RAILWAY BRIDGE OVER THE LAN-HO, CHINA.

THE single line standard gauge railway between Kaiping and Shanhai-Kwan, north-east of Tientsin, built by the Chinese Government, crosses the Lan-ho on a bridge consisting of five through spans of 206ft. and ten deck spans of 103ft. 9in. between centre of bearings, as shown in Fig. 1. In accordance with instructions of Mr. Claude W. Kinder, Engineer-in-Chief, Tientsin, and Sir Benjamin Baker, Consulting Engineer, a competition of designs and tenders was held in autumn, 1891, in Westminster. Ten manufacturing firms, viz., five British, three French and Belgian, and two American, took part in it, and eventually the order was placed with Messrs. Andrew Handyside and Co., of Derby, Mr. Max am Ende, of Westminster, acting as their engineer.

The specification of strength, drawn up by Mr. Kinder and Sir B. Baker, contains the following paragraphs:—

Rolling load.—All of the main line bridges shall be constructed to carry a rolling load on each line of rails of two engines, followed by a train weighing $1\frac{1}{2}$ tons per foot run, as shown in I. and II.

I.

Inches.

48—84—54—54—54—120—66—78—66—96—84—54—54—54—120—66—78—66—96
10—14—14—14—14 — 10—10—10—10—10—14—14—14—14 — 10—10—10—10

Tons.

Followed by train of 1·5 tons per ft. run.

II.

Inches.

48—72—108—96—96—66—78—66—96—72—108—96—96—66—78—66—96
10—10 — 20—20—10—10—10—10—10—10 — 20—20—10—10—10—10

Tons.

Followed by train of 1·5 tons per ft. run.

Dead load.—The weight of the timber floor, permanent way, and guard rails may be taken at 400 lb. per lineal foot for each line of rails.

Wind pressure.—In calculating wind stresses, the wind must be assumed to be blowing at a slight angle to the axis of the bridge, so as to take effect on the exposed areas of both the windward and the leeward girder, except where the latter is temporarily screened by a passing train. The wind pressure with the train on the bridge shall be taken at 50 lb. per square foot. In the latter case the height of the train may be assumed to be 9ft., and the resultant wind pressure of, say, 450 lb. per lineal foot. shall be treated as a moving load.

Other stresses.— In the details of the designs regard shall be had to the stresses resulting from the sudden application of continuous brakes, or from the end action of wind, and also from the centrifugal action of the rolling load on sharp curves, should such occur on a bridge or viaduct.

Working stresses on steel.—All bridgework and trestle piers shall comply with the whole of the following conditions:—(1) The combined stresses resulting from the rolling load, dead load, and wind, shall not produce a greater tensile stress than $7\frac{1}{2}$ tons per square inch, nor more than the corresponding compressive, shearing, and bending stresses, as hereinafter set forth. (2) The combined stresses resulting from the rolling load and dead load alone, exclusive of wind, shall not produce greater tensile stresses than those tabulated below:—

TENSILE STRESSES.

For Main Girders, Cross Girders, and Rail Bearers of Plate Construction.

	Tons per sq. in.
Under 20ft. span	$4\frac{1}{2}$
20ft. and under 25ft.	$4\frac{3}{4}$
25ft. and under 30ft.	5
30ft. and under 50ft.	$5\frac{1}{4}$
50ft. and above	$5\frac{1}{2}$
For Truss or Lattice Girders.	
80ft. and under 160ft. span—	
Bottom chords	$5\frac{1}{2}$
Diagonals	$4\frac{1}{2}$ to $5\frac{1}{2}$
160ft. and under 200ft. span—	
Bottom chords	$5\frac{3}{4}$
Diagonals	$4\frac{1}{2}$ to $5\frac{3}{4}$
200ft. to 400ft.—	
Bottom chords	6 to 7
Diagonals	$4\frac{1}{2}$ to 7*
For wind bracing, all spans	for alternating stresses $5\frac{3}{8}$ $\left(\cdot 95 - \cdot 0045 \frac{l}{r}\right)$ on gross section.
For floor suspenders all spans	$2\frac{1}{2}$

Compressive stresses.—For plate girders the compressive stress shall not exceed 85 per cent. of the corresponding specified tensile stress. For truss or lattice girders the compressive stress shall, in the case of riveted members, not exceed the fraction ·95—·003— of the corresponding specified tensile stress; nor in the case of pin-connected members the fraction ·95—·0045 r, when r is the ratio of the length of the unbraced portion of a member to the least radius of gyration; nor in any case shall it exceed 85 per cent. of the said tensile stress.

* $4\frac{1}{2}$ tons near centre of girder and $5\frac{1}{2}$ to 7 tons at ends.

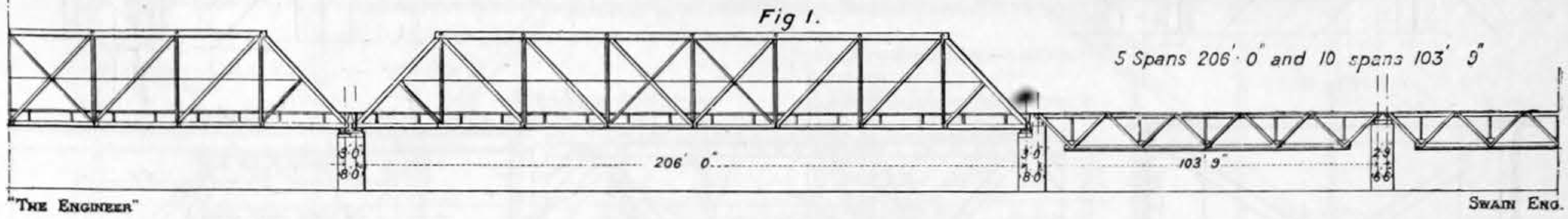
Alternating stresses. — Members subject to alternate tension and compression must have sectional areas equal to the joint areas required for the compressive and tensile stresses considered independently, except in the case of wind bracing, where the additional sectional area may be one-half the preceding.

Shearing, bearing, and bending stresses.—The shearing stress per square inch on any rivet, bolt, or pin shall not exceed two-thirds of the corresponding specified tensile stress, and on plate girder webs seven-twelfths of the same. The bearing stress, measured on the diameter of the rivet, bolt, or pin, and the bending stress on pins, shall not exceed one and a-half times the said tensile stress. Where a bending stress occurs on a member of a bridge subjected to a direct tensile or compressive stress, the sectional area shall be proportioned to the sum of the stresses. No part of the web-plate of a girder shall be included in the estimated sectional areas of the flanges.

Rollers and bed-plates.—The pressure on rollers shall not exceed half a ton per lineal inch on 2in. diameter rollers, three-quarters of a ton on 3in., and one ton on 4in. and above. Bed-plates and rockers shall be of sufficient area and strength to distribute the load over the masonry without exceeding a pressure of 16 tons per square foot.

In the case of the Lan-ho Bridge, sketches showing the system of triangulation of the main girders, the system of the floor, &c., were given, and it was further specified that the five through spans should be pin-connected, and the ten deck spans riveted bridges.

Fig 1.



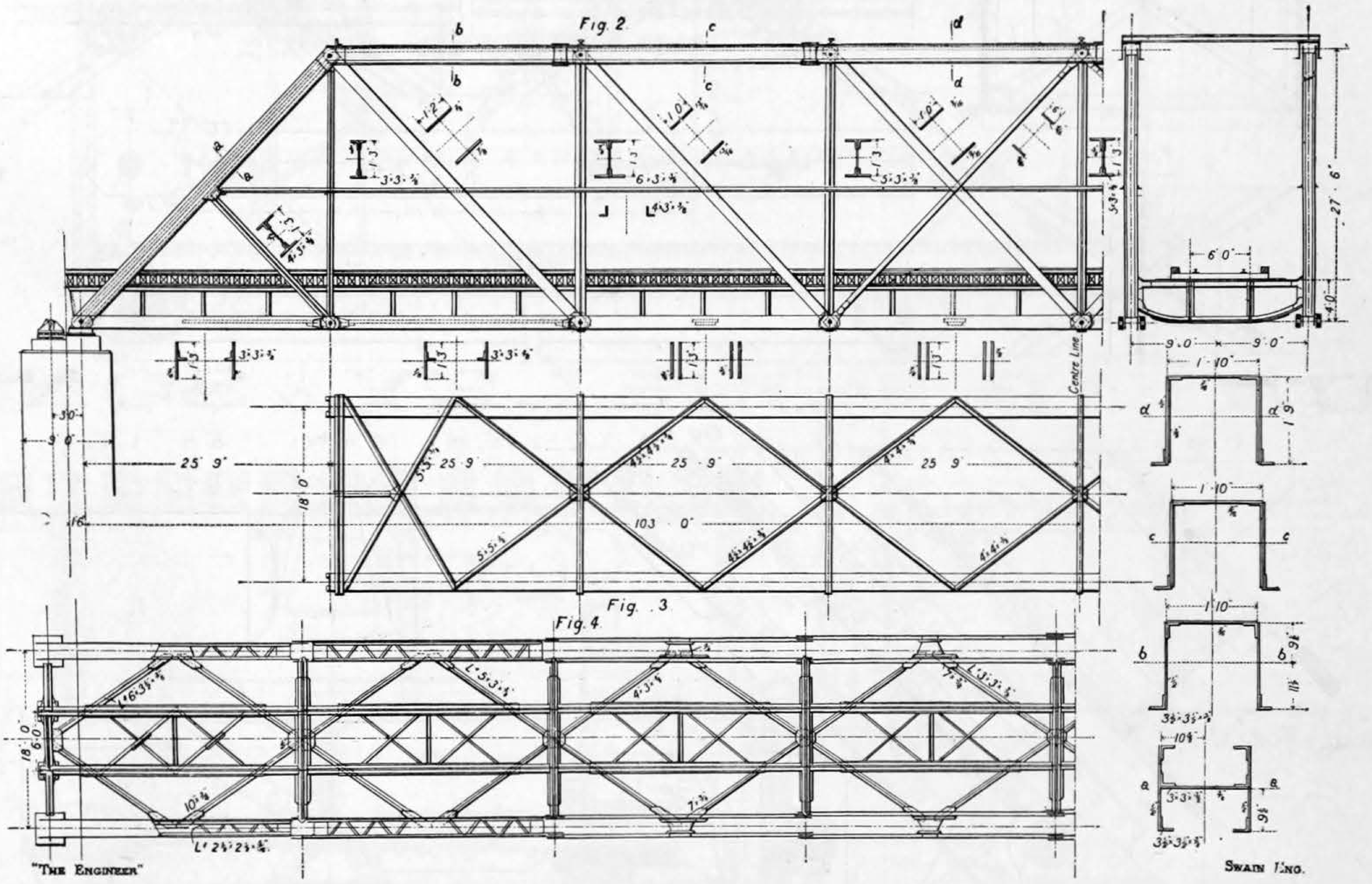
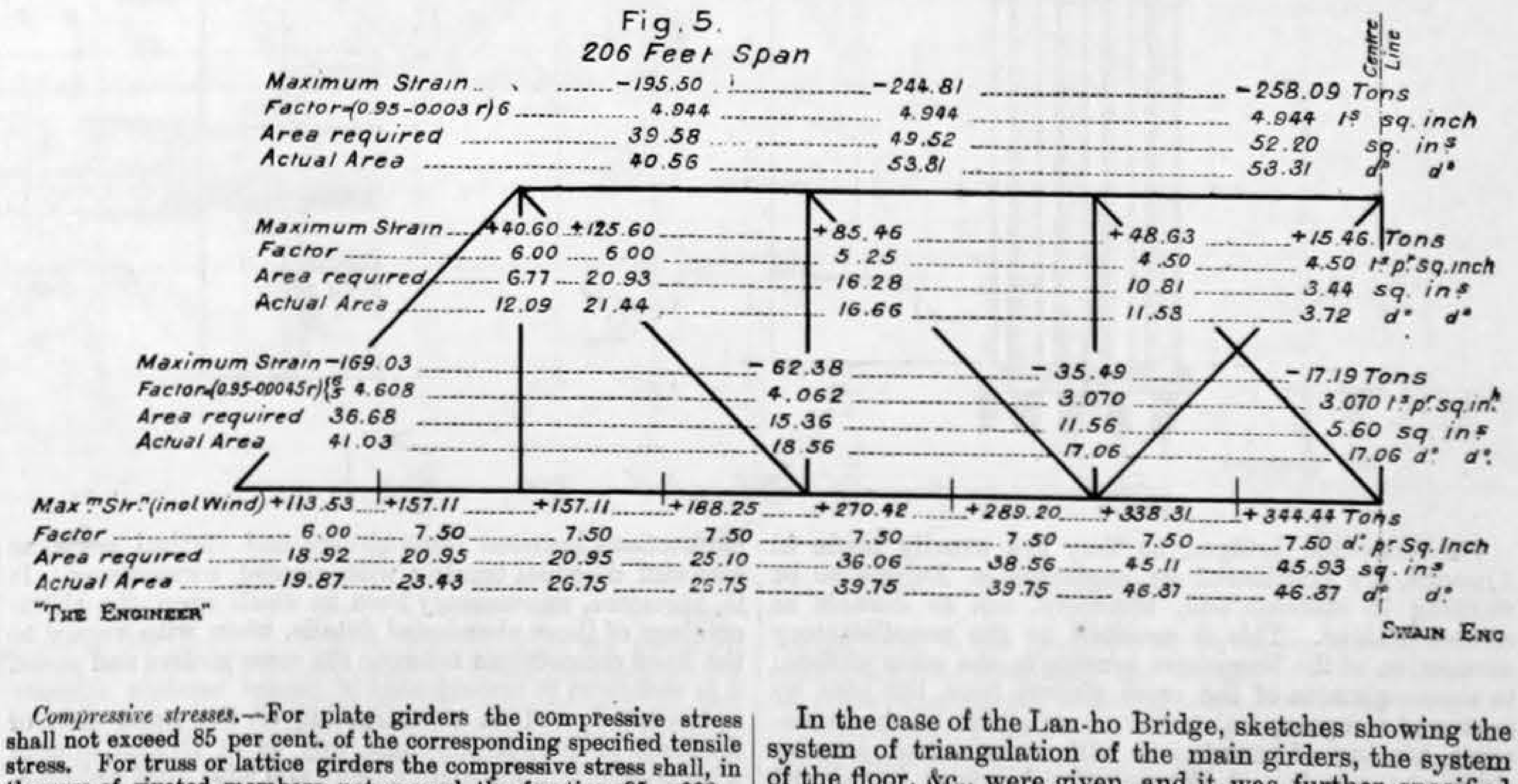
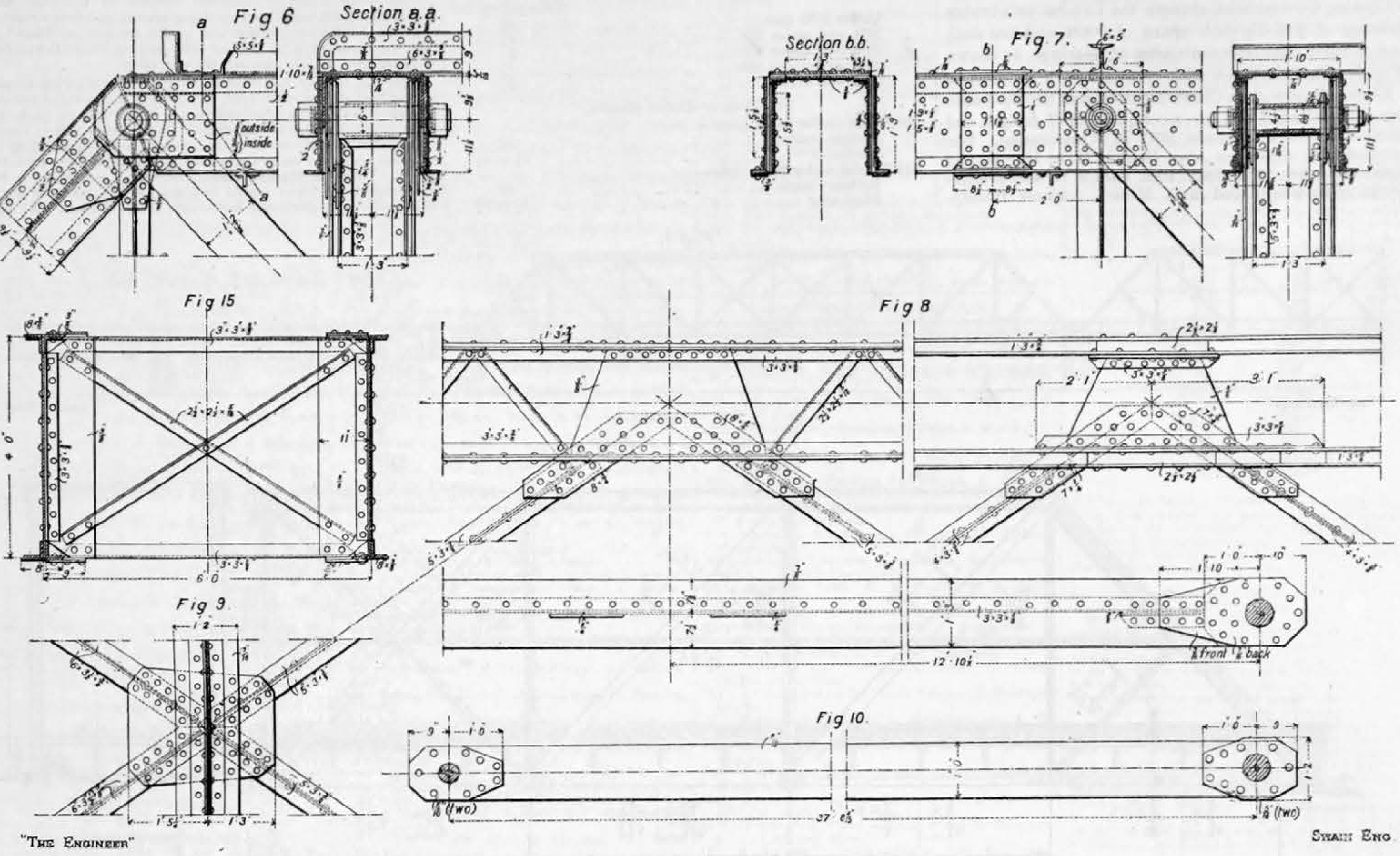


