ENGLISH AND AMERICAN RAILWAYS.

No. IV.

IT is reasonable to suggest that some improvements in English railway working might result from greater publicity of the official details of the actual results of working. The high position which English railways hold in regard to freedom from accidents is due in great measure to the influence of public opinion based upon the published official reports of investigations as to the causes of accidents. In the same way public opinion might have considerable influence in inducing the adoption of reforms or improvements. In comparing the annual reports of leading English and American railway companies, one cannot but be struck by the vagueness and paucity of information contained in the former. American reports are usually in pamphlet form, and contain detailed statistics as to traffic, rates, earnings, expenses, mileage, coal consumption, &c., and the relation of these items to one another. The statistics are also worked out on certain basis, and not given merely as totals, while comparisons are made with the figures of preceding years, thus showing how the traffic and working conditions have varied. The following table—No. II.—is compiled from the working statistics given in the annual report of the Lake Shore and Michigan Southern Railway, a road which earns 8·13 per cent. dividends, and pays 7 per cent.

TABLE No. II.—*Working Statistics of the L.S. and M.S.R., U.S.A.*

Miles	1413
Gross earnings	£4,170,736
Working expenses, 63·76 per cent	£2,785,604
Net earnings	£1,365,133
Fixed charges	£560,488
Tons of goods carried	15,551,976
Average haul or lead per ton, miles	178·2
Receipts per ton per mile	0·251d.
Cost per ton per mile	0·165d.
Profit per ton per mile	0·086d.
Passengers carried	4,292,573
Average haul or lead per passenger	48 miles
Receipts per passenger per mile	1·047d.
Cost per passenger per mile	0·740d.
Profit per passenger per mile	0·307d.
Gross earnings per mile of road	£2943
Expenses (including taxes) per mile	£1975
Net earnings per mile of road	£968
Average goods train load	352⅔ tons
Goods earnings per train mile	7s. 5·12d.
Goods expenses per train mile	4s. 10·35d.
Passenger earnings per train mile	5s. 7·36d.
Passenger expenses per train mile	3s. 11·62d.
Passenger train miles	4,748,428
Freight train miles	7,866,883

The average weight of the goods trains seems rather low, but it must be remembered that this is the average for the entire service, including local and branch trains as well as the heavy main line through trains, which represent the maximum loads. In the above table are given the average earnings, expenses, and profits for both passenger and goods traffic, and these figures may be compared with those of the Pennsylvania Railroad and the New York Central Railroad, as follows:—

TABLE No. III.—*Working Statistics of American Railways.*

	Pennsylvania R.R.	New York Central R.R.
Earnings per passenger per mile	0·966d.	0·91d.
Expenses per passenger per mile	0·716d.	0·67d.
Profit per passenger per mile	0·250d.	0·24d.
Earnings per ton per mile	0·249d.	0·29d.
Expenses per ton per mile	0·177d.	0·20d.
Profit per ton per mile	0·072d.	0·09d.
Earnings per passenger train mile (including mails and parcels)		4s. 6d.
Expenses per passenger train mile (including mails and parcels)		2s. 9d.
Profit per passenger train mile (including mails and parcels)		1s. 9d.
Passenger earnings per mile of road		£1146
Passenger expenses per mile of road		£850
Passenger profit		£296
Goods earnings per train mile		7s. 11d.
Goods expenses per train mile		5s. 5d.
Goods profit per train mile		2s. 6d.
Goods earnings per mile of road		£2299
Goods expenses per mile of road		£1583
Goods profit per mile of road		£716
Average number of wagons per goods train		49
Average tons of paying goods per train mile		322

In the latter part of Table No. III. are given some of the same items for the New York Central Railroad, but calculated out on a train-service basis, with results in amounts per train mile and per mile of road for both passenger and goods traffic. On the New York, New Haven, and Hartford Railroad, the similar results figure as follows:—

	£.	s.	d.
Passenger earnings per train mile	0	5	9
Passenger earnings per mile of road	1805	0	0
Goods earnings per train mile	0	8	1
Goods earnings per mile of road	1805	0	0
Operating income per mile of road	2512	0	0
Operating expenses per mile of road	1135	0	0

Two other points of great importance are the percentage of earnings absorbed by working expenses, and the distribution of the working expenses among the principal classes of expenditure. On American railways, as an average, the working expenses represent a slightly higher proportion of the earnings than on English railways, but there is not such a wide difference as is very frequently assumed. In Table No. 4 are shown the proportions of working expenses, and the distribution of these expenses for some American and English railways. In the four columns representing the distribution of working expenses, however, the percentages for the English lines are not exact, since the published accounts are not kept in the same form as those of the American lines. The accounts have been carefully analysed, however, and arranged in accordance with the American system, and the percentages given are probably very close approximations to the reality. Even allowing for a certain variation, the figures as given show a very interesting comparison. The percentages given in the first column are those taken from the official reports of the several railways whose working expenses are here tabulated:—

TABLE No. IV.—*Working Expenses of American and English Railways.*

Railways.	Proportion of working expenses to gross earnings.	Distribution of working expenses. Maintenance of way and struct'res	Maintenance of engines & roll. stock	Conducting traffic.	General.
U.S.A.:	Per cent.	Per cent.	Per cent.	Per cent.	P. c'nt
New York, New Haven, and Hartford	68·87	19	16	61	4
New York Central	63·50	16	17	63	4
Pennsylvania	67·85	18	20	59	3
Erie	74·57	12	20	60	8
Lake Shore and Michigan Southern	63·76	17½	19½	60½	2½
Boston and Albany	71·60	19	14	54	13
Chicago, Burlington, and Quincy	64·84	23	18	53	6
Chicago and North-Western	62·23	20	21	55	4
Chicago, Rock Island, and Pacific	61·75	25	16	53	6
Northern Pacific	46·90	28	16	50	6
ENGLAND:					
Great Eastern	59·79	14	16	48	22
Great Western	62·21	23	17	47	13
London and North-Western	58·44	15	14	57	14
Midland	59·81	13	17	63	7

Another matter of importance is the analysis of the earnings and their distribution among the several sources of revenue. Such an analysis enables it to be seen at a glance whence the bulk of the revenue comes, and where improvements may be made. Table No. V. shows the analyses of the earnings of five American railways.

TABLE No. V.—*Analyses of Earnings of American Railways.*

Earnings.	New York Central.	Lake Shore and Michigan Southern.	Erie.	Chicago, Rock Island, and Pacific.	Northern Pacific.
	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
Passenger	29·0	20·63	18·0	24·45	20·5
Goods	59·0	67·57	74·0	69·64	73·6
Mail	3·5	7·20	1·5	2·88	5·9
Express (parcels)	3·0	2·57	1·8	1·98	
Other	5·5	2·03	4·7	1·05	—
Total	100·0	100·00	100·0	100·00	100·0

On the Lake Shore and Michigan Southern Railway the operating or working expenses are also worked out in percentages of the earnings, with the following results for 1898 given in Table No. V.:—

TABLE No. V.

	Percentage of earnings.
Maintenance of way and structures	11·11
Maintenance of engines and rolling equipment	12·51
Conducting transportation	38·60
General operating expenses	1·54
Total operating expenses	63·76
Taxes	3·35
Operating expenses and taxes	67·11
Net earnings	32·89

The figures so far given relate to the general results of railway working, but the expenditures in the traffic departments are also worked out in detail, and statements of these details are given by many railways in their annual reports. There is, however, no uniformity in these statistics, different railways keeping their special accounts of this kind in their own way. In the general statistical and financial reports a considerable degree of uniformity has been arrived at, owing to the requirements of the Interstate Commerce Commission in having reports made to it annually in accordance with certain set forms, which forms the railways have now largely adopted for their own use as a matter of convenience. Some figures from the detailed reports are given below as examples of the character of the statistics annually recorded and compared.

Table No. VI. gives an analysis of the working expenses of the outdoor service of the Chicago, Milwaukee, and St. Paul Railway, calculated upon the basis of revenue train miles, and distributed among the various items of expenditure in this service.

TABLE No. VI.—*Expenses per Revenue Train Mile; Chicago, Milwaukee, and St. Paul Railway.*

	Pence.
Repairs of locomotives	2·80
Repairs of wagons and carriages	3·98
Station service	5·62
Train service	3·62
Locomotive service	4·30
Train and station supplies	1·01
Fuel	4·72
Oil and waste	0·23
All other expenses	22·33
Total working expenses per rev. train mile	48·61

Following on in this line, a series of figures representing locomotive service are given below, selected from the annual reports of the railways mentioned:—

Working Statistics of American Railways.

ERIE RAILROAD.

Miles run per passenger engine per year	47,818
Miles run per goods engine per year	40,836
Coal per mile, passenger engines	87·1
Coal per mile, goods engines	146·6
Locomotive miles per quart of cylinder oil	127·4
Locomotive miles per quart of lubricating oil	50·7
Pounds of waste per 100 locomotive miles	1·0

Cost per locomotive per mile:—

	Erie Railroad. Pence.	Lake Shore and Michigan Southern Railroad. Pence.
Fuel	3·34	2·62
Repairs and renewals	3·25	2·59
Oil and waste	0·16	0·11
Water supply	0·22	0·19
Other supplies	0·06	0·03
Wages of enginemen and firemen	3·50	3·57
Wages of running-shed men	0·75	
Total	11·28	9·12

	Chicago and North-Western Railway.	Chicago, Rock Island, and Pacific Railway.
Miles run per engine per year (average)	—	33,722
Cost of coal per ton	6s.	—
Locomotive miles per ton of coal	22·84	28·78
Locomotive miles per pint of oil	15·40	—
Locomotive miles per pound of waste	182·93	—

Cost per locomotive per mile:—

	Pence.	Pence.
Renewals, repairs, and supplies	2·33	1·62
Enginemen, firemen, hostlers, &c.	3·64	3·43
Fuel	3·18	2·98
Oil and waste	0·12	0·08
Total	9·27	8·11

Inquiry has been made as to the much talked-of rate of 0·11 pence per ton per mile on the Chesapeake and Ohio Railway, and what items are covered by this cost. It may be said that the rate was a special one on coal, and was not established as a permanent rate, although on many roads the average goods rate is getting uncomfortably near this low figure. The items covered by the cost of transportation, as referred to in the first part of this paper—in THE ENGINEER of December 1st, 1899—include maintenance, repairs and renewals of engines, rolling stock and permanent way, as well as wages and general train expenses. It also includes its proportion of expense of renewals of equipment and a large amount expended for new side tracks and also for heavier rails. This is accounted for by the fact that the company carries no construction account, except for certain specified new work, such as double tracking and the enlargement of terminals. It does not include unloading the wagons into the vessels, which cost is independent of transportation expenses.

On this railway the rates have dropped 32 per cent. since 1893, in spite of which the profits have been steadily increased by skill and care in the management, and by improvements in methods of working. The tonnage has had to be increased very considerably in order to add so largely to the revenue, with the ton mile rate falling so rapidly and steadily. The statistics of traffic and revenue are given in Table No. VII.

TABLE No. VII.—*Traffic and Revenue: Chesapeake and Ohio Railway.*

	Gross earnings.	Net earni'gs.	Surplus over charges.	Tonnage.	Ton miles.	Ton mile rate on coal.	Ton mile rate on all goods
	£	£	£			P'nce	P'nce
1893	2,069,953	640,587	84,752	5,498,900	1,479,487,000	0·163	0·181
1895	1,919,206	626,301	3,740	5,671,200	1,720,788,000	0·146	0·208
1897	2,141,636	684,283	60,508	6,491,297	2,000,095,000	0·148	0·212
1899	2,401,968	786,491	141,226	8,130,661	2,506,000,000	0·110	0·255

In the former part of this paper it has been shown that for several years past there has been a steady reduction in goods rates. This is one of the remarkable features of American railway operation, and one of the most serious problems to be dealt with by managers. It is also one of the great forces leading to the introduction of various means for so reducing the cost of performing the transportation service that a profit may still be earned. Table No. VII. has shown these conditions on the Chesapeake and Ohio Railway, where the net earnings have increased but little, while the traffic has increased enormously. In Table No. VIII. are given somewhat

TABLE No VIII.—*Traffic and Revenue, Lake Shore and Michigan Southern Railway.*

Years.	Tons carried.	Goods earnings.	Rate per ton per mile.	Average lead per ton.
		£	Pence.	Miles.
1870	2,978,725	1,726,894	0·752	192·7
1875	5,022,490	1,906,008	0·505	187·8
1880	8,350,336	2,778,112	0·375	221·7
1885	8,023,093	1,771,804	0·276	199·7
1890	11,531,266	2,700,962	0·313	187·0
1895	14,382,641	2,780,265	0·280	172·1
1898	15,551,976	2,784,954	0·251	178·2

Years.	Passengers carried.	Passenger earnings.	Rate per pas-seng'r per mile	Average lead per passenger.
		£	Pence.	Miles.
1870	2,065,440	838,592	1·306	77
1875	3,170,234	784,560	1·189	52
1880	3,313,485	752,201	1·067	53
1885	3,479,274	727,875	1·029	51
1890	5,019,595	1,012,005	1·123	45
1895	4,627,175	902,474	1·069	46
1898	4,292,573	856,284	1·047	48

similar figures for the Lake Shore and Michigan Southern Railway during the past thirty years. From this it will be seen that while the tonnage increased from 3 million to 15½ million tons, the goods earnings increased only from £1,726,894 to £2,784,954, the rate per ton per mile having fallen from three-fourths of a penny to one-fourth of a penny. In passenger working the results are similar

but not so extreme, the number of passengers having increased from 2 millions to 4½ millions, while the passenger earnings increased only from £838,592 to £856,284.

In conclusion, it may be said that while English railways are not likely to have such a serious problem to meet as has been met—and successfully met—in the United States, yet undoubtedly economies and improvements in present methods of working can and should be introduced. The somewhat extensive introduction of corridor cars, dining and luncheon cars, &c., within very recent years, to meet the perfectly reasonable demands of the public, has necessarily increased the proportion of dead load in the trains, and has consequently increased the cost of transportation. Economies in passenger train service, either by reducing expenses or increasing the accommodation and traffic, are now, therefore, to be sought for by progressive railway managers. It may be well to say again that the question is not that of introducing or forcing upon English railways certain features of American railway practice. The question is in regard to the possibility of effecting improvements and economies by investigating and following out the reasons and principles which have governed the remarkable development of American railway practice, more especially in regard to economy in cost of service or cost of working. In considering this question, it should be considered purely from a broad-minded business standpoint, without prejudice, and without clouding the main points at issue by giving undue weight to minor parts, or by petty objections and too conservative a point of view.

ARMOURED CONCRETE.

It is a little singular that a compound system of construction—no longer a novelty—which has been applied with unquestionable success on the Continent and in America, to nearly every description of engineering and architectural work, should have been both theoretically and practically almost completely ignored by English engineers. But with the exception of some altogether insignificant examples, little or no notice has been taken of a principle which has been utilised abroad for bridges and numerous other structures, though upon a minor scale of magnitude. It must be admitted that the system alluded to has entirely emerged from its experimental or trial stage, or it could not possibly have been so extensively employed in the erection of the buildings, and in many of the important subsidiary and collateral works pertaining to the Paris Exhibition. It is a well-known fact, though it is not necessarily to be accepted as an excuse, that a large number of our engineers, like the rest of their countrymen, are averse from change. They cling to their preconceived opinions, their time-honoured habits and customs, and their old, and possibly a little antiquated grooves, with true insular pertinacity. From this standpoint it is not surprising, therefore, that they have always regarded with feelings closely allied to suspicion and distrust, the employment of two distinct materials built up and incorporated together, which possess not only very different, but possibly absolutely conflicting properties and characteristics. For instance, in the early days of railways, combinations of cast and wrought iron in the same girder were denounced, and in the main, rightly too—by theory. Nevertheless the Newark Dyke bridge, consisting of triangular girders erected on Warren's principle of equilateral triangulations and turned pin attachments, and of which one-half was cast iron, did its duty well, until the ever-increasing weight of the rolling stock of our great railways subjected it to stresses which it was never designed to carry, and necessitated its removal.

Some few years ago a series of experiments was undertaken by the Austrian Government upon concrete, armoured concrete, and steel-ribbed arches of different spans, ranging up to a maximum of nearly 30ft. The result, with which we are alone concerned at present, was not in favour of any of the three types submitted to trial, and gave no preference to the compound system over its neighbours. Very recently some novel experiments have been carefully conducted, which throw a new light and afford additional information upon the whole subject. We propose to place before our readers a brief *résumé* of the results obtained at these trials, and to point out in what manner the conclusions arrived at affect the whole question. Among the objections raised to combined structures of this character, the principal theoretical one is that it is impossible to be certain that the two distinct materials will act together conjointly as they ought to do, and that the exact proportions of the total stresses which each material should bear is indeterminable. In other words, there is no method of calculation sufficiently exact to warrant it being relied upon. It has been also stated, as an argument against the use of armoured concrete by its opponents, that it was launched upon the public totally unsupported by any theory, and that consequently in the eyes of professional and scientific men it had no claim to possessing any *raison d'être*. This assertion was no doubt true at the time it was made, but it is contended by the advocates of the principle that it is no longer so now. While admitting, as is common to all analytical investigations concerning every description of important engineering structures, that certain assumptions and hypotheses must be made, they claim that the formulæ deduced from them are quite as accurate and trustworthy for the armoured concrete system as those obtained for any other type of construction. There certainly appears no valid reason why theoretical data should be demanded in the one case, far surpassing in precision those which have been cited, and found sufficient during many years for numerous other examples, such as the gigantic long-span bridges in the United States and our own hitherto unrivalled Forth Bridge.

Without asserting that all mathematical and analytical investigations are absolutely based upon, and in every sense dependent upon assumptions, it may yet be taken for granted that not one is altogether exempt from them. The theory of metallic bridges, as evidenced recently in our columns, bristles with them, and the variety of stresses induced by the bending and torsional moments of their component parts and from other causes which cannot be taken into actual calculation, must impart a good deal of uncertainty to the final results. We do not maintain that the formulæ put forward—some of which are of a very complicated character—for the determination of the stresses in constructive examples of armoured concrete are not susceptible of improvement. On the contrary, they will, in the course of further experience, be probably both modified and simplified, but the fact that they, in common with many others, are invested with a strong element of uncertainty does not, in our opinion, justify the rejection of the entire system. There is no doubt considerable force in the objection that the qualities of concrete are capable of variations so wide that the ultimate strength of the specimens cannot be predetermined. It is well known that in laboratories, discrepancies, amounting to as much as 20 per cent. and 25 per cent., have been registered in test pieces, identical in every respect. It follows from this want of uniformity that it may be truthfully alleged that the success of any one large work—a bridge, for example—is no guarantee that another similar structure based upon the same lines, both with regard to materials and workmanship, should be equally fortunate. The allegation that samples of armoured concrete give proofs of non-homogeneity during the operation of testing is of little importance, as the same statement holds good for nearly all materials, and it may be safely assumed that the same precautions which nullify any evil effect from this cause, with respect to other materials, are adopted in the case of the combined system. For the rest, it is a simple matter of the selection of a cement of good quality, proper preparation of it, and careful and skilful supervision of the whole work. Without due attention to these indispensable details, no structure could be efficiently or securely built.

So far as absolutely dead weight is regarded, the armoured concrete type of construction, as might be expected, is at a discount, since for a given strength the weight of the specimen amounts to five times as much as that of a sectional area of steel, endowed with the same powers of resistance. This wide difference is, however, somewhat diminished by the plain and massive character of the design, which enables it to dispense with most of the additional auxiliary ties and struts, which very appreciably augment the dead weight of a pure metallic erection. Against this disadvantage, and a few others which need not be particularised, must be placed the superior rigidity of the system, and its power, due to its dead weight, of almost annulling the effects of the heavy rolling loads common to all railway bridges. When compared with ordinary stone masonry and brickwork, the balance with regard to dead weight is greatly in favour of the new system, and it is no doubt partly due to this cause that it has been extensively employed in piers, retaining, and dock and reservoir walls, in the building of sewers and drains, and a vast number of other works placed beneath the soil. It is a very possible contingency that repeated vibrations and shocks, produced by violent dynamical action, might, after a time, give rise to a separation of the two materials, by destroying the adherence between them, but it is stated that no indication has as yet been afforded of any such action. It is a well-established fact that in railway bridges the effects of a serious impactive force have but a small local range, and are not felt in other parts of the structure, although situated at a very moderate distance from the point where the maximum disturbance occurs. The vibrations in their transit throughout the length and breadth of the bridge become rapidly absorbed and negatived by its insistent weight and *vis inertiæ*.

It is evident that unless the combination of the concrete and the metal be of so intimate a nature as totally to exclude all atmospheric influences, the advocates of armoured concrete must be nonsuited. The least oxidation of the metallic constituent would ultimately lead to its utter deterioration, and be fatal to the principle. In spite of the protection against oxidation afforded by the cement, it might be possible, owing to the porous nature of cement, and the facility with which it absorbs water, that air might find its way to the steel framework, and so ruin the combination. Again, it is also possible that air might penetrate through some of the small cracks and fissures which are generally present in those parts of the arch or girder which are exposed to stresses of tension. Experience has demonstrated that, in the great majority of instances, all surmises of this kind may be put aside. On different occasions buildings of armoured concrete have been pulled down, and the metal extracted from its matrix of concrete perfectly clean and bright. It is further asserted that a bar of rusty iron buried in a bed of cement concrete will, after remaining for a certain period in that situation, recover its original blue tint.* This fact was put beyond a doubt after the erection of the aqueduct of Achères. It is not at all improbable that the close union of the two materials may excite a chemical action between the metal and the cement, which may result in depositing a protective insoluble layer upon the former component of the mixture. Thermal stresses exist in examples of the application of this system, but may be disregarded, as they frequently might, in similar structures built of other materials. Incombustibility is another virtue which is justly attributed to the new type of construction, and it is this valuable property which has contributed so largely to its employment for the building of depôts, huge stores, warehouses, and great manufacturing and industrial premises. In respect to this quality, and also to its behaviour when exposed to the action of water, which often does more injury than the fire itself, brick is its only rival. Rapidity of execution, simply and easily procurable materials in almost any locality, and the absence of all ponderous and expensive tackle and mechanical appliances, are characteristics of this style of building. It is now quite unnecessary to advert to the progress that armoured concrete has made, or to the further advance it will probably make in its application to what may be termed the minor examples of construction. But whether it will, either in this or any other country, attain to first-class rank as a constructive type for the execution of important engineering works, upon a scale of fitting magnitude, is a problem for the solution of which the present available theoretical data and actual practical experience are altogether inadequate. It is not suitable for any description of bridge design, except that of the arch, and in this respect it is a long way behind what has been achieved even by cast iron.

* *Vide* "Annales des Ponts et Chaussées," 1897. 2e trim., page 135.

FRENCH AND BRITISH GUNS AND SHIPS.

Last week we made a comparison between British and French guns, taking our figures from the *Naval Annual* for 1899. Since writing this we have received a fuller account of the speech made by M. Claudinon in the French Chamber of Deputies—a speech which seems to have carried considerable weight. This was to be expected in one way, seeing that the speaker is "Forge Master" of the Loire, and has, as a maker of guns and war stores, the knowledge of a specialist. On the other hand, he is interested in defending *materiel* to which he has largely contributed. M. Claudinon stated that he quoted his figures from the *Naval Annual*; but this must be understood with reserve. He makes a comparison between certain British and American guns, taken from the *Annual* for 1899, with some Russian and French guns of newer design. He shows thus that of the 12in. guns, the French stand first, with 12,200 metre-tons (39,370 foot-tons); next comes the Russian, with 10,700 metre-tons (34,530 foot-tons); the British, with 10,600 metre-tons (or 34,207 foot-tons); and, lastly, the American, with 8100 metre-tons (26,155 foot-tons). He states that this is not the whole case, for the velocity has had to be reduced in the British gun. Indeed, our guns must be in a bad way, for M. Claudinon states that out of sixteen wire guns, three burst, and ten others were unable to continue firing. He says that it has been asserted that, owing to the lightness of the French projectile, the superiority at the muzzle would soon be lost; but this, he adds, is disproved by two things; first, that the speed of a shell from a 305 mm. gun, at a distance of 6000 metres, was 563 metres, while that of a corresponding English shell 505 metres; and, again, that a French shell, of the 1893-1896 model, discharged at an angle of 20 deg., would, at 17,350 metres, still have a speed of 310 metres, which would enable it to pierce the deck of any English cruiser. Before passing on to M. Claudinon's application of his conclusions to the case of ships, we should like to deal with those above, which are too serious to let pass.

When a speaker is in possession of information which has hitherto escaped us, it no doubt is difficult to deal satisfactorily with his statements. M. Claudinon's statements as to the French guns we accept, and we may be content to take the new Russian gun on trust, especially as a note in the *Annual* warns us that probably better Russian guns exist than there appear. It happens, however, also that the United States have now in hand a new 12in. gun, giving, it is claimed, 2800 foot-seconds muzzle velocity, with a projectile of the same weight as the British, namely, 850 lb., implying a muzzle energy of 46,246 foot-tons. Before this, the French 39,370 foot-tons pales even at the muzzle, and every 100 yards range tells against the lighter French projectile. This speaks for itself so far as America is concerned. Both guns are new, and their figures may be equally authentic; at all events, there is nothing more to add except that such statements will have to be made good by results. We are, however, rather concerned with England's position, and we have to confess at once that the 2600ft. velocity, the highest one given in the *Annual* is more than is desirable for a continuance, on account of the wear of the gun under present conditions, though a higher velocity might be attained without testing the strength of the gun, which is far beyond what is necessary. Probably 2600 foot-seconds might be assigned to our gun as safely and fairly as the velocities which are generally given in tables which, in fact, apply to new pieces; but we must point out that the energy quoted by M. Claudinon, given in the *Annual*, is not that due to 2600, but to the figure of the earlier Mark VIII. gun, namely, 2367, and this is simply the wrong velocity. With 2600 foot-seconds, our Mark IX. gun has 39,850 foot-ton energy, that is to say, more than this new French gun, even at the muzzle, and our superiority increases with every 100 yards of range, owing to the lighter weight of the French projectile. M. Claudinon does not give the weight of the French projectile, but as he speaks of a type of shot of a few years back, *i.e.*, 1893 to 1896, we are right, we suppose, in taking it as 643·8 lb., as given in the *Annual* and the Pola annual. This means that he takes the muzzle velocity at 2959 foot-seconds, which, with this light shot, is conceivable, thus giving his 39,071 foot-tons muzzle energy. We, however, make the velocity to come down to 2452 foot-seconds at 2000 yards, with a striking energy of 26,850 foot-tons, while the British shot at this range has 2252 foot-second velocity and 29,890 foot-tons; in other words, the difference which was small at the muzzle has grown to over 11 per cent. of the French blow at 2000 yards. We think the *Annual's* figures might be arranged more clearly, but it is strange that M. Claudinon, who has calculated the velocities for different ranges, did not take the precaution of testing whether the energy shown in the *Annual* was that of the velocity in bold type figures opposite to it, rather than the smaller figures entered below with a note of interro-

gation after them. At all events, we think that the answer is complete, namely, that the British gun, even at the muzzle, s more powerful than this new French piece.

But to pass on to the startling facts which M. Claudinon reports. We have accepted his figures in the case of France and Russia, but we must be excused for demurring to his statements as to British guns. Three wire guns could not burst without their possessors being aware of the fact, and we can assure him that it is not possible to detect any sign of bursting in any of our wire guns, nor have we been unable to continue firing. The beginning and ending of our causes of complaint with our guns is, as we mentioned last week, that the bores wear out much too fast. The new American gun is almost identical with our own, and its proportions are probably in a great measure taken from ours. It is rather heavier, but ours being of wire construction would probably do all that the American can with the same powder, and this is, as we have seen, much more than the French gun. The fact is that these high velocities which are to be attained with new guns seem to be deceptive, and tables are not required merely for purposes of "bluff," or even of fair comparison of the possibilities of new pieces, but for service purposes, and very commonly the heavy guns on board foreign men-of-war remain year after year without firing full charges and shot, while ours have their annual sea practice. We, however, have already in our last number admitted the possibility that cordite may be putting our heavy guns at a disadvantage, and that it is desirable, in our opinion, to make comparative trials with other explosives. Sir Andrew Noble's paper noticed elsewhere does not deal with comparisons between our own and foreign modern powders. Till that is done it is difficult to pronounce as to powder. As to the guns themselves we are quite satisfied.

M. Claudinon follows our guns on board ship, and tells us that in our gunnery trials with the Mars, Resolution, Hannibal, and Jupiter we attempted to get a muzzle velocity of 731 metres (2400 foot-seconds), but had to abandon it for the very sufficient reason, if true, above referred to, namely, that three guns burst and ten had to discontinue firing, so that apparently these lamentable accidents did not occur in the dark places of Woolwich or Shoeburyness, where evils of this dye can be, doubtless as he thinks, carefully concealed, but on Her Majesty's ships in broad daylight on the high seas. Is it possible for M. Claudinon to persuade himself and his listeners that three 12in. wire guns could thus burst on board our new ships and the matter be kept dark until he told the fell secret to the Chamber? He adds also that only some of the results were made public. Does he mean that still worse remains to be told? Under these circumstances the cries of *très bien* which greeted the speaker seem almost heartless. We made fuss enough about the Thunderer accident, but that seems nothing to what now takes place without our even hearing of it.

We will pass on to ships. "The English," we are told, "did not deem it necessary to protect battleships against high explosive shells, from which it can only be inferred that they were not satisfied with the results of their trials, and did not think that the shells would be dangerous except to those who handled them." How shall we begin to meet this extraordinary statement and the conclusion drawn from it? Any one who looks at drawings of British and French battleships will see that for the sake of maintaining a thick complete belt the French ships have had to leave many portions of their hulls unprotected. The British, by stopping the belt a little short of bow and stern, are enabled to be covered pretty completely upwards from belt to above the battery. We made trials of shell-fire at the Resistance, and adopted casemates and defences specially to meet it. We have long maintained that the French ships courted destruction by common shell, and this opposite statement is to us inexplicable. Then how can we be supposed to be afraid to handle and use shells with high explosives? Does M. Claudinon never read the papers? Has he not seen that we are using lyddite shells in the South African war, and does he not know that lyddite is almost identical with melinite? Shall we follow M. Claudinon further? Our difficulty is that we have not enough ideas in common with him to criticise satisfactorily. He makes an extraordinary supposition of the Powerful cruiser engaging the Charlemagne, and shows that the battleship ought to destroy this cruiser, which, considering that she is not even an armoured, but only a protected vessel, is not wonderful. The Powerful is constructed for entirely different work. We have not even checked the figures of this most improbable engagement. We think our readers will probably so far agree with us that it is hardly necessary to follow the subject further, and that we need not take M. Claudinon so seriously as to be unhappy about our ships and guns.

HIGH ANGLE FIRE ORDNANCE IN THE FIELD.

HIGH angle fire in the field by the means of field howitzers is one of the latest and most interesting developments of artillery science. To Russia belongs the honour of the introduction of the field howitzer or mortar, and the piece scheduled in the table below was first issued about eight years ago. The example thus set was shortly afterwards followed by Germany, Turkey, France, and Great Britain in the order named; and at the present moment these are the only nations which have adopted this distinctive type of field ordnance. The campaign now in progress, however, is the first occasion upon which it has been tried on active service, since, greatly to the disappointment of all artillerists, the Turkish howitzer batteries did not come into action during the war of 1897. It is easy to conceive, therefore, with what absorbing interest the performances of our own are now being followed. The following table affords an interesting comparison between the construction, weights, principal dimensions, &c., of the various howitzers; also information concerning their ammunition, projectiles, and high explosives for use with common or high capacity shell, as it is more generally termed.

Our 6in. howitzer is, strictly speaking, a siege train piece. When mounted on the travelling carriage, 35 deg. is its maximum elevation possible, when fired on the upper carriage only—as would be the case from trenches or other more or less permanently-fortified positions—the gun can be elevated to an angle of 70 deg. The piece corresponds to the German gun of 15 centimetres, which, now that no less than sixty-nine six-gun field batteries have been equipped with the lighter 10·5 centimetre howitzer, Model 1898, is only retained in field service for use against strongly entrenched and fortified positions. Great secrecy is being observed concerning this new weapon, which is not even mentioned in Commandant Vallièr's recent work, setting forth the military and naval artillery armament of every Power from the highest to the lowest. It is said that the Artillery School at Jüterbog is delighted with the 10·5 centimetre howitzer, which "fulfils all modern requirements, and is as efficacious as it is exact." The South African Republic possesses one or two of the 4·7in. Krupp howitzers, similar in every respect to those manufactured for the Turkish Government.

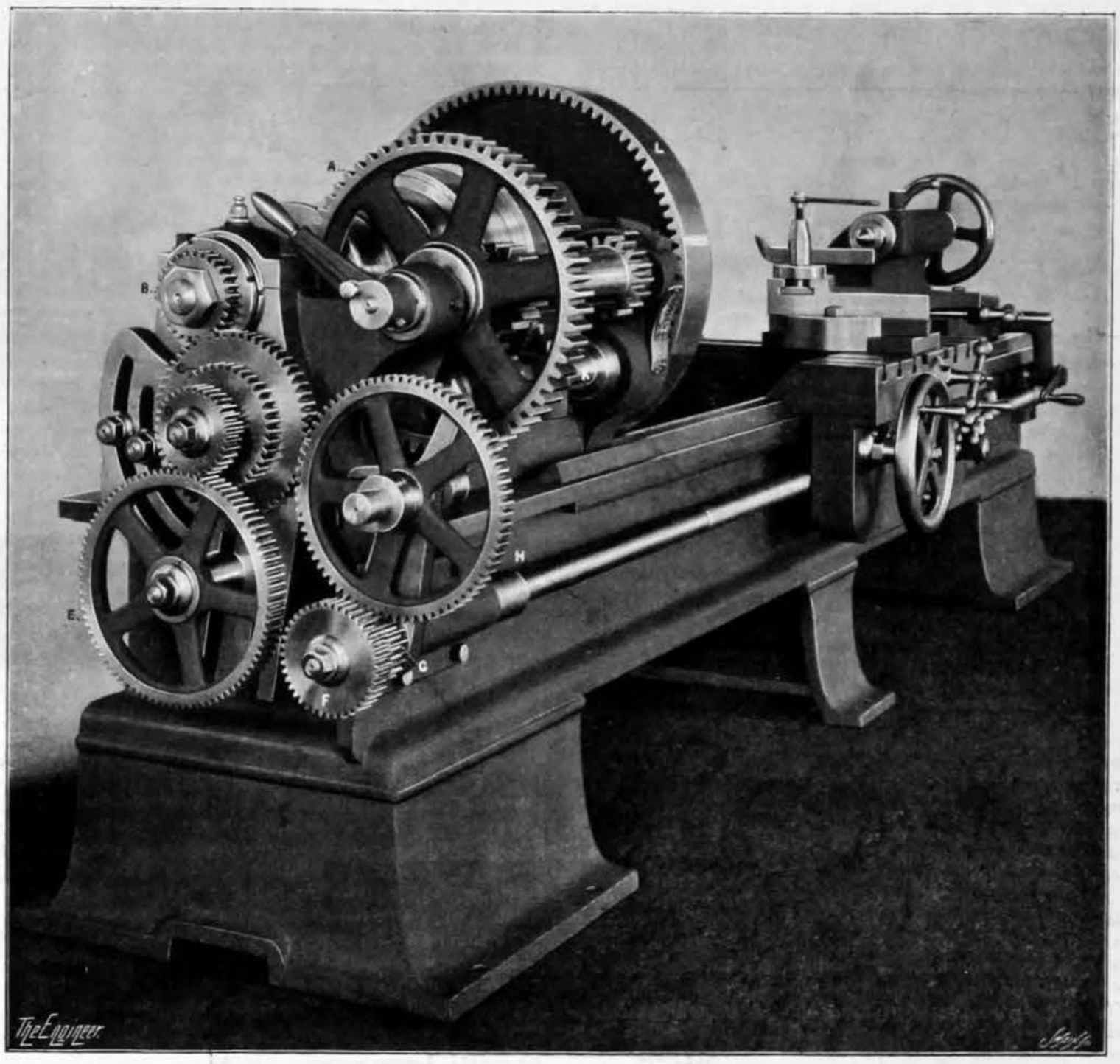
	England. 6in howitzer of position.	England. 5in. field howitzer.	France. 120 mm. field howitzer.	Germany. 15 cm. heavy howitzer.	Germany. 10·5 cm. c/98 field howitzer.	Russia. 6in. field mortar.	Turkey. Krupp 12 cm. field howitzer.
Construction	steel	steel	nickel steel	nickel steel	nickel steel	steel	steel
Calibre	6in.	5in.	4·7in.	5·9in.	4·1in.	6in.	4·7in.
Length of barrel	94in.	49in.	66·8in.	66·8in.	49in.	53·9in.	55in.
Weight of barrel and breech	30 cwt.	9½ cwt.	13·5 cwt.	21 cwt.		9 cwt.	8·8 cwt.
Greatest possible elevation	35° (70°)	45°	44°	65°		47°	45°
Weight of gun and carriage unlimbered	54·7 cwt.	31·6 cwt.	29 cwt.	43 cwt.	No details.	24·8 cwt.	21·9 cwt.
Weight of gun and carriage limbered up	68·2 cwt.	45 cwt.	46·5 cwt.	50·5 cwt.		41·3 cwt.	41·3 cwt.
Ammunition—							
Material	Forged steel	Forged steel	steel	steel	steel	steel	iron
Weight of projectile	118½ lb.	50 lb.	45 lb.	93 lb.	—	57 lb.	44 lb.
Explosive in common shell	Lyddite	Lyddite	Melinite	picric acid	picric acid	Melinite	black powder
Bullets in shrapnel	518	372	630	no shrapnel		683	460
Muzzle velocity, feet per second*	779	782	951	905	No details	621	—
Maximum range, yards†	10,000	4,900	7,217	6,561		3,718	6,342

* Muzzle velocity with maximum charge. † Maximum range with common shell only, that with shrapnel is considerably less.

THE mineral production of Canada continues to grow at a very satisfactory rate, the value for 1899 being officially returned at 47,250,000 dols., as against 38,000,000 dols. in 1898. Gold stands first with a total value of over 21,000,000 dols., of which about 16,000,000 dols. came from the Yukon placers. The Ontario goldfields, however, are becoming an appreciable factor in the gold production of the Dominion. In 1896 Canada's output of gold was under £550,000, about one-eighth of the present yield. Iron and nickel alone of the metallic minerals show increased production in the year just closed. Copper, silver, and lead remained stationary, largely owing to the prolonged labour troubles in British Columbia, now happily at an end. Of the other chief minerals, coal and coke, petroleum, pyrites, salt, and asbestos, have all advanced to a considerable extent.

32IN. TRIPLE-GEARED LATHE

THE FIFIELD TOOL COMPANY, LOWELL, U.S.A., ENGINEERS



AMERICAN MACHINE TOOLS.

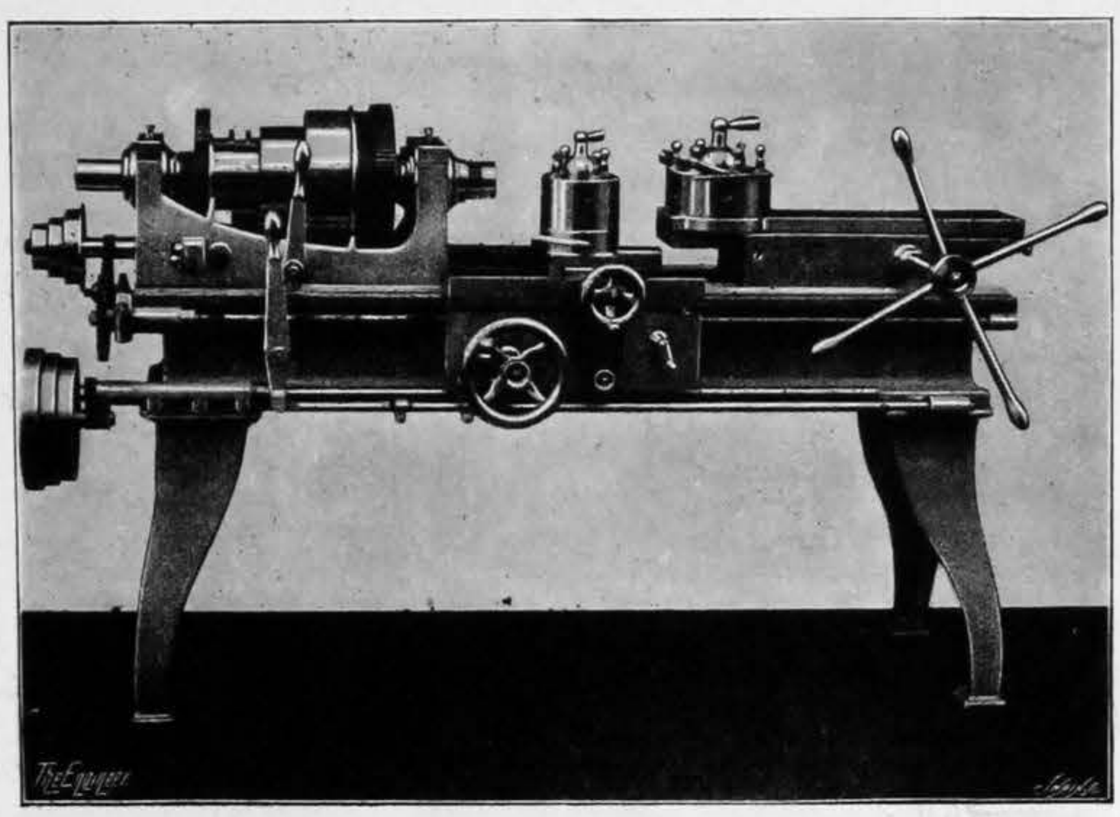
BY OUR AMERICAN CORRESPONDENT.

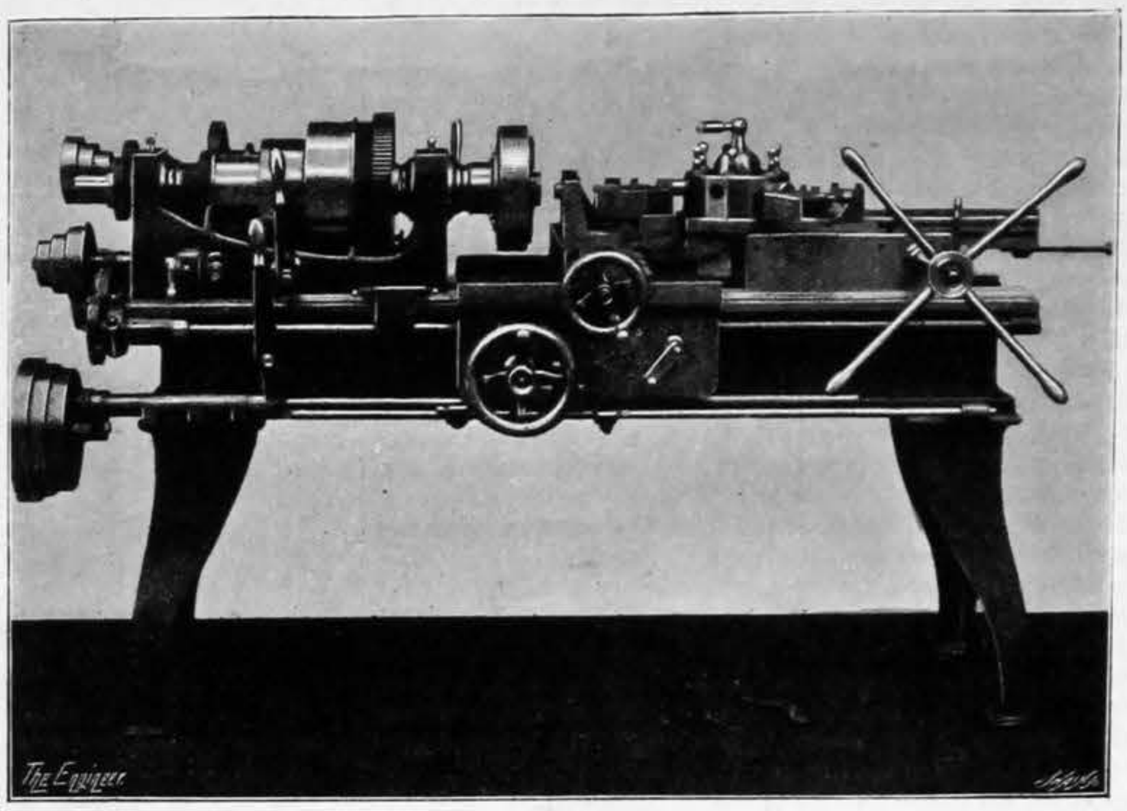
No. IV.

IN Fig. 17 above is given a view of the gearing of a 32in. triple-geared lathe, which is equipped with a tailstock instead of a turret. The head is strongly back-geared, and is triple-geared into an internal gear on the back of the face plate, the teeth of this gear being cut from the solid metal. A slip gear engages this internal gear, and a greater ratio is obtained in this way than by external teeth on a face-plate and head of the same size. The ratio of the back gearing is 12 to 1, and that of the triple gearing is 36 to 1. All the gearing is on the front side of the head for the sake of convenience, and as being better construction, the pull being on the same side as the work. The spindle is solid, made of forged cast steel, and runs in bronze boxes, with large and long bearings. The cone is of large diameter, and has broad faces. The feed is made positive by a cone of gears, and can be changed instantly. The triple-gear wheel which engages with the internal gear on the face plate is fitted to the shaft K, seen just above the V of the bed, being enclosed by a housing in which the slip-gear wheel slides in and out of the internal gear. The following is an explanation of the gearing as shown in Fig. 17: A, back gear; B, spindle gear; C, cone of feed gears on stud; D, change gear or screw gear; E, intermediate screw gear; F, screw gear; G, feed gear or screw; H, slip gear for feeds; I, gear driving to triple-gear shaft; K, triple-gear shaft; L, internal gear or face plate.

This lathe, with a swing of 32in. over the ways, has a bed 12ft. long takes in work 5ft. long between the centres, and swings 19in. over the carriage. The diameter of the front bearing is 5in., and of the back bearing 3¾in. The solid head spindle—of forged cast steel—is 4in. diameter, and the tail spindle is 3⅝in. diameter. The cone pulley has five steps, the largest 20in. in diameter, and the cone belt is 4½in. wide. The distance between the headstock V's is 16⅜in. The weight is about

8000 lb., with an extra weight of 250 lb. for every additional foot of length of the bed. The carriage has a bearing of 38in. on the ways, and is strongly gibbed to both back and front flanges of the bed. It is fitted with friction feed, inside power cross feed, and a compound rest to move in any horizontal direction. The rack-and-pinion gear for the carriage is cut from solid steel, and the important sliding parts are surfaced by scraping and iron pieces they are usually furnished with pan bed, oil pump, tank, piping, and fittings for automatic oiling apparatus as in Fig. 20. When they are to be used for finishing cast iron or brass, they are generally furnished with a plain bed and no pan, as in Figs. 18 and 19. Plain or revolving tool posts are furnished according to the requirements of the work to be done, and these are interchangeable.





Figs. 18 and 19—HARTFORD LATHES

not ground with emery. The carriage is connected with the screw by an open-and-shut nut, and can thus be connected to it at any point. The feed can be changed from right to left, or *vice versâ*, at the feed plate instantaneously. This tool is one built by the Fifield Tool Company, of Lowell, U.S.A

Lathes made by the Pratt and Whitney Company, of Hartford, U.S.A., are shown in Figs. 18, 19, and 20.

