately superseded by simpler constructions involving the same principle. It was soon found that no special precautions were needed to prevent the separation of the surfaces constituting the tension regulator. I am informed that Mr. Edison now uses a carbon button placed between two plates of platinum, without the agency of a spring or mechanical pressure to hold them together. In the respondent's instrument, against which the interdict is directed, the variations of resistance to the electric current are produced by the contact of two surfaces of gas carbon, one of them being loaded with a piece of brass, and suspended obliquely, so as to press slightly against the other. To these pieces wires are attached, and the current passes through them. This is said to be a different instrument from Edison's, both in principle and construction. It is said that Edison aimed at varying the resistance in the line by the compression of a fibrous material throughout the mass, and not by the vibration of pressure at the surface of contact. Again, it is denied that the operation of the respondent's instrument depends on pressure. It is said that in his instrument the two carbons react on each other, in the manner of rigid, non-elastic, incompressible substances, and that, instead of the electric current being merely

COMBINED MECHANICAL AND HYDRAULIC RIVETTING MACHINE.

MESSRS. DE BERGUE AND CO., MANCHESTER, ENGINEERS.



The illustration above explains of itself pretty fully the arrangement of a combined mechanical and hydraulic rivetting machine just completed by Messrs. De Bergue and Co., of Manchester, and referred to last week by our correspondent in his "Notes from Lancashire," but a few additional details may be of interest. The arrangement, as already stated, has been specially designed to obviate the objections to machines working with falling hydraulic accumulators, and the machine is driven by belt and double gearing, actuating the heading ram by an ordinary excentric shaft. By the arrangement adopted in this machine the holding-up pillar instead of being cast with the frame, or otherwise firmly fixed to it, passes through a planed gap in the frame, and extending downwards is pivotted at the foot, being held in its upright position by two strong tension bolts, which are drawn tight by the action of water in compression in a hydraulic cylinder fixed at the back of the machine. The only outlet from this cylinder is in direct communication, by means of piping, with another smaller cylinder closed at its upper end, loaded like an ordinary accumulator with dead weights, and working upon a hollow vertical spindle, which is bolted to a suitable base, and placed near the machine, or in any other convenient position. To prepare the machine for working the screwed plug is removed from the top of the weighted cylinder, and water is poured in until both cylinders and the connecting pipes are quite full, when the plug is screwed in again. By a few strokes of a small hand pump —joined to the connecting pipes by an ordinary T-piece— the pressure is put on and the cylinder is raised a few inches from the base upon which it has hitherto rested. It will thus be seen that the actual pressure, which is, of course, common to both cylinders, is determined by the load upon the vertical cylinder, which in practice, we are informed, will not exceed one ton to the square inch. The weights are attached to the cylinder in such a way that any of them may be instantly disengaged and remain at rest upon the base, the cylinder picking up only the weight required for giving the needful pressure to the different sizes of rivets. It is, however, claimed that whatever weight is used, the resulting pressure for the time being upon the head of the rivet can be absolutely relied upon as constant and invariable, quite unaffected by any possible leakage, and once charged by the means already indicated, no renewal of the water or any further attention to the apparatus is needed. From the illustration and the description already given it will be seen that when the heading ram in the machine presses the head home the holding-up pillar yields, and the water displaced from the larger cylinder lifts the weighted one, which resumes its first position as soon as the pressure upon the head is withdrawn, and the water returns to the large cylinder ready for the next stroke. By this arrangement all pumps and valves are dispensed with, and the machine has the advantage peculiar to ordinary hydraulic rivetting, whilst some of the objections to this system are to a large extent obviated. The advantages which Messrs. De Bergue claim for their new machine are, that whereas in purely hydraulic pressure a large proportion of the accumulated power is necessarily wasted, merely by moving the heading cup into contact with the rivet to be headed, without performing any useful work, this movement in their machine is effected by the excentric shaft and gearing with no appreciable expenditure of power, and that the force exerted on the head of the rivet is a slow, steady squeeze, with a constant known pressure of dead weight, which can be varied to suit any diameter of rivet, so as to avoid unnecessary pressure or waste of power. As the traverse in the large cylinder will rarely be more than a quarter of an inch, nor the rise of the accumulator more than 2in. or 3in., the wear and tear on the machine is also reduced to a minimum, and we understand that one weighted cylinder—standing about 5ft. high, and measuring with its weights about 3ft. by 3ft.—can be made to serve for three or more machines in operation at the same time. The machine we have illustrated is constructed to work up to a pressure of 70 tons; but Messrs. De Bergue have in hand one of smaller dimensions for rivetting portable boilers which will work up to a pressure of 40 tons.

---

varied, under the influence of vibration, as the surfaces of carbon tend alternately to approach and recede from each other, the electric current is actually broken at each vibration. According to the respondent's theory, his instrument is not an example of the action of undulatory electricity in a closed circuit, but is an extremely delicate "make and break" of the current, so delicate and instantaneous—if I rightly understand—that the undulations are virtually, and in their acoustic effects, equivalent to continuous vibrations.

It would probably not be satisfactory to the parties if I should abstain altogether from offering an opinion on this interesting scientific question. I think it right to say at once that, in the view I take, its solution cannot affect the decision of the case. Because, in my opinion, it is apparent—at least, in the present state of scientific knowledge—that the principle and mode of action of Edison's tension regulator and that of the respondent is one and the same. If the respondent's surfaces vary the resistance by a "make and break," so must Mr. Edison's. Nothing is more clear upon the evidence than that the wonderful and hitherto unexplained responsive action of the electric force to vibrations propagated through surfaces in loose contact depends neither on the form of the surface nor on the mode or amount of pressure, although some forms of contact and of pressure certainly give better results than others. Mr. Edison's methods have this in common with the respondent's—that they produce similar phenomena under every mode of bringing semi-conducting surfaces into contact in an electric circuit, and until some distinction is shown to exist, similar phenomena must, in my opinion, be referred to one and the same general law. Even if Mr. Edison were held to be in error in supposing that his method was that of a closed circuit, yet if it is a useful invention, and if it is sufficiently described for practical purposes, it is no objection to his patent that he has used language which would be scientifically inaccurate, according to the present state of knowledge.

While, for these reasons, I hold that, in any view of their mode of action, the principle of the respondent's instrument is identical with Edison's, I must also hold that the weight of the evidence is in favour of the accuracy of Edison's description of the principle of his invention as being that of a closed circuit.

Sir F. Bramwell and Sir William Thomson are strongly of opinion that articulate speech cannot be, and is not under any of the instruments referred to, produced by a make-and-break arrangement. According to these gentlemen, the elastic waves of sound passing through two surfaces in contact produce phenomena analogous to those produced by the collision of elastic bodies. The surfaces in contact are slightly altered in form by the sound vibrations —passing through alternate phases of greater and less convexity, or of expansion and compression. These changes are understood to be molecular, and do not involve any visible change of figure, such as may take place under mechanical or forced vibration. During the phases of compression, there are a greater number of molecules of the respective surfaces in contact than in the phases of expansion, and the transmission of the electric force at each vibration is supposed to be proportional to the number and extent of the molecules or minute surfaces in contact. To the objection, that carbon —the most sensitive material for this purpose—is not a highly elastic body, the reply is, that carbon is sufficiently elastic for the purpose of transmitting the sound vibrations, and that its suitability to this purpose depends on it being a semi-conductor of electricity. A good conductor would transmit the force too easily when the pressure was withdrawn. But it is the property of a semi-conductor that its power of transmitting the electric force varies considerably under varying conditions of pressure, and Edison's invention consists in taking advantage of that property by appropriate appliances. Professor Fleeming Jenkin, a most accomplished electrician and of very great experience, does not differ from Sir F. Bramwell and Sir William Thomson in his view of the mode of action of the carbon regulator. All these gentlemen are agreed, that when the surfaces are separated even in an infinitesimal degree, there results an irregular instead of an undulatory variation in the electric current, producing a buzzing sound, and interfering with the acoustic action of the instrument. This result may follow even from speaking in too loud a tone, and it has been found necessary to moderate the vibrations of the tympanum of the telephone by introducing cork between its surface and the carbon regulator, in order that its action may not be so strong as to cause the carbon surfaces to separate under vibration.

Another point urged for the respondent is, that under his instrument a tympanum is unnecessary, because the carbon regulator, or microphone, as he prefers to term it, is sufficiently sensitive to be acted on by the direct pulsations of the air. Now, as Edison's patent is for a tension regulator in combination with a diaphragm or tympanum, it follows that the interdict sought would not apply to the use of the respondent's carbon regulator without a tympanum. But in the instruments sold by the respondent, the sound is transmitted across a circular metal disc, interposed between the mouthpiece and the carbon regulator, and although this metal disc is mounted on a sheet of cork, I have not the slightest doubt that it acts as a tympanum, and that it is a useful and necessary adjunct of the acoustic apparatus. The cork does not prevent the metal plate from being thrown into vibration by the voice, and it transmits the sound waves, possibly with some diminution of intensity and suppression of superfluous vibrations, to the carbon regulator, whose function it is to react upon the electric circuit. It was contended by the respondent's counsel —if I rightly understood—that the cork plate would have the effect of entirely stopping the waves of sound; but this proposition appears to me to be untenable, in view of the well-known fact that sound waves are transmitted through the earth over distances measured by hundreds of yards, or even miles, traversing in their course substances of the most various density and elasticity.

Being satisfied that the respondent's instrument is an application of the principle of Edison's tension regulator, and that it involves the combination of a tension regulator with a tympanum, I have only to consider whether the instrument itself is distinct from anything described by Edison, or is an imitation or mechanical variation of his invention.

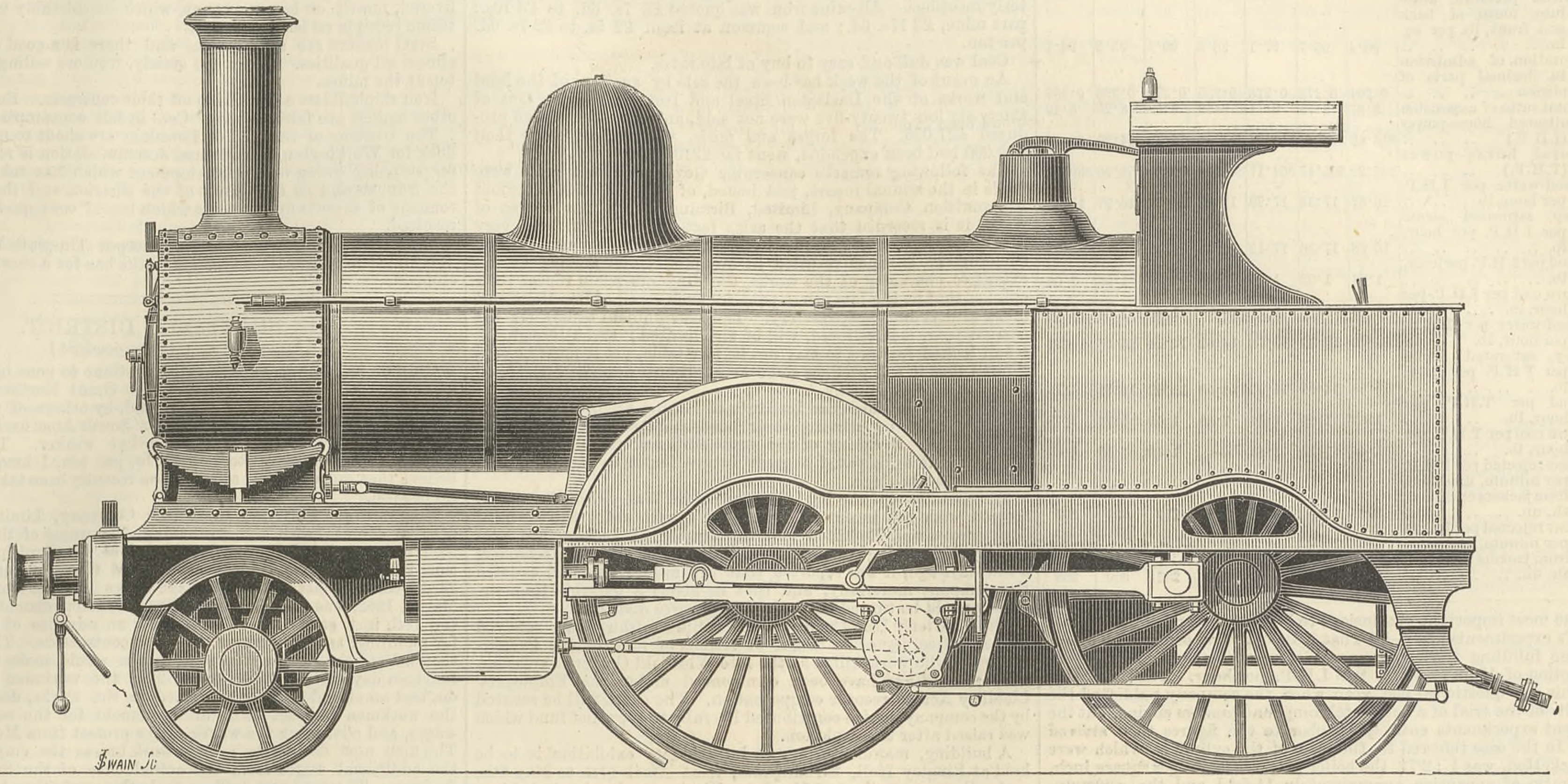
In answering the question, it must be observed that Edison's patent is not for a specific instrument, but for a combination, in which the material element is an "electric tension regulator," of which many forms are given, all depending on a mode of action of great simplicity, and capable of being indefinitely varied. The mode of action I take to be this:—The variation of the electric current by pressure applied to a carbon surface—not the constant pressure of a screw or spring, which is a mere accident of the arrangement—but the elastic pressure of the sound waves, which are made to operate upon the carbon through a tympanum. In such a case, it may well be said that the instrument admits of as many variations as there are modes of bringing two surfaces into contact. But however unlike any particular variation may be to those which are described in the specification, yet if the contact is that of a semi-conductor of electricity, and is used in a telephone for the purpose of varying the resistance to the electric current in the line, I am of opinion that it is a form of Mr. Edison's invention, and that the words of the specification are broad enough to cover it.

In the particular case the respondent's form appears to possess such merit that it might have been patented as an improvement upon Mr. Edison's tension regulator; but that, of course, would imply that it could not be used without Mr. Edison's licence. It follows from this opinion that the complainers are entitled to protection by interdict under Edison's as well as Bell's—or Morgan-Brown's patent.

Counsel for complainers, the Lord Advocate, Mr. Balfour, M.P., Q.C., the Solicitor-General, Mr. Asher, M.P., Q.C., and Mr. C. S. Dickson; agents, Messrs. Davidson and Syme, W. S. Edin. Counsel for respondent, Mr. Mackintosh and Mr. Salvesen; agents, Messrs. Boyd, M'Donald, and Jamieson, W. S. Edinburgh.

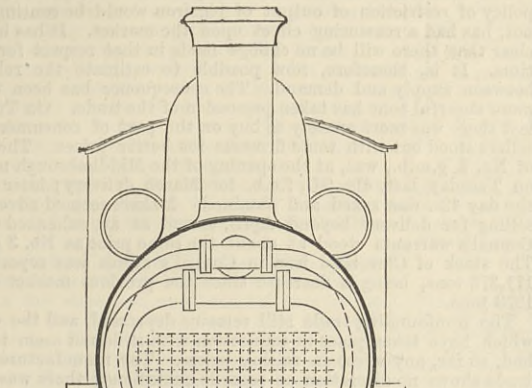
COMPOUND LOCOMOTIVE, LONDON AND NORTH-WESTERN RAILWAY.

MR. F. W. WEBB, M.I.C.E., ENGINEER, CREWE.



IN THE ENGINEER for Feb. 10th we described at some length the new compound locomotive invented by Mr. Webb, locomotive superintendent of the London and North-Western Railway, and constructed by him at Crewe. Above we give an elevation of this engine, which illustrates its peculiarities.

The engine has three cylinders, two high-pressure, one of which is shown, 11½in. diameter and 24in. stroke, which actuate the two trailing driving wheels. Under the smoke-box is placed a single-low pressure cylinder 26in. diameter and 24in. stroke, which actuates the leading driving wheels. The engines are independent of each other, save in so far as the rails may be said to couple the four driving wheels. The steam expanding from the high-pressure cylinder enters a system of pipes passing through the smoke-box, and acting as an intermediate receiver. The low-pressure cylinder slide valve is worked by Joy's patent valve gear, arranged precisely as in the engine shown to the



TRANSVERSE SECTION

members of the Institution of Mechanical Engineers, at Barrow-in-Furness in 1880. Reversing is effected by a hand-wheel on the foot-plate not shown.

The valve gear of the high-pressure cylinder is also Joy's, and closely resembles that illustrated in THE ENGINEER for Dec. 2nd, 1881, p. 401. The dotted lines show its construction. In a kind of box under the running board is fitted a disc, which may be said to resemble the plug of an ordinary stop-cock. In this plug is a curved slot as shown, the slot having the same radius of curvature as the length of the link leading from a die in this slot to the end of the valve rod. This link is coupled to the conecting rod by two bars as shown. The effect is that as the crank shaft revolves the die is caused to travel up and down in the slot in the plug. If the slot is set at angle with the vertical, the valve stem will obviously be caused to move backwards and forwards; when, however, the slot is vertical the valve has no motion imparted to it by the travel of the die. The plug has a lever arm attached to it answering to the handle of a tap. This lever is coupled to a reversing lever with quadrant, the top of which lever can be just seen over the side guard of the foot-plate. By this means the plug can be made to partially rotate, and so alter the angle of inclination of the slot that the engine will run forward or backwards. The means by which lead is obtained will be readily understood by any reader conversant with valve gear.