Fig. 5.
206 Feet Span

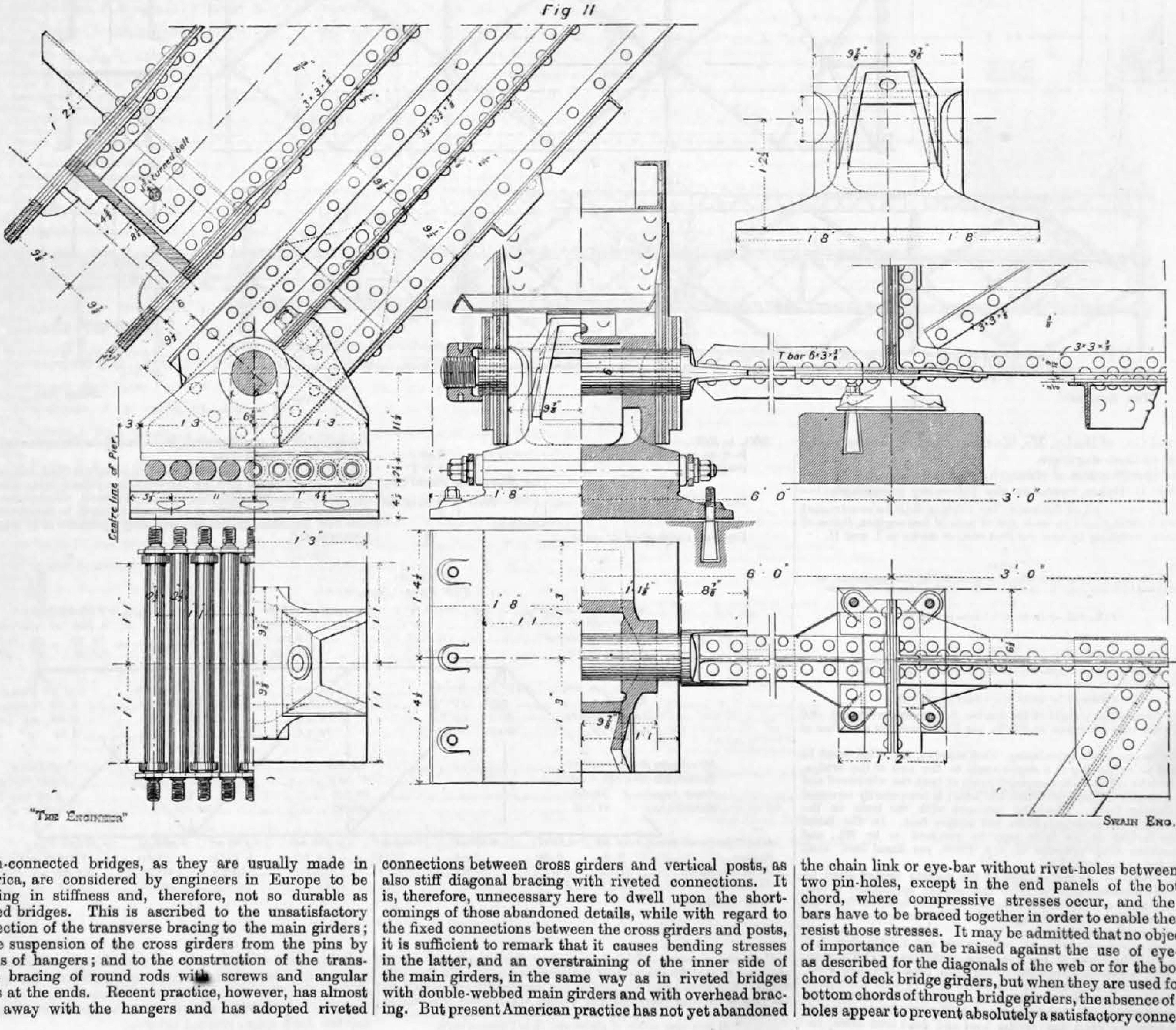


IMPERIAL CHINESE RAILWAYS—BRIDGE OVER THE LAN-HO

DESIGNED BY MR. MAX AM ENDE, M. INST. C.E.; MESSRS. A. HANDYSIDE AND CO., DERBY, CONSTRUCTORS



"THE ENGINEER" SWAIN ENG.



"THE ENGINEER" SWAIN ENG.

Pin-connected bridges, as they are usually made in America, are considered by engineers in Europe to be wanting in stiffness and, therefore, not so durable as riveted bridges. This is ascribed to the unsatisfactory connection of the transverse bracing to the main girders; to the suspension of the cross girders from the pins by means of hangers; and to the construction of the transverse bracing of round rods with screws and angular cleats at the ends. Recent practice, however, has almost done away with the hangers and has adopted riveted connections between cross girders and vertical posts, as also stiff diagonal bracing with riveted connections. It is, therefore, unnecessary here to dwell upon the shortcomings of those abandoned details, while with regard to the fixed connections between the cross girders and posts, it is sufficient to remark that it causes bending stresses in the latter, and an overstraining of the inner side of the main girders, in the same way as in riveted bridges with double-webbed main girders and with overhead bracing. But present American practice has not yet abandoned the chain link or eye-bar without rivet-holes between the two pin-holes, except in the end panels of the bottom chord, where compressive stresses occur, and the eye-bars have to be braced together in order to enable them to resist those stresses. It may be admitted that no objection of importance can be raised against the use of eye-bars as described for the diagonals of the web or for the bottom chord of deck bridge girders, but when they are used for the bottom chords of through bridge girders, the absence of rivet holes appear to prevent absolutely a satisfactory connection

IMPERIAL CHINESE RAILWAYS—BRIDGE OVER THE LAN-HO

MR. CLAUDE W. KINDER, M. INST. C.E., ENGINEER-IN-CHIEF; SIR BENJAMIN BAKER, M. INST. C.E., F.R.S., CONSULTING ENGINEER

Fig 12.

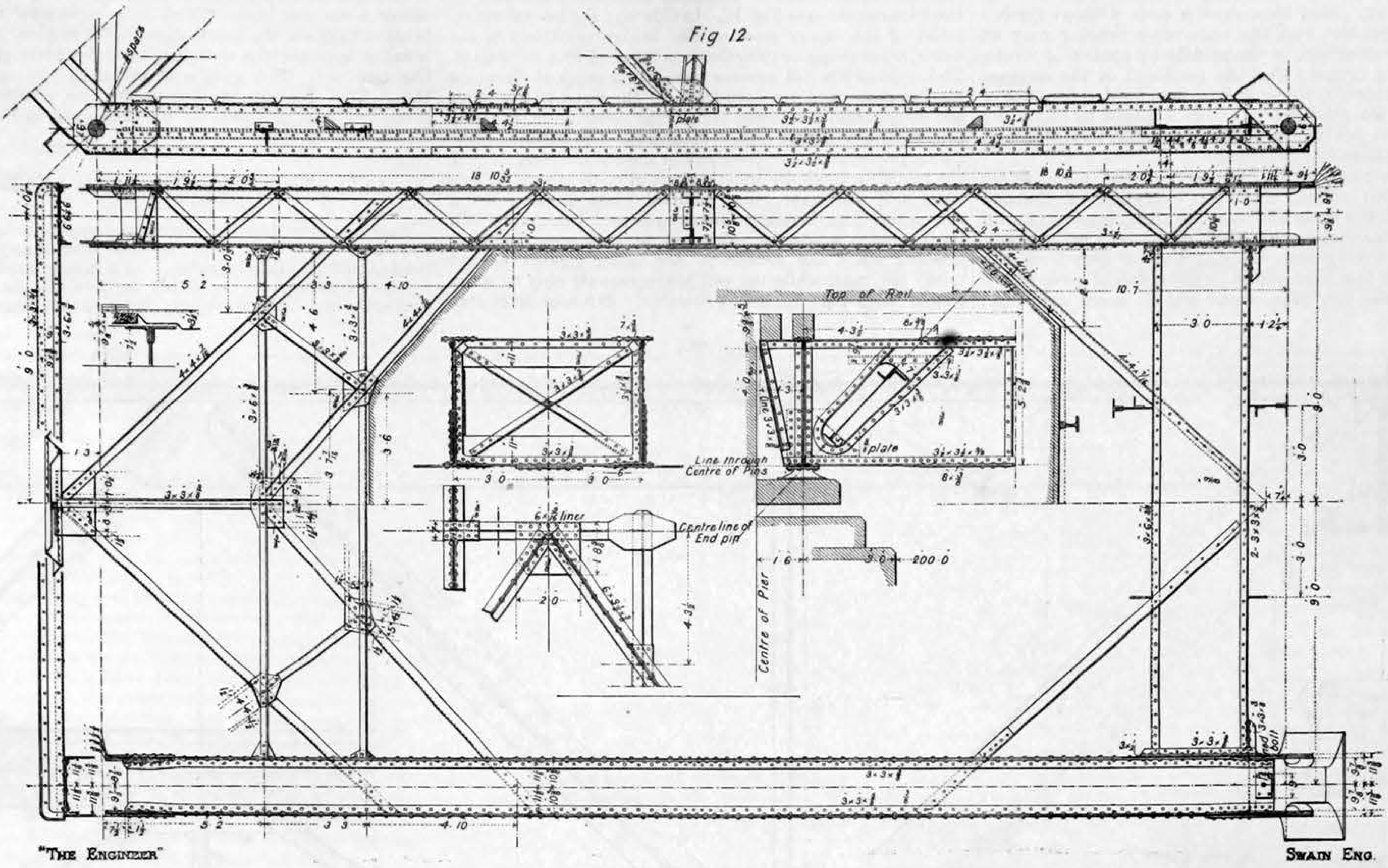


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Fig. 14.

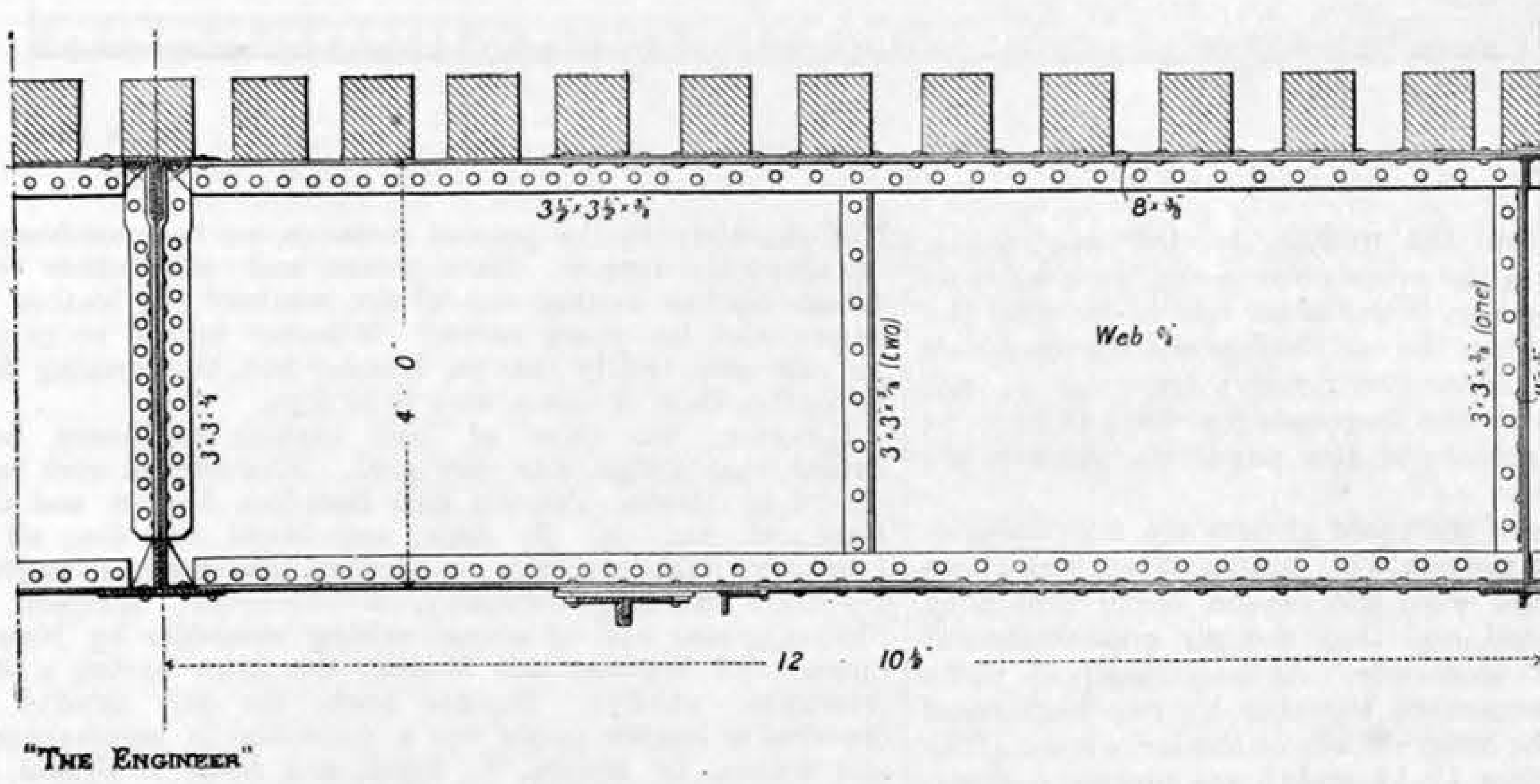

Fig. 15.