The lathe is not the only machine tool built to operate on the turret system, but turret drilling machines, turret milling machines, and turret tapping machines are all in use. The turret drills will do much of the same work that is done on turret lathes, but with the advantage that the cutting tools revolve instead of the work, thus allowing large and irregularly-shaped pieces to be operated upon. The drills are made with four to twelve

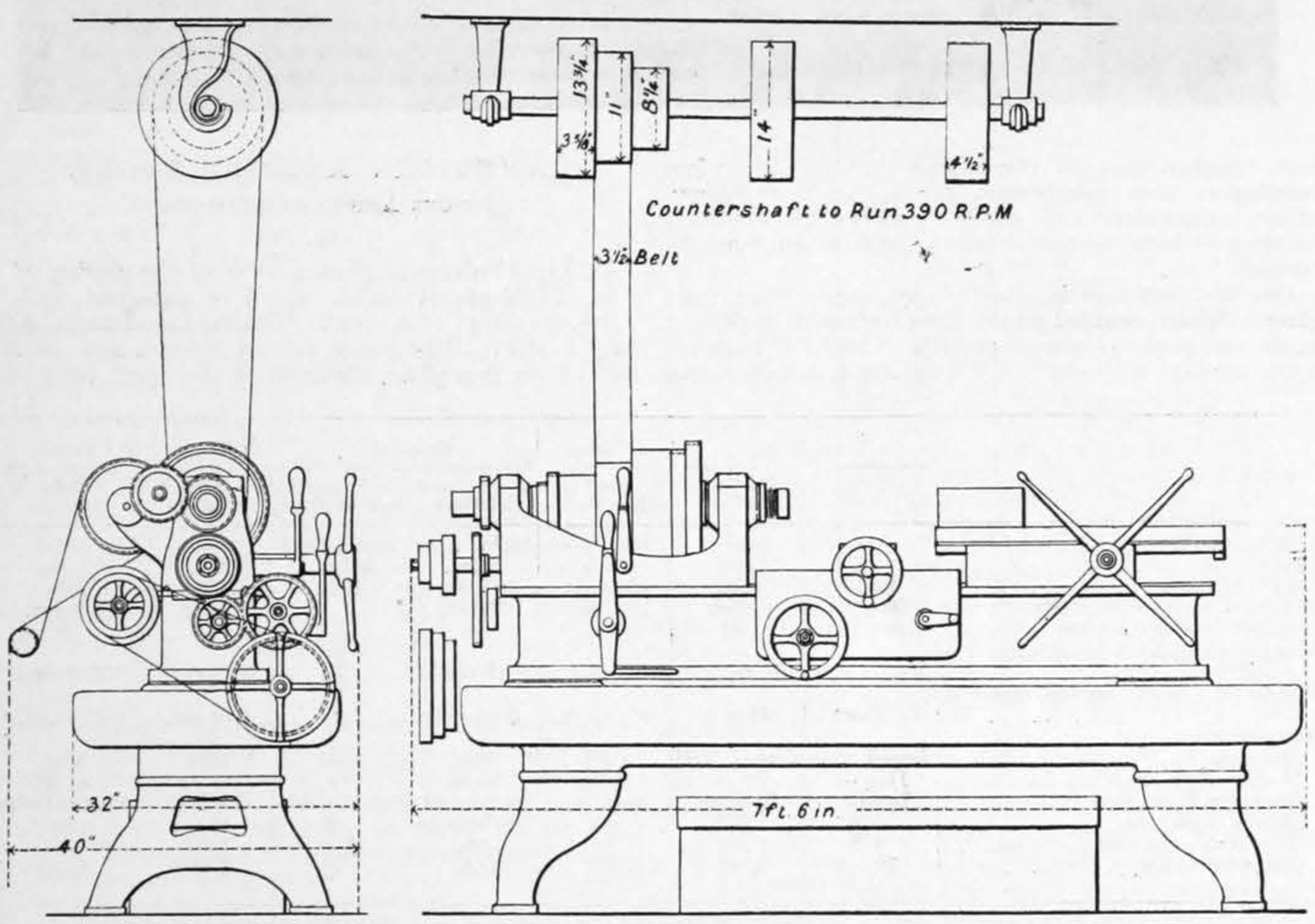


Fig. 20—16in. HARTFORD LATHES

That shown in Fig. 18 is a turret lathe with special tools for finishing cast iron and brass pieces; Fig. 19 shows a lathe having a special turret on the carriage; Fig. 20 is a general diagram of a 16in. turret head chasing lathe of the latest pattern, having a pan bed. This latter machine is designed for chasing and threading valves, cocks, injectors, and similar articles, in which it is necessary to turn up to a shoulder, and inconvenient to use a die. Threads can also be cut in work where it would be impossible to use a die. The spindle is hollow to receive stock bars if necessary, and the patent back-geared friction head gives nine spindle speeds. The machine has a special tool slide on the carriage, an automatic arrangement for stopping the feed, and a regular automatic feed with adjustable knock-off on the turret slide. It is also furnished with a pulley spline shaft feed in addition to the regular screw feed, and has also the automatic cross feed for the cut-off slide. The general dimensions are as follows:—Swing over bed, 16in.; front bearing of spindle, 4¾in. by 2¾in.; diameter of hole through spindle, 1¾in.; diameter of turret, 8¾in.; distance from top of slide to tool holes in turret, 2¼in.; three-step cone pulley, 11in. largest diameter; width of belt, 3½in.; length of bed, 6ft.; floor space occupied, 7½ft. by 2½ft.; counter-shaft pulleys, 14in. diameter and 4¼in. face; speed of countershaft, 390 revolutions per minute; weight, including countershaft, 2160 lb.

Lathes of the same general type are made for various classes of work, having special fittings to suit the work. When they are to be used for finishing steel or wrought spindles, and are adapted for all kinds of jig drilling. They will also drill, ream, counterbore, and tap a piece of work without any loss of time for changing the tools or moving the work. The turret milling machines are made with four spindles, and are intended for light manufacturing work, die sinking, engraving, &c., finishing each piece at one setting. Figs. 21 and 22 show the turret mechanism of two turret drills manufactured by A. D. Quint, of Hartford, U.S.A.

These drilling machines have a heavy rectangular base, on which is cast the bracket carrying the countershaft and lower cone. A vertical post or column carries the shaft of the upper cone and the turret mechanism, and on this post slides the knee which carries the table for the work, having a travel of several inches and being moved by a rack and pinion. It can also be turned to the right and left. Fig. 21 shows part of a six-spindle Quint turret drill with friction gear. In the bearing on top of the frame post are mounted the shafts of the two bevel driving gears, one being tubular and enclosing the other. On the outer ends of the shafts are the bevel discs A and B, revolving in opposite directions. These discs are within the turret. The six drill spindles are carried in suitable bearings in the circumference of the turret, and on the inner end of each spindle is secured a raw-hide or leather friction cone C. The turret is pivoted excentrically to the driving shaft, and by this arrangement only the drill in use or vertically over the bed is driven by the gearing. The other spindles are motionless or "dead." When a spindle is in position over the bed, its driving cone is wedged between the bevel driving discs, and takes the upward thrust of the drill. By revolving the turret one-twelfth of a revolution in either direction, all the spindles are stopped and out of gear. Each driving shaft is fitted with means for horizontal adjustment of the discs, and each drill spindle has means for vertical adjustment of the friction cone. The locking pin for locking the turret in position is of tool steel, hardened and ground to a close fit. The bearings are all lined with phosphor bronze bushings. This machine is intended for light drilling, with holes up to ⅜in. diameter, and also for light tapping up to ¼in., and to the centre of a 20in. circle. For tapping, a straight and crossed belt are used, with a clutch operated by a rocking treadle at the side of the base. The speed of the tool is from 250 to 2000 revolutions per minute, and may be changed to any intermediate speed at will by the operator.

The driving gear of the larger size of turret drill is of somewhat different design, as shown in Fig. 22, there being a direct drive from the cone to the turret mechanism, without the intervention of the bevel gearing shown in Fig. 21. The driving shaft A passes into the turret, and has at its end a bevel gear wheel B, which meshes with a bevel gear C. This gear C is loosely splined upon the driving spindle D, the lower end of which has a clutch E, engaging, when in operation, with the corresponding clutch F on the inner end of the drill spindle. Pivoted on the front of the gear case, in the interior of the turret head, is a bell-crank lever G, one end of which is forked and loosely connected to the driving spindle. The other arm is connected to the locking bolt H, which holds the turret in position. This bolt is operated by the rod I, the bell crank K, and the treadle rod L. The latter passes to the treadle at the base of the frame. When the treadle is pressed down, the locking bolt is thrown back, releasing the turret. In doing so, the bolt raises the driving spindle by means of the bell crank G, and thus releases the drill spindle. It is thus impossible to move the turret while the driving spindle is clutched to the drill spindle. When the turret is revolved to the tool wanted, the bolt will automatically slip into the socket, and the driving spindle then moves downward and engages with the drill spindle. The turret has long projecting bearings for the drill spindles. The feed is by hand or by a foot lever.

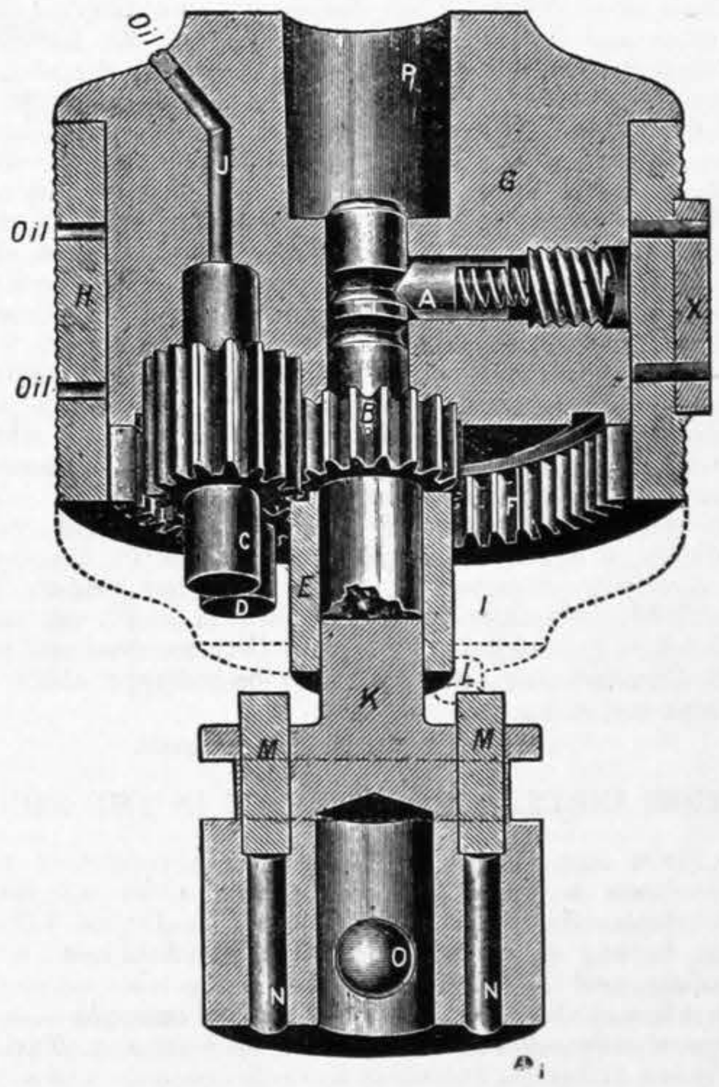


Fig. 23—TAPHOLDER

AMERICAN TURRET DRILLS

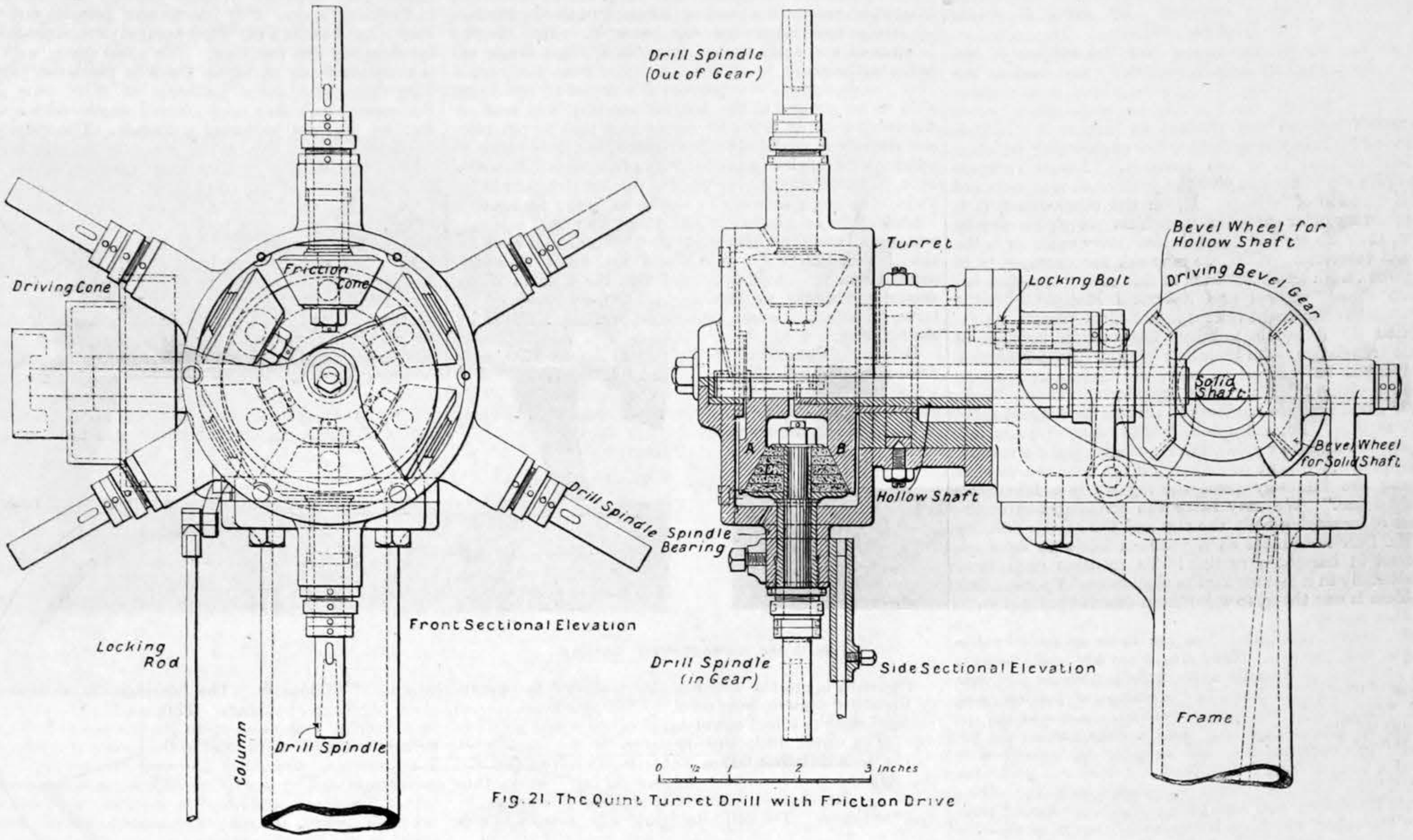


Fig. 21. The Quint Turret Drill with Friction Drive

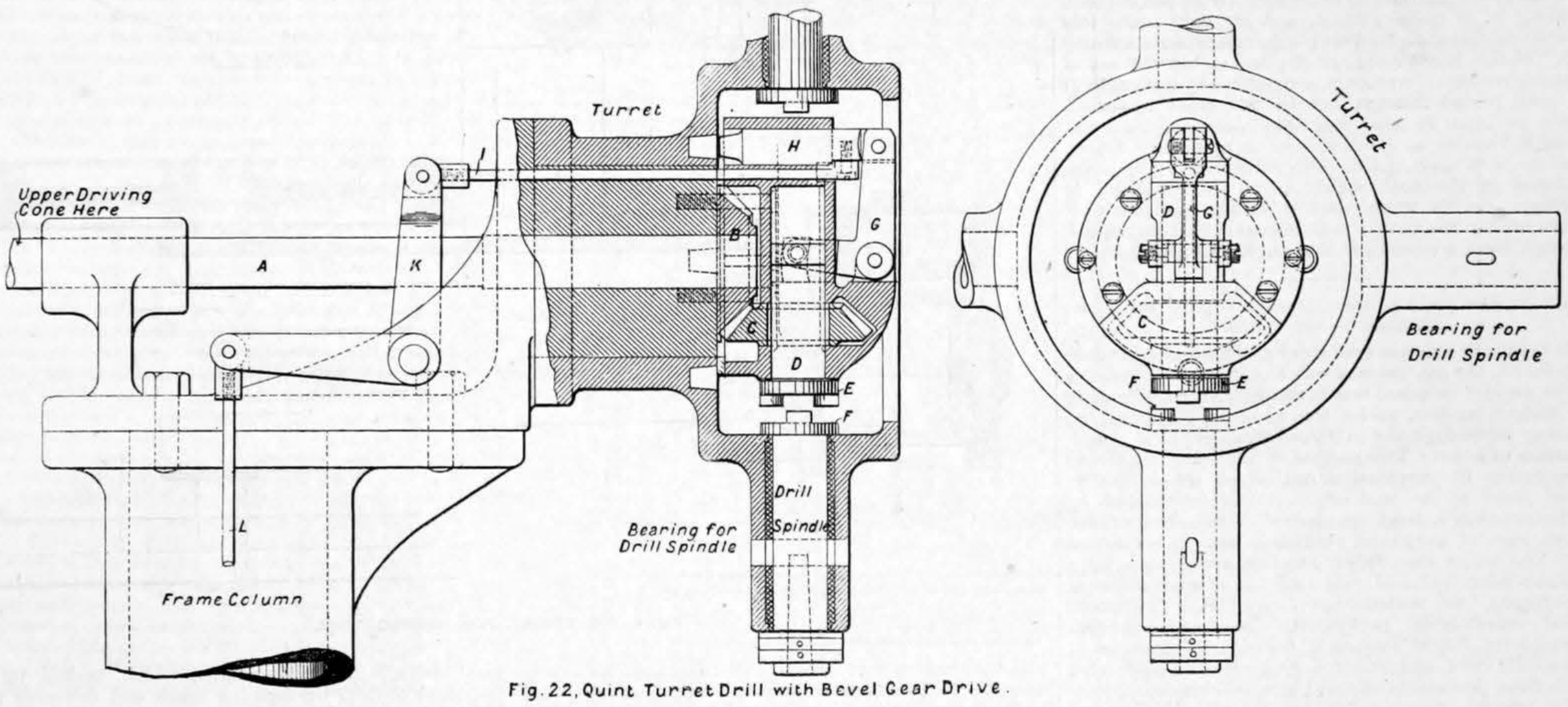


Fig. 22, Quint Turret Drill with Bevel Gear Drive.

The dimensions, &c., of these two turret drills are as follows:—

	Friction gear drill.	Bevel gear drill.
Distance from table to end of spindle, maximum	18¼in.	20in.
Distance from table to end of spindle, minimum	1in.	—
Distance from centre of drill to face of column	10in.	—
Size of table	13¼in. diam.	12in. by 18in.
Vertical movement of table	4½in.	7in.
Speed of countershafts, revolutions per minute	350	250
Speed of drills, with patent cone countershaft	250 to 2000	75 to 750
Speed of drills, with common countershaft	350 to 1400	
Height from floor to centre of turret	4ft. 9in.	4ft. 9in.
Size of base	14½in. by 19in.	14½in. by 19in.
Weight, complete	430 lb.	650 lb.

For tapping, a patented reversing tap-holder is used, shown is Fig. 23. It is made of steel, and all parts subject to wear are of hardened tool steel. It will tap to any depth, and from the smallest size up to ½in. diameter. It automatically stops and backs out, no reversing belt or experienced workman being required to operate it. One of its great advantages when used with the turret drill is that the work can be drilled and tapped at one setting, thus ensuring accuracy.

This reversing tap-holder is shown in Fig. 23. Here P is the socket by which the holder is attached to the driving spindle, and O is the socket for the shank of the tap. Outside the main body G of the holder is a sleeve H carrying at its lower edge two driving pins L and on its side a lug X. Inside it are cut teeth F, and the train of gearing B, C, D, driven by it, is fitted. In this train D is driven by F and C meshes with B. The operation of the holder is as follows:—The two pins L engage with the pins M and drive the tap, the spindle being fed forward at the required speed until the desired depth has been reached. The feed is then stopped, but the tap still revolving draws the pins M away from L, and the tap then stops too. At this moment the lug X engages a fixed stop and the rotation of the sleeve H is arrested, but as G still continues to revolve, D, C, and B are driven in a reverse direction, and the tap is screwed out of the hole at an increased speed.

In the turret milling machine the turret is rigidly held by a double locking device while the machine is running. By pressing on a foot lever the double locks and the driving shaft are released from the cutter spindle, so that the turret can be revolved by hand to the tool wanted without stopping the machine. The work table is attached to a balanced vertical slide, which has a travel of 4in. on the supporting knee by means of a rack and pinion operated by a hand lever. The knee is moved up and down on the post or column by means of screw and bevel gears, the crank handle operating, which is provided with an index pin fitting a circular perforated index plate. This gives any measurement desired with great accuracy.

THE WORKMEN'S COMPENSATION ACT (1897) EXTENSION BILL.

THE recent discussion in Parliament upon the second reading of this Bill seems to show that the provisions of the Act of 1897 bid fair to be extended during the present session to the agricultural labourer. Seamen, according to the Home Seeretary, cannot be dealt with by any modification of the Compensation Act, but "he hopes that the time will come when the principle of the Bill will be applied to seamen also." In our issue of February 23rd, 1900, we published a *precis* of the proposed measure. It must not in any way be confused with the Bill which has been laid on the table by Mr. Woods, Mr. John Burns, Mr. Pickard, and Mr. Steadman. Mr. Goulding's Bill merely asks for the extension of the present Act to agricultural labourers, while that brought in by the labour members asks for drastic reform. As pointed out by the Home Secretary, the greatest difficulty will arise when it is sought to find a satisfactory definition of the term "agricultural labourer." We venture to hope that the extension of the Act of 1897 will be accompanied by the abolition of those artificial distinctions between the different categories of the working-class population which, according to Mr. Asquith, have taxed all the resources of her Majesty's judges to interpret. If, while enlarging the boundaries of the Act, our legislators would at the same time turn their attention to amending certain of its hazy clauses, much trouble might be saved. The proper definition of the word "factory" is still uncertain. It is at present doubtful whether proceedings must be brought within six months of the accident, and whether a workman must have been employed for at least a fortnight before compensation can be assessed. These questions might easily be settled once for all by a clause in the new Bill.

LITERATURE.

Kinematics of Machinery. A Brief Treatise on Constrained Motions of Machine Elements. By John H. Barr. Chapman and Hall, Limited. 1899.

We are not in a position to say how the subject of Mr. Barr's book may have been regarded when used in the lecture theatre or class-room, but as a book it is unquestionably a failure. It is either too elementary or too advanced, just as one chooses to look at it. If it is intended for lads just beginning an engineering training, it fails in that it is too abstract. Actual concrete examples are wanted to give the young and inexperienced mind a notion of motions. If, on the other hand, it is designed for older students, though its principles may be right, they are applied to such elementary cases as to be almost valueless. What, we may ask for example, is to be gained from an observation of this sort, "Relation between Plane, Helical and Spherical Motions.—If the translation component (pitch) in a helical motion be increased till it equals infinity, the motion reduces to plane translation. On the other hand, if the translation component be reduced to zero, the motion reduces to plane rotation?" The least ingenious scientific Rackstraw could produce numberless such Little Buttercupian dark sayings. For example:—"If the zigs of a vertical zig-zag are infinitely great, the zig-zag becomes a vertical straight line. On the other hand, if the zags of a vertical zig-zag are infinitely great the zig-zag is a horizontal straight line." We may leave the consideration of the effect of increasing both the zigs and the zags to infinity to Mr. Barr's students as a problem likely to develope interest in harmonic motion! To mention such facts incidentally in a lecture for the elucidation of some other problem is one thing, to write them down in print is quite another matter.

Mr. Barr's definitions, too, are more suitable to the tongue than the pen. They are, to say the least, inexact. We find what is virtually a contradiction in the first few pages. Motion is defined as "a change of position, and it is measured by the space traversed. Time is not involved in this conception;" and a little further on we read, "two portions of a rigid body can have no motion relative to each other." If, then, we mark two points on a revolving disc, one nearer the centre than the other, in one revolution one has passed through a longer path than the other, which, as it implies a change of relative position, flies in the face of the second definition. The only thing that has been the same is the time, the very element which Mr. Barr has withheld. What the author's meaning is, is quite evident, and we only make this *reductio ad absurdum* to show whither slack definition may lead. Motion is not a change of position, but the act of changing position; its amount is measured by the length of the path passed through, not by the space traversed, unless we know in what way that space has been traversed. Time is as good, and in many cases a better, measure of it than space. Other definitions could also be found in the book which might be subjected to criticism. On the whole, then, it is not a book on kinematics which we should feel disposed to recommend, although there are here and there in it useful sections.

Traité de Nomographie. Par Maurice D'Ocagne. Paris: Gauthier-Villars. 1899.

To reduce to a simple reading of graphical tables, made once for all, the calculations which occur in the practice of the various technical arts is the subject considered in the present treatise, under the name of Nomography, meaning etymologically in Greek the graphical representation of a law. This method of replacing numerical computation by graphical tables, which enable the required result to be read off, is much appreciated by engineers when a large number of calculations of the nature, say, of earthwork quantities, has to be carried out. The author has made his treatise appeal to a large class of readers by introducing such varied applications of nomography as meteorology, barometric formulas, optical calculations, navigation, plane and spherical trigonometry, Kepler's equation, solutions of equations of the second, third, and higher degrees, loss of light from lighthouses, probability of fire, thrust of earthwork, locomotive traction, flow of water, &c. The simplest nomographic instrument in common use is the Slide Rule, now becoming of more frequent use in elementary instruction from the advocacy of Professor Perry.

Lalanne's principle of anamorphosis is explained on page 31, by means of which curved lines of a nomograph can be replaced by straight lines. A familiar instance is found in Human's logarithmic chart, utilised by Boys and Vincent for recording results of wave velocities in solid and liquid media. Captain Weir's azimuth diagram, sold by Potter of Cheapside, might well find mention; invented for the graphical solution of a problems in navigation, the system of confocal ellipses and hyperbolas comes in useful for plotting electro-magnetic curves, besides forming a handsome wall diagram to illustrate the principal features of confocal conic sections. Employers of labour will find it useful to construct an abacus of the wages and output of their workmen, as a sort of indicator diagram referred to co-ordinates not yet employed in thermodynamics.

The work has obviously been a labour of love to the author, who may be said to have created the systematic study of the construction and use of the abacus in all its variety. His book is a very complete treatise, and should be the study of our scientific engineers.

BOOKS RECEIVED.

Fire Tests with Floors: A Floor by the "Gypsine" Brick Company. London: The British Fire Prevention Committee. 1900.

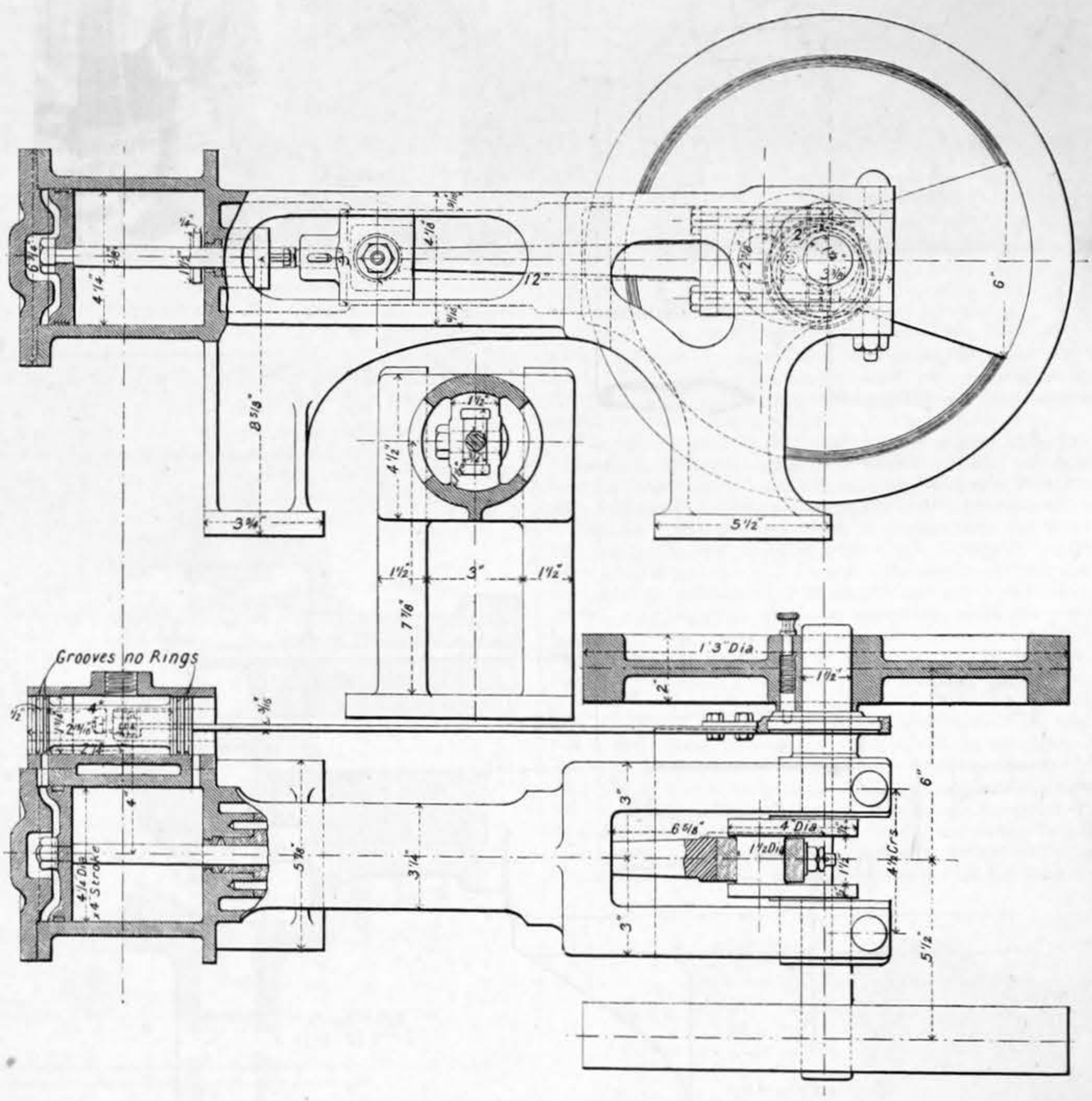
Traverse Tables for Use in Mine Surveying. By Wm. Lintern. London: Crosby Lockwood and Son. Price 3s. net. 1900.

Les Bandages Pneumatiques et la Résistance au Roulement: Etude Theorique et Pratique. Bon de Mauni. Paris: Vve. Ch. Dunod. 1899.

INSTITUTION OF MECHANICAL ENGINEERS.

On Thursday evening, the 22nd inst., the discussion on two papers read at the previous meeting of the Institution of Mechanical Engineers was resumed. Mr. Hartley Wicksteed was again in the chair, Sir William White not being well enough to attend. A letter from him, dated Malvern, in which he expressed his regret at not being able to be present at the council meeting, was read by the secretary. In it the President said that he put himself entirely in the hands of the council, and if they were of opinion that, in view of the quantity of business to be transacted occasioned by the reception of the American engineers and the summer meeting, it would be better for another President to be elected in his place, he would willingly retire. His whole wish was to do whatever was best for the Institution. Mr. Wicksteed intimated that the council had unanimously agreed that Sir William White should be retained as President till the expiration of his term, an announcement which was cordially received by the meeting.

Before the discussion of the papers began Mr. Amos drew attention to a diagram of the "Little Giant" drill which had been completed since the last meeting. This diagram, with the description, is reproduced with the rest of the paper on another page.



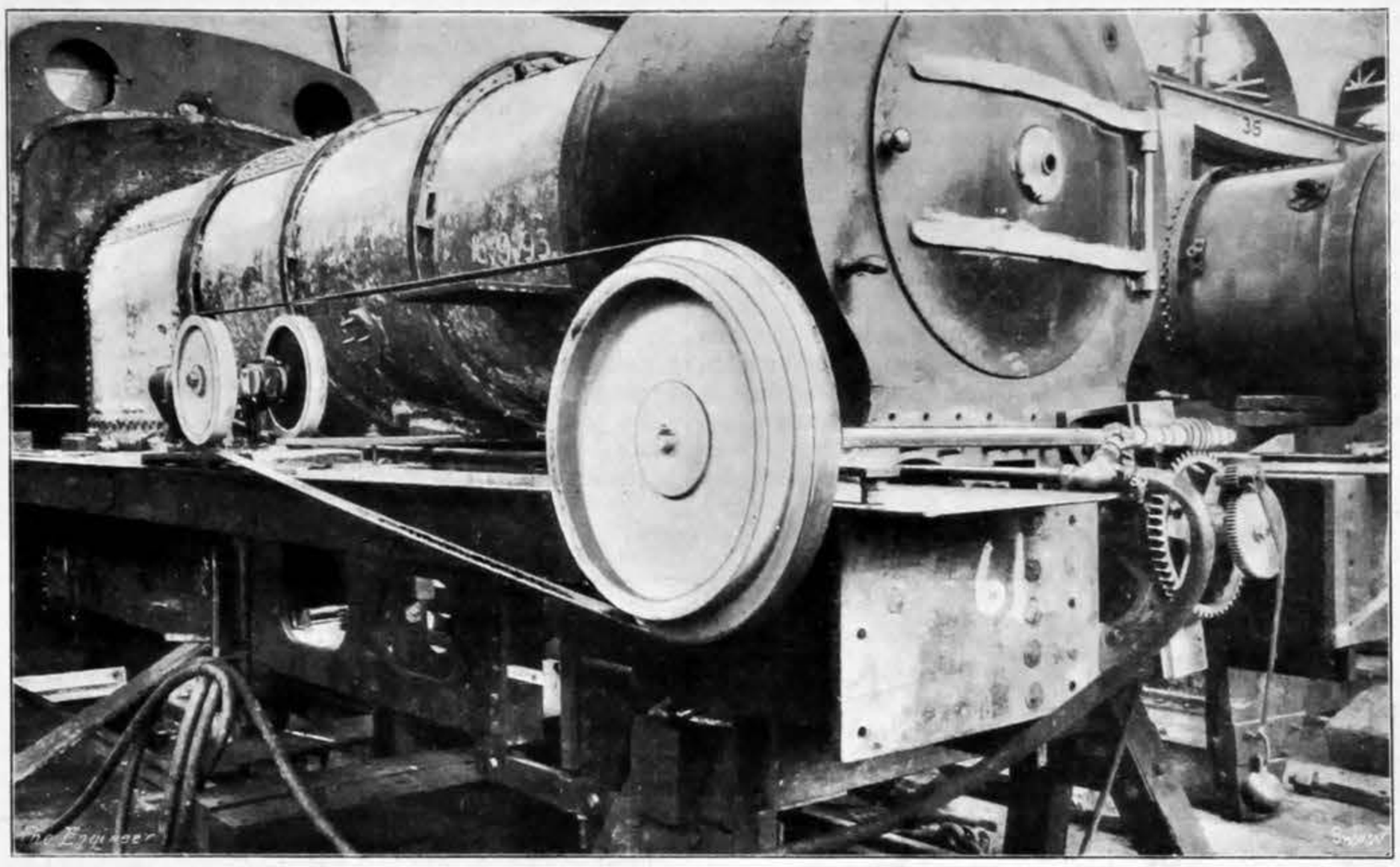
The discussion was opened by Mr. C. L. Simpson, who, referring to the manner in which Mr. Samuelson estimated the power of hammers, said he thought the shortness of stroke in the pneumatic hammer should be taken into account. If the steam hammer was used under proper conditions it was not so uneconomical as the comparison made it appear. To get the best result, small pipes should be used, and the steam should be superheated. Mr. Simpson then described the class of work for which they used pneumatic tools at Pimlico. As a rule, they found no difficulty in getting the men to adopt the Boyer hammers, but in the ironfoundry the trimmers complained of the vibration, and only the younger men could be prevailed upon to work them. For nearly all purposes they find Boyer drills more convenient than flexible shafting or ratchet braces. They were now taking air down a well 200ft. deep, and were drilling holes in girders in the well with a piston drill. As far as they had gone they had found pneumatic tools a success; but whether they would pay when renewals and repairs were taken into account it would need time to decide. They believed they would, and they expected before very long to increase the number of tools they had in use. Besides these tools they employed the compressed air for several other purposes, for hoists over lathes, for Tabor moulding machines, and for whitewashing.

Mr. Ivatt, called upon by the President, said that pneumatic tools were now largely in use at Doncaster. Air at a pressure of 80 lb. per square inch was supplied to the mains by one two-stage air compressor delivering 40 cubic feet, and two other compressors each giving 100 cubic feet of free air per minute. It was important that the air should be delivered to the compressors as cold as possible, and it was worth while erecting trunks on the north side of the shops or taking them through cellars in order to keep the temperature down. It was also advisable to so arrange the reservoirs that any moisture in the air might be deposited in them instead of in the tools. At Doncaster they used the Bradford rotary drill for tapping and driving stays. For the former purpose a reversing cock is fixed to the tool. They use also pneumatic hammers for chipping and caulking. The great thing with these is to select those in which there is the least vibration. They have also some machines of their own design. For repair work they used a small engine with cylinders 4in. by 4in. for re-boring cylinders. The little engine illustrated below, Fig. 1, has piston valves, the air being taken between the pistons and exhaust taking place from both ends of the valve chest, which are quite open. This engine is bolted at a convenient place to the frame, and the boring tool is driven by a strap from it—see Fig. 2, page 327. If the strap gets loose the engine is simply moved back a little further. For refacing valves the engine is placed vertically instead of horizontally, and belted to the tool. They have also a whitewashing plant rigged up on a truck, which they use for whitewashing buildings, and so on. They had also tried a pneumatic apparatus for cleaning the cushions of railway carriages. It consisted of a sort of currycomb, which was run over the cushion; the air entered through one pipe and left by another, the end of which was in a bucket of water. A current of air was induced by the rush of air in the apparatus, which sucked up the particles of dust through the comb and delivered them into the water. The action was very pretty, but it was not fast enough. They used their compressed air at Doncaster also for blowing through cylinders after repairs, and for taking engines out of the shops they filled up the boiler with compressed air and ran them out with that instead of raising steam.

Mr. Fielding said he had used pneumatic riveters and drills. As regards the former, although he does not consider that they do work equal to hydraulic pressure, he believes there is a field for them for the replacement of hand riveting. As regarded caulking tools, some twenty-four years ago he had made tools which did not differ much from those in use at the present day, but at that time the trend of opinion was that superior riveting by hydraulic pressure would do away altogether with caulking, and not very much had been done with the tool. A diagram of it was shown. It did not differ very greatly from the caulking hammers used to-day. A feature of it was a spring which kept the tool pressed away from the tup, so that though the latter might be reciprocating, it did not strike till the workman compressed the spring by pressing the edge of the tool against the work. He believed that the use of the spring in this way reduced vibration. He asked the author if there was any serious objection to the air pressure being increased from 80 lb. to 100 lb. By so doing both the weight and bulk of the compressors would be reduced. Mr. Amos replied at once that the London and North-Western Railway Company was, he believed, using pressure from 100 lb. to 120 lb.

The next speaker was Mr. Martell, who praised the paper, the subject, and the author, with an impressiveness which is only to be acquired by constant practice at the Institution of Naval Architects. It was a subject of the greatest importance, he could not tell the meeting

with what interest shipbuilders all over the world regarded it, and he thought the utmost credit was due to Mr. Amos for bringing it before the Institution of Mechanical Engineers. From the nature of his business he had but little to do with the manner of doing work, but he had to see that things were well done, and he could say of pneumatic tools that they turned out excellent work. He had seen ⅞in. rivets driven up by long

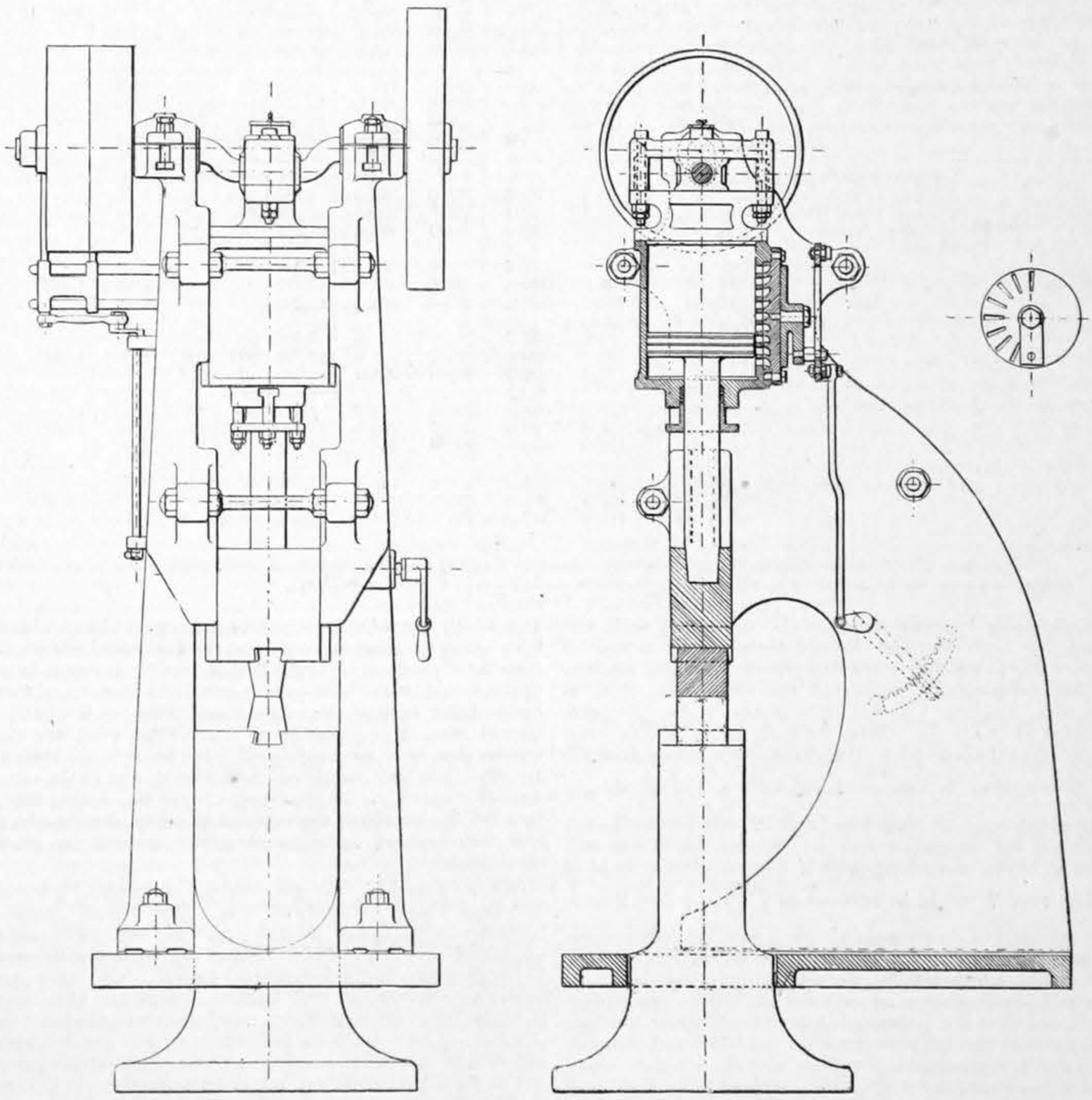


RE-BORING CYLINDERS WITH AIR ENGINE AT DONCASTER

Boyer hammers, and had slotted the plates through, and found the holes very well filled. In rapidity, and economy was effected thereby, they were greatly superior to hand labour. Contractors saw in pneumatic tools the means of obviating some labour troubles, and they found to their hand a means of executing contracts within specified times. With regard to the cost of riveting by air pressure, he read parts of an interesting letter referring to work done in Cramp's shipbuilding yard at Philadelphia. From a record of 95,000 rivets they had found the cost to be about 1·25 cents, as against 3·19 cents for hand work, and a saving of about 47 per cent. had been effected by their use. The two things necessary to the use of pneumatic tools was common sense and plenty of compressed air.

Mr. Mariner gave some account of the use of pneumatic tools at Yarrow and Co.'s yard. They employ air hammers for a good many purposes, and prefer the Boyer to other makes, as it gives less vibration. They have no complaints from workmen on that account. Arrangements are made so that the power of the blow can be regulated by a screw, and thus the operator need give no attention to how far the trigger is pressed down. For supplying the air they find a good quality light india-rubber hose better than armoured hose, which is too heavy and inconvenient. The pressure they use is 100 lb. An advantage of pneumatic chipping is that, on account of the nature of the blow, the chisel can be ground much keener, and, consequently, cuts faster and better. The force of the blow delivered by an ordinary hand hammer makes it necessary to have a comparatively thick edge to the chisel. Pneumatic drills are employed for a large variety of work on their boats. They had tried them for expanding boiler tubes, but with little success at first, because the spindle ran too fast, because they would not reverse, and because just at the end great pressure is required. They had then modified a Boyer drill, fixing a reducing gear of a reversing cock. They used pneumatic hoists also, but had found that until the operator had got used to the valve their action was too rapid. Comparing electric and air transmission, there were, said Mr. Mariner, distinct fields for each. Where it was necessary to give blows, for example, pneumatic pressure had to be used; but, on the other hand, when the power required exceeded about 30,000 foot-pounds per minute electricity had to be adopted. An advantage of pneumatic tools was that they were self-contained, the power being exerted on the spindle, and no flexible shaft being required as with electric tools. Then the electric drill is heavier, but the cable can be led through places where the pneumatic hose could not be taken, and the weight can be taken advantage of, when drilling vertical holes, as in decks, &c. Thus the decision of which class of tool was best could only be decided by a consideration of all the circumstances.

The Player power hammer, which we illustrate, was then described by a member of the firm. The hammer is driven by means of a crank, which works with a gun-metal block in a cast steel banjo. The bottom part of the banjo is a solid with the cylinder cover, to which the cylinder is bolted, and the cylinder itself is thus driven up and down by the crank, being guided by slides which are cast on it, and which move in corresponding recesses on the frame. The bottom of the cylinder is provided with a suitable stuffing-box, and through this the piston-rod projects. The stuffing-box provides an air-tight joint, so that the piston has an air cushion above and below it. The tup, or hammer head, is fastened to the bottom of the piston-rod, and all power is transmitted to this tup by means of either the top or bottom air cushion in the cylinder. The force of the blow is varied by varying the amount of the air cushion above and below this piston, and this is done by a series of holes being drilled at various heights in the cylinder, and a suitable valve being provided which opens any one of these holes at will, but only permitting one hole to be opened at one time. By this means, escape for the air is provided at different heights in the cylinder, and the cushion is formed either above or below the piston immediately the top or bottom of the piston passes the hole which is open. Thus by having a low hole open, only a small cushion is formed underneath the piston, consequently a heavy blow is obtained, while if a higher hole is open, a heavy cushion underneath and a small cushion above the piston is obtained, and the piston is consequently held off its work. There being a number of holes thus permits considerable variation of the weight of the blow. Snifting valves are provided a top and bottom of the cylinder which allow the piston to suck in air to replace any leakage or to renew the cushion when the hole that is open is altered. The valve gear used consists of a casting which fits on the back of the cylinder, and which has scored in it passages leading from the holes drilled in the cylinder to slots which are arranged as part of the radii of a circle, the air connection from the cylinder being, therefore, through each hole to corresponding slots on the face. Over this face is fitted a plate which is free to move about its centre, and this plate is provided with slots forming parts of radii of a circle similar to the face underneath it, with the exception that the radii are at different angles, so that when one slot of the plate corresponds with the slot underneath it all the rest are closed, while the small angular movement of the plate closes the open slot and opens one of the closed ones. This angular movement is obtained by providing this plate with a pin which projects into a slot in a sliding bracket. As the cylinder goes up and down this pin runs up and down the slot; but as the bracket containing the slot can be moved horizontally by means of a treadle or hand gear, the pin is pushed to one side or the other, and thus causes the plate to revolve through an angle large enough to open each slot in turn. It is estimated that the power required to drive this 3 cwt. hammer is under 4 brake horse-power at 220 blows per minute.



PLAYER'S 5 cwt. PNEUMATIC HAMMER

The President of the Chicago Pneumatic Tool Company said that, when he started making pneumatic tools some five years ago, the output was about 100 per year, whereas last year they were turning out at the rate of 800 per month, and they expected shortly to double that quantity, so that there were good reasons for thinking that the pneumatic tool was coming into favour. They were developing some new tools, particularly one for cutting the ends of tubes in a boiler. They had a good tool, too, for biting the heads off rivets instead of chipping them off; altogether they made some 70 or 80 different styles of tools. He felt confident that in a few years' time pneumatic tools would be very largely used in Europe.

Mr. J. J. Churchward, assistant locomotive superintendent, Great Western Railway, in showing the parts of pneumatic tools which wear out most at Swindon, remarked that although these tools were worth having in spite of repairs, because of the rapidity with which they worked, endeavours should be made to construct the parts so that they would last longer. Improvements are possible in the following directions: In reducing the vibration of hammers; in providing means for preventing the tool from dropping out; and in fixing a shield over the exhaust to prevent the operator's hand from getting numbed. A first-class light hose with a perfect unleaky joint is needed; a stronger type of hammer is required, and also some tool for shearing the heads off rivets and stays, which will take only five seconds instead of fifteen seconds as now required for copper stays. A good tool for cutting out tubes and dropping them to the bottom of the boiler was also required.