It is not too much to say that Mr. Joy's ingenious valve gear has rendered the construction of this fine engine possible. A link motion might indeed have been used, but not with any satisfaction. Mr. Webb states that this engine works ordinary passenger trains with a little over 23 lb. of coal per mile, which represents a saving of perhaps 20 per cent. in fuel on the ordinary consumption. We have already stated that this engine is beyond question the best type of compound locomotive ever constructed, and we shall be much surprised if a large number of such engines are not soon put into regular traffic. The only thing to militate against the extended adoption of the Webb engine is the possibility that repairs may be heavier than is desirable. On this point only opinions can be expressed, and we prefer to reserve ours until we have some experience of the working of the engine to go upon.

TRIAL OF ENGINES AND BOILER AT MR. E. HEYWORTH'S AUDLEY HALL WEAVING SHED, BLACKBURN.

WE have referred at length in another place to a report by Mr. Michael Longridge, M.A., from which we take the following extract:—

The object of the experiments were, first, to ascertain the weight of water used by the engines per I.H.P. per hour, also the weight evaporated by the boiler and economiser per pound of fuel burnt; secondly, to ascertain the effect of the steam jackets, collectively and separately; and, thirdly, by comparison with some experiments made by the company last year to check the results then arrived at.* The trials were commenced on Tuesday, the 27th October, and were continued till Wednesday, the 2nd November, with the exception of the Saturday and Sunday, on the former of which days the works stopped at mid-day. On Tuesday, the 25th October, the engines were worked without steam in the jackets; on Friday, the 28th October, with steam in all the jackets; and as these were considered to be the most important experiments, they were repeated on Tuesday and Wednesday, the 1st and 2nd November. On Wednesday, the 26th October, the jacket of the condensing cylinder only was in use; on Thursday, the 27th October, that of the receiver only; and on Monday, the 31st October, that of the non-condensing cylinder only. It would have been interesting to have tried the effect of working one day with the jackets of the non-condensing cylinder and the receiver in use, and another day with those of the condensing cylinder and receiver; but time did not permit. A preliminary trial was made on Monday, the 24th October, for the purpose of making the observers acquainted with their duties, but as the observations were not complete, they are not given. In tabulating the results of the trials an attempt has been made to follow the method indicated by M. G. A. Hirn, whose clear and practical exposition of the subject the writer here desires to acknowledge. Unless otherwise mentioned, the figures in the tables refer to a single stroke of the engines, the object being to eliminate the element of speed, and so render the results more easily comparable with those obtained from other experiments.

The engines are a pair of horizontals working compound, with a receiver between the cylinders, and the cranks at opposite ends of the shaft set at right angles. The non-condensing cylinder is fitted with a single slide valve, worked by an excentric, with a grid cut-off valve on the back, actuated by the governor through McNaught and Varley's motion. The regulation of the expansion is automatic. The condensing cylinder has a single slide valve, worked by an excentric. Both the cylinders and the receiver are steam jacketted with the boiler pressure on the sides, but not on the ends or steam-chests; these, as well as the connecting pipes, are well covered with non-conducting composition. There is a separate steam trap and drain pipe from the lowest point in each jacket. In ordinary working the jackets drain into a cistern from which the boiler is fed, but during the experiments these pipes were disconnected from the cistern, and the discharge from them received into separate boxes for measurement. The air pump, 21in. diameter by 23in. stroke, is worked by a bell crank, from the piston-rod cross-head of the condensing engine. The power is transmitted by a belt 3ft. 6in. wide, the drum being 25ft. diameter. The engines were made by Messrs. W. and J. Yates, of Blackburn, in 1878, and have run almost continuously since. The principal dimensions are:—

Diameter of cylinders	20in. and 34in.
Stroke of pistons	5ft.
Nominal number of revolutions per minute ..	48
Diameter of piston rods	3⅝in. and 3¾in.
Length of connecting rods..	15ft.
Volume of clearance, smaller cylinder, front (8·25 per cent.)	0·870 c. ft.
Volume of clearance, smaller cylinder, back (8·37 per cent.)	0·913 c. ft.
Volume of clearance, larger cylinder, front (6·80 per cent.)	2·115 c. ft.
Volume of clearance, larger cylinder, back (6·85 per cent.)	2·160 c. ft.
Volume of space between cylinders	17·263 c. ft.
,, smaller cylinder, including clearance	11·62 c. ft.
,, larger ,, ,, ,,	33·48 c. ft.
Relative volumes of cylinders	1 : 2·88
Internal diameter of steam pipe	6in.
Length of ditto	67·5ft.

The boilers are two in number, also made by Messrs. W. and J. Yates. They are of the ordinary Lancashire type, 30ft. long by 7ft. diameter, with two internal flues 2ft. 9in. diameter, tapering to 2ft. 3in. in the last ring at the back end. In each flue are five Galloway tubes. The grates, 2ft. 9in. wide by 5ft. 6in. long, are fed by Proctor's mechanical stokers. There is also a Green's economiser of 120 pipes. During the experiments one boiler only and the economiser were used for raising steam for the engines, the other boiler supplying steam for the donkey and for sizing and heating the works. The connection between this boiler and the engine and economiser was cut off by blank flanges on the steam and feed pipes, and the gases from the furnaces were caused to pass through the "by-flue" to the chimney by a partition wall built in the main flue. The boilers are covered with non-conducting composition and bricked over on the top; the front ends are also well covered. In fact every precaution is taken to prevent waste of heat by radiation. The leading particulars of the boiler used for the trial are as follow:—

Grate surface		30·25 sq. ft.
Heating surface:—		
Internal flues	515 sq. ft.	
Side flues, external	310 sq. ft.	
Bottom flues, external	110 sq. ft.	
		935 sq. ft.
Economiser		1200 sq. ft.
Total		2135 sq. ft.
Ratio of grate to heating surface, exclusive of economiser		1 : 31
Ratio of grate to heating surface, inclusive of economiser		1 : 70·9
Grate surface per I.H.P., taking I.H.P. at 320.. ..		0·094 sq. ft.
Heating ,, ,, ,, ...		6·68 sq. ft.

The gases, after leaving the internal flues, pass along the sides of the boiler, then back along the bottom, and so through the economiser to the chimney.

The duration of each day's trial was accurately noted by one of the observer's watches. It was nominally seven and a-half hours, viz., from about 8.45 a.m. to about 5.15 p.m., less one hour for dinner. The engines commenced running after the breakfast time at 8.30 and stopped at 5.30. They were therefore thoroughly warm, and drove the full load during the whole time of the trial, except during the time of stopping for dinner and starting again.

The drain taps on the cylinders and steam pipe were opened before breakfast in the morning, but not during the day, so that all condensed steam went through the cylinders to the hot well and tumbling bay. The boiler safety valves were loaded to 110 lb., while the working pressure did not exceed 90 lb., so that no steam escaped. The valves and pistons of the engines, and also the jackets, with the exception of that of the receiver, were tested. The smaller piston was not quite tight, otherwise there was no escape.

In what follows it is assumed that the boiler produced dry saturated steam, which contained 1 per cent. of moisture on entering the cylinder owing to loss of heat by radiation from the steam pipe; also that the loss by radiation from the cylinders and receiver was balanced by the heat produced by friction of the valves and pistons. These premisses being granted, we may now proceed to the conclusions, and in doing so it will be best to treat the engines and the boiler separately, beginning with the engines. The proper test of merit applicable here is the weight of dry saturated steam required to develope 1-horse power for one hour at the strap connecting the engines to the mill machinery; but inasmuch as the power required to overcome the friction of the engines alone could not be determined, we must be content with ascertaining the weight of feed-water and of dry saturated steam used per hour for 1-horse power developed in the cylinders, both as measured by the indicator in the ordinary way, and as calculated on the supposition

* Trial of the engine and boilers, at Messrs. Thomas Nuttall and Sons, Oak Mill, Farnworth.

of a perfect vacuum in the larger one. The results are given in the following table :—

		Tu. 25 Oct	Wed. 26 Oct	Th. 27 Oct	Fri. 28 Oct	Mon. 31 Oct	Tu. 1 Nov.	Wed. 2 Nov.
1	Jackets in use	None.	L.P.	Rec.	All.	H.P.	None.	All.
2	Initial pressure, absolute, mean of back and front, lb. per sq. in.	96·4	96·7	97·1	98·8	95·5	95·2	94·7
3	Duration of admission in decimal parts of stroke	0·294	0·272	0·275	0·235	0·279	0·293	0·285
4	Total ratio of expansion	8·27	8·78	8·71	9·82	8·58	8·29	8·49
5	Indicated horse-power (I.H P.)	313·62	314·63	318·67	313·78	313·48	314·29	338·02
6	Total horse-power (T.H.P.)	362·29	365·17	364·17	365·23	360·75	358·90	389·82
7	Feed-water per I.H.P. per hour, lb..	16·87	17·54	17·29	17·00	16·26	16·97	17·16
8	Dry saturated steam per I H.P. per hour, lb.	16·68	17·36	17·12	16·83	16·10	16·80	16·98
9	Fuel per I.H.P. per hour, lb.	1·88	1·92	1·89	1·85	1·86	1·96	2·04
10	Pure coal per I.H.P. per hour, lb.	1·68	1·73	1·72	—	1·62	1·80	1·86
11	Feed-water per T.H.P. per hour, lb.	14·60	15·13	15·12	14·61	14·14	14·86	14·88
12	Dry saturated steam per T.H.P. per hour, lb.	14·53	14·95	14·97	14·53	14·00	14·71	14·73
13	Fuel per T.H.P. per hour, lb.	1·63	1·65	1·66	1·60	1·68	1·72	1·78
14	Pure coal per T.H.P. per hour, lb.	1·46	1·49	1·54	—	1·46	1·58	1·62
15	Heat rejected per I.H.P. per minute, discharge from jackets excluded, th. un.	292	308	306	289	279	300	297
16	Heat rejected per I.H.P. per minute, discharge from jackets included, th. un.	292	310	308	295	282	300	303

The most important conclusions to be drawn from these and last year's experiments are :—(*a*) That it is possible to construct a steam engine fulfilling the requirements of manufacturers with a consumption of 17 lb. of water per I.H.P. per hour. The possibility of this was questioned last year when the company published the results of the trial of a horizontal compound tandem engine, but the present experiments entirely corroborate the figures then arrived at. In the case referred to, the ratio of the cylinders, which were unjacketted, was 1 : 2·73, the boiler pressure 80 lb. per square inch, the ratio of expansion approximately 11-fold, and the consumption of feed-water per I.H.P. per hour 16·81 lb. In the present instance the ratio of the cylinders was 1 : 2·88, the boiler pressure 90 lb., the rate of expansion approximately 8·25-fold, and the consumption of feed-water per I.H.P. per hour, when the jackets were not in use, 16·91 lb., or within 1 per cent. of the former result. When all the jackets were in use the consumption was greater, but we must not conclude that steam jackets are therefore useless in all cases ; for in the first place, the sides only of the cylinders were jacketted ; and in the second it is doubtful whether the whole surface jacketted was effective, for the heat furnished by the jackets was only about 6 per cent. of the total quantity supplied, and as there were no air taps on the top, there is no certainty that the jackets were filled with steam. (*b*) That with cylinders of these proportions the degree of expansion may be varied from 8 to 11-fold without materially affecting the consumption. (*c*) That probably for cylinders proportioned about 1 : 2·8 these ratios of expansion give the most economical results. (*d*) That as regards economy of steam in compound engines, it matters little whether the cylinders be set one behind the other, as in the tandem type, or side by side with the cranks at right angles. (*e*) That if only one of the cylinders is to be jacketted it is better to jacket the smaller one.

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

(*From our own Correspondent.*)

HERE and there slightly less time is this week being run at the mills and forges. A few instances were to-day—Thursday—cited on 'Change in Birmingham, as to which two turns within full time has now become the rule. Yet if the specifications could be obtained the orders upon the books would keep on the hands full time.

Ironmasters who have sold bars as well those who have sold sheets were to-day in Birmingham as well as yesterday in Wolverhampton seeking customers' specifications. Such firms, to secure orders needing prompt execution, were not indisposed to take a shade less money than they required last week.

It would have been possible to get orders for bars of the least valuable sort accepted at only a little more than £6 10s. per ton, and common bars at nothing in advance of £6 15s. Good bars were procurable at £6 17s. 6d., and excellent bars at £7 ; while marked bars retained their £7 10s. quotation upwards. There were a few sales of both forge bars and also angles ; but the lots which changed hands were not conspicuous. Excellent cable bars keep in request, and the nail rod business is better than usual at this period of the year. Nail rods were easy at £6 15s.

Gas strip might have been secured at from £6 15s. upwards, but the price did not tempt consumers. Coopers' hoops were procurable at £7 to £7 5s., and for the high-class hoops of the "marked" houses £8 10s. was cited. More, proportionately, was done in bedstead strip, for which £9 was asked, though seldom secured. Inquiries to test hoop prices are still being made on account of the United States, but purchases are the exception. Nevertheless, a fair extent of business is being done in hoops and strips for the Continent and the Colonies.

Sheets were to be had at £8 10s. for good singles, fit for galvanising ; and this price would have been promptly accepted yesterday in orders for singles merely, but the same gauge could have been secured for less money in association with doubles and latens. Doubles were to be had down to as low as £9 10s., and latens were not difficult to buy at £11 per ton—all suitable for galvanising and corrugating.

Galvanised sheets were quoted on both Exchanges at £15 10s. for 24 w.g., £17 10s. for 26 w.g., and £19 10s. for 28 w.g., all in bundles, in London. These were the "Association prices ;" but the iron was not difficult to get at under those figures, makers being generally prepared to give their customers the benefit of the slightly easier terms upon which they can get the black sheets to-day compared with the date when the Association prices were fixed. The leading markets to which roofing sheets are this week going are those of South America and the Cape, where somewhat better prices are procurable than can now be got in the Australias ; for somewhat heavy consignments have, this week's Australian advices say, again reduced the prices to an almost unprofitable level.

Best stamping sheets held their own, both to-day and yesterday, with tolerable firmness ; for new orders are arriving less tardily than in respect of most other descriptions of finished iron.

Girder-plate orders were not difficult to place to-day at £8 10s. per ton.

Common and medium sorts pigs were a little stronger in Wolverhampton and Birmingham because of the better market on Tuesday at Middlesbrough, but hematites could not be had at less money because of the less favourable aspect of Monday's market at Barrow-in-Furness. Higgling between buyers of Tredegar qualities and the selling agents was continued, and though there was only 1s. per ton between them, yet the vendors would not give way, and the negotiations were again stopped. For both Barrow and Tredegar the prices asked in the open market were 75s. per ton delivered here. But Ulverstone hematites were to be had at £7 2s. 6d. Still they were not pressed at that figure. For steel-making 1000 tons of that quality have just been sold hereabouts at half-a-crown under the quotations at date of the quarterly meetings. All-mine iron was quoted £3 7s. 6d. to £3 10s. ; part mine, £2 17s. 6d. ; and common at from £2 5s. to £2 7s. 6d. per ton.

Coal was dull and easy to buy at late rates.

An event of the week has been the sale by auction of the land and works of the Darlaston Steel and Iron Company. Out of thirty-six lots twenty-five were not sold, and the other eleven produced £21,055. The forges and mills, upon which more than £25,000 had been expended, went for £3100.

The following remarks concerning Government contracts were made in the annual report, just issued, of the National Arms and Ammunition Company, Limited, Birmingham, in the course of which it is recorded that the arms factory has again been very poorly employed :—" The small contract issued to the company by Government has not resulted in any profit ; and looking at the extensive character of the works, the directors again repeat their opinion that at the low prices paid for such small orders the result must always be unsatisfactory. The Government orders for the current year, it is believed, will be also limited ; and although the result looked forward to may not be profitable, yet it must be considered that it will produce something towards defraying the fixed expenses of the company."

The South Staffordshire Institute of Mining Engineers will very probably soon be moving their head-quarters from Dudley to Birmingham. Speaking of the probabilities of the electric light, the president anticipated a great future for it in signalling and underground haulage.

The operations of the East Worcestershire Waterworks Company, formed with the intention of supplying with water the towns of Bromsgrove and Redditch and the district of Lickey, are now rapidly approaching completion. At a meeting of the shareholders a few days ago, it was reported that the mild winter had assisted the company materially, and that in about a month's time the supply could be turned on to the Bromsgrove district.

The Chatterly Iron Company, North Staffordshire, has received formal notice, issued on behalf of friends of most of the twenty-four men who were killed at the late Whitfield Colliery explosion, that proceedings have been commenced under the Employers' Liability Act to recover compensation. The claim will be resisted by the company, which contributed liberally to the relief fund which was raised after the explosion.

A building, manufacturing, and machinery exhibition is to be held at Bingley Hall, Birmingham, from April 17th to May 6th, under the management of Mr. John Black, who has lately held an exhibition for builders only, in London.

A project is under consideration for the formation of a trade society for the operative machinists and tool makers of Birmingham and the district. Preliminary meetings have been held, and a code of rules has been drawn up for the regulation of members. The scheme is to partake of the nature alike of a trade-protection and trade-benefit society.

On Wednesday there was opened for traffic a new district line of railway between Stechford and Aston. It forms an important connection between the main line from London and that part of the South Staffordshire Railway which serves the Walsall and Wolverhampton districts. By its opening the traffic through New-street station, Birmingham, will be greatly lessened. The construction of the line has rendered necessary the building of a new station at Stechford. The new platforms are 153 yards in length, and 10 yards in width. They are connected by a substantial iron bridge consisting of three spans. The piers and abutments are of brickwork, and the girders are of wrought iron.

NOTES FROM LANCASHIRE.