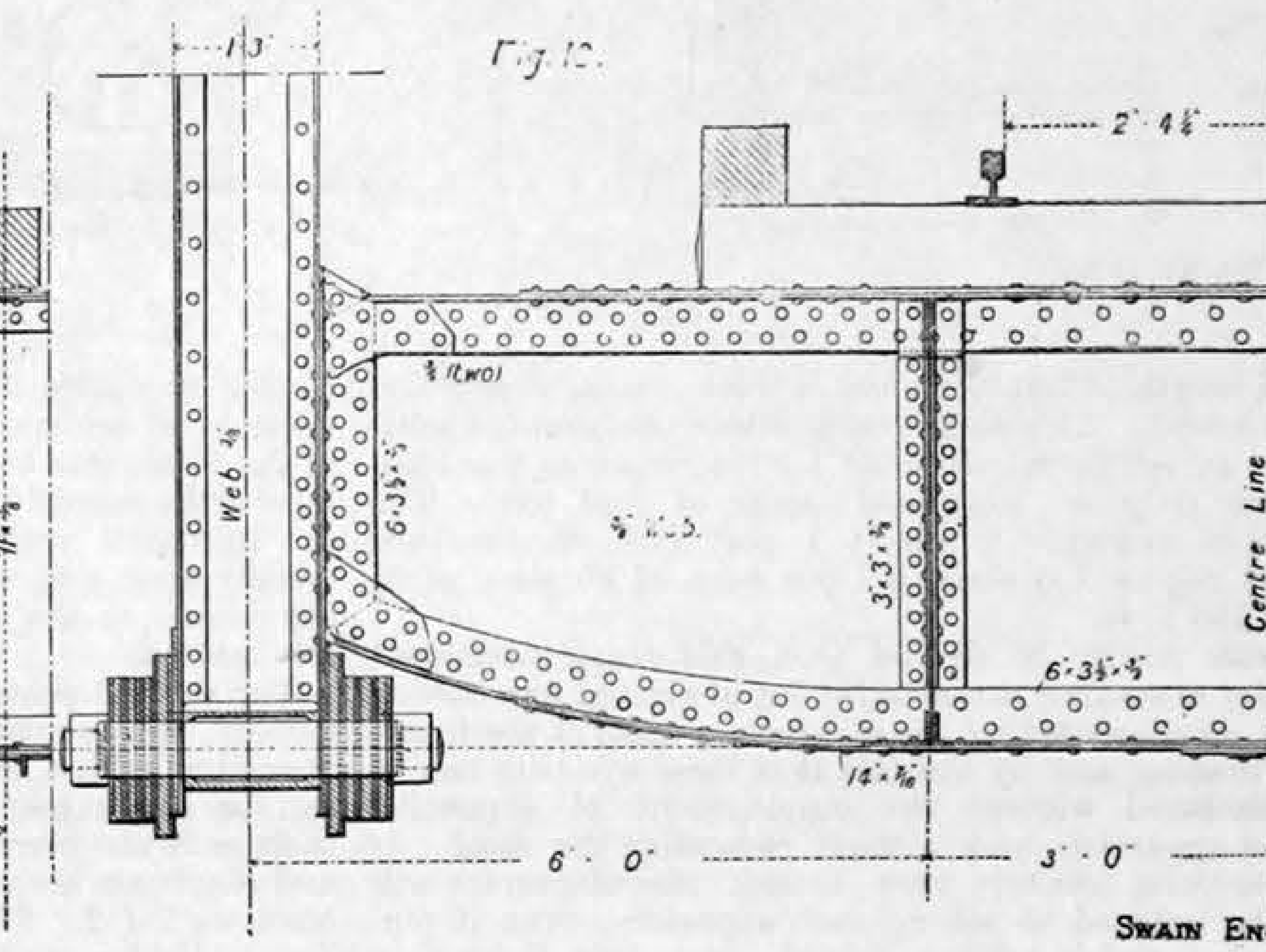

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Fig 16

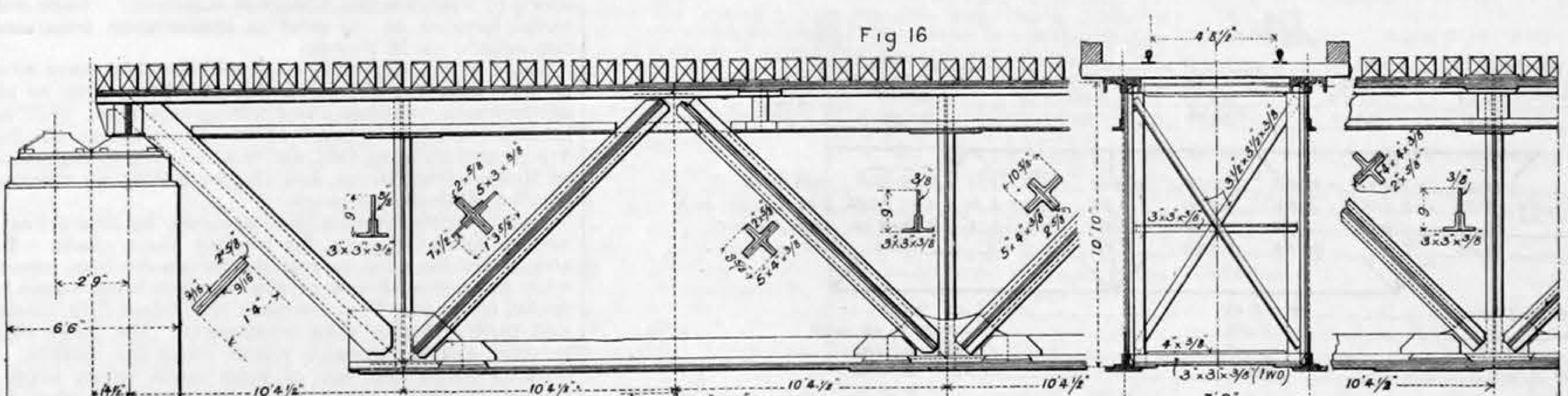
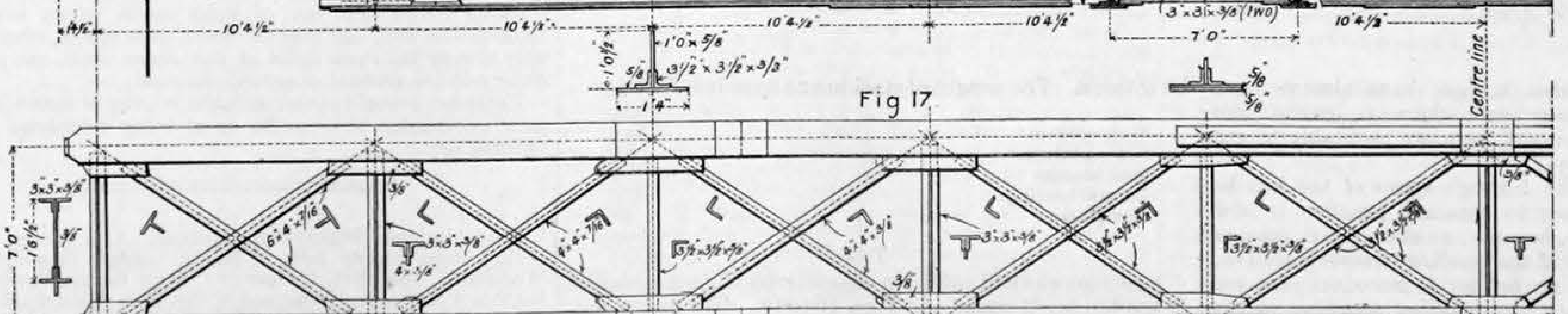
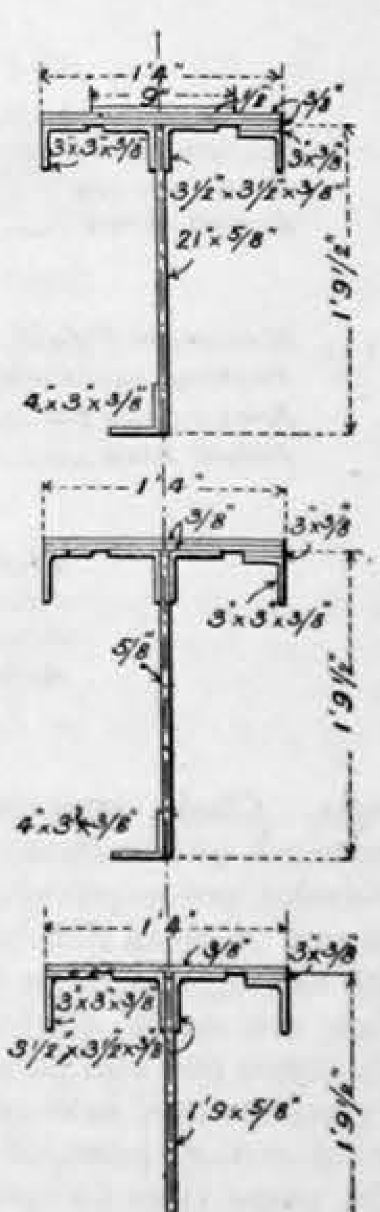


Fig 17





"THE ENGINEER" SWAIN ENG.

between them and the transverse bracing. If the latter is attached to the pins, the apparently insuperable difficulty arises of directing the resultant of the stresses in the diagonals into the centre of gravity of the section of the chord. On the other hand, if the transverse bracing is attached to the posts above or below the heads of the eye-bars, the posts are bent in transmitting the resultant stress to the chord, even if special flanges are added in the plane of the transverse bracing, which, moreover, are objectionable on account of the distribution of the horizontal stress between the flange and the chord being rendered uncertain. In actual practice, therefore, the flange is omitted and the transverse bracing is in the state of a girder without flanges, at least without flanges lying in the plane of the web, an unsatisfactory state to anyone admitting the tantamount importance of the transverse bracing to that of other parts of the bridge in the question of durability. Now, the details of the Lan-ho Bridge show how this may simply be obviated by the substitution of an eye-bar *with* rivet holes for the usual one without them, see Fig. 8. The loss of sectional area is not great.

The eye-bar is made of an ordinary flat bar, 15in. wide for pin-holes of 6in. diameter, the ends are strengthened by plates riveted on each side; the two rivet-holes of ⅞in. diameter, by which the bar is weakened to the extent of 13·2 per cent. on the remaining sectional area, may be repeated at any point between the ends without further weakening the bar, and the transverse bracing may be attached, for example, in the middle by means of rivets, and in such a manner that the resultant of the stresses acts in the centre of the section of the chord. In place of one of the two rivet holes, a slot is made to allow the bracing-bar to pass through, see Fig. 8, but this, although best, is not absolutely necessary.

The above surplus of 13·2 per cent. of metal refers to the bottom chord, with the exception of the end panels and to the main diagonals, in all to 36 tons in a total of 156 tons for each span. This percentage is, however, reduced by taking into account the stresses from the weight of the bars themselves. The width of an ordinary eye-bar on the 6in. pins would not be more than 8in., with a length of 25ft. 9in., and is often ess in proportion to the length. This corresponds within the limit of elasticity to an additional stress of 1·1 ton, whereas the 15in. bar has only an additional stress of 0·59 ton. The difference amounts to about 7 per cent., so that the surplus required is about 6·2 per cent. of 36 tons, or 2¼ ton in 156 tons,

It can hardly be denied that this small additional quantity attending the substitution of riveted eye-bars is amply compensated by the satisfactory state of the transverse bracing, and by the fact that these eye-bars can be manufactured without the employment of expensive forging apparatus, and without re-heating the steel. It is, therefore, unlikely that British manufacturers will ever be induced to set up such apparatus, even if pin-connected girder bridges should come into fashion in Europe. Chain suspension bridges have almost been abandoned, and in those rare cases where eye-bars without rivet-holes are required, it will be more profitable to cut them out of plain flat bars.

The raking struts in the through spans of the Lan-ho Bridge are made, contrary to common practice, to turn freely upon the end pins, because, as one of the reasons why pins are used is to avoid the bending stresses from fixed connections, it appeared inexpedient to introduce pins and at the same time to retain the bending stresses, except in the horizontal part of the top chord, see Figs. 6 and 7.

The diagonals of the lateral bracing are constructed so as to be capable of resisting thrust, and, as already mentioned, are made to act in the central axis of the chord —see Figs. 8 and 9. The shearing stress is finally brought to the end pin in the direction of its axis by means of a transverse strut, as shown in Fig. 11. The head of the pin transfers the stress to the cast steel bed-plate, to which also the shearing stress from the overhead bracing, see Fig. 3, is conducted through the raking strut by the 1¾in. turned bolt, see Figs. 11 and 12, while the flange stress is brought to the bed-plate through the large pin.

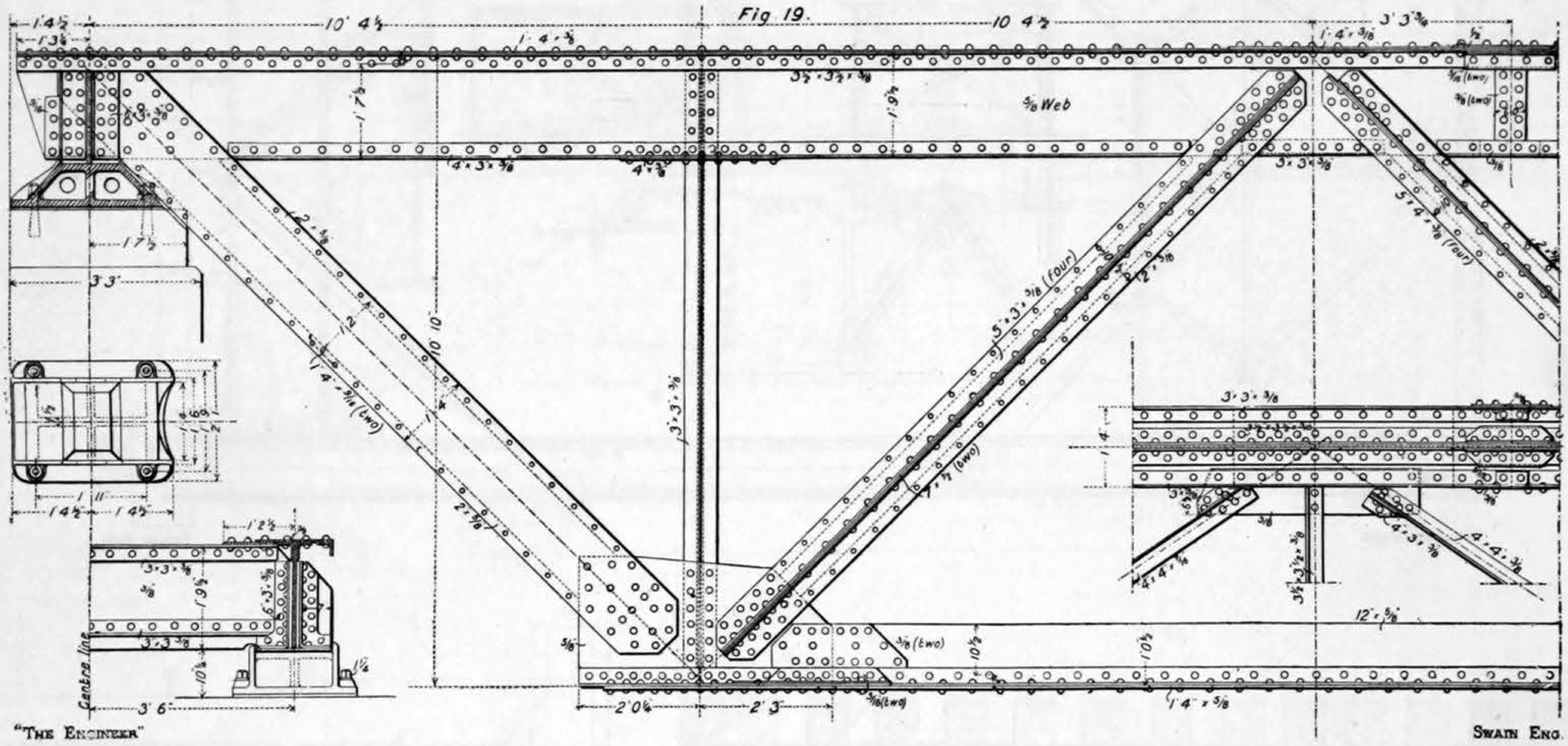
The inclined end frames, which usually have only a transverse bracing on the top, have in the Lan-ho Bridge a similar one also at the bottom, the latter consisting of a plate girder 3ft. deep and two angle bar struts in the plane of the frame; the required open profile for the passage of the train is therefore accurately enclosed by the framework—see Fig. 12. In this way the lateral movement of the upper part of the bridge relatively to the lower, from forces or vibrations, is reduced to a minimum. The ends of the rail bearers have their support direct on the masonry, and are here fixed to the strut which takes the stress from the lower transverse bracing to the end pins as described, see Figs. 4, 11, and 12. The inclined plate girder passes through openings in the rail bearers, so that the two structures are independent of each other. If this were not the case, the inclined plate girder, being prevented from bending downwards, and being very stiff horizontally, would be subjected to very great bending stresses when the chords of the main girders extend under the load, while the rail bearers would only to some extent take part in this extension. Stresses from this cause, increasing from the middle to the abutments, occur in all bridges in the cross girders and the diagonals of the transverse bracing, if the latter lies in or near the level of the chords, unless the rail bearers and the diagonals are furnished with expansion joints: but this is not usually done, and with the diagonals meeting, as here, at the chords in the middle of the panel, the stresses are less intense.

The vertical posts of the main girders are not made, as usually, of a tubular section with braced sides, but of an H section with a solid web, the reason being that they can be better painted, and that the pin connections at their ends are more accessible. At half height all posts and diagonals are connected together by two horizontal bars, see Fig. 2. The other details of the large span of the Lan-ho Bridge, see Figs. 13, 14, and 15, are without particular interest. The weight of steel in one span is as follows:—

	Tons.
Main girders	108·0
Cross girders	8·2
Rail bearers	22·3
Lateral bracings...	12·8
Bed-plates	4·6
Total	155·9

Few remarks will suffice to characterise the construction of the ten small spans, see Figs. 16 to 19. The heavy connections of the diagonals with the flanges, consequent upon adherence to the given outline of the main girder, induced the majority of competitors to propose box-shaped flanges, so as to avoid excessive length of the groups of rivets, although this construction is unusual in bridges of about 100ft. span, because the box shape is needlessly complicated, and the girder difficult to paint properly.

In the present case, where the flanges are T-shaped, the excessive length of the connections is avoided by making the web thick enough to carry a rivet in double shear. This thickness is ⅝in., the rivets being ⅞in. diameter. The diagonals, being in pairs, are riveted on each side of the web—see Fig. 19; the number of rivets is therefore half of what it would be in a box-shaped girder. The ⅝in. space between the bars is closed by 2in. × ⅝in. strips at the edges. The main girders are 7ft. apart, and the sleepers rest direct on the top flange, which is strengthened for the purpose of sustaining the bending stress from the load. There is a horizontal transverse bracing between the top flanges and a vertical transverse bracing between the uprights, as also a plate girder over the bearings. The weight of metal in one span is 34½ tons. The diagram of stresses for the through span is given in Fig. 5, and that for the deck span in Fig. 18.



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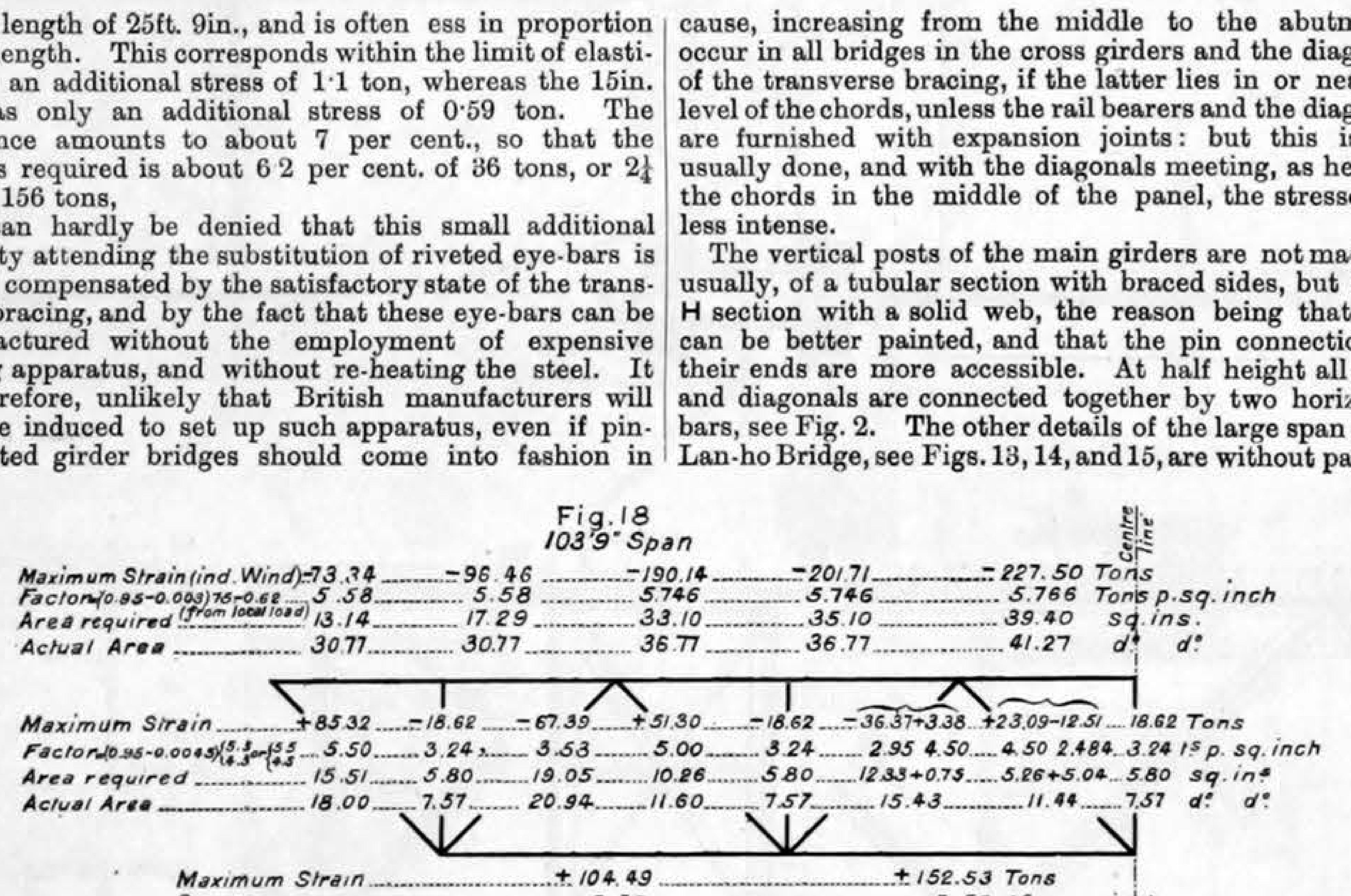


INTERNATIONAL SHOE AND LEATHER EXHIBITION.

THERE is something of interest to engineers at all the Industrial Exhibitions which are held from time to time in the Agricultural Hall, Islington. At a leather exhibition the objects of interest to us should be twofold—the material produced, and the machinery used in its manufacture. Unfortunately, in the present instance, we have nothing to say about the former. Have woven and india-rubber belts driven leather belting out of the market? Is leather no longer used for pump valves? Whether this be so or not, we can only testify that on Monday last, the opening day, no leather belts or valves were to be seen.

However, the show of boot making-machinery, both British and foreign, was very good. Machines at work were shown by Messrs. Pearson and Bennion, Simson and Co., Pegg and Son, H. F. Dale, and Mudd and Co., all of Leicester; Keats and Bros., of Stafford; Bateman, of Halifax; the Gare Machine Company, of Stockport; Timpson, of Northampton; and of course sewing machines by Messrs. Singer, and Wheeler and Wilson; the latter having a very interesting exhibit. Besides boots, the only novelty we observed in leather goods was a collection of portmanteaus and trunks, by Messrs. W. Insall and Sons, of Bristol, including some ladies' trunks strong enough to resist the efforts of Transatlantic "baggage smashers." Their weight would, however, be too great to hinder them from coming into general use in Europe.