With regard to the noise that caulking and chipping tools make in a boiler-shop, they found that this could be greatly reduced by pulling a broad old driving belt tight round the barrel of the boiler. They had made a great success of tube expanding by air at Swindon. He recommended any one who thought of starting the use of compressed air to begin on a large scale; they had found themselves seriously hampered at Swindon by the difficulty of expanding their system. Big mains and sufficient compressors should be laid down. As the actual compressing is expensive, it would be an advantage if some means of using waste power could be used up for the purpose. With this end in view they were arranging a special plant at Swindon. About three locomotives a day were tested under steam, and it was the intention to test these on a special apparatus, so that the power

His proposition is astounding, and if based on a sound study of the question, and not only such stuff as day dreams are made of, then we do sincerely hope that Sir William will see his way at, no distant date, to explain his plans more fully than he has so far done. It is easy to talk of driving a bore-hole down into the earth till it reaches a seam of coal, then setting fire to the coal and feeding it with air and water in the correct proportions to produce a combustible gas which is to be led to the surface and burnt in gas engines, but it is quite another thing to carry such a scheme into practice, and until we have further particulars of how it is to be done we shall remain sceptical as to its achievement. But Sir William Ramsay's proposition does not end even there. We are not only to obtain gas by the subterranean combustion of coal, but we are also, so to speak, to manufacture our own petroleum. "You must remember," Sir William is reported to have said to a representative of the *Morning Post*, "that the mines would be red-hot underground, and the bore pipes would be conveying to the surface gas at a very high temperature. In these circumstances the oil would distil up the pipes, and would be separated from the gas by the ordinary methods. In this way we ought to be self-supporting as regards our oil." We thus are to obtain all the fuel we want for the generation of power on land and sea. The gas is to be consumed in engines which will generate electricity, and the electricity will be transmitted all over the country for heating, lighting, and power purposes, whilst the oil will supply our ships with means of propulsion.

Such, in brief outline, is Sir William Ramsay's view of the future methods of working mines. He has been informed that from the engineering standpoint the idea is workable, but for ourselves we must confess that we see enormous difficulties in the way, and we look forward with interest to hearing how they are to be overcome. Let us consider one or two of the more obvious. We will suppose that means of igniting a mass of coal at the bottom of a long bore-hole are really available, and we will further suppose that air and water can be administered in the proper proportions to make gas. What steps are to be taken to prevent the gas from escaping through the cracks and fissures in the ground, or to ensure that it shall have something approaching a fixed composition? Unless there is a sound method available for the satisfaction of the first question, much of the gas will be lost, whilst, unless the second can be satisfied, it will be extremely difficult to run engines with anything approaching regularity. But there is a still greater problem. The burning away of coal beneath the ground must lead to subsidences and collapses of a very serious order, to which the enormous heat generated by the combustion would contribute. Many mines extend beneath the sea, and such falls and collapses as would follow the Ramsay system of working would open cracks and fissures which would quickly lead to the hopeless flooding of the workings. Under even normal conditions the inflow of water would be difficult to deal with unless all the usual methods, involving the construction of proper shafts and a staff of underground workers, were followed. How much more would it be when the whole earth had been indiscriminately riddled by the burning away of seams? In indicating these great difficulties, we have assumed for the moment that the coal can be consumed in the manner Sir William Ramsay proposes, but until it has been definitely proved we hesitate to accept the assumption. To supply air and water just where they are wanted; and to prevent the accumulation of ashes, cinders, coke, and fallen rock from continually choking or changing the progress of the fire will be found no easy task; whilst the control of the supply of gas so that it may not greatly exceed the demand is a problem before which the heart of the stoutest engineer might well fail. On such purely practical problems as the nature of the lining for bore-holes which are to be subjected to the intense heat of a burning mine we do not touch, nor do we propose to discuss the economical question connected with the scheme, as to do so would be waste of time and labour till the practicability of the proposals has been demonstrated.

It is, we think, to be regretted that attention should be directed to such airy schemes when there are still so many practical problems in the economy of coal mining yet to be solved. Sir William Ramsay has discoursed on the subterranean making of gas, but he would have been better employed in discussing the great stores of gas already there which now are turned to waste in every pit. Whoever can show some method of saving that gas, of bringing it to the surface, and of burning it in engines, will do the world an enormous service. Some day the question may be grappled with, and already preliminary steps are not wanting. An investigation is afoot to discover how much gas can be absorbed by coal under great pressure. That is the converse of the conditions in the pit, where the gas is liberated by the breaking of coal, but it is one direction in which further knowledge of pit gases may be sought. No one can yet say whence it may lead, but it is at least a practical effort to find out more about a material on which the very existence of England, and, indeed, of Europe, depends.

The Coal Strike.

The end of the strike is now in sight, and it is possible to forecast, with some degree of confidence, what the general outcome of the sorry business will be. At any rate, the old facts which have been too long ignored, together with the new facts of the new situation, have now to be faced even by the most unwilling, and all parties must now act in the light of these facts. Empty theories and dangerous delusions have now to be cast aside. Briefly, the stern realities of the situation are these:—A million mine workers went on strike because half a million voted for a strike; half a million voted for a strike because they had been misled; the men having come out upon an impossible demand and under a delusion—the demand for a time-wage system on top of a piece-work system, and the delusion that they could win easily—have lost their case; in the conference room the leaders have been badly beaten by the unanswerable facts, figures, evidence, and arguments of the coalowners; they have been routed in conference, but have not dared to go into the country among the men and admit their beating. Thus, while the hundreds of thousands of men who never desired to strike have been itching to get back to work, the others who were misled into the strike have still been misled during the strike, and a general resumption of work has been delayed. The false hopes originally raised have been kept sufficiently alive to prolong the agony. No efforts have been made to explain the cold and sober facts to the men. No terms have been submitted to them. There has, till now, been no ballot on the question of a voluntary settlement with the owners upon the best concessions offered, and not even the protection of the law has been extended to the men willing to work.

Thus we are brought back to the root principle from which we ought never to have departed—the principle that industry depends primarily and ultimately upon employers and workmen, and not upon false agitators. Sober, solid, and disciplined trade unionism, ably officered and lawfully regulated, can be a potent force in the humanisation and progressive development of industrialism. But trade unionism has been captured by political windbags and industrial wreckers. Both men and employers have permitted themselves to drift into an impossible position, from which the State has endeavoured to rescue them. But in its haste, it has misjudged the position; the result is that instead of a secret ballot of all the men on the question of returning to work as an organised body, as they came out, we have the legislation of an empty principle, and a form of compulsory arbitration set up to enforce it. This principle strikes at the very root of the individual piecework system so essential to the welfare of the industry and the freedom of the men. The real leaders have lost most of their powers and prestige; trade unionism is weakened; we come back to the conduct of industry by employers and workmen according to local conditions, but with the added handicap of State interference with wages. The real trade unionism and the real leaders are discredited by this new measure and the methods it establishes, while the bare enactment of the Bill will be greedily seized by the false unionists and false leaders as a new instrument of discord and destruction. The State has embarked and is carrying industry upon a perilous voyage. State interference and compulsory arbitration may be all very well for disorganised trades and badly paid workers; but the coal mining industry and workers are neither badly organised nor badly paid. In the future things may be different. This new law will make them different. The strike marks the turning point. It has sown disorganisation among the men. The law will cultivate it. Men are already breaking away from the ranks. The moment the Bill becomes an Act and the State guarantees protection men will return to the pits by the thousand before even the ballot, as it inevitably will, gives them the sanction.

When the new joint boards get to work the owners will state their case just as they have in recent conferences; the men, already in receipt of the highest wages and best conditions their organisation could enforce or their industry afford, save in very rare cases, will gain nothing, but probably lose by the new form of arbitration. Besides, employment will be restricted. Some old pits will be closed. Some of the least profitable seams will be abandoned. The owners will concentrate upon the best seams and introduce more mechanical coal cutters. Again, millions of householders have learned to economise coal. Engineers will effect further economies in its industrial consumption. The nation's *per capita* demand will certainly decrease. Coal prices will be kept down relatively, and so will miners' wages, while the very introduction of the minimum wage by legal enactment will tend to pull the usual high earnings down to the minimum. In the long run, neither the colliery owners nor the coal consumers will suffer. The miners will pay the price of the misleadership that has characterised the last few years of their movement—their employment is bound to be restricted, their labour conditions rendered more harsh, and their average earnings pulled down. One bright aspect of the matter is that the doctrine of the general strike, or Syndicalism, has received a check. If there had been no Minimum Wage Bill, but a secret ballot, as we suggested, this dangerous doctrine would have been well-nigh stamped out, and trade unionism would have returned to a saner and soberer policy, stronger as a result of the change. Now, we fear, while Syndicalism is only checked, *bona fide* trade unionism receives a staggering blow—funds depleted, leaders discredited, men bitterly disappointed. The next step is for the whole country to see that under no circumstances can it ever again be put to the peril and disorganisation of the last few weeks. Labour has been treated with all tolerance, but the time has come when it must learn that it has a duty to the State no less than to itself. It must not be allowed to play fast and loose with the welfare of the nation. Strong and fearless legislation is wanted. The soberer section of the working population will welcome it as bringing them peace, whilst the general body of citizens will support the Government in any sensible course, or, if it is lethargic, find means of quickening it into activity.

Electric Vehicles.

At a recent meeting of the Institution of Electrical Engineers Messrs. J. C. Macfarlane and H. Burge presented a paper entitled "The Supply and Transmission of Power in Self-contained Road Vehicles and Locomotives," and from the abstract we gave last week it will be seen that the authors have devised an entirely new type of electric omnibus. The cost of running this vehicle is estimated to be appreciably less than that of a petrol omnibus, the saving, in fact, being fixed at no less than 1d. per omnibus mile. All the well-known points in favour of electric traction, such as absence of vibration, uniform acceleration, no noise or smell, and the various other claims usually brought forward are, naturally, emphasised. But, in view of the past history of accumulator traction in this country, it will be a little surprising if all the authors' hopes are realised, notwithstanding the ingenuity that has been exercised in the evolution of the scheme illustrated and described in the paper. One of the most attractive features of the contribution is undoubtedly the table of comparative costs, wherein the cost of power is estimated at .5d. per omnibus mile. This figure, it is to be noted, is based on the assumption that power will be obtainable at ½d. per Board of Trade unit; but it would be interesting to know how many supply undertakings are prepared to sell current at that price. As a matter of fact, central station engineers in this country have not hitherto shown any great desire to cater for this class of load, and we should be surprised to learn that there are many of them who are now prepared to provide current for charging purposes on such advantageous terms.

Possibly the cause of central station engineers being somewhat indifferent to propositions of this description is to be found in the fact that in many cases the voltage at the station bus-bars differs widely from the pressure needed to charge traction batteries, and the installation of additional plant therefore becomes necessary. In any case, the charging of cells calls for a variable supply pressure, and with an ordinary type of vehicle a booster or motor generator must be used. Otherwise expressed, the central station engineer cannot connect the battery directly across the mains like an ordinary motor or lighting load. This, we believe, gave rise to the high price which was often demanded for charging the electric launches on the Thames. In that case, however, the launches were not all designed for the same voltage and the proper charging current was some-

the pressure from 160 lb. or so to 250 lb. is so small that it is not worth having, while the additional pressure brings with it troubles which we shall not stop to recapitulate here. As to the reduction in size of the engines brought about by the rise in pressure, an old adage tells us that we cannot have our cake and eat it. The rise in pressure can only effect an economy because it permits us to increase the ratio of expansion. But, be the boiler pressure what it may, the final pressure must be always about the same, and that, other things being equal, must be fixed by the capacity of the low-pressure cylinder. All which means simply that, although the power being a constant, we can use a smaller and smaller engine as the pressure is higher and higher, yet no such statement holds if the augmentation of pressure is intended to secure a greater range of expansion; and, so far as we can judge, no attempt has been made to effect any very great reduction in the size of cylinders as a consequence of the increase in boiler pressure. Turning next to the actual results obtained from the new type of machinery as compared with the old, we cannot do better than give Sir John Durston's own figures. He tells us that the average of battleships with triple-expansion engines and Scotch boilers is as follows:—

I.H.P.	Piston speed. ft.	Pressure in engines. lb.	Revolutions per minute.	Coal per H.P. lb.
12,414	875	145	103·0	2·40
10,404	827	141	97·3	2·25
6,170	712	138	83·8	1·77

Here it will be seen that the lower the power the more economical was the engine. It would appear, therefore, that the argument that a rise in pressure was required to secure economy in fuel at low powers is not quite substantiated by the facts.

In the same table, for the purposes of comparison, Sir John Durston has given particulars of six ships of the Canopus class with Belleville boilers. The piston speeds are given at 918ft.; the boiler pressure, 300 lb.; and the engine pressure, 250 lb.; but we have no data as to the consumption of fuel per horse per hour. Turning, however to the particulars of the Diadem, which may be regarded as fitted with the very latest and best of the new type of machinery and boilers, we find, curiously enough, that at 3318 indicated horse-power she required 2·21 lb.; at 12,813 indicated horse-power she used 1·61 lb.; and at 17,262 indicated horse-power she used 1·76 lb. of coal per horse-power per hour. From which we gather again that at low powers next to nothing is gained by the augmented pressure. Nor, indeed, is this remarkable, because we find that there is no great reduction in the dimensions of the engines secured beyond that got by an increase in piston speed. Comparing the weights of the old and new type engines, we have the Edgar class with Scotch boilers. The engines weigh 91 lb. per indicated horse-power when the ships are working at full power—12,551 horse-power; while those of the Diadem weigh 100 lb. when indicating full power—17,262 horses. Nor has the increase in pressure secured a considerable reduction in the weight of the boilers and engines as a whole, for at full power, as given above, the weights per horse-power are, for the Edgar class, 202 lb., and for the Diadem 197 lb., representing a total saving of 5 lb. per horse-power—something worth having, no doubt. Yet even about this we are uncertain as to whether the figures do or do not include the boiler-room accessories, which, with water-tube generators, are very heavy.

It may be taken for granted that Sir John Durston's paper sets forth with precision the available information concerning the machinery of our Navy—within limits. That is to say, while it is accurate, and even complete as far as it goes, it does not go very far. Nor is it permitted to go far. The Admiralty, like the young lady in Longfellow's poem, "knows how much 'tis best to show." Very very strict rules indeed are promulgated as to the publication of information. When an experiment is to be carried out all concerned have to sign an undertaking that they will supply no information to the Press. On this point we shall have more to say presently; for the moment, however, we must confine our attention to published information. The question we are discussing is, What has been the result of a radical and extensive change in the method of generating power in our warships? It is quite true that the House of Commons is not the right place in which to carry on a technical discussion; yet debates on the Naval Estimates in Parliament are not without their value. We are told that considerable advantages have been gained by the adoption of high pressures at sea and the Belleville boiler. The accuracy of this statement is traversed by very eminent authorities. Which side is right? The subject is so large, and so much may be said on both sides, that it is quite impossible within reasonable limits to thrash the matter out. But the time has undoubtedly come when, as we have said, stock should be taken and the facts ascertained as to the true results of that change in the mechanism of our ships about which we are writing. It is clear from what Sir John Durston has said that the advantages claimed by the Admiralty for the new system are a reduction in weight per unit of power at full power; a reduction in the consumption of fuel at all powers; and a special saving at small powers. The figures we have quoted tend to show that the saving in weight is little more than nominal, but it must be admitted that there is a good deal of uncertainty about the true meaning of the figures. In order that there may be no suspicion of unfairness in our statement, we give on the preceding page a table, which has been condensed from official statements already published. It is contained in Sir John Durston's paper, from which we have already quoted.

Here we have the means of making a general comparison of the results of the old and new systems. We may take figures haphazard, anywhere, and analyse them. For example, the Scotch boilers of the Edgar class have 30·6 square feet of heating surface to one of grate surface; Belleville boilers with economisers have 27·34 square feet. The Scotch boilers come much nearer equality with the Belleville boiler in horse-power per ton than is commonly supposed. Take, for example, the figures given in column 19 in the preceding table. It will be seen that The difference is small—16·2 horse-power as against 16·50 for the Andromeda. The Powerful's boilers actually weigh more per horse-power than those of the Edgar class, the figures being 15·85 and 19·51 horse-power per ton in the Powerful against 16·2 and 20·1 horse-power per ton in the Edgar. A difficulty based on an uncertainty confronts us, however, in dealing with these figures. Everything depends on how much the boilers are forced, and it is quite possible to say that, whereas the figures given represent the best that the Edgar can do, they do not set forth the best efforts of the Powerful. We venture to say, notwithstanding, that the figures fairly enough represent the relative proportionate weights of the two types of boilers. It may be admitted, nevertheless, that there is some reduction of weight secured by using the Belleville instead of the Scotch boiler. Indeed, if we had to consider the boilers alone without their appurtenances, the Belleville boiler would perhaps compare favourably with the Scotch boiler. It may also be conceded that the Diadem type of engines requires less steam per horse-power per hour than the older engines of the Edgar. But it is quite well known that until an economiser was added to the Belleville boiler the new system required more coal than the old, in spite of the excellent performance of the engines. The economiser, perched on top of the boiler, high up in the ship, is a dangerous innovation in a man-of-war, and it has been stated that, when going into action, such a ship as the Diadem would have to shut off her economisers and empty them.

Balancing, then, all that can be said in favour of the old and new types, it appears that by the use of high-pressure steam a small economy in fuel is effected, and by the adoption of the Belleville boiler a saving in weight worth having, but not very considerable, has been secured. It is, we think, quite fair to add that high-pressure steam and the Belleville boiler could not have taken the place they hold in the British Navy if nothing else enforced their adoption than these savings. There is little reason to doubt that high pressure was adopted because the Belleville boiler primes heavily at low pressure; only throttled steam may be drawn from it, otherwise the steam is too wet for use. The new system has been introduced into the Navy, not because of its intrinsic merits, but because the Scotch boiler had failed disastrously. Why it failed is a long story, which contains a strong indictment of the Admiralty; but we shall not tell it here. The Scotch boiler is not competent to meet the demands of a modern navy; and the Admiralty were quite right to discard it for something else. But the system of working, the method of construction, and the design of the Scotch boiler as used in our warships, did not give it a fair chance, and even now some of the most serious objections formerly urged against it have been overcome.

We have, we think, stated as fairly as possible the position from an Admiralty point of view. The new system is better than the old, in that it is lighter and more economical; how much lighter, and how much more economical, our readers can determine for themselves from the table we have printed. We shall not stop to argue whether the saving is worth having or not, we freely admit that it is. Next we have to consider whether the methods by which the saving has been effected are or are not the best. Far be it from us to reproduce the old hackneyed abuse of the Belleville boiler. It must be judged by results, not by theories about its action, or prejudices against a French invention. Here we come into direct opposition to Admiralty policy on a most important point. Whitehall takes care that nothing that can possibly be kept secret about the working, the durability, and the safety of the boilers and engines in our Navy shall be made known. What the result of this policy has been, and the effects of the absence of initiative, are not recognised as they should be. When information is sought for in the House of Commons or elsewhere, the answer is invariably either that there is nothing to tell, or that it would not be for the good of the service to tell it. Under a different system, we hold that our Navy would be more efficient than it is now. Why, it shall be our business to explain in another article.

TRIALS OF THE ASAHI.

THE trials of the Japanese battleship Asahi, or Asaki, were concluded last week. This vessel was built and engined by John Brown and Co., Limited. She is 400ft. long between perpendiculars, her beam is 75ft., her mean draught 27ft. 3in., and her displacement 15,200 tons. The armament was designed and constructed by Sir W. Armstrong, Whitworth, and Co., and consists of four 12in. wire guns, fourteen 6in. quick-firing guns, twenty 12 lb., and sixteen smaller pieces and four submerged tubes. The arrangement of the guns is not very dissimilar to the plan adopted in the Formidable, but the British vessel has only twelve in place of fourteen 6in. guns. The armour made by the builders is of nickel steel, and consists of a main belt 9in. thick, 250ft. long, 8ft. 3in. wide, 3ft. being above the normal water-line; surmounting this is a second belt of the same length but 6in. thick, extending to the main deck. There are armoured bulkheads at each end of the vessel. The redoubts for the big guns have 14in. armour, and the smaller guns are protected by casemate walls with a maximum thickness of 6in.; the conning towers are of Harveyed steel. There is a total bunker capacity of 2000 tons, and therefore, according to the 80 per cent. of her full power consumption trial of Wednesday last, the ship has a radius of action, at 17½ knots, of about 4000 miles, with a proportionately higher radius at more economical speeds. The Asahi is lighted throughout with electricity, and carries six search-lights and about 800 incandescent lamps. She has accommodation for an admiral and staff and a complement of 800 officers and men.

The trials began on Tuesday last on the measured mile in Stokes, Bay with the following results:—613 indicated horse-power, 6·69 knots; 1610 indicated horse-power, 9·28 knots, and 4355 indicated horse-power, 13·06 knots. On Wednesday she completed her high-speed consumption trial, the result showing that at 12,947 indicated horse-power the consumption was only 1·59 lb. per horse-power per hour. There was a high wind and a heavy sea, but the records taken gave an approximate speed of 17·5 knots. The ship then put in at Plymouth to clean boilers, and on Friday started on her full-power trial between Start Point and Barry Head, a distance of 12·26 nautical miles. Four runs were made, the first and third being in the teeth of a north-easterly gale; but with this disadvantage the mean speed was 18·3 knots. The speeds on the four runs were:—First run, 17·92 knots; second run, 18·08 knots; third run, 18·65 knots; fourth run, 18·3 knots. The mean indicated horse-power for the entire series of runs was slightly over 16,000. After the full-speed trial circles were made to port and starboard with each steam-steering engine with the vessel still at full speed, and at a speed of 15 knots the hand-steering gear was successfully tried. On the return to Spithead, at 17 knots, the stopping, starting, and reversing trials were carried out.

DOCKYARD NOTES.

THE Spartiate—the last of the Diadem class—leaves Pembroke for Portsmouth on the 7th of April. She is probably the last big protected cruiser that we shall ever build—the armoured variety now holding the field. The curious thing is that everything to be said for the armoured cruiser was to be said long before the Spartiate was commenced at Pembroke dockyard.

THE Hood, from the Mediterranean, has arrived at Sheerness, *en route* for Chatham and paying off. The Hood is generally spoken of as one of the Royal Sovereign class, as she was built at the same time and has much the same armament. Actually, however, she is rather an improved Trafalgar, and of the same type as the Russian Tri Soiatitelia. An ex-chief engineer of the Hood's, who worked out her weights, always asserted that she was the heaviest ship in the world, displacing 15,400 tons, though she is usually credited with more than a thousand tons less. Still, one must bear in mind that chiefs are human, or rather—should we say?—sailors, and he would be a poor sort of sailor who could not swear to some superiority of his ship over all others. Whatever she displaces, however, the Hood is a fine ship, and though perhaps of the second rank, she is superior to all the Royal Sovereign class on account of the protection to her big guns. The Hood's big guns could not be silenced by a Maxim.

THE Grand Duke Alexander of Russia has been appointed captain of the new battleship Rostislav—a reduced Poltava—of 8880 tons. She belongs to the Black Sea Fleet, of which it has been said that the crews are not worthy of their splendid ships. We do not know whether this reproach is true, but if so, this appointment of the Grand Duke Alexander is likely to take it away pretty effectually. Imperial sailors are usually looked at askance, as being probably a deal more imperial than nautical; but the Tsar's brother-in-law is after quite another pattern, and as he will be virtually in command of the Black Sea Fleet we may look to see that fleet reach the highest pitch of efficiency to which it can be brought. Possibly the appointment has more political significance than is suspected.

The Rostislav is, by the way, the most famous ship name in the Russian navy. The old three-decker Rostislav was at the battle of Tchesma, and a few years later flagship of the Scotchman Greig at Gogland. The ironclad is of the second rank, as she only carries 10in. for her principal armament, but she is well protected and fast. On trial she made 18 knots with liquid fuel—at least a knot more than was expected of her. Everything in her is "made in Russia," too!

THE Royal yacht has lost all her raised forecastle except at the extreme bow, where it has been left to avoid disturbing her particularly gorgeous figurehead.

THE old Boadicea is now being dismantled in Portsmouth dockyard. She is going to be a hospital ship. The Ruby is being turned into a coal hulk.

ADMIRAL DUPERRE—who gave his name to perhaps still the best-known French battleship—has just died.

THE destroyer Osprey has made 28·2 knots off Plymouth in a heavy sea, all weights on board. This is a very fine performance, and rather takes away from the French creed that our destroyers cannot exceed 25 knots or less in a seaway. The Osprey is a 340-ton, 30-knot, Fairfield boat.

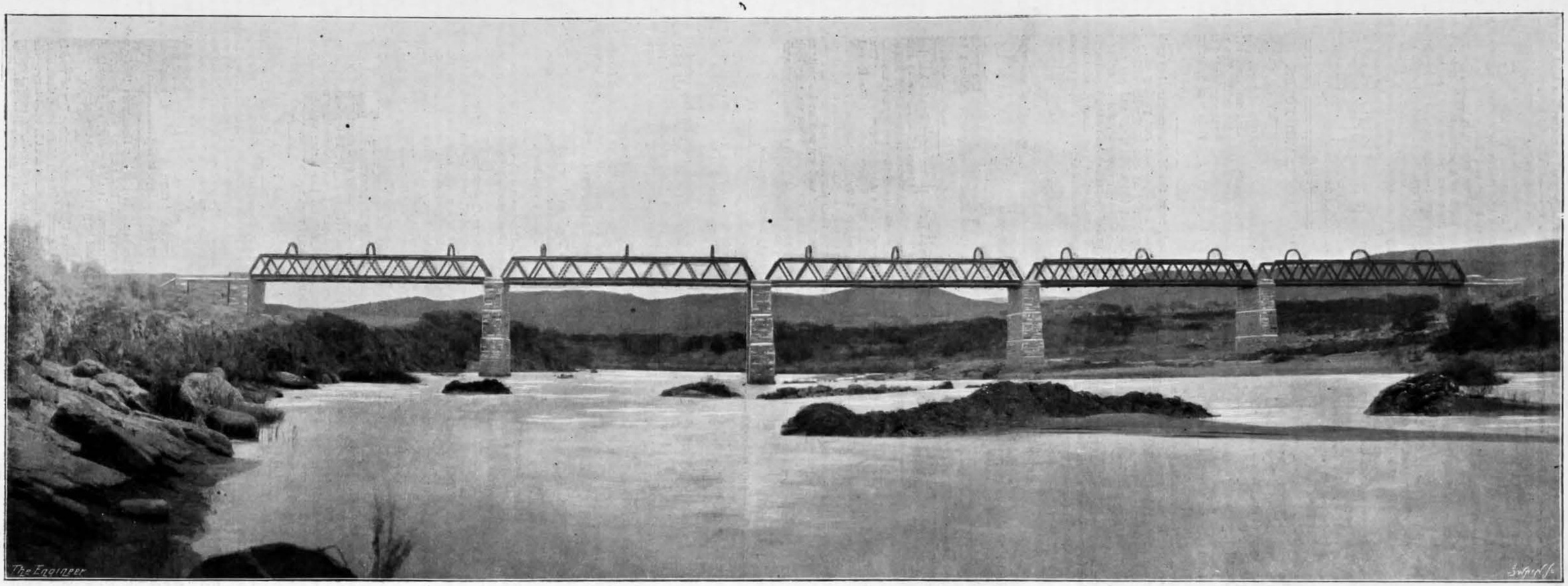
THE old guns, which for so long a time have been lying in the road outside Southsea Castle, were moved on Tuesday by hand power. At present rates they will be right across the Common before Midsummer, but presumably the haulage by manual power is merely evolutionary and drill. The moving of such guns—either 12½ or 18-tonners, it is doubtful which they are—by hand is an interesting sight, and attracted a large crowd, despite the bitter weather. Mr. Stead and his friends did not turn up to protest.

A PATENT has just been taken out in Russia for a fuel that claims to increase the calorific of coal some 25 per cent., and also to render it smokeless. If smokeless coal is really the "breath of Empire" that the Navy League tells us it is, the Russian navy would appear to be within measurable distance of the necessary breath. Their smoke hitherto has been pretty black, as they burn all kinds of things alternated with best Welsh. A Mr. Strong, an Englishman, we are told, is the patentee. At the same time we are reminded that Westport coal from Australia is nearly smokeless, and was used by the Calliope at the time of the Samoan affair.

THE Sanspareil is leaving Sheerness this week for Portland to carry out her annual prize firing. The Trafalgar from Portsmouth is also going, so altogether the Reserve Fleet should be pretty well up to strength.

YESTERDAY the Japanese cruiser Iwate was launched from Elswick shipyard. She is 400ft. long, 68ft. 6in. in beam, and 41ft. deep. Her displacement is 9750 tons. She carries four 8in. and fourteen 6in. quick-firing guns, twelve 12-pounders, eight 2½-pounders, and four submerged torpedo tubes. She is thus a very typical Elswick ship.

THE COLENSO BRIDGE OVER THE TUGELA RIVER



THE TUGELA BRIDGE.

As a supplement to to-day's issue we give reproductions from two most interesting photographs which have been courteously handed to us by Mr. M. W. Carr, consulting engineer to the Natal Government. These photographs show the bridge over the Tugela River at Colenso, which our readers will remember was blown up by the Boers. An examination of these photographs will show the wanton damage caused to this bridge. All military objects would have been achieved had only one span been destroyed, but not content to simply do this, the Boers have wrecked every span, and have completely demolished one of the piers. The explosive used was probably placed on the top and bottom of each girder at some distance away from the piers, and the result was that the girders collapsed and slid off the masonry piers. In the case of the wrecked pier, however, it would seem that undermining had been resorted to.

The destroyed bridge, an engraving of which as it appeared before being destroyed is shown above, formed part of the Maritzburg-Ladysmith extension of the railway which was commenced in 1882 under the superintendence of Mr. Carr, when chief resident engineer to the Natal Government. The bridge was completed in the year 1885. The contractors for this piece of railway were James Perry and Co., and the iron structure of the bridge was supplied by Head, Wrightson, and Co. It consisted of five spans, each of 100ft. —the girders being 105ft. long—carried on masonry piers. These piers were built of a fine hard freestone quarried in a neighbouring locality. Great care was exercised in their erection—and indeed in the construction of the whole bridge—which was considered quite the show bridge of the colony. The excavation for the piers was taken down to the solid rock, which at this place comes near the surface, and the foundation stones were set on the rock in one to one cement and sand. In design the piers are very strong, and necessarily so, as frequently they have to withstand furious floods which come down in a remarkably short space of time. Colenso is so near the foothills of the Drackensberg that the stream, which one evening may have but little water in it, may in the morning following have risen 20ft., and be a raging torrent. In the views we reproduce, it would seem as though too large a bridge had been provided at this point, but this is by no means the case, as the water stretches from abutment to abutment in times of high flood. This same remark applies to all the bridges in Natal. Streams that in dry weather one could almost jump across are often traversed by railway bridges of 100ft. span. This great length is quite necessary. In floods the water level may rise so greatly that it comes but a few feet below the underside of the girder, and the stream may be much more than 100ft. wide.

In our issues of January 19th and February 6th we gave photographs and drawings of the new spans, which were made by the Patent Shaft and Axletree Company to take the place of the spans destroyed at Colenso and at Frere. These were ordered by the Natal Government, when these bridges were blown up, and now some of the spans, if not all of them, have arrived at their destinations, and in the case of the Colenso Bridge, at all events, they will have arrived before they can be used. As a matter of fact, the Natal authorities, as soon as ever hostilities begun, set to work to make provision for the temporary repair of such bridges as might be blown up. It was recognised that such an eventuality was more than a probability. The locality does not produce timber of the requisite character for making temporary bridges, and all of this had to be imported. So quickly was the work organised, however, that weeks before our forces finally occupied Colenso, the necessary timbers for the temporary repair of the bridges were obtained, worked to size and shape, and loaded ready on trucks. In the original of one of the photographs which we reproduce there is very faintly shown a train of trucks with the timbers made ready for the necessary repairs. The temporary bridge is alongside the wrecked bridge, but at a lower level, of course, the rail being diverted on to the new structure. The timbers are made up into trestles, which are placed on the bed of the stream and as securely fastened as circumstances require, being further secured by weights piled up on the cross beams at the bottom. The temporary bridge at Frere has long since been completed, and that at Colenso was reported complete recently, enabling through traffic between Durban, Ladysmith, and Elandslaagte to be resumed. All necessary repairs and reconstruction of the way and works have been carried out in the most expeditious manner by the engineering department of the railway, under the supervision of Mr. J. W. Shores, M. Inst. C.E., engineer-in-chief.

HYDRAULIC MACHINERY FOR HANDLING ORE.

The Pittsburgh, Bessemer, and Lake Erie Railroad Company hauls a large quantity of iron ore from Conneaut harbour, Ohio, to the smelters in the vicinity of Pittsburgh, Pa. To facilitate the transfer of ore from vessels to the cars, an unloader has been designed which accomplishes more in the same time than any other machine of its character now in use in the United States. We illustrate this machine on page 331. It is known as the Hulet automatic unloader, and has removed cargo at the rate of 300 tons an hour. Its operations are somewhat similar to the American scoop dredge, except that it works in the hold of a vessel instead of on the bottom of a harbour.

The machine is operated as follows:—Mounted on a railroad track, it is moved along the dock to a point opposite the hatchway of the steamer or barge. Mounted on the frame of the machine is a trolley; this trolley carries a cylinder that moves the trolley to and from the boat. Pivoted to this trolley is a walking beam, which is operated by a cylinder secured to the same for raising and lowering the outer end over the boat. Pivoted to the outer end of the walking beam is a depending mast or leg; this leg being mounted on rollers, swings a complete circle, actuated by a cylinder. At the lower end of this leg is a shoe; secured to this shoe is a "clam shell" bucket holding ten tons of ore. This bucket is worked by hydraulic cylinders. By turning this mast the bucket has a reach of 20ft., and can be filled under the deck of a boat.

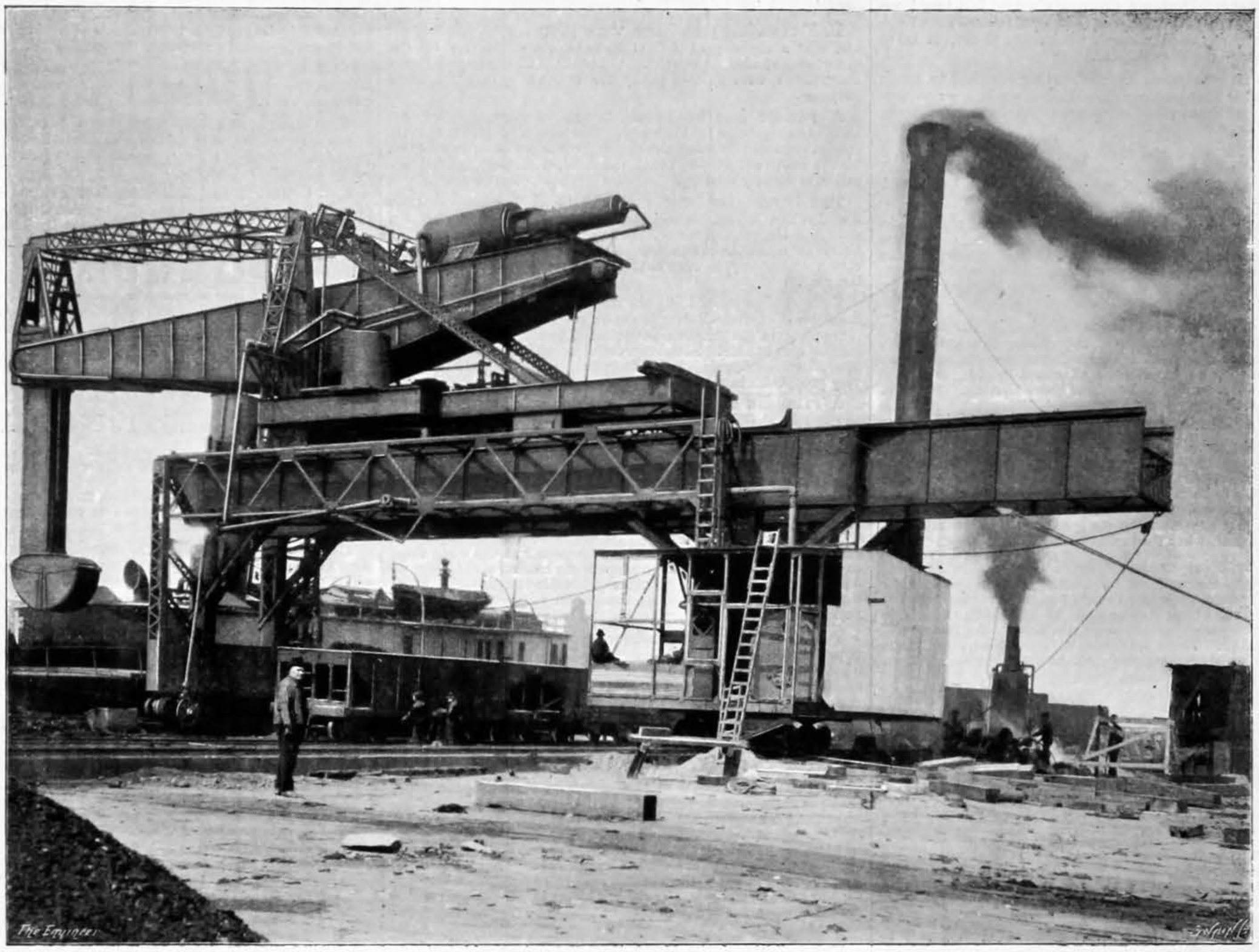
Three men are required to control the operations—the engineer, the bucket operator, who regulates the movements of the cylinder as the bucket works in the hold, and a man to guide the mechanism on the top platform. About 25 horse-power is utilised in moving the unloader up and down the track, and the same boiler is used in working a steam accumulator giving hydraulic pressure which is also communicated to the cylinders of the superstructure. In removing the cargoes of vessels carrying 4000 and 5000 tons, it is intended to employ an unloader at each hatch, transferring the ore, coal, or other freight from the hold to the shore at the rate of 1000 to 1200 tons an hour.

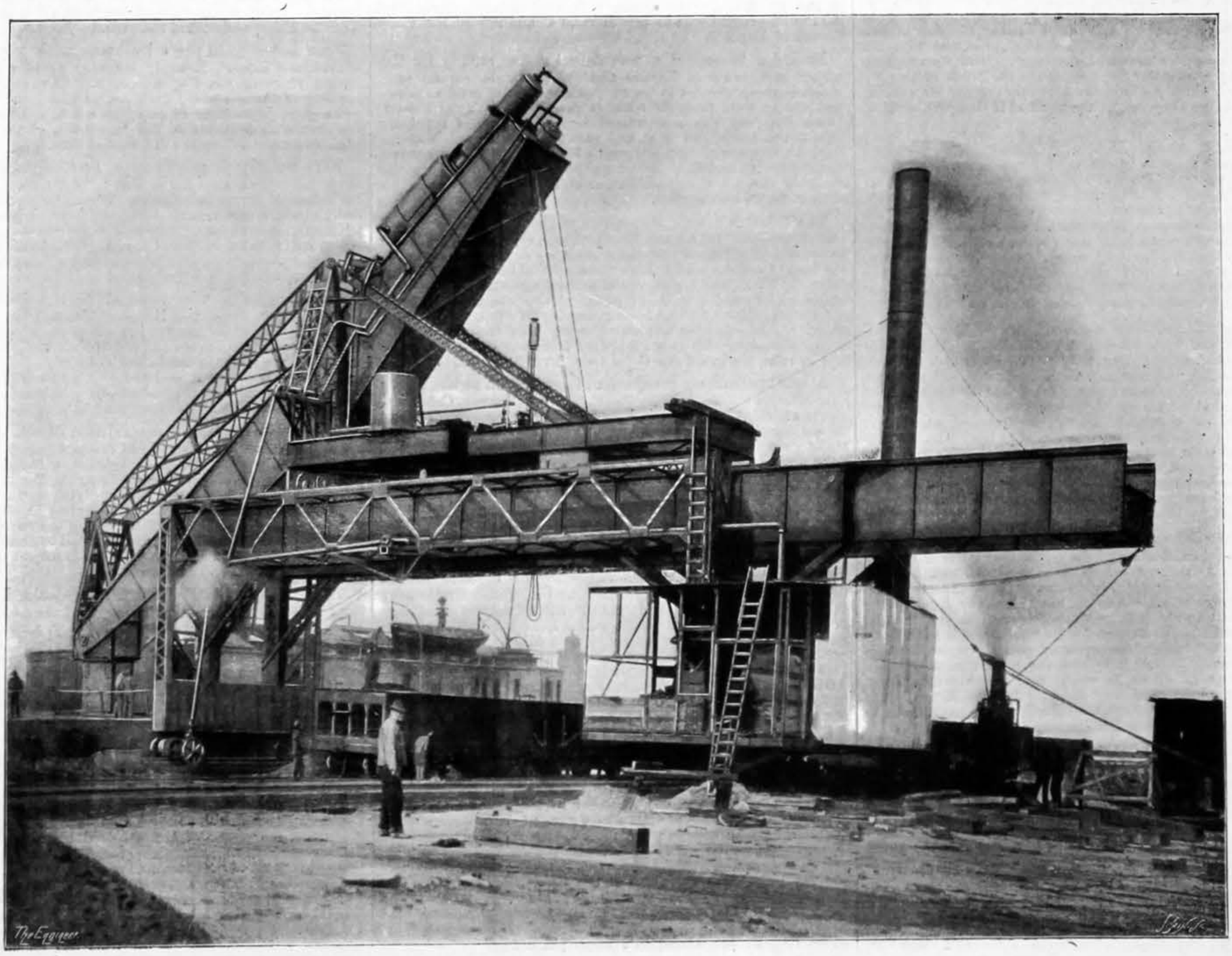
The machine has been examined by a number of engineers, and it it understood several are to be built immediately, to be used at various ports on the Great Lakes, also at New York and elsewhere.

The Waterworks Committee of the Kidderminster Town Council have recommended that application be made to the Local Government Board for sanction to borrow £6000 for outlay connected with the additional water supply of the town.

THE HULET HYDRAULIC UNLOADER

(*For description see page 330*)





RAILWAY MATTERS.

THE ceremony of cutting the first sod for New York's first underground railway occurred on Saturday last.

THE Baldwin Locomotive Works is said to have orders on hand for 700 engines to be delivered as fast as the work can be done.

THE Caledonian Railway Company's coal bill went up £25,023 during the past half-year, and of this only £2942 was accounted for by increased mileage; the balance of £22,081 being attributable to the higher price paid.

A WRITER in a Russian journal estimates that to reach the level of other European countries, Russia would have to construct 53,000 additional miles of railways, not including Siberia, and this only in proportion to population.

AMONGST the new railways projected in Russia is a great line for developing the mineral industries, from Cheliabinsk to Tsaritzin. This line would provide the Donetz basin with minerals from the Ural, and the Urals with coal and naphtha fuel.

IN response to an invitation to engineering firms to tender for the supply of one, two, or three additional engines for the Leeds Tramway Electrical Generating Station, twenty-nine offers have been received. The Tramways Committee are anxious that as little delay as possible should occur in the laying down of the extra plant.

IN view of the increased cost of traffic through the advanced prices in coal and iron, the railway companies have decided to raise their excursion fares during the ensuing holiday season. Fares up to 5s. will be advanced by 3d., over that sum and up to 10s. by 6d., and on fares above that amount by 1s. The new scale will apply to both day and half-day trips, and also to tickets for longer periods issued at holiday rates.

THE results of draw-bar tests taken on the South London Electric Railway show that the tractive resistance per ton of train is 40 lb. at the moment of starting, and that it drops quickly to 10 lb. at six miles. Between six and thirteen miles per hour the resistance remains constant, and then continues to rise almost proportionately to the speed until twenty-six miles per hour is reached, when the resistance is about 21 lb. per ton.

AN effort is being made by the Midland Railway Company to complete the work of constructing the new deep-water harbour at Heysham, so as to be ready for the summer traffic of 1901, and with this object they propose to have built three high-speed twin-screw passenger and cargo steamers for the Belfast and Isle of Man traffic. These steamers, it is proposed, shall steam 24 knots, and it is probable they will be fitted with water-tube boilers.

A CONVENTION has been signed at Athens by M. Theotokis, the Prime Minister, M. Simopoulos, the Minister of Finance, and Baron George de Reuter representing the Eastern Railway Construction Syndicate, for the completion of the railway from Piræus to Demerli, in Southern Thessaly, and its eventual extension to the Turkish frontier. Branches will be constructed to Chalcis and Lamia. The necessary capital will be provided by a 4 per cent. loan of 43,750,000f., issued by the Government and taken at a fixed price by the syndicate.

THE Tramways Committee of the Halifax Town Council met last week to consider what attitude they should adopt with regard to the tramway clauses in the Corporation's Parliamentary Bill, seeing that a Parliamentary Committee has refused to allow Huddersfield to carry out extensions beyond the borough boundaries. This the Halifax Bill seeks power to do to a large extent, lines being proposed to Hebden Bridge, Brighouse, Elland, and other districts. The Committee, notwithstanding the decision in the case of Huddersfield, decided to proceed with the Bill in its present form.

WITH the completion of the extensions of the Dresden tramways now in hand there will be about 70 miles of line worked by electricity. A new generating station is being erected at a cost of £260,000. In the new station there will be installed five steam sets of 1000 horse-power each, while a further addition of two such sets will be made to the original plant, together with the additional boiler power rendered necessary. The tramways at Dresden, says the *Electrical Engineer*, are in the hands of two distinct companies, which purchase the necessary current for working their lines from the Corporation, the method of charging being an interesting one.

IN the works of the Dublin, Wicklow, and Wexford Railway Company there is in course of construction a new train, intended for tourist and general traffic between Dublin and Wexford. According to the *Irish Times*, it consists of handsomely-appointed first, second, and third-class carriages, fitted with all the most recent improvements. Most interest will attach to the third-class carriage, which is of a large bogie pattern, and is fitted with patent spring cushions, lavatory accommodation, luggage racks, &c. This is a decided step in advance of other Irish railways in the matter of the comfort of that numerous section of the public who travel long journeys in third-class carriages.

A DISASTROUS collision occurred on Wednesday between Glasgow and Helensburgh, in which five people lost their lives and over twenty were injured. The trains to which the accident happened left the terminus at Bridgeton at 5.45 a.m. and 6 o'clock respectively. Queen-street was reached by the earlier of the two trains at about 6 o'clock. The first train had got half-way through the tunnel about half a mile from Queen-street, when it was pulled up in consequence of an accident to the brake. Meantime the second train had, contrary to regulations, been signalled to proceed, and dashed with tremendous force into the obstructing carriages. The last three vehicles were practically wrecked, and in every compartment passengers were thrown from their seats and suffered more or less severely.

IT is reported from Constantinople that the pending negotiations between Russia and Turkey in the matter of railway construction in Asia Minor are drawing to a close. The stipulations made by Russia are certainly such as might be expected to be made by a Power which knows it has the upper hand. The Russian stipulations are that railways projected in the Turkish provinces adjacent to the Russian frontier shall be built exclusively by Turkish capital, and be subsequently entirely under Turkish control. Moreover, Turkey is to give the preference to Russian syndicates before all others in every case in which the Porte contemplates the construction of railways in Asia Minor. It is thought that these stipulations are intended to act as a check to German railway enterprise in Northern Asia Minor.

WITH the object, says the *Globe*, of encouraging emigration to the fertile regions recently opened up by the Trans-Siberian Railway, the Russian Government have given orders for the issue of tickets at a very cheap rate. These special tickets will be issued for Tobolsk, Irkutsk, and, beyond there, for Vladivostock and Port Arthur. One ticket, apparently, will cover a whole family, and will be available at something like 114 stations on the line of route. The zone tariff has been adopted. From any point in Russian Europe to Tobolsk the price per head has been fixed at two roubles. Beyond Tobolsk to any spot in the vast Siberian region the charge for these emigrant tickets will be 4½ roubles a head—that is to say, that for about 14s. 6d. one will be able to travel a distance of over 6000 kiloms., or something like 4000 miles.

NOTES AND MEMORANDA.

THE price of copper this month has reached £79 per ton, or 30s. more than the record of last April.

THE production of Bessemer steel ingots in the United States last year amounted to 7,586,354 tons, against 6,609,017 tons in 1898, 5,475,315 tons in 1897, and 3,919,906 tons in 1896. Pennsylvania produced slightly over one-half of the total last year.

IN Prussia last year there were 2799 steam engines in use, with a capacity of 258,511 horse-power, exclusively for the generation of electric energy. A further 1000 engines of 74,831 horse-power were in use, partly for this and partly for other purposes.

A PATENT has been taken out in America for an aluminium electrode for arc lamps. The inventor claims that more light is produced by using aluminium for the negative, and carbon for the positive electrode, because aluminium lasts longer and the carbon is entirely used up.

THE imports of raw cotton into this country from America and Egypt, *viâ* the Manchester Ship Canal, this season show a remarkable increase. It is said that there is now forty times as much American cotton and twice as much Egyptian cotton on its way to Manchester now as there was at this time last year.

THE production of ingots in France, whether by the Bessemer or Siemens-Martin process, more than one-third of which takes place in the Meurthe-et-Moselle Department, increased by 108,000 tons in 1898. Altogether, steel works have increased their production considerably in all branches, and their condition was very prosperous in that year.

A FAIR idea of the extent to which cold storage is now adopted in the British Isles can be gathered from the fact that there are now nineteen frozen meat stores in the metropolis, with a combined capacity of 6,000,000 cubic feet, and forty-seven frozen meat stores in twenty-six provincial towns, with a cubic area of about 8,000,000 cubic feet. If these stores were all filled with frozen sheep they would hold nearly 4,000,000 carcases.