(*From our own Correspondent.*)

Manchester.—There is no improvement to report in the iron market here. During the week the business doing in either pig or manufactured iron has been very limited, and there was a very flat market at Manchester on Tuesday. Lancashire makers of pig iron were open to offers at about 49s. to 50s., less 2½ per cent., for forge and foundry qualities delivered equal to Manchester, and district brands were quoted at about the same figures ; but buyers were not disposed to do business on the basis of these prices, and sellers were to be found at less money. Middlesbrough iron was quoted at 49s. 10d. to 50s. 1d. net cash delivered equal to Manchester, but in the face of the lower price of district brands, was partially out of the market.

Finished iron makers who are still mostly well supplied with orders are, as a rule, holding for £7 per ton for bars delivered into the Manchester district, but there are complaints in some cases that specifications are difficult to obtain even where makers are well sold, and in isolated cases orders for prompt delivery might be placed at 2s. 6d. per ton under current rates, whilst merchants are still sellers at as low as £6 15s. per ton. There are, however, very few new orders offering in the market at present.

A meeting of the Lancashire iron manufacturers, which had been specially called to take into consideration an application sent in at some of the works for a return of 6d. per ton on puddlers' wages and 5 per cent. on the wages of other workmen, which was taken off some years back, for the purpose of equalising the rate of wages with that paid in Staffordshire, was held at Manchester on Tuesday. An advance in wages of 7½ per cent., following a similar upward movement in Staffordshire, has only just recently been conceded by the Lancashire ironmasters, and as no promise had been made, as the men alleged, to return the 6d. per ton and 5 per cent. in addition, it was unanimously resolved that the further demand on the part of the men should not be entertained.

Hematites are much easier to buy than they were a short time back, and foundry qualities delivered into the Manchester district now average about 70s. per ton, which represents a drop of about 5s. per ton as compared with the prices recently quoted.

General founders are not so busy as they were, and the early advance in list rates which was contemplated at the commencement of the year does not seem likely to be realised at present.

The engineering branches of trade generally throughout the district continue well employed.

A continued very limited demand for all classes of round coal is the report from all the Lancashire colliery districts, and the month opens with a reduction in prices. In the Manchester district the leading firms have reduced their delivered rates for house coal 10d. per ton, and for burgy 5d. per ton, other sorts being untouched ; and in the West Lancashire districts there is a pretty general reduction of 6d. per ton in the pit prices for the better classes of round coal. Furnace and steam coals, as a rule, are without change, and good slack is generally firm. The average prices at the pit mouth are now about as under :—Best coal, 8s. 6d. to 9s. ; seconds, 6s. 6d. to 7s. ; common round coal, 5s. to 6s. ; burgy, 4s. 6d. to 5s. ; and good slack, 3s. 9d. to 4s. 3d. per ton.

For coke there is a fair demand at about 9s. to 10s. for common up to 12s. and 13s. per ton for the better sorts at the ovens.

Barrow.—The transactions on the past week in the hematite pig iron trade have been less than for some time past, and the demand shows a falling off as compared with that experienced since the new year. Makers, however, have their hands full, and I don't think there is much likelihood of their stinting in any way the enormous production of the furnaces. The amount of orders on hand will keep manufacturers fully employed, and orders which are being received will be sufficient to find an outlet for their output. The purchases for the year—for buyers I believe may almost be said to have secured what they require for this year, or well on towards the end of it—have been very heavy, and this will keep makers fully engaged till the close of the shipping season. The demand, although not so brisk, is by no means slack, and I am assured that the colonies show a disposition to increase their parcels. From the Continent and America the inquiry is good. Prices are a shade lower. No. 1 Bessemer is quoted at 61s. 6d. net at works, or f.o.b.; No. 2, 60s. 6d.; No. 3 forge, 59s. 6d., and inferior samples, 58s. A heavy tonnage of metal is being delivered, mostly on home account, which considerably increases the traffic receipts on local railways.

Steel makers are still active, and there is a good demand for almost all qualities. Prices are steady, iron ore selling at 17s. per ton at the mines.

Iron shipbuilders are working off their contracts. Engineers and other makers are fairly active. Coal in fair consumption.

The trustees of the Earl of Lonsdale are about to make a new dock for Workington. Additional accommodation is required here for shipping owing to the development which has taken place in the iron, steel, and coal trade of the district, and the increasing tonnage of exports and imports which has of consequence thereby resulted.

Work has been resumed at the Beerpot Tin-plate Works near Workington. Operations at these works has for a short time been stopped.

THE SHEFFIELD DISTRICT.

(*From our own Correspondent.*)

ORDERS for railway material still continue to pour in, the latest being 2000 tons of steel rails from the Great Northern Railway Company, to be followed, I understand, by others of more consequence. An order for 20,000 tons for South America has also to be noted. Prices are again somewhat weaker. Though the average rate is still quoted at £6 5s. per ton, I have reason to believe that one contract, at least, has recently been taken at about £6 per ton.

The Horbury Junction Ironworks Company, Limited, has a peculiar dispute with the workmen. The wages of the workmen have been regulated by the decision of the Staffordshire Arbitration Board, but the manager contended that the settlement of 23rd December last, which fixed the wages for three months ending March, 1882, was still binding. The workmen dissented, and on the 18th inst. gave a week's notice for an advance of 9d. per ton for puddling, and 7½ per cent. to other contractors. The manager then offered the advance if the workmen would make their notice fourteen days in place of seven. This the workmen declined to do, and an official notice was posted in the works, declaring that the workmen had set aside an agreement for the regulation of wages, and advancing the wages under protest from Monday next. The men now decline to resume work unless the employers pay the additional wages from the actual date of the Staffordshire decision. The company declines to do this, and offers to arbitrate. There the matter stands.

At the half-yearly meeting of the Hull and Barnsley Railway Company, in which the Sheffield district is so deeply interested, the report showed that the amount of paid-up capital was £1,329,580, of which £731,805 has been paid in advance of calls. The total amount of money expended since the company's formation has been £660,000, leaving a balance of £669,000. The chairman, Colonel Smith, stated that the people of Halifax and Huddersfield had heartily taken up the proposition to extend the line to those towns, and it would be proposed that the corporations in each case should subscribe £50,000 towards the cost of the undertaking. The progress of the railway in the Pontefract district is very rapid. At Barnsdale, where there is a tunnel of over a mile in length, several pits have been sunk, and the works pushed vigorously forward. From Pontefract several millions of bricks are being conveyed by traction engines to the viaduct at Kirk Smeaton and the Barnsdale tunnel.

THE NORTH OF ENGLAND.

(*From our own Correspondent.*)

THE settlement of the uncertainty as to whether or not the policy of restriction of output of pig iron would be continued or not, has had a reassuring effect upon the market. It has become clear that there will be no change made in that respect for some time. It is, therefore, now possible to estimate the relations between supply and demand. The consequence has been that a more cheerful tone has taken possession of the trade. On Tuesday last there was more anxiety to buy on the part of consumers, and sellers stood out with some firmness for better prices. The price of No. 3, g.m.b., was, at the opening of the Middlesbrough market on Tuesday last, 41s. 9d., f.o.b. for March delivery; later on in the day 42s. was asked and obtained. Makers seemed adverse to selling for delivery beyond April, except at an enhanced price. Connal's warrants stood at about the same price as No. 3 g.m.b. The stock of Cleveland iron in Connal's stores was reported as 171,376 tons, being a decrease since the previous market day of 1273 tons.

The ironfounding trade still remains depressed, and the strikes which have taken place in connection with it do not seem to have had, so far, any effect in raising prices. The manufactured iron trade shows no alteration as regards quotations ; there was, however, very little business transacted. Buyers have for some time been abstaining from making contracts, in the hope that finished iron would follow the downward movements of pig iron. Sellers, on the other hand, have made no concession, as they have plenty of specifications, plenty of contracts, and are even pressed for delivery. So long as this continues they are not likely to quote lower. It is said that an attempt has been made to "bear" the manufactured iron market by the sale of 5000 tons of plates to a Glasgow merchant, by a Middlesbrough firm of merchants, at 5s. per ton below present nominal prices. It remains to be seen whether the sellers will be able to cover themselves without loss or not.

The present price of ship plates is £7 5s., and of angles and bars £6 10s., f.o.t. Middlesbrough less 2½ per cent. Old rails are offered at 79s., c.f.i. Tees, and puddled bars at £4 5s. to £4 7s. 6d. at makers' works.

On Saturday, the 25th ult., the pattern-makers, smiths, and fitters, hitherto employed by Messrs. Cochrane, Grove, and Co., Middlesbrough, came out on strike for an advance of 10 per cent. This amount they say was taken off during the depressed times about four years ago, and they think it should now be restored. The employers contend that whatever may have taken place as regards other branches of the iron trade, founders have as yet experienced no return of prosperity. The boiler smiths employed at the same works came out on strike the week previously.

On Saturday, the 25th ult., a meeting of the Durham Miners' Association was held at Durham, under the presidency of Mr. John Foreman. The sliding scale under which the miners have recently been working has now lapsed, and no other has been adopted. The men contend that they are entitled to a substantial rise in wages. It was decided to send a deputation to wait upon the employers and to demand an advance, and that if this were not conceded they would have a further meeting to consider what course they should pursue. A resolution was passed deploring the recent calamity at Trimdon Grange, and calling upon the Government to amend the law in such a way as to make such accidents more difficult or impossible.

On Monday, the 27th ult., a meeting of the Standing Committee of the Board of Arbitration for the manufactured iron trade, was held at Stockton, Mr. Wm. Whitwell presiding. After discussing and disposing of certain minor questions, the claim of the ironworkers for a further advance of 7½ per cent. upon all labour rates, and for a still further advance of 7½ per cent. in certain special cases was considered, together with the employers' reply offering to arbitrate the whole matter. It was finally decided that Sir Rupert Kettle should be requested to act as referee upon the matter in dispute.

NOTES FROM SCOTLAND.

(From our own Correspondent.)

The Glasgow iron market has been very quiet during the past week. Towards the close of last week a considerable amount of business was done in the sale of warrants by holders, who were disappointed by the unfavourable reports as to the condition of the American market. This had the effect of still further depressing the quotations, which had fallen to their lowest point on Monday, but have since slightly recovered. The volume of business in the iron trade is very satisfactory, but prices cannot but be regarded as exceptionally low. There is an impression that it would be an advantage were pig iron to rise several shillings per ton, but the extensive stocks and the heavy accounts of the Bears in the market serve to keep them down. The contracts for delivery of pig iron to manufacturers must, however, in some cases be running out, and there is a probability that fresh purchases will have to be made before long, which will in some degree influence the market. The exports have been very satisfactory in bulk. For the past two months they show an increase of fully 7000 tons over those of the corresponding period of 1881. There has been some small addition in the course of the week to the stocks in Messrs. Connal and Co.'s stores, but they have not been such as to materially alter the figures.

Business was done in the warrant market on Friday forenoon at from 48s. 5d. to 48s. 3d. cash, and from 48s. 7d. to 48s. 6d. one month, the afternoon quotations being 48s. 2½d. to 47s. 11d. cash, and 48s. 4½d. to 48s. 2½d. one month. On Monday the market was somewhat uneasy, with a decline in prices. In the morning business was done at from 47s. 10d. to 48s. cash, and 48s. to 48s. 3d. one month; and in the afternoon, transactions were recorded at 47s. 10½d. to 48s. 1d. cash, and 48s. 2d. to 48s. 3d. one month. On Tuesday forenoon the market was strong, with improved business at from 48s. ½d. to 48s. 5d. cash, and 48s. 7½d. one month; the afternoon's business was at 48s. 6d. to 48s. 4d. cash, and 48s. 9d. to 48s. 7d. one month. The market was quiet on Wednesday, with business at 48s. 3d. cash and 48s. 6d. one month. To-day—Thursday—the market was flat at 48s. 2d. to 48s. cash, and 48s. 5d. to 48s. 3d. one month.

The demand for makers' iron has been rather slow, but there is not much alteration in prices:—Gartsherrie, f.o.b. at Glasgow, per ton, No. 1, 58s., No. 3, 51s. 6d.; Coltness, 58s. and 52s.; Langloan, 59s. and 54s. 6d.; Summerlee, 58s. and 50s. 6d.; Calder, 58s. and 52s.; Carnbroe, 53s. and 50s. 6d.; Clyde, 51s. and 49s.; Monkland, 49s. 6d. and 47s. 6d.; Quarter, ditto ditto; Govan at Broomielaw, 50s. 6d. and 48s. 6d.; Shotts at Leith, 58s. 6d. and 54s. 6d.; Carron, at Grangemouth, 52s. 6d. (specially selected, 55s.) and 51s. 6d.; Kinneil, at Bo'ness, 49s. and 47s.; Glengarnock, at Ardrossan, 53s. 6d. and 50s. 6d.; Eglinton, 49s. and 47s.; Dalmellington, 49s. and 48s.

There have been considerable arrivals of iron ore from Spain, a proportion of which has been landed at Port Glasgow. The hematite trade continues very good, the works making pig being active and the demand being good at the steelworks.

As was to be expected, the Cleveland and Scotch ironmasters have resolved to prolong the agreement for restricting the output of pig iron for another six months after the 31st March.

In the malleable trade there is little of fresh interest to notice this week; works are all busy, but there is a lack of fresh orders, and prices are in some cases decidedly easier. The quotations for common malleable bars extend from £6 5s. to £7 per ton, less 5 per cent. discount.

The coal trade of Lanarkshire and of Scotland generally is in rather a backward condition at present. The prices are without quotable alteration.

The annual festival of the Clyde District Boilermakers and Iron Shipbuilders, held in Glasgow a few days ago, and presided over by Lord Dean of Guild Stephen, was a very interesting gathering. The chairman, who is a large shipbuilder on the Clyde, gave an interesting address, showing the advances which had been made in shipbuilding and engineering in recent times. Mr. Rothwell stated that the Friendly Society had increased in the Clyde district from twenty branches, with a membership of 2348, in 1879, to twenty-five branches, with 4749 members in 1881, and that during the same period the funds had benefitted to the extent of £8500.

The shipbuilding trade of the Clyde during the past month has been very productive, the number of vessels launched being eighteen, with an aggregate tonnage of 29,946, as compared with ten vessels, and 20,700 tons, in February, 1881.

WALES & ADJOINING COUNTIES.

(From our own Correspondent.)

The battle of the railways is now approaching, and the whole interest of the district is centred upon the various schemes. The promoters of the Swansea and Rhondda scheme leave for London this week, and there will be no sparing of effort in carrying this out to a successful issue. There is a strong opinion prevailing that the two rival schemes should be amalgamated, and probably this will be done.

Those interested in the coal riches of South Wales say that there will be a marked change in the coal traffic in the course of a few years. Newport, on the one hand, by the greater development of the lower measures of the Monmouthshire districts, will take a huge slice away from Cardiff, and Swansea to the west will also have its share of the trade that now runs down the Taff Vale Railway. The unprecedented dividend of 17 per cent. given on the original shares of the Taff Vale is the great temptation that inspires the various railway movers, all of whom are wishful, and naturally so, to compete for a share, and the contest will be a severe one.

The Sliding Scale Committee, at their meeting on Monday in Cardiff, decided to retain the existing wages. Prices did not justify the advance which the colliers anticipated.

This week the National Steam Coal Company struck upon the 6ft. seam near the Perth Station. It was gained at 420 yards from the surface.

The books of the various ironmakers are well filled, and there will be no lessening in work for some time to come.

The Rhondda tramway scheme is being carried on with satisfactory signs of a successful result. The Bute Dock Bill has passed the preliminary courses. It is supported by the town and corporation of Cardiff, and opposed by a section of the shipowners.

The tin-plate manufacturers are contemplating a reduction of make in order to improve prices, and at one of the principal works notice to that effect has been issued. An impression exists, how far correctly based I cannot state, that the market is being "beared," and it is suggested that a limitation of work will prove an antidote. Several of the Welsh firms are disposed to try the remedy.

I referred last week to the claim of £150 brought by a Rhondda door-boy against the Aberghorky Company for injuries sustained through the alleged neglect of the employers. The decision was given this week by Judge Williams, of the Welsh circuit, in favour of the boy, and £109 4s. awarded as damages. As the first victory to the working class under the provisions of the Employers' Liability Bill, the result has caused a good deal of sensation.

THE PATENT JOURNAL.

Condensed from the Journal of the Commissioners of Patents.

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

Applications for Letters Patent.

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

21st February, 1882.

825. Penholders, M. Benson.—(*W. W. Stewart, U.S.*)
826. Scouring, &c., Fabrics, A. C. Adam and D. Stewart, Glasgow.
827. Omnibuses, J. Abbott, Bideford.
828. Smelting Furnaces, W. Ferrie, Calderbank.
829. Obtaining Ammonia, J. and J. Addie, Glasgow.
830. Baths, C. Bailey, Leeds.
831. Electric Lamps, J. Rapieff, London.
832. Propelling Vessels, W. R. Lake—(*J. Root, U.S.*)
833. Perpetual Calendars, P. M. Justice.—(*T. H. Hoveden, Canada.*)
834. Electric Lamps, W. R. Lake.—(*B. Land, U.S.*)
835. Asbestos Paints, C. J. Mountford, Birmingham.
836. Moulding Boxes, C. Bailey, Leeds.
837. Storing Electric Currents, I. L. Pulvermacher, Regent-street, London.
838. Dynamo-electric Machines, W. R. Lake.—(*B. Lande, New York, U.S.*)
839. Ratchet-braces, S. Gardner, Adderbury.
840. Penholders, H. J. Haddan.—(*A. Cohn, Berlin.*)
841. Knitting Machines, J. W. Watts, Countesthorpe.
842. Measuring Gas, A. G. V. Harcourt, Oxford.
843. Detaching Ships' Boats, J. A. Wilkinson and N. McGonnell, Folkestone.
844. Transmitting Motive Power, J. Dobney, Gosberton-Risegate, Lincoln.
845. Seats of Bicycles, C. Edwards, Birmingham.
846. Weldless Tubes, R. Elliott, Newcastle-on-Tyne.
847. Sash-pulley, W. Meakin, London.
848. Velocipedes, J. Humpage, Bristol.
849. Reflectors, F. H. Engel.—(*G. Franke, Hamburg.*)
850. Raising Blinds, J. Everard, Birmingham.
851. Files, &c., for Letters, R. Stettin, Birmingham, and H. Dyer, Bridgewater.
852. Reaping Machines, J. Harrison, Ipswich.
853. Lifts, A. M. Clark.—(*J. McCarroll, New York.*)
854. Locking Nuts, A. M. Clark.—(*S. Pattee and A. B. Smith, San Francisco, U.S.*)
855. Moulding Machines, F. Wirth.—(*J. G. Sebold and F. Neff, Karlsruhe, Germany.*)

22nd February, 1882.