There is the usual display of exhibits which have no connection with the object of the exhibition, such as safes, writing-desks, ventilating and heating apparatus. Still, great interest seemed to be taken in the Eagle ranges, the Baird-Thomson ventilating fans, and in a little calculating machine, by Messrs. Arter, Dixon, and Co., for adding up columns of pounds, shillings, and pence.

A pretty little machine is that shown by Keat's Featherweight Spool Company, for winding their spools. These articles are intended to replace the wooden reel, especially when the cotton, thread, or silk which is being wound is intended for export. They are made of celluloid, 2¼in. diameter, and hardly thicker than letter-paper. The outer edge is serrated, and the thread is wound round the notches. The inventor states that ten of these spools empty weigh the same as one reel, and that six dozen new spools, when filled, only occupy the same space as one dozen reels, carrying the same relative amount of sewing material.

There are probably other exhibits worthy of notice, but like most exhibitions, this was far from being completed on the opening day.

MASON COLLEGE ENGINEERING SOCIETY.—At a general meeting of the above Society held in Mason College, Birmingham, on Wednesday, April 25th, a paper on "Some Recent Developments in Cycle Construction" was read by Mr. C. R. Garrard, M.I.M.E., Mr. R. J. Richardson in the chair. The author traced the early history of the cycle, giving examples in the sixteenth century, and an interesting sketch of a bicycle made in Scotland in 1840, which had a very similar appearance to an ordinary "safety." He fully described the early manufacture of light rims and wire spokes, and traced the development of ball-bearings, which have been so important a feature in modern cycles. A reference was made to pneumatic tires—experiments thereon—the author mentioning that vehicles with a maximum load of 4500lb. on four wheels could safely be used on our roadways. The process of detaching oxides and the flux used in brazing by the electrolytic method was described, and the new jointless rim and process of its manufacture fully explained. The paper was followed by a discussion, in which Professor A. H. Smith spoke of the importance of the cycle manufacturing industry from a commercial standpoint, and also of the large field it afforded for engineering ingenuity and calculation.

THE IRON AND STEEL INSTITUTE.

THE annual meeting of the Iron and Steel Institute was held on Wednesday and Thursday last at the Institution of Civil Engineers, the President, Mr. E. Windsor Richards in the chair, being supported by a numerous and representative gathering from all parts of the country, including beside many others, Sir Henry Bessemer, who appeared to be in good health, but was unable to address the meeting on account of a temporary loss of voice. Sir Lothian Bell, Sir B. Samuelson, Mr. Carnegie, Mr. Snelus, Mr. Hadfield, Sir E. Carbutt, Mr. E. P. Martin, and Mr. David Dale, the treasurer. The report of the Council, read by Mr. Brough, the secretary, on Wednesday morning, stated that 39 members had been elected last year, but the diminution by deaths and resignations of membership were in excess of that number, but this will probably be reversed by the large number of 72 candidates proposed for election on the present occasion. Satisfaction was expressed at the very successful result of the autumn meeting at Darlington in 1893, which was largely to be attributed to the skilful organisation of Mr. Dale and Mr. Ianson, the president and secretary of the reception committee. It was announced that the autumn meeting of this year would be held in Belgium between August 20th and 25th, the first two days being devoted to a formal meeting in Brussels, and the remainder of the time to excursions in the Liége and Charleroi districts.

The Bessemer gold medal for the year was awarded to Mr. John Gjers, of Middlesbrough, the presentation being made in a short address, by the President recalling the numerous additions and improvements made by Mr. Gjers since 1865, including the Cleveland calcing kiln, and the developments of hoisting plant, blowing engines, and hot blast stoves made in connection with his model works at Ayresome; the last-mentioned apparatus especially being taken as the perfection of iron pipe stoves, and what would probably have been almost exclusively used at present but for the introduction of fire-brick stoves. The greatest service, however, that he had rendered to the iron and steel trade was the invention of the soaking pit, which had been widely adopted, with the consequent saving of a very large amount of fuel. Mr. Gjers acknowledged the medal in a short speech, and the business of the meeting began with the reading of the Presidential address, which seems now to have become an annual necessity, and which we give below.

Mr. E. Windsor Richards, President, said :—The practice of your president delivering more than an inaugural address became established by Dr. Percy, and has been followed ever since by all succeeding presidents. Custom decides that ordinarily the address shall be a comparatively short one. In 1886 the learned doctor referred to the then universal depression in the iron and steel industries, and to over-production ; adding, that either consumption must be increased or production limited. All interested in these industries have said the same thing many times over. Our own country is too small to keep our immense establishments occupied ; we have lost the greater part of the Continental trade owing to protective tariffs, having for their main objects the fostering of their own industries and finding occupation for their own population. We anxiously look abroad for fresh fields to receive our products, so as to maintain and possibly increase consumption. Always keeping in mind the fact that our Institution confines its attention almost wholly to iron and steel, my remarks refer only to those industries. I must be careful not to transgress Rule 2, which states that the object of the Institution shall be to afford means of communication between the members of the iron and steel trades upon matters bearing upon their respective manufactures, excluding all questions connected with wages and trade regulations. Since that rule was framed, the Institute has become quite cosmopolitan in character. During the whole of last year the depression was so great that there was little encouragement to spend money to improve either processes or machinery, so that there is little in this direction to call your attention to. Indeed, there is a lull in invention, with few new developments, and there seems to be almost as little new to record in steelmaking as there is anything fresh to say about the puddling process. Under these circumstances, therefore, I purpose deviating a little from the beaten track in this short address; my excuse being that it is impossible for those engaged in metallurgical pursuits to separate the consideration of the commercial from the manufacturing aspect of our industries, so intimately are both associated and bound together.

During the two years of the learned doctor's presidency, which he characterised as "those of great depression," the production of Bessemer steel rails in 1885—as given in the *British Iron Trade Journal*—was 706,583 tons, and in 1886 it increased to 730,343 tons; whereas in 1893 the same source shows that the depression had become more accentuated, for we find the figures are lowered to 579,386 tons, which was less than for many years except the previous year, when the production was 43,550 tons lower than in 1893. The price of rails, which in 1886 was £4 13s. 10d. per ton in England, fell to as low, in some instances, as £3 12s. in 1893. These figures show that the production of iron and steel has become very greatly restricted, and the question the country generally is deeply interested in is, whether the diminished demand is due to any falling off in quality of material, excellence of finished products, or increased cost of manufacture? I feel quite sure, from careful observations made at several establishments, that our metallurgists and manufacturers still keep a foremost position, and have not fallen away in any one of the above respects. It is true we have almost lost our continental trade, but it is not for the want of skill or knowledge of manufacture, but by reason of protective tariffs which operate against us in two ways: First, the high tariff rate we are called upon to pay for admission to the various countries, to a great extent excludes our products; and secondly, the high prices obtained by our competitors enable them to make such substantial profits in their own country that they can afford to quote very low prices, leaving them little or no profit when in competition with us. This may seem paradoxical, but the object is to obtain as large a production as possible, as that has proved to be of very great importance in reducing general and establishment charges.

But even under such greatly disadvantageous conditions, we have several times quoted and obtained considerable orders for rails, delivered inland on the Continent, at prices which have left a profit. The competition has, however, become altogether one-sided, for the railway companies have latterly, after receiving the lowest tenders from us, allowed their manufacturers to amend their offers, so that we are quite shut out from those countries, whilst our own is left open to their attacks. I could cite many instances of this, what I term unfair competition; the figures have many times been published in the newspapers, and so are public property. The following recent example illustrates what I particularly desire to direct attention to. In January of this year, England tendered for some steel rails delivered in Oldenburg at a price of 109 marks per 1000 kilos.; the lowest German tender was 114 marks. Notwithstanding a strong protest, the order was given to the German firm at the English price, but if the German manufacturers had been tendering for steel rails for delivery in England, their price would have been about £3 15s. per ton or less. In the English tender before referred to an import duty of £1 5s. 6d. per ton was included, as well as the cost of carriage; so I repeat that, though it is generally thought otherwise, the successful competition is not accomplished by greater skill or by more economical methods of manufacture.

We have been repeatedly advised to adopt better methods of working, to construct further labour-saving contrivances, to afford a better and more thorough technical education. We have continually advanced in these matters. We are still doing all that lies in our power in those directions, and much yet remains to be done. But of what avail is it to construct labour-saving machinery, and so throw more men out of employment, when we have already thousands of willing hands out of work? And then labour-saving machinery can be, and is, as readily and as quickly adopted by our competitors as by us. Is it not true, and cannot we assert without egotism, that almost all the great inventions, improvements, and labour-saving contrivances in the industries I am referring to, have been brought about in this country? Thorough technical education is of the very utmost importance, and is receiving the greatest attention from the highest and best people in our land. But what even will technical education avail us against the unfair conditions I have pointed out? And what relief will these things, which are so generally and so persistently preached to us, give us when they are adopted? They can give no relief in the present condition of things.

Never since the organisation of this Institute has the metallurgist experienced a more difficult time than the depression we are passing through. Added to his commercial troubles are constant demands from the workmen for either higher wages or fewer hours of work. The gravity of the situation demands the closest consideration of commercial men and of statesmen. We may well anxiously look round to see where the markets for our produce and employment for our workmen and capital are to come from. Great hopes are entertained at home that the tariff laws in America will be so altered and improved in our favour that we shall be able to resume delivery of iron and steel to that country. But American legislators are perfectly well aware of the needs of their own country, and know quite well that their own industries must first be fostered, and employment found for their own people. We may rest perfectly assured that they will legislate in that direction, and not in favour of England or any other country to the detriment of their own. We should not turn our eyes either so much to America for a market, for they have experienced a far greater degree of depression than we have. Nor must we look to continental nations to take our iron and steel, for they are well able to supply themselves; and if present tariffs are not sufficient to keep out our productions, they will be increased. We cannot and do not complain of countries fostering their own industries, but we claim to exercise our privilege of grumbling when these tariffs are so high as to enable our competitors to poach on our lands and throw our workmen out of employment, and especially when, by placing even a small quantity of iron and steel in Great Britain, they depress the value of the whole of our products, and we have reason for complaining of a competition which is so one-sided and unfair to our manufacturers.

But we must look to our own possessions and to our own Colonies for relief, and our legislators must safeguard their interests and ours. Canada is thoroughly loyal to us, and needs our markets as much as we need her to take our surplus population. We look anxiously for further development of railways in India and Australia, and Africa should, ere long, become of enormous advantage to us. It is to be hoped that our legislators may find time to consider these important questions, which affect the well-being of so many thousands engaged in the iron and steel industries, and are indeed of vital interest to the whole of the community.

The invention of our venerated and most highly-esteemed past-president, Sir Henry Bessemer, conferred the greatest good on the greatest number, but even he could scarcely have imagined that steel rails would be put on board ship at £3 12s. 6d. per ton. The manufacturer, not being included in the category of the greatest number, would perhaps not complain so much of the price if he could obtain enough employment to keep his workmen together until times improved. One cannot wonder, however, that orders for rails are few when we are informed that those laid down from Ostend to Brussels, made to Mr. Sandberg's Goliath section of flange rail weighing 105 lb. a yard, have recently been accurately gauged after being in use for five years, and are calculated, at present rate of wear, to last a hundred years. These rails were made at Seraing, and contain from ·4 to ·45 of carbon. We learn that rails are being laid down abroad containing as much as from ·6 to ·7 carbon, the object being to lengthen the life of light sections of rails. One can only regard such extremes with alarm, and there can be no necessity for running such great risks to life and property when heavy rails are so cheap and last so long. We hope and believe that such a dangerous practice as this will not be imitated in Europe.

Very considerable trouble and expense have been experienced by manufacturers through differences in analyses by different chemists, and it seems to be a desirable thing that a committee of our chemical members should be appointed to consider whether standard methods of analysis could be determined on, and if so, that such standards should be recognised and adopted in the trade for our guidance. For such a purpose as this, and for scientific research generally, in which our members are interested, we might well make grants of money from the funds of the Institute. It is the intention of the Council to consider this matter, and they will ask your consent that such grants may, from time to time, be made in aid of scientific research.

Dr. Dudley, of Altoona, has just sent me a description of an attempt made to ascertain the quantity of phosphorus in three samples of steel. A large quantity of drillings was taken from each of the three samples, care being taken to eliminate the influence of segregation as much as possible; he analysed some himself, and sent the others to several eminent chemists. The results varied. In No. 1 sample from ·035 to ·042; in No. 2 sample from ·041 to ·056; in No. 3 sample from ·019 to ·033. And at home we find quite as much difference as these analyses show, and much vexation and loss have been occasioned thereby. Permit me to call the attention of steelmakers to the unsatisfactory manner in which ingots are generally made. It is a rare thing to see clean, well-made, and sound ingots. What with running stoppers, sand marks, cracked moulds, and stickers, the present method of ingot-making is not creditable, and should be improved. I own to having been as great a sinner in this respect as it is possible to find, but I made many efforts to extricate myself from the position, but without much success. It was owing to my failure to improve ingot-making that induced me to reduce the number of ingots made per cast by doubling the size of the ingot, and so having only one-half the number to make; and to deal with the greatly increased size, I designed and made the cogging-rolls 39in. diameter, and so dealt effectually and economically with ingots 16in. square, rolling them into rails over 150ft. in length.

After successfully dealing with ingots for rails weighing up to about 30 cwt., and being still extremely dissatisfied with the ingot-making department, I much desired to go further and reduce again the number of ingots made per cast. About this time we constructed at Eston rolls 5ft. diameter to reduce ingots weighing five tons to slabs 30in. by 6in. thick for plate-making; this was then found to be, and is to-day, a most successful and economical plant. I was thus not far from the task I had set myself of dealing with one ingot to one cast, but was deterred from going further at that time by two considerations—1st, A dim fear of segregation; and 2nd, a strong fear of the great length and weight of the rolls of so large a diameter as 5ft. If the hydraulic forging press of a couple of thousand tons power had been available in those days, I believe that at Eston we should long ago have been making a cast of from 8 to 10 tons of steel into one ingot. This seems a small thing to say at this time, when ingots 6ft. 9in. square, weighing up to 70 tons, are being dealt with by the hydraulic forging press, and easily handled by appliances which have been so simplified and perfected that weights up to 100 tons can be manipulated with perfect ease and safety.

The first paper read was that by Mr. G. J. Snelus, F.R.S., describing the Walrand-Legénsel method of making steel castings direct from a small Bessemer converter, which is intended for use as an adjunct to ordinary foundries and machine works where there is not work enough even for a small open hearth furnace. The Walrand process consists in simply adding to the metal at the end of the ordinary blow a definite quantity of melted ferro-silicon, then making the afterblow, turning down when the extra silicon has been burnt out, and adding the ordinary final additions of ferro-manganese, &c., as circumstances require. The advantage is, first, that we can use an ordinary Bessemer pig iron with 2—3 per cent. silicon, thus insuring a steel comparatively free of silicon; secondly, that the combustion of the added silicon produces such a large amount of heat at the right time, and so rapidly that the metal becomes very fluid; thirdly, that as the silicon burns to a solid, it leaves the metal comparatively free of gas, and the steel is sound and free from gas cavities; fourthly, that in consequence of the metal being so fluid and already free from oxide of iron, the ferro-manganese or other substances added, such as aluminium, are more effective and remain in the final steel; fifthly, that in consequence of the great fluidity of the metal, much more time and facility is given for casting operations.

The experiments witnessed by the author were—first: Those carried out at Paris by Messrs. Walrand and Legénisel, where there are two small converters, one for 300-kilogramme charges and one for 600 kilogrammes. The latter is about 4½ft. high and 2½ft. in diameter. Both vessels are turned down by hand power. The blast is taken from the city pressure service, being passed through a reducing valve to reduce the pressure from five atmospheres to one to two atmospheres. The experiments were carried out in the smaller vessel. A mixture of English pig iron, chiefly Ayresome and Harrington, is employed, as, after many brands had been tested, these were found most suitable. The cost at present is about 90f. per ton—2000lb. Coke costs 32f. per ton, and the selling price of steel castings is about 24s. per cwt. The pig iron is melted in a small cupola, and brought in a ladle by an overhead crane to the vessel. The ferro-silicon is melted in a very small cupola of ingenious construction, the blast being heated, the melted metal dropping into a heated crucible as it melts, and being weighed before use. There are usually six small tuyeres in the small vessel, eight in the large vessel. These are made at Le Creusot, but the quality of the fire-clay is not equal to English. They last seven to eight blows in the small vessel, ten to twelve in the large vessel. One thousand charges from the same lining have been run in the large converter. Mr. Walrand finds a loss of 5 per cent. on the iron melted in the cupola, 10 to 12 per cent. loss of metal in the converter. About half per cent. silicon is lost in melting the ferro-silicon. The ferro-manganese added is melted in a crucible, and the aluminium is put in in small pieces during pouring and casting. Four blows were made, varying from 22½ to 24 minutes for the main, and 1½ to 2½ minutes for the after-blow. The following table gives the results of analysis of the samples from No. 4 blow :—

	I.	II.	III.	IV.	V.	VI.
	Melted pig iron.	Blown metal.	Metal after after-blow.	Finished steel without carbon in ladle.	Finished steel with carbon in ladle.	Ferro-silicon (melted).
Iron (by difference)	92·72	99·801	—	—	—	80·795
Combined carbon...	Trace	0·13	0·12	0·25	0·255	Trace
Graphite	3·45	—	—	—	—	4·543
Silicon	2·93	0·013	0·013	0·043	0·042	10·419
Sulphur	0·037	0·033	0·039	0·035	—	0·065
Phosphorus	0·043	0·043	0·055	0·069	—	0·115
Manganese	0·820	Traces	Traces	0·288	—	4·063
Aluminium	—	—	—	—	—	—

A visit was next made to Creusot, where there is a Walrand plant in use, but unfortunately it was not at work, but a number of castings, chiefly pit wheels in green sand, were inspected and found to be of excellent quality.