WHEN catalogues are forwarded to Consulates, writes H.M. Consul for Thessaly, it might be well if some specification of trade terms were to be transmitted at the same time, so that persons to whom the catalogues are handed could form an immediate opinion as to whether profitable business would be likely to ensue, without having themselves to apply by letter for such details, thus incurring trouble and losing much time.

THE accounts from the new gold mining districts at Cape Nome on the Alaskan coast are still very contradictory, and must be accepted with caution. It is certain, however, that a considerable amount of gold has been brought down from the region this season; though the exact amount cannot be stated with any approach to accuracy. According to the *Engineering and Mining Journal* the workings are in placer or alluvial deposits entirely, and are in the immediate neighbourhood of the sea coast; some of them being actually on the shore.

IN the new United States mint at Philadelphia electricity is to be used throughout for driving the presses and milling machines. The electrical equipment includes four direct-connected engines and dynamos, in addition to the following motors installed in the coining departments:—14 motors of 45 horse-power each, 16 of 5 horse-power each, 6 of 25 horse-power each, 30 of 5 horse-power each for the presses, and 15 of 5 horse-power each for the milling machines. There is also to be an electro-refining department, and electric power will be used in the engraving department.

THE validity of the MacArthur-Forrest cyanide patents has been a source of much litigation and negotiation in various parts of the world. According to the *Engineering and Mining Journal*, the Government of Victoria has just purchased the patent rights in the Colony for the sum of £20,000, allowing the owning company to retain all royalties up to date. This amicable arrangement puts an end to litigation, which had been expensive to all parties, and makes it unnecessary to proceed with the appeal from the Colonial High Court to the Judicial Committee of the Privy Council of England.

IN order to secure a permanent water supply for the various gold mines in Nevada County, California, several companies have constructed in the mountains a series of artificial lakes, and leading from these 800 miles of canals. In 1892 the Electric Power Company was incorporated for the purpose of supplying light to the towns, and light and power to the mines. Water is carried a distance of 3½ miles, with a fall of 195ft., and this drives water wheels furnishing 2200 horse-power. The present power available through the consolidation of several flumes is not far short of 20,000 horse-power.

THE relative actinic intensities of the three parts of the electric arc—viz., (*a*) a green tinted aureole, (*b*) a darker mantle of flame, and (*c*) a bright blue-violet nucleus—depend greatly upon the kind of carbons used. Experiments have been carried out by Herr E. W. L. Richter in which a Nicol's prism photometer is employed for comparing the apparent relative intensities, using in some cases carbons with a known percentage of a salt, such as sodic chloride. In one case mentioned, using solid carbons 13 millimetres diameter, with an arc length of 6 millimetres, 15 ampères, and 56 volts, the ratios are—$b : a : c = 1 : 2{\cdot}28 : 3{\cdot}32$.

A REMARKABLE air compressor is employed at the North Star Mine, in the Grass Valley District, Nevada County, California, where a 30ft. Pelton wheel is driven by a water pressure of 335 lb. to the square inch, controlled by a nozzle regulated by an automatic governor. The wheel is constructed of steel, with bronze cups, and makes sixty-five revolutions per minute. A duplex air compressor is attached directly to the axle of this wheel, with the low-pressure cylinders 30in. in diameter and high-pressure cylinders 18in. The air, under 90 lb. pressure, is conveyed 800ft. to a pneumatic hoisting engine of 100 horse-power, and to a 75 horse-power compound pump. The air is also conveyed to the drills in the mine. The output of the compressor is 300 horse-power.

SOME tests to show the efficiency of electric incandescent lamps made by various firms in the United States have been carried out in America recently. After burning about fifty hours, it is found that the light varies from 8·2 to 23·0 candle-power, while the watts per lamp vary from 45·7 to 72·1, the watts per candle varying from 2·32 to 4·10, the general averages being 17·5 candle-power at 55 watts per lamp, and 3·27 watts per candle. After about 100 hours, the general averages are 17·5 candle-power at 53 watts per lamp, and 3·30 watts per candle. After 400 hours the averages give 16·0 candle-power at 56·5 watts per lamp, and 3·54 watts per candle. After 600 hours the averages give 14·7 candle-power at 55·6 watts per lamp, and 3·82 watts per candle.

EXPERIMENTS were some time ago carried out by MM. Berthelot and le Chatelier to ascertain the velocity of detonation of acetylene. The gas was exploded in horizontal glass tubes about 1 m. long and of 2 mm. to 6 mm. in diameter, and was operated with at various pressures between 5 and 30 kilos. per sq. cm. The velocity was registered by a falling photographic apparatus, released at the moment of detonation. The image of the horizontally-moving flame in the tube, combined with this vertical movement, gave a curve on the photograph, from which at any point the velocity could be found. The results indicate that the velocity depends upon the initial pressure of the gas, from about 1000 m. per second at 5 kilos. per sq. cm. to 1600 m. at 30 kilos.

MISCELLANEA.

A NEW pier is to be erected at Great Yarmouth. The old Britannia Pier will be demolished, and the new one erected on the same site.

IT is stated that a company is being formed for taking over the shipyard and arsenal of the Compagnie Générale Transatlantique at St. Nazaire.

A FIRE took place last week in the lamp room of the Castle Pit, one of the Cyfarthfa Collieries, 450 lamps were destroyed, but by energetic action working was not delayed.

THE new Norddeutscher Lloyd steamer Strassburg, 5000 tons gross, built for that company's line of cargo-boats to the Far East, was launched at Bremen on the 17th inst.

A CONTRACT has been concluded between the Rossija Steam Navigation Company and the Libau-Romny Railway Company for carrying on a direct oversea export trade from Russia *viâ* Libau to ports of Finland.

THE Committee of Selection last Friday had a conference with the promoters of the several electric power Bills before Parliament, when it was resolved to take the Durham, the Tyneside, and the Lancashire Bills in the order given, at sittings commencing on Thursday, the 3rd of May.

THE Chesterfield and Midland Counties Institution of Engineers are to hold an excursion meeting in the neighbourhood of Nuneaton, on April 7th. Arrangements have been made for a visit to the Haunchwood Colliery, Stockingford, and the Tunnel Mine—new colliery—Ansley Hall.

THE Selkirk Town Council have engaged an engineer to prepare a supplementary water supply for the town. Under this scheme water will be taken from the Ettrick River, passed through polarite filters, and then pumped by turbines and gas engines to the reservoir. The estimated cost is about £11,000.

ACCORDING to the *Novosti*, the Russian engineer M. Natorsjky, director of the canalisation works of the estuary of the river Dnieper, on the Black Sea, is at work on a project for constructing a harbour of great depth on the said estuary. The project will be submitted in due time to the Ministry of Ways of Communications.

THE Russian ice-breaker Yermak will undergo alterations at Armstrong's yard during the coming summer. The vessel will be fitted with a new stem of increased strength, in order that it may be able to offer greater resistance to the ice during its projected Polar voyage. At the same time the hull of the Yermak will be lengthened.

THERE are quite a large number of vessels trading in the East in the neighbourhood of the Borneo oilfields that are using liquid fuel regularly, and their experience, says *Fairplay*, appears to show that the steaming capacity of the boiler is increased as high as 50 per cent. by the use of liquid fuel under forced draught as compared with the use of coal under natural draught.

A LARGE maritime undertaking is being organised by Rostock, Wismar, and other Mecklenburg capitalists, to run a service of 1500 to 2000-ton steamers on the North Sea, and possibly also, in winter, to the Mediterranean, &c. The first two or three boats are to be acquired by purchase. According to *Fairplay*, it has not yet been decided whether the company will be domiciled at Rostock or at Wismar.

THE industrial centres of Germany have just given a practical proof of the fact that they recognise both the value and necessity of a knowledge of the languages of countries in which they foresee immense openings for their productions. The *Novoe Vremya* announces that the German commercial schools have asked the Russian Ministry of Finance to aid them in procuring teachers of the Russian language.

THE results of the past year's working of the Holland-American Line, of Rotterdam, are satisfactory, the net profits amounting to 463,540·13 florins, out of which a dividend of 7 per cent. will be paid. Both outward and homeward freights were less remunerative than in the year 1898, but the passenger traffic was brisker. A new service to Newport News, in connection with the New York line, was started last year.

JUST as we go to press we learn with regret the death of Professor Pepper, formerly honorary director for upwards of twenty years of the Polytechnic, Regent-street. He was the inventor of the celebrated "Pepper's Ghost" and other illusions, and a great populariser of every branch of science. Mr. Pepper was elected an Associate of the Institution of Civil Engineers in 1844, and was a Fellow of the Chemical Society.

IRON mining is relatively a new industry in Mexico; nevertheless Chihuahua has a well-equipped plant supplied from the mines of Sierra del Hierro, Durango, Mercado, and other districts which now manufacture steel rails, mining machinery of all kinds, as well as agricultural implements. Another large rolling mill is to be erected at Monterey, Nuevo Leon, most of the capital for the same—£2,000,000—having already been subscribed in the country.

THE surplus at the disposal of the directors of the German Steam Navigation Company Hansa, from the past year's operations is 1,793,547 marks 84 pfennigs, out of which a dividend of 14 per cent. is to be paid and about M. 66,500 carried to the new account. The traffic in the Indian route, says *Fairplay*, left much to be desired last year, and the voyages to Bombay had to be reduced in number, but good results were secured by the boats running to Argentina. The Rangoon line is developing slowly.

IN order to improve the condition of the Amur River, the Russian Ministry of Ways of Communications has resolved to begin dredging operations in the estuary of the river during the coming spring. Six lighters, a dredging machine, and the Khabarovsk, the largest steamer at present plying on the Amur, will be employed in dredging a channel 20 fathoms in width and 8ft. in depth. Owing to the bar at the mouth of the river, goods have to be disembarked as a rule and taken overland to Alexandrovsk. The Amur is ice-bound for half the year, and is subject to great inundations during the summer months.

THE London County Council has decided upon taking steps with regard to No. 17, Fleet-street, known incorrectly as the Palace of Henry VIII. and Cardinal Wolsey, which will meet with general approval. It has been decided to move back the ground floor to the level of the other house fronts, but to leave the upper storeys in their present position, supporting them on cantilevers. The big room with the celebrated ceiling will thus be left intact, and is to be let for meetings of antiquarian societies and the like. It has been found that the front of the building is at present covered by a false screen, which is to be removed.

THE preamble of the Bill for the construction of a transporter bridge, on the same principle as those at Bilbao and Rouen, across the Mersey and Manchester Ship Canal between Runcorn and Widnes, was passed by a Committee of the House of Commons last Monday. According to the evidence given for the promoters, the girder of the proposed bridge is 82ft. above the ordinary high-water mark. The central span is a clear 1000ft. from centre to centre of the piers, and carried over both the river and the Ship Canal. The transporting car will be 55ft. long and 24ft. wide. It will have a clearance of 12ft. 6in. above ordinary spring tides at high-water mark. This car will be worked by duplicate electric motors, and be under the control of two men. The time occupied in transporting the car from one landing place to the other will be two and a-half minutes.

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Advertisements cannot be inserted unless delivered before Six o'clock on Thursday evening; and, in consequence of the necessity for going to press early with a portion of the edition, ALTERATIONS to standing advertisements should arrive not later than Three o'clock on Wednesday afternoon in each week.

Letters relating to Advertisements and the Publishing Department of the Paper are to be addressed to the Publisher, Mr. Sydney White; all other letters to be addressed to the Editor of THE ENGINEER.

Telegraphic Address, "ENGINEER NEWSPAPER, LONDON."

PUBLISHER'S NOTICES.

*** *With this week's number is issued as a Supplement a Two-page Engraving of the Colenso Bridge after its Destruction. Every copy as issued by the Publisher includes a copy of this Supplement, and subscribers are requested to notify the fact should they not receive it.*

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CONTENTS.

THE ENGINEER, 30th March, 1900. PAGE

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 stamped, in order that answers received by us may be forwarded to their destination. No notice can be taken of communications which do not comply with these instructions.*

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

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

REPLIES.

G. J. (Dublin).—We know nothing whatever about the material you mention.

W. (Richmond Hill, Birmingham).—We fail to understand the object of your letter. It does not contain any information about water-tube boilers that is not already fully known to every engineer or steam user who has given the subject the least attention.

H. S. (South Lambeth-road).—You will find full information about the construction of locomotive boilers in "The Construction of the Modern Locomotive," by George Hughes, reprinted from THE ENGINEER. If you will call at this office our publisher will show you all the recent drawings of locomotives which we have published, and which are now in print.

J. C. L. (Stafford).—You are probably short of steam, because your fireman does not understand the coal. If it is that type which burns with little flame, he must carry a heavy fire in the locomotive-type boiler. A thin fire suitable for bituminous coal will not answer. A couple of hooks hung on the blast pipe will augment the draught, in a rough-and-ready way known to most portable engine drivers.

D. B. (Birmingham).—You will find the solution to your question in any treatise on the indicator. The loop in the low-pressure card is due to the fact that the pressure has actually fallen below the condenser pressure. The engine is obviously much underloaded and the ratio of expansion is too high, and you will save fuel by reducing the initial cylinder pressure and the ratio of expansion by resetting your valves.

STELLA.—Tail rods are used in marine engines to prevent the pistons from being forced against the sides of the cylinders as the ship rolls. There is much diversity of opinion as to their value. With stiff piston rings they do not appear to be of much use. They are in favour abroad for locomotive engines, and they have been tried in this country, but they do not appear to be worth the trouble and expense, no appreciable reduction in the wear of cylinders or piston rings resulting from their use.

V. W. (Durham).—When heavy loads are to be carried by stone columns, it is usual to put lead plates, about one-eighth of an inch thick, between the sections of each column, to distribute the bearing equally, and prevent the sharp angles of the stone from flying off or "spalling." Some of the finer kinds of granite are very liable to this accident. You will see that there is nothing exceptional in the use of lead in the case to which you call our attention. It is certainly not used "to make up length" in the way you fancy.

H. T. D.—The time of oscillation of a pendulum, through a small arc, depends on the distance between the centre of suspension and the centre of oscillation; but the time of revolution of a conical pendulum does not depend on the length of the arms directly, as you seem to suppose, but on the height of the cone described by the arms, which is, of course, quite a different thing. The time of revolution of a conical pendulum varies directly as the square root of the height of the cone. Thus you may have a governor with very long arms revolving at a very high speed, the arms being nearly horizontal, or one with short arms nearly vertical, making comparatively few revolutions. Try your experiments again.

INQUIRIES.

EMERY CLOTH MACHINERY.

SIR,—Can any of your readers tell me who are the best makers of machinery for the manufacture of emery cloth? E. C.

GARDNER'S VALVE.

SIR,—Can any reader kindly tell me who is the maker of Gardner's patent valve?

March 24th. J. H. C.

MEETINGS NEXT WEEK.

LIVERPOOL ENGINEERING SOCIETY.—Wednesday, April 4th. Paper, "Further Progress in Space Telegraphy," by Prof. Oliver J. Lodge, D.Sc., F.R.S.

THE RÖNTGEN SOCIETY.—Thursday, April 5th, at 8 p.m., at 20, Hanover-square. Paper, "The Influence of the X-Rays upon the Growth and Development of Micro-organisms," by Dr. Norris Wolfenden and Dr. Forbes Ross.

GEOLOGISTS' ASSOCIATION, LONDON.—Friday, April 6th, at 8 p.m., at University College, Gower-street, W.C. Paper, "Zonal Features of the Kentish Chalk Pits between London and the Medway Valley," by Mr. G. E. Dibley, F.G.S.

THE INSTITUTION OF ELECTRICAL ENGINEERS.—Wednesday, April 4th, at 7.30 p.m., in the Library of the Institution, 28, Victoria-street. Students' meeting. Paper, "Electric Driving in Workshops," by Mr. J. H. Johnson, Student.

THE CLEVELAND INSTITUTION OF ENGINEERS.—Monday, April 2nd, at 7.45 p.m., in the Friends' Adult School, Mill-lane, Stockton. Paper, "Automatic Coal Weighing and Recording Machine" (lantern illustrations), by Mr. Charles Ingrey, A.M.I.C.E., Westminster.

SOCIETY OF ENGINEERS.—Monday, April 2nd, at 7.30 p.m., at the Royal United Service Institution, Whitehall. Paper, "Disinfection of the Maidstone Water Service Mains," by Dr. G. Sims Woodhead, M.A., and Mr. W. J. Ware, Memb. Brit. Assoc. of Water Engineers.

THE INSTITUTION OF JUNIOR ENGINEERS.—Friday, April 6th, at the Westminster Palace Hotel. Paper, "A Comparison of Railway Bridge Structures of Moderate Dimensions, and of Methods of Determining their Working Loads," by Mr. E. W. Porter, Assoc. M. Inst. C.E., Member.

SOCIETY OF ARTS.—Monday, April 2nd, at 4.30 p.m. Foreign and Colonial Section. Paper, "The Century in our Colonies," by the Right Hon. Sir Charles Wentworth Dilke, Bart., M.P.—Tuesday, April 3rd, at 8 p.m. Applied Art Section. Paper, "Process Engraving," by Mr. Carl Hentschel.—Wednesday, April 4th, at 8 p.m. Ordinary meeting. Paper, "Cotton Supplies," by Mr. John A. Banister.

ROYAL METEOROLOGICAL SOCIETY. — Jubilee Celebration. — Tuesday, April 3rd, at 3 p.m., at the Institution of Civil Engineers, Great George-street, Westminster, Commemoration Meeting. Conversazione at the Royal Institute of Painters in Water Colours, Piccadilly, at 8.30 p.m.—Wednesday, April 4th, Excursion to the Royal Observatory, Greenwich. Dinner at the Westminster Palace Hotel, Victoria-street, S.W., at 7 p.m.

THE INSTITUTION OF CIVIL ENGINEERS.—Tuesday, April 3rd, at 8 p.m. Ordinary meeting. Papers to be read and discussed, "Economical Railway Construction in New South Wales," by Mr. Henry Deane, M.A., M. Inst. C.E.; "The Tocopilla Railway," by Mr. Robert Stirling, M. Inst. C.E.—Friday, April 6th, at 8 p.m. Students' meeting. Paper, "Experiments on Struts with and without Lateral Loading," by Mr. H. E. Wimperis, Wh.Sc., Stud. Inst. C.E.

ROYAL INSTITUTION OF GREAT BRITAIN.—Friday, April 6th, at 9 p.m. Discourse on "Solid Hydrogen," by Prof. Dewar, M.A., LL.D., F.R.S., M.R.I.—Afternoon Lectures at 3 p.m.: Tuesday, April 3rd, "The Structure and Classification of Fishes," by Prof. E. Ray Lankester, M.A., LL.D., F.R.S.; Thursday, April 5th, "Equatorial East Africa and Mount Kenya," by Mr. Halford John Mackinder, M.A.; Saturday, April 7th, "Polarised Light," by the Right Hon. Lord Rayleigh, M.A., D.C.L., LL.D., Sc.D., F.R.S., M.R.I.—Monday, April 2nd, at 5 p.m., General Monthly Meeting.

THE INSTITUTION OF NAVAL ARCHITECTS.—The meetings of the present session will be held in the Hall of the Society of Arts, John-street, Adelphi—by kind permission of the Council—on April 4th, 5th, and 6th, the Right Hon. the Earl of Hopetoun, G.C.M.G., presiding. Programme:—Wednesday, April 4th: Morning meeting at 12 o'clock; in the evening the Annual Dinner will be held at the Hotel Cecil. Thursday, April 5th: Morning meeting at 12 o'clock; evening meeting at 7 o'clock. Friday, April 6th: Morning meeting at 12 o'clock; evening meeting at 7 o'clock. For detailed programme see page 302 in our last issue.

THE ENGINEER.

MARCH 30, 1900.

ELECTRIC LIGHTING LOANS.

THE conference held at the Islington Vestry Hall, on Thursday week, of the representatives of London Vestries and district boards interested in electric lighting undertakings is a forcible illustration of the express desire of these local authorities to overcome, if possible, some of the red tape with which the London County Council has entwined itself in relation to the sanctioning of loans for electric lighting purposes. The Vestries represented on that occasion were those of Islington, Fulham, Hammersmith, Newington, St. Pancras, and Shoreditch, and the Whitechapel Board of Works, and the conference was convened to consider the County Council's procedure in regard to loans for the purpose in question. Before referring to the proceedings at the conference, it should be mentioned that in recent years the County Council before authorising the raising of loans for electric lighting machinery and plant, has stipulated, not only that the applying local authority should supply details of the proposed expenditure, but also that information should be furnished to convince the Council's officials that the amounts to be borrowed for particular items are reasonable. These two points do not appear to have been pressed in the early days of electrical illumination in the metropolis, when it was, perhaps, impossible to ascertain with any degree of accuracy the cost of carrying out works until tenders had been invited in open competition. However, as time passed away the demand on the part of the Council for details and information became so acute that the St. Pancras Vestry found that, if it had to wait such a long period before receiving sanction, as appeared to be the pleasure of the Council, the work of extending the electric lighting system would be considerably delayed; and after remonstrating with the Council on several occasions for its unreasonable attitude, the Vestry came to the conclusion that the only course open if the undertaking was not to be brought to a standstill, was first to borrow the money required, and afterwards obtain approval of the expenditure. The decision was at once carried into effect, and loans were raised from the Vestry's bankers as occasion arose, the overdrafts on the electric lighting account sometimes exceeding the formidable sum of £40,000. Though this policy is not sound from a financial standpoint, it has met the circumstances of the case, and the County Council has subsequently sanctioned and advanced the amount of the loans, and thus enabled the overdrafts to be paid off. The remedy adopted would appear to have also indirectly benefited the undertaking generally, since at the present time St. Pancras experiences less trouble in obtaining permission from the Council to borrow money for electric lighting purposes.

It is, however, noteworthy that whilst St. Pancras has apparently solved the problem by first incurring expenditure and then applying for approval, the Islington Vestry has assumed an attitude of defiance, and refused to accept sanctions of £10,000 and £38,000 offered by the Council on account respectively of loans of £13,200 and £56,261, for which application was made as long ago as August of last year. The contention of Islington is that it has already supplied all the details and information necessary for the purpose of these loans, and from the reports made by the Vestry's electrical engineer it is obvious that the particular department of the County Council entrusted with the consideration of these matters fails to understand either the position of affairs or the technical details of electric lighting systems. As an illustration reference may be made to the proposed loan of £13,200. The figures submitted to the Council show both the estimates of the Vestry's engineer and the actual quotations of the makers. This will be understood from the following figures, the first item in each case being the estimate and the second the makers' price:—Steam and other piping, £4950 and £4950; combined heating, softening, and filtering plant, £1150 and £1154; electric coal-tipping winch, £400 and £400; six superheaters on new boilers, £1200 and £1200; four superheaters on old boilers, £700 and £560; three pumps, £800 and £780; and condensing plant, £4000 and £4290. By adding these figures together it will be found that the total of the estimate is £13,200 and that of the makers' quotations £13,334. The difference between the estimate and price of the four superheaters is explained by the fact that £140 has been added for the alterations necessary in affixing them to existing boilers. It will thus be seen that, even when confronted with actual prices, the County Council refuses to sanction the amount required, but offers to approve £10,000. What is the use of £10,000 without the balance? Is one-half of the steam mains required to be purchased, one-half of the condenser to be ordered, or how is the £10,000 to be expended when exactly £13,200 is needed? It is objected by the Council that the price of the condensing plant is too high; but is the Council to sit in judgment and determine whether a cheap and, in the long run, an expensive plant is to be bought, or whether a plant that is slightly dearer in price and more economical in the end should be acquired? If this is to be the policy of the Council, the electric lighting undertaking had better be transferred to it straight away. It is scarcely necessary to enter into the question of the loan of £56,261, although here again the Council questions the accuracy of the items in a somewhat similar manner. One point should, however, be mentioned, namely, that which refers to the cables. It appears that the Council, rule in hand, measures up the frontages from the plans, and allows a certain percentage for waste, and because the total does not agree with that represented by the Vestry, the expenditure is regarded as excessive and unreasonable. But the Council omits the lengths of

cable required to connect the generating station with the district proposed to be served; it leaves out of consideration the questions of slack, and of cables for connections, and for certain duplications which have ensured the successful continuity of the supply in the Islington electric lighting system since its inauguration. The whole dispute may be summarised by saying that the Council requires the Vestry to accept a four-wheeled cart and declines to allow it to buy a horse to haul it. As the Council still insists on further information being forthcoming, and as the Vestry expresses its inability to supply it, there is a deadlock between the two parties. The Shoreditch Vestry is also in a dilemma in regard to electric lighting loans, and a few weeks ago the banker's overdraft on this account amounted to £25,000.

The conference held last week was convened by the Islington Vestry for the purpose of considering the general position created by the Council in relation to electric lighting loans, and after considerable discussion two resolutions were adopted for presentation to the County Council. The first expressed the opinion that the procedure of the Council is not warranted by statute or by the practice of other sanctioning authorities, and that such procedure tends to undue delay as well as unnecessary expense and waste of official time on the part of local authorities engaged in electric lighting work. The second resolution decided to request the Council, in the forms asking for detailed particulars, to follow the Board of Trade forms, so as to harmonise with the book-keeping system in which electricity accounts are bound to be kept. A third resolution, which was, however, not adopted owing to equal voting, suggested the holding by the Council of public inquiries in a manner similar to that followed by the Local Government Board throughout the country. Whatever may be the result of these representations to the County Council, there would appear to be a good case made out for a radical alteration in the present policy, or failing any change, for the question to be raised in the House of Commons. The new borough Councils will, it is true, next year have the right of appeal to the Local Government Board in regard to refusals to sanction loans, but this will only be possible after a delay of six months, and as the Board already has plenty to do with provincial authorities, little relief may be expected from that department.

RAILWAY SERVANTS IN SOUTH WALES.

The strike threatened by the South Wales railway workmen is, happily, no longer to be feared; but more than local interest attaches to some of the details of the agitation, and the part the Amalgamated Society of Railway Servants played during the five or six months of protracted suspense. It is the more desirable to refer to a few of the earlier incidents, because the policy of the Amalgamated Society, as expressed by Mr. Richard Bell, its secretary, bears a suspicious likeness to the methods pursued in that perturbed coalfield by the Miners' Federation at the beginning of last year; and because, also, the tactics have been the same as those followed in the campaign against the North-Eastern Railway, and the Southern Scotch railways, although the latter contests may have been conducted under other counsels than those of Mr. Bell. There is always, almost necessarily, some amount of friction among the operatives of such a vast organisation as our railway system. It is equally true that the lamb does not lie down with the lion in the less effectually organised coal industry of the kingdom. The strategy of the Amalgamated Society and of the Miners' Federation has been to seek the line of least resistance, and make one or another district the "dumping ground" for grievances, with a view to a general attack further afield. It is the peculiar misfortune of South Wales that it should have been more frequently than other parts of the kingdom the cockpit for the settlement of issues of really national concern and consequence. There the staple commodities are at higher prices and more in demand than they have been for twenty years, according to the chairmen of colliery companies, and the prospectuses of new undertakings offered to the public investor. Therefore, argued the Amalgamated Society, the railways traversing the prosperous district must be hauling in a full harvest; "they ought to be made to share their increased emoluments with their men; we will insist on the redemption of our long-delayed claims, in confidence that, under the pressure of traffic, they will deem it unwise to deny them."

The fact that the profits of the railway companies by no means kept pace with the gains of the coalowners was indicated with sufficient clearness in the reports for the June half of 1899. That the enhanced prices of coal, and materials for roadways and rolling stock, would actually diminish shareholders' dividends, as was demonstrated by the reports of the December half-year, was either not considered or was deliberately ignored. The workmen on the Taff Vale, Rhymney, Barry, and the Cardiff railways were urged from headquarters to insist upon higher rates of pay, improved conditions of labour, and—this was the leading fighting point—an eight hours day for all work performed between six at night and six in the morning. It may be conceded that reason had arisen for a revision of the terms agreed to ten years ago between the railways named and their workmen. The proof of it is that when the respective managers received a definite statement of the men's complaints they separately, but as with one accord, admitted that revision was called for, and made considerable amendments in the ten-year-old agreement. But the under-running current throughout the agitation, and from about October last, when the Amalgamated Society actively intervened, was one with which labour disputes all over the country have made the public only too familiar. The workmen were members of the society, and could only be dealt with through the agency of the officers of the society, and in this instance there is no mention of a President or Executive Committee; the medium had to be Mr. Bell. Sir William Lewis, of the Cardiff Railway, and his colleagues of the other three lines, had expressed their readiness to meet their own men in a friendly discussion of the matters in question. They merely declined to constitute themselves a collective Board for the purpose of receiving a delegation of the Amalgamated Society of Railway Servants. To this effort of *rapprochement* Mr. Bell objected that the union leaders, who knew the conditions of railway service throughout the United Kingdom, were the most capable spokesmen for the Welsh workmen, and that it would be a sacrifice of principle for the various grades of railway operatives to interview the managers by themselves, and without the guidance of an official of the head organisation. The alluring words had the effect of inducing the men to take a ballot of the whole of their number to decide whether they should give notice to terminate contracts—a step which would have produced a state of paralysis in the entire industrial organism of the steam-coal basin.

Meanwhile, there had been meetings between the railway authorities and deputations of their servants. Liberal allowances were made on points of difference, always excepting that relating to charging night overtime on the scale of an eight hours day. These were acknowledged to be substantial concessions, as the men have subsequently testified by their action. But by the influence of the Amalgamated Society, a second ballot was ordered to be taken, and in recommending that course Mr. Bell is reported to have used some very remarkable words. As to the second ballot, said he, "they would have to prove of what metal they were made, and for his part he was now in an absolutely fighting mood." Again, "in determining to try to wring from the companies their demands without the intervention of their society, they had degraded both their Committee and their society, and proved themselves woefully mistaken; and as far as he was concerned he did not intend to be played with any longer." It would be difficult for the moment to say whether a better parallel for this style of speech would be found in one of Napoleon's mandates to his conquered continent, or in the black Emperor of Hayti's menaces to his rebellious subjects. Nor need an exact parallel be sought after, for the climax soon arrives. Mr. Bell concluded his harangue with the remarks that "if the railway workers in South Wales meant to drop this agitation, let them be men enough to say so now, once for all. If they decided to go on they must give instructions that their delegates should in every case be accompanied by the society's officials in any negotiations." Most of us know that an "if" is not permissible in strict logic, and is a double-edged weapon in an argument *ad hominem*. It was announced in the Cardiff journals on the day we last went to press that the railway companies' proffered concessions had been accepted; that the second ballot had not resulted in the required majority in favour of a strike; and that Mr. Bell had himself advised that nothing further could be done until the whole matter was examined by the Executive Committee of the Amalgamated Society at its meeting in Cardiff during April. It will not be held on the ill-omened first of April, or the coincidence would be too forcible. But compare the general secretary's language, and his "ifs," with the anti-climax, and only one conclusion can be drawn in regard to the influence of the Amalgamated Society of Railway Servants with the bulk of the workmen on the mineral lines of Glamorganshire.

THE CARNEGIE SETTLEMENT.

Mr. Carnegie and Mr. Frick have settled their differences, and the world is to be treated to no more revelations concerning the profits and the internal management of the largest steel-making concern on earth. The lawsuit instituted by the second-named gentleman has been abandoned, so we learn by cable from New York. He himself will continue to be a member of the firm, and the company will be re-organised—this time under the accommodating laws of New Jersey—with a capital of 40,000,000 sterling. The present capitalisation of the group of undertakings included under the style of the Carnegie Steel Company is just one-eighth of this sum, and only four-fifths of that has been paid up. It will naturally occur to the reflecting man, seeing that the present owners propose to take the whole of the stocks and bonds, to wonder why it has been found advantageous to go through the formality of raising the nominal capitalisation from 25,000,000 dols. to 200,000,000 dols. It is true that the H. C. Frick Coke Company is to be bought up. Some of the stockholders of that company, following the action of Mr. Frick, who has interests in both firms, had instituted proceedings against the management to annul a contract whereby the Carnegie Company has been obtaining coke at a ruinously low price, and we assume that the absorption of the Coke Company by the larger one will mean the abandonment of this action as well as the other, because neither the company nor individual stockholders stand to lose by the arrangement. But the acquisition of the Frick Coke Company can mean no more than a tithe of the difference between the two capital sums mentioned, for that company's capitalisation is only 10,000,000 dols., and the better part of the increase will represent what the Stock Exchange calls "water." It may possibly be the intention of the directors to acquire other interests and to pay for them in shares of the enlarged company. This, in fact, seems to be indicated by the statement that "a number of subsidiary branches will be established;" and certainly, if the company is going to make a profit of eight millions sterling during the current year out of its present undertakings, it will be enabled to distribute respectable dividends even on 200,000,000 dols. of capital without taking count of what is to accrue from any other businesses to be acquired. In a progressive country such as America, which has infinite resources still to be developed, there is room for further expansion, even by a business of the magnitude of the Carnegie Company. It must be clear, too, to the management that the existing tariff conditions, which alone make fancy profits possible, will not be perpetuated during all time; and probably, while not insensible to the beauties of handsome dividends in the meantime, they are keeping one eye on the future when the margin will become narrowed by home and foreign competition, and when it will be necessary for them to extend operations in order to keep up the total of profits. If, however, the intention be to rest content with the present extent of the business, it may be found very difficult in the years to come to keep at the present level of profit. We scarcely imagine, however, that a company whose enterprise in the past has been phenomenal will adopt this course, especially as we are shortly to have the giant combination, referred to in our last issue, with which in all likelihood it will not work in harmony.

We recapitulated recently the main points of the action instituted by Mr. Frick. It seems desirable, notwithstanding the settlement of the dispute out of Court, that an outline should be given also of the company's answer to the allegations of fraud and unjust and malicious treatment, which answer was not available when we wrote last on the subject. The Carnegie Company—meaning Mr. Carnegie himself, in effect—asserts that Mr. Frick's interests were acquired in the same manner as the interests of other young partners. "He was not required," we are told, "to pay for same, provision being made, as in all cases of newly-admitted members, for payment out of the future profits." Between 1887 and 1895 he acquired an interest of 11 per cent. in the company, and in February of the last-named year he owed Mr. Carnegie 1,809,192 dols. balance of purchase price. Then, trade being poor and the burden heavy, he re-sold 5 per cent. to the chief proprietor. "After this transfer," the answer goes on, "Mr. Frick held only 6 per cent. of the whole, and the balance due on that percentage from Mr. Frick for the purchase price was finally adjusted and paid to Mr. Carnegie, the payment consisting of 129,000 dols. in bonds of the H. C. Frick Coke Company at par and 192 dols. in cash. This is all Mr. Frick has paid for his interests in the Carnegie Steel Company. With the credits from his stock earnings, the amount paid was only 30,000 dols. all told, for an interest worth 5,000,000 dols. He accepted without question the book value for 5 per cent. of his holdings at a time when he was scared and feared the stock would depreciate, but now refuses to accept book valuation for the balance of his holdings." After this there is much recrimination. Mr. Frick's ability is not questioned, but he demanded absolute power, and though he was regularly at the meetings and kept himself informed as to the businesses of the company, his time was largely employed in connection with "other enterprises and various speculative schemes for placing the property of the association in the hands of promoters to be floated in marketable securities on the public." Seeing that Mr. Carnegie was a party to these schemes, and gave an option on his 58½ per cent. interest, there does not appear to be any good reason to charge this as an offence against his partner. It is not denied that the profits for last year amounted to the sum stated by the plaintiff in the action, but that sum "referred only to the difference between the sales and the actual expenses of manufacture;" and as for the 40,000,000 dols. spoken of for the current year, this was only a guess made over luncheon at results which were then and are still involved in great uncertainty. This is the gist of the Carnegie Company's reply, and as the dispute is no immediate concern of ours, and especially as it has been settled, there is no necessity to judge as between the two conflicting statements.

The terms of the settlement, however, indicate that the Carnegie argument is not so strong as it looks on paper—that is, unless Mr. Carnegie himself is more generous and less just than he is usually credited with being. It is to be observed, too, that the ex-secretary of the company, who was cited as a defendant, along with the board of management, sustains Mr. Frick as to the "ironclad agreement," and the other points at issue, "as to nearly all, of his own knowledge, and as to the remainder, to the best of his knowledge and belief." We have said that the Frick Coke Company has been absorbed. The lawsuit instituted against the management of that company by some of the stockholders concerned the Carnegie indirectly. It appears that at the beginning of last year a contract was made for the supply of the latter for five years with coke at 1.35 dol. per ton, when the market price was something like twice that figure; and the allegations against the board of directors is that they were working solely in the interests of the Carnegie Company, and certainly against the interests of such stockholders as had no concern with this last-named firm. The Coke Company's capital is divided into 200,000 shares of 50 dols. each, and of these 59,104 shares are held by the Carnegie Company, and 51,213 shares by Mr. Carnegie personally. In other words, the Carnegie's controlled the Coke Company, and put their own nominees on the board. From these facts the reader will no doubt be able to draw a clear inference for himself without aid from us. On the face of it, the action looks disreputable, but possibly there may be another side to it, to tone down its asperities, and, anyway, the Carnegie Company has taken over the property, no doubt on a fair valuation basis.

As it stands, the Carnegie Company is a consolidation of manufacturing enterprises larger than any other in existence, except the giant steel "combine," of which we are shortly to hear more. Its ultimate justification can only be secured by further expansion. By a continuance of capable management, it may be expected to hold its own, but in the future, probably under the next Democratic administration, it will have its artificial prop—the tariff, to wit—knocked from under it, and will then be compelled to stand by its own inherent strength. That the country has plenty before it, we make no question; but the dangerous point for the company is that when the import duties are lowered it will have to face a situation radically different from the present. It was during the time the last moderate tariff was in force that

Mr. Frick was anxious to rid himself of a portion of his interest in the Carnegie Company. In connection with the tariff, Mr. Kirchhoff, of the *Iron Age*, and one of the leading authorities on iron and steel manufacture and markets, said in a recent address in New York that the tariff is no longer needed to stimulate the industry. Up to the present time, he says, the effect has been to promote great competition in the home market, and that now "in the greater number of the different branches of the iron industry the tariff has become merely a safeguard against raids on the part of foreign producers." The American citizen is becoming convinced that a business which can make the profits of the Carnegie Company ought to be able to guard itself against foreign duties, which, in the essence, represent so much more out of his pocket than he should fairly be called upon to pay for his goods.

RAILWAYS IN ASIA MINOR.

THE policy of Russia with regard to its so-called "railway activity" in Persia seems destined to be repeated in the case of northern Asia Minor. The success of the German Syndicate in obtaining from Turkey the concession for constructing the Bagdad Railway was bound to rouse Russia to action, and Russia has at last responded by making a demand from the Porte for what amounts really to a railway monopoly in the whole of northern Asia Minor. These demands have now been published officially. Turkey pledges itself to allow no railways to be built by foreign capital in the "basin of the Black Sea." If Turkey has no capital available for railway construction in the region referred to, then Russia, if she approves of the projected railways, will find the necessary funds for Turkey. It is quite in accordance with Russia's usual methods of statecraft to learn that she carefully evades any exact definition of the term "basin of the Black Sea;" however, the recent negotiations regarding the privilege of the eventual construction of railways by Russia herself refer to the provinces of Kastamuni and Trebizond on the littoral of the Black Sea, to the northern district of the province of Sivas, and to the provinces of Erzeroum and Van, which border on the Russian frontier. Turkey is left free to exercise her railway activity in the unimportant district between Erekli and Ada Pazar, while Germany is confined to the region between Van, 145 miles S.E. of Erzeroum, and Diarbekir, on the right bank of the Tigris, and 390 miles N.W. of Bagdad. With regard to railway construction on the Persian frontier, Russia has reserved to herself the right to come to an understanding with Turkey on this point at a later date. However, a private telegram received in Berlin a few days ago from Constantinople says that a temporary settlement has been arrived at. A syndicate will take the place of the Russian Government, and will enable Turkey to carry out railway extension in Northern Anatolia. The frontier of the district included in this concession extends in a south-easterly direction from the mouth of the Sakaria on the Black Sea; it then crosses the river Kizil-Irmak to the north of Angora, and continues in almost a straight line to Erzeroum and the Russian frontier. Thus, Russia's influence will be firmly established in North-Eastern Anatolia, and the Russian Government may be said to have made the expected "move" in answer to Germany's concession for the Bagdad Railway. Nevertheless, it is scarcely likely that Russia will undertake railway construction to any large extent just at present in Northern Asia Minor. The Russian Exchequer is already overburdened by ceaseless calls upon its resources. The railway concession extorted from Persia in 1890 has been renewed twice, and still Russia has not set to work to "develop" that country beyond sending thither a surveying party of engineers a few weeks ago. Russia knew perfectly well in 1890, and the remark may be said to apply at this moment, that she could not undertake for some long time the construction of railways in Persia, and the concession in question was wrung from Persia solely with the idea of keeping out any other Power in the shape of Great Britain, while time would be gained thereby for undermining the country of the Shah by Russian intrigue. Russia's very evident chagrin at having been forestalled by German enterprise in Asia Minor will doubtless be increased by the recent announcement made by an official of the Turkish Court to the effect that Germany, in her desire for colonial expansion, is on the point of securing a coaling station on the way to her possessions in the Far East. The island of El Kuweit, opposite the united mouths of the Euphrates and Tigris at the northern end of the Persian Gulf, will be taken over for this purpose by Germany. The island is sheltered from the southern storms, and has an absolutely safe anchorage. As the southern terminal point of the projected German Bagdad Railway will probably be in the vicinity of El Kuweit, the presence of a German coaling station on that island would not only assist materially the development of German shipping in the Persian Gulf, but it would mean the advent in those waters of a strong Power with important growing commercial interests, and this fact would still further shatter Russia's dream of ultimately expelling British commerce and influence from the Persian Gulf, in the vain hope of being able to make that coast line of Persia a naval station for the Russian fleet. There can be only one predominant Power on the Persian Gulf, and that must be the Power which upholds the doctrine of the "Open Door," and Germany knows full well by this time, that wherever her frontiers meet those of Russia there is a ceaseless "war of tariffs."

THE CONTINENTAL COAL FAMINE.

CONCERNING the shortage of coal supplies on the Continent we have already spoken in these columns, and the desperate remedies adopted by Russia in the hope of meeting the emergency were the subject of a reference in our last issue. The explanation of the situation is found in the paucity of the English fuel available and the high prices asked. A few consignments have been received from America, but they have done nothing to relieve the situation. The trade demand in the United States continues on a very large scale, and the lack of eagerness on the part of American producers to ship to Europe indicates pretty clearly, we should say, that there is no very handsome margin of profit when the cost of laying down is kept in mind. Even for the new coal year, which commences shortly, the foreign orders booked in America are relatively insignificant. Meantime the situation in Germany is growing worse. In advance sheets of the annual report of the American Consul-General at Berlin we read that "each succeeding day during the past fortnight has increased the general deficit of fuel, and the situation has become critical and ominous for the manufacturers and export trade of the country. Numerous important glass, porcelain, and machine factories in Silesia and Saxony have been obliged to shut down for want of fuel. There are a dozen electric lighting and power plants which have less than a fortnight's coal provision on hand, and no source from which to obtain further supplies." In the circumstances it is not surprising to learn that frequent letters are received at the Consulate from importers of English anthracite and gas coals, complaining of the meagre supply and high price, and asking to be put into communication with American exporters of those grades. Mr. Mason writes that if there remains any considerable surplus of American coal for export, and the conditions of freight are not prohibitory, "the present season offers a rare and fertile opportunity to establish in the German market the standard grades of American anthracite and gas coals." We doubt if American coal could hold its own in any market of the Continent save during abnormal periods such as the present, because that would imply the maintenance of English coal at existing quotations, and that is scarcely to be looked for. There is no room, therefore, for a trade which shall grow into "vast and permanent importance." But the stringency in Germany just at present is sufficiently bad—for the Germans. The principal wholesale agency for Silesian soft coal—of the qualities used for steam and general manufacturing purposes—is now selling its scanty stock at 21 marks per ton, delivered at Berlin, and according to Mr. Mason there is a general panic among coal dealers, who are unable to provide coal for their customers at any price, and can see no encouraging prospect of obtaining their next season's supply. In Russia the situation is equally desperate. The enormous development of railways and manufactures in that country during the past three years has completely outrun the limited domestic coal supply, so that naphtha fuel, which has been hitherto largely used, has advanced in price from 4 to 19 copecks, and the Russian Government has sought to ease the pressure by suspending for an indefinite period the usual prohibitory import duty on coal. As to France, in spite of two or three consignments from the United States, the Consul at Marseilles sums up the position by saying that the question of the moment is where to get coal, and not its price. This gentleman, more perspicacious than his colleague at Berlin, recognises that under ordinary conditions there is no chance for American coal in that market in competition with Cardiff.

CORDITE IN A HURRY.

UNDER this heading is an article in the *Times* of March 28th, on a very serious event which has occurred and which has been kept remarkably close, namely, the spontaneous combustion of cordite in the magazine of a ship of war. The writer evidently knows a good deal about cordite, and also is interested in favour of the chemists who were the means of bringing it into the service. He specially depreciates the efforts of those who have since manufactured it. He is a rash man if he wishes to remain unknown, for any one who had a mind to it could trace the authorship home to one of a very small group of men indeed. His plea is that cordite is an admirable explosive, but that it has not had justice done to it. Safe and powerful when sound and pure, it is ruined by being made in a hurry. He says that our stores were disgracefully low when the present war broke on us, and that so hurried and scrambling was the supply then established that as much as 30 per cent. from one source was rejected for failing to pass the ballistic test, and probably a quantity of cordite entered the service without having been thoroughly washed and purified. Further, he urges that the erosion from which we suffer in our large guns is due to cordite not having been modified to suit various calibres. All this may have a certain amount of truth in it, that is to say, cordite may have been imperfectly made, but the correspondent is a bold man to seize this opportunity to prefer the claims of the eminent chemists to whom he refers, for the accident is not a circumstance that brings the virtues of cordite into strong relief, but rather the opposite, since we learn that special care is needed to prevent this most terrible danger, although, with the writer, we believe that cordite, thoroughly well made, stood climatic tests well. The writer then deals with the constituents, and tells us that nitro-glycerine can be easily washed, but gun-cotton is more difficult to purify, and we can bear him out in the statement that washing out the free acid is a tedious process. Vaseline, it is urged, may also contain impurities, and if "certain impurities exist in any one of the three ingredients it is impossible to answer for the behaviour of the resulting cordite." Slow chemical changes may set up, and may go on for weeks or months, and sooner or later end in spontaneous combustion. "Save me from my friends," cordite might well say. Here is an advocate for cordite and its introducers who practically tells us that it must be very sharply watched if we are to escape spontaneous combustion. In his advocacy he brings up its erosion, but he blames the artillery and engineer officers for this, for they ought to have modified its manufacture so as to prevent it. For its dangerous elements he blames the Government for needing the supply so fast, and the private manufacturers for scamping their work. We happen to have discussed cordite lately with regard to erosion; we would here only remark that if cordite cannot be made fast without the probable liability to spontaneous combustion in our magazines, it is all the more reason that we should thoroughly test it, as we have advocated, in comparison with other smokeless powders. It may be worth all it entails, but let us have a thorough trial, and be sure of it. Sir Andrew Noble has compared it with brown prismatic powder, but he does not tell us that he has tested it in comparison to the powders now used in Germany, France, Russia, and America.

SIR ANDREW NOBLE ON MODERN EXPLOSIVES.

ON March 23rd Sir Andrew Noble gave a lecture at the Royal Institution on "Some Modern Explosives." After describing cordite and ballistite, Sir Andrew compared the velocities and energies obtained by cordite with those obtained by the old-fashioned R.L.G. powder. He especially warned his audience against accepting velocity alone as a test of results obtained. This is important, seeing that some foreign guns have light projectiles, with which high velocities are easily obtained. The lecturer preferred heavier projectiles for three reasons. (1) More work was got out of the powder. (2) The resistance of the air was less against a shot with a given energy in proportion as its velocity was lower. (3) The heavier shot had more power to keep up its velocity, even were the resistance equal. Sir Andrew stated that the cordite adopted in this country is superior to the powder recently brought in abroad. With it any practical velocity or energy was at our disposal; but other considerations had to be taken into account, and our military authorities had sound reasons for not giving a high velocity to our field gun at the present time. As an old artilleryman, he ventured to say that our field gun was inferior to none, and certainly in the present war it had been handled in a way worthy of the reputation of the corps. With regard to erosion, he could assure them that brown prismatic powder would produce as much erosion as cordite if made to develop the same energy. It was, in fact, the great energy now obtained that involved the great erosion. Lately, in conjunction with Sir F. Abel and Professor Dewar, he had been experimenting with cordite with varying proportions of gun-cotton and nitro-glycerine, and made in various sizes to endeavour to reduce this most objectionable erosion. Heat was, he found, the principal factor in determining the quantity of erosion. This trial showed that cordite in any of its forms was not liable to detonation. Sir Andrew had also experimented with the following objects:—(1) To test the time of combustion of various thicknesses of cordite; (2) the rate at which heat was given out; (3) the temperature of explosion and the relation between temperature and pressure under the conditions of ignition in the bore of a gun. Finally, he expressed a hope that the above-mentioned experiments would add to our knowledge of the kinetic theory of gases.