856. Storing &c., Electricity, J. Williams, London.
857. Boots & Shoes, L. Groth.—(*J. Wahlen, Germany.*)
858. Preventing, &c., Fires, K. and J. McLennan and R. Owen, London.
859. Screw Propellers, T. Lambert Plymouth.
860. Nosebags, J. Archibald, Kensington.
861. Closet Valves, H. Haddan.—(*W. Rüdiger, Berlin.*)
862. Fire-bars, T. Nash, Sheffield.
863. Drawing in Warp Threads, J. H. Johnson.—(*L. P. Sherman and R. H. Ingersoll, Bideford, and G. Moore, Beswick, U.S.*)
864. Furnaces, J. H. Johnson.—(*La Société Nouvelle des Forges et Chantiers de la Mediterranée, Paris.*)
865. Treatment of Hair Felt, J. Forsyth, Glasgow.
866. Cables, J. C. Mewburn.—(*La Société Alamagny et Oriol, Paris.*)
867. Bobbin-net Machinery, H. Payne, Nottingham.
868. Tell-tales, M. Levy & F. Lowe, Aylestone Park.
869. Lighting by Electricity, C. Spangoletti, London.

23rd February, 1882.

870. Autographic Pen, O. Bussler, London.
871. Showing Speed, T. Davison, Glasgow.
872. Electrodes, F. Des Vœux.—(*G. Cumming and C. Brinkerhoff, New York, U.S.*)
873. Fire-arms, J. Dickson, jun., and A. G. Murray, Edinburgh.
874. Wrought Nails, J. Maynes, Manchester.
875. Supporting Buildings, J. Slater and R. Pollock, Edinburgh.
876. Spinning Machinery, G. Perkins, G. Wimpenny, and G. H. Evans, Manchester.
877. Alarum Bells, H. Lees, Ashton-under-Lyne.
878. Screw Propellers, T. Heppell, Birtley.
879. Anmunciator, M. Volk, Brighton.
880. Electrical Signal, C. Spratt, London.
881. Wool-combing, W. Lake.—(*W. H. Grundy, U.S.*)
882. Match and Fusee-box, G. Simons, Leeds.
883. Motive-power Engines, J. Nisbet. Bishopbriggs.
884. Grippers for Stretching, J. Hardacre, Leeds.
885. Treating Ores, W. Barlow.—(*C. de Vaureal, Paris.*)
886. Spinning Fibres, F. Ripley & T. Brigg, Bradford.
887. Regulating Artificial Light, J. R. Smith and J. I. Learoyd, Halifax.
888. Apparatus for Water-closets, H. Sutcliffe, Halifax, York.
889. Water-closets, J. Mewburn.—(*J. E. Boyle, Brooklyn, and H. Huber, New York, U.S.*)
890. Testing Pressure, &c., W. C. de Wit.—(*C. D. Gäbler, Hamburg.*)
891. Projectiles, T. Nordenfelt, London.
892. Desiccating Sewage, J. H. Johnson.—(*E. Coignet, Paris.*)

24th February, 1882.

893. Mixing Concrete, A. Jamieson, Blantyre, N.B.
894. Tin-plate, A. J. Maskrey, Coatbridge, N.B.
895. Coverings for Walls, &c., C. Hibbs, Plaistow.
896. Wheel Gearing, W. Lake.—(*J. Tibbits, U.S.*)
897. Cooking Apparatus, J. Mitchell, Newcastle-on-Tyne.
898. Electric Lamps, J. Brockie, Brixton, London.
899. Cotton Opening Machines, W. R. Lake.—(*R. Kitson, Lowell, U.S.*)
900. Gas-burner, G. S. Grimston, Brockley.
901. Treating Maize, A. G. Fraser, London.
902. Asbestos Fabrics, H. J. Haddan.—(*T. Trivier, Belgium.*)
903. Drilling Rock, G. F. Wynne, Minera.
904. Coke Ovens, B. Cochrane, Durham.
905. Secondary Batteries, J. W. Swan, Newcastle-on-Tyne.
906. Motor Apparatus, W. Lake.—(*M. Rosenstock, U.S.*)
907. Pendulum Motor Apparatus, W. R. Lake.—(*J. von Zäch, Hungary.*)
908. Washing Wool, W. Lake.—(*E. Mehl, Germany.*)
909. Hats, &c., H. Orth.—(*W. E. Doubleday, U.S.*)

25th February, 1882

910. Cores, B. Johnson, jun., Pudsey, near Leeds.
911. Bricks, J. Parker, Kilmarnock, N.B.
912. Washing Gases, H. A. Bonneville.—(*L. A. Chevalet, Troyes, France.*)
913. Rolling Mills, P. Kirk, Workington.
914. Water-closets, S. S. Hellyer, Strand, London.
915. Gas Chimneys, G. G. Paul, Toulouse.
916. Folding Paper, H. M. Nicholls, London.
917. Reflectors, H. Haddan.—(*W. Wheeler, U.S.*)
918. Ventilators, H. J. Haddan.—(*P. Mihan, U.S.*)
919. Elastic Fabrics, T. H. Harrison, Derby.
920. Utilising Gas, R. Dempster, sen., and J. Dempster, Elland.
921. Sulphate of Ammonia, J. Dempster, Elland.
922. Transmitting Signals, A. F. St. George, London.
923. Filter Presses, H. Newton.—(*A. Dehne, Germany.*)
924. Valve Cases, H. Newton.—(*A. Dehne, Germany.*)
925. Earth Closets, W. H. Lascelles, London.
926. Omnibuses, A. Margetson and W. Hek, Bristol.
927. Lubricating, J. J. Royle, Manchester.
928. Horseshoes, T. Grason, Emley, near Wakefield.
929. Hygrometer, L. Boye, Finsbury, London.
930. Indicating Length, A. Akeroyd, Bradford.
931. Dynamo-electric Machines, A. M. Clark.—(*H. B. Sheridan, Cleveland, U.S.*)
932. Tempering Hackle, &c., T. Crabtree, Leeds.
933. Compass Correctors, J. J. Wilson, Sunderland.
934. Opening Windows, J. Carpenter, Southampton.

27th February, 1882.

935. "Dobbies" for Weaving, J. Shorrock, Darwen.
936. Carpet, J. J. Delmar and W. Folliott, London.
937. Corrugating Machines, V. B. Daelen, Berlin.
938. Carriage Drawbar, W. Turnbull, Longton.
939. Trouser Protector, L. Groth.—(*A. Milvers, Berlin.*)
940. Taps, J. E. Chambers, Smethwick.
941. Regulating Speed of Engines, J. Richardson, Lincoln.
942. Hair Clasps, F. L. B. Kopp, Hamburg.
943. Obtaining Currents of Electricity, H. E. Newton.—(*A. I. Gravier, Paris.*)
944. Packing, H. J. Haddan.—(*O. Lonze, Paris.*)
945. Saddle-bars, J. L. Reed, Watford, near Rugby.
946. Railway Signalling, P. P. Sykes, Diggle.
947. Thimbles, F. H. F. Engel.—(*I. Hirsch, Stockholm.*)
948. Lamps and Burners, P. Molloy, Limerick.
949. Folding Paper, F. Wolff.—(*J. Eickhoff, Denmark.*)
950. Window Fastenings, W. P. Bonwick, London.
951. Clearing Woollen Materials from Vegetable Impurities, C. D. Abel.—(*La Société Anonyme La Laine, Paris.*)
952. Pumps, C. D. Abel.—(*A. Osenbrück, Germany.*)
953. Centrifugal Apparatus, C. D. Abel.—(*C. Rudolph and Co., Germany.*)
954. Ice, C. D. Abel.—(*Osenbrück and Co., Germany.*)
955. Reducing Metals, F. Wirth.—(*H. Rossler, Germany.*)
956. Ventilating Apparatus, C. D. Abel.—(*E. Oehlmann, Berlin.*)
957. Spinal Support, G. E. Vaughan.—(*P. J. Le Belleguic, Paris.*)
958. Cutting Paper, W. W. Colley, Camberwell.

Inventions Protected for Six Months on Deposit of Complete Specifications.

819. Electric Lighting, S. Pitt, Sutton.—A communication from E. T. Starr, Philadelphia, U.S.—*20th February*, 1882.
825. Fountain Pen-holders, M. Benson, Chancery-lane, London.—A communication from W. W. Stewart, Brooklyn, U.S.—*21st February*, 1882.
832. Propelling Vessels, W. R. Lake, Southampton-buildings, London.—A communication from J. B. Root, Portchester, U.S.—*21st February*, 1882.
834. Electric Lamps, W. R. Lake, Southampton-buildings, London.—A communication from B. Lande, New York.—*21st February*, 1882.
838. Dynamo-electric Machines, W. R. Lake, Southampton-buildings, London.—A communication from B. Lande, New York.—*21st February*, 1882.
854. Locking Nuts to Screw-bolts, A. M. Clark, Chancery-lane, London.—A communication from S. Pattee and J. B. Smith, San Francisco.—*21st February*, 1882.
902. Asbestos Fabrics, H. J. Haddan, Kensington.—A communication from T. Trivier, Belgium.—*24th February*, 1882.
909. Articles with Fur Naps, H. Orth, Washington, U.S.—A communication from W. E. Doubleday, New York, U.S.—*24th February*, 1882.

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

698. Formation of Compounds, H. J. Smith, Glasgow.—*21st February*, 1879.
722. Brewers' Yeast, C. Graham, London.—*22nd February*, 1879.
850. Screw-propellers, J. Skinner, South Shields.—*3rd March*, 1879.
1019. Gas Checks, W. Morgan-Brown, London.—*14th March*, 1879.
1090. Explosive Compounds, G. McRoberts, Glasgow.—*19th March*, 1879.
1197. Swell-pin Hinge-joint, J. Lang, W. Stancliffe, and J. Brierley, Preston.—*26th March*, 1879.
721. Gas, W. P. Wilson, Brockley.—*22nd February*, 1879.
731. India-rubber Fabrics, T. Forster, Streatham.—*22nd February*, 1879.
746. Valves, &c., G. Kingdon, Kingswar.—*24th February*, 1879.
782. Sawing Wood, J. Smith, Rochdale.—*26th February*, 1879.
752. Metallic Tubes, S. Fox, Leeds.—*25th February*, 1879.
766. Cultivating Land, J. E. Philips, Derby.—*25th February*, 1879.
783. Electric Light, G. P. Harding, Paris.—*26th February*, 1879.
796. Motive Power, E. H. Leveaux, Hampton Wick.—*27th February*, 1879.
880. Umbrellas, A. F. Boham, Birmingham.—*5th March*, 1879.
756. Inserting Staples, H. J. Haddan, London.—*25th February*, 1879.
905. Air-heating, H. J. Haddan, London.—*7th March*, 1879.
760. Looms, G. Keighley, Burnley.—*25th February*, 1879.
791. Regulating Water, J. G. Stidder, London.—*26th February*, 1879.
818. Permanent Way, C. Wood, Middlesbrough.—*28th February*, 1879.
819. Rock Tunnelling, H. N. Penrice, Hatfield.—*28th February*, 1879.
857. Feed Apparatus, A. Thomson, Southampton.—*4th March*, 1879.
1189. Permanent Way, A. Greig, Leeds.—*25th March*, 1879.

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

649. Water-closets, S. H. Rowley, Swadlincote.—*22nd February*, 1875.
662. Signalling, W. R. Sykes, Nunhead.—*23rd February*, 1875.
684. Balancing Apparatus, &c., H. A. Taylor and A Muirhead, London.—*24th February*, 1875.
719. Hydraulic Machinery, B. Walker and J. F. A. Pflaum, Leeds.—*26th February*. 1875.
1168. Printing on Tin, &c., R. Barclay and J. D. Fry, London.—*31st March*, 1875.
714. Copper Plates, J. Brown, Chelsea.—*26th February*, 1875.
789. Revolving Furnaces, T. R. Crampton, London.—*3rd March*, 1875.
810. Glucose, S. H. Johnson, Stratford.—*4th March*, 1875.

Notices of Intention to Proceed with Applications.

Last day for filing opposition 17th March, 1882.

4542. Velocipedes, F. W. Eicke, Beulah Hill.—*18th October*, 1881.
4550. Steam Generators, R. Mills, Victoria-street, Westminster.—*18th October*, 1881.
4569. Drying Sugar, &c., J. Roper, New Goulson-street, London.—*19th October*, 1881.
4572. Guards for Thrashing Machines, R. Moore, Fulbourn, and J. Lee, Cambridge.—*25th October*, 1881.
4589. Gas Engines, L. Bénier and A. Lamart, Beaumetz, France.
4594. Hydraulic Buffer Brake, W. Beck, London.—A com. from J. B. G. A. Canet.—*20th October*, 1881.
4600. Velocipedes, G. Singer, Coventry.—*20th October*, 1881.
4601. Ornamenting Glass, J. W. Savage, Fulham-road, London.—*20th October*, 1881.
4606. Tea, J. C. Marillier, Chancery-lane, London.—*21st October*, 1881.
4614. Treating Peat, &c., J. A. London, Southampton-buildings, London.—*21st October*, 1881.
4618. Preventing the Purloining of Letters, G. Nobes, Harrow-road, London.—*21st October*, 1881.
4628. Treating Peat, A. Wilkinson, Marylebone, London.—*22nd October*, 1881.
4635. Treatment of Ores, F. M. Lyte, Savile-row, London.—*22nd October*, 1881.
4652. Ships' Sleeping Berths, W. Lake, London.—A communication from D. Parks.—*24th October*, 1881.
4658. Watches, S. M. Morgan, Kingsland, London.—*25th October*, 1881.
4672. Steam Pumps, T. H. Ward, Tipton.—*25th October*, 1881.
4684. Balloons, F. C. Kinnear, Coleman-street, London.—*26th October*, 1881.
4687. Asbestos, S. Pitt, Sutton.—A communication from H. W. Johns.—*26th October*, 1881.
4719. Treatment of Malt, A. and M. Conroy, Liverpool.—*28th October*, 1881.
4743. Preservation of Milk, E. G. Brewer, London.—A com. from L. Scherff.—*29th October*, 1881.
4774. Shaft Machines, C. Barlow, Manchester.—A com. from N. Anderson.—*1st November*, 1881.
4801. Sizing Paper, W. R. Lake, London.—A communication from P. E. Minor.—*2nd November*, 1881.
4839. Nut-locking Device, S. Danischewsky, Paris.—*4th November*, 1881.
4882. Electric Timepieces, W. P. Thompson, London.—A com. from A. Lemoine.—*8th November*, 1881.
4889. Mining, J. Mills, Hanley, and T. D. Brown, St. George's, near Wellington.—*8th November*, 1881.
4936. Extracting Glycerine, &c., W. R. Lake, London.—Com. from M. Ruffin.—*10th November*, 1881.
4957. Ships' Pump Valves, J. Gwynne, Cannon-street, London.—*12th November*, 1881.
5139. Tricycles, &c., F. Beauchamp, Edmonton.—*24th November*, 1881.
5439. Boilers, W. C. Burder, Loughborough.—*13th December*, 1881.
5492. Range-finding, T. Bolton, Calcutta.—*15th December*, 1881.
5629. Shifting Grain, &c., E. J. Power, London.—A com. from W. H. Power.—*23rd December*, 1881.
173. Producing Signals, C. B. Crisp, Manchester-street, London.—*12th January*, 1882.
208. Spring Mattresses, A. M. Clark, London.—A com. from E. T. Slayton.—*14th January*, 1882.
231. Telephonic Conductors, C. W. Siemens, Westminster.—Com. from F. Jacob.—*17th January*, 1882.
232. Permanent Way, H. R. Meyer, Liverpool.—*17th January*, 1882.
259. Raising Sunken Ships, R. Richards, Manchester.—*18th January*, 1882.
295. Water-closets, S. H. Terry, London.—*20th January*, 1882.
301. Sewing Buttons on Cloth, &c., H. J. Haddan, London.—Com. from J. Mathison.—*21st January*, 1882.
741. Urethral Syringes, A. M. Clark, London.—A com. from. F. Wilhöft.—*15th February*, 1882.
819. Electric Lighting, S. Pitt, Sutton.—A communication from E. T. Starr.—*20th February*, 1882.

Last day for filing opposition, 21st March, 1882.