The newest and most important installation, however, is that at Hagen, in Westphalia, which was visited by the author and Mr. Lange, of Messrs. Beyer, Peacock, and Co.'s locomotive works at Gorton Foundry, Manchester. This consists of two small converters of 600 kilos. = 12 cwt. capacity each. It is, however, possible to deal with 750 kilos. = 15 cwt. The space across the shop is arranged for two small cupolas, of which one is at present erected, along with a windlass and hoist; the windlass being worked by a rope from the engine working the Roots blower in the engine-room adjoining. In this engine-room is the blowing engine for the converters. When the work of the foundry necessitates the utilisation of both converters at once, the engine will be completed to a compound vertical. At present, only one converter being used, the high-pressure portion of the engine is alone finished. Adjoining the engine-room is the boiler-room, containing a water-tube boiler working at six atmospheres. An overhead travelling crane, worked by hand, traverses the shop. The casting-shop is 68ft. in length, 43ft. wide. The engine-room is 24ft. by 22ft., and the boiler-house 35ft. 6in. by 22ft. The converters are similar in shape to those used for the basic process, but of very small size; the linings and bottoms are rammed in the usual way. The cupola is of the Luhrman-Greiner type, which is meeting with considerable success in Germany. The blowing engine, when the low-pressure half is erected, will be a compound engine, vertical, with the air cylinders above the steam. The engine works at a steam pressure of 90 lb.; diameter of high-pressure cylinders, 400 millimetres = 15¾in.; diameter of low-pressure cylinders will be 550 millimetres = 21⅝in., stroke 600 millimetres = 23⅝in.; diameter of air cylinder 650 millimetres = 25½in. The engine delivers the air at a pressure of 1½ to 2 atmospheres. The engine was built by Klein. Between the blowing engine and the converter is arranged an air accumulator or equaliser, with a safety-valve to blow off at two atmospheres. At Hagen they have made such progress with the process that they are able to produce castings at will—within reasonable limits—having predetermined tensile strength, and on the occasion of the previous visits of Mr. Lange, and at his and the author's joint visits, three casts were made—1st, for mild steel; 2nd, for intermediate steel; 3rd, for hard steel. Examples of the composition of these are given in the following table:—

	No. 54, to give mild steel 45—50 kilo., mean of two tests gave 47·7 kilo. (=30·4 tons).	No. 55, to give medium hard steel 55—60 kilo., gave 53·75 kilo. as mean of two tests (=34 tons).	No. 56. to give 70—75 kilo. gave 68·8 kilo. (=43·6 tons)
Iron (by difference)	98·233	97·35	97·03
,, (by experiment)	98·4	97·4	97·10
Combined carbon ...	0·23	0·27	0·34
Silicon	0·356	0·508	0·833
Sulphur	0·058	0·049	0·048
Phosphorus	0·067	0·069	0·072
Aluminium	0·087	0·150	0·144
Manganese	0·966	1·594	1·513

At Hagen it is the practice finally to harden the steel by an addition of ferro-silicon with ferro-manganese, and that they depend more upon the silicon than the carbon for getting the desired strength. For many purposes, and especially for castings, such steel is no doubt very useful, but the author doubts whether it is suitable for use where it may have to stand sudden shock. This departure from ordinary practice is interesting, but, as the Paris experiments show, it is no part of Mr. Walrand's process, but has been worked out at Hagen, and the very high tensile tests obtained and certainty of results is very remarkable. The cost of the process, which is gone into in considerable detail, is said to work out to about 4s. 6d. per cwt. of finished steel in the ladle.

With regard to the cost of a complete installation, Mr. Daelen states that the total cost of the buildings and plant complete at Hagen would be about £3500, and gives the following details:—

Blowing-engines as completed for blowing	£400
Blast-pipes and accumulator	75
One converter of 600 kilogrammes capacity	150
Cupola, stage, and hoist	250
Boiler, tubular	400

In most foundries, buildings, cupolas, steam services, &c., would be available, and the main items of cost would be the blowing-engine and converter. The mechanical turning gear for converters used at Paris, Le Creusot, and Hagen is simple and inexpensive, and answers admirably. The advantage to an ironfounder to be able to make steel castings cheaply, just when wanted, as easily as those of cast iron, and even in green sand, is so apparent, that in all probability no foundry of importance will in future be considered as properly equipped without a Bessemer converter.

Although the chief aim of the inventors of this process has been to facilitate the manufacture of steel castings suitable for ordinary iron foundries, it by no means follows that it is not applicable to other purposes; and the author believes that it will be useful in all cases where quality of product is of more importance than a slight extra cost. If, for instance, it is possible by this process to make a sound soft steel of uniform quality without blow holes, why should it not reinstate the Bessemer process for the manufacture of plates? In examining a vast number of fractures of tensile tests of plate steel, the author has rarely failed, with a powerful lens, to detect indications of want of continuity in the metal, due to gas cavities, even in samples of Siemens steel; and all such defects must involve irregularity, and possibly failure; so that if this process will largely eliminate gas cavities and give a sounder steel, the slight extra cost of the process should be more than compensated by the improved quality of the material. It is also possible by this process, with careful attention to the quality of the materials employed, to make steel of all grades of hardness equal in quality to crucible steel.

After the reading of the paper some explanatory statements were made by Mr. Genésil, one of the inventors, Mr. Lange, and Mr. Daelen, by whose advice the process was adopted at Hagen, but nothing of the nature of a discussion took place. Subsequently a paper by Mr. Jeremiah Head on "Scandinavia," and more particularly the North of Norway, as a source of supply of iron ore for the North of England, was read, and occupied the time until the hour of adjournment on Wednesday, so that a third paper by Mr. Bamber, on "The Analysis of Steel," which was on the programme, was not taken.

THE Leicester Corporation Waterworks department is growing very anxious concerning the low water, in consequence of the remarkably small rainfall. The reservoirs are about 15ft. below the weir, and the deficiency amounts to some 580 million gallons.

LETTERS TO THE EDITOR.

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

KINETIC THEORY OF GASES—VALUES OF β AND γ IN NATURAL GASES.

SIR,—In my last letter on this subject a method was given of obtaining the value of $\sqrt{\beta}$ for natural gases, the equations required for that purpose being:—

$$\bar{v}_i = \sqrt{\frac{6\,p}{\rho}};\quad \bar{v}_n\sqrt{\beta} = \sqrt{2\,\mathrm{K}_v\,\mathrm{T}};\ \text{and}\ \sqrt{\beta} = \frac{\bar{v}_i}{\bar{v}_n\sqrt{\beta}};$$

in which equations $\bar{v}_i$ and $\bar{v}_n$ are the velocities of the mean square of the molecules in the ideal and natural gases respectively; p their pressure on unit surface, K_v their specific heat at constant volume, T their absolute temperature, and β the ratio of their total energy to their energy of translation. The second and third of the above equations are applicable to the case of gases composed of perfectly smooth, elastic, non-spherical molecules, as well as to rough, spherical, elastic molecules; this I inadvertently omitted to mention in my last letter.

Assuming that a gas raised to double its absolute temperature has twice the kinetic energy that it had before its increase of temperature, then the product $\bar{v}_n\sqrt{\beta}$ can be found experimentally by Professor Jolly's steam calirometer, or otherwise. Thus for any gas, when the pressure, volume, and absolute temperature are known, the value of β can be found independently of its specific heat, or of γ, the ratio of specific heat at constant pressure and constant volume.

We will now proceed to find the value of β by another method in terms of γ.

The total energy in unit volume of a natural gas is given by the equation

$$\mathrm{E}_n = \tfrac{1}{2}\,\beta\,\rho\,\bar{v}_n^2;$$

we have also, from my former letters, the equations

$$\bar{v}_i^2 = \frac{6\,p}{\rho};\ \text{and}\ \bar{v}_n^2 = \frac{\bar{v}_i^2}{\beta}.$$

Combining these equations, we get

$$\mathrm{E}_n = \frac{3\,p}{\beta}.$$

The above equation gives the energy in unit volume, hence the energy in unit mass is given by the equation,

$$\mathrm{E}_n\,\mathrm{V} = \frac{3\,p\,\mathrm{V}}{\beta};$$

where V is the volume of unit mass. Again, from the definition of specific heat we have

$$\mathrm{K}_v = \frac{\mathrm{E}_n\,\mathrm{V}}{\mathrm{T}} = \frac{3\,p\,\mathrm{V}}{\beta\,\mathrm{T}}.$$

Now, $\frac{p\,\mathrm{V}}{\mathrm{T}}$ in all gases = constant = $\mathrm{K}_p - \mathrm{K}_v$; K_p being the specific heat at constant pressure. Hence—

$$\mathrm{K}_v = \frac{3}{\beta}(\mathrm{K}_p - \mathrm{K}_v)$$

$$\beta = \frac{3\,(\mathrm{K}_p - \mathrm{K}_v)}{\mathrm{K}_v}$$

$$\therefore \beta = 3\,(\gamma - 1) \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (1)$$

And this may be written—

$$\gamma = \tfrac{1}{3}(\beta + 3) \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (2)$$

In the following table the values of $\sqrt{\beta}$, β, $\bar{v}_i$, $\bar{v}_n$, and γ, calculated from the equations, proved in this and my former letters, are given for certain permanent gases, and also the experimental values of γ for the same gases. Some of the values given in my last letter were incorrect and should be altered; the experimental values are taken from the "Encyclopædia Britannica," vol. xxiii., page 480.

	$\sqrt{\beta}$	β	$\bar{v}_i$	$\bar{v}_n$	$\gamma = \frac{1}{3}(\beta + 3)$	Experimental value of γ
Hydrogen ..	1·111	1·234	8551	6925	1·4115	1·412
Oxygen ..	1·094	1·197	2140	1787	1·399	1·402
Nitrogen ..	1·108	1·227	2282	1860	1·409	1·411
Dry air ..	1·1058	1·222	2250	1841	1·407	1·409

The calculated and experimental values of γ given in the last two columns would agree exactly if the values of K_v and T in the two cases agreed. Thus, for the first time it has been shown that the experimental values of γ are quite in accordance with the kinetic theory of gases.

It has been proved by Clerk-Maxwell that for non-spherical perfectly elastic molecules—"Phil. Mag.," vol. xx., 4th series, pages 35 and 36—"the whole *vis viva* of translation is equal to that of rotation in each system of particles," which gives 2 for the value of β. If Clerk-Maxwell's proof is correct, it seems to indicate that gas particles are smooth, spherical, perfectly elastic bodies—perfectly elastic in the sense that the forces of compression and restitution are equal—and that the value of β over unity given above is due to vibrations in the molecules, and not to a rotary motion. This seems quite in accordance with Waterston's theory, as explained in the introduction of his paper on this subject, and regarding which I hope to be able soon to give a short account.

8, Norfolk-square, London W., April 27th. C. E. BASEVI.

SPECIFIC AND LATENT HEATS OF STEAM.

SIR,—In my letter of March 13th I committed an error in stating that the fall in temperature corresponding to a fall in pressure from 150 lb. to 45 lb. is, according to Regnault's tables, 86·4 deg. Fah. The data on which the calculations contained in that letter are based are those given to me by Mr. Harrison. I find on consulting D. K. Clark's tables, which are, I think, based on the results of Regnault's experiments, that the temperatures and volumes corresponding to given absolute pressures do not agree exactly with Mr. Harrison's values. Thus we have:—

	Pressure. lb.	Temp. deg.	Vol. c. ft.	Pressure. lb.	Temp. deg.	Vol. c. ft.
Harrison ..	150	362·7	3	45	276·3	9
Regnault ..	150	358·3	2·95	45	274·4	9·1
Difference ..	..	−4·4	−·05	..	−1·9	+·1

Whatever may be the true volume of a pound of steam at 150 lb. pressure, its volume after threefold expansion must be three times its initial volume. Either the volume adopted by Harrison for 150 lb. pressure is correct, or the final volume at full stroke, if Regnault is correct, ought to be equal to 2·95 × 3 cubic feet = 8·85 cubic feet, or 1·8 per cent. less than Harrison's. Notwithstanding that the temperature, according to Regnault, is nearly 2 deg. less, the volume is more than 1 per cent. in excess of Harrison's. If we determine the value of J by means of Regnault's values of the temperatures, and work done calculated from Harrison's diagram, we have—

$$\mathrm{J} = \frac{68{,}007{\cdot}7}{83{\cdot}9}\ \text{foot-pounds} = 810{\cdot}6\ \text{foot-pounds}.$$

If we use 2·95 cubic feet and 8·85 cubic feet as initial and final volumes, and 1·098 as the value of n, we get—

$$\frac{p\,v - p_0\,v_0}{n - 1} = \frac{(442{\cdot}5\ \text{deg.} - 398{\cdot}25\ \text{deg.})\ 144}{{\cdot}098}\ \text{foot-pounds} = 65{,}020{\cdot}4\ \text{foot-pounds}.$$

$$\text{Whence J} = \frac{65{,}020{\cdot}4}{83{\cdot}4}\ \text{foot-pounds} = 779{\cdot}6\ \text{foot-pounds}.$$

If we determine the value of n from Regnaults' tabular values we get—

$$\left(\frac{9{\cdot}1}{2{\cdot}95}\right)^n = \frac{450}{45} = 3{\cdot}34,$$

whence $n = 1{\cdot}07$, and we have

$$\frac{p\,v - p_0\,v_0}{n - 1} = \frac{(442{\cdot}5 - 409{\cdot}5)\ 144}{{\cdot}07}\ \text{foot-pounds} = 67{,}885\ \text{foot-pounds},$$

$$\text{and J} = \frac{67{,}885}{83{\cdot}4}\ \text{foot-pounds} = 814\ \text{foot-pounds}.$$

The complete absence of arguments and of evidence of the thinking out for themselves manifest in the communications of my opponents afford irrefragable proof that intellectual training forms no part of the system of modern education. The system appears to be devoted entirely to securing the successful passing of examinations for the sake of the immediate concrete pecuniary results. The methods adopted to gain this end would not, however, be successful if the examiners themselves were masters of the subjects in which they have to examine. To my statement that Zeuner's values of n in the equation $p\,v^n$ = const., which are, I believe, generally accepted as being very near the truth, are really values of γ, the ratio of the specific heat of steam at constant pressure to the specific heat at constant volume, I received simply the dogmatic reply that the value of γ for steam is 1·3. With this value the pressure after threefold expansion would be equal to $150 \div 3^{1{\cdot}3}$ lb. = 36 lb., and we have with Regnault's volume of 1 lb. of steam at 150 lb. and 36 lb. and of the corresponding temperatures

$$\frac{p\,v - p_0\,v_0}{\gamma - 1} = \frac{(442{\cdot}5 - 318{\cdot}6)\ 144}{{\cdot}3}\ \text{foot-pounds} = 55{,}472\ \text{foot-pounds},$$

$$\text{whence J} = \frac{55{,}472}{97{\cdot}4}\ \text{foot-pounds} = 569{\cdot}5\ \text{foot-pounds}$$

if the specific heat of steam is equal to the specific heat of water. If we adopt Joule's value of J, viz., 772 foot-pounds, the corresponding value of the specific heat of steam at constant volume would be equal to $\frac{569{\cdot}5}{772} = {\cdot}74$. According to Regnault the volume of 1 lb. of steam at 36 lb. pressure is 11·4 cubic feet. After adiabatic compression up to 150 lb. pressure we should therefore have volume of 1 lb. of steam at 150 lb. pressure, equal to 3·8 cubic feet if $\gamma = 1{\cdot}3$ in the case of steam. It is clear then that the *fin de siècle* scientists must be wrong either as to the value of the specific heat of steam or the value of γ. I feel sure the majority of your readers will come to the conclusion that they are wrong on both points, and will be convinced that the specific heat of steam is equal to the specific heat of water, and that Isherwood's value of J, viz., 789 foot-pounds, is more nearly the value of J than Joule's value, viz., 772 foot-pounds.

It is strange that hitherto in numerical calculations the value of the temperature of air on a Boyle and Marriotte scale should have been adopted in the case of steam to represent the same indicated temperature, since the experimentally ascertained values of the corresponding pressures and indicated temperatures of the steam not only show that the Boyle and Marriotte temperatures cannot be the same in both cases, but afford also the means of determining the approximate value of the Boyle and Marriotte temperature in the case of steam. In accordance with the law of Boyle and Marriotte, if $v\ v_1$ be the volumes of a given weight of steam at the indicated temperatures $t_2\ t_1$ respectively when subjected to a constant pressure p_1, and $p_2\ v_2$ corresponding pressures and volumes of the same weight of steam at temperature t_2, t_2 being greater than t_1, and k the Boyle and Marriotte temperature of t_1, the least of the two limiting of indicated temperatures, we shall have

$$\frac{v}{v_1} = \frac{k + t_2 - t_1}{k} = \frac{p_2\,v_2}{p_1\,v_1} = \frac{450}{405} = 1{\cdot}1112$$

for the values p_2 = 150 lb., p_1 = 45 lb., if Harrison's values of the volumes are adopted. According to Harrison $t_2 - t_1 = 86{\cdot}4$ deg. and we get $k = 777$ deg. Also if α is the coefficient of expansion per degree of temperature

$$v = (1 + \alpha)^{86{\cdot}4}\,v_1 = 1{\cdot}1112$$

whence $\alpha = {\cdot}00012$. For a range of 180 deg. temperature we have, therefore,

$$v = (1{\cdot}0012)^{180}\,v_1 = 1{\cdot}25\,v_1$$

$$k = \frac{180\ \text{deg.}}{{\cdot}25} = 720\ \text{deg.}$$

In all existing works on thermodynamics 491 deg. F., the value of the lower of two indicated temperatures separated by an interval of 180 deg. on a Boyle and Marriotte scale in the case of air, has been adopted as the absolute temperature of melting ice, or of the indicated temperature 32 deg. Fah., so that 459 deg. Fah. has been considered as the absolute temperature corresponding to 0 deg. Fah. In using, therefore, the adiabatic equation of relation between temperatures and absolute pressures deduced from the law of Boyle and Marriotte, viz., $\mathrm{T}_2 = \left(\frac{p_2}{p_1}\right)^{\frac{\gamma - 1}{\gamma}}\mathrm{T}_1$, in which $\mathrm{T}_2\ \mathrm{T}_1$ are the temperatures on a Boyle and Marriotte scale, the following incorrect form for indicated temperatures has been adopted, viz.:—

$$t_2 + 459\ \text{deg.} = \left(\frac{p_2}{p_1}\right)^{\frac{\gamma - 1}{\gamma}}(t_1 + 459\ \text{deg.})$$

The correct equation is—

$$t_2 - t_1 + 459\ \text{deg.} = \left(\frac{p_2}{p_1}\right)^{\frac{\gamma - 1}{\gamma}} 459\ \text{deg.} \quad . \quad . \quad (\mathrm{A})$$

In the case of steam, the equation for the same range of temperatures is, in accordance with Harrison's data—

$$t_2 - t_1 + 720\ \text{deg.} = \left(\frac{p_2}{p_1}\right)^{\frac{\gamma - 1}{\gamma}} 720\ \text{deg.} \quad . \quad . \quad (\mathrm{B})$$

459 deg. in the case of air, and 720 deg. in the case of steam, being the temperature on a Boyle and Marriotte scale, corresponding to t_1, the lower of the two indicated temperatures, whatever the value of t_1 may be.