THE FRENCH NAVAL BUDGET.

THE French Chamber has just fixed the Naval Budget for the current year at 310,000,000f. (£12,400,000). This sum is 7,000,000f. less than the Government proposal, but it is 6,000,000f. more than the Budget of 1899. Ten years ago the French Naval Budget amounted to 201,000,000f. Nevertheless, the report made by the Budget Commission lamented the inadequacy of the French naval defences in view of present circumstances, and quoted a list of requirements which could not be carried out under the present Budget. Moreover, the Budget contains certain very important items, such as new vessels, the formation of naval bases, and the harbour defences, all of which have not been considered sufficiently, and which will take years to bring into being, while, meanwhile, all sorts of eventualities may arise. The *Journal des Débats* upbraids the authorities with having neglected the navy, and blames the Parliament for having regarded the navy as a luxury until within recent years, while none of the Ministers had the courage to throw the patchwork system overboard and to adopt a uniform system. Matters have now assumed a better aspect; the French Chamber was unanimous for once in granting the Naval Estimates, and it was also of one mind in deciding to leave the principal questions on one side until the plans for naval construction and general measures of defence come under discussion. Meanwhile the Chamber has accepted the proposals laid down by the Commission, and any future modifications will be solely in view of increasing the proposed defences. The discussions have shown that the Chamber is quite agreed with the Government as regards the great battleships, while public opinion asks for information concerning the relative utility of the various types of vessels. The *Journal des Débats* expresses the hope that, when once the Parliament has raised the number of ships of the squadron by six, the supporters and opponents of this type of ship will cease their unreasonable polemics, since the one thing most needful is confidence in the superiority of the French navy, especially in its artillery, over those of foreign Powers.

RAILWAY COMPANIES AND EXCURSION STEAMSHIPS.

THE House of Lords' Committee has passed the Barry Railway Steamships Bill, and, so far as its decision goes, it introduces a new ruling in regard to legislation dealing with the power of railway co-operation to run tourists in excursion steamers to popular resorts. The Barry Company asked for authority to subsidise or construct a fleet of vessels to ply between its docks and the holiday haunts on the other side of the Bristol Channel; or, indeed, to any other place whither chance or circumstances might invite a service. The Great Western Railway, among others, opposed, on the ground that Parliament had never hitherto permitted railway companies to be owners of steamships, except on specified routes, and for the purposes of facilitating the transport of railway passengers. Here, it was insisted, was a claim for liberty to run to and from all the bays or havens of the Severn estuary, and the Bill, according to Mr. Horatio Lloyd, for the Great Western Railway, would sanction "that snatching of advantage by one railway over another which Parliament had expressly set its face against." On the merits of the Bill we have no opinion to express, but Lord Elgin's Committee evidently saw no danger to "vested interests" in approving the preamble. It went further, in fact. On the condition that the Barry Railway authorities gave equal facilities at their docks to all similar steamship companies, the Bill was allowed to proceed in scarcely restricted measure—*i.e.*, to the right to run summer excursion vessels anywhere in the Bristol Channel westward to a line drawn from Tenby to Hartland Point. The decision has, of course, to be ratified by the Commons, and is mainly of local interest; but it means an innovation and establishes a precedent, and that is why it is noticed now.

ELECTRIC TRAMWAYS IN LONDON.

WHEN referring in these columns two or three weeks ago to the two tramway Bills promoted by the London County Council in the present session, for the purpose of authorising the construction of new tramways, and the introduction of electric traction on the lines at present owned, and upon those likely to be acquired on the expiration of the twenty-one years' concession under the Tramways Act, 1870, it was suggested that the opposition of a few out of the forty local authorities to the adoption of the overhead trolley system should not be allowed to wreck No. 2 Tramways Bill, and thus retard for another year the prospects of the institution of improved methods of tramway working throughout the metropolis. At the same time it was also suggested that although it might be inadvisable to permit the overhead trolley system in parts of inner London, yet there could be no reasonable objections to it in suburban districts provided with wide main roads. The extent to which these suggestions have been adopted is shown by the fact that the Highways Committee, in the meantime, has agreed on behalf of the Council to modify No. 2 Bill, in order to meet the wishes of a number of the local authorities, to the extent of pledging the Council not to introduce the trolley sytem in any district without the consent of the Vestry or the Board of Works, as the case may be. The undertaking given to this effect is, however, somewhat tempered by the decision to retain the power to use that method in the east, the south, and the south-west of London. Whatever may, therefore, be

the value of the concession to the Vestries in relation to aërial conductors, it is evident by inference that it has only been made after prolonged negotiations with the metropolitan local authorities, with the result that only three were represented by counsel on the Bill coming before the Select Committee of the House of Commons, presided over by Sir Samuel Hoare.

The Bill, therefore, came before the Select Committee proposing the employment generally of the conduit system, the surface contact method, and the overhead trolley principle specially in certain suburban districts, and in this form the Committee found on Thursday week that the preamble of the Bill had been proved. In making this announcement, Sir Samuel Hoare stated that the Committee were satisfied that, if London is to have the full advantage of electric tramways, it will not be desirable to introduce special clauses in the Bill for the protection of the three Vestries—Hackney, Wandsworth, and Battersea—which had petitioned against the measure out of the forty local authorities in the metropolis. The decision of the Committee in this respect was influenced by the fact that Hackney has six members on the County Council, Wandsworth two representatives, and Battersea two members, so that if any grievance arises in those districts they have equal opportunity with other districts represented on the Council of bringing that grievance before the Council. The objections of the South Metropolitan Gas Company and the Lambeth Water Company, which related chiefly to the disturbance of their mains and the possible effects of electrolytic action, were overruled by the Committee, who expressed themselves satisfied that the provisions of the Bill and the enactments of the Tramways Act, together with the fact that the County Council is subject to the Board of Trade, both as to the approval of the system of traction and as to the regulations which may from time to time be laid down, make every reasonable provision to meet the contention of the two companies. In this connection, Mr. James Swinburne, in giving evidence before the Committee, expressed the opinion that the Board of Trade regulations that are intended to deal with small systems would protect gas and water pipes sufficiently in a small town, but that in a large system the pipes would be attacked to some extent. The extent of the damage, he said, was a matter of degree, and electrolytic action was silent, secret, and continuous. These observations may, of course, apply to the surface contact and the trolley methods, but not to the conduit system where an insulated return is used; and as far as can be gathered from the evidence given on behalf of the Council, it is the latter system which is intended to be most generally adopted on the tramways, and therefore the danger of electrolysis should be obviated.

The cost of converting the existing tramways to the conduit system is estimated by Prof. A. B. W. Kennedy at £14,450 per mile of single line, including alterations of mains, provision of rolling stock, and power station, or, say, an average of £15,000 per mile. It is satisfactory to note that the preamble of the Bill, which proposes a total capital expenditure of £3,000,000, has been proved. The clauses of the Bill are now under the consideration of the Select Committee, and there is every reason to believe that the Bill will be passed, and the initial steps taken for the purpose of modernising the tramway system of the most backward city in the world in respect of improved methods of locomotion on street tramways. Since writing the above we find from a report of the Parliamentary Committee of the County Council that the Bill has been passed by the Select Committee.

JOHN HENRY JOHNSON.

We much regret to announce the death of Mr. John Henry Johnson, the well-known solicitor and patent agent, who died at his residence, Mountains, Tonbridge, on the 12th March, in his 73rd year. The son of a solicitor practising in Kendal, Mr. Johnson was born and spent all his early life in that town. His father died young, and he and his two elder brothers had to fight their own way in the world. Mr. Johnson was first articled to Mr. John Harrison, solicitor of Kendal, and ultimately came to London, when be became conveyancing clerk to Messrs. Cookson and Wainwright, of Lincoln's-inn. After a time he left their employment and went to Glasgow, where he joined his eldest brother, William Johnson, long since deceased—who was an engineer, and editor of the *Practical Mechanics' Journal*—and who had commenced business there as a patent agent. The business prospered, and later Mr. J. H. Johnson returned to London, and started in practice as a solicitor and patent agent at 47, Lincoln's-inn-fields, with the intention of founding a London branch of the Glasgow business. But the branch soon outgrew the parent stem, and the London business ultimately became the large business which it still is.

Mr. Johnson was a man of very great ability, and would have made his mark in whatever walk of life he had found himself. He had wonderful organising powers, and was a man of very quick, and, at the same time, remarkably sound judgment. These qualities enabled him to build up a large patent agency practice, carried on first by himself and subsequently in partnership with his sons, Mr. James Yate Johnson and Mr. George William Johnson, and Mr. Benjamin Willcox—who still carry on the business—at 47, Lincoln's-inn-Fields. He had also a large practice as a solicitor, more especially in patent actions, also at first carried on by himself, and subsequently in partnership with his son, who still carries on the business. His name will be remembered in connection with many important cases, notably the paraffin-oil case in 1864—which occupied Vice-Chancellor Stuart for twenty-nine days—the sewing machine litigation in the sixties, and later on the great aniline dye and colour cases. No one who was associated with Mr. Johnson in this class of business could fail to be struck by the quickness and accuracy with which he grasped all the intricate questions which constantly arose, and the manner in which he had mastered the details of subjects often, of necessity, unfamiliar to him.

He was for some years the proprietor of the *Practical Mechanics' Journal*—after the death of his brother William—and in 1862 he brought out the *Practical Mechanics' Journal* "Record" of the International Exhibition of that year, a book written by various writers under the editorship of the late Robert Mallet, which was and is a trustworthy and accurate representation of the manufacturing arts at that date. He was an associate member of the Institution of Civil Engineers, the first president of the Patent Agents' Institute, and was consulted by the authorities on many points which arose in the preparation of the rules under the New Patent Act of 1884. Mr. Johnson for the last thirteen years suffered from a painful and lingering complaint, which compelled his entire absence from his business. He was an omnivorous and rapid reader—travels were his special delight, and he read literally every book of travels which was published; and he not merely read, but remembered what he read. His favourite reading after the travels was the Waverley Novels, which, since his confinement at home, he made a point of reading through once in every year. He was a kind and just man, and a firm and most trustworthy friend, and his death is deeply lamented by all who knew him.

FREDERICK WILLIAM STEVENS.

The death is announced from India of Mr. Frederick William Stevens, the well-known designer of public works and civil engineer of Bombay, at the comparatively early age of fifty-two. He was the eldest son of Mr. Matthew Stevens, of Lansdown, Bath, and was educated at King Edward the Sixth's Grammar School, and the Competitive College, Bath. Having served his articles to the city surveyor, he entered the Public Works Department of India by competition in 1867 as an assistant engineer. From this he was promoted in 1872 to be executive engineer, Bombay, and the following year was appointed to the Presidency division and secretary to the Esplanade Fee Fund. In 1877 Mr. Stevens' services were lent by the Government to the Great Indian Peninsula Railway Company, to design and supervise the erection of the Victoria Terminal Buildings, Bombay, his services being continued under similar conditions until 1884, when he retired from the Indian Civil Service, but remained in the service of the railway company until 1888. He had been appointed a Government member of the Bombay Municipal Corporation in 1884, and in 1887 was appointed by the Government of Bombay a member of the Select Committee for the future extension of Bombay, receiving the thanks of the Government for his services. Mr. Stevens was a magistrate for Bombay, a member of the Society of Arts, an Associate Member of the Institute of Civil Engineers, and a Fellow of the Royal Institute of British Architects. In 1889 he was decorated with the C.I.E. for his services in connection with the public buildings of Bombay.

NEW GERMAN CRUISER, PRINZ HEINRICH.

The new German cruiser Prinz Heinrich, which was launched on March 22nd from the Imperial Yard at Kiel, is the first of the great cruisers provided for by the Navy Bill of 1898, and also the last piece of work produced by the late Chief Constructor of the German Navy, Privy Councillor Dietrich. With a displacement of 8800 tons, this vessel stands midway in size between the Fürst Bismarck with 10,650 tons displacement and the Kaiserin Augusta, with 6290 tons. Her length is 120 metres, her beam 19·6 metres, and her draught 7·3 metres. Like all German vessels of recent construction, the Prinz Heinrich has triple screws; the combined power of the three engines will be 15,000 horse-power, giving a speed of 20½ knots an hour. The engines are triple-expansion with four cylinders. The fourteen water-tube boilers of the Dürr system are in four heating chambers, which, like the engine-rooms, are divided by water-tight compartments. In addition to many other mechanical appliances there are four dynamos for lighting the interior of the vessel, for working the search-light, and driving the motors. The coal bunkers are unusually large, and take 1500 tons of coal; on this account the radius of action of the vessel will be greater than is generally the case. The experience gained in the Japanese and Spanish naval combats has been turned to account, with the result that a new type of armour has been introduced. Not only is the cruiser provided with an armoured belt of 100 mm. thickness at its centre, and 80 mm. at its ends, but above this belt there rises a "citadel" similarly armoured, and protecting from an enemy's fire the middle part and about two-thirds of the entire length of the vessel. Above the "citadel" are three revolving turrets protected by armour plates of 150 mm., and worked by electricity. The ship has an armoured deck of 40 mm. to 60 mm. thick. The armour plating is hardened nickel steel, that for the turrets being made by Krupp, and the rest by the Dillinger Works; in fact, the industries of the Rhine and of Westphalia have supplied nearly all the material used in building this vessel. The armament consists of two 24 cm. guns in two revolving turrets worked by hydraulic pressure, ten 15 cm., ten 8·8 cm., ten big machine guns of 3·7 cm., and four smaller machine guns. The torpedo equipment consists of three submerged tubes and one above-water tube. The speed with which this vessel has been built is certainly a striking evidence of what German shipbuilding is now capable of doing. The cruiser was laid down on December 1st, 1898, and she is to be ready for sea in April, 1901. Thus, only twenty-eight months will be occupied in her construction, instead of the usual fifty.

RECEDING PROFITS OF HOME RAILWAYS.

NO INCREASE IN THE COAL RATE.

(From the *Statist*.)

During the past few weeks the stockholders of our railways have been encouraged to take a hopeful view of their prospects of dividends by the expected advance in the rates for the carriage of coal. At the half-yearly meetings the chairmen of some of the most important railways declared they would not be adverse to such a movement; conferences were arranged for giving practical effect to the idea; and it was stated that an agreement for increasing the rate for the carriage of coal by 3d. per ton had been reached. The effect of this latter statement has been to induce considerable purchases of the stocks of the coal roads which were especially expected to benefit. Calculations have, indeed, been made to show that the North-Eastern, with its coal traffic of 33,000,000 tons; the Midland, with 22,000,000 tons; the North-Western, with 18,000,000 tons; the Great Western, with about 16,000,000 tons; the Great Central, with 12,000,000 tons; the Great Northern, with over 8,000,000 tons; and the Lancashire and Yorshire, also with over 8,000,000 tons; would all benefit from the increased charge on coal to an extent which would much more than neutralise the effect upon their profits of the higher price of coal and material. From the figures given, our readers will appreciate that had the lines in question agreed to an advance of 3d. per ton in the rate for coal, and had the Board of Trade sanctioned such an advance, the benefit to the companies would have been very great, even if due allowance be made for some of the coal having to pass over the lines of several railways and the additional rate having to be shared with other companies on a mileage basis. In 1898 the production of coal in England was 148,000,000 tons, in Wales, 24,000,000 tons; in Scotland, 30,000,000 tons; and the total output was 202,000,000 tons. Most of this coal passed over the railways. An all-round advance of only 3d. per ton in the coal rate would thus mean an increase of some £2,500,000 to the gross earnings of the railways—a sum which would have met the probable increase in expenditure and capital charges, and possibly have given an additional £1,000,000 of profit.

But the conferences of railway officials have been practically without result, and the suggested increase in the coal rate has fallen through in consequence of the difficulties raised by our premier road. Moreover, had the railway companies decided to ask the Board of Trade to sanction such an advance its assent under the circumstances was doubtful. The railway companies, indeed, appear to have acted wisely in not proceeding with the suggestion. The present high prices of both coal and railway material are due to abnormal and temporary causes, and the railways will doubtless suffer in the present year; but the very height of the prices will foster production and curtail consumption, and before long bring about a low level of prices, probably excessively low; and if the railways had now raised their rates in consequence of the temporary high prices, when prices fell, traders would have agitated for a reduction, probably for still lower rates than those now ruling, on the plea that the railways were buying their coal and railway material at excessively low prices.

Although the railway companies have not found feasible the suggestion to increase the rate for coal, we understand that they have decided to make some minor additions to their charges, by which they hope in some degree to recoup themselves for the increased cost of fuel and materials. The charges they propose to modify are governed by competition, and not by statute, and by agreement amongst themselves these charges can be raised, and no one—neither the Board of Trade nor the public—can object. The charges to be increased affect wagon hire, siding rents, the hire of bags, rebates, cartage, excess coal weight, passengers' excess luggage, &c. In the aggregate the increased charges for these minor services would bring in a substantial sum could they be effected in every case. But customers usually obtain concessions in these minor services in consideration for business, and increased charges in respect of competitive traffic will thus be difficult to obtain. The difficulty in maintaining higher rates for these services is especially great at the present time, when the new line into London is bound to push for business, and the older roads are doing their best to prevent the diversion of traffic. This reasoning does not, of course, affect non-competitive traffic. Here the companies will doubtless have no difficulty in securing somewhat higher remuneration for the miscellaneous services mentioned. In view of all the conditions attached to these miscellaneous services, the additional revenue likely to be obtained may not be nearly sufficient to cover the increased cost of working and the additional capital charges. We consequently anticipate that unless gross earnings show a much greater rate of expansion than they have yet done in the current half-year, a general decline in dividends may occur in June next.

LETTERS TO THE EDITOR.

(*We do not hold ourselves responsible for the opinions of our correspondents.*)

BRITISH AND FRENCH GUNS.

Sir,—In a most interesting article entitled "British and French Guns," which is based on a question by me to Mr. Goschen, and a reply by him in debate, you finally conclude that "Sir Charles Dilke was wrong in saying that any attainable figures go to 'show superiority at every period.' Even at the muzzle, our shots have greater energy, so that Sir Charles Dilke's statement is literally the reverse of the truth, unless he takes the less weight of the French guns into account."

I gave no figures of my own. It would have been absurd for me to do so, as I have no technical knowledge of the subject.

What I did say was to quote in the House of Commons the elaborate and apparently—on the face of them—conclusive figures of a great French expert, M. Claudinon, as recently given in debate in the French Assembly, and to suggest that they needed a reply—which they certainly did not receive. Those figures did show "superiority at every period;" and it is an unfortunate admission which has since been made on our side that these figures on both sides are the figures for full charges, but that, while full charges are used in France, we are unable to use a full charge in our wire gun. This is the point to which you yourself allude in your article, where you add, "Whatever foreign guns do, our own wear at a rate which causes the velocity to fall shockingly fast."

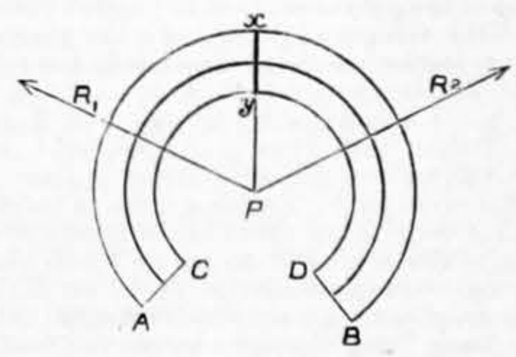
Since the debate in Parliament we have had the meeting of the Vickers Company, and the statement made there on behalf of the company that the Government have purchased from them a new gun, Mark IX. It is, however, unfortunately the case that our cordite is likely to destroy this gun as rapidly as it does the inferior gun, Mark VIII., on which the debate turned.

76, Sloane-street, S.W., March 28th. Charles W. Dilke.

[Sir Charles Dilke will find, on page 322, that reply to M. Claudinon which Mr. Goschen was apparently not in a position to supply. Sir Charles Dilke will, we think, find the summary of a paper by Sir Andrew Noble, on page 335, of considerable interest. —Ed. E.]

BOURDON GAUGES.

Sir,—A glance at "W. B. M.'s" diagram in your last impression is enough to show that he is wrong. He has forgotten the pressure



on the ends A C, D B, which tends to force these ends together, and prevent the tubes from opening out. The action on these ends is one of the great difficulties of the question. P. V.

London, March 27th.

RECEIVER DROP.

Sir,—Professor Weighton is by no means the first in the field with a formula for cylinder ratios. Mr. Rockwood, a United States engineer, has worked in the same direction. He much favours the triple-expansion engine with the intermediate cylinder left out, and has used compound engines with the ratio 7 to 1. A paper by Mr. Knapp will be found in your issue of October 4th, 1895. In that the formula

$$R = \sqrt{\frac{175}{3 \cdot 5}} = 7 \cdot 06$$

will be found, the numerator and denominator are the absolute pressures in the cylinders. Mr. Rockwood agrees with your view that drop is not a serious matter.

Birmingham, March 26th. J. E.

AN OPTICAL PROBLEM.

Sir,—I am sorry that the word "not" has inadvertently crept into the first line of the last paragraph of my letter in your last issue, thereby reversing my meaning. It should read, "I do mean what your correspondent," &c. Geo. M. Seabroke.

Rugby, March 26th.

PORTABLE PNEUMATIC TOOLS.*

By Mr. EWART C. AMOS, Member, of London.

(*Concluded from page* 316)

HAVING now described four representative types of hammers which may fairly be said to cover the types at present in use, it may be interesting to refer to Table I., showing sizes and air consumption; but in regard to these the author wishes to point out (1) that they are as given by the different makers; (2) that the claims as to air consumption can only be sustained when the tools are in the hands of competent workmen, as otherwise the air consumed may greatly exceed the quantities given; (3) that the air consumption is not alone indicative of the efficiency of the tool.

TABLE I.—*Table showing Sizes, Weights, and Approximate Air Consumption of Hammers.*

Type.	Description number.	Length of stroke.	Diam. of piston.	Weight of piston.	Estimated speed.	Air consumption in free air.	Weight of hammer
		in.	in.	oz.	Revs. per min.	Cub. ft. per min.	lb.
"Ross." Fig. 1. Plate 1.		$\frac{7}{8}$ $\frac{15}{16}$ 1 $1\frac{1}{16}$ $1\frac{1}{8}$	$1\frac{3}{4}$ $1\frac{5}{8}$ $1\frac{1}{2}$ $1\frac{3}{8}$ $1\frac{1}{4}$	$2\frac{1}{2}$ 2 $1\frac{3}{4}$ $1\frac{5}{8}$ $1\frac{1}{4}$	11,000 ,, ,, ,, ,,	30 25 18 15 13	$11\frac{1}{2}$ $10\frac{3}{4}$ $10\frac{1}{2}$ $6\frac{1}{2}$ 6
"Q and C." Fig. 2. Plate 2.	Single hammer. C	1	$1\frac{1}{2}$			12	$5\frac{3}{4}$
	Single hammer. D	$\frac{7}{8}$	$1\frac{3}{8}$			12	$5\frac{1}{4}$
	Single hammer. F	$\frac{3}{4}$	$1\frac{1}{4}$		10,000 to 15,000	10	$3\frac{1}{2}$
	Double hammer. A	1	$1\frac{1}{2}$			18	$10\frac{3}{4}$
	Double hammer. C	1	$1\frac{1}{2}$			15	$9\frac{1}{4}$
"Little Giant." Figs. 3 to 9. Plates 1 to 3.	0	5	$1\frac{1}{2}$	20	1,200	20	16
	1	4	$1\frac{1}{2}$	16	1,500	15	12
	2	3	$1\frac{1}{2}$	14	2,000	15	$9\frac{1}{2}$
	3	$2\frac{1}{4}$	$1\frac{1}{2}$	14	2,000	15	$8\frac{1}{2}$
"Boyer." Figs. 10 to 15. Plate 3.	000	5	$1\frac{5}{16}$	34	1,000	20	26
	0	5	$1\frac{1}{16}$	$23\frac{1}{2}$	1,800	20	13
	1	4	$1\frac{1}{16}$	17	2,200	15	$9\frac{3}{4}$
	2	3	$1\frac{1}{16}$	13	2,600	15	$8\frac{1}{4}$
	3	$1\frac{3}{4}$	$1\frac{1}{16}$	13	3,000	12	$8\frac{1}{4}$
	B	2	$1\frac{5}{16}$	12	3,500 to 5,500	10	8
	BB	$1\frac{3}{4}$	$1\frac{1}{16}$	8		10	$6\frac{1}{2}$
	F	1	$\frac{3}{4}$	4		10	4
	U	$\frac{3}{4}$	$\frac{5}{8}$	3		10	3

The author, however, whilst putting against each maker the amount claimed by him as being the amount of air consumed, is inclined to think that these amounts may be a little exceeded, and in any case provision must be made for leakages, &c.; it is therefore not advisable to cut down the air supply to these amounts, and in actual practice some margin must be provided over and above what the experimental trials would seem to indicate the tools require.

Some reference must now be made to vibration, and its effect upon the operator. Some hammers vibrate more than others, but even in the best the shock is noticeable. Its effect, however, is greatly reduced as soon as the operator learns how to use the hammer to its best advantage, and it is probable that no injury will be done to the operator as soon as he has adapted himself to its proper handling. The purposes to which these hammers may be applied are many, and include chipping, caulking, beading, fettling, scaling, riveting, stone-dressing and carving, driving plug holes in stone, planishing brass and copper, driving nails and spikes, &c. To whatever purpose, however, the hammer may be put, it is necessary to remember that proper efficiency can only be obtained by selecting hammers of suitable weight and stroke for each class of work. No tool can be adapted to all classes of work. It is not uncommon to find operators attaching blame to a tool on account of its failing to successfully do its work when the real cause of failure is due to the application of the wrong tool. For results of work done by hammers in caulking, chipping, &c., reference must be made to the table on page 338.

Riveters.—Compressed air has long since been recognised to possess great advantages for the purposes of riveting. Portable pneumatic riveters may be divided into two types, viz., those that effect their purpose by squeezing, and those that have a percussive action. The former type are well known, and it is therefore proposed to consider only the latter. These again may be sub-divided into (*a*) hand-riveters used in conjunction with a pneumatic holder up, and (*b*) yoke riveters.

* The Institution of Mechanical Engineers. Figs. 9 and 30 are not reproduced. Several drawings which had been used in the years '58, '65, and '71 by the Institution were again put on the screen. They showed tools by Joy, Beyer, and Wyllie.

Hand riveters.—The hand riveter is simply a heavy pneumatic hammer fitted with suitable snaps, and therefore it becomes unnecessary to describe its mechanical action. It should be mentioned, however, that when used for riveting air pressure up to 100 lb. to 125 lb. is advantageous. In the hands of a skilful operator, this tool will be found exceedingly useful, as it can be extensively used in shipbuilding and constructional ironwork to drive rivets in places inaccessible to a yoke or bear riveter. At the same time, in the hands of an incompetent or lazy workman, it lends itself to doing anything but satisfactory work, as care is required to avoid making the head of the rivet on one side. It is, of course, necessary to have a holder-up, and this usually takes the form of a simple piece of mechanism consisting of a piston working in a cylinder into which compressed air is admitted, the end of the piston being kept up to the rivet head by the fluid pressure. Under this heading may also be described shell riveters, which are hand riveters mounted in a gimbal or suitable pivoted frame, which permits of shell rivets being driven up to a considerable size, and in places where a yoke riveter is unworkable. These are exceedingly valuable for shipwork.

"Boyer" Pneumatic Riveter with Pipe Gap-Frame.

Fig. 16.

Fig. 17.

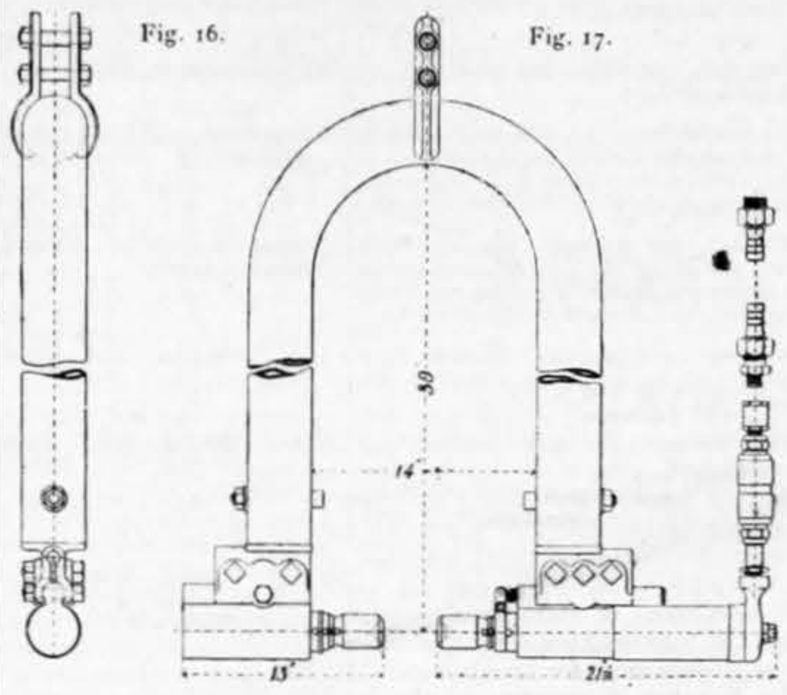
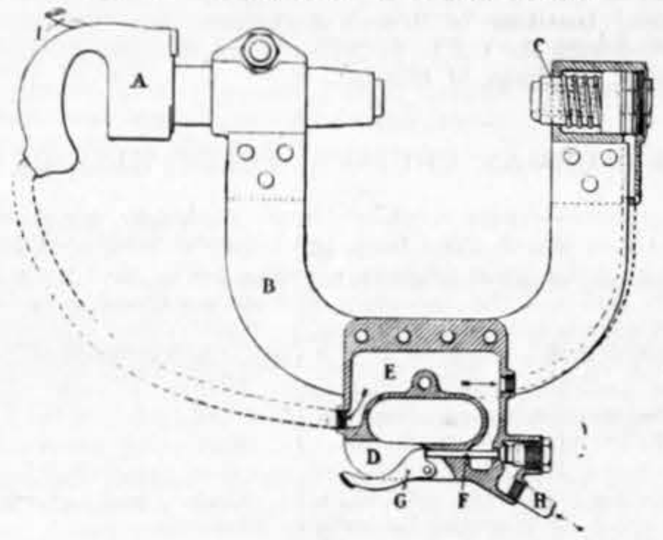


Fig. 18. *"Little Giant" Light Yoke Riveter.*

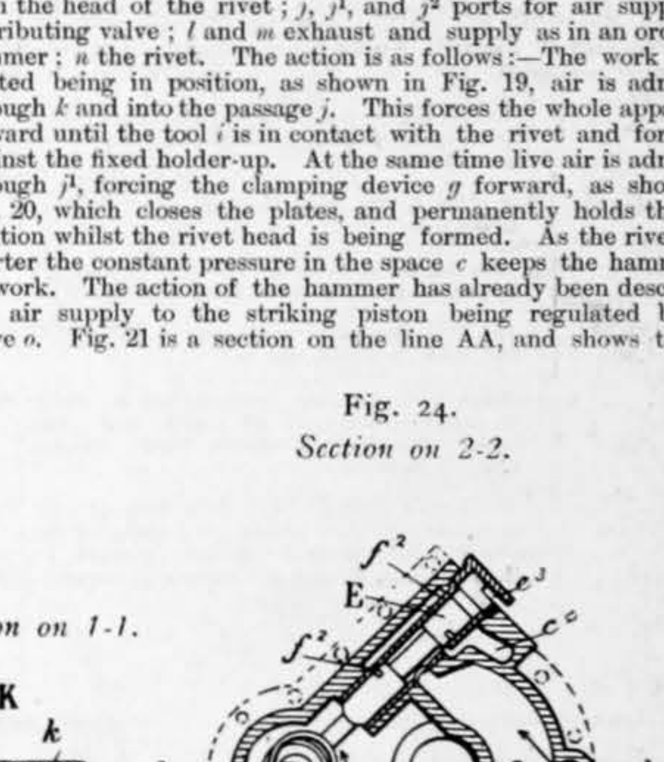


Yoke riveter.—Figs. 16 and 17 illustrate an ordinary yoke riveter suitable for shipwork and constructional ironwork generally, tanks, gasholders, wagon under-frames, and a variety of other purposes. One arm of the yoke is fitted with what is practically a percussion hammer, whilst on the other is a solid holder-up. Suitable adjustment of the hammer portion permits of the snaps being the correct distance apart. In a riveter of this type great as its value for certain classes of work, no provision is made for closing the plates, except that which may result from the snapping of the rivet; and to obviate this difficulty and to supply the want of a percussive-action plate-closing riveter, the "Little Giant" yoke riveter, which is shown in Figs. 19, 20, and 21, has recently been made. This riveter consists of an ordinary yoke *a*, having at one end a fixed holder-up and at the other a small frame or yoke carrying a pneumatic hammer, and provided with a special clamping device for clamping the work together during the process of riveting. This clamping device also takes the place of the ordinary pneumatic holder-up. Fig. 19 shows the device in section and the rivet in position with its head against the fixed holder-up and through th work to be riveted together, whilst the hammer and clamping device are in their normal position before live air is admitted.

Fig. 20 is a similar view, but with the clamping device shown against the work in readiness for the hammer to commence the operation of riveting the head. Its action will be readily understood by a short description, reference being had to the letters shown on the drawing, in which *a* is the main yoke; a^1 the small yoke or frame carrying the percussion hammer and clamping device *g*; *b* a projection of a^1; *c* an air chamber formed by the extension of the back of the hammer and the projection *b*; *d* the said extension of the hammer casing, and which also forms a guide to carry the hammer; *e* the hammer cylinder; *f* an extension of the coupling sleeve of hammer, and which slides in the other end of the small yoke a^1, and also acts as a guide for the clamping device; *k* a spring for returning *g* to normal position when air pressure is cut off; h^1 the hammer piston; *i* the tool shaped to form the head of the rivet; *j*, j^1, and j^2 ports for air supply; *k* distributing valve; *l* and *m* exhaust and supply as in an ordinary hammer; *n* the rivet. The action is as follows:—The work to be riveted being in position, as shown in Fig. 19, air is admitted through *k* and into the passage *j*. This forces the whole apparatus forward until the tool *i* is in contact with the rivet and forces it against the fixed holder-up. At the same time live air is admitted through j^1, forcing the clamping device *g* forward, as shown in Fig. 20, which closes the plates, and permanently holds them in position whilst the rivet head is being formed. As the rivet gets shorter the constant pressure in the space *c* keeps the hammer to its work. The action of the hammer has already been described, the air supply to the striking piston being regulated by the valve *o*. Fig. 21 is a section on the line AA, and shows the air passage from the valve *k* to the regulating valve *o* and also to the cylinders.

"*Little Giant*"
Portable Air-Drill.

Fig. 22.



"*Little Giant*"
Plate Closing Riveter

Fig. 21. *Section at AA.*

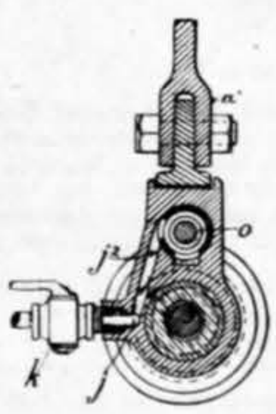


Fig. 19.
Open position.

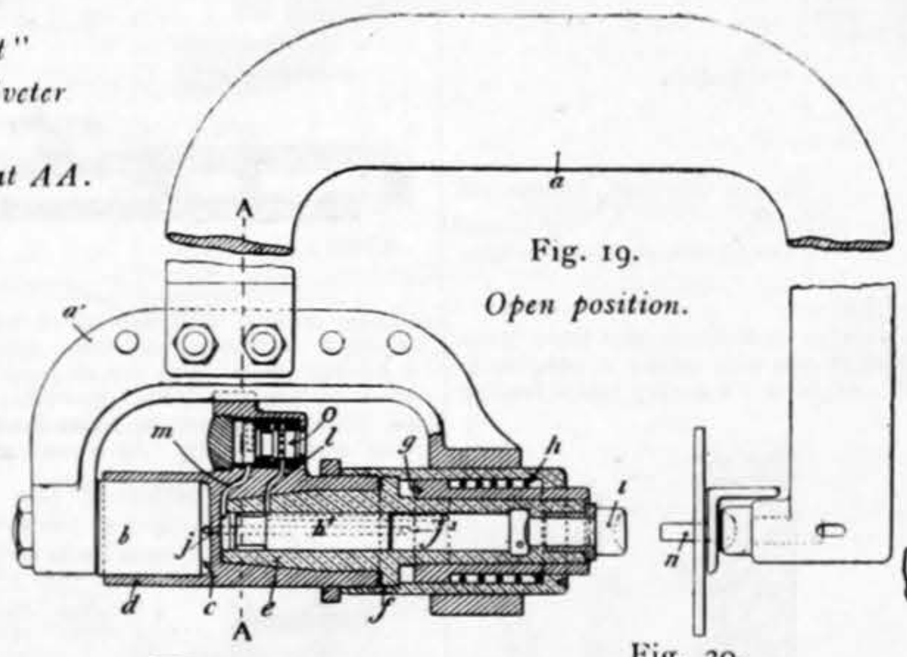


Fig. 20.
Ready position.

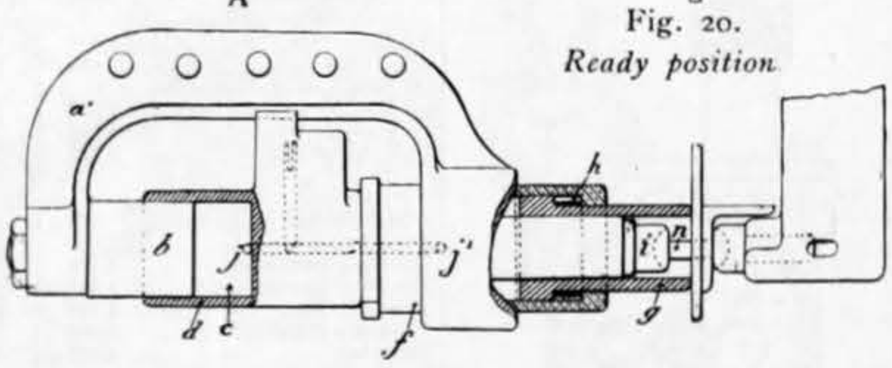


Fig. 23
Longitudinal Section on 1-1.

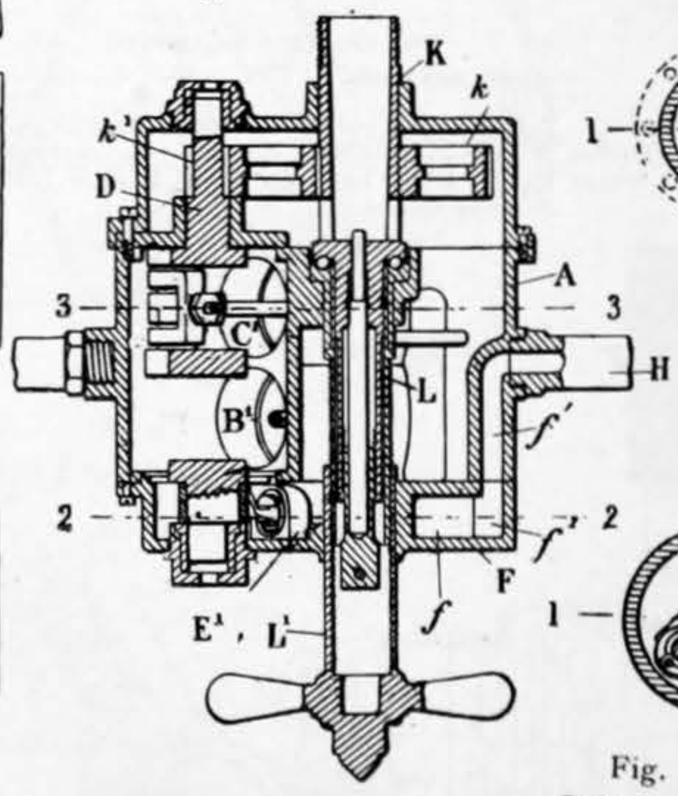


Fig. 24.
Section on 2-2.

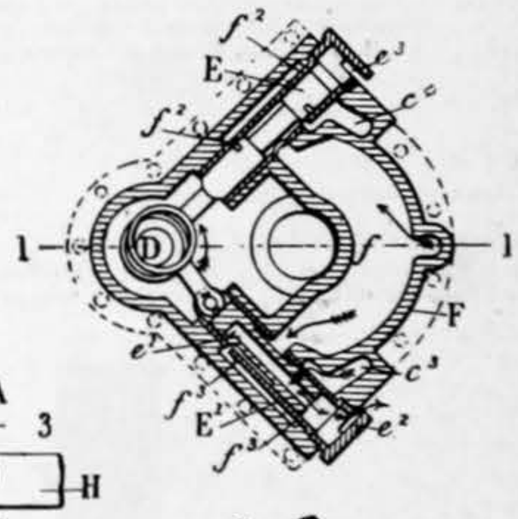
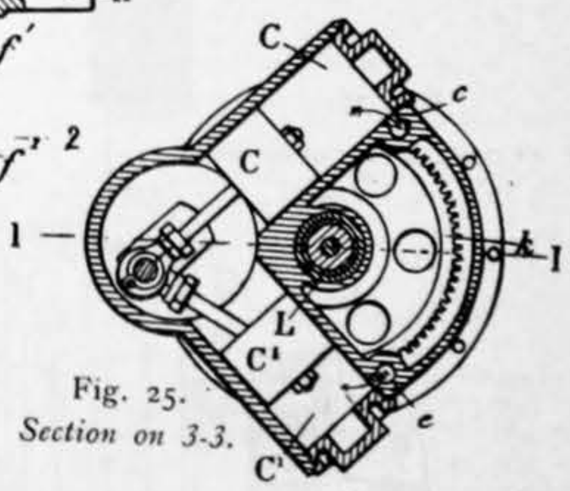


Fig. 25.
Section on 3-3.



Yoke riveter.—Figs. 16 and 17 illustrate an ordinary yoke riveter suitable for shipwork and constructional ironwork generally, tanks, gasholders, wagon under-frames, and a variety of other purposes. One arm of the yoke is fitted with what is practically a percussion hammer, whilst on the other is a solid holder-up. Suitable adjustment of the hammer portion permits of the snaps being the correct distance apart. In a riveter of this type great as its value for certain classes of work, no provision is made for closing the plates, except that which may result from the snapping of the rivet; and to obviate this difficulty and to supply the want of a percussive-action plate-closing riveter, the "Little Giant" yoke riveter, which is shown in Figs. 19, 20, and 21, has recently been made. This riveter consists of an ordinary yoke *a*, having at one end a fixed holder-up and at the other a small frame or yoke carrying a pneumatic hammer, and provided with a special clamping device for clamping the work together during the process of riveting. This clamping device also takes the place of the ordinary pneumatic holder-up. Fig. 19 shows the device in section and the rivet in

It will be obvious from this description and the drawings shown that although it is not possible to get a very great pressure on the clamping device without increasing the area of the pressing cylinders to an abnormal amount, yet this arrangement possesses very considerable advantages over the ordinary percussion yoke riveter, as it ensures that the riveting hammer shall be automatically kept up to its work, and that the work shall be firmly held together whilst the rivet is being driven, both of which are very important points.

Another and very valuable form of riveter is that shown in Fig. 18. This shows the "Little Giant" light yoke riveter, and represents the very latest development, which should prove an exceedingly useful addition to the pneumatic appliances at present in use. Its simplicity and value will be at once appreciated by reference to the diagram, in which A represents an ordinary standard type "Little Giant" hammer as used for chipping or

riveting, clamped to a light yoke B carrying at its other end a pneumatic holder-up C. There is also clamped to the yoke B a small casing D, containing an air chamber E, valve F, trigger G, and suitable pipe connections for providing compressed air communication with the hammer A and holder-up C. The action is as follows:—The main air supply enters the chamber E at H, being admitted past the valve F by pressing the trigger G, and thence passes to the holder-up and hammer handle. The holder-up at once brings the rivet into its place, and the operator then puts the hammer in action in the ordinary way by depressing its trigger I. The object of this riveter is to replace a separate holder-up in light riveting work where a yoke is permissible. To deal with such work it has hitherto been necessary either to use a hand riveter and separate holder-up, thus requiring two operators, or else a yoke riveter, which is generally too cumbersome for one operator. Moreover, it ensures that the holder-up first brings the rivet home before the percussion action begins, and also makes it possible to use an ordinary hammer. This would prove a very useful feature should anything go wrong with the percussion mechanism, when the hammer can be easily unclamped and immediately replaced. Such a riveter would close $\frac{7}{16}$in. cold rivets or $\frac{3}{4}$in. hot rivets with a gap up to about 12in., and can easily be handled by one man.

Table IV.—*Results of Work done with Various Types of Pneumatic Tools.*

Type of tool.	Nature of work done and time taken.	Remarks.	Authority.
Hammer	General	On general work each tool will do the work of two men.	Joseph Adamson and Co., Hyde.
Hammer	Caulking	In caulking each tool will do the work of three men.	Penman and Co., Glasgow.
Hammers	Caulking	In caulking each tool will do the work of three skilled hand caulkers.	Mechan and Sons, Glasgow.
Hammers	Caulking	Two and a-half to three times as much work in given time can be done by these machines as by hand. (Machine caulking is far preferable, as it makes more sound and satisfactory work.)	Edwin Danks and Co., Limited, Oldbury.
Hammer	Caulking and chipping	Useful for both caulking and chipping, doing work for about half the cost of hand labour, and in most cases making a tighter and better job. Several machines constantly at work.	Clayton, Sons, and Co., Limited, Hunslet, Leeds.
Hammer	Caulking	In a general way a caulking tool will do as much work as five or six men with ordinary tools, and besides the work is better done.	Alex. Stephen and Sons, Glasgow.
Hammer	Caulking	60 per cent. cheaper than hand caulking, and quite as efficient. The plates are punished less, and on this account pneumatic caulking is particularly useful for light plate work, such as tenders and tanks.	James Holden, Esq., Great Eastern Railway Works, Stratford.
Hammer	For cutting off thin steel plates, they have proved very satisfactory, and the work is done in one-quarter of the time taken for punching and shearing.	—	James Holden, Esq., Great Eastern Railway Works, Stratford.
Hammer	A chipping 7in. long and $\frac{3}{8}$in. thick was cut from a $\frac{1}{2}$in. steel boiler plate in 58 seconds.	—	The author.
Hammer	It is stated that when using a pneumatic caulker, one man can completely caulk in one day a marine boiler 14ft. 6in. diameter, having plates $1\frac{1}{16}$in. and $1\frac{3}{16}$in. thick, and tested to 360 lb. per square inch.	Another instance is given in which one man caulked in one day inside and out a flue 30ft. long by 2ft. 9in. diameter. This previously took 10 days by hand caulking.	The makers.
Hand riveter	70 $\frac{3}{4}$in. diameter rivets can be driven per hour per riveter.	—	The makers.
Stay riveter	It is stated that they have put in 60 stays, that is, 120 heads, in one hour per riveter.	—	Mr. Earl, London and North-Western Railway Company.
Drills	—	Have found them both effective and economical after trial.	Samuel Johnson, Esq., Midland Railway Works, Derby.
Drill	Drilling boilers	Very ingenious and useful tool. Can be used anywhere, even through a boiler manhole Does its work quite as quickly as any radial or other drilling machine, being much quicker than if done by hand.	Clayton, Sons, and Co., Limited, Hunslet, Leeds.
Drills	When tapping holes in fore boxes, it takes 36 seconds to pass the tap right through the inside and outside plate, as compared with 1 minute 48 seconds with a flexible shaft.	Until recently, we have exclusively used a flexible shaft for this purpose. This class of work is now seldom done by hand, but would take five to six minutes to effect the same purpose.	James Holden, Esq., Great Eastern Railway Works, Stratford.
Drill	As used for drilling work in place, a $\frac{3}{4}$in. diameter hole can be drilled through $\frac{1}{2}$in. plate in 22 seconds.	This compares by four minutes with a flexible shaft, and 10 minutes with a ratchet brace.	James Holden, Esq., Great Eastern Railway Works, Stratford.
Drill	Will drill a 2in. hole through 3in. steel in 11 minutes.	—	The makers.
Drill	A hole $1\frac{5}{16}$in. in diameter was drilled through Bessemer steel 2in. thick in $3\frac{1}{2}$ minutes.	—	The author.
Drill	A hole 3in. diameter was bored in pitch pine 5in. thick in 35 seconds.	—	The author.
Drill	54 holes, $\frac{13}{16}$in. diameter, were drilled in 1 hour 10 minutes, through $\frac{3}{4}$in. thick end plate furnace flange of a marine boiler, furnace being in position.	The drill was mounted on a special device which permitted of rapid adjustment of the drill, and also acted as a holder-up. The same work would take $8\frac{1}{2}$ hours if drilled by hand.	The makers.
Drill	A small drill drilled a $\frac{1}{2}$in. hole through 1in. Bessemer steel in 1 minute 10 seconds, whilst a larger drill will drill $1\frac{1}{16}$in. hole through the 1in. thickness of steel in 1 minute 15 seconds.	—	The makers.
Various	—	Giving very satisfactory results.	Locomotive Dept., London and North-Western Railway.
Various	—	Great saving over hand labour.	Lumby, Son, and Wood, Halifax.