4626. Crushing Ores, C. J. Appleby, London.—*22nd October*, 1881.
4631. Vans, H. Mousell, Gloucester, and O. Lythgoe, Manchester.—*22nd October*, 1881.
4637. Rotary Apparatus, A. J. Boult, London.—A com. from L. B. Villebonnet.—*22nd October*, 1881.
4654. Electric Lamps, G. G. Andre, Dorking.—*24th October*, 1881.
4659. Gas and Electricity, R. H. Courtenay, London.—*25th October*, 1881.
4669. Brakes, W. H. Marks, London.—*25th October*, 1881.
4682. Locks, J. Jackson and C. Sheekey, Westminster.—*26th October*, 1881.
4688. Caster, W. R. Lake, London.—A communication from A. J. Mauchain.—*26th October*, 1881.
4691. Cutting Corks for Mouthpieces, H. Gardner, London.—A communication from S. Elkins, C. Clark, and E. C. Hine.—*26th October*, 1881.
4700. Steam Engines, S. Geoghegan, Dublin, and J. Sturgeon, London.—*27th October*, 1881.
4701. Fish-hooks, T. Morgan, Redditch.—*27th October*, 1881.
4712. Ash-pans, C. Ezard, Bradford.—*27th October*, 1881.
4734. Combing Cotton, P. C. Marsden and W. Pendlebury, Bolton.—*29th October*, 1881.
4741. Chimney-pieces, J. Thomas, Bangor.—*29th October*, 1881.
4752. Weaving, M. Bauer, Paris.—A communication from P. Besté.—*31st October*, 1881.
4753. Air Compressor, M. Bauer, Paris.—A communication from C. A. Mayrhofer.—*31st October*, 1881.
4773. Steering, &c., A. W. Cooper, Dundee.—*1st November*, 1881.
4784. Ships' Rudders, W. Cooke and D. Mylchreest, Liverpool.—*2nd November*, 1881.
4803. Keels, &c., W. Cooke and D. Mylchreest, Liverpool.—*3rd November*, 1881.
4856. Ships' Sleeping Berths, W. R. Lake, London.—A com. from J. H. Porter.—*5th November*, 1881.
4883. Winding Clocks, M. Bauer, Paris.—A com. from C. Mayrhofer and W. Otto.—*8th November*, 1881.
4904. Consuming Smoke, E. P. Alexander, London.—A com. from J. Elliott.—*9th November*, 1881.
5065. Treating Fish, G. Leach, London.—*19th November*, 1881.
5095. Bricks, W. R. Lake, London.—A communication from W. W. Potts.—*22nd November*, 1881.
5162. Ventilating Buildings, F. Lönholdt, London.—*25th November*, 1881.
2. Refrigerators, P. M. Justice, London.—A communication from H. C. Goodell.—*2nd January*, 1882.
11. Desiccating, &c., A. Goutard, Leipsic, Germany.—*2nd January*, 1882.
15. Transmitting Heat, T. W. Duffy, Liverpool.—*2nd January*, 1882.
86. Steam Generators, J. Jones, Liverpool.—*7th January*, 1882.
87. Valves, J. W. Hackworth, Darlington.—*7th January*, 1882.
303. Voltaic Batteries, A. R. Bennett, Glasgow.—*21st January*, 1882.
340. Cigarette Papers, A. G. Goodes, London.—*23rd January*, 1882.

377. ELECTRIC LAMPS, C. T. Bright, London.—25th January, 1882.
444. DYEING YARNS, F. A. Gatty, Accrington.—28th January, 1882.
513. ELECTRIC METERS, C. V. Boys, Wing.—2nd February, 1882.
536. OVENS, D. and W. H. Thompson and W. J. Booer, Leeds.—3rd February, 1882.
552. KNIFE-CLEANING MACHINES, W. H. D. Jones, London.—4th February, 1882.
557. DYEING YARNS, F. A. Gatty, Accrington.—4th February, 1882.
564. FLOATING COFFER-DAMS, H. H. Lake, London.—A com. from H. P. Kirkham.—6th February, 1882.
581. TREATING PLANTS, C. D. Ekman, London.—7th February, 1882.
605. REFRIGERATING MACHINERY, G. Barker, Birmingham.—Com. from J. Chambers.—8th February, 1882.
619. EXPLOSIVES, W. F. Reid, Stowmarket, and D. Johnson, Chester.—8th February, 1882.
649. WAGONS, J. Watling and E. Chaston, Lambeth.—10th February, 1882.
832. PROPELLING VESSELS, W. R. Lake, London.—A com. from J. B. Root.—21st February, 1882.
834. ELECTRIC LIGHT, W. R. Lake, London.—A communication from B. Lande.—21st February, 1882.
838. DYNAMO-ELECTRIC MACHINES, W. Lake, London.—A com. from B. Lande.—21st February, 1881.
854. LOCKING-NUTS, A. M. Clark, London.—Com. from S. Pattee and A. Smith.—21st February, 1882.

Patents Sealed.

(*List of Patent Letters which passed the Great Seal on the 24th February, 1882.*)

3700. EXHIBITING ADVERTISEMENTS, J. Cooper, Nottingham.—25th August, 1881.
3706. CHAIN BARREL, J. Lynn, Sunderland.—25th August, 1881.
3733. STARTING CARS, E. A. Brydges, Berlin.—26th August, 1881.
3748. HYDRATE OF STRONTIA, C. F. Claus, London.—27th August, 1881.
3754. COATING METALS, W. Elmore and J. J. Atkinson, London.—29th August, 1881.
3758. CUTTING-OUT FABRICS, J. Fox, London.—29th August, 1881.
3768. AUTOMATIC ELECTRIC SIGNAL, W. Morgan-Brown, London.—30th August, 1881.
3778. OPENING WINDOW-SASHES, W. Leggott, Bradford.—30th August, 1881.
3791. PREPARING VEGETABLE FIBRES, W. A. Barlow, London.—31st August, 1881.
3860. PIANOFORTES, W. H. Squire, London.—5th September, 1881.
3921. BUTTON-HOLE STITCHING, W. R. Lake, London.—9th September, 1881.
3940. REMOVING IMPURITIES from WATER, A. W. L. Reddie, London.—12th September, 1881.
3955. LAMPS, J. Whitehead, Ashton-under-Lyne.—13th September, 1881.
4328. PAPER WIRES, M. M. Whiting, Manchester.—5th October, 1881.
4908. CARPETS, J. S. and S. Smith, Glasgow.—9th November, 1881.
5048. RECOVERING RUBBER, C. A. Day, London.—17th November, 1881.
5156. ROTARY ENGINES, A. Brossard, Paris.—25th November, 1881.
5302. DRYING COFFEE-BEANS, F. Des Vœux, London.—5th December, 1881.
5342. TEMPLES FOR LOOMS, J. Hardacre, Leeds.—7th December, 1881.
5355. BELT-FASTENERS, W. H. Steil, Battersea.—7th December, 1881.
5429. GELATINE, &c., J. H. Johnson, London.—12th December, 1881.
5518. TORPEDO OPERATIONS, C. A. McEvoy, London.—16th December, 1881.

(*List of Letters Patent which passed the Great Seal on the 28th February, 1882.*)

2009. COMBING WOOL, J. F. Harrison, Bradford.—9th May, 1881.
2167. VALVES, W. Askew and A. Aird, Manchester.—18th May, 1881.
2260. METALLIC ALLOY, W. L. Wise, Westminster.—24th May, 1881.
2471. CUTTING STRAW, J. M. Gorham, New-road, Lincoln.—7th June, 1881.
3817. AIR-COMPRESSORS, A. Chapman, Liverpool.—2nd September, 1881.
3820. ENAMELLING BRICKS, F. G. Pearson, Dudley.—2nd September, 1881.
3821. ELECTRIC LAMPS, A. L. Fyfe and J. Main, London.—2nd September, 1881.
3838. RATCHET BRACES, C. Neil, Sheffield.—3rd September, 1881.
3844. SALTS OF MAGNESIA, A. M. Clark, London.—3rd September, 1881.
3859. SELF-MASSAGE, C. A. Angstrom, Stockholm.—5th September, 1881.
3865. PENTAGRAPH MACHINES, J. Hope, Manchester.—6th September, 1881.
3897. MOTIVE-POWER ENGINES, H. G. Hosmer, Chancery-lane, London.—8th September, 1881.
3913. FIRE-ARMS, M. Kaufman, Wellington-street, London.—9th September, 1881.
3934. TRANSMITTING MOTION, A. M. Clark, Chancery-lane, London.—10th September, 1881.
4043. MILK CANS, H. H. Lake, Southampton-buildings, London.—19th September, 1881.
4175. GRINDING MILL, W. P. Savage, West Winch, Lynn.—27th September, 1881.
4196. AGGLOMERATING SCRAP IRON, W. R. Lake, London.—29th September, 1881.
4198. ARMOUR-PLATES, W. R. Lake, Southampton-buildings, London.—29th September, 1881.
4274. LOWERING SHIPS' BOATS, I. A. Timmis, Westminster.—3rd October, 1881.
4394. OBTAINING BAS-RELIEFS, &c., by PHOTOGRAPHY, E. de Pass, London.—10th October, 1881.
4444. COATING METAL, H. H. Lake, Southampton-buildings, London.—12th October, 1881.
4551. WATER-CLOSETS, G. E. Waring, jun., Blackfriars, London.—18th October, 1881.
4916. BREECH-LOADING FIRE-ARMS, J. Lang, Cockspur-street, London.—9th November, 1881.
5224. WINDOW SASHES, E. V. Harris, Winchester.—29th November, 1881.
5238. PORTABLE CABINETS, R. H. Bishop and A. S. Bishop, Islington, London.—30th November, 1881.
5329. MACHINE BROIDERY, C. A. Barlow, Manchester.—6th December, 1881.
5421. TRUSS BARS, S. Alley, Glasgow.—12th December, 1881.
5424. GAS STOVES, E. A. Rippingille, Aston-juxta-Birmingham.—12th December, 1881.
5441. PUMPS and PUMPS, H. J. Haddan, Kensington, London.—13th December, 1881.
5543. BRICK-MOULDING MACHINES, C. F. Schlickeysen, Berlin.—17th December, 1881.
19. PUSHING INGOTS from their MOULDS, J. Imray, London.—3rd January, 1882.

List of Specifications published during the week ending February 25th, 1882.

3988, 4d.; 2246, 6d.; 2739, 8d.; 2781, 6d.; 2820, 4d.; 2903, 2d.; 2906, 2d.; 2923, 2d.; 2929, 2d.; 2976, 8d.; 3008, 8d.; 3010, 8d.; 3019, 6d.; 3025, 6d.; 3032, 10d.; 3040, 6d.; 3044, 4d.; 3045, 6d.; 3048, 6d.; 3057, 4d.; 3065, 6d.; 3066, 6d.; 3069, 6d.; 3074, 6d.; 3082, 2d.; 3093, 6d.; 3100, 6d.; 3102, 6d.; 3103, 2d.; 3106, 2d.; 3114, 4d.; 3116, 6d.; 3123, 8d.; 3125, 6d.; 3126, 4d.; 3130, 6d.; 3131, 6d.; 3132, 6d.; 3141, 6d.; 3143, 10d.; 3149, 6d.; 3150, 6d.; 3163, 6d.; 3170, 6d.; 3176, 4d.; 3184, 4d.; 3189, 8d.; 3201, 6d.; 3202, 2d.; 3210, 6d.; 3211, 8d.; 3216, 4d.: 3220, 2d.; 3222, 2d.; 3224, 2d.; 3226, 2d.; 3229, 2d.; 3233, 6d.; 3236, 2d.; 3239, 6d.; 3241, 2d.; 3242, 2d.; 3244, 2d.; 3245, 2d.; 3248, 2d.; 3249, 2d.; 3253, 2d.; 3257, 2d.; 3260, 2d.; 3262, 2d.; 3265, 2d.; 3266, 2d.; 3270, 2d.; 3273, 2d.; 3277, 2d.; 3281, 4d.; 3285, 2d.; 3286, 4d.; 3288, 2d.; 3289, 2d.; 3290, 2d.; 3293, 2d.; 3296, 4d.; 3297, 4d.; 3303, 4d.; 3305, 2d.; 3306, 2d.; 3308, 4d.; 3311, 4d.; 3312, 2d.; 3314, 4d.; 3493, 1s.; 3497, 6d.; 4011, 8d.; 4013, 4d.; 4532, 2d.; 5117, 6d.

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

ABSTRACTS OF SPECIFICATIONS.

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

2246. VELOCIPEDES, *G. Singer, Coventry.—23rd May, 1881.* 6d.

This relates to means of diminishing the width of tricycles, so as to enable them to pass through narrow passages, and it consists in jointing the frame so that it may be folded up when desired.

2739. IMPROVEMENTS IN THE MODE OF AND APPARATUS FOR DISTRIBUTING ELECTRICITY, APPLICABLE TO THE PRODUCTION OF THE ELECTRIC LIGHT, &c., *H. E. Newton, London.—22nd June, 1881.—(A communication from A. Gravier, Paris.)* 8d.

This invention consists in the application of derived circuits so as to distribute the electric currents to any number of apparatus, which shall all be independent of one another, and shall only absorb the exact amount of current required to work each one.

2781. OIL OR HYDROCARBON GAS SOLDERING APPARATUS, *E. A. Brydges, Berlin.—25th June, 1881.—(A communication from F. Stoll, jun., Stuttgart.)* 6d.

A reservoir for oil or hydrocarbon has attached to it a tube filled with cotton to dip into the oil, and on it is formed a handle. The upper end of the tube is connected to the soldering iron, and the reservoir is heated by any suitable means, so as to vaporise the fluid, the vapour being ignited and heating the iron.

2820. FLOOR CRAMP FOR CRAMPING FLOOR BOARDS, *H. Fabian, Erith.—28th June, 1881.* 4d.

Into a toothed sliding rack with a cramp head at one end gears a worm, the shaft of which has bearings in the plate guiding the rack, and on it is an internal ratchet wheel, with which gear one or more pawls attached to a plate running loose on the shaft. Recesses are formed in the ratchet wheel to receive a bar, and on the underside of the guide plate for the rack are one or more eccentric catches to automatically jamb the cramp and the floor joists. A bar or wrench is fitted to the pawl plate and moved to-and-fro.

2903. PERAMBULATORS, &c., *G. B. Lovedee, Birmingham.—4th July, 1881.—(Void.)* 2d.

This relates, First, to making perambulators reversible by shifting the handle and seat from one end to the other; and Secondly, to the method of connecting metallic spokes to the hub of the wheel.

2906. PIANOFORTES, &c., *J. Maas, Surrey, and J. Browne, London.—4th July, 1881.—(Provisional protection not allowed.)* 2d.

This relates to an action constructed with one or two levers, and has a sticker and hopper, producing an oscillating movement, a direct retro-action and perfect check, which is produced by the action itself, and not by the blow on the wire, and also produces a perfect repetition touch.

2923. LOCOMOTIVE ENGINES FOR TRAMWAYS, &c., *T. Morgan, Westminster.—4th July, 1881.—(A communication from D. McReid, India.)—(Void.)* 2d.

The boiler consists of a round fire-box with a series of direct heating surface vertical tubes arranged round it, passing from an auxiliary water space at the bottom of the boiler, up through the fire-box, and into the roof plate, above which is a steam and water space. The driving wheels are larger than usual, and to them the engines are coupled.

2929. ELASTIC BULB SYRINGES FOR WASHING OUT THE HUMAN STOMACH, *J. A. Grant, Ottawa, Canada.—5th July, 1881.—(Void.)* 2d.

An elastic bulb syringe is provided with a sleeve-joint connection of the tubes and bulbs, so that when a tube is inserted down the throat the bulb can be detached to allow the contents of the stomach to be thrown up through the tube, or the bulb may be used to inject fluid into the stomach and withdraw it by suction. A gag is placed on the tube to enable the patient to hold the syringe in place with his jaws.

2976. EXTRACTION OF FATTY MATTERS FROM BONES, &c., *W. P. Thompson, Liverpool.—7th July, 1881.—(A communication from F. Seltsam, Germany.)* 8d.

This consists in a so-called circular process in which the bones are kept in closed apparatus and subjected to the action of high-pressure vapour from sulphuret of carbon, benzine, ligroine, or similar substances, so that the solvent is constantly being completely recovered without leaving the apparatus, and thus there is no danger to the health or safety of the workman.

3008. DREDGING MACHINES, *W. R. Lake, London.—8th July, 1881.—(A communication from J. Menge, Point Michel, U.S.)* 8d.

A boat is provided with outwardly projecting timbers and a frame, the bottom of the former and top piece of the latter forming bearings for the vertical journals of a swinging frame carrying a horizontal shaft, connected by a double universal joint with a driving shaft. Pivotted to the sides of the swinging frame on a line with its shaft is a bucket frame, over chain wheels between the upper ends of which passes a chain of buckets of special construction. The bucket frame moves over tracks curved in opposite directions when desired to dig a canal with curved bottom.

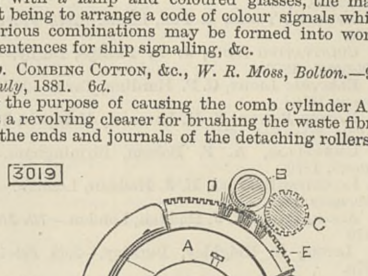
3010. SIGNALLING CODE AND APPARATUS, *H. Gardner, London.—8th July, 1881.—(A communication from E. Roe, Western Australia.)* 8d.

This relates to a system of semaphore signalling at night with a lamp and coloured glasses, the main object being to arrange a code of colour signals which in various combinations may be formed into words and sentences for ship signalling, &c.

3019. COMBING COTTON, &c., *W. R. Moss, Bolton.—9th July, 1881.* 6d.

For the purpose of causing the comb cylinder A to act as a revolving clearer for brushing the waste fibres from the ends and journals of the detaching rollers B

3019



and C, a brush or brushes D are fixed on any convenient part of the comb cylinder. For example, in each end of the fluted segment E of the cylinder a series of holes are drilled, into which a number of tufts of bristles or brushes are inserted, and which are secured in their places by cementing, screwing, or otherwise, thus forming a revolving clearer which brushes or clears the waste fibres of cotton from the ends of the detaching rollers at each revolution of the cylinder.

3025. ROASTING TOBACCO, &c., *C. H. Andrew, Stockport.—9th July, 1881.* 6d.

The tobacco is placed in a rotating cylinder partly surrounded with a casing lined with asbestos, and is heated by means of a gas-burner beneath it.

3032. IMPROVEMENTS IN REGULATING ELECTRIC CURRENTS AND IN THE APPARATUS OR MEANS EMPLOYED THEREIN, *Sir W. Thomson, Glasgow.—9th July, 1881.* 10d.