Since the value of γ varies with the temperature, formulas A and B, with an average value for γ in each case, can only give approximations to the true value of the temperatures. If, in the case of steam, we adopt 212 deg. as the lowest temperature, the formula reduces to—

$$t = \left(\frac{p}{14{\cdot}7}\right)^{\frac{\gamma - 1}{\gamma}} 720\ \text{deg.} - 508\ \text{deg.} \quad . \quad . \quad . \quad (\mathrm{C})$$

In equations B and C we must use the value of γ calculated from Harrison's diagram data, viz, 1·098, so that $\frac{\gamma - 1}{\gamma} = {\cdot}082$. If we determine k and γ from the tabular data corresponding to 212 deg. and 302 deg., an interval of 90 deg., the corresponding tabular pressures and volumes are 14·7 lb., 69·1 lb., 1642 cubic feet, and 383 cubic feet respectively, and we get—

$$t = \left(\frac{p}{14{\cdot}7}\right)^{{\cdot}06} 934\ \text{deg.} - 722\ \text{deg.} \quad . \quad . \quad . \quad (\mathrm{D})$$

and $\gamma = 1{\cdot}064$. If we determine k and γ from the tabular data corresponding to 212 deg. and 392 deg., an interval of 180 deg., the corresponding tabular pressures and volumes are 14·7 lb., 226·6 lb., 1642 cubic feet, and 126·6 cubic feet respectively, and we get—

$$t = \left(\frac{p}{14{\cdot}7}\right)^{0{\cdot}64} 953\ \text{deg.} - 741\ \text{deg.} \quad . \quad . \quad . \quad (\mathrm{E})$$

and $\gamma = 1{\cdot}068$. The divergence in the values of k and γ in equation E from those in equation D, and in the case of both D and E from the values obtained from Harrison's data for ranges of about 90 deg. of temperature, is due solely to experimental differences. Why the value of k for both ranges of temperature deduced from the tables is practically the same, and why in the case of the formulæ deduced from Harrison's data for ranges of 90 deg. and 180 deg., respectively, the value of k is so much larger for the range of 90 deg. than for that of 180 deg., admits of easy explanation. This explanation will also, I think, remove the difficulties under which some of your correspondents appear to be labouring as to the significance of the word temperature.

To insure clearness of argument I will first give exact definitions of the meanings of the terms used.

Definition No. 1.—The quantity of heat possessed by a body is the quantity of thermal power possessed by the body in a given thermal state.

Definition No. 2.—When two bodies are in contact and no heat passes from one body to the other, the two bodies are in the same thermal state, and are said to have the same temperature.

Definition No. 3.—A thermometer is an instrument for measuring the difference between the quantities of heat possessed by a thermal unit of mass of any substance in different thermal states.

Definition No. 4.—The English thermal unit of mass is the mass of the platinum standard. In analytical dynamical investigations, when one pound, one foot, and one second are adopted as units of force, space, and time respectively, the unit of mass is equal to g times the mass of the platinum standard.

The difference between the quantities of heat possessed by a unit of mass of any substance in two different thermal states is ascertained by measuring the difference in volume of the operative substance used in the thermometer, when it is brought into the same thermal states as the substance, by bringing its bulb in contact with the substance and comparing this with the difference in volume of the operative substance corresponding to two thermal states, of which the difference between the quantities of heat possessed by unit of mass of any substance in those thermal states is known. For instance, water between the thermal states of melting ice and ebullition. This quantity may be divided into any number of thermal units. The English thermal unit is $\frac{1}{180}$th part of the difference between the heat possessed by a thermal unit of mass of water at the temperatures of melting ice and boiling water respectively. If, then, the increment of the volume of the operative substance produced by raising its thermal state from that of melting ice to that of boiling water is properly divided into 180 parts, each increment of volume will correspond with an increment of heat equal to the English thermal unit multiplied by the specific heat of the substance at constant volume. Each of these intervals marked on the tube of the thermometer is called a degree of temperature. If equal increments of heat corresponded with equal increments of volume, the intervals on the tube of the thermometer would be of equal length, and the mode of marking the divisions at present adopted correct. Equal increments of volume do not, however, correspond with equal increments of heat. The heat possessed by unit of mass of any substance is independent of the volume occupied by unit of mass, which varies with the pressure to which the substance is subjected. Now it has been ascertained that whatever the volume may be of a given weight of gas at the temperature of melting ice, its volume at the temperature of boiling water bears a constant ratio to it, so long as the pressure remains constant. This law must, therefore, hold true for all intermediate states. If, therefore, we divide the difference between the heat possessed by unit of mass of any substance at the temperature of boiling water and melting ice into any assigned number n of parts and v_1, v_2, v_3, &c., v_{n-1} v_n represent the volumes of the operative substance of the thermometer at the temperature of melting ice and at the successive temperatures of the substance after one, two, three, &c., $n-1$, n units of heat multiplied by the specific of the substance have been added to each thermal unit of mass of the substance, so that v_n represents the volume of the operative substance of the thermometer at the temperature of boiling water, we shall have

$$\frac{v_2}{v_1} = \frac{v_3}{v_2} = \&c. = \frac{v_{n-1}}{v_{n-2}} = \frac{v_n}{v_{n-1}} = \frac{v_{n+1}}{v_n} = \&c. = (1+\alpha)$$

where α is the coefficient of expansion determined from the equation $(1+\alpha)^n = \frac{v_n}{v_1}$. The coefficient of voluminal expansion per unit of increment of heat is therefore constant, so that equal increments of volume do not correspond with equal increments of heat. The higher the temperature the greater the increment of volume per unit of increment of heat.

Now all existing thermometers are graduated by dividing the difference between the volume of the operative substance at the temperature of boiling water and melting ice into a number of equal parts and intervals of the same length are continued below the point corresponding to the temperature of melting ice and above the point corresponding to the temperature of boiling water. Near the temperature of melting ice the intervals between the marks on the tube of the thermometer are longer than the true intervals. Below the temperature of melting ice the divergence continues to increase, above the divergence decreases until at some point between the temperatures of melting ice and boiling water the true increment of volume corresponds with the mean. Thereafter the mean increment is less than the true increment, and the divergence continually increases. At the temperatures of boiling water and melting ice the marks on a correctly graduated thermometer coincide with those on thermometers graduated into divisions of equal length, but at no other points. Since the mean intervals are greater than the true intervals in the neighbourhood of the freezing point, temperatures below the freezing point indicated by an ordinary thermometer are higher than the true temperature, and the divergence continually increases. Above the freezing point the indicated temperatures are lower than the true temperatures, but the divergence continues to decrease until at boiling point they coincide. In the neighbourhood of the boiling point the mean increment of volume is less than the true increment of volume per unit of increment of heat, so that the indicated temperatures below boiling point are lower, and above boiling point higher than the true temperatures, and the divergence continues to increase. In the case of formulas D and E the values of k are practically the same, because the increment of volume from 212 deg. to 302 deg. is by the law of Boyle and Marriotte equal to the increment from 302 deg. to 392 deg., whilst in the case of formula C the increment was calculated in accordance with the true law of expansion.

In the letter from Mr. Harrison, referred to in my letter to yourself dated March 13th, after commenting on the close agreement of the work calculated from the diagram for pressures of from 45 lb. to 150 lb. with the tabular values, Mr. Harrison makes the following remark:—"Unfortunately for my theory it does not apply outside these limits—*i.e.*, 45 lb. and 150 lb.—of pressure as the steam table stands to-day. Above 150 lb. there is more heat shown than I require, and below 45 lb. there is too much volume. I think there may possibly be an error, and that the low-pressure volumes may be much too great. I can think of no method of experiment which will give those low-pressure volumes with anything like accuracy." The discrepancies to which Mr. Harrison refers would be reduced to within the limits of allowable experimental differences by the use of a correctly graduated thermometer. It would suffice to mark out correctly the spaces corresponding to successive differences of 45 F., 25 C., and 20 R. thermal units and to divide the intervals into equal spaces. The temperatures would in this way be ascertained correctly enough, but it is almost impossible to determine the volumes exactly. In accordance with the tables the volume of 1 lb. of steam at 14·7 lb. pressure and 212 deg. temperature is 26·3 cubic feet, and at 200 lb. pressure the tabular volume is 2·26 cubic feet and the temperature 381·7 deg., so that the rise in temperature according to the tables is 169·7 deg. The value of γ determined from the equation $p\,v^{\gamma}$ = const. is 1·064, and we have

$$\frac{p\,v - p_0 v_0}{\gamma - 1} = \frac{(452 - 386{\cdot}6)\,144}{{\cdot}064} \text{ foot-pounds} = 147{,}127 \text{ foot-pounds},$$

$$J = \frac{147{,}127}{169{\cdot}7 \text{ deg.}} \text{ foot-pounds} = 867 \text{ foot-pounds.}$$

If we deduce the volumes from Harrison's value of the volume at 45 lb., which agrees with the tabular volume within 1 per cent., viz., 9 cubic feet, by means of the value 1·098 for γ, we get volume at 200 lb. equal to 2·31 cubic feet, or only 2 per cent. more than the tabular value, and at 14·7 lb. to 24·94 cubic feet, or 7 per cent. less than the tabular values. These discrepancies, considering the difficult nature of the experiments and the fact that the formula by which they are tested is only approximately true, are certainly not outside allowable limits of error. We have, from the values last obtained,

$$\frac{p\,v - p_0 v_0}{\gamma - 1} = \frac{(462 - 366{\cdot}6)\,144}{{\cdot}098} \text{ foot-pounds} = 139{,}694 \text{ foot-pounds},$$

$$J = \frac{139{,}694}{169} \text{ foot-pounds} = 823 \text{ foot-pounds.}$$

The Boyle and Marriotte values of the temperatures, however, differ very widely from the true values. The difference between the volume occupied by the air in an air thermometer graduated according to the law of Boyle and Marriotte—*i.e.*, with equal intervals corresponding to two successive thermal states—is equal to the mean volume per degree of temperature determined by ascertaining the amount of expansion between the temperatures of melting ice and boiling water, multiplied by the difference between the numbers of degrees, which denote the temperatures of the two states. In the case of air the mean volume is equal to $\frac{{\cdot}3665}{180}$ cubic feet. The increment, therefore, between 32 deg. and 381·7 deg. is equal to

$$\frac{{\cdot}3665 \times 349{\cdot}7}{180} = {\cdot}7106 \text{ cubic feet.}$$

Since the coefficient of expansion of air per degree F is equal to ·00174, if t be the true temperature, we shall have

$$(1{\cdot}00174)^{t-32} = 1{\cdot}7106.$$

Whence $t = 342{\cdot}8$ deg. The following table gives the values of the temperatures indicated by a truly graduated thermometer, in which every rise or fall in one degree of temperature indicates an equal increment or decrement of heat, corresponding to the values on a Boyle and Marriotte scale, which refer to the same thermal state of the body.

Boyle and Marriotte	−459°	−357°	0°	32°	55°	77°	180°	212°	276·3°	362·7°	381·7°	3000°
True scale.	−∝	−874°	−4°	32°	58·5°	82·8°	184·9°	212°	265·8°	328·3°	342·8°	1130°

We get then for the value of the thermal unit corresponding to the differences between the temperatures on a correctly graduated thermometer, in the case of the examples worked out for Boyle and Marriotte temperatures, the following result. Corresponding to the range of pressures from 45 lb. to 150 lb., and the corresponding true indicated temperatures 265·8 deg. and 328·3 deg., we have from Harrison's indicator diagram data

$$J = \frac{68{,}607{\cdot}7}{62{\cdot}5} \text{ foot-pounds} = 1088 \text{ foot-pounds.}$$

From the tabular value of the volume at 150 lb., 2·95 cubic feet and 8·85 cubic feet at 45 lb., and value $\gamma = 1{\cdot}098$ deduced from Harrison's experiments,

$$J = \frac{65{,}020{\cdot}4}{62{\cdot}5} \text{ foot-pounds} = 1040 \text{ foot-pounds.}$$

From tabular values of pressures and volumes and the corresponding value of γ, viz., 1·07,

$$J = \frac{67{,}885}{62{\cdot}5} \text{ foot-pounds} = 1086 \text{ foot-pounds.}$$

Corresponding to the range of pressures from 147 lb. to 200 lb., and the corresponding true indicated temperatures, 212 deg. and 342·8 deg., we have from tabular values of volume and corresponding value of γ,

$$J = \frac{147{,}127}{130{\cdot}8} \text{ foot-pounds} = 1125 \text{ foot-pounds.}$$

From values of volumes deduced from the value 9 cubic feet at 45 lb., which is Harrison's value, and which differs by about 1 per cent. only from the tabular value, by putting $\gamma = 1{\cdot}098$ we get

$$J = \frac{139{,}694}{130{\cdot}8} \text{ foot-pounds} = 1068 \text{ foot-pounds.}$$

From 32 deg. to 180 deg., within which limits must be included the temperature of the water during Joule's experiments, the difference between the true temperatures is greater than the difference between the Boyle and Marriotte temperatures. The value of J, therefore, correctly estimated from the result of Joule's experiments is less than 772 foot-pounds. Are we then to reject the data obtained from Regnault's experiments and from indicator diagrams as worthless, because the average value of J calculated from these data exceeds that determined by Joule by his direct experiments by more than 40 per cent.? The mean of the values determined from the tabular volumes and pressures is 1080 foot-pounds, and that determined from Harrison's diagram 1088 foot-pounds, which differs from the former by less than 1 per cent. Can we, in the face of such strong corroborations of the truth of the result of one set of experiments by the result of another set of a totally different kind, hesitate to come to the conclusion that the true value of the thermal unit lies between 1050 foot-pounds and 1130 foot-pounds.

Since the true temperature corresponding to the Boyle and Marriotte temperature 55 deg. is 58·2 deg., if t represents the true temperature of the mixture of one pound of steam at 212 deg. with 50 lb. of water at 58·2 deg., we shall have, leaving the effects of latent heat out of consideration,

$$212 - t = 50\,(t - 58{\cdot}2 \text{ deg.})$$

From this we get $t = 61{\cdot}5$ deg. If, then, the actual resulting temperature of the mixture is 82·8 deg., we shall have latent heat = 51 (82·8 deg. − 61·5 deg.) T.U. = 1086 T.U. If we put J = 1080 foot-pounds, the latent heat of one pound of steam at 212 deg. is equal to 1086 × 1080 foot-pounds = 1,172,880 foot-pounds; according to the hitherto accepted values it is equal to 744,980-foot pounds only. The difference, 427,900 foot-pounds, is an addition of nearly 60 per cent. to the hitherto accepted value. There is clearly still a wide field left open for improvements in the utilisation of steam. Unless a much greater proportion of the total heating power of fuel is utilised in boilers than has hitherto been supposed, the total heating power of fuel must be much greater than the amount stated in the tables. Since the true temperature, corresponding to 3000 deg. on an equally divided scale, is only 1130 deg., the indicated number of thermal units is nearly 170 per cent. greater than the true number, whilst the increase to the value of the thermal unit is only about 40 per cent. The actual heat required to smelt cast iron must be much less than the estimated quantity.

It can be demonstrated that the number of degrees of the absolute temperature of boiling water cannot be less than the number of thermal units of latent heat and may be more. It cannot therefore be less than about 1086 deg. The Boyle and Marriotte temperature corresponding to − 874 deg. is − 357 deg. Corresponding to the Boyle and Marriotte temperature − 459 deg., the true temperature is − ∝.

The conclusions at which I have arrived are the result of calculations based on experimental data, which are universally accepted as being very near the truth. Those, therefore, who decline to accept my conclusions, are bound to refute my arguments. Appeals to authority on questions which admit of being settled by argument are simply childish.

WILLIAM DONALDSON.

April 7th.

CARNOT AND MODERN HEAT.

SIR,—In common with a good many others who have not a very clear conception of thermodynamic problems, I have sought instruction from Dr. Lodge's chapters appearing in THE ENGINEER. If I understand him correctly, he contends that motive power can only be obtained by descent of temperature from a higher to a lower level, without reference to molecular constitution, and in Section XI., April 20th, he instances the example of the steam engine in these words:—"The steam engine and boiler is not an efficient arrangement, only about 8 or 9 per cent. at the best, but that is because of the great unnecessary drop of temperature between the furnace and the boiler. Starting with the temperature of the boiler, and ignoring all energy below the temperature of the condenser, it may be efficient enough, 80 or 90 per cent., I suppose."

Now, I have always been under the impression that, although much of the energy of combustion certainly goes to waste between the furnace and the boiler, the engine itself is an imperfect machine, incapable in its action of turning to account the greater part of the energy which has been imparted to the steam. Taking the pressure of the steam at 50 lb., the initial temperature in the cylinder, as determined by Regnault, will be 281 deg. Fah., and the latent heat 916 deg.; total heat, 1167 deg. According to Dr. Lodge, therefore, the total possible efficiency during one stroke is that due to the fall of temperature from 281 deg. to that of the condenser; but if there were no such thing as latent heat—that is to say, if the whole of the heat energy imparted to the steam could be available for conversion into motive power by the engine—the efficiency would be rather more than four times as much.

Everybody now admits that the steam engine and boiler is not an economical producer of work, but all I wish to point out is that the boiler alone is not to blame. The most serious defect of the system is the impossibility of utilising three-fourths of the total constituent heat of the steam. The hope of the future lies in the study of internal molecular motion and the possibilities derivable therefrom.

R. H.

Middlesbrough, April 26th.

THE FORTY-EIGHT HOURS' WEEK.

SIR,—The correspondence which has appeared in THE ENGINEER from various parties interested in the forty-eight hours' question, has induced me, as an old member of the Amalgamated Society, to ask the insertion of my opinions on the matter, which I know are shared by a number of my brother members. I agree with Mr. Hope that the result of the introduction of this system is at present unsatisfactory, but for different reasons. It will no doubt be in the recollection of many of your readers, that when the change was first suggested three leading principles were laid down: (1) That a larger number of men would be employed. (2) That those men would have more time in the evening for intellectual improvement, recreation, or otherwise. (3) That their condition would be improved physically by the lessened amount of labour to be performed during the day. The system as adopted at Messrs. Allan's, Mather's, and Woolwich Arsenal has signally failed to comply with each of these conditions. Since Mr. Allan announced in the press that production had not decreased through its adoption, it has been made an imperative condition that no decrease in the output must take place wherever the system has been adopted. This at once disposes of the idea that more men would find employment.