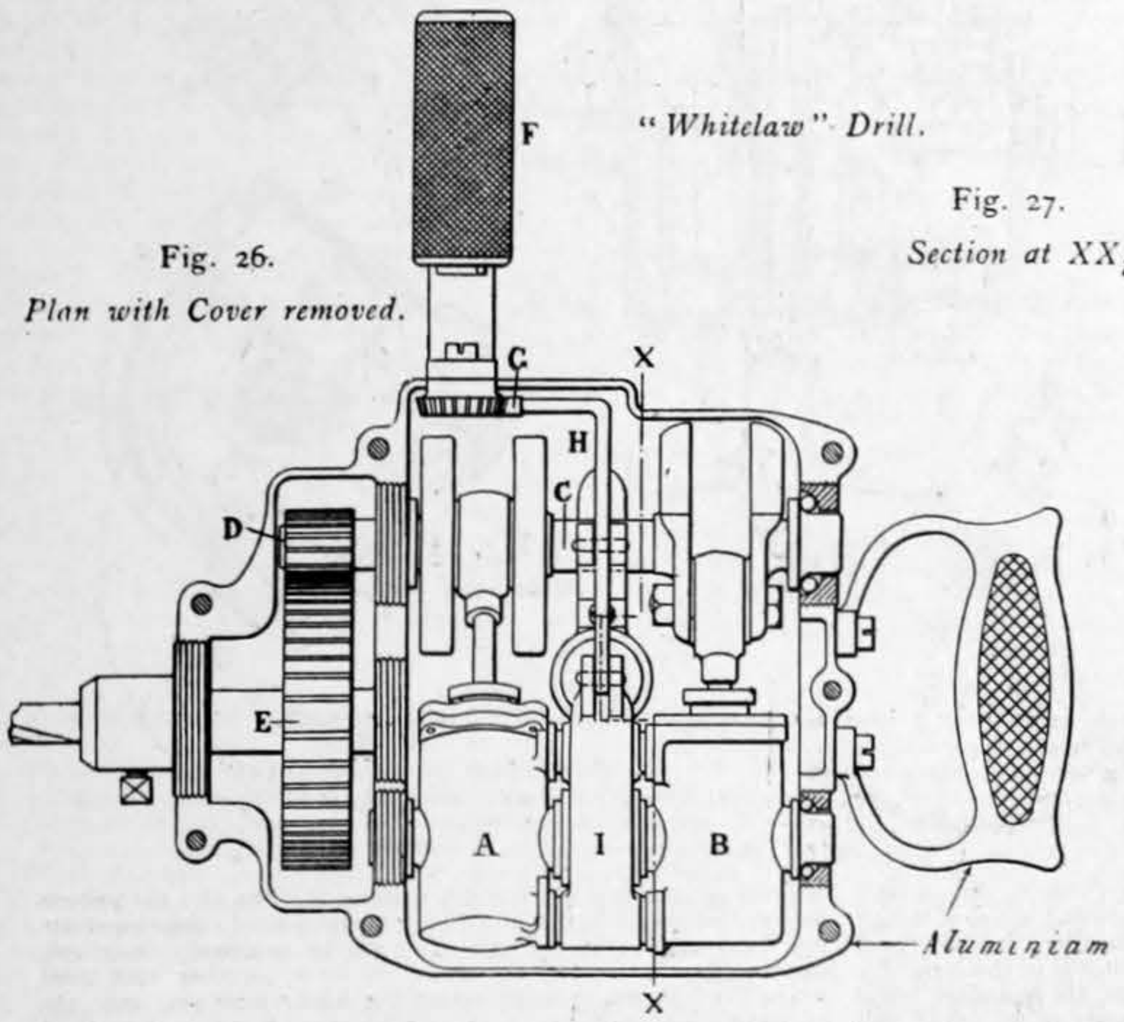


Fig. 26. *Plan with Cover removed.*

"*Whitelaw*" *Drill.*

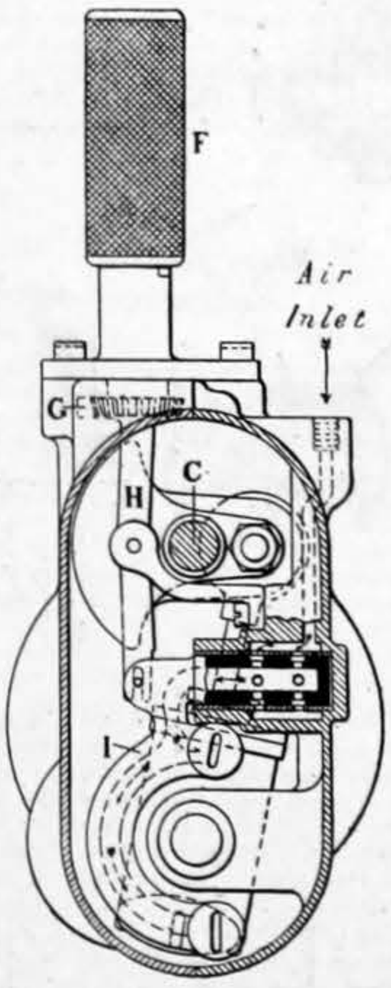


Fig. 27. *Section at XX.*

With regard to the respective advantages of percussion riveters and squeezing riveters, especially of the hydraulic type, there is considerable difference of opinion. In this country we have so long been used to hydraulic squeezing riveters that the percussion riveter at first met with but scant recognition until its advantages were proved, and the author ventures to think that a solution of the difficulty will be found when the true value of each type for its respective work has been fully recognised. To those who have tried both systems, the pneumatic percussion riveter has shown itself to possess certain advantages in the form of lightness, portability, convenience in manipulation, and other points over its rival. On the other hand, the advocates of the percussion system do not at present claim advantages where the riveted work has to stand high pressure as in boiler work, although the "Little Giant" plate-closing yoke riveter is certainly a step in the direction of using it for this purpose.

Table II. gives a comparison between pneumatic machine and hand riveting in the Chicago shipyards.

Portable drills.—The many advantages to be derived from the application of compressed air for the purpose of driving portable drills are probably more apparent than in the case of either hammers or riveters. In the author's opinion, the portable pneumatic drill, with its many applications, will soon be recognised—if it is not already—as one of the most important additions that have been made in recent times to our stock of labour-saving machines. A great deal of work, which for economic reasons had before to be drilled in the shop previous to erection, can now be drilled *in situ*, and the result, besides being more satisfactory in itself, has considerably reduced the cost. Besides drilling, portable pneumatic drills can be used for reaming, tapping, tube expanding, cleaning castings, boring wood, screwing nuts on to bolts, boring cylinders and Corliss valve seats, grinding steam-pipe joints, turning up crank and car-wheel pins in position, and a variety of other purposes which will readily suggest themselves. The method by which compressed air is utilised for driving the drills is generally by means of single or double-acting

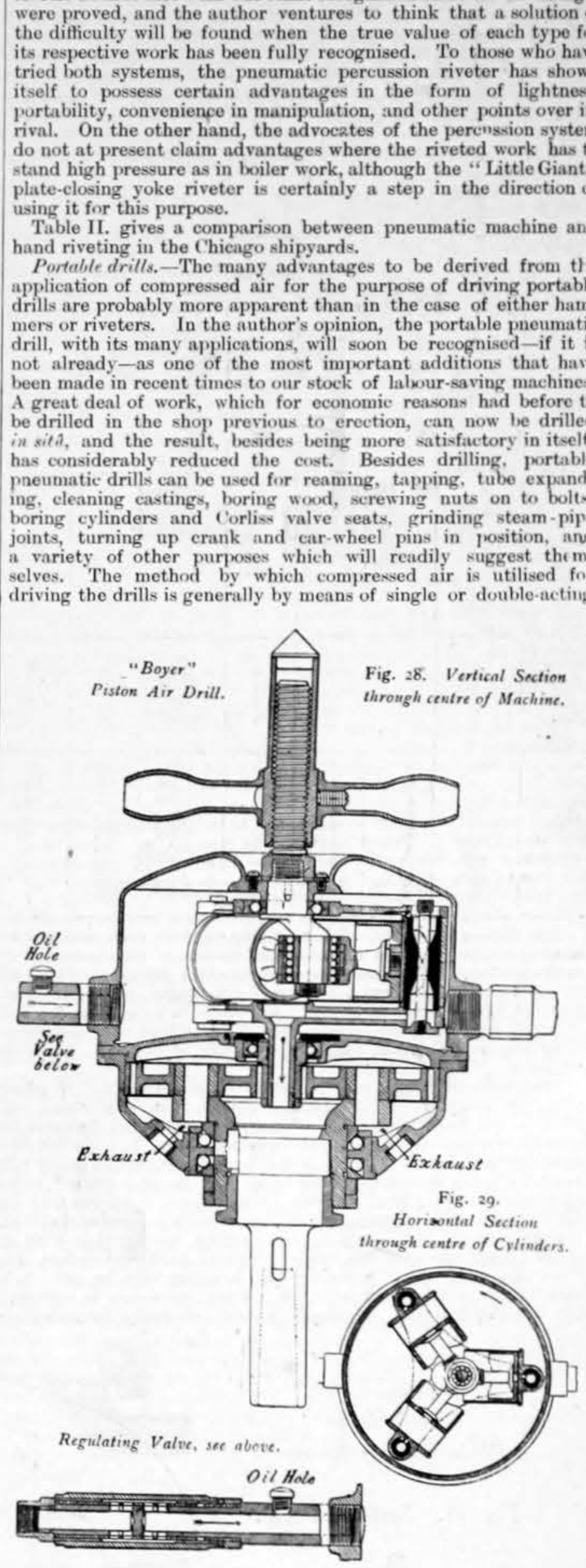


Fig. 28. *Vertical Section through centre of Machine.*

Fig. 29. *Horizontal Section through centre of Cylinders.*

cylinder motors, the cylinders of which are sometimes fixed and sometimes oscillating, and these again actuate suitable mechanism for driving the bit, and are encased in the body of the drill. The piston air drill, as it may conveniently be termed, has become a very important factor in boiler work, shipbuilding, and constructional work generally. As a reamer or tube expander the saving

Table II. — *Comparison of Cost between Machine and Hand Riveting at Chicago Shipyards.*

(Taken during three weeks ending October 12th, 1899.)

Distribution.	Number of rivets.	Diameter of rivets.	Machine rate each.	Hand rate each.
Keel	6,217	1in.	$2\frac{1}{2}$ cents	$4\frac{1}{2}$ cents.
Shell	21,628	$\frac{7}{8}$in.	$1\frac{3}{4}$,,	$3\frac{1}{2}$,,
Shell margin (bilge single line)	1,122	$\frac{7}{8}$in.	3 ,,	$4\frac{1}{2}$,,
Longitudinals open	24,632	$\frac{7}{8}$in.	$1\frac{1}{4}$,,	$2\frac{3}{4}$,,
C. V. K. brackets	3,197	$\frac{7}{8}$in.	1 ,,	$3\frac{1}{2}$,,
,, ,,	,,	,,	$1\frac{1}{4}$,,	$3\frac{1}{2}$,,
,, ,,	,,	,,	$1\frac{1}{4}$,,	$3\frac{1}{2}$,,
Longitudinals under tank	664	$\frac{7}{8}$in.	$1\frac{1}{4}$,,	$2\frac{3}{4}$,,
Longitudinal bars	2,989	$\frac{7}{8}$in.	$1\frac{1}{4}$,,	$2\frac{3}{4}$,,
Tank-top stiffeners	1,129	$\frac{7}{8}$in.	$2\frac{1}{2}$,,	$3\frac{1}{2}$,,
Tank-top margin	4,033	$\frac{7}{8}$in.	1 ,,	$2\frac{1}{2}$,,
Tank-top lugs	1,520	$\frac{7}{8}$in.	$1\frac{1}{4}$,,	$2\frac{3}{4}$,,
Tank-top rider	3,209	$\frac{7}{8}$in.	$1\frac{1}{4}$,,	$2\frac{3}{4}$,,
Tank top	4,467	$\frac{7}{8}$in.	$1\frac{1}{4}$,,	$2\frac{3}{4}$,,
C. V. K. cross vertical kelson	12,723	$\frac{7}{8}$in.	1 ,,	3 ,,
Hold stringer	1,184	$\frac{7}{8}$in.	$1\frac{1}{4}$,,	3 ,,
Floors	123	$\frac{7}{8}$in.	$1\frac{1}{4}$,,	3 ,,
Floors (odd)	5	$\frac{7}{8}$in.	2 ,,	6 ,,
C. V. K. (odd)	38	$\frac{7}{8}$in.	2 ,,	6 ,,
Bulkheads	1,318	$\frac{7}{8}$in.	$1\frac{1}{4}$,,	5 ,,
,,	3,051	$\frac{7}{8}$in.	$1\frac{1}{2}$,,	$3\frac{1}{4}$,,
,,	231	$\frac{7}{8}$in.	$1\frac{1}{2}$,,	$2\frac{1}{2}$,,
Total	93,479			

Total cost by machine, 1403.31 dols. Average, 1·50 cents each.
Total cost by hand would have been 2987.87 dols. Average, 3·19 cents each.
Saving, 1583.56 dols. Average, 1·69 cents each.
Average cost of machine riveting was 47 per cent. of hand cost.

over hand labour is very great, and at the same time the work is turned out much faster—a great point in shipbuilding. Pneumatic drills are made in a large number of sizes, from light drills suitable for small holes up to powerful ones developing two to three horse-power. The latter are capable of driving bars for boring work in position, or re-turning crank pins, &c., and their range of usefulness is very large. They can economically be worked with 60 lb. to 80 lb. of air pressure.

Fig. 22 shows an outside view of a "Little Giant" portable air drill. Fig. 23 is a longitudinal sectional elevation taken on lines 1—1 of Figs. 24 and 25. Fig. 24 is a cross sectional view taken on line 2—2 of Fig. 23. Fig. 25 is a similar view taken on line 3—3 of Fig. 23. In this type of drill the motor consists of four single-acting cylinders arranged in pairs, and having each pair of pistons connected to opposite ends of a double crank shaft. The pistons of each pair travel in opposite directions at all parts of the stroke to effect smooth running. The cylinders are controlled by balanced piston valves set to cut-off at five-eighths of the stroke, with a simple reversing arrangement—not shown on drawing—which enables it to do all classes of work for which a drill is suitable.

Fig. 26 shows the interior of a "Whitelaw" drill with half the casing removed, whilst Fig. 27 shows the passage of the air leading to the cylinder and the method of reversal. This type of drill is actuated by two double-acting oscillating cylinders A and B,

TABLE III.—*Pneumatic Drills.*

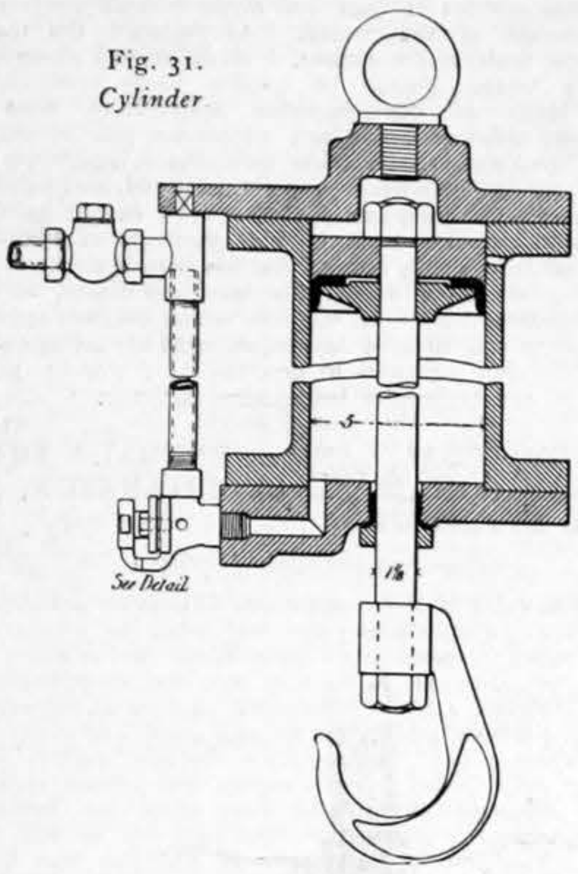
Type.	Descriptive number.	W'i'ht	Revolutions per minute, machines unloaded*	B. H.P	Air-consumption in free air.	Maximum duty.
		lb.			cub. ft. per min	
"Little Giant," Figs. 22 to 25	0	45	125	2¾	45	3in. holes in metal
	1	35	190	1½	35	2in. ,, ,,
	2	19	250	1	25	1¼in. ,, ,,
	3	8	750	—	15	⅝in. ,, ,,
"Whitelaw." Figs. 26 and 27	4	—	1000	¼	15	¼in. ,, ,,
	6	14	720	¾	20	3in. holes in soft wood
	7	20	250	1	25	For tube expanding
	8	39	120	1½	30	5in. holes in metal
"Boyer" Figs. 28 and 29	2	46	180	1¼	10	3in. ,, ,,
	3	41	240	1	25	1in. ,, ,,
	6	17	500	¾	20	¾in. ,, ,, 5in. holes in soft wood

* Thus, 1400 speeds too high for tools when cutting taken unloaded, as the load varies so much.

driving a crank shaft C, to which is attached a pinion D driving the gear wheel E, attached to the drill spindle. Its action is therefore at once seen, and reference to the cross section—Fig. 27—will show that by rotating the milled handle F which gears into a short rack G at the end of the lever H, the hollow portion I changes its position, with the result that reversal takes place in the usual way adopted in oscillating cylinders. The exhaust is made into the casing and escapes through suitable apertures. The reversal is instantaneous, and the machine is well adapted for all kinds of drilling, tapping, tube expanding, wood boring, &c., the reversing arrangement especially lending itself for such purposes. The machine is supplied with ample lubrication, and is fitted with ball bearings throughout.

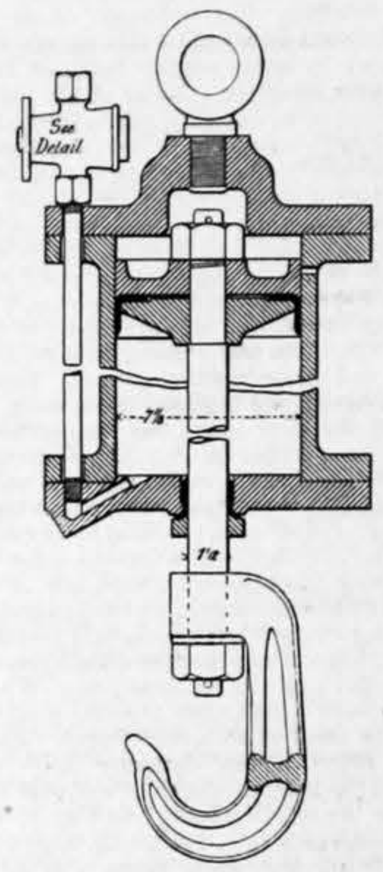
Fig. 28 illustrates a transverse vertical section of a "Boyer" piston drill, and Fig. 29 is a horizontal section taken through the centre of the cylinders. The machine consists of three main parts: (1) The upper housing into which the throttle valve and steadying handle are screwed, and which forms a live-air chamber carrying the motor; (2) the diaphragm which forms the lid or cover of the upper

Fig. 31. *Cylinder*



and should therefore prove economical. Referring to Figs. 22 to 25, A is the main casing, which contains the mechanism; B and B¹ are one pair of cylinders, and C and C¹ the other, and arranged at right angles to each other and connected to a common crank shaft D. By this arrangement a dead centre is avoided. The air admission and exhaust is controlled by two piston valves E and E¹, shown most clearly in Fig. 24. These are worked by small excentrics off the crank shaft, and serve to control the four cylinders; *f* is the main pressure chamber, having communication with the supply pipe H. Fig. 24 shows one of the piston valves in section, from which it will be seen that it is reduced in diameter in the centre, and is hollow. The arrows show the direction taken by the air. Cylinders B and B¹ receive air communications through f^2 and f^3, and cylinders C and C¹ through c^3 and c^4, the exhaust taking place through the interior of the two valves. Fig. 24 shows the action to be as follows: *f* is full of live air which is blowing through c^4 and f^3, to supply cylinders C¹ and B¹, whilst cylinders B and B¹ are exhausting through f^2 and c^3 into the centre of the valves and thus to the atmosphere. Referring to Fig. 23, *k* and k^1 are gear wheels by which the rotary motion of the crank shaft is conveyed to the part K, which is fitted with a suitable drill holder or chuck. L is a threaded sleeve, which, in conjunction with L¹ and other parts, provide for the feeding down of the drill. This tool is also fitted

Fig. 35. *Cylinder.*

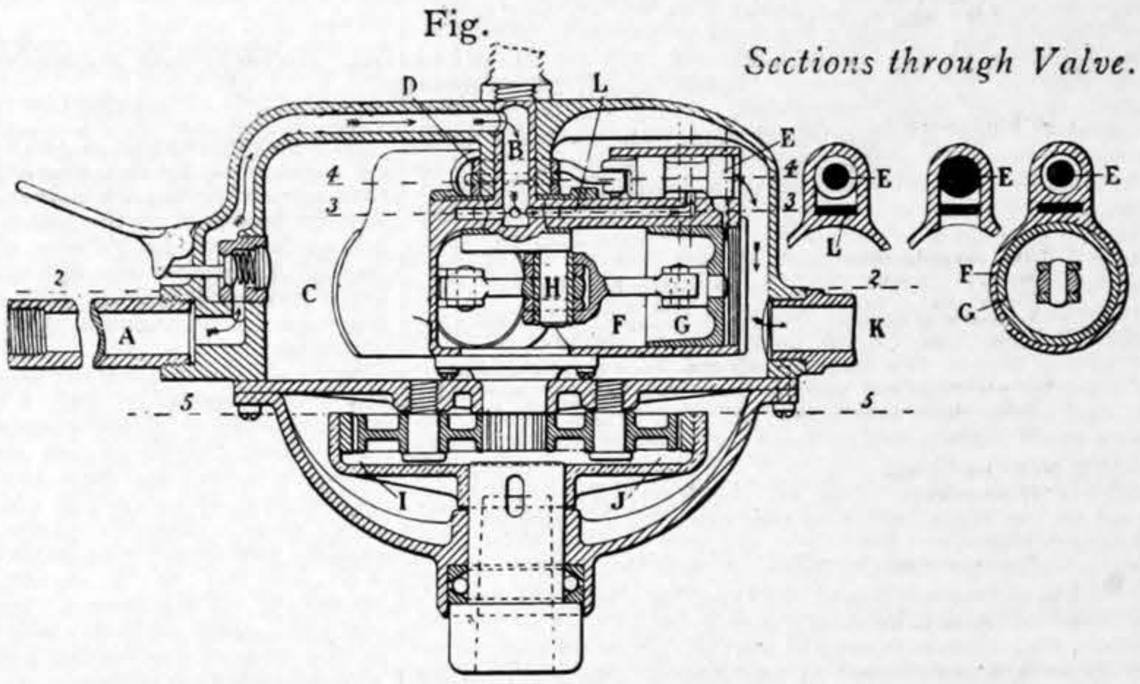


which the upper casing is always full, has free access to the pistons on that side. It would seem, therefore, that air being admitted through the pivot valves would only produce equilibrium, but since one of the cylinders is always open to the exhaust through the hollow bearing of the triangular frame, this equilibrium becomes disturbed, and the compressed air has full effect upon each piston as the valve comes in line with the exhaust. The cylinders are constructed of steel tubes, and are fitted with trunk pistons having their connecting-rod ends attached to a crank pin common to them all; the pistons having been set in motion by the introduction of compressed air into the upper casing, and into the cylinder as already described, has the effect of causing the three cylinders, together with their triangular framing, to rotate round the fixed crank pin, and thus transmit rotary motion to the spindle by means of the gearing before referred to. This class of machine is fitted with a regulator, by means of which the power and speed of the drill can be varied as desired.

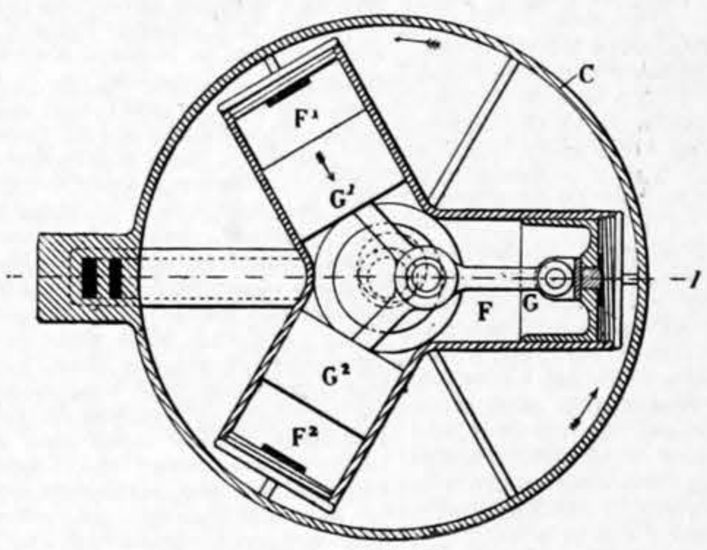
Other pneumatic appliances—air hoists.—Having put down a system of compressed air supply for the purpose of driving hammers, drills, and riveters, it soon becomes evident that such supply may be employed for other purposes; and one of the most useful

"Little Giant" High Speed Rotary Drill.

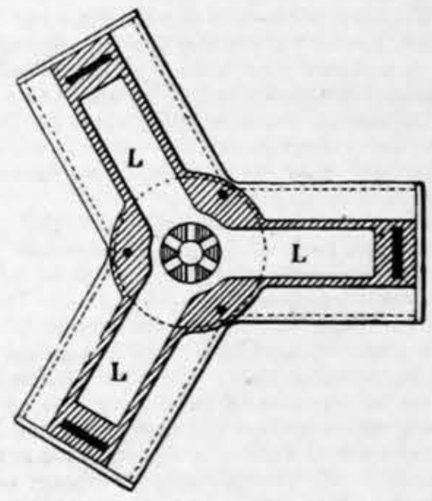
Fig. *Sections through Valve.*



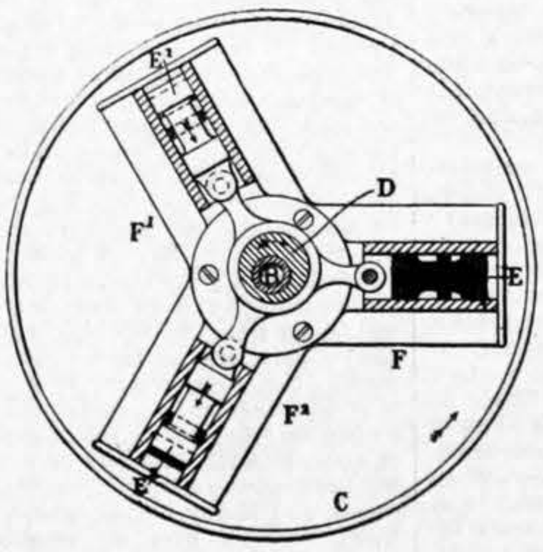
Section on 2-2.



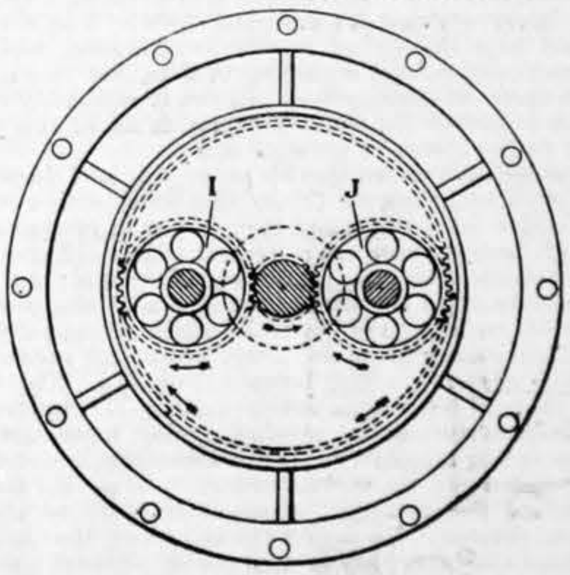
Section on 3-3.



Section on 4-4.



Section on 5-5.



5-inch Air-Hoist.

Fig. 32.

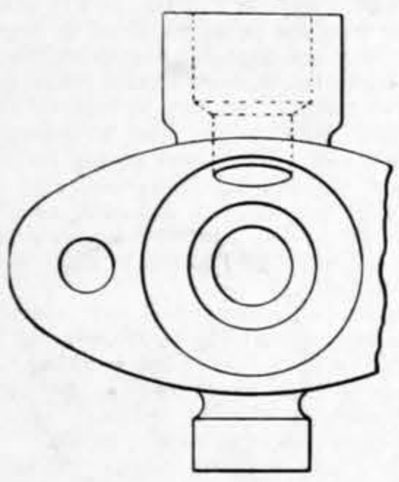


Fig. 33.

Starting Cock.

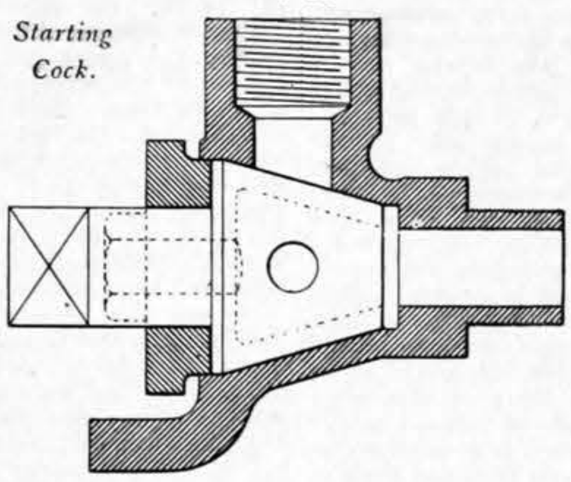
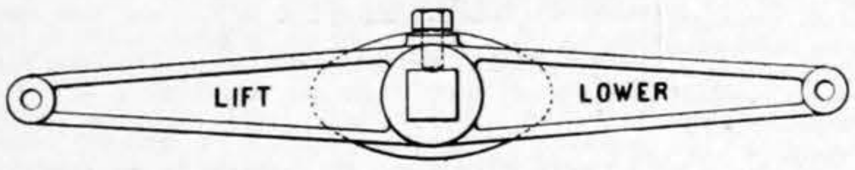


Fig. 34. *Lever.*



7⅛-inch Air-Hoist.

Safety Regulating Valve.

Fig. 36.

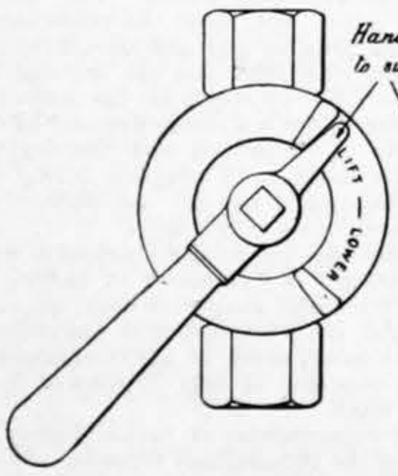


Fig. 37.

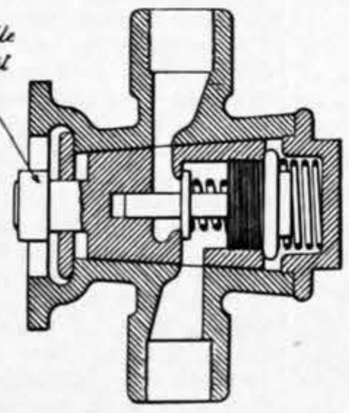


Fig. 38.

This Valve is in the form of a plug cock, the plug being fitted with a check valve, so arranged that in the event of failure to the hose pipe it is impossible for the air to be suddenly released, which might cause serious injury. The release is effected by a bye-pass in the side which allows the weight at all times to be lowered gently.

Both Hoists and Jacks are fitted with this Valve.

applications that can be made is for working air hoists. These are now coming into extensive use in this country, and there is every indication that before long few shops will be without them. The economy effected when they are fitted up on a light jib and suspended over a lathe or other tool is very considerable, and they save both time and labour. As is well known, much delay is experienced in lowering the ordinary chain blocks, even when unloaded, whilst with an air hoist this operation is rapidly effected. The load can also be more readily brought into position, as the adjustment is very sensitive. Many of the air hoists in use in this country have come from America, where they have been adopted for some time, but British firms have now commenced to manufacture them, and reference to Fig. 30 shows one of the "Reavell" type. Their construction is simple, consisting mainly of a long cylinder with piston sliding in same; the piston-rod passes through a stuffing box at the lower end, and has fitted to it a hook or loop. There are also suitable valves for regulating the air supply and exhaust. The difference between one make of hoist and another lies chiefly in the system of valves, and also in respect to the material used for the cylinder. For the latter some makers use cast iron, others wrought iron, and others again use brass. Some hoists have only one valve, this kind being used for quick work, and when it is not desired to keep the load accurately suspended for any length of time. This valve is either an ordinary opening and closing valve operated by the hand chain, or it may be a valve to automatically close when the chain is released when either raising or lowering the load. Another type of valve provides for the admission and release of the air in the cylinder, and is left open for supply when lifting the load; working in conjunction with this valve and controlled by the piston-rod in another valve, which automatically closes the air supply when any desired level is reached; at the same time should there be any leakage of air, it automatically re-admits just sufficient air to maintain the load at a constant level. When, however, it is desired to maintain in a stationary position a varying load, such as a foundry ladle, a third valve is introduced. Referring to the drawings, Fig. 31 shows a 5in. diameter hoist with the regulating valve placed at the bottom, length of cylinder being 4ft. 6in. Figs. 32 and 33 show the starting cock, and Fig. 34 the lever for a 5in. hoist. Fig. 35 shows a 7½in. hoist with the valve placed at the top, whilst in addition to this valve there is fitted a small non-return valve to prevent accidents, in case of bursting of the air supply pipe or reduction of pressure. Figs 36—38 show the safety regulating valve. In the larger hoists this valve is combined for convenience with the main plug of the regulating valve. It will be noticed that there is a small ¼in. hole near the top of the cylinder; this ensures that the piston shall be brought to rest before touching the cylinder cover, since as soon as the piston passes this port it encloses a certain amount of air and forms an air cushion. The piston is packed with "woodite," as a considerable number of experiments have shown that it is better than leather, since it does not harden, and is consequently less liable to permit leakage. It may be stated that a 5in. straight lift hoist will lift 10 cwt. to 11 cwt. with 75 lb. air-pressure. Hoists, such as have been described, may be simply suspended, or they can be mounted on a trolley and light jib for ordinary shop use to serve lathes and other tools. Or, again, they may serve the whole length of a shop by causing the trolley to run on a fixed over-head girder. The same principle may also be applied for the purpose of lifting in almost every kind of crane, and for foundry and shop use they are likely to have considerable application.

Pneumatic chain hoists.—When it is desired to use a chain hoist for want of head room or length of lift in preference to a straight lift hoist, and at the same time to obtain a portable power lifting device, this may be secured by using an ordinary chain hoist in combination with a reversible rotary pneumatic motor, such as was described under piston air drills. This form secures a result satisfactory in every way, and effects a considerable saving on hand lifting.

Pneumatic jacks.—These may also be termed inverted hoists. They act on the same principle, and where an air supply exists they are very useful.

Portable pneumatic shears.—Shears of this description are of great service in connection with breaking up ships, boilers, &c., also in repair work, as it becomes possible to shear off rivets and bolt heads, &c., without damage to the plates, as a portable power shears are as light and efficient as anything of their kind. They can be slung from a crane, air hoist, or any suitable appliance, and readily brought into position. They consist mainly of an air cylinder and piston operating on a toggle joint to work the shear blades, and will conveniently deal with bolts, &c., up to 1⅛in. diameter.

Mining drills.—The application of the principle of the pneumatic rotary motor for drilling through fire-clay, coal, and other ores, is likely to meet with considerable success. Piston air motors, such as have been described, with slight modification as to the feeding arrangement, are now being used for mining work, and will drill a 2½in. hole through 6ft. of coal per minute. They are exceedingly light and easy to handle, and the results so far promise an extended application.

When making comparison of the cost of work as between pneumatic tools and hand labour—and it must be borne in mind that they compete largely with hand labour—it is necessary to take into consideration three points. (1) That with the same-sized shop and the same standing expenses in the form of rent, rates, and taxes, and wages bill, a very great deal more work can be turned out in the same time. (2) That although against this there must be set off the cost of producing the compressed air, yet even supposing this equalled the cost of manual labour—which it does not—there would still be a considerable saving for the reason given in item (1). (3) That with hand labour, especially in riveting, caulking, and place drilling, work can only proceed at a comparatively slow rate, however many men be employed, and however closely together they work. This frequently becomes a serious matter in ship and bridge building, railway works, &c., and even were the cost double that of hand labour, other advantages as regards speed, &c., would outweigh it; but, as a matter of fact, when properly carried out, the saving is very considerable, and it is, in the author's opinion, only a question of time, and that not far distant, when every engineering shop will find it absolutely necessary, if it wishes to keep in the van of progress, to adopt the pneumatic, or some similar system of portable tools.

The author is aware that his paper will lend itself to considerable criticism, because (1) he is dealing with a subject which, although a most important one, is yet in comparative infancy; and (2) because there are at present widely different opinions held by engineers as to the advantages of the system; and (3) on account of the very rapid improvements which are being made in the construction and design of the tools, which not only makes it difficult to obtain particulars of the latest types, but renders any data as to their efficiency to soon become unreliable. The makers admit that many of these tools are in a state of transition. There is, however, in the author's opinion, a wide future for this class of labour-saving machinery. Notwithstanding, however, the deficiencies pointed out, the author ventures to hope that the information given and the discussion which it is likely to elicit may be of general interest. He thanks the makers of the various tools for the kind assistance they have so readily afforded him, both in supplying information for the drawings and for the loan of the tools which are shown here this evening.

The "Little Giant" high-speed drill.—A brief reference was made to this machine at the last meeting, since when a new plate illustrating this drill in detail has been added to the paper, and is now in the hands of members. By reference to this it will be noted that there is a main casing containing the mechanism, which consists chiefly of three cylinders, each provided with piston valves, and rotating round a fixed excentric and fixed crank pin. Live air having been admitted by actuating the admission valve shown in left-hand portion of top figure, passes through a port as shown by the arrows, into the valve bushing, and from thence into the cylinders. The action of the compressed air acting on each piston in turn causes the cylinder to rotate about the fixed crank pin, whilst the fixed excentric regulates the valves for the proper admission of air to each cylinder. Attached to the bottom of the cylinder castings is the pinion which engages through two idlers with an internally toothed wheel forming part of the drill holder, and thus rotary motion is imparted to the drill bit. This machine will attain a speed of about 1400 revolutions per minute, and the chief advantage claimed for it is that it comprises a high-speed engine with a minimum consumption of air, and this is obtained by employing the stationary excentric referred to in combination with the piston valves, which secures the proper cut-off of the air supply. Further, both the live air and the exhaust pass through suitable ports, and are thus prevented from surrounding the working parts, as in other drills of this type.

In the description given of the "Little Giant" portable air drill, it is stated that this drill is also fitted with a reversing arrangement, although not shown on the diagram, and in the absence of this it is somewhat difficult to clearly describe it in detail. It may be stated, however, that when so fitted a handle takes the place of the star centre shown in Fig. 22, and by revolving this handle a valve placed in the main pressure chamber, marked *f*, reverses the direction taken by the air when entering the valve bushing, suitable ports being also provided. The drill when thus fitted is capable of dealing with all kinds of drill work where reversing is necessary, as in tapping, tube expanding, wood boring, &c. Detail drawings on the wall illustration clearly show the working attachment just referred to.

Attention must be called to the photographs* of the "Little Giant" drill doing special work at the carriage department of the London and North-Western Railway, at Wolverton, in which it will be seen that these machines are driving special saw-bits for the purpose of cutting out the lamp holes and openings for the heating apparatus in railway carriages. This is the first application of its kind, and members will doubtless be interested to examine the photographs.

Another diagram* to which attention must be called shows the "Boyer" long-stroke hammer. This differs from the "Boyer" hammer already described and illustrated, in that it is provided with two hollow cylindrical valves, one at either end of the working cylinder. These valves automatically control the admission and exhaust of the air at either end of the piston through suitable ports, whilst their object is to secure a much longer stroke to the striking piston than is possible with one controlling valve. Another distinctive feature is that the machine is inoperative except when pressed up to its work. The diagram shows a hammer with a stroke of 9in., capable of giving a very powerful blow; and this type of hammer is doing good work in connection with hand riveting.

* These illustrations are not reproduced.

IPSWICH ENGINEERING SOCIETY.

AMERICAN WORKSHOPS.

At a general meeting of the members of the Ipswich Engineering Society on Monday evening, 19th inst., Mr. H. S. Jefferies read a paper dealing with American workshops, founded upon a visit he had paid to the States some two and a-half years ago. After referring to the tidiness, good lighting, and general arrangement of American works, he continued: I found the electrical driving of tools and shafting very generally and extensively used in the shops I went through. Baldwin's people told me that their experience with electrical driving had been very satisfactory. They found that the cost of the upkeep of the dynamos and motors was about covered by that of the shafting and belting, and in addition to the extra convenience from the separate driving of the various tools, they found they could save about 20 to 25 per cent. in boiler power, by their being enabled to use large central engines and do away with the shafting and belting and long steam pipes. Their shops, like most American shops, were extremely well served with electric overhead cranes, varying from 5 to 100 tons lifting capacity, and travelling up to 300ft. per minute. The system of tool-rooms is wonderfully well organised and carried out in the best machine shops in America. But in foundry work I saw nothing very new or striking. On repetition work moulding machines are used, made on much the same principle as those we have on this side. I noticed that in nearly all foundries the castings were "pickled" in acid, and there was little or no use made of "Rumblers" such as are employed in this country. Beyond the longer life it gives to the tool edges, I personally see no advantage in "pickling" over "rumbling" castings, and there is no doubt that in castings containing many cores, such as engine cylinders, the rumbling is preferable, as by this means the sand cores are loosened and fall out, thus saving the trimmers' work. The labour cost of "rumbling" castings is no more than in "pickling" them, and besides this the expense of the acid is saved. In the forge departments I especially noticed the excellent work that was being done under the drop stamping hammers. The boiler work I saw in the States was certainly not up to the standard of this country. In one of the large locomotive works, in which otherwise they turned out good work, most of the flanging was done by hand, and all the rivet and stay holes punched; the water space stay holes were, however, rhymered out afterwards, when the fire-box was riveted into the boiler. Pneumatic tools were used throughout this boiler shop for rhymering and tapping the stay holes and putting in the stays, as well as for caulking. I noticed in this shop that in many of the boilers for use in their own country the Americans were putting in steel tubes and steel fire-box plates, as is common in the States. Most of the steel plates used were made by the basic process. The technical details of the arrangement and working of blast furnaces and rolling mills do not, perhaps, concern us at Ipswich very directly, but there can be, I think, no doubt that in these two industries the States are farther ahead of us than in any other branch. One cannot meet the masters and principals of American factories without being immensely struck with the vast amount of work and energy they put into their business. In England, the majority of us, perhaps, look on our work as the means of making a living, and while doing this endeavour to enjoy our lives and have a certain amount of recreation as well. In the States, on the contrary, many look on their work as the means and end of existence, and seem to understand neither the necessity nor the enjoyment of recreation. They have learnt the pleasure of successful hard work, but they don't seem to appreciate that this is not the only object in life. Whether this view of ours is the right one, is a matter of judgment. In nearly all the works I was in, the standard hours of work were sixty per week, from seven to twelve, and one to six. No Saturday half-holiday. In the majority of the shops there was no hard-and-fast system of piecework or day work; the men made their own individual arrangements with the foreman, as suited them mutually best. There is no restriction whatever on the amount of wages earned, or the output of work, by either masters or men; the best men who could turn out the largest amount of profitable work being paid the highest wages, and it was no uncommon thing to see one man working three, four, or even six machines. The Americans are born improvers, as the American patent records prove. They are always ready to try improvements, and are never afraid of giving a trial to new ideas, and this characteristic is one reason for their success in life; the mere fact of many of these new ideas turning out failures does not discourage them from trying others. In considering the question of American competition, how it is likely to affect us, and how we can best meet it, I will first mention the points in which I consider the American manufacturer at present has an advantage over his English competitor. These points are, I think, an unlimited supply of cheaper raw material and fuel, and cheaper transport; in many cases better-arranged and equipped workshops, and more up-to-date tools; and, finally, a higher rate of output from their workmen. The first point is, I think, the most serious one for English manufacturers, especially for the makers of steel and iron, and it is almost impossible to suggest how the American competition in raw materials is to be met in the future. At the present time, owing to the extraordinary activity all over the world in the iron and steel industries, the American manufacturers have all the work they can do in supplying the demand for raw materials in their own country, where, just now, iron and steel are quoted at even higher rates than on this side. When, however, this spurt in trade slackens off again, I cannot help thinking that the manufacturers in this country will find the American competition in iron and steel extremely severe again in every market of the world. As regards the questions of workshops, tools, and workmen, I think that in these matters we have a better chance of getting level with our competitors. Many of our factories here have been established a long time, and, although we cannot pull all our shops completely down and rebuild them throughout, according to the latest ideas, we can keep them properly arranged, and see that our tools are kept up-to-date, and that the work in our factories is properly organised, and that the best methods of working are adopted; and I also firmly believe that the British workman can do every bit as good a day's work as his American cousin, and I see no reason whatever why, with the free use of the best appliances, he should not be able to bring his output up to the latter's level.

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

(*From our own Correspondent.*)

The closing meeting of the quarter this—Thursday—afternoon in Birmingham was a satisfactory one, and from the number of inquiries to hand, it seems more than likely that another three months of good trade lies in front of iron and steel masters and engineers. Producers are not, however, anxious about accepting forward engagements, preferring to book small lots from time to time at current rates. Contracts for the new quarter are not taken except at a decided improvement over present values. It seems not altogether improbable that at or just before the forthcoming quarterly meeting marked bars will be still further advanced. The present basis price of £11 10s. was fixed on January 31st, and is the highest recorded since July, 1874. Some makers will not be surprised if a further advance to £12 is soon declared, though others are believed to be in favour of "letting well alone," and of not "rushing" advances unduly. The new bi-monthly average of selling prices under the Midland Iron and Steel Wages Board should shortly be declared, when ironworkers' wages will probably go up 2½ or 5 per cent., and this may have considerable influence in determining the action of the marked bar houses. All the six preceding advances which have occurred in marked bars since April last—twelve months ago—have been 10s. each, averaging £3, and thus raising the price from £8 10s. to the present level of £11 10s. The rise in unmarked bars during the same period has been even more marked, prices having gone up from £6 15s. to £10 10s., so that as much as £3 15s. has been added. Hoop iron is quoted £11; sheets, singles, £10 12s. 6d. to £10 17s. 6d.; doubles, £10 15s. to £11, and trebles, £11 7s. 6d. to £11 12s. 6d. For nail rod and rivet iron £10 10s. to £11 is asked.

Considerable quantities of steel are being required by engineers, railway contractors, and railway carriage and wagon building companies which have recently booked good contracts for India, and also for South Africa, which have been given out, as regards the last-named market, in order that the damage done to railways and rolling stock may be made good. Mild steel plates for railway bridge building and other engineering purposes are quoted £9 12s. 6d. to £9 17s. 6d., and are in good demand, as also are steel girders at £9 2s. 6d. to £9 7s. 6d., and steel angles at £8 15s. to £9 5s. Mild steel bars are quoted £9 12s. 6d. to £10; Bessemer billets, £7 15s.; and Siemens, £8.

Pig iron is in good request and values are well maintained. Northampton and Leicestershire pigs are 75s. to 77s. 6d., and Derbyshires 76s. to 78s. The furnaces have been kept working to their full capacity, and seem likely to have to continue in that state for some time to come. Staffordshire all-mine ordinary pig iron is 77s. 6d. to 82s. 6d., and superior descriptions 90s. to 95s.