This invention consists in an automatic appliance for regulating by means of electro-magnetic force the work of an electric accumulator or voltaic battery by increasing or diminishing the number of working cells. One species of this appliance gives a constant strength of current, another a constant electromotive force.

3040. PURIFYING WATER, *J. H. Porter, Blackfriars.—11th July, 1881.* 6d.

This relates to means for automatically regulating the supply of solution of lime or other reagent employed in carrying out the softening or purification of water.

3043. BICYCLES, &c., *G. J. T. Barrett, London.—12th July, 1881.—(Void.)* 2d.

This relates, First, to attaching the saddles to the springs by hinges or ball-and-socket joints, so as to allow of a slight side movement; Secondly, to the use of a sun-and-planet motion, the sun wheel being fixed to driving wheel, and the planet wheel to the treadle axle; Thirdly, to an attachment on each side of the fork carrying a wheel driven by chain from the driving wheel; Fourthly, to the construction of tricycles with bent axles; Fifthly, to a tricycle with a single front wheel, the backbone carrying two small wheels revolving independently of each other; and Sixthly, to a method of converting bicycles into tricycles.

3044. PRINTING ON ENVELOPES, *W. McKenzie, Dublin.—12th July, 1881.—(A communication from S. A. Grant, U.S.)* 4d.

The envelopes are laid side by side in a sloping trough, down which they slide. In front of the lower end of the trough a travelling band consisting of two parallel straps with transverse wires is made to move intermittently, and at each movement one of the wires catches under the flap of the envelope and carries it along an upwardly inclined printing table, where during the pause in the movement of the band it receives its impression, and is then carried forward and discharged into a sloping trough.

3045. SHUTTLES OF LOOMS, *J. Broadhead, Huddersfield.—12th July, 1881.* 6d.

The shuttle consists of a cast iron shell with a rib within which the weft and cop rests, the side of the shell being open and covered with a plate which may be renewed when worn. The runners are constructed of outer flanges inclosing a roller of compressed paper or cotton, and they are connected to a blade spring, so as to prevent damage by shock and obstructions. To admit the use of weft direct from the cop without employing a skewer, the cop is enclosed in a box in the shuttle and over it closes a spring or other guard and holding finger, which permit the weft to run out while holding the cop in its box.

3057. BOOTS AND SHOES, *C. Lion, Spitalfields.—12th July, 1881.* 4d.

The object is to facilitate the fastening of button boots, and it consists in introducing an elastic strip in one or other side of opening, which will give sufficiently to bring the holes well over the buttons, and allow them to pass over same without using a button hook.

3065. PROPELLING SHIPS, *E. A. Brydges, Berlin.—12th July, 1881.—(A communication from J. B. Merkl, Berlin.)* 6d.

This consists in the use of a number of oars or paddles with suitable flaps which open as the oars are moved forward, but press with their entire surface against the water when moved in the opposite direction.

3066. MULES FOR SPINNING AND DOUBLING COTTON, &c., *H. Robinson, Bolton.—13th July, 1881.* 6d.

This consists in arrangements to enable the bottom of the cops to be formed with a short "chase" without increasing the liability to underwind. To the copping rail a supplementary rail is attached, and can be raised or lowered to the level of the upper surface of the copping rail. To the copping plates which carry the copping rail is attached a nut, through which passes a screw, and by which the supplementary rail is raised above level of the copping rail, thereby causing it to act upon the bowl connected to the faller, and so shortening the "chase" of the cop to any desired extent.

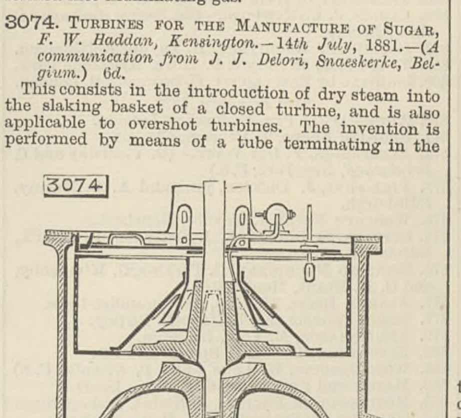
3069. MANUFACTURE OF ILLUMINATING GAS, *W. R. Lake, London.—13th July, 1881.—(A communication from A. Wittamer, Antwerp, Belgium.)* 6d.

This relates to apparatus for transforming properly prepared atmospheric air into illuminating gas by means of liquid volatile hydro-carburets or hydro-carbons. Three superposed cylinders are used, the central one connected with the lower one by a series of tubes. Air is forced into the upper chamber by a caloric pump and passes into a copper tube surrounding the central cylinder, and then through the small tubes into the bottom of the lower cylinder, where it passes in fine jets through the hydrocarbons, and finally enters the top of the central cylinder transformed into illuminating gas.

3074. TURBINES FOR THE MANUFACTURE OF SUGAR, *F. W. Haddan, Kensington.—14th July, 1881.—(A communication from J. J. Delori, Snaeskerke, Belgium.)* 6d.

This consists in the introduction of dry steam into the slaking basket of a closed turbine, and is also applicable to overshot turbines. The invention is performed by means of a tube terminating in the

3074



upper annular space of a cone, into which the steam is led, and wherefrom it passes into a second superposed cone, which is provided with orifices or openings, through which the steam passes into the slaking basket completely dry.

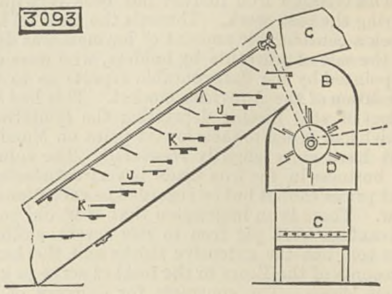
3082. FOOD FOR HORSES AND CATTLE, *J. Long, Reading.—14th July, 1881.—(Void.)* 2d.

This consists of maize, pollard, beans, oatmeal, wheat, peas, rice cone, linseed cake, fenugreek, carraways, and allspice reduced to powder, and mixed with treacle and water so as to form a paste, which is then baked.

3093. DRYING MACHINERY, *W. A. and D. H. Gibbs, Chingford.—15th July, 1881.* 6d.

An inclined trough A communicates at top with a chamber B, in which is mounted a fan D. The material to be dried is fed in at C and passes over the tines J, below which are louvres K, to both of which a vibrating motion is imparted, so as to cause the hay or other material to pass towards the bottom of the trough. Below the fan is a furnace G, to which air is admitted, and becoming heated is propelled by the

3093



fan into the trough A through the louvres, and acts on the material to be dried.

3100. UTILISATION OF CARBONIC ACID AND OTHER GAS FOR OBTAINING MOTIVE POWER, &c., *W. R. Lake, London.—15th July, 1881.—(A communication from E. W. Kellogg, Hartford, U.S.)* 6d.

This relates to improvements in the utilisation of carbonic acid and other gas for obtaining motive power, and in the apparatus therefor, and is specially applicable to the propulsion of torpedo boats. One feature consists in producing a reservoir containing a liquid produced by subjecting the gas to pressure, and another vessel connected therewith, and intermediate space between the reservoir and engine, this vessel being of suitable form and size to permit within it the expansion of the liquid into gaseous form, and connecting with the reservoir below the level of the liquid therein, so that the expansion takes place in the vessel and not in the reservoir, thus avoiding the excessive refrigeration within the reservoir incident to such expansion. Another feature consists in making the second vessel in the form of a coil of pipe, and heating it to avoid refrigeration; and a third feature consists in placing the expansion chamber upon the exterior of a torpedo boat, so as to be in contact with the water and thus prevent refrigeration therein.

3102. INTERNAL STOPPERS FOR BOTTLES, &c., *A. T. King, Nottingham.—16th July, 1881.* 6d.

One form of stopper consists of a central plunger of wood, ivory, or china, with a disc or button at each end, between which is an india-rubber washer.

3103. STEAMSHIPS, &c., *R. F. Fairlie, Westminster.—16th July, 1881.—(Void.)* 2d.

This consists in mounting the deck of the vessel loosely on the top of the hull, so that should the vessel sink, the deck would float to the surface and be available as a raft.

3106. HORSESHOES, &c., *T. G. Farmer, Yorkshire.—16th July, 1881.—(Not proceeded with.)* 2d.

This consists in fitting renewable toe-and-heel calks to slide into a groove in the shoe.

3114. ROOFS FOR HOUSES, *W. R. Lake, London.—16th July, 1881.—(A communication from J. Schieder and C. Polzer, Vienna.)* 4d.

A lattice or trelliswork of wire or strips of metal or wood is stretched over and fastened to the rafters and then coated with cement or hydraulic lime.

3116. APPLIANCE FOR RAISING, &c., BLINDS, *G. Furness and J. Robertshaw, Manchester.—18th July, 1881.* 6d.

The roller has a stud at each end, and is supported in brackets, the one on the right having a slot, a guide eye, for a cord to pass through from the pulley, and a stud to arrest the motion of the blind. The pulley is formed with a ratchet, the teeth of which come in contact with the stud when the cord is released and stop the blind in the desired position.

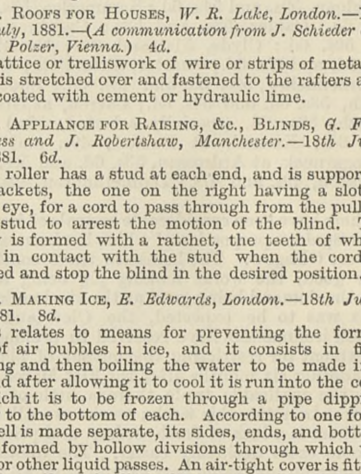
3123. MAKING ICE, *E. Edwards, London.—18th July, 1881.* 8d.

This relates to means for preventing the formation of air bubbles in ice, and it consists in first filtering and then boiling the water to be made into ice, and after allowing it to cool it is run into the cells in which it is to be frozen through a pipe dipping nearly to the bottom of each. According to one form each cell is made separate, its sides, ends, and bottom being formed by hollow divisions through which the brine or other liquid passes. An air-tight cover is fitted over the cell, and all air liberated and withdrawn during freezing by means of an air pump.

3125. MACHINERY FOR DRILLING THE SHELLS OF BOILERS, *W. Allen, Sunderland.—18th July, 1881.* 6d.

This relates to improvements on patent No. 297, A.D. 1875, and consists of improved machinery for drilling the shells of boilers, in which the axes of

3125



the standards B, which are movable around the circular bed A, are driven by cords H around a central pulley E.

3126. BOILER TUBES, *F. H. F. Engel, Hamburg.—18th July, 1881.—(A communication from J. Empson, Steinwärder, Germany.)* 4d.

The boiler tubes are formed with a thread-like or spirally corrugated surface, so as to present increased heating surfaces.

3130. EVAPORATING APPARATUS, *W. R. Lake, London. 18th July, 1881.—(A communication from J. A. Morrell, New York, U.S.)* 6d.

This relates to apparatus to treat juices extracted from sugar-cane and similar substances, so as to reduce them to a semi-liquid or solid form. The juice passes in a continuous stream through a coil of pipe heated by a furnace or other suitable means. The coil of pipe may, if necessary, gradually increase in diameter from the point where the juice enters to the point where it leaves the coil.

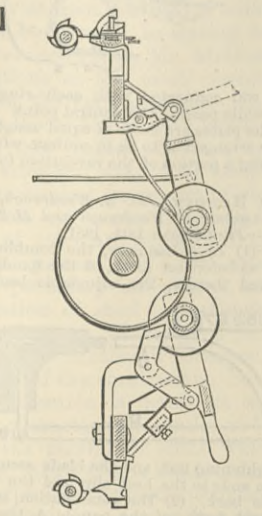
3131. HORSESHOES, &c., *W. R. Lake, London.—18th July, 1881.—(A communication from J. A. Burden, Troy, U.S.)* 6d.

A large wheel carries the lower dies, and is driven and held in its stopped position by a double ratchet wheel secured to it. The main shaft carries two excentrics which actuate the pawls gearing with the double ratchet wheel. The invention also relates to means for thickening the heels of the shoes after they are bent, swaged, creased, and punched.

3132. DOUBLING, WINDING, AND TWISTING FIBROUS MATERIALS, *J. and J. Horrocks, Manchester.—19th July*, 1881. 6d.

This consists in improved combinations and arrangements of machinery described in patent No. 4278, dated 22nd October, 1879, the principal feature of which consists in so arranging the bobbin that when a thread breaks it does not require to be lifted out of contact with the periphery of the driving drum, but is brought out of contact therewith by allowing it to roll or come away from the periphery of the driving drum by its own gravity, or its gravity in addition to

3132



that of the frame in which it is carried, and the weight suspended upon it. By this arrangement a weight to lift the weight of the frame and bobbin when a thread breaks is dispensed with, and thus, for doubling and winding coarse counts, additional weight may be conveniently used for pressing the bobbin upon which the threads are being wound more firmly against the driving drum, which is an advantage with that class of threads. The drawing is a sectional elevation illustrating two modes of carrying out this part of the invention. Other improvements are described.

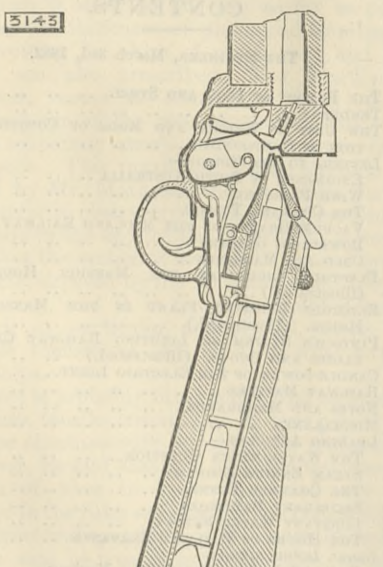
3141. TOOTH BRUSHES, *G. Gillies, London.—19th July*, 1881. 6d.

A recess is formed in the back of the brush, and holes are drilled through the back to receive the bristles, a small looking-glass being then secured in the recess, the object being to enable the user to examine his mouth, teeth, and gums.

3143. BREECH-LOADING MAGAZINE SMALL-ARMS, *J. Edge, jun., Yardley, and J. Deeley, Birmingham.—19th July*, 1881. 10d.

The store of cartridges is contained in a tube extending from the breech chamber of the gun throughout the length of the stock, the cartridges being urged forward by a spring. The raising and

3143



lowering of the sliding block which opens and closes the breech end of the barrel, the working of the extractor, and the liberation from the magazine of the cartridges one at a time are effected by the motion of a hand lever on the side of the body of the gun. The raising of this hand lever effects the lifting of the sliding block, and the lowering of the said lever effects the depression of the sliding block, the ejection of the spent cartridge case, and the liberation of another cartridge from the magazine. The said hand lever is fitted on an axis which passes across the body of the gun. The distant end of this axis carries an arm of a lever, the curved end of the long arm of which engages in a slot or opening in the bottom of the sliding block.

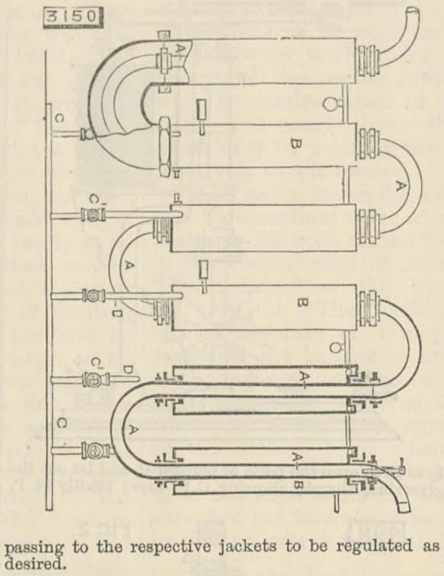
3149. MALT EXTRACT, *H. R. Randall, Brooklyn, U.S.—19th July*, 1881. 6d.

This invention relates to a process of manufacturing malt-extract from raw grain or starch bearing material for brewers' use, and consists in reducing the grain to a ground condition, then eliminating the starch therefrom at a comparatively high temperature, and subjecting it to the action of malt at a lower temperature for converting it into dextrine and glucose, or a malt extract, so that the starch being by the first step completely eliminated from the refuse is exposed to the full action of the malt, thereby ensuring the complete conversion of the starch into malt extract, and in expressing the extract or liquid from the refuse through the agency of a reticulated or foraminous apron and elastic rollers, between which the apron passes and carries the mass from which the extract is to be separated.

3150. EVAPORATING AND DRYING APPARATUS, *W. R. Lake, London.—19th July, 1881.—(A communication from C. G. Till, Brooklyn, U.S.)* 6d.

This relates to apparatus for reducing liquids to a semi-liquid state or jelly, and it consists in providing means for subjecting the liquid to different degrees of heat at certain stages. A is the pipe through which the liquid passes, and which is of a circuitous form, the upright parts each having steam jackets B. The steam pipe C leads from a boiler, and branches D connect it with the steam jackets, cocks C^1 being fitted to each branch to enable the amount of steam

3150



passing to the respective jackets to be regulated as desired.

3163. EVAPORATING VACUUM APPARATUS, *F. H. F. Engel, Hamburg.—20th July, 1881.—(A communication from Niederberger and Co., Hamburg.)* 6d.

This relates to apparatus for evaporating liquids and condensing extracts or solutions to a thick and pastelike consistency. It consists of a stationary cylindrical vessel, into which the evaporating liquid is introduced. Through the vessel passes a rotating iron tube, placed below the centre of the outer vessel, and containing a number of copper boiler tubes, through which steam is caused to circulate. A vacuum is maintained within the stationary vessel.

3170. COOLING, CLEANSING, AND PURIFYING AIR, *R. R. Gibbs, Liverpool.—21st July*, 1881. 6d.

Strips of glass, wood, or other material are placed in a frame so as to form a series of horizontal V or U troughs extending from side to side, and made watertight. Water is admitted to the top trough and overflows from one to the other to the bottom, the air to be purified and cooled passing through the frame and coming in contact with the falling water.