The rule that the men should start later in the morning and work later in the evening seems to me utterly absurd. The arguments advanced for this are to my mind ridiculous, and simply mean, when one reads between the lines, that managers, foremen, timekeepers, and other officials, who are mostly rated men, do not like to turn out early in the morning, while they are, when leaving-off time comes, clean and fit to go to any place of amusement; but the workman has to go home, probably by rail, clean himself, and have his tea, before he is in a position to do so. After spending nearly half a century in labour, I would rather go to work at six in the morning and leave at five with the exception of the three months in the depth of winter, when the time might be altered to seven a.m. to six p.m. The third condition is nullified from the fact that the severity of the labour is increased by it being compressed from nine hours into eight.

Taking these circumstances into consideration, I have come to the conclusion that the men are in a worse position than they were previous to the alteration, while the employer is considerably benefited. For instance, at Woolwich the running expenses of machinery and plant in an establishment employing 14,000 hands will be saved on 300 hours per year. This will amount to a considerable sum, and may perhaps account for the willingness of the Government to carry out the change in the Government establishments. The despondent tone of Mr. Hope's letter at first puzzled me, but I have since come to the conclusion that it contains a warning of an ultimate reduction of wages as a result of the forty-eight hours' system. In conclusion, I assert that whoever supports the change on the lines laid down at the three establishments I have mentioned, is acting entirely in the interests of employers.

AN OLD MAUDSLAYITE.

April 30th.

SIR,—Will you let a woman say a word about the eight hours. I do not want my man at home in the morning when the breakfast has to be cooked and the children washed and dressed; he is in the way. Let him go to his work early and come home to a comfortable breakfast and a clean hearth, Sir. If the women of Manchester were allowed a word, we would not have the hour saved in the morning. Cut it off the other end of the day, when it will be of some use.

Manchester, May 1st.

A FITTER'S WIFE.

FOREIGN TESTS OF STEEL.

SIR,—In a recent communication in THE ENGINEER, December 29th, 1893, under the title of "Tensile Tests of Wrought Iron Railway Axles," I drew attention to the undesirability of engineers demanding too high a tensile strength for iron and steel used in constructive work. It is also desirable to notice the fact that mild steel of low tensile strength is preferred in Germany, and the following extract from a letter from one of the highest metallurgical authorities in Germany confirms my views on this question:—

In Germany "they are able to make the mildest qualities, which do not show the 'mysterious' cracks and other occurrences as with steel of greater tensile strength. While you say in England that the most trustworthy and satisfactory results are obtained with material of twenty-six to thirty tons tensile strength, we in Germany are of the strong opinion that the better results are obtained from steel of lower tensile strength. The boilermakers take, as a rule, material of not more than 25·4 tons, and their specification is for furnace plates from 27·6 to 25·4 tons tensile and 25 per cent. elongation. In the same direction goes the strong opinion in Germany that all tensile tests of the steel for shipbuilding purposes, for constructions, &c., are too high, because the milder steel is more trustworthy. Certainly there is made steel of higher tensile strength in Germany, but only for special purposes and in the case where the consumers wish expressly to get the harder material."

This communication affords an idea of the present practice in Germany. It may further be surmised in connection with this subject that the successful competition of our German rivals in engineering work is partly due to the practical metallurgical knowledge displayed by them in this selection of mild steel of low tensile properties for general constructive work.

THOS. ANDREWS, F.R.S., M. Inst. C.E.

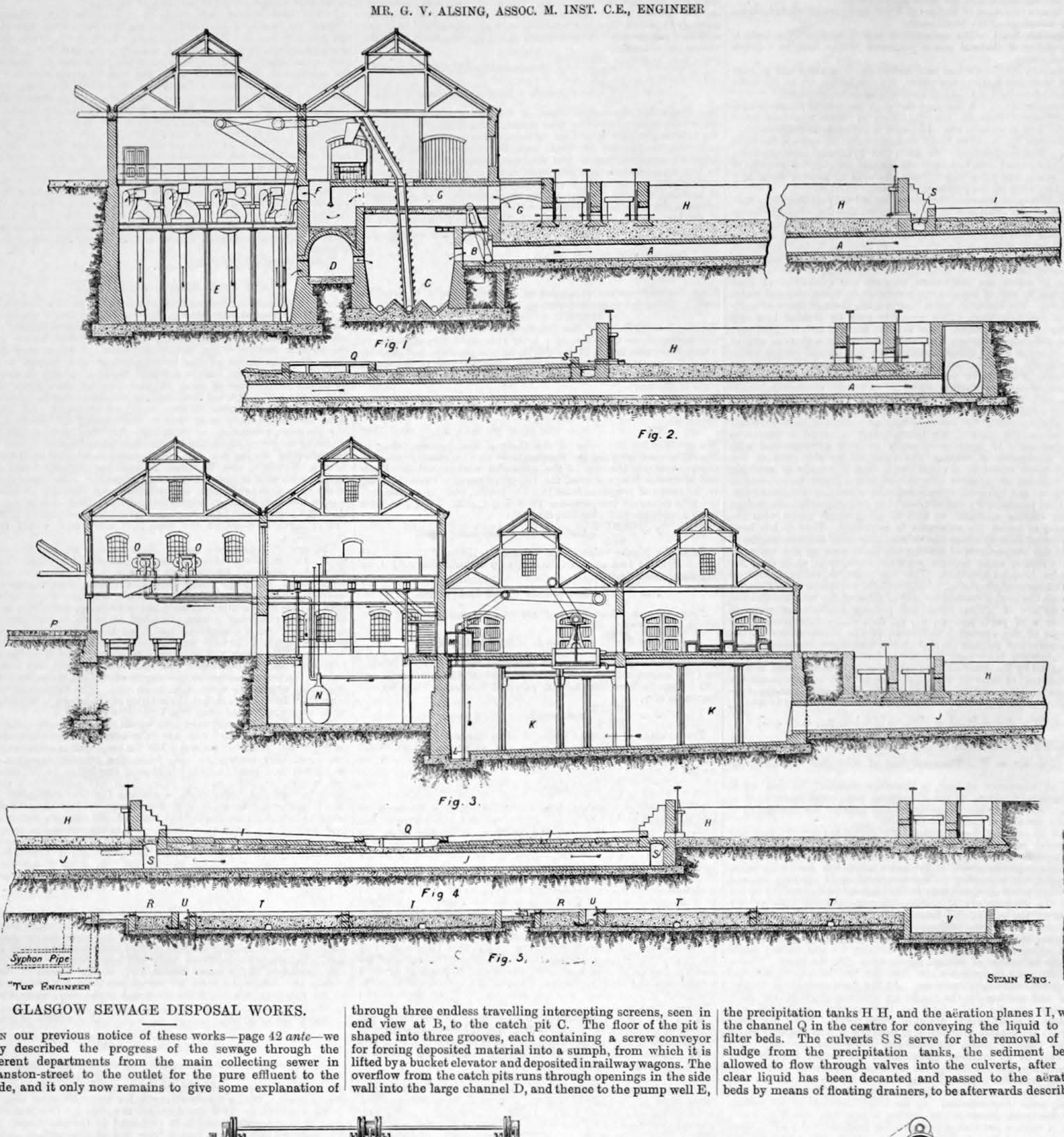
Wortley Ironworks, near Sheffield.

[It seems possible, however, that German engineers are compelled to accept these low steels simply because German makers do not know how to produce higher steels which are trustworthy.—ED. E.]

THE Select Committee of the House of Commons which has been considering the Southwark and Vauxhall Company's Bill announced on Tuesday that they considered the preamble proved, but might, when dealing with the clauses, have to suggest that the extent of the proposed works should be modified. Nor did they wish to prejudice the question of the acquisition of the London water supply by a competent water authority.

THE GLASGOW SEWAGE DISPOSAL WORKS

MR. G. V. ALSING, ASSOC. M. INST. C.E., ENGINEER



GLASGOW SEWAGE DISPOSAL WORKS.

IN our previous notice of these works—page 42 *ante*—we fully described the progress of the sewage through the different departments from the main collecting sewer in Swanston-street to the outlet for the pure effluent to the Clyde, and it only now remains to give some explanation of the accompanying sectional drawings of the machinery building, &c., which in conjunction with the description and plans already published will, we hope, render the structural arrangements and *modus operandi* perfectly clear. Fig. 1 is a sectional elevation of the machinery building through one of the two catch pits and the pump-room. The sewage, after passing from Swanston-street under the precipitation and aëration tanks by the channel A, as shown in Fig. 2, flows through three endless travelling intercepting screens, seen in end view at B, to the catch pit C. The floor of the pit is shaped into three grooves, each containing a screw conveyor for forcing deposited material into a sumph, from which it is lifted by a bucket elevator and deposited in railway wagons. The overflow from the catch pits runs through openings in the side wall into the large channel D, and thence to the pump well E, from which it is raised by centrifugal pumps and discharged through a large cast iron main into the mixing pit F. In this chamber the chemicals required to effect the precipitation of matter held in solution are added, the treated liquid afterwards flowing by way of the channel G G, to the north end of the precipitation tanks H H, to which it is admitted for either the intermittent or continuous modes of operating, as described in our first article. Fig. 2 shows a sectional view of the precipitation tanks H H, and the aëration planes I I, with the channel Q in the centre for conveying the liquid to the filter beds. The culverts S S serve for the removal of the sludge from the precipitation tanks, the sediment being allowed to flow through valves into the culverts, after the clear liquid has been decanted and passed to the aëration beds by means of floating drainers, to be afterwards described.

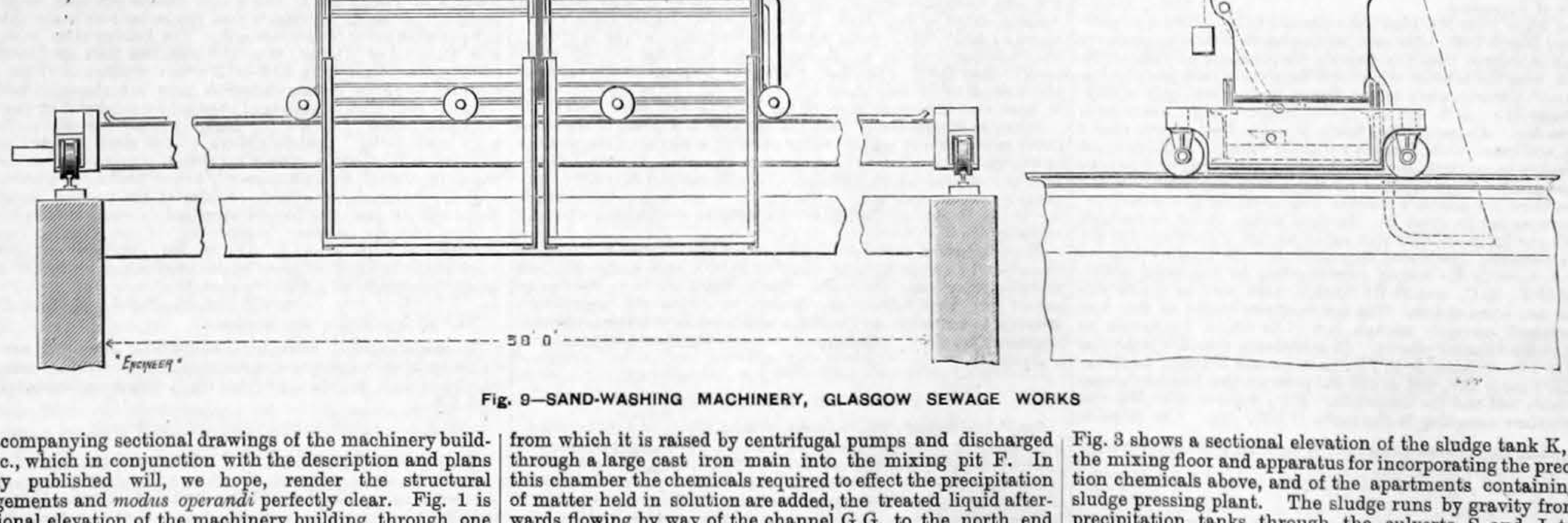


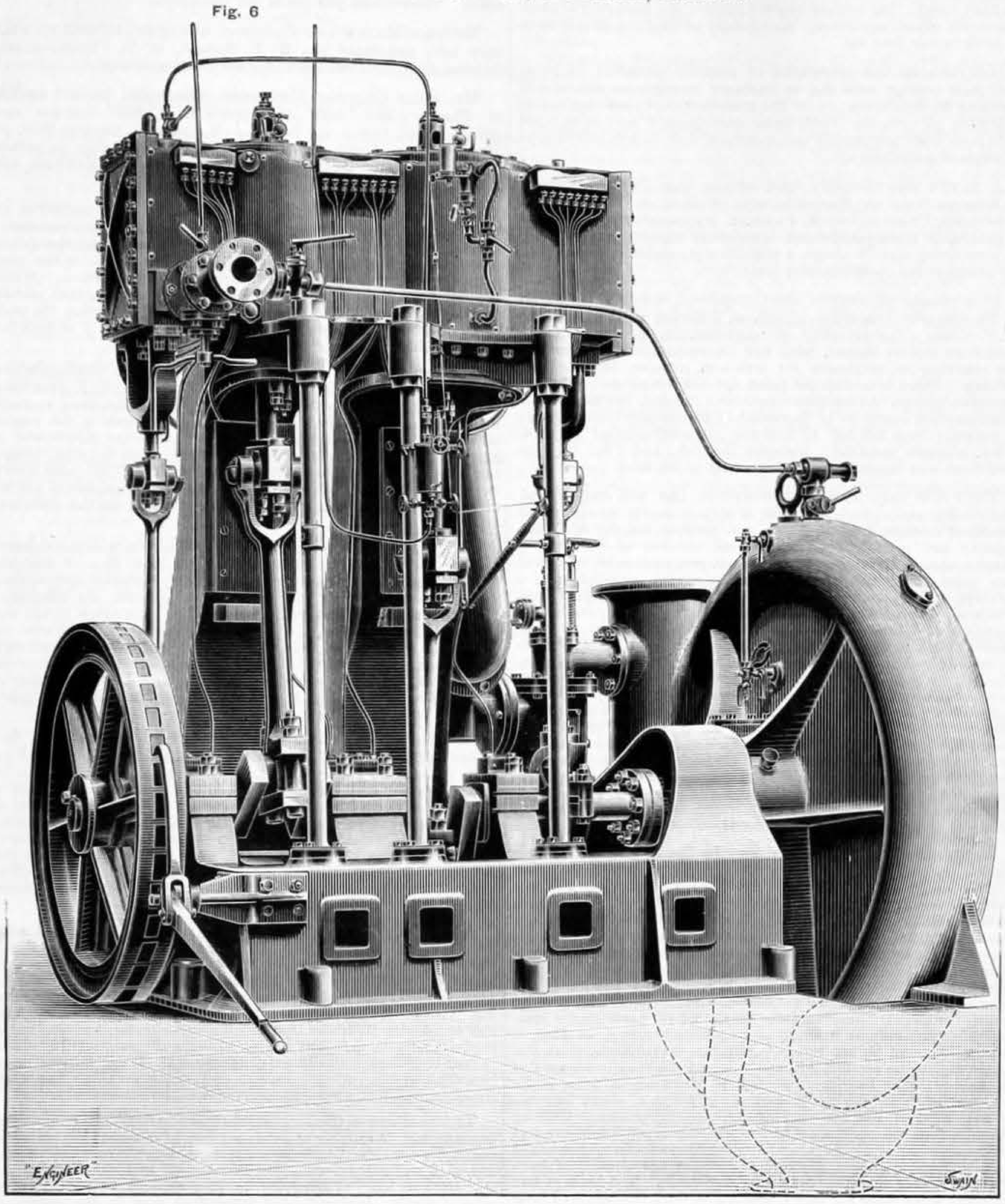
Fig. 9—SAND-WASHING MACHINERY, GLASGOW SEWAGE WORKS

Fig. 3 shows a sectional elevation of the sludge tank K, with the mixing floor and apparatus for incorporating the precipitation chemicals above, and of the apartments containing the sludge pressing plant. The sludge runs by gravity from the precipitation tanks through the culverts S and J to the reservoir K, which has a capacity equal to a twenty-four hours' supply. From the sumph L, at the left hand side of the tank, the sludge is lifted by means of two chain pumps to

CENTRIFUGAL PUMPING ENGINE

MESSRS. DRYSDALE AND CO., ENGINEERS, GLASGOW

Fig. 6



the mixer M on the floor above, in which it is thoroughly stirred with a quantity of either lime or charcoal, after which it flows through pipes to the sludge rams N. From the rams the sludge is forced by compressed air to the filter presses O O, on the upper floor of the building; the compressed cake falling through shoots into railway wagons below. To the left of the railway siding a loading bank P has been formed to facilitate the dispatch of dry refuse collected by the city cleansing department, along with the sludge cake, to the Corporation farms in the country. Fig. 4 shows a section through the precipitation tanks and the aëration beds in the line of the channel J, which conveys the sludge from the collecting culverts S S, to the sludge tank K. Fig. 5 shows two sets of filter beds in section. The strained and aërated liquid, after passing under Swanston-street by the syphon pipe shown in dotted lines, passes first through the coke filter R, and thence by way of the channel U to the sand filters T T, where the last traces of impurity are removed. The liquid reaches the second set of filters by a distributing channel, passing from the syphon pipe about midway between the filter beds, and communicating on either side with the channels shown to the left of the coke filters. After percolating through the beds of graduated filtering materials, the clarified liquid finds its way by numerous division channels to the main outflow watercourse V, which carries the effluent to the Clyde.