Coal is not so dear as it was, and in better supply. Good steam fuel can be had at 7s. 6d. to 10s., delivered to works. Foundry cokes are 25s., gas cokes 16s., breeze 12s. 6d. Shallow coal from Cannock Chase is quoted 13s. to 15s., and best deep 17s. 6d. to 20s. A good deal of interest is taken locally in the proposed Wolverhampton, Essington, and Cannock Junction Railway, which has recently been under the consideration of a Parliamentary Committee. It will serve about twenty-one collieries. The capital of the proposed company is £270,000, with borrowing powers of £90,000, and the estimate for the construction of the line is £230,000. It is estimated that if the line were made, a saving of 1s. per ton would be effected in the carriage of coal from the districts served by it to Wolverhampton.

A satisfactory year has been experienced by the Shelton Iron, Steel, and Coal Company. Alterations and improvements, with a view to maintenance of the plant and economy in working, have been effected both at the collieries and works during the past year, and every effort is being made to keep the property of the company up to the requirements of the trades. The company has declared a dividend of 8½ per cent. upon the preference shares. The makes of pig iron and finished iron and steel have increased during 1899, as compared with 1898, and the demand has been active at advancing prices. The prospects for the current year are encouraging, and at present there is a strong demand for both iron and steel. The operations in connection with the sinking of the new Deep Pit have made satisfactory progress during the year, the surface plant and permanent way are well forward, and the pit has now reached a depth of some 420 yards.

Steel is coming into increasing use for nails instead of iron. The annual report of the Chamber of Commerce of Dudley observes that the Admiralty had again sent samples of nails, spikes, &c., for the inspection of intending contractors, but it was clear that the local nail trade would not secure much of the Government orders, as the last specification consisted of only 12 tons of hand-made nails against 132 tons of steel.

Commenting upon the improvement of values during the past year, the annual report of the Birmingham Chamber of Commerce gives the following useful comparison of prices. The three totals represent, first, the January prices; secondly, the December prices; and thirdly, the highest prices for the year 1899:—Scotch warrants, £2 9s. 11d., £3 5s. 6d., £3 15s.; marked bars, £8, £10 10s., £10 10s.; unmarked bars, £6 15s., £10, £10; copper, G.M.B., £58, £70, £77 10s.; tin ingots, £90 10s., £117, £154; pig lead, £13 5s., £16 15s., and £18.

New waterworks machinery and plant will before long be required by the Town Council of Wenlock, in connection with the new water supply scheme, for which they propose to borrow as soon as possible £23,000.

NOTES FROM LANCASHIRE.

(*From our own Correspondents.*)

Manchester.—Although there would seem to be a probability that, notwithstanding the recent strong advance, prices have not yet touched their highest point, the position of the iron market is still regarded as being too much of a speculative character to justify any but the most cautious operations. There is, however, one fact which must have an important bearing upon the immediate

future—the rapid depletion of the iron stores in this country, owing mainly to the large shipments abroad, and until makers have a surplus production over their deliveries that they can put into stock—which is not the case at present—the possibilities of the approaching situation can only be regarded with serious concern.

In the meantime activity is for the most part fully maintained throughout all the principal iron-using industries, the engineering branches remaining in much the same position that I have reported for some time past, and this necessarily means not only that a large weight of iron is still steadily going into consumption, but that large quantities will be required for a considerable time forward. The position itself is sound and healthy enough so far as legitimate trade is concerned, but the mere anticipation of an "iron famine" which a clearing out of stocks might produce would almost inevitably bring about reckless speculation, with more or less disastrous results.

On the Manchester iron market prices for all descriptions of pig iron show a further advance on the rates quoted last week, but buyers still appear to be disinclined to follow the upward move, and there was again comparatively very little business reported as being put through at the 'Change meeting on Tuesday. Both merchants and consumers purchase sparingly, and in most cases only in the smallest possible quantities to cover immediate pressing requirements. So far local and district makers have not followed the continued upward move in North-country brands by any actual official advance on their basis rates, but these are little more than nominal, Lincolnshire makers quoting 1s. 6d. to 2s. above their list upon business they are now putting through, and to some extent Lancashire and Derbyshire makers are also taking up much the same position. Delivered Manchester, Lancashire foundry is quoted 79s. 6d. to 80s., less 2½; Lincolnshire, 77s. 6d. net; and Derbyshire about 80s. to 81s. net cash, with forge qualities, delivered Warrington, about 77s., less 2½, for Lancashire, and 75s. 2d. to 75s. 8d. net for Lincolnshire. Middlesbrough brands are more than maintaining the exceptional prices recently quoted, and delivered by rail Manchester, good foundry qualities could scarcely now be bought under 83s. 4d. net. Scotch iron, delivered Manchester docks, is quoted 82s. to 82s. 6d., and American iron about 80s. net cash.

In the finished iron trade only a moderate weight of new business is reported, but this is quite as much as makers care to book, and prices are exceedingly strong at £10 5s. for Lancashire, and £10 10s. for North Staffordshire bars; £11 5s. to £11 7s. 6d. for sheets; and £10 7s. 6d. for random to £10 12s. 6d. for special cut lengths of hoops, delivered Manchester district, and 2s. 6d. less for shipment.

Prices for hematites show a continued upward move, ordinary foundry qualities not now being obtainable under 93s. to 94s., less 2½, but makers' quotations for the most part are practically withdrawn. Steel billets are firm at £7 10s. net; bars range from £9 10s. to £10 and £10 5s.; and boiler plates are quoted £10 5s., less 2½, delivered in the Manchester district.

All descriptions of manufactured metal goods continue in brisk request, makers being exceedingly pressed to keep up requisite deliveries. Prices are firm, with a hardening tendency, but there is no upward move in list rates, except on condenser plates, which have been raised ¼d. per lb., yellow metal plates being now quoted 7½d., and naval brass plates 7¾d. per lb., as the basis, delivered Manchester district. An upward move in other descriptions of manufactured metal goods is, however, anticipated.

All classes of fuel continue in good, steady demand, and collieries in this district are mostly moving away their production without difficulty, the only descriptions at all hanging being some of the better qualities of round coal, and it is still exceptional where pits have any surplus output to lay down in stock. In the open market, however, the position would seem to be if anything somewhat easier. As I have previously reported, supplies are coming in more fully from outside districts, and are being offered here at lower prices. This, however, does not affect the strong position held by Lancashire collieries, and there is no giving away whatever upon the full rates they have been quoting for some time past, but it has a tendency to induce buyers to hold back from placing orders in the hope of securing more favourable terms, and it also places consumers in a rather better position of obtaining supplies.

With no lessening activity in all the principal coal-using industries, there is necessarily no falling off in the requirements for iron-making, steam, and general manufacturing purposes. Large users of the lower qualities of round coal report, however, that they find themselves able to obtain supplies more readily than has been the case for some time past, although, so far as Lancashire collieries are concerned, no lower prices are being taken, these remaining firm at about 12s. to 12s. 6d. for ordinary descriptions of steam coal at the pit mouth. The situation is pretty much the same in engine classes of fuel. Lancashire collieries for the most part continue short in their supplies of slack to meet the demands which are made upon them, and they are firm at recent quotations, ranging from 9s. 6d. for medium sorts to 10s. 6d. for better qualities at the pit, but from other districts slack can be bought at lower figures, although not in sufficient quantity to have any appreciable effect upon the market here.

In the shipping trade a continued slackening in the pressure of orders, and a resulting tendency to ease down in prices, is reported. The basis quotations of the Lancashire collieries remain at 16s. per ton for steam coal, delivered Mersey ports, but business is not being very readily booked at this figure.

Coke makers have withdrawn their present list rates, pending a substantial advance in prices which is to come into operation next month.

Barrow.—The hematite iron trade is very strong in tone, and the orders offering are much more numerous than makers can undertake, because first of all they are already very largely sold forward; secondly, they are greatly handicapped in the shortness of supply of raw material, and thirdly, the high prices to which raw material have risen has resulted in the blowing out of four furnaces, there being now only 43 furnaces in blast, as compared with 47 at the end of last month. This is a very serious position, because trade is going elsewhere, and makers cannot help themselves. Makers quote 83s. to 85s. per ton for mixed Bessemer numbers, net f.o.b., and warrant iron has advanced to 82s. 6d. net cash sellers, buyers 82s. 5d. There is likely to be a good business in warrant iron, as warrant stocks are the only available supply of iron that is needed for prompt delivery. During this week 4616 tons have been cleared out of warrant stores, and the stocks still in hand now represent 135,158 tons, being a reduction since the beginning of the year of 62,689 tons.

Iron ore is still a very brisk business, and local qualities are in active demand at prices which show an improvement on the week, good average sorts selling at 17s. 6d. per ton, while Spanish ores are at 21s. to 22s. net delivered at West Coast ports.

The steel trade is very busy, and with the exception of the Barrow works, where a breakdown has occurred this week, all the mills are briskly employed. Heavy steel rails are firm at £7 8s. 9d. to £10 per ton. A considerable business is being done in shipbuilding classes of steel, and there is every prospect of a long continuance of activity in this trade. There is also considerable activity in the minor branches of the steel trade.

Shipbuilders are all busy, but no new orders are noted. There is, however, every prospect of a very good continuous trade when builders are ready for new orders.

The coal and coke trades are buoyant, and supplies are short, while prices continue to improve.

The shipping trade is full of life. Last week the shipments of iron were 20,784 tons, and steel 8085 tons, as against 6656 tons of iron and 6837 tons of steel in the corresponding period of last year, an increase in iron of 14,128 tons, and in steel an increase of 1248 tons. Up to date this year the metal exports represent 206,279 tons of iron and 92,841 tons of steel, as compared with 102,048 tons of iron and 115,289 tons of steel, an increase in iron of 104,231 tons, and in steel a decline on the year of 22,448 tons.

The Ramsden Dock lock sill at Barrow is about to be deepened 6ft., and with that object this entrance to the docks has been closed, and John Aird and Company are now busy in putting in the cofferdams, preparatory to commencing this interesting engineering feat. The work is expected to be completed in about four months if favourable weather is experienced. The object of the deepening of the sill is to give greater depth of water for the great warships now being built at Barrow.

THE SHEFFIELD DISTRICT.

(From our own Correspondent.)

ALTHOUGH winter still lingers with us, there is less pressure for coal in household sorts. A giving way in prices is reported from one or two quarters, but it is not at all general, and the expected lowering of quotations next week may not take place, after all. There are no stocks at any of the collieries, the market requirements being quite equal to all that is raised. Complaints as to railway delays are less heard of now, although occasionally coalowners complain that they cannot take advantage of the brisk market through lack of facilities to put their coal upon it. There will no doubt be a large increase in wagons before long, as all the wagon-makers are very busy, and the companies themselves are doing their utmost to add to their rolling stock in engines as well as in wagons.

For the London market there has been considerably less doing of late, and it is reported that merchants have fair stocks in hand. The season being now so far advanced, they are not likely to add to these stocks, as, given anything like good weather, quotations must come down. At present, house coal is generally fetching from 14s. to 14s. 6d. per ton, and in some instances supplies have been obtained at 13s. 6d. In steam coal the market is quite equal to taking all that is offered, and there is likely to be a stiffening towards the time of the Easter holidays, when practically six days are lost between ceasing and resuming work. A heavy weight of coal under contract is being supplied to the railway companies, while the export business with the Humber ports seems to get heavier. Values are maintained at their high level, with every likelihood of being still higher; 15s. to 16s. per ton is easily obtained for immediate delivery, while those who take smaller quantities have to pay from 1s. to 2s. more per ton. With the lengthening of the days, gas coal is in less demand, but the falling away is not yet perceptible. Engine fuel is also easier, and values are still kept up, engine nuts making 10s. 6d. to 12s. per ton, screened slack from 8s. 6d. to 9s. 6d. per ton. The coke ovens are working up to their full output, and more coke could be taken by the market if it were available. Values are maintained steadily at 21s. to 22s. 6d. per ton.

In all departments of the heavy industries there is but one report—that of continued activity. Ironmasters are being pressed for deliveries, while manufacturers of Bessemer and Siemens steels are so heavily booked forward that their output is practically sold for several months. Bessemer steels make £9 10s. to £9 15s. per ton, while Siemens steel fetches £10 to £12 10s. per ton according to temper. For all kinds of railway material, but chiefly on home account, there is an abnormal demand, and foreign markets are also ordering very freely. Several of the latest orders have come from the Indian States Railways, Russia, and several of our Colonies. A very large business is at present being done in specialities connected with the South African war, in regard to accessories for the railways and tools for engineering purposes, and in repect of camp equipments and like goods. The extreme activity in the collieries is affecting firms who make a speciality of corve wheels, picks, hammers, shovels, and similar goods.

A comparatively new industry in Sheffield is the production of articles for electric plant, the demand for which is so great that the principal firms are booked forward for several months. In Sheffield and the immediate districts one of the busiest of trades is the manufacture of pipes for water and drainage, as well as for electric, telegraph, and telephone wires. The means of production have been largely increased, but the demand is still in excess of the output.

In the lighter trades an improvement is noted in one industry which has been most adversely affected by the war—the silver and plating industry. Although the London demand is still below the average, the provincial centres are partly making up for the loss sustained in the capital, while French and Swedish markets are taking an increased quantity of the best Sheffield goods. In the cutlery trades the various kinds of sailors' and sportsmen's knives are in heavy request, and the razor trade, particularly on Government account, has rarely been so brisk. Files are also heavily called for.

Sir Alexander Wilson, Bart., chairman of Charles Cammell and Co., Limited, Cyclops Works, Sheffield—one of the three armour-making establishments in the city—presiding at the annual meeting of shareholders on the 28th inst., referred to the supply of armour plates for her Majesty's ships. He said there need be no alarm whatever on this score so far as Sheffield was concerned, and his firm in particular. Any demand that might be made upon them would be quite within their capacity, and should necessity arise they were prepared to go still further and increase their output to meet the requirements of the British Admiralty whatever they might be, notwithstanding the fact that during the last two or three years they had already spent enormous sums in adapting and extending their new plant. These views are entirely in harmony with those of the principals of the two other armour firms, as given in THE ENGINEER last week.

NORTH OF ENGLAND.

(From our own Correspondent.)

THIS has been an exciting week on the pig iron market, prices have gone up at a great rate, not because of any speculation, because there has been little of that, but because iron is wanted urgently for early delivery, and can only be obtained with the greatest difficulty, as the supply falls considerably short of the demand. As there are consumers and other buyers who are obliged to have the iron the producers have pretty much their own way in the regulation of prices, more of it, in fact, than they have had for very many years. The consequence has been that this week Cleveland iron prices have touched figures higher than anything that has been realised for the last quarter of a century. During the first three days of this week Cleveland warrants rose no less than 3s. 3d. per ton, making 8s. 6d. advance for the month, and 12s. this year, the lowest price being that ruling when the year commenced. The ordinary law of supply and demand is asserting itself very stongly, and traders expect to see 80s. realised within the next few days. Only three or four makers in the district appear to be in a position to supply iron for prompt delivery, and the others regret that they have no iron in stock, so that they might participate in the extraordinary prices. Producers as a rule have no stocks on which to draw—a circumstance which is rather unusual at this season of the year, for generally during the winter months stocks have accumulated. However, trade was too good during the winter to admit of demand falling short of supply, and probably never since 1873 have makers commenced the spring season with so insignificant a stock. The stocks in the public stores are also very small, and if they continue to decline as quickly as they have been doing this month Connal's stock will have disappeared before the spring is over. On Wednesday night the quantity of Cleveland iron held in their stores was only 42,271 tons, the decrease during the month having been 15,577 tons—over 25 per cent.—while the stock of hematite iron was only 6313 tons, a decrease of 835 tons this month.

The export of pig iron this month from the Cleveland district is unprecedented. Last year was remarkable as being the briskest shipping year on record, but the shipments for March, 1899, were very far from being as good as they have been this month. Up to the 28th the quantity had reached 120,370 tons, as compared with 71,346 tons last month, and 96,139 tons in March, 1899, to 28th. What is more significant than this, is that the deliveries would have been considerably larger even than they are if the iron had been forthcoming. The wharves of the ironmasters are crowded with steamers, and there is general complaint among their owners anent the long delays that are experienced in connection with the landing of their cargoes. Some vessels, indeed, are sent away in ballast, as the owners cannot afford to have them wait for days for iron that should have been forthcoming at once. Never since 1873 has there been anything like the present state of affairs in regard to shipments of pig iron, and considering that the spring shipping season is only commencing, greater difficulties are expected before it is over. There is in this district now something approaching a famine in pig iron, the demand being in excess of the production, and the stocks insignificant. Makers could do with a considerably larger output, but however desirous they may be to re-light idle furnaces they cannot do it because they cannot count upon getting proper supplies of materials. The situation is not favourable to consumers, and those who have yet to buy for spring delivery are not in an enviable position.

The maximum price attained for Cleveland pig iron in the "boom" of last summer was 75s. 1½d. cash, that being the best figure that had ruled since the early seventies; this week, however, 77s. has not only been quoted, but realised, and holders are quite indifferent about selling at the present prices. They have very little for sale for early delivery, and are not prepared to sell for the second half of the year, especially as consumers offer 2s. to 2s. 6d. per ton less than the prices ruling for prompt. As the opinion of makers is that still better prices will be obtainable, they refuse to entertain the offers of consumers. No. 1 Cleveland pig iron has risen to 79s.; No. 4 foundry to 75s. 6d., and grey forge to 74s. 4d.

Wilsons, Pease, and Co., of the Tees Ironworks, Middlesbrough, have just blown out a furnace which has been in continuous blast for close upon twenty-four years, having been started in May, 1876, and during this period it is estimated to have produced over 600,000 tons of ordinary Cleveland pig iron. It will now be relined. This is believed to be almost a record for the life of a furnace, and contrasts with the short lines of American furnaces. Wilsons, Pease, and Co. will shortly start another furnace which has been rebuilt.

Hematite pig iron has risen considerably, there being much difficulty in securing supplies. Some of the makers have put up their price for mixed numbers to 87s. 6d., but 85s. is quoted and readily realised. Rubio ore is fully 21s. per ton, delivered at wharves on the Tees or Tyne, freights having continued to advance, and in addition to that the Spanish Government, on the 22nd inst., commenced to levy an export duty on all iron ore shipped from Spanish ports.

The demand for manufactured iron and steel continues satisfactory, but is not as pressing as it was, especially in the plate and angle branches, this being owing to the irregular work at the shipyards. Operations have been much interrupted there ever since Christmas by the bad weather, and this week has probably been worse than all. In consequence of these stoppages both iron and steel manufacturers and marine engineers have got ahead of the shipyards, and there is not such pressure for supplies as was the case last year. Besides this, the high prices asked by shipbuilders have rather checked the demand for new vessels, notwithstanding the good freights, and the probability is that the latter will be maintained all the year, if not increased materially. But the fact that they have to pay 30 to 40 per cent. more for steamers than they had a year ago rather deters them, as it will be difficult to compete with the cheaper vessels. Iron and steel manufacturers are under these circumstances somewhat circumspect about advancing prices, and are rather inclined to nurse the trade. They have not advanced their prices this month as much as was generally expected, and quotations this week are practically the same as they were last week in all branches. Iron ship-plates are at £8 7s. 6d., steel ship-plates £8 5s., iron ship angles £8 7s. 6d., steel ship angles £8 5s., packing iron £8 5s., common iron bars £9 5s., best bars £9 15s. per ton, all less 2½ per cent. f.o.t. Heavy iron rails are firm at £7 10s. net at works, and sleepers, for which the demand is poor, can be bought at £8 15s. net.

A company is being promoted by Messrs. Geo. E. Hemingway, Charles R. Hemingway, and A. G. Forbes for the purpose of establishing and carrying on constructional ironworks—iron and steel bridge work, roofs, girders, and boilers. A site for the works has been secured on the north bank of the Tees between Stockton and Haverton Hill, close to the new railway by which the North-Eastern Railway Company, and the Tees Conservancy Commissioners are to endeavour to open up that district. The new concern will have excellent railway and river facilities.

The statistics of Mr. Waterhouse relative to the deliveries and realised prices of manufactured iron in the North of England during the first two months of the current year, are so far as regards prices undeniably the best that have ever been issued for close upon twenty-five years. The average was £7 6s. 10½d., this being no less than 9s. more than was reported in the previous two months, and not since November, 1875, has such a high figure ruled. It is 33s. 7d., or 30 per cent. more than was reported for the corresponding period of last year, and since prices began to move up in June, 1895, the advance has been 52s. 9d. per ton, or nearly 60 per cent., while as compared with the minimum price ever reported in this district—that of December, 1886, the rise has been 55s. 8d. The maximum of the "boom" of 1880 was 18s. 10d. below the figure now reported, and that of the prosperous time of 1890 was 10s. 5d. less. The advance in the last four months was nearly equal to the 15s. 10d. that was gained in the three and a-half years between June, 1895, and December, 1898. Further advances are expected to be reported, as the realised prices are still a good deal below the quoted prices that have ruled for a considerable time past.

In accordance with this return the wages at the mills and forges will from Monday next be advanced 2½ per cent., but it is interesting to note that if the advance had been 9s. 7½d. instead of 9s., the advance of wages would have been double what it will be, as the price would have come up to £7 7s. 6d. The following is the summary drawn up by Mr. Waterhouse for the two months ended February 28th:—

Description.	Weight invoiced. Tons	cwt.	qr.	lb.	Percentage of total.	Average net selling price per ton. £	s.	d.
Rails	775	1	3	22	2·96	6	7	10·14
Plates	9,196	16	1	20	35·12	6	17	7·08
Bars	12,843	8	0	21	49·04	7	15	0·87
Angles	3,373	6	3	23	12·88	7	5	4·82
	26,188	13	2	2	100·00	7	6	10·51

The wages of steel millmen at the Consett Works, and those establishments which regulate their wages by the Consett sliding scale, will be raised 2½ per cent. from next week.

As is apparent from the above, the orders are not coming in so freely for new steamers. Among those which have been recently placed are three steamers, each 350ft. long, 45ft. 9in. broad, 30ft. 1in. deep, and 6000 tons, which will be constructed by C. S. Swan and Hunter, of Wallsend-on-Tyne, for C. T. Bowring and Co., of New York. J. T. Eltringham and Co., of South Shields, have secured orders for four steel screw steam trawlers, while J. P. Renoldson and Sons, also of South Shields, are to build a well-deck steamer, 204ft. 8in. long. Wigham Richardson and Co. are reported to have got an order for a spar-decked steamer 418ft. long, Wm. Gray and Co., of West Hartlepool, one 329ft. long, and Wm. Pickergill and Sons, Sunderland, one 359ft. long.

Mr. F. C. Marshall has retired from the directorate of R. and W. Hawthorn, Leslie, and Co., Limited, and his son, Mr. F. T. Marshall, has been appointed in his stead. Mr. F. C. Marshall in 1870, in conjunction with Mr. (now Sir) B. C. Browne and Mr. J. H. Ridley acquired the well-known engineering works of R. and

W. Hawthorn, and have since added the St. Peter's Works of Leslie and Co. Ill-health and advancing years are the cause of Mr. Marshall's retirement.

The borough engineer of Middlesbrough, Mr. Frank Baker, F.G.S., in the course of some work in Sussex-street, came across some cast iron fish-bellied rails, such as were used in the early days of railways, and the Free Library Committee has arranged to have them placed in the Middlesbrough Museum.

A curious quarrel is in progress between the North-Eastern Railway Company and the Harris Deep Water Wharf Company. The latter want to construct a loop line from the works to the wharf, which is situate on the Tees near Cargo Fleet. The North-Eastern Railway Company have tried to prevent this, and twice the matter has been before the Courts, going against the railway company each time. This week the Harris Company started on the construction of the line, but the North-Eastern Railway Company sent a large gang of platelayers with a *posse* of policemen to stop the work, as the case is to come again before the Courts. A disturbance was expected, but for the present the Harris Company's servants have suspended operations.

The shares of the South Durham Steel and Iron Company, Limited, have been largely over-subscribed, applications having been received for more than double the number offered to the public.

The coal trade is satisfactory in all branches, and prices are firmly held. Plenty of steamers are forthcoming now, and coal-masters have no difficulty in getting away all the coal they can raise, so that work at the collieries is going on more fully than for some time past. The Russian Admiralty have given out orders for 100,000 tons of best Northumberland steam coal to be delivered at Cronstadt during the current year, and the price to be paid leaves 19s. per ton f.o.b. Foundry coke for export varies from 32s. 6d. to 35s. f.o.b., while blast furnace coke has been raised 6d. this week, 27s. being quoted and paid for medium qualities delivered at the Teesside furnaces.

NOTES FROM SCOTLAND.

(*From our own Correspondent.*)

The Glasgow pig iron market has again been very strong this week. The amount of business done has not been very large, but, owing to an apprehended scarcity of iron, prices have been moving further upward. Business has been done in Scotch warrants from 72s. 1d. to 74s. 6d. cash, and 72s. to 74s. 6d. one month. There has been very little doing in Cleveland iron on account of its great scarcity. A few transactions have taken place at very irregular prices, such as 74s. 8d. for delivery in twenty-one days, 75s. 7½d. to 75s. 9d. sixteen days, 76s. 10½d. to 77s. fifteen days, 77s. cash, and 74s. 10½d. up to 77s. 3d. one month. Cumberland hematite warrants have sold at 80s. 6d. to 82s. 3d. cash, 80s. 6d. to 82s. 6d. one month, 80s. 8d. seventeen days, 82s. 4½d. to 82s. 6d. twenty-three days, and 82s. 4½d. nine days. The irregularity of the market makes business very difficult to put through.

It seems impossible for makers of pig iron to increase materially their output at present, and as a scarcity of raw material is feared, the market is full of reports as to the expedients that are likely to be adopted in order to obtain supplies. It is even said that some of the leading Glasgow iron merchants intend taking a journey to America in order that they may obtain iron there for shipment to this country. There is certainly a feeling that the trade is likely to be easier in the States than on this side, but whether imports of American iron can be advantageously made on a large scale remains to be seen.

The prices of special brands of makers' iron continue to move upward, and in some cases the iron is so scarce that no quotations are given. Govan, f.o.b. at Glasgow, No. 1, is quoted 75s.; No. 3, 74s. 6d.; Monkland, No. 1, 76s.; No. 3, 74s. 6d.; Wishaw and Carnbroe, Nos. 1, 80s.; Nos. 3, 77s. 6d.; Clyde, No. 1, 87s. 6d.; No. 3, 79s.; Gartsherrie and Calder, Nos. 1, not quoted; Nos. 3, 80s.; Summerlee, No. 1, 90s.; No. 3, 81s.; Coltness, No. 1, not quoted; No. 3, 81s.; Glengarnock at Ardrossan, No. 1, 83s. 6d.; No. 3, 78s.; Eglinton at Ardrossan or Troon, Nos. 1, 80s.; Nos. 3, 78s.; Dalmellington at Ayr, No. 1, 80s. 6d.; No. 3, 78s. 6d.; Shotts at Leith, No. 1, 88s.; No. 3, 80s.; Carron at Grangemouth, No. 1, 87s. 6d.; No. 3, 81s. per ton.

There are 82 furnaces in blast in Scotland, compared with 83 last week and 83 at this time last year. Of the total 41 are producing ordinary, 36 hematite, and 5 basic iron.

The output of hematite is less than it was a year ago to the extent of from 1200 to 1400 tons per week, but the prices of Scotch-made hematite have been advancing, having gone up about 2s. per ton in the course of the last ten days. Merchants quote this class of iron 87s. 6d. per ton for delivery at the steel works.

Consumers of pig iron continue to make increasing inroads upon stocks. The stock in Connal and Co.'s Glasgow stores shows a reduction for the past week of fully 7000 tons. The total reduction in these stocks during the last three months has been about 57,000 tons, and if a similar decrease should continue throughout the year, the stock would be well nigh exhausted by the month of December. The total stock at present in these stores is about 199,000 tons. There is no positive information as to the amount of stocks held in makers' private yards, but it is understood that these are also being reduced. The prospect, therefore, is that if the present demand for pig iron continues, prices are likely to go still higher, and there will be difficulty in obtaining full supplies.

The shipments of pig iron from Scottish ports in the past week have amounted to 10,285 tons, compared with 4789 in the corresponding week last year. There was despatched to the United States 125 tons, South America 164, India 210, Australia 844, France 20, Italy 1810, Germany 640, Holland 500, Belgium 110, Spain and Portugal 150, China and Japan 100, other countries 320, the coastwise shipments being 5292 tons, compared with 3545 in the same week of 1899.

It has been stated within the last few days that some consumers of iron in the Glasgow district are finding it so difficult to obtain adequate supplies that they have been obliged to give notice to a number of workmen that their services will have to be dispensed with, at least temporarily, unless an improvement takes place in respect to the amount of iron available. Among the firms so circumstanced are Neilson, Reid, and Co., of the Hyde Park Locomotive Works, Glasgow. This firm is reported to have booked orders for ten locomotives for South Africa, and also ten engines for the Egyptian railways.

The finished iron and steel trades are very firm. Wages are advancing, and the dearness and scarcity of pig iron is such that makers will be obliged to raise their prices.

The coal trade is active, but there has been much less difficulty in obtaining full supplies. The pressure for shipping coals has been considerably relaxed, owing mainly to an impression that purchases may ere long be made on easier terms. The demand for coals for manufacturing purposes is well maintained, and notice has been given by coalmasters that contract prices will remain unchanged during April, on the basis of 13s. per ton for splint coal at the pits. The price of shipping coals is somewhat easier. Steam coal is quoted f.o.b. at Glasgow 14s. 6d. to 14s. 9d.; splint, 14s. 6d. to 15s.; and ell, 14s. 6d. to 15s. 6d. per ton. There is a very good demand for household coals for home consumption.

WALES AND ADJOINING COUNTIES.

(*From our own Correspondent.*)

The steam coal trade continues in strong demand all over the district; small, not quite so firm. House coals and semi-bituminous remain steady, demand having evidently been strengthened by the severe weather, though the high prices prevailing in some districts evidently affect local consumption. This applies especially to the chief ironworks district, Dowlais, Cyfarthfa, and Plymouth having advanced prices 5s. per ton. The result is that local prices are now at 30s. At one of the Boards of Guardians in the district it was shown on Saturday last that the reason urged for advancing 5s. per ton, "owing to the coal assessment being increased 20 per cent.," was not a valid excuse, as the advance in assessment only amounted to 1¾d. per ton. The fact is that the large ironmasters are also considerable coal exporters, and as they also hold large Government contracts, the troublesome details of local coal business are not acceptable. At one time, in early iron history, when the 3000 colliers of Plymouth at present were represented by three colliers only, ironmasters objected to sell coal at any price. Wm. Crawshay's reply to a buyer was, "I want all my coal for use." Now the largest ironmasters are in the front rank of coalowners. Colliers are working well, and are anticipating a good audit, and all over the district, in everything pertaining to coal, the animation is marked. In the Swansea Valley there has been an increase of colliery labour, especially at the Birchgrove. At Briton Ferry two pits are projected. Exports have shown a decided increase. France and Spain have been large buyers at the chief ports. Last week the total from Swansea was over 25,000 tons to France alone. Cardiff has also been shipping freely, also to Port Said. More coal and fuel reported going to Alenzia, and steady consignments to Cape Town. A steamer going out of dock last week from Penarth to Savona with 3500 tons, met with a singular accident, grounding with one end on bank and the other across the drain. When the water receded she literally broke in two between her engines and boilers. Big ships are now in evidence for coaling and bunkering. This week the Mimiso, in the Australian meat trade, came into Barry; tonnage, 12,000; length, 440ft.; depth, 55ft.; width, 30ft.; owners, Tyler and Co., of London. Newport figured near this in respect of the Rippingham Grange, 9200 tons, which has been dry-docked in the large graving dock of the Union Dry Docks Company. She has been fitted up with stalls for 1000 horses for South Africa, and was bunkered this week with 4200 tons at the Alexandra Docks. This fine vessel is owned by Houlder Brothers and Co., London.

Patent fuel is in strong request, particularly at Cardiff and Swansea. Patent coal prices, Cardiff, were as follows:—

Best steam, 22s. to 23s.; seconds, 19s. to 20s.; drys, 18s. 6d. to 19s. 6d.; best steam smalls, 14s. to 14s. 3d.; seconds, 13s. 3d. to 13s. 9d.; drys and inferior sorts, 12s. 6d. to 12s. 9d.; best Monmouthshire semi-bituminous, 18s. to 18s. 3d.; seconds, 16s. 3d. to 16s. 6d.; best households, 22s. to 23s.; seconds, 18s. to 19s.; No. 3 Rhondda, 20s. to 23s.; brush, 19s.; small, 17s. to 17s. 6d.; No. 2 Rhondda, 15s. 6d. to 16s.; through and through, 14s. to 14s. 6d.; small, 13s. to 13s. 6d.

Patent fuel, 19s. to 21s. Coke: Furnace, 29s. to 31s.; foundry, 32s. to 33s.; special foundry, 35s. 6d. to 36s.

It is being urged that corporations like railways should go in for coal properties, and even the Government acquire steam coal seams. Lately there has been an increase of colliery companies, and the tendency is to give the people, more than capitalists, an interest in them. One in the anthracite district has just been floated, £10,000 in £5 shares.

The Lewis Rhondda Company promotion has been closed, having been largely over-subscribed.

I have heard that Belgian capitalists are endeavouring to acquire lead properties in North Cardiganshire. A large tract exists from Aberystwith up to the Plinlimmon ranges, and on to the margin of the Birmingham water shed. Last week a Belgian syndicate started the "Société Anonyme de Mine de Frongoch," Merioneth, 1½ million francs, with 6000 preference shares, apart from debentures. The Pritchard Morgan gold mines continue in operation, but I have not heard of the progress of the Mawddach estuary scheme.

The iron and steel works are being vigorously conducted. The chief complaint is the scarcity of men. The drain for the war has been greater than from the collieries, and several leading works are much inconvenienced in consequence, the pressure for supplies, rails, plates, and bars being very great. The exports of the week include 1150 steel plates for Hamburg and Rostock from Cardiff, with one cargo iron to Ghent; rails from Newport to Highbridge, and one large consignment of rails to Topsham.

There has been no falling off in arrivals of pig iron, Whitehaven, Barrow, and Ulverston figuring principally, and the latter sending also ingot mould. Swansea imported 4397 tons. A good average output of hematite took place at the Briton Ferry works last week, and the make of steel bar was well maintained. In the Swansea Valley the pig iron trade is most satisfactory. Wright, Butler, and Co.'s works are in full vigour, and at Upper Forest, Pontardawe, and Duffryn, the steel make shows the greatest animation. Tin-plate bars in the district are now at £7 7s. 6d., or best brands up to £7 10s.

High pressure is the leading feature at all the Bessemer works, and what with constant arrivals of ore and coke, and despatches of rails, bars, and plates, each present a scene of almost unparalleled activity.

On 'Change, Swansea, mid-week, strong evidence was given of an unchecked prosperity in all branches of iron and steel. Since my last report the pig iron market has shown an advance on all hands. Scotch, 1s. 2d.; Middlesboro', 2s. 2d.; hematite, 3½d. The last named has varied during the week to the extent of 1s., and at close was very firm. It was stated that stocks had been drawn upon to the extent of nearly 20,000 tons, and the general opinion was that no change in the upward progress of prices was likely, unless the threatened importation from America should occur. With regard to the American bar import, it was maintained that sales had been effected by the National Steel Company of America, and the figures given were £6 17s. 6d. per ton c.i.f., range of gauges from 9ft. upwards, probably experimentally; at all events, if anything like business is done it will soon be well known.

Latest quotations Swansea are as follows:—Glasgow pig iron warrants, 72s. 9d. to 72s. 10½d. cash; Middlesbrough No. 3, 75s. 5d.; other numbers in proportion. Hematite warrants, 80s. 10½d. to 81s. 2d. for mixed numbers f.o.b.; Cumberland, according to brand. Welsh bars, £9 10s. to £10; angles, at usual extras f.o.t. Sheets, iron and steel, £11 10s. to £11 15s., with usual extras for higher gauges. Steel rails, heavy, £7 10s. to £7 15s.; light, £8 10s. to £8 15s.; sleepers, angles, channels, according to section and specification. Bessemer steel tin-plate bars, £7 5s.; Siemens tin-plate bars, best, £7 7s. 6d. Billets and blooms, delivered Midlands, £7 15s. to £8. Tin-plates: Bessemer steel cokes, 16s. 9d. to 17s.; Siemens coke finish, 17s. to 17s. 3d.; ternes per double box, 28 by 20 C., 30s., 31s., 32s., to 34s. 6d.; best charcoal, 17s. 6d. to 18s. 6d. Big sheets for galvanising, 6ft. by 3ft. by 30 g. per ton f.o.t., £16 10s. to £17 5s.; finished black plate, £13 10s. to £13 12s. 6d. Canadas, £12 to £13 5s. Galvanised sheets, 24 g., £15; 26 g., £16 15s. Block tin, £133 to £129 10s. Lead, £16 15s. Copper: Chili bars, £78 10s. to £76 15s. Spelter, £21 5s.

Tin-plate prices are very firm. Makers contend that they are still below the cost of production. Last week the shipment was limited to 32,738 boxes; receipt from works, 58,141 boxes; leaving stocks at 234,864 boxes; but it is understood that a good deal of stock is held for buyers. Good loadings may be expected, with moderating weather, from America, China, and Japan, and three cargoes for Holland, also several for Mediterranean ports. Works are now well off for coal, and the production of tin and steel last week was considerably the best of the quarter.

A meeting of the Tin-plate Association was held at Swansea on Tuesday, when matters under the Factory Act were discussed. It was agreed at the close to send a deputation to London to get, if possible, amendments in the new Bill providing for the employment of boys above thirteen on eight hours shifts. The Bill at present specifies that no boys should be employed under eighteen.

Latest Swansea coal prices are as follows:—At pit mouth a fairly uniform price for steam prevails in the Valley of £1 per ton; anthracite, 16s. 6d. to 17s.; seconds, 14s. to 14s. 6d.; ordinary large, 12s. to 12s. 6d.; small rubbly culm, 9s. to 9s. 6d.; steam, 20s.; seconds, 17s. to 18s.; bunker, 14s. 6d. to 15s.; small, 12s. 6d. to 13s. 6d.; bituminous, according to arrangement; patent fuel, 18s. to 20s. Coke, furnace, 30s. to 31s.; best foundry, 32s. 6d. to 35s.; pitwood, 18s. 6d. into trucks. Cardiff prices are 18s., firm; iron ore, Cardiff or Newport, Tafna, 19s. to 19s. 6d.; Rubio, 20s. to 20s. 6d.

The annual meeting of the Miners' Provident Society was held this week in Cardiff. The membership at the close of the year was 30,269; balance in hand, £203,409 14s. 1d. In the course of the meeting it was agreed that the board allot one hundred allowances of 5s. per week to the most aged members, whose membership had been sustained for ten years, and who are not in receipt of disablement pay, from May 7th, 1900, until December 31st, 1903.

In the anthracite district coal owners do not, so far, agree to join the association. There is one threatened trouble in that quarter; the enginemen and stokers having given in notices. Some hopes were entertained this week that they would be withdrawn.

Some little interest was aroused amongst the colliers generally this week to hear of the deputation of colliery leaders who waited upon the Home Secretary. The deputation included "Mabon," Brace, Davies, &c., and Robinson, from the Forest of Dean. The Home Secretary, after hearing, decided that no case was made out for interfering with the present Local Mines Regulation Act. The second reading of the Amendment Act would not be supported by the Government. He admitted defects in the Compensation Act, and hoped they would be dealt with by Parliament later on. He could not promise to advocate the appointment of a Minister of Mines, although such an official would much relieve him. There were mining experts at the Home-office, and he did not think that the Government would sanction the expense of another minister.

An accident at Merthyr Vale by a runaway train on the workings caused the death last week of two of the colliers. This week an inquest was held, and a verdict of accidental death recorded.

On the eve of my despatch I hear that the Government is again endeavouring to place large contracts for coal. This has given increased tone to the market.

THE NEWPORT HARBOUR COMMISSIONERS' WEEKLY TRADE REPORT.

Steam coal firm, a better supply of tonnage having come on. House coal is quiet owing to non-arrival of sailing vessels. Tin and copper remain about same as last quotations. Exports for week ending March 24th were:—Coal, foreign, 55,287 tons; and coastwise, 16,099 tons. Imports for week ending March 27th were:—Pig iron, 2020 tons; iron ore, 3400 tons; cement, 650 tons; pitwood, 2494 loads; 1 cargo of scrap.

Coal: Best steam, 18s.; seconds, 16s. 9d. to 17s.; house coal, best, 18s.; dock screenings, 14s.; colliery small, 13s. to 13s. 6d.; smiths' coal, 15s. Pig iron: Scotch warrants, 74s. 6d.; hematite warrants, 82s. 6d. f.o.b. Cumberland; Middlesbrough, No. 3, 77s. prompt. Iron ore: Rubio, 20s. to 20s. 6d.; Tafna, 19s. to 19s. 6d. Steel: Rails, heavy sections, £7 10s. to £7 15s.; light ditto, £8 10s. to £8 15s. f.o.b.; Bessemer steel tin-plate bars, £7 5s.; Siemens steel tin-plate bars, £7 7s. 6d., all delivered in the district, cash. Tin-plates: Bessemer steel, coke, 16s. 9d. to 17s.; Siemens, coke finish, 17s. to 17s. 3d. Pitwood: 17s. 6d. to 18s. London Exchange Telegram: Copper, £78 5s.; Straits tin, £136 5s. Freights: Steady.

AMERICAN NOTES.

(*From our own Correspondent.*)

New York, March 21st, 1900.

The financial situation is the absorbing feature in the markets of this country. The Currency Law just passed ensures an immediate increase in the volume of currency to the extent of 10 per cent. of the Bank Law capital, with the exchange of bonds now out, which in the aggregate amount to 800,000,000 dols., and which money will be issued by the formation of new banks, an enormous increase in the circulation is assured.

There is certainly a very great demand for more money because of the extraordinary industrial and commercial activity in all directions from Cape Nome to Southern Mexico. The iron trade is more active than a few days ago.

Great combinations are not anxious to push these advances, but recognise that the influences behind the market are bound to establish a higher level of values. The prospects for railroad construction are very flattering. Inquiries from west of the Mississippi region show that the greatest activity in building will be there. Inquiries from Japan and other far-off points during the past few weeks would figure up 30,000 tons for steel rails. It is intimated to-day in some circles that steel rails will be advanced to 36 dols., and ultimately to 39 dols. There is a very active demand for girder rails for trolley lines, the construction of which will assume very large proportions during the coming year. Copper is firm; tin is high; spelter is active; lead is in abundant supply. Electrical interests are all doing a good business, and preparations are being made for still further enlargements during the coming summer to meet what everybody thinks here will be a continuous demand for electrical equipment of all kinds. Money averages 6 per cent. interest, and just at the present time there is a little apprehension of a stringency over the confidence of the introduction of the new legislative measures. A measure has been introduced into Congress to provide for the printing of 50,000,000 dols. worth of small notes ranging from 5 cents to 5 dols. for mailing purposes. All engineering plants are overcrowded with work. All rolling mills are booking as much new business as they care to take. Plate iron has advanced in price during the past few days 8s. per ton.

Naval Engineer Appointments.—Staff engineer: A. W. Turner, to the Argonaut, to date April 19th. Chief engineers: A. Hills, to the Charybdis, and E. A. Short, to the Vivid, for the Comus, undated. Engineers: A. S. Crisp, to the Duke of Wellington, for the Chamois, and W. C. S. P. Bartwell, to the Victory, for the Sylvia, both in lieu of a chief engineer, to date March 17th; T. W. Cleave, to the Pembroke, to date March 23rd, and to the Argonaut, to date April 19th; R. Spence, to the Vernon, for charge of machinery of steam boats other than torpedo boats, and for electric light duties, and instruction of engineer officers and engine-room artificers in electric light apparatus; and L. J. Watson, to the Pembroke, supernumerary, to date March 23rd.

Royal Meteorological Society.—The monthly meeting of this Society was held on Wednesday evening, the 21st instant, at the Institution of Civil Engineers, Great George-street, Westminster, Dr. C. Theodore Williams, president, in the chair. Reference was made to the loss which the Society had sustained by the death of Mr. G. J. Symons, F.R.S., who had held the office of secretary from 1873 to 1899, except for the two years 1880-1881, when he was president. At the annual meeting on January 17th last he was elected president for the second time, in order to preside over the jubilee celebrations of the Society next month. Owing to being seized with paralysis on February 14th, he had to resign the presidency, and, as he never rallied, he died on the 10th inst. A vote of condolence with his relatives was passed by the meeting. Twenty-seven new fellows were elected, as well as two honorary members, viz., Mons. Albert Lancaster, director of the Belgian Meteorological Service, Brussels; and Gen. M. A. Rykatcheff, director of the Central Physical Observatory, St. Petersburg. The following papers were read:—"The Ether Sunshine Recorder," by Mr. W. H. Dines, B.A.; "Remarks on the Weather Conditions of the Steamship Track between Fiji and Hawaii," by Captain M. W. C. Hepworth; and "Comparison by Means of Dots," by Mr. A. B. MacDowall, M.A.

NOTES FROM GERMANY.

(*From our own Correspondent.*)

ALL branches of the iron and steel industries continue very busy, and the works are in many cases so well supplied with contracts that they do not care to accept orders which have to be executed before summer. Prices show increasing firmness generally, but during this week and the last no official advance has taken place. The tone all round remains strong and hopeful, spring orders for home consumption coming in freely, and foreign demand has also been fairly good, especially for structural iron. Pig iron is, of course, stiff in price and in very good call, but as scarce as before. The production of pig iron in Germany, including Luxemburg, was for February of present year 620,707 t., of which 121,009 t. were forge pig and spiegeleisen, 32,768 t. Bessemer, 354,985 t. basic, and 111,945 t. foundry pig. Output in January of present year was 658,512 t.; in February last year 625,158 t. were produced. From January 1st to February 28th of present year 1,279,219 t. were produced, against 1,282,779 t. for the same period the year before.

A rise in the demand for plates and sheets has been noticed both in the Siegerland and in the Rhenish-Westphalian district, consumers trying to buy as much as they can get at the present rates, because advances are expected for all sorts of plates when the spring trade developes more strongly. Exceedingly brisk employment is reported to be going on at the machine shops, and the locomotive and wagon factories have, perhaps, never before been so busy as during the past few months, while prospects for fresh work are very good.

The situation of the wire and wire nail business, which has previously been stated as improving, was remarkably firm last week. The wire nail manufacturers are at last profiting from the general upward tendency in quotations, and are doing quite a remunerative trade now, at least so far as regards inland demand, export being still weak and limited.

German total export in January and February of present year was 5,025,237 t., against 4,556,023 t. in the year before, plus amounting to 469,214 t. Coal, corn, wood, drugs, show an increase, while export in earth, ore, and iron shows a falling off against last year.

Spring orders come in pretty regularly on the Austro - Hungarian iron market, and some branches are in fairly good occupation, but as many works had to limit, or even suspend, operations in consequence of the colliers' strike, makers find it very difficult to supply the quantities required. Products of the Austrian iron industry have for the first time successfully competed on the Constantinople iron market with articles from other countries, and several contracts for bars and sectional iron were lately placed with Austrian firms, both articles having previously been imported from Belgium or England. Tools and locks have likewise been sold in large lots to Turkey, and there is little doubt that a good business in the above-named articles, the quality of which is stated to be excellent, might be done to Turkey, provided that prices remain so low as to beat all other countries.

In the Falkenau district the colliers' strike is reported to have come to an end, nearly all the men having resumed work on March 22nd ; from other parts there have likewise been better accounts given, and the number of the strikers is decreasing.

Firmness and activity are the principal features of the French iron market. Consumers who were at first reluctant to pay the advanced rates fixed by the works some time ago, have now come forward very freely with orders, and numerous contracts, chiefly in manufactured iron, were placed in the course of last week. The advanced quotations of 280f. to 300f. p.t. for merchant iron No. 2, 310f. p.t. for hoops, 310f. p.t. for steel wire rods, are firmly maintained. The ironworks of the Departement la Loire et le Centre are showing a strong inclination to raise their prices.

In Belgium ironmasters have likewise tried to advance their rates, and the tendency generally appears to be in an upward direction, but a rise for girders that had been resolved upon could not be carried owing to underquoting on the part of German works, which are selling girders at 190f. p.t., free Antwerp ; and so the Belgian mills had to be content with the same price. It is, however, very likely that in spring and early summer a rise for most articles of manufactured iron will take place, the outlook being bright in all trades. Plates have been comparatively quiet last week, and prices were a trifle less firm. Demand and consumption in coal, coke, and briquettes have been extraordinarily brisk, and the industrial establishments are feeling the want of fuel very keenly, in spite of large supplies that come in from abroad. During the first two months of present year import in coal to Belgium was 560,000 t., against 340,000 t. for the corresponding period the year before. In February alone 277,000 t. coal were imported, against 185.000 t. in the same month in 1899. Increase was accordingly 70 per cent. for January and February, 45,000 t. falling to Germany ; while import in English coal rose 156,000 t. In coke about 4000 t. more were imported this year than last, supplies coming chiefly from England ; import of German coke went down from 34,845 t. for January and February last year on 31,768 t. for this year. Belgian export in coal during the period above mentioned increased 90,000 t.; export in coke, 19,000 t. against last year.

ENGINEERING NOTES FROM SOUTH AFRICA.