3172. SOUNDING MACHINES, PRESSURE GAUGES, &c., *T. Bassnett, Liverpool.—21st July, 1881.—(Not proceeded with.)* 2d.

This consists of a tube cut in two diagonally from near the side at one end to an inch from the other end, then draught across the wide part, the cut in its diagonal direction not being straight but in a long curve somewhat resembling an "ogee," in such manner that if the half tube is closed at its cut side and ends and water be forced over and into one end against the pressure of the containing air, the water will rise and compress the air in equal or nearly increments of height for equal increments of pressure.

3174. FENCE WIRE, *A. C. Henderson, London.—21st July, 1881.—(A communication from Messrs. Witte and Kämper, Osnabrück, Germany.)—(Not proceeded with.)* 2d.

Whilst twisting the strands of wire, pieces of metal with pointed ends are inserted at regular intervals between them, so as to form spikes or barbs.

3176. CARPETS, *E. Crossley, G. Marchetti, R. Cochrane, and W. Mallinson, Halifax.—21st July*, 1881. 4d.

This relates to the manufacture of jacquard loom carpets by the introduction of printed worsted, jute, cotton, or other yarn for warps or wefts along with dyed, grey, or plain yarn.

3177. IMPROVEMENTS IN THE INSULATED COATINGS AND COVERS, &c., FOR WIRES AND CABLES FOR TELEGRAPHIC PURPOSES, &c., *T. J. Mayall, Reading, Mass.—21st July, 1881.—(Not proceeded with.)* 4d.

The inventor employs a compound of india-rubber and graphite. This is rendered plastic, cut into strips, and the wires enclosed in it, an external covering being afterwards wound round. The invention also refers to machinery for winding the compound round the wires.

3183. DECORATION OF PAPER HANGINGS, &c., *W. and W. Cunnington, Chelsea.—21st July*, 1881. 2d.

A surface to be decorated is either covered or has any desired pattern printed on it with size, and a mixture of powdered mica with brocade; bronze powder and powdered gold leaf is then shaken, beaten, flocked, or blown on.

3184. APPARATUS FOR TANNING, *W. H. Cox, Bermondsey.—21st July*, 1881. 4d.

The hides, after being prepared by liming and washed clean, are placed in a long pit in several piles, with movable divisions between them, but through which there may be a free flow of liquor. Each pile stands on a skeleton platform capable of being raised or lowered, and the hides are successively moved from one division of the trough to the next.

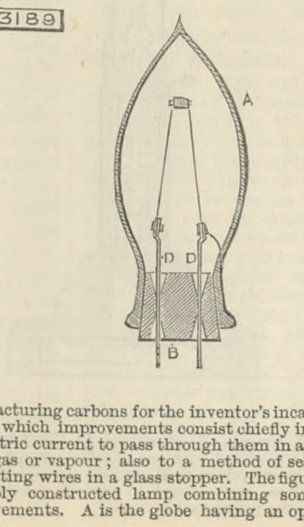
3185. SOLITAIRES OR STUDS, &c., *L. A. W. Lund, London.—21st July, 1881.—(Not proceeded with.)* 2d.

This relates to solitaires in two parts, and consists in forming the shanks flat so as not to turn in the buttonhole, and forming a flange between which and a projection on the shank the material is held so as not to allow the shank to fall out when the head of the solitaire is removed. The head and shank are secured together by a spring fastening.

3189. IMPROVEMENTS IN AND RELATING TO ELECTRIC LAMPS, &c., *W. R. Lake, London.—21st July, 1881.—(A communication from H. S. Maxim, Brooklyn, New York.* 8d.

This relates to improvements in the method of

3189



manufacturing carbons for the inventor's incandescent lamps, which improvements consist chiefly in causing an electric current to pass through them in a carbonaceous gas or vapour; also to a method of sealing the conducting wires in a glass stopper. The figure shows a simply constructed lamp combining some of the improvements. A is the globe having an open neck, into which is fitted stopper B, containing conductors D D. The stopper is cast in a mould so as to form the indentations shown; the small holes for conductors are then drilled. The conductors, which have a slight taper, are then drawn through, and the spaces round filled with gum copal powder. The whole is then heated, and the wires drawn through until they quite fit the holes. Other improved forms of lamps are illustrated and described in the specification.

3197. GALLERY FOR GLOBES AND OTHER LAMP GLASSES, *J. W. Cade and T. W. Duffy, Liverpool.—22nd July, 1881.—(Not proceeded with.)* 2d.

The object is to prevent the pressure of the gallery on the globe when the latter expands by heat, from cracking it, and it consists in substituting a spring clip to one of the arms of the gallery in place of the usual holding screw.

3198. FASTENER FOR CORDS AND ROPES, *J. W. Cade and T. W. Duffey, Liverpool.—22nd July, 1881.—(Not proceeded with.)* 2d.

The fastener consists of a plate carrying a pin or stop and a serrated quadrant hinged to the plate, and so arranged as to join or hold the blind cord between its serrated face and the pin or stop on the plate.

3201. PRINTING CHARACTERS AND COMPOSING DEVICES THEREFOR, *W. P. Thompson, Liverpool.—22nd July, 1881.—(A communication from A. H. Rogers, Springfield, Mass.)* 6d.

This relates, First, to the formation of the characters; Secondly, to an elastic composing tube; Thirdly, to a rigid composing bar having sides of differential areas; Fourthly, to printing characters adapted by their form to be set side by side to form parallel lines; Fifthly, to a self-inking hand stamp; Sixthly, to an oscillating platen dating stamp therein; Seventhly, to spring clamps fixed on the platen; Eighthly, to a combined hand and dating stamp; Ninthly, to solid composing rods on which the characters are held in the last-named stamp and in the self-sinking hand stamp; Tenthly, to a hand stamp having dating characters therein; Eleventhly, to a curved composing rod; and Twelfthly, to a character stamp which may be used with special characters not perforated to receive the elastic tube, composing bar, or rod.

3202. STANDARD WEIGHTS, *W. Parnall, Bristol.—22nd July, 1881.—(Provisional protection not allowed.)* 2d.

This consists in nickel-plating cast iron weights so as to prevent rusting and loss of weight.

3205. WRITING INSTRUMENTS, *J. Kuttner, Dalston.—22nd July, 1881.—(Not proceeded with.)* 2d.

This relates to stylographic fountain pens, and consists, First, in the application of a needle wire which extends throughout the instrument and is of uniform thickness, and serves as vibrating by its own inherent elasticity without the forming of such wire into a spring, or as non-vibrating according to the will of the writer; and, Secondly, in the application of a regulating plug in which the needle wire is permanently secured, and which serves to regulate simultaneously the tension of the needle wire and the air supply.

3210. LIGHTING LAMPS AND MATCHES, *W. H. Stokes, Birmingham.—22nd July*, 1881. 6d.

This relates to means for igniting the match by which the lamp is to be lighted, and it consists in placing the match in a holder and forcing it through a tube, the further end of which is split so as to bear with a certain pressure on the end of the match and ignite it as it is forced out. The match-holder may be inserted in a tube formed in the lamp over the wick.

3211. AN IMPROVED PROCESS FOR OBTAINING ZINC FROM ITS ORE AND FROM OTHER MATERIALS, *H. H. Lake, London.—22nd July, 1881.—(A communication from L. Létrange, Paris.)* 8d.

This consists in the application of dynamo-electric or magneto-electric currents to the decomposition of the zinc ore. In the case of *blende*, the ore is roasted at a moderate temperature so as to decompose the sulphates without allowing the sulphur to escape more than is absolutely necessary; the sulphate of zinc thus produced is then dissolved in water and subjected to the action of the electric current, which precipitates the zinc in a metallic state and renders the acid derived from the decomposed salts available for use. When calamine or oxides of zinc are to be treated a sufficient quantity of *blende* is introduced to furnish the sulphuric acid required to form a permanent bath of sulphate of zinc.

3216. SUGAR, &c., *W. E. Halse, Mincing-lane.—23rd July, 1881.—(A communication from U. Esmarch and E. Passburg, St. Petersburgh.)—(Not proceeded with.)* 4d.

This relates to the drying of refined sugar, and consists in the employment, either alternately or combined, of an elevated temperature and a vacuum upon refined sugar contained in a peculiar arrangement of apparatus, whereby the water contained in the syrup with which the refined sugar is contaminated is more economically and advantageously removed.

3220. LOOMS, *C. T. Bradbury and R. H. Harrison, Chester.—23rd July, 1881.—(Not proceeded with.)* 2d.

This relates to the letting-off motion, and consists in arrangements to enable an uniform and regular quantity of warp to be given off from the warp roller for weaving. Two core pulleys are employed, one connected to the "sand roller" which "takes up" the piece, and the other to the yarn beam or warp roller. A band passes over these pulleys and is gradually shifted along them as the diameter of the warp beam decreases.

3222. DRYING FABRICS AT TENSION, *R. F. and W. H. Carey, and W. Partington, Nottingham.—23rd July, 1881.—(Not proceeded with.)* 2d.

The object is to simplify and expedite the operation of drying fabrics which have undergone a wet process, and it consists in enclosing the upper portion of endless chains which carry the fabric within an expanding horizontal flat tube which is intended to receive currents of hot air, and is capable of expanding and contracting laterally as the chains are adjusted to hold the fabric stretched from selvage to selvage.

3224. IMPROVEMENTS IN GALVANIC BATTERIES, &c., *J. Higgin and A. J. Higgin, Manchester.—23rd July, 1881.—(Not proceeded with.)* 2d.

This consists in the use of tin and carbon for the elements in a solution of dilute sulphuric acid.

3226. WEAVING GAUZE, LENO, &c., *R. Ecroyd, Burnley.—23rd July, 1881.—(Not proceeded with.)* 2d.

The object is to dispense with doup healds in weaving leno, gauze, and such-like fabrics, and it consists in forming a metallic reed arranged so as to act as a heald in each space between the dents, or in as many spaces as are required to form the pattern of the piece a metal bar with an eye at top is secured, and through the eye the warp threads to form the loop or crossing pass, the remainder of the warp threads being free between the metallic partitions. A vertical reciprocating motion is given to the reed, and when a crossing of the warp threads is required the reed is moved to the right or left.

3229. RAILWAY BRAKE APPARATUS, *T. T. Ramsden, Smileworth, Yorkshire.—23rd July, 1881.—(Not proceeded with.)* 2d.

A cistern on the engine is stored with a fluid, and a pipe leads from it to all or any portion of the train under brake, a branch pipe being joined to the main pipe opposite each wheel of each carriage. The branch pipe may be of smaller diameter than the main pipe, and it conducts the pressure from the main pipe into the brake shoe provided for each wheel.

3233. SPINNING MACHINERY, &c., *T. Coulthard, Preston.—23rd July*, 1881. 6d.

This relates to an improved construction of adjustable ring holder for double flanged rings employed in ring and traveller frames, and is designed to obviate the necessity of springing or bending the holder to allow of the lower flange of a double ring being introduced within the jaws of the holder, and it consists of a flat annular ring of sheet metal whose central opening can pass easily over the ring.

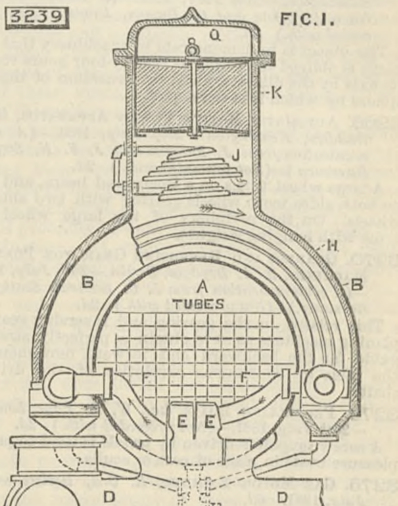
3236. SHARPENING THE TEETH OF CARD RIBBON, *A. C. Henderson, Holborn.—25th July, 1881.—(A communication from A. Rousseau and Sons, Reims, France.)—(Not proceeded with.)* 2d.

The card ribbon winds on to a drum round which three grindstones are mounted, and act upon the teeth so as to give them a sloping edge.

3239. FEED-WATER HEATERS, *J. H. Johnson, London.—25th July, 1881.—(A communication from G. S. Strong, Pennsylvania, U.S.)* 6d.

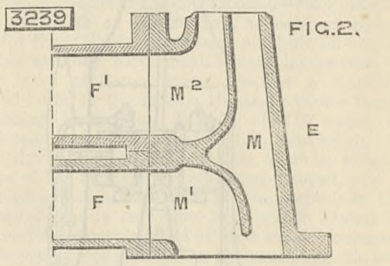
This relates to feed-water heaters especially adapted to locomotive boilers. A is part of the barrel of the boiler, and B the heater, which is saddle-shaped and is supported by brackets free from contact with the shell of the boiler. D are the exhaust pipes from the

3239 FIG. I.



two cylinders, and E two exhaust nozzles, one of ordinary construction to allow a direct passage of steam through it, while the other is formed as shown in section at Fig. 2, that is with three chambers, through one of which M steam passes direct into the smoke-box, while a portion of the steam also passes by chamber M^1 into pipe F, and back through pipe F^1, into chamber M^2, from which it also passes into the

3239 FIG. 2.



smoke-box. The pipe F leads to the heater B and passes the steam through a series of pipes H—round which the water circulates—and then enters pipe F on the opposite side of heater B. Off top of the heater is a chamber containing a coil J, heated by live steam, and above it is a filtering medium K, so that the feed-water must be first superheated by the coil, and then pass through the filter before escaping at O.

3241. ARMY TRENCHING TOOLS, *A. H. Storey, Surrey.—25th July, 1881.—(Not proceeded with.)* 2d.

This relates to a combined pick and shovel or spade.

3242. PRINTING PLACARDS, *W. Brierley, Halifax.—25th July, 1881.—(A communication from P. Dhonan, Dresden.)—(Not proceeded with.)* 2d.

This relates to the printing of placards by means of sheet copper stencils and an elastic inked roller.

3244. CORDS, &c., *W. Dean and A. Orrah, Huddersfield.—25th July, 1881.—(Not proceeded with.)* 2d.

The piece is woven with plain cotton back, the cotton being undyed, and after scouring it is passed over a roller immersed in a dye of the colour of the pile or face of the fabric, thereby ensuring uniformity of colour of the back and of the pile.

3245. MONOCYCLE, *T. Brown, London.—25th July, 1881.—(Not proceeded with.)* 2d.

The one wheel is balanced by two riders, one sitting on either side thereof, and their seats being capable of sliding to compensate for any difference of weight.

3248. CAPS AND HATS, *S. R. Prager, Spitalfields.—25th July, 1881.—(Not proceeded with.)* 2d.

This relates to the manufacture of hats and caps of cloth, fur, silk, oilskin, or other pliable material, so that the crown and sides may be changed or shifted from one material to another at pleasure.

3249. BELLS AND GONGS, *R. C. Lindop, Liverpool.—25th July, 1881.—(Not proceeded with.)* 2d.

This relates to means for giving any desired number of strokes of the hammer by one movement, and it consists of a serrated or V-grooved bar and a pallet connected to the inner end of the hammer rod. The serrated or grooved rod can be moved in and out, and when so moved causes the pallet to rise and fall over the projections and into the hollows one at a time.

3250. STEAM COOKING APPARATUS FOR MILITARY PURPOSES, &c., *D. Grove, Berlin.—25th July*, 1881. 6d.

The cooking apparatus consists of two large and two small boilers with inclined bottoms, the large ones to contain the soldiers' food, and the small the officers' food. These boilers are steam jacketted, and are mounted on a frame running on wheels and provided with a suitable furnace and chimney to supply the necessary heat.

3253. BLUE AND VIOLET COLOURS, *Dr. W. Majert, Heidelberg.—26th July, 1881.—(Not proceeded with.)* 2d.

This consists in the production of colours by oxidation in an alkaline, neutral or weak acid solution of a mixture of mono or bihydroxylised substances derived from aromatic carburets of hydrogen or from their substitutes, and of the sulphonic acids of aromatic diamines derived from the primary, secondary, and tertiary aromatic amines.

3257. TREATING OR FINISHING GAUZE, BOBBIN-NET, TULLE, &c., *C. D. Abel, London.—26th July, 1881.—(A communication from G. H. Gruner, Dresden.—(Not proceeded with.)* 2d.

This relates to treating or finishing gauze-like textile fabrics by subjecting them in a stretched condition, and while coated with starch powder, First, to the action of steam inside a closed retort or chamber, then to the action of cold water, and lastly, to the action of steam again.

3260. GASELIERS, &c., *C. D. Abel, London.—26th July, 1881.—(A communication from Messrs. Keyling and Thomas, Berlin.)* 2d.

This relates to the substitution for the usual balance weights of sliding gaseliers and pendant lamps, of a spring drum on to which the chains of the lamps are wound.

3262. MORDANTING TEXTILE FABRICS FOR DYEING AND PRINTING, *J. Knowles, F.C.S., Manchester.—26th July, 1881.* 2d.

This relates to the mordanting of fabrics previous to dyeing with alizarine, madder, logwood, or other dyeing material, and consists in substituting for the acetates of iron and alumina usually employed, a solution of the double salt known as ferrous ammonium sulphate of a suitable strength, by using which the fabrics are in a fit state to be completely dried, and are ready for dyeing without the intermediate process of ageing.

3265. ASTRONOMICAL APPARATUS, *H. J. Haddan, Kensington.—26th July, 1881.—(A communication from J. Blanc and C. Dumas, Lyons.—(Not proceeded with.)* 2d.

The object is to demonstrate by machinery that the earth is obliged to revolve in twenty-four hours round its axis by the dilatation and condensation of the air sphere by which it is enveloped.

3266. AUTOMATIC MOTIVE POWER APPARATUS, *H. J. Haddan, Kensington.—26th July, 1881.—(A communication from J. Rahtjen and J. F. N. Steffen, Hamburg.)—(Not proceeded with.)* 2d.