Fig. 6 represents one of the largest of the centrifugal pumping engines made by Messrs. Drysdale and Co., of the Bon-Accord Engine Works, Glasgow, for lifting the sewage from the pump well to the mixing pit in the machinery building. The four large pumps, jointly capable of raising 1,120,000 gallons per hour to a height of 28ft. with a steam pressure of 100 lb. per square inch, are all similar in design to that shown in our illustration, two of them being adapted for 15in. and two for 18in. suction and delivery pipes. The engines, representing a total of about 350 indicated horse-power, embody the latest improvements, all working parts being arranged to secure great strength and accessibility. The crank shafts are cut out of solid steel forgings, and all bearings are of bronze lined with white metal. The cylinders are fitted with patent pistons, sight-feed lubricators, and improved relief valves; and lagged and covered externally with planished sheet steel. A novel hand barring gear is provided for turning the engines, and patent ejector condensers are fitted, so that they can be worked either condensing or non-condensing as desired, by simply turning a hand-wheel. The centrifugal pumps, which have been carefully designed for the special duty required, with a view to securing high efficiency and small frictional losses, are fitted with patent improved charging appliances and the necessary sight glasses. Similar installations of pumps and engines have been supplied by the same makers to the London County Council for the metropolitan main drainage stations at Barking and Pimlico; also for main drainage stations at Dublin, Belfast, and other places, with, we understand in all cases, highly satisfactory results. In addition to the four main pumping engines described above, Messrs. Drysdale and Co. have supplied the Glasgow works with two smaller belt-driven pumps, seen to the right hand of the installation in Fig. 1, delivering into a pipe in communication with the lime mixers, which raise the total pumping capacity to one and a-quarter million gallons per hour.

Figs. 7 and 8 show respectively an elevation and a plan of the floating drainers supplied by the Glenfield Company, Kilmarnock, for emptying the clear liquid from the surface of the precipitation tanks after the sludge has settled to the bottom. They are designed for placing close to the sides of the tanks so as to be easily operated by men standing on the division walls. The drainers are controlled by means of double-faced sluice valves, operated by rods passing through pillars placed on the walls, with hand wheels for opening and closing. Before the sewage is admitted to the tanks the arms are drawn up to an almost vertical position and fixed by chains to the pillars. After precipitation has sufficiently advanced the arms are lowered, and the cocks on the pillars of the sluice valves opened to allow water to enter and sink the arms till the floats rest on the surface of the liquid. The floats keep the open mouths of the arms just below the surface of the water, the arms sinking with the liquid till the floats rest on the sludge, after which the arms are again hauled up and fixed to the pillars to await the refilling of the tanks. By this method of surface draining considerable time is saved, and all risk of disturbing the settled sludge is avoided.

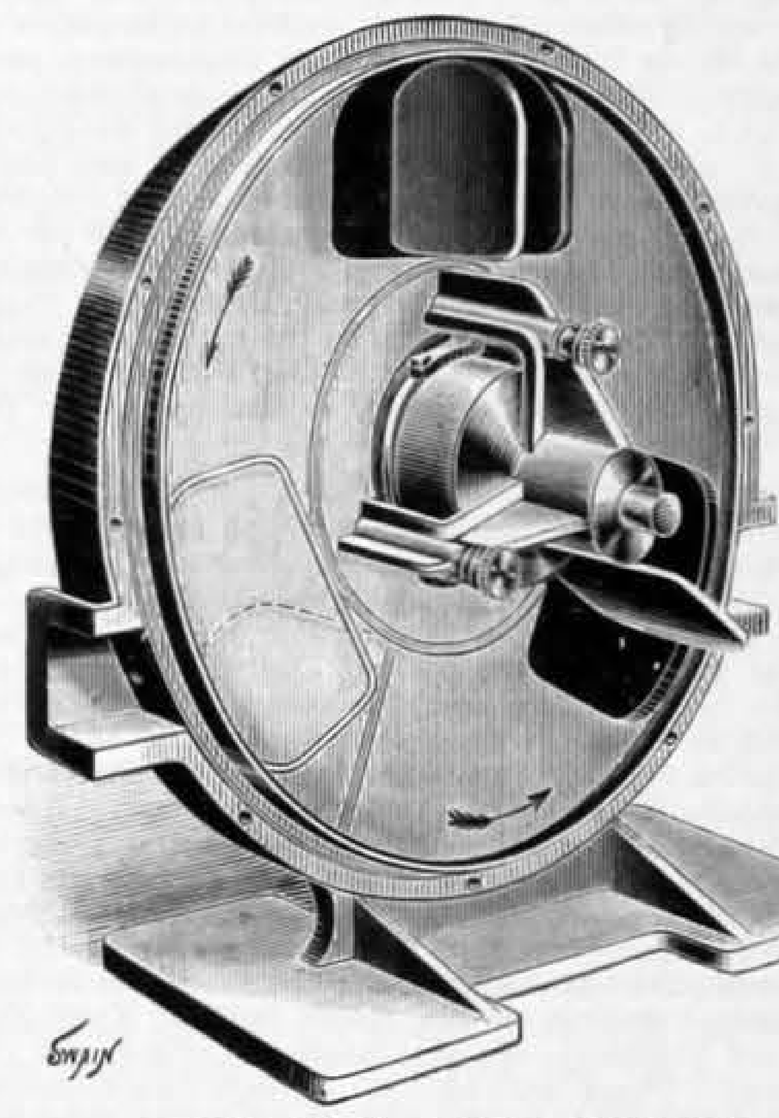
Fig. 9 gives a general view of a novel sand-washing machine employed for cleansing the filtering material, which has also been made by the Glenfield Company. As the filter beds cover a large area, the moving of impregnated sand to and from the ordinary stationary washing-box would have formed a serious item of expense. The washing vessel is mounted, in this case, on a travelling carriage, which runs on movable rails placed as required along the walls of the filters. The wheels of the carriage are made to turn at right angles, so that the entire apparatus is not only able to travel from end to end of a series of filter beds, but can at will be transferred from one series to another. When the spot to be operated upon is reached, the movable wooden platform of the machine is lowered to within a few inches of the surface of the filter. The workmen then easily throw the soiled sand on to the perforated inner bottom of the washing-box. A current of gravitation water led to the machine by a hose passes upwards through the sand and speedily cleanses it, the dirty water being returned by another hose to the surface of the coke filters. The front plates of the washing vessel are formed as sluice doors with suitable gear for opening, and when the washing is completed the doors are raised and the sand falls back into the filter, the whole operation being rapidly, cheaply, and effectively performed.

The Dalmarnock sewage works, which it may be mentioned have been effectively lighted with incandescent and arc lamps by the staff of the Corporation electric lighting department, were formally opened by the Lord Provost on the 2nd inst.; but they have already been long enough in experimental operation to show that they are easily capable of performing the duty expected of them, viz., the purification of the sewage from the eastern portion of Glasgow, amounting to about one-fifth of the city's total production. The entire establishment has been constructed to the designs, and under the superintendence of, Mr. G. V. Alsing, A.M.I.C.E., and when in ordinary operation the works will be under the control of the Corporation cleansing department, the practical management devolving on Mr. T. Melvin, who has acted as clerk of works since the commencement of operations two years ago. As to further steps likely to be taken in the direction of dealing with the sewage from other parts of the city, nothing is as yet definitely decided; but it is not improbable that other similar works, to deal with the western drainage, may ere long be commenced at Dalmuir, where the Corporation owns about 200 acres of suitable land, purchased a number of years ago at a cost of £110,000, for the purpose of forming a sewage farm; an intention, it is hardly necessary to say, long since abandoned.

GROOMBRIDGE'S SLOW SPEED DIRECT-ACTING FAN.

THIS fan, which is illustrated by the engraving below, is non-centrifugal, but is constructed with a rotary disc, having apertures in which are mounted feathering or swivelling vanes acting as pistons, and working in an annular casing formed with a diaphragm or partition near the outlet, preventing the return to the inlet of the air drawn into the machine. The vanes are mounted on spindles provided with cranks or arms which engage in a cam groove or path formed in the cylindrical surface of a stationary boss, arranged concentrically with the annular disc.

The shape of the cam groove or path is such as to keep the vanes at right angles to the disc during a portion of each revolution, but to cause them to feather or swivel and lie flush with the surface of the disc in the apertures therein, and so enable them to pass through the diaphragm or partition. The annular casing is formed in two parts or halves



FRONT VIEW—COVER REMOVED

which are situated on opposite sides of the disc, and the diaphragm consists of two internal projections, one on each of the said parts or halves, so that when the casing is fitted together a gap or space is left between them, to allow passage to the disc and vanes in their movement of rotation, but which gap or space is in reality always filled by the rotary disc or a vane therein, and so prevents the air returning to the inlet. The working of the fan is as follows:—The disc being set in motion, the vanes are caused to travel round the

COVER SHOWING DIAPHRAGM

annular chamber or casing, and are guided by the cam groove into a position of right angles with the disc, and transversely to the annular chamber or casing, while they are caused by the cam groove at the proper time to feather and turn flush with the disc, so as to pass through the diaphragm, after which they return to their former position, so that as they pass the air inlet they occupy a position at right angles to the disc. In this way air is drawn in behind each vane, and is carried round the annular casing or chamber by the vanes, and striking against the diaphragm is forced through the outlet. The vanes correspond in shape to the cross section of the annular casing.

One of these fans has been made by Messrs. Wailes, of Euston-road, London, by whom it is worked at 320 revolutions per minute, at which speed, we are informed, it gives an air pressure of 23in. of water. Mr. Chas. Groombridge, Enfield, is the inventor.

RAILWAY MATTERS.

THE Gold Car system of heating carriages by steam from the engine, which has been in operation upon the Manchester, Sheffield, and Lincolnshire Railway, is now about to be adopted throughout upon the system of the Manchester South Junction and Altrincham Railway, which runs between Manchester and Bowdon, and the carriages will be fitted up in time to be brought into use next winter.

THE improvements in preparation by the North-Eastern Railway Company at Sunderland Station do not meet with the approval of the Corporation, who have instructed their town clerk to inform the company that the alterations to be made are totally inadequate to meet the needs of the town, and that, short of an entirely new station, the only satisfactory plan would be the extension of the existing station westward.

IN Europe no railway accident of importance, in which petroleum has played a part, has occurred since that at Abergele. History has, however, repeated itself, and at ten o'clock on the night of the 1st inst. the Paris-Amsterdam express came into collision with a goods train between the villages of Zwyndrecht and Barendrecht, in the province of South Holland. Some of the trucks of the goods train were laden with petroleum, which at once caught fire, and a large number of the carriages of the express were burned. According to Reuter the engine-driver and the stoker of the express were both seriously injured, and six of the passengers received slight hurts. Other accounts speak of a large number of injured. The mails for Amsterdam were saved.

IN a Board of Trade report on the accident at the public road level-crossing near Altrincham Station, and to the desirability of substituting a bridge for the crossing, it is stated by the manager of the railway that the present is the first case of personal injury sustained at the crossing during the twenty-four years he has been manager. Major-General Hutchinson describes the accident, which was due to a misunderstanding between the driver and guard of a ballast engine train, and then refers to the proposed substitution of a new foot-bridge for an existing one, which people will not use. One proposed arrangement would cost the company £20,000, and even then would not be as convenient as a subway, which the inspector suggests would be better for foot passengers, perambulators, and cycles, which cannot use the present step bridge.

THE Belgian State Railroads had 2018 miles of road at the end of 1892, 2091 locomotives, 1287 tenders, 2841 passenger cars, 577 baggage cars, 43,710 freight cars, and 916 stations—a station for every 2¼ miles. The total number of employés of all grades was 42,881, or 20·5 per mile of road, four times as many as in this country. The train movement was equivalent to 9·74 passenger trains, and 7·10 freight trains each way daily, with an average of 7·51 passenger cars, and 17·46 freight cars per train. Further progress was made in reducing the Sunday freight train movement. In 1891 out of 1621 freight trains 1442—89 per cent.—did not run Sunday; in 1892, 1505 out of 1639, or 91·7 per cent. The respectable sum of 107,776 dols. was received for "platform tickets," that is, tickets which authorise the holder not to ride, but to pass through the station to the platform in front where passengers get off and on the train, to accompany his friends, offer his services, &c.

THE Great Eastern Railway Company announces that for the accommodation of passenger and live stock traffic to and from the Royal Agricultural Society's show at Cambridge it is erecting an extensive new station at Mill-road, which will be nearer to the show ground than the present station. It has also been arranged that stock from any part of England and Scotland consigned by the Great Eastern Company's route will be conveyed in through vehicles. Special arrangements will be made for the prompt despatch of return show traffic. In addition to the ordinary excellent fixed service of express trains between Liverpool-street, St. Pancras, and Cambridge, extra fast trains will be run. Great Eastern through express trains will also be run between York, Doncaster, Lincoln, and Cambridge, enabling passengers to travel without change of carriage between these points and affording direct communication with the principal places in Scotland, and the principal stations on the North British, North-Eastern, Lancashire and Yorkshire, and Manchester, Sheffield, and Lincolnshire Railways. There will also be through communication for passenger and live stock traffic with the London, Brighton, and South Coast and South-Eastern Railways, *viâ* the East London Line and Liverpool-street, and for live stock traffic with the London and South-Western Railway, *viâ* Kentish Town, and the Great Western Railway, *viâ* Victoria Park and Acton. Through tickets will be issued between the principal places in England and Cambridge.

A SPACIOUS harbour, a city on sand and arid cliffs, a dry and sand-logged stretch of maritime plain, two enclosing rivers, and a magnificent Hinterland. Such is the heart of Angola, Portugal's most important colony, as described by the British Consul at Loanda, who thus reports on the railway in course of construction in the district. It will not work miracles, but it will reduce the expense of transporting coffee to the coast from 1½d. per pound to about ½d., provided that the owners of estates and local dealers can find means of getting the produce to the line economically, and will for ever keep out of their account books such astounding items as £7 10s. for the carriage of a barrel of cement worth 14s. Nearly eight years have elapsed since work on it first began, and the terminus is not expected to be reached before the close of 1895. Dividing the distance by nine gives an average advance of 125 yards per day, which cannot be called a brilliant achievement. The gauge of the line is metre, and the cost of the line has been at the rate of £4182 a mile. The material is all of Belgian manufacture. Trains are now running regularly over 162 miles of the total projection of 230 miles, and the first load of coffee was brought down a few weeks ago. Before the next crop is ready for transport Cazengo and Golungo Alto will have the permanent way laid straight between them. The third-class passenger is charged less than 1d. a mile, and the second three times as much, while a first-class passenger and a ton of coffee are considered equivalents, each being tariffed at 4d. For some kinds of goods, says the *Railway News*, such as building materials, the rate is as low as 2½d. per ton.

WRITING on the cost of working Liverpool Overhead Railway, a correspondent says:—In the *Railroad Gazette* of March 16th, page 190, appears a table giving the cost of working, &c. of the Liverpool Overhead Railway, from which I rearranged the following little table:—

	Train miles.	Pence.	Cents.
July	39,250	3·441	6·978
August	41,430	3·701	7·612
September	40,640	4·075	8·364

Hence during these three months 121,320 train miles averaged 3·743d., or 7·591c. per train mile. On page 193 you publish an abstract of the first half-yearly report ending December 31st, 1893. The train mileage, 243,539, is pretty close to twice that of the three months mentioned. The operating expenses were £13,773 sterling, which is 13·573d., or 27·526c., per train mile; that is 3⅝ times as much as the mean cost given in the table. Of course, one who is familiar with these matters will see that the costs summed up in the table cover only the items there specified, and he will notice that a good many items which cause expense somewhat near that arising from the items tabulated have been omitted. The trains are composed of two light cars each. The latest analysis of the cost per train mile on the Manhattan Railway of New York which I have at hand, is for the year ending September 30th, 1887. Assuming that these trains were made up of four cars, the cost for trains of two cars would be as follows: Motive power, 12·6; cars, 5·72; station and other expenses, 6·95; way and structure, 2·86; general, 2·87; total, 31 cents.

NOTES AND MEMORANDA.

WRITING in a German paper, a brewer attributes disastrous results obtained in a brewery to the employment of the lac-lined casks. The lac had become porous, and teemed with wild yeasts and other organisms. He strongly advises the employment of pitch rather than lac.

WRITING on the structure of certain varieties of rust, and their analogy with the sedimentary ferruginous minerals of Lorraine, M. Bleicher says:—"The combination of ferric hydroxide and silica in presence of soft water underground may be so rapid as to form rusts comparable in appearance and structure with iron minerals of geological age."

A PAPER was recently read before the Paris Academy of Sciences "On an Electrochemical Method of Observation of Alternating Currents," by M. P. Janet. By means of paper soaked in potassium ferrocyanide and ammonium nitrate, and wrapped on a revolving metallic drum, a metallic style registers the periodic variations of the electro-motive force.

IN a recent number of the *Comptes Rendus* is a paper on the magnetic properties of iron at different temperatures by M. P. Curie. The intensity of magnetisation slowly decreases, then more rapidly lessens, with rise in temperature, the rate of loss attaining its maximum for soft iron between 740 deg. and 750 deg. There is no definite point for the *temperature of transformation of iron*. At temperatures above 750 deg. the intensity of magnetisation continues to decrease at a continually lessening rate in general; from 950 deg. to 1280 deg. the coefficient of magnetisation is almost constant. Between 755 deg. and 1365 deg. the coefficient is independent of the intensity of the field.

THAT it is easy to find microbes in the soil capable of assimilating atmospheric nitrogen, if culture media devoid of all combined nitrogen are employed, was pointed out by M. Winogradsky last summer, and in a recent number of the *Comptes Rendus* an account is given of important progress made by him in this most interesting subject. By progressive cultivation of a mixture of microbes derived from soil, in a nutritive liquid from which all traces of combined nitrogen were carefully excluded, *Nature* says, Winogradsky reduced the varieties present to three bacilli, of which one was finally separated out and discovered to be endowed with this function of assimilating atmospheric nitrogen. This organism is strictly anaërobic, and will not grow in either broth or gelatine. It ferments glucose, producing butyric, acetic, and carbonic acid, and hydrogen. The amount of atmospheric nitrogen assimilated is proportional to the quantity of glucose contained in the culture material, and which undergoes decomposition in the presence of this bacillus. Winogradsky concludes his paper by suggesting that this phenomenon of the fixation of atmospheric nitrogen may be due to the union within the living protoplasm of the microbial cell, of atmospheric nitrogen and nascent hydrogen, resulting in the synthesis of ammonia.

IN an article on the machinery in the Postal Telegraph Cable Company, New York, the *Electrical World* describes a lift in which the ball threaded nut is used. The only points of contact between the nut and screw are by a chain of balls, which occupy twelve threads, and enter and leave the ends of the nut through a tube, which takes the balls as they leave one end and returns them to the other end at a tangent to the line of travel between the threads of nut and screw. This is one of the most vital points of the elevator apparatus, and herein lies one of the most potent reasons of its success—the reduction of friction by rolling instead of sliding surfaces on almost all parts under pressure—for not only is the nut so constituted, being, in fact, a developed spiral thrust bearing, but the thrust bearing at the motor end of the screw is taken on balls and the sheaves are carried on ball or roller bearings. So free is this machine from static friction that it is possible to start the lift with a slight increase of current over the normal hoisting current, provided time be taken so that the work done in acceleration is small compared to