(*From our own Correspondent.*)

Maritzburgh, March 3rd.

THERE can be no question now of the comparative harmlessness of wounds caused by the Mauser bullet, and the Boers are having recourse to "nicking" the heads, and wherever possible, are using the Martini-Henry rifle instead of the Mauser. It is quite probable that the burghers' disappointment with their new weapon has had something to do with the distinct falling off in the stubbornness of their resistance which has been noticed in recent engagements. It is surely making a farce of war to insist upon the use of ammunition which does not disable an enemy unless it kills him outright or breaks a bone.

As to lyddite, it seems to have satisfied all reasonable expectations, though coming far short of the exaggerated ideas some people had formed of it. Actual experience of the explosive shows that a 4·7in. shell will breach a 4ft. earthen or rubble rifle parapet, but as it bursts on impact it is doubtful whether it would prove of much use against the 6ft. masonry of a fortress or against naval armour. The picric-acid fumes which arise from the exploded shell do not possess the deadly power ascribed to them. They are simply non-respirable.

Lord Roberts' success has put quite a new complexion on the outlook, and much more cheerful views now prevail in business and industrial circles. Already orders for pumping and other plant have been cabled home in connection with several of the Witwatersrand mines. The majority of South African opinion is that there will be but little fighting once a British army enters the Transvaal, and the Boers appear to be basing their hopes upon continental intervention rather than upon the defence of their strongholds.

At the annual meeting of the De Beers Company the other day Mr. Rhodes justified the heavy expenditure which that company has undertaken upon cold storage plant at Kimberley and the Cape ports. There is no question that as soon as the war is over there will be a vigorous demand throughout South Africa for refrigerating machinery, both on public and private account. Hitherto the country has been content to depend for much of its food supplies on tinned stuffs, but with Australia now pouring in consignments of fresh meat and dairy produce this can no longer continue.

UNITED KINGDOM RAILWAY OFFICERS' AND SERVANTS' ASSOCIATION.—Speaking at the anniversary festival of this Association on Wednesday night, Mr. J. Lloyd Wharton, M.P., said that it was noteworthy that during the past year there had been an absolute minimum of accidents to passengers, and, he hoped, to railway servants also.

TRADE AND BUSINESS ANNOUNCEMENTS.—The business of the Pridmore Molding Machine European Agency will in future be carried on by J. W. Jackman and Co., who are removing to larger promises at 39, Victoria-street. Besides the Pridmore machines, J. W. Jackman and Co. represent the Whiting Foundry Equipment Company of Chicago, makers of the Whiting cupolas ; the S. Obermayer Company, of Chicago ; and the Buffalo Forge Company, of Buffalo ; and make a speciality of foundry equipment in all its branches. —The Patent Shaft and Axletree Company, Limited, has opened London offices at Members' Mansions, 36, Victoria-street, S.W., under the management of Mr. Lincoln Chandler.—Mr. F. T. Marshall has been appointed to be a director of R. and W. Hawthorn, Leslie, and Co., Limited, Engineers and Shipbuilders, St. Peter's Works, Newcastle-on-Tyne, his father, Mr. F. C. Marshall, having retired from the board.—The Epstein Electric Accumulator Syndicate, Limited, have granted to W. O. Rooper and Robins, electrical engineers, of Stafford, the sole licence to make and sell Epstein accumulator plates and storage batteries. W. O. Rooper and Robins will manufacture the plates by Mr. Epstein's original process with the assistance of many of his staff, at their new works at Stafford.

NEW COMPANIES.—Henry Pooley and Son, 1900, Limited, is a company with a share capital of £130,000, divided into 13,000 5½ per cent. cumulative preference shares of £5 each, and 65,000 ordinary shares of £1 each. In addition to the share capital, the company is now issuing £70,000 4 per cent. first mortgage debenture stock, redeemable at the company's option on or after January 1st, 1915, at 105 on six months' notice, and in the event of the stock becoming repayable before that date, it will be repayable at the same price. The company acquires the business of Henry Pooley and Son, Limited, weighing machine manufacturers and engineers, of Liverpool, London, Belfast, &c. The purchase price has been fixed at £180,000, payable in cash, but the vendors are prepared to accept any amount up to £60,000 in debenture stock, and up to £65,000 in ordinary shares.—On the 21st instant a company was registered by Jordan and Sons, Limited, of 120, Chancery-lane, London, under the title of John Langfield and Company, Limited, to acquire and take over the business of engineers now carried on under the style of John Langfield and Co., at 11, Blackfriars-street, Manchester, and Furnace-street, Dukinfield, Chester. The nominal capital of the company is £10,000, divided into 10,000 shares of £1 each.

DIVIDENDS AND REPORTS.—The report for 1899 of A. and J. Stewart and Menzies, Limited, states that the net profit amounts to £130,301, which, with £9743 brought forward, makes a total available balance of £140,044. Interim dividends at the rate of 6 per cent. on the preference, and 9 per cent. on the ordinary shares have been paid, leaving £107,044, which the directors recommend should be appropriated as follows :—To depreciation account, £25,000 ; to reserve fund, £25,000 ; final dividend at the rate of 6 per cent. on the preference shares, £10,500 ; final dividend at the rate of 11 per cent. on the ordinary shares, making 10 per cent. for the year, £27,500, leaving to be carried forward £19,044.—The net profits of the National Electric Wiring Company for the past year amounted to £1785, and after including £1222 brought forward, and writing off £1225 for depreciation and reserve on contracts, the balance permits of a dividend of 3 per cent., and the carrying forward of £281.—The report of the directors of Robey and Co. for the year 1899 states that after writing off £6105 for depreciation, there remains a net profit of £36,860. Deducting debenture interest and adding £351 brought forward from the previous year, there is a balance of £30,255 available for division. The directors recommend this sum to be appropriated as follows : To the payment of a dividend of 6 per cent., amounting to £16,698, adding £11,000 to the reserve fund—thus increasing that fund to £40,000—and carrying forward £2557.

THE PATENT JOURNAL.

Condensed from "The Illustrated Official Journal of Patents."

Application for Letters Patent.

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

16th March, 1900.

5010. FINGER GUIDES for MUSICAL INSTRUMENTS, P. Marcuson, London.
5011. SPRING HINGES, E. C. Hoffman, London.
5012. APPARATUS for HOLDING BREAD, A. E. Edwards. —(*C. Friedrich, Germany.*)
5013. APPARATUS for WEIGHING, W. F. Stimpson, London.
5014. APPARATUS for WEIGHING, W. F. Stimpson, London.
5015. CRANK BEARINGS, H. H. Lake.—(*Fahrrad-Fabrik Süderland Theodor Hüttebräucker ——.*)
5016. POROUS DIAPHRAGMS, T. J. Holland and A. P. Laurie, London.
5017. RAILROAD TIES, P. A. Newton.—(*The New Jersey Wire Cloth Company, United States.*)
5018. FIREPROOF CONSTRUCTIONS, P. A. Newton.—(*The New Jersey Wire Cloth Company, United States.*)
5019. FIREPROOF CONSTRUCTIONS, P. A. Newton.—(*The New Jersey Wire Cloth Company, United States.*)
5020. FIREPROOF CONSTRUCTIONS, P. A. Newton.—(*The New Jersey Wire-Cloth Company, United States.*)
5021. FIREPROOF CONSTRUCTIONS, P. A. Newton.—(*The New Jersey Wire-Cloth Company, United States.*)
5022. FIREPROOF CONSTRUCTIONS, P. A. Newton.—(*The New Jersey Wire-Cloth Company, United States.*)
5023. FIREPROOF CONSTRUCTIONS, P. A. Newton.—(*The New Jersey Wire-Cloth Company, United States.*)
5024. WEAVING APPARATUS, C. Vorwerk, London.
5025. ACTUATING ARRANGEMENTS for EXPANSION VALVES, R. Hardie, London.
5026. RADIATORS, F. Clarke, London.
5027. FILLING and CLOSING MEDICAL CAPSULES, F. Panzner, London.
5028. PRESSURE REDUCING VALVES, R. Hardie, London.
5029. LUGGAGE CARRIER for BICYCLES, W. J. Lloyd and W. Priest, London.
5030. BULLET-PROOF MATERIAL, T. Macdonald, London.
5031. LEATHER SKIVING MACHINES, C. H. Bayley, London.
5032. ELECTRICAL CUT-OUT DEVICES, A. Malignani, London.
5033. COMPRESSING GAS, A. I. V. Vriesland, London.
5034. FLUSHING VALVES, W. E. Hinsdale, London.
5035. MATCHBOX, L. H. Thomas, London.
5036. TOYS, L. H. Thomas, London.
5037. BOTTLE STOPPERS, P. G. Hercht and L. H. Thomas, London.
5038. GARMENT HANGERS, G. C. Marks.—(*W. F. Hall and W. Donaldson, United States.*)
5039. MOTORS for ROAD VEHICLES, A. E. Stirckler, London.
5040. PRODUCING AROMATIC COLOURING MATTERS, J. Y. Johnson.—(*The Badische Anilin and Soda Fabrik, Germany.*)
5041. BOILER FURNACE, W. Broadbent and J. Beaumont, London.
5042. BOOTS, W. F. Biggs, London.
5043. AUTOMATIC COUPLINGS for CARS, J. Cameron, London.
5044. MEANS for SUPPORTING BLINDS, A. W. Bentley, London.
5045. PRODUCING PRINTING BLOCKS, A. T. Woodhead, London.
5046. ELECTRICITY METERS, A. Wright and the Reason Manufacturing Company, Ltd., London.
5047. PRESERVING UNCOOKED MEAT, &c., E. Natho, London.
5048. REFRIGERATORS, F. Gerhard and R. Berg, London.
5049. BARASCOPE or WEATHER INDICATOR, E. Reddiess, London.
5050. ASYNCHRONOUS ROTARY CONVERTERS, W. P. Thomson.—(*Hesios Electricitäts Actien Gesellschaft, Germany.*)
5051. MULTIPLE LUBRICATOR for MACHINERY, C. Lang, London.
5052. ADVERTISING on PAVEMENTS, T. E. Andrews, Birmingham.
5053. INDICATING SPEEDS of ROTATION, A. Mallock, London.
5054. MACHINE for COMPOSING TYPE, G. A. Goodson, London.
5055. VALVES for HYDRAULIC PRESSES, J. Jacobsen, London.
5056. MAKING PRODUCTS for MORDANTING PURPOSES, F. M. and D. D. Spence and T. J. I. Craig, London.
5057. MAKING CERTAIN PRODUCTS for MORDANTING PURPOSES, F. M. and D. D. Spence and A. Shearer, London.

17th March, 1900.

5058. PLOUGHS, E. A. Probert, Worcester.
5059. A FERRET LOCATOR, E. A. Probert, Worcester.
5060. ATTACHED OPENER for ENVELOPES, D. W. Haddon, Birmingham.
5061. BOTTLE HOLDER, &c., J. and J. Maxfield, Sheffield.
5062. CONDENSING STEAM, H. T. Newbigin, Newcastle-on-Tyne.
5063. PNEUMATIC HAMMERS, G. and J. H. Nutter, Burnley.
5064. SLIP HOOKS for STEAMERS, H. Dansey, Teddington, Middlesex.
5065. SOCKET and SPIGOT DRAIN PIPES, J. A. Reid, Glasgow.
5066. BLEACHING TEXTILE FABRICS, H. Hadfield, Manchester.
5067. WAGON COUPLING, J. Edwards and W. Morgan, Bristol.
5068. MAKING BUCKLE TONGUES, S. Greenfield, Birmingham.
5069. INVERTED ELECTRIC ARC LAMPS, H. M. Darrah, Manchester.
5070. MUSICAL TOY, T. W. and M. Masters, Nottingham.
5071. DECORATING TILES, G. Thorley, Hanley.
5072. ELECTRIC INCANDESCENT LAMP HOLDERS, G. Bayliff, Liverpool.
5073. LETTER BOXES, S. A. Collis, Birmingham.
5074. PRODUCTS for COLOURING MATTERS, W. H. Claus and A. Rées, Manchester.
5075. DESTINATION INDICATOR for TRAMCARS, J. Caldwell, Glasgow.
5076. VIEWING ENLARGED PICTURES, J. E. Thornton and C. F. S. Rothwell, Altrincham.
5077. DEVICE for HUNTSMEN, G. Chard, Bristol.
5078. PRINTING MACHINERY, W. H. Lock and W. D. Ross, London.
5079. CUTTING TOOLS of ENGRAVING MACHINES and GRINDERS for same, W. H. Lock and M. Barr, London.
5080. MICROMETERS, W. H. Lock and H. Isherwood, London.
5081. REELING MACHINES, H. M. Girdwood, Manchester.
5082. STEAM TRAPS, T. Allison and F. Shaw, Halifax.
5083. VENTILATING MINES, C. P. Kenyon, Glasgow.
5084. GUTTER PATTERN ROLLING MACHINES, D. M. Drummond, Glasgow.
5085. REGULATING the ARC in ELECTRICAL ARC LAMPS, E. L. Thorp and L. B. Codd, Leeds.
5086. MANGLING MACHINE, J. E. Wisart, Crosshills, near Keighley.
5087. TRAVELLERS' COMPANION, H. Keane, Cork.
5088. BONDING for ELECTRICAL CONDUCTORS, R. Thomson.—(*C. Brown, Switzerland.*)
5089. EXPLOSIVE GAS ENGINES, A. Dougill, Bradford.
5090. RETURN STEAM TRAPS, T. W. Mitchell, Bradford.
5091. BREAD BOXES, F. Schmidt, Berlin.
5092. AIR PROPELLERS, P. Y. Alexander, London.
5093. APPARATUS for STRETCHING FABRICS, J. Westley, Manchester.
5094. READING MARK, L. Gillrath, Cologne.
5095. MAKING TABLE LEGS and BODY, T. Bashforth, Wigan.
5096. PHOTOGRAPHIC SHUTTER, S. D. McKellin, Manchester.
5097. HOB NAILS for BOOTS, E. J. Smith, Ystalyfera, Glam.
5098. MAKING BRICKS, Hall and Boardman, Limited, and J. Hall, London.
5099. FIRE ARMS, S. N. McClean, London.
5100. LADDERS, J. J. Howard, London.
5101. MOTIVE FLUID OPERATED HAMMERS, C. H. Johnson, London.
5102. RECEPTACLE for the STORAGE of COFFEE, J. Rohde, Berlin.
5103. POTATO HARVESTING MACHINE, H. Harms and H. Seegelke, Berlin.
5104. MERCERISING APPARATUS, H. E. Aykroyd and J. Graham, Liverpool.
5105. TAKING BEARINGS on BOARD SHIP, J. E. Bohm, Liverpool.
5106. WATERPROOF DEVICES for VEHICLES, H. Williams, Liverpool.
5107. PLACKET HOLE and POCKET FASTENERS, M. Evans, Liverpool.
5108. MANUFACTURING BUILDING MATERIALS, A. Haacke, Liverpool.
5109. DRYING TEXTILES, A. Pitsch, London.
5110. METALLIC PENS, J. L. Petit, London.
5111. PACKING VALVE SPINDLES, E. C. R. Marks.—(*R. Scott, China.*)
5112. STITCH MECHANISM for SEWING MACHINES, D. Noble, London.
5113. READING-IN CARDS for LOOMS, C. Vorwerk, London.
5114. AIR TUBES for PNEUMATIC TIRES, H. E. Pope, London.
5115. BRAKES for VELOCIPEDES, J. E. Challoner, London.
5116. FILLING and WEIGHING GRAIN, R. Brown, London.
5117. TAPS for BARRELS, F. Parsler, London.
5118. COMBINATION MUZZLE for HORSES, W. C. Peters, London.
5119. PENCIL CASES, F. W. Golby.—(*A. Brauchle, Sussen.*)
5120. CHANGING FILMS, C. and W. Beck, jun., London.
5121. WHEELS, A. Feist, London.
5122. ORGANIC BROMO-COMPOUNDS, C. D. Abel.—(*Actien-Gesellschaft fur Anilin Fabrikation, of Berlin, Germany.*)
5123. IODO COMPOUNDS, C. D. Abel.—(*Actien-Gesellschaft für Anilin Fabrikation, Berlin, Germany.*)
5124. AXLE-BOXES, A. Katona, P. Varga, and J. Krompecher, London.
5125. PRESSURE-INDICATING APPARATUS, H. G. Prested, London.
5126. PRODUCING DESIGNS on CARDS, J. Y. Johnson.—(*La Société des Dessins Industriels, Paris, France.*)
5127. ROLLER BEARINGS, H. L. G. M. Zornow, M. Leipziger, and H. Löwenstein, London.
5128. VALVE GEAR for STEAM ENGINES, L. Serpollet, London.
5129. COUPLINGS for HOSE PIPES, L. de L. Wells, London.
5130. CONVERTIBLE SHIELD, T. W. Offin, jun., London.
5131. FREE WHEEL GEAR for CYCLES, J. A. Holyoake, London.
5132. OVENS, C. Teschske, London.
5133. COMBINED SHIELD CART, W. C. Cowie, London.
5134. TYPEWRITING MACHINES, R. Robertson, Wishaw, N.B.
5135. MERCURIAL THERMOMETER ALARMS, A. Morley, London.
5136. INTERCOMMUNICATION TELEPHONE SYSTEMS, M. Byng and F. G. Bell, London.
5137. INCANDESCENT ELECTRIC LAMPS, W. C. Gale, London.
5138. LOOMS, The Radax Pneumatic Tire Company, Limited, and W. Caldwell, London.
5139. SPEED-CHANGING GEAR, G. Iden, London.
5140. SAFETY ATTACHMENTS for PURSES, A. Müller, London.
5141. GUIDING the SHUTTLE in LOOMS, P. Schmidt, London.
5142. ASCERTAINING the SECTION of BEAMS, W. Dohm, London.

19th March, 1900.

5143. DRIVING GEAR for BICYCLES, J. J. B. Arter, Birmingham.
5144. CLOSET-SEAT BRACKET, G. Sharpe and A. L. Haas, London.
5145. BRACKETS for SHELVES, H. Martin, Stoke-on-Trent.
5146. FITTINGS for ELECTRIC LIGHTING, F. Shaw and F. Greenfield, Birmingham.
5147. WATER HEATERS, G. Rose, Glasgow.
5148. TOY, C. R. H. Pickard, Leeds.
5149. ROAD MACADAM SCARIFIER, W. Lambert, Horsmonden, Kent.
5150. "KALIFAH" PLATE POWDER, D. Roose-Jones, Birmingham.
5151. READILY RECORDING GAMES, W. Bradford and J. Hallam, Leicester.
5152. UNIVERSAL VALVE JOINT, A. Trueman, Birmingham.
5153. PREVENTING the STINKING of BARRELS, A. J. Barratt and F. H. Westwood, Birmingham.
5154. ELECTRIC TRACTION, S. G. Bennett, Wolverhampton.
5155. HERRING FISHING BOATS, J. A. Duthie, Dundee.
5156. CANDLESTICKS, J. R. Dix, Corris, Merionethshire.
5157. DRIVING MECHANISM for CYCLES, J. Shellabarger, Kingston-on-Thames.
5158. IMPLEMENT for GATHERING FRUIT, M. J. Cross, Kingston-on-Thames.
5159. REAPING MACHINES, L. Sansarlat, London.
5160. INHALATION APPARATUS, C. Renault, London.
5161. COLLAPSIBLE TRIPODS, C. de Redon, London.
5162. COMPENSATING GOVERNORS, P. E. and F. Dazey and A. Gregoire, London.
5163. ATTACHMENT for FASTENING BANDAGES, T. Monks, Egremont, Cheshire.
5164. COMBINED MEASURING and DRINKING GLASS, T. H. Purves, Edinburgh.
5165. PUMP for SPRAYING MACHINE, S. H. Pillar, Dublin.
5166. HAND CRAMP, G. Wilkes, Southampton.
5167. ALTERNATING CURRENT ELECTRO-MOTORS, J. and W. Yates and J. B. Bent, Manchester.
5168. SMOKE-PREVENTING ARRANGEMENT, G. Gregory, London.
5169. LAYING BRICKS for BUILDING, J. H. Knight, Farnham, Surrey.
5170. HAND and FOREARM EXERCISER, L. J. Phelan, London.
5171. MANUFACTURE of METALLIC SALTS, J. B. de Alzugaray, London.
5172. OBTAINING OXIDES from ORES, J. B. de Alzugaray, London.
5173. DRY PROCESS of COPYING DOCUMENTS, B. Wechsler. —(*M. Levi and Dr. Bendix, Germany.*)
5174. HANDLE-BARS of CYCLES, W. H. Rose, London
5175. PNEUMATIC TUBES, C. M. Johnson, London.
5176. JOINING METAL SURFACES, C. A. Day.—(*J. G. White, United States.*)
5177. METAL JOINT, C. A. Day.—(*J. G. White, United States.*)
5178. CONNECTING CABLES, C. A. Day.—(*J. G. White, United States.*)
5179. TOOL, &c., C. A. Day.—(*J. G. White, United States.*)
5180. PENS, W. A. Israel, London.
5181. DOOR-CLOSING MECHANISM, &c., H. Ward, London.
5182. TIRE, T. Burrell, London.
5183. LOCKS, H. E. Newton.—(*H. G. Carleton, United States.*)
5184. TRAMWAYS, F. B. Aspinall and A. J. Ireland, London.
5185. TOBACCO PIPE, A. Wyllie, London.
5186. CONTROLLING FLOW of FLUIDS, T. S. Martin, London.

5187. TELEPHONE-CALL RECORDER, A. E. Lamkin, London.
5188. TOBACCO PIPE, C. Clement and J. Collomb, London.
5189. TOBACCO PIPE, C. Clement and J. Collomb, London.
5190. CUTTING MACHINES, A. McDonald and E. E. Turner, London.
5191. ELECTRIC CAR HEATING SYSTEMS, The Westinghouse Brake Company, Limited.—(*F. C. Newall, United States.*)
5192. HINGES for DOORS and GATES, J. H. Pentland, Liverpool.
5193. WOOD-IMPREGNATING APPARATUS, G. F. Lebioda, Liverpool.
5194. HEATING APPARATUS, J. McHardy and J. H. Reeves, London.
5195. LIFE-SAVING DEVICE, W. de Lombardo and K. Pelizon, London.
5196. ELECTRIC TELEGRAPHY, C. Adam-Randall, London.
5197. TEMPORARY BINDERS, A. J. Boult.—(*Jones Perpetual Ledger Company, United States.*)
5198. TURBINES, H. T. Ashton, London.
5199. CYCLE, H. Glade, London.
5200. PREVENTING RAILWAY ACCIDENTS, E. Lawrence, London.
5201. SECURING HUBS of WHEELS, H. P. Childress, London.
5202. DEVICES for HOLDING SHEEP, W. M. Ashton, London.
5203. AIR BRAKE, S. Lakerda and L. Nikolajeff, London.
5204. TOWING SYSTEMS for CANALS, &c., P. M. Justice.—(*Columbia and Electric Vehicle Company, United States.*)
5205. TURNING ON GAS, H. Burtles and O. V. Siguardsson, London.
5206. LOCKING DEVICE, H. C. Walker and C. W. Hildred, London.
5207. CLUTCH GEAR, E. R. Salwey and the Salwey Free Wheel Gear Company, Ltd., London.
5208. GAUGES, R. G. Brooke, London.
5209. FIXING BASINS of WATER-CLOSETS, N. E. Cooke, London.
5210. LUBRICATING AXLES and SHAFTS, F. Sürth, London.
5211. CYCLES, E. J. Hitchcox, London.
5212. LIFE BELTS, E. O. Spetmann, London.
5213. STUDS, T. G. Hull, London.
5214. TAP for MEASURING LIQUIDS, H. S. Watkins, London.
5215. CIGARS and CIGARETTES, J. H. McLean, Wolverhampton.
5216. INCANDESCENT LAMPS, A. J. Boult.—(*A. Blondel, France.*)
5217. WAR SHIELDS, M. M. Smith and A. P. Koe, London.
5218. BREECH-LOADING SMALL ARMS, T. R. R. Ashton, London.
5219. TOOLS for FACING VALVE SEATS, T. L. Evans, London.
5220. GAITERS or COVERINGS for the LEGS, T. W. Hill, London.
5221. DISTRIBUTING ELECTRIC CURRENTS, G. Davis, London.
5222. ENGINES, J. M. Evans, London.
5223. SMALL FIRE ARMS, G. Roth and C. Kruka, London.
5224. PRODUCTION of WIRE GAUZE, F. Ulrich, London.
5225. LETTER WINDOW BLIND, J. Hart and G. Romp, London.

20*th March*, 1900.

5226. COUPLING CARS, J. Kordin and E. von Noury, London.
5227. COOLING OILS, W. Fraser and J. Bryson, Glasgow.
5228. STERILISING RECEPTACLE, I. L. Roberts and F. S. Duncan, Glasgow.
5229. BORAX and like COMPOUNDS, T. L. G. Bell, London.
5230. CUTTING SLOTS or GROOVES, R. J. Lines, Northampton.
5231. ATMOSPHERIC OIL BURNER, &c., C. Scouller, Glasgow.
5232. BATTERIES, P. Kennedy, London.
5233. SEATS, N. K. MacKenzie, Dundee.
5234. BACK-PEDALLING CYCLE BRAKE, J. Allen, Leicester.
5235. SLICING ORANGES, W. A. Craig and J. Robbie, Dundee.
5236. DEVICE for CLEANING KNIVES, H. Barraclough, Liverpool.
5237. SCUTCHING FLAX, T. F. Mackie and G. Shaw, Belfast.
5238. LOOM SHUTTLE EASING DEVICES, H. Rycroft, Bradford.
5239. HAND CIGARETTE-MAKING MACHINE, B. Fisch, Glasgow.
5240. EDUCATIONAL BLACKBOARDS, D. W. Steele, Liverpool.
5241. CATALOGUES, H. R. Richards, Birmingham.
5242. CARBORUNDUM ARTICLES, W. B. Johnson.—(*F. A. J. Fitzgerald, United States.*)
5243. "CHRISTMAS CARD ALBUM" LEAF, J. Goulden, Blackpool.
5244. CYCLE and WALKING SHOE, W. J. C. Carter, Birmingham.
5245. CASTORS, G. Mason, Birmingham.
5246. LAWN MOWERS, W. Lumley and E. H. Letts, Stockton-on-Tees.
5247. CYLINDERS for MOTORS, N. Vincke, London.
5248. FURNACES, E. Tharaud, London.
5249. GAS and LIQUID BURNERS, J. Sala, London.
5250. DRIVING GEAR for CYCLES, W. King, Glasgow.
5251. CONSTRUCTING GLASS LETTERS for SIGNS, J. Price, Birmingham.
5252. REGULATING ELECTRIC MOTORS, L. Higginbottom, J. H. Hindle, and T. Mannock, Manchester.
5253. APPARATUS for DISINFECTING DRAINS, J. E. Lewis, Manchester.
5254. BODY SUPPORT for CYCLE SADDLES, E. Wever, Glasgow.
5255. CUTTING CHENILE, J. J. Buckley and R. Whitehead, Manchester.
5256. SAFETY MATCH, F. G. Lynde, Sevenoaks.
5257. WINDING BOBBINS, W. G. Heys.—(*J. Scott, R. Varley, and J. C. Anderson, United States.*)
5258. The MACDONALD REVOLVING GUN, J. S. Macdonald, Aberdeen.
5259. BOX TOES for BOOTS, G. L. Preble, London.
5260. BEER SYPHONS, J. House and E. W. Lancaster, London.
5261. STERILISING HOPS, J. House and E. W. Lancaster, London.
5262. CIGARETTES, W. Pullen, Birmingham.
5263. ROTATING COOL CABINET, G. Fido, London.
5264. WEIGHING APPARATUS, A. J. Boult.—(*The Computing Scale Company, United States.*)
5265. LOOMS, A. E. Edwards.—(*C. H. Drew, United States.*)
5266. LOOMS, A. E. Edwards.—(*C. H. Drew, United States.*)
5 67. WATER CANS, F. Remsbery and J. A. Samuels, London.
5268. SOLDERING IRONS, J. Hürlimann, London.
5269. APPARATUS for DRILLING, &c., G. F. Restall, London.
5270. MILITARY SHIELD, G. Harrison.—(*R. A. Bush, Canada.*)
5271. CIRCULAR SAWS, B. Leitmayr, London.
5272. CLAMPS for TENTERING MACHINES, C. L. Weichelt, London.
5273. MACHINE for POLISHING HIDES, E. H. Brown, London.
5274. ELECTRO-DEPOSITION of METALS, W. Y. Buck, London.
5275. PRINTING TYPE BARS, E. V. Beals and F. A. Gray, London.
5276. CORSET BELTS, B. H. Jacobsen, London.
5277. MANUFACTURE of BOOTS and SHOES, L. Lajanthe London.
5278. STRAPS for BOOTS, H. H. Lake.—(*The Shawmut Machinery Company, United States.*)
5279. BALL-COCKS, H. H. Lake.—(*J. W. Dickinson, United States.*)
5280. CRANKS for SHAFTING, C. L. Kindsfatter, London.
5281. STEAM POWER INSTALLATIONS, F. Sargent, London.
5282. FIRE ENGINES, A. Kernreuter, London.
5283. SAND BOXES, E. F. de Witt, London.
5284. DEEP-WELL PUMPS, S. H. Hauslich, London.
5285. GIRDERS for CONSTRUCTING BRIDGES, H. B. James, London.
5286. MATTRESS FILLER, N. L. Johnson, London.
5287. TOYS, J. G. Dauber, E. L. Ruth, and O. K. Fisher, London.
5288. COVERS for CLOSET SEATS, D. Grant and A. Macpherson, London.
5289. STEAM STEERING ENGINES, W. Pepper, London.
5290. A NEW SCREW-DRIVING APPARATUS, F. Gude, London.
5291. MACHINES for MEASURING, E. L. Giles, London.
5292. PROJECTION APPARATUS, J. J. Frawley, London.
5293. LEAD PRESSES, W. P. Thompson.—(*Accumulatoren und Electricitäts Werke Act.-Ges. vorm. W. A. Boese and Co., Germany.*)
5294. ELECTRIC BELLS, W. R. Wynne, London.
5295. VAPOUR BATH APPARATUS, A. Pfister-Schmidhauser, London.
5296. SHIRTS or SHIRT FRONTS, R. Ripley, Liverpool.
5297. PIPES, G. H. F. E. M. Drenckhahn and C. H. A. C. Sudhop, Liverpool.
5298. RECEPTACLES for MANURE, A. J. S. Morris, London.
5299. IRONING APPARATUS, A. J. Boult.—(*Müller and Hager, Germany.*)
5300. INTERNAL COMBUSTION MOTORS, A. Misch, London.
5301. APPARATUS for MEASURING DISTANCE, F. H. Zaiser, London.
5302. CIGAR and CIGARETTE HOLDERS, H. Bliksläger, London.
5303. LATHE CENTRES, J. and P. Körner, and E. Mahla, London.
5304. APPARATUS for ROASTING, E. G. Martin, London.
5305. EXPLOSION ENGINE, O. Pollak, and A. Spitz, London.
5306. ATTACHING SPRING SIDES to BOOTS, R. Fendler, London.
5307. PHOTOGRAPHIC APPARATUS, E. A. Hardy, London.
5308. INDICATING WATER LEVEL in BOILERS, P. N. Grammelgaard, London.
5309. RAKE for UPROOTING DAISIES, J. H. Beach, London.
5310. MAKING CIGARS, W. Tice, London.
5311. INVALID LIFTERS and BATHS, C. B. Ulrich, London.
5312. TIRES, E. R. Steinhardt, London.
5313. TIRES, E. R. Steinhardt, London.
5314. PREVENTING LOCKS from BEING MOVED, F. J. J. Gibbons, London.
5315. CLOTHES HORSES, T. J. Jones, London.
5316. FOLDING LADDERS, S. J. Mercer, London.
5317. COMBINED GAS BLAST FURNACES, J. K. Stewart, London.
5318. CUTTING BOILER TUBES, J. Mackenzie, London.
5319. FURNACE for MAKING CALCIUM CARBIDE, G. W. Emmerson, and J. Ward, London.
5320. DOUCHES and INJECTIONS, J. R. Buff-Stünzi, London.
5321. PLATES for STORAGE BATTERIES, H. J. Haddan.—(*C. A. Lindstrom, J. and T. Hewitt, United States.*)
5322. CALCULATING MACHINES, J. Mallmann, London.
5323. MACHINES for PACKING SOAP POWDERS, P. Ney, London.
5324. OPENING HERMETICALLY-CLOSED TINS, G. Farquhar and R. North, London.
5325. HOLDING BLOCKS for STEREOTYPE PLATES, J. H. Simpson and E. H. Walker, London.

21*st March*, 1900.

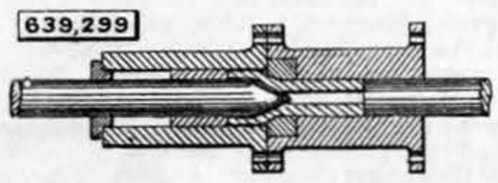
5326. SALOON SLIDING SPITTOON, W. O. Brown, London.
5327. DISTRIBUTION of CURRENT for ELECTRIC TRACTION, G. Davis, London.
5328. CUFF ADJUSTER, W. H. Entwisle, Manchester.
5329. CONDENSING APPARATUS, E. Armstrong, Portsmouth.
5330. RECLAIMING MACHINES, J. T. Wicks, Birmingham.
5331. "SELF-FASTENING" SASH FASTENER, G. A. Pexton, Birmingham.
5332. WINDOW WEDGES, B. Parker and Co., Limited, Birmingham.
5333. CYCLE SADDLE SECURING ATTACHMENTS, J. B. Brooks and J. Holt, Birmingham.
5334. STENCH TRAPS, J. Bruce, Glasgow.
5335. SUSTAINING FLOATING BODIES at SEA, H. W. Ibettson, Sheffield.
5336. CURTAIN BANDS, B. Parker, and Co., Limited Birmingham.
5337. TRAMCAR SEATS, W. Mannox, Halifax.
5338. PICTURE SUSPENDERS, B. Parker and Co., Limited, Birmingham.
5339. COLLAPSIBLE BAG, R. Philpot, Dublin.
5340. PORTABLE DRILLING MACHINE, W. H. Clegg, Burnley.
5341. METAL TOP for DRINKING CUPS, Gardner and Son, Edinburgh.
5342. TRAVELLING MILK CAN, A. O. Evans, Pontypridd, Glam.
5343. FLUSHING TANK, A. O. Evans, Pontypridd, Glam.
5344. COIN-PREPAYMENT MECHANISM, R. Kinnedy, Glasgow.
5345. LOOM-SHEDDING MECHANISM, J. Park, Keighley.
5346. WASHING MACHINES, W. H. Murton, W. S. Varley, and E. Murton, Keighley.
5347. BELT DRIVING GEAR, J. White, Glasgow.
5348. PORTABLE COOKING APPARATUS, P. Hoffmann, London.
5349. BUNK TRAY for use on SHIPS, F. J. Hill, Birmingham.
5350. SOVEREIGN PURSE, C. J. Trevitt, Birmingham.
5351. STRAW HATS, W. Kronheim, Dresden.
5352. RAILWAY SLEEPERS, W. M. and E. G. Hodson, London.
5353. ELECTRIC TRACTION, E. H. Tyler, London.
5354. STEERING or MANŒUVRING SHIPS, W. M. Walters, Liverpool.
5355. MECHANICAL FOG SIGNAL, P. J. Fauchon, Hildenborough, Kent.
5356. ELECTRIC CABLES, R. K. Gray, London.
5357. CARBURETTERS, E. Lisle and G. F. Prew, London.
5358. LOCKS, A. B. Godrej, Manchester.
5359. BALL RACE for PRESSURE SPINDLES, F. O. Kolbe, Birmingham.
5360. ANIMAL TRAPS, A. Lindemann, Berlin.
5361. LAMP CAPS, E. G. Sheppard and Nernst Electric Light, Limited, London.
5362. SPOONS, F. W. Kowalski, London.
5363. MINCING MACHINES, T. Williams, London.
5364. LOCKING BOTTLES, L. Shilton, London.
5365. LAMP EXTINGUISHER, J. Hinks and Son, Limited, and H. D. Hinks, London.
5366. INCANDESCENT BODIES for LIGHTING, O. Knöfler, London.
5367. TREATING FIBROUS MATERIALS, A. Masson and R. Scott, London.
5368. FILTERING WATER, F. T. Bond, Gloucester.
5369. TAKING UP SLACK in BRAKE APPARATUS, J. E. Anger and J. J. Nef, Liverpool.
5370. FUEL BRIQUETTES or FIRE-LIGHTERS, J. P. Dalby, Liverpool.
5371. APPARATUS for DIGGING POTATOES, R. Battersby, Liverpool.
5372. POROUS BALLS of CLAY, M. Bradshaw, Liverpool.
5373. ARTICULATED SYSTEM of LEVERS, P. A. Gagarin, London.
5374. INTENSIFYING and REDUCING FLUID PRESSURE, E. J. Preston and F. L. Conway, London.
5375. DECORATIONS for HATS, E. H. Spencer, Coventry.
5376. ELECTRODES for ELECTROLYTIC PURPOSES, E. Hopkinson and A. T. Smith, jun., London.
5377. SPINNING of YARNS, A. F. Spooner.—(*E. Charié and P. Sterbecq, France.*)
5378. HORSESHOES, H. H. Lake.—(*Budd Doble Tire Company, United States.*)
5379. DRIVING GEAR, A. E. Finch, London.
5380. CLOTH FINISHING APPARATUS, J. T. Lister, London.
5381. PAPER HOLDING DEVICE for TYPEWRITING MACHINES, J. Bodeman, London.
5382. STEP-BY-STEP PRINTING TELEGRAPH INSTRUMENTS, L. M. Casella, London.
5383. MANUFACTURE of CLOTHING, R. Haddan.—(*C. and O. Wyers, and O. Hiclet, France.*)
5384. DELIVERING SILVER CHANGE for GOLD, H. and F. Nehmer, London.
5385. PURE SULPHURISED DERIVATIVES of INDOPHENOLS, O. Imray.—(*The Society of Chemical Industry in Basle, Switzerland.*)
5386. CHARGING PAPER CIGARETTE TUBES with TOBACCO, O. Imray.—(*J. Aïvaz, Russia.*)
5387. WIRELESS TELEGRAPHY, G. Marconi, London.
5388. RAILWAY SIGNALS, L. Coene and V. Geraads, London.
5389. RAILWAY SIGNALS, J. Shoecraft and C. C. Gardiner, London.
5390. CYCLE-DRIVING MECHANISM, A. A. Brown, London.
5391. CYCLES, A. J. Boult.—(*J. M. M. Truffault, France.*)
5392. PRODUCING AMMONIA COMPOUNDS, W. Ostwald, London.
5393. STANDARDS for ELECTRIC TRACTION, R. P. Strachan, London.
5394. INSULATORS, &c., E. Nappert.—(*O. Schaefer, Germany.*)
5395. GUNS, J. H. Barry and R. G. Pemberton, London.
5396. ATTACHMENTS for VEHICLE WHEELS, M. R. Ward, London.

SELECTED AMERICAN PATENTS.

From the United States Patent-office Official Gazette.

639,299. APPARATUS FOR MANUFACTURING STEEL OR OTHER METAL TUBES, *T. B. Sharp and F. Billing, Birmingham, England.—Filed June 30th*, 1897.

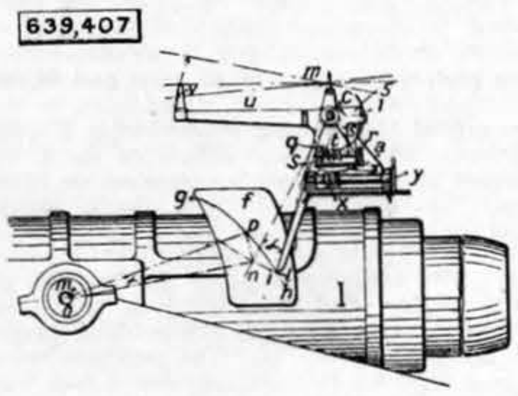
Claim.—In combination, the cylinder A adapted to contain the billet to be operated upon, the ram or pusher extending into the rear end thereof, the die



seated in a rabbet in the forward end of said cylinder, the cylinder C forming an enlarged continuation of the cylinder A and the piercer working in said enlarged cylinder C, substantially as described.

639,407. APPARATUS FOR ADJUSTING ELEVATION OF GUNS, *J. Krone, Essen, Germany.—Filed April 21st*, 1899.

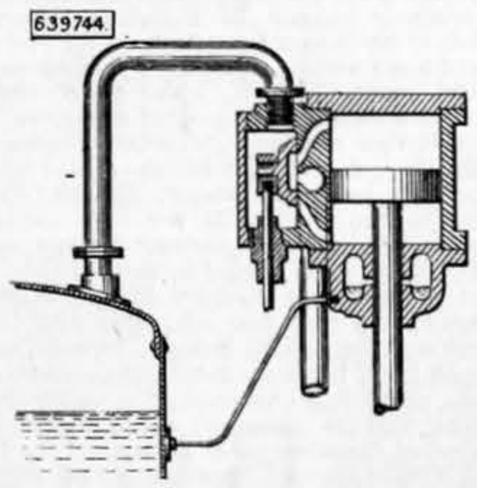
Claim.—In an apparatus for adjusting the elevation of guns; index plates *f* fixed to the gun; index curves *g h* drawn on said index plates; a standard *a* fixed to the gun support, a shaft *c* supported in bearings *b b* of the standard, and in outer fixed bearings *d d*, index hands *e e* fixed to the shaft *c* and extending over the index plates; a casing *s* pivoted to the shaft *c* between the sides of the standard, and carrying the sighting beam *u*, front sight *v*, and back sight *w*; worm wheel sector *t* and worm *q* for turning the shaft, respectively the index hands *e e* fixed thereon, in relation to the casing *s* for adjustment to the angle of elevation due to distance; scale 1 and cross-piece 2 for reading off



said angle; worm *x* mounted in the standard *a*, provided with hand wheel *y* and engaging worm wheel sector *z* on the lower side of the casing *s*, whereby the casing, sighting-beam, and index hands are turned together and the index hands adjusted for difference of level, as the sight line is turned up or down toward the target, and the guns brought to the proper elevation by turning them on their trunnions until the ends of the index hands come up to the index curves, substantially as described.

639,744. ATMOSPHERIC STEAM ENGINE, *F. M. Leavitt, New York, N.Y.—Filed January 18th*, 1899.

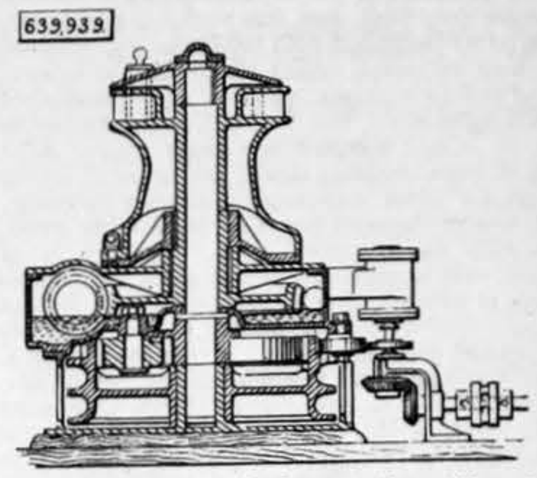
Claim.—An atmospheric steam engine having in lieu of piston-rod packing a live steam chamber surrounding the piston-rod between the piston and the outer



air, and means for keeping said chamber filled with steam at not less than atmospheric pressure, whereby leakage of air into the cylinder around the rod by reason of the exhaust vacuum is prevented.

639,939. STEERING AND WARPING GEAR, *R. Richardson, Glasgow, Scotland.—Filed November 3rd*, 1898.

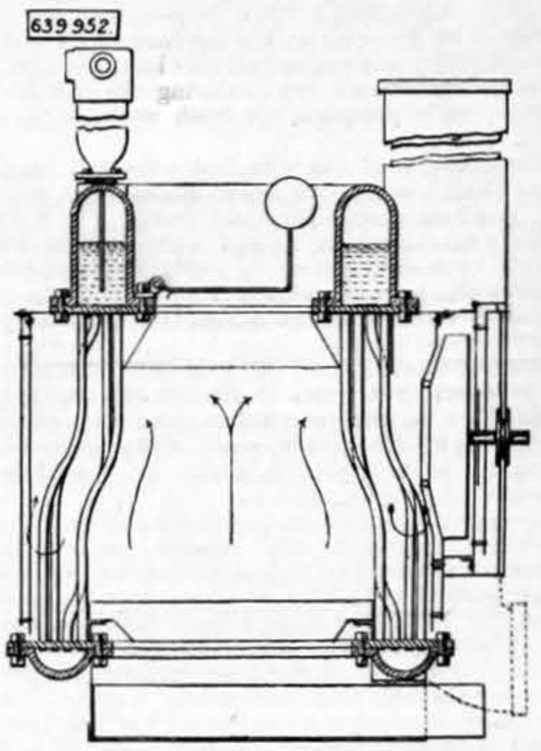
Claim.—The combined steering and warping gear comprising a drum casing, a chain drum rotatable in said casing, one of said parts being provided with teeth, toothed pinions within said casing and gearing with said mentioned teeth, a rotatable spindle provided with apinion gearing with said toothed pinions, a worm wheel rotatable on said spindle, a worm shaft for driving the worm wheel, a capstan made in parts separately connected together and having one part



connected to the worm wheel to turn therewith, and a disc connected to the spindle to turn therewith and separably connected to one part of the capstan, substantially as described.

639,952. STEAM GENERATOR, *J. E. Thornycroft, London, England.—Filed December 22nd*, 1897.

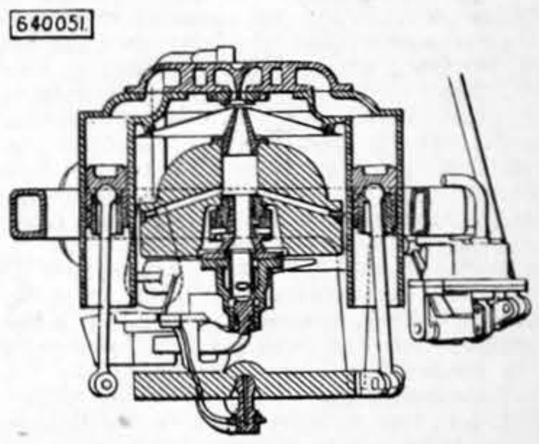
Claim.—A steam generator comprising an upper annular steam and water chamber having a removable side, a fuel opening bounded by the chamber, means for closing said opening, a lower annular



water chamber having a removable side, tubes connecting the under side of the upper chamber with the upper side of the lower chamber, said tubes being arranged close together so as to form a combustion chamber, and means for maintaining a fire in the combustion chamber, substantially as described.

640,051. APPARATUS FOR STEADYING OF GUNS ON SHIPBOARD, *B. Tower, London, England.—Filed June 26th*, 1899.

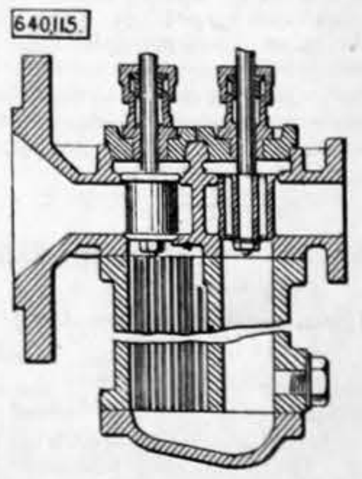
Claim.—(1) The combination with a gun mount, a gun, and a recoil cradle trunnioned on the gun mount and in which the gun can slide, of the gyroscope, the hydraulic gyroscope cylinders governed by the gyroscope, a swing frame suspended under the gyroscope and connected with the pistons of the said cylinders, the correcting cylinder, a swinging arm connected with and controlled by the piston of the correcting cylinder, and a rod connecting said swing-



ing arm with said recoil cradle, substantially as described. (2) The combination with a gun mount, a gun, a recoil cradle trunnioned on the gun mount, and a sight carrier carrying a sight-bar, of the gyroscope the hydraulic gyroscope cylinders, the swing frame the suspending links for suspending said swing frame from the gun mount, a suspended swinging rod connected with the sight carrier, a bell crank, a lever connecting one arm of the bell crank with said swinging rod, and connections between the other arm of the bell crank and one of the said swing frame suspending links, for maintaining the movement of the sight-bar in a vertical plane, substantially as described.

640,115. SUPERHEATER, *F. Dürr, Berlin, Germany.—Filed December 11th*, 1897.

Claim.—The combination with a working cylinder and the pressure pipe of an engine, of the superheater, interposed between the pressure pipe and the working cylinder, comprising a housing constructed with flanges, with a vertical partition, dividing the



upper part of the housing into two valve chambers and with a pendent heater having a vertical partition dividing the heater into two chambers, the valves located in the valve chambers, and controlling the heater chambers, and the cap to the heater, whereby communication is established between the lower ends of the heater chambers, substantially as described.