A large wheel turns on a horizontal beam, and has on both sides tooth wheels gearing with two smaller wheels. On the periphery of the large wheel are arms with hanging weights.

3270. GEARING AND REVERSING GEAR FOR PLANING MACHINES, *E. A. Brydges, Berlin.—26th July, 1881.—(A communication from J. C. Eckardt, Stuttgart, Germany.)—(Not proceeded with.)* 2d.

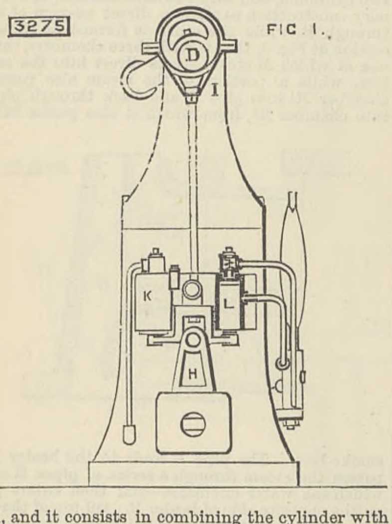
This relates to the gearing and reversing gear for planing machines so as to obtain a perfectly straight guide for the backward and forward movement of the table by continuous revolution of the driving shaft.

3273. PROPELLING BOATS, &c., *W. A. Pope, London.—26th July, 1881.—(Not proceeded with.)* 2d.

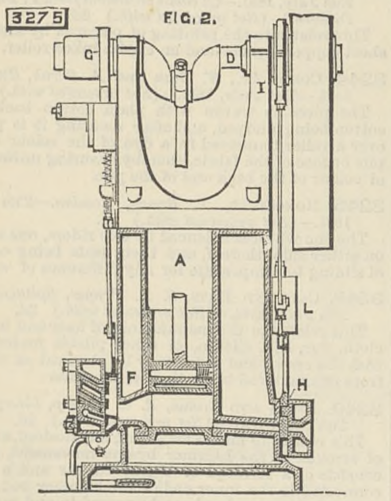
A screw propeller driven by pedals is used to propel pleasure boats in place of oars or sculls.

3275. GAS MOTOR ENGINES, *R. Ord, Devizes.—26th. July, 1881.* 6d.

This relates to gas engines with a piston working in a cylinder in which the explosion of gas and air is effected, causing the piston to drive a crank shaft, and its object is to increase the certainty of firing the charge, and thus enable the engine to run at a greater



speed, and it consists in combining the cylinder with a pump to force gas into the lighting chamber, and air into a contiguous chamber, whereby a certainty of ignition of the charge is obtained. A is the cylinder the admission of gas and air to which and to the lighting chamber, and the ignition of the lighting charge, and the firing of the main charge is controlled by slide valve F, which is forced downward by a snail cam G on the crank shaft, a spring effecting the



return. The spent gases are discharged by valve H operated by excentric I, which also works the air pump K and gas pump L, the latter supplying gas to a lighting chamber in the slide valve F, while the air pump supplies a current of air which acts upon the protruding flame from a fixed light in a cone, in such a manner that the light and air are blown into the lighting chamber.

3277. LOOMS, *J. L. Byrom, Yorks.—26th July, 1881.—(Not proceeded with.)* 2d.

This consists in arrangements for weaving in power looms pieces containing swivels or picks of weft extending across a portion only of the breadth of the fabric, thereby avoiding the waste of weft which now takes place by the weft having to be floated over the middle portion of the piece.

3281. PURIFYING OILS, *W. A. Barlow, London.—26th July, 1881.—(A communication from J. H. Chaudet, Paris.)* 4d.

This relates to purifying oils by the reducing agency of sulphurous acid, alkaline bisulphites, and alkaline hydro-sulphites.

3285. PAINTS FOR COATING SHIPS' BOTTOMS, &c., *A. B. Rodyk, London.—27th July, 1881.—(A communication from N. B. Dennys, Singapore.)—(Not proceeded with.)* 2d.

Zinc is suspended in a semi-saturated solution of crystals of sulphate of copper in the proportion of 1 cwt. of zinc to 1½ cwt. of sulphate of copper. The resulting deposit is collected and dried, pulverised, sifted, and ground to a fine powder, to which the juice of the tree known as "elæococcus vernicia" is added in sufficient quantity to form a paint.

3286. DEODORISING AND DISINFECTING AGENT, *R. E. Goolden and A. Mackay, Southwark.—27th July, 1881.* 4d.

This relates to the use in various forms and combinations of gum kauri as a disinfectant and deodoriser.

3288. RIVETTING BY WATER, AIR, STEAM, OR OTHER POWER, *F. A. Paget, London.—27th July, 1881.—(A communication from J. Haswell, Vienna.)—(Not proceeded with.)* 2d.

This relates to apparatus whereby, when a simple pin is inserted in a hole in the two parts to be joined, a rivet head is simultaneously formed on both ends of such pin.

3289. BICYCLES, *W. H. Hyde, Sheffield.—27th July, 1881.—(Not proceeded with.)* 2d.

The object is to reduce the friction of the working parts, and consists in introducing a set of antifriction balls between the head of the backbone and the head of the front fork, and another set between the head of the backbone and the socket of the steering handle.

3290. ATTACHMENT OF BUTTONS TO BOOTS, &c., *L. A. W. Lund, London.—27th July, 1881.—(Not proceeded with.)* 2d.

This relates to a staple which is passed through the shank of the button, and then through a hole in the material, and also through a metal plate, and the ends turned up so as to enter slots in such plate.

3293. IGNITING GAS, *A. J. Hallam and J. Walsh, Lancaster.—27th July, 1881.—(Not proceeded with.)* 2d.

This relates to the ignition of gas jets by means of an electric current.

3296. CONNECTORS OR FASTENINGS FOR STRAPS, BANDS, OR CORDS, *E. P. Alexander, London.—28th July, 1881.—(A communication from A. J. Violette, Paris.)* 4d.

The ends of the strap or band are secured between plates through which pass screws.

3297. UTILISING PEAT FIBRES FOR THE MANUFACTURE OF PAPER, &c., *H. Armstrong, Darlington, and J. A. London, London.—28th July, 1881.* 4d.

The peat is washed and treated with a hot solution of caustic alkali, and after being again washed is added to the ordinary materials used in making paper.

3303. ARTIFICIAL STONE AND MARBLE AND COLOURING THE SAME, *J. H. Johnson, London.—28th July, 1881.—(A communication from La Société Anonyme de Certaldo.)* 4d.

Gypsum, or other substance having sulphate of lime as its base, is dehydrated in a stove or furnace, and then indurated by exposure to the action of the following chemical products, either singly or in combination, viz., sulphate of iron, oxalic acid, carbonate of potash, sulphate of soda, salts of magnesia, sulphate of alumina, and the like.

3304. PROTECTION OF IRON AND STEEL SURFACES, &c., *F. S. Barff, Kilburn, and G. and A. S. Bower, St. Neots, Hunts.—28th July, 1881.* 6d.

This relates to the more effectual protection of the surfaces of iron and steel articles by the creation of a film or coating of magnetic oxide thereon as described in patents No. 862, A.D. 1876; No. 2051, A.D. 1877; No. 1280, A.D. 1878; and No. 3811, A.D. 1880; and it consists in a gas furnace composed of a cast or wrought iron chamber heated externally by the combustion of gas furnished by generators placed at the side. The products of combustion pass round the chamber, and the waste heat is utilised to generate and superheat steam by being made to pass round iron pipes filled with pieces of iron, and to which water is allowed to enter at the coolest end. The articles to be treated are placed in the chamber, and the superheated steam generated in the pipes is caused to act on them.

3305. IMPROVEMENTS IN APPARATUS FOR DISPLAYING AND REGULATING ELECTRIC LIGHT, *Sir C. T. Bright, London.—28th July, 1881.—(Not proceeded with.)* 2d.

The invention consists in regulating the feed of the carbons by the action of two bar electro magnets, together with a rack and train of wheels.

3306. FASTENING BOOTS, SHOES, &c., *E. Wright, Birmingham.—28th July, 1881.—(Not proceeded with.)* 2d.

This consists in the employment of a series of lugs, hooks, or links attached to the edges of the boot or other opening, and of a slide which passes under the lugs, thereby drawing the edges of the opening together, and securely fastening the boot or other article.

3308. BRONZE, *H. H. Vivian, Swansea.—28th July, 1881.* 4d.

This consists in the addition of antimony to bronze formed by an alloy of copper and tin.

3311. PREPARING VEGETABLE SUBSTANCES AND ARTICLES SO AS TO RENDER THE SAME CAPABLE OF BEING SUBSEQUENTLY COATED WITH METALS, *J. H. Johnson, London.—29th July, 1881.—(A communication from A. I. Mahu, Paris.)* 4d.

The substance or article is immersed in an oleaginous liquid prepared by placing 4 oz. linseed or other oleaginous matter in 2 gallons of water at a temperature of 120 deg. Fah. After this immersion the article is placed in an aqueous solution containing about 20 per cent. of a nitrate, preferably nitrate of silver, and when coated with the solution the article is exposed to the action of hydro-sulphuric acid gas, after which it may be coated with metal by electro-plating or electro-deposition.

3312. TREATMENT OF WASTE SAND FROM GLASS FACTORIES, *H. J. Haddan, Kensington.—29th July, 1881.—(A communication from F. J. Mote, Dampremy, Belgium.)* 2d.

The refuse sand from glass works is moulded, compressed, dried, and baked, so as to form refractory bricks, slabs, flagstones, building materials, and ceramic ware.

3314. TREATMENT OF MAIZE TO SEPARATE THE GERMS AND OBTAIN HIGH-QUALITY MEAL AND FLOUR, *T. Muir, Glasgow.—29th July, 1881.* 4d.

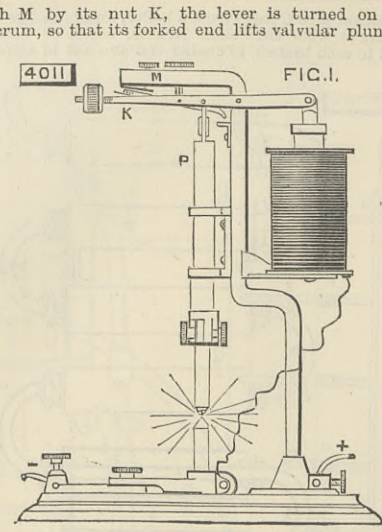
The size after sifting is broken by rolls, the product sifted, and the grit sized. Each size of grit contains the germs or parts of germs of the same size. The grit or semolina is then passed between rolls with surfaces, which break the fleshy parts and flatten the germs, which are then sifted out by reels or otherwise.

3497. PIANOS, *J. M. Laboissière and C. L. Daujon, Paris.—12th August, 1881.* 6d.

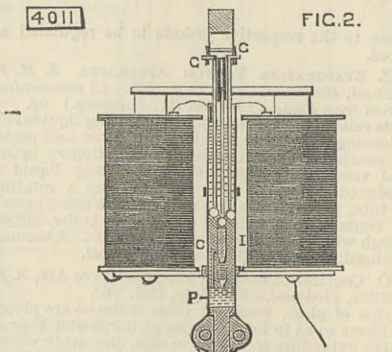
The whole body—that is, the sound-board, string plate, framing, and other parts—are arranged in a cast iron frame, consisting of a general frame with stays, which carry the devices to receive the screws securing the woodwork of the piano. The upper part of the frame forms a dovetail sheath, into which slides a board which receives the upper studs for the strings, the lower studs being rivetted to a plate cast with the frame. The hammer of the action is held in its butt behind the ordinary position, so as to give more weight to act on the hopper, which engages directly with the tail of the key, formed with an escapement with two steps, so that if one fails the other will act on the hopper. The damper is mounted on a rail, pivotted and under the action of the "forte" pedal, the rail being supported by arms screwed at the back to the hammer ruler. A fixed block supports a spring which forces back the damper against the strings.

4011. IMPROVEMENTS IN ELECTRIC LAMPS, *B. Hunt, London.—17th September, 1881.—(A communication from A. B. Brown, Cleveland, Ohio, U.S.)* 8d.

Fig. 1 shows an elevation and Fig. 2 a vertical central cross section of the method by which the inventor regulates his carbons. When the current is passing and the arc established, a shunt current passes through F and F¹, H vibrates C, which lifts plunger C, which, in turn, lifts the upper carbon. The free end of small lever L then makes contact with M by its nut K, the lever is turned on its fulcrum, so that its forked end lifts valvular plunger



I, so as to open the ports of plunger C, and let out the glycerine, thereby allowing C to move readily in P,



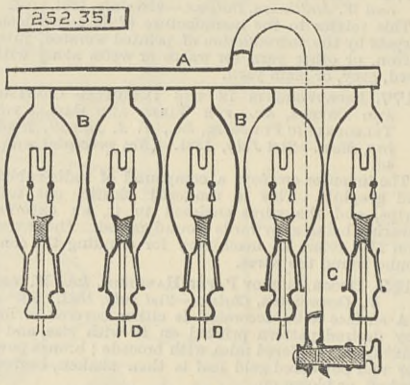
and the carbon to descend. Various modifications of this apparatus are also illustrated and described. The feed is constant and is alternately increased or diminished as the current increases or diminishes.

SELECTED AMERICAN PATENTS.

From the United States' Patent Office Official Gazette.

252,351. APPARATUS FOR THE PREPARATION OF CARBON CONDUCTORS, *Ludwig K. Böhn, New York, N.Y., assignor in the United States Electric Lighting Company, same place.—Filed June 23rd, 1881.*

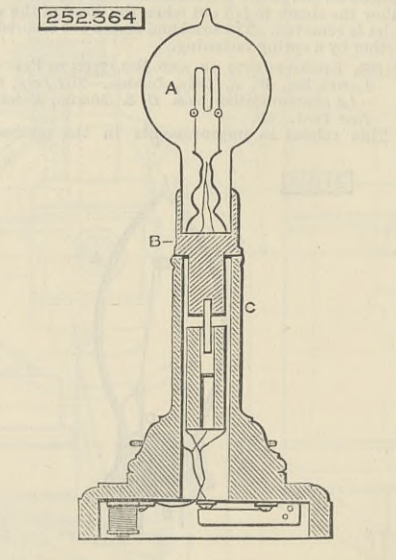
Claim.—(1) The combination of two or more separate carbon depositing or testing receivers, each closed by a plug or stopper containing the metallic conductors to which the carbons are attached, the several receivers being connected by a pipe or tube common to them all, and adapted to be combined with devices



for exhausting the air and for introducing a gas into the said receivers, as and for the purpose set forth. (2) In an apparatus for electrically heating and testing carbon conductors for incandescent lamps, the combination, with main tube G and horizontal tube A, of the several bulbs B B, closed by plugs or stoppers containing the conducting wires D D, carrying clamps for retaining the ends of carbon conductors, as and for the purposes described.

252,364. ELECTRIC LAMP, *Moses G. Farmer, Newport, R.I.—Filed May 26th, 1881.*

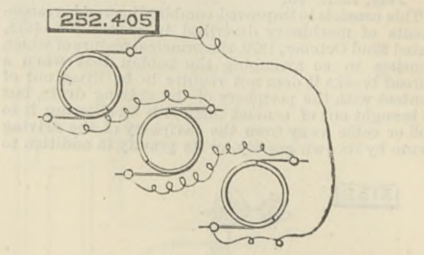
Claim.—The globe mounted in the socket, in combination with the carbon A, contained in said globe, the wires B and B¹, connected at one end to said carbon, the metallic ring D, connected to the other end of the



wire B, the pin E, connected to the wire B¹, the stand C, provided with one or more springs F F¹, and one or more springs G G¹, and the wires I I¹ and J J¹ all arranged and adapted to operate substantially as and for the purposes described.

252,405. COMMUTATOR FOR DYNAMO-ELECTRIC MACHINES, *Addison G. Waterhouse, New York, N.Y., assignor to the United States Electric Lighting Company, same place.—Filed April 2nd, 1881.*

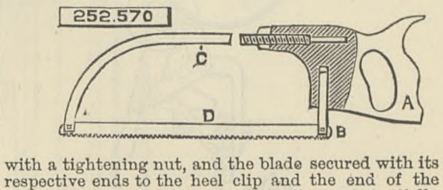
Brief.—The rings are formed of two sections or plates, to which the ends of the armature coils are connected, one of the plates extending more than half-way around the commutator, whereby the



armature coil connected with each ring is short circuited while passing the neutral point. As a modification, the plates are made of equal length and the brushes so arranged as to be in contact with a single plate, during a portion of the revolution for the same purpose.

252,570. HANDSAW, *Jas. R. Woodrough, Cincinnati, Ohio, assignor to Woodrough and McParlin, same place.—Filed October 18th, 1881.*

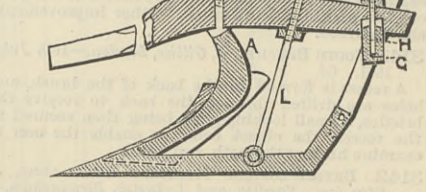
Claim.—(1) In a handsaw, the combination, substantially as before set forth, of the handle, the heel clip secured thereto, the adjustable back provided



with a tightening nut, and the blade secured with its respective ends to the heel clip and the end of the adjustable back. (2) The combination, substantially as before set forth, of the handle A, the clip B, the barbed shank of which is driven into the handle, the saw blade D, and the back C.

252,585. PLOUGH, *Franz Nitschmann, Flatonia, Tex., assignor to Franklin P. Walters and Charles A. Arnim, same place.—Filed June 18th, 1881.*

Claim.—The combination, with the adjustable standard iron A and the handles, of the transverse bar



G, clamp or hook bolt H, and the pivotted adjustable brace L, connected to the furrow bar of said iron, substantially as specified.

CONTENTS.

THE ENGINEER, March 3rd, 1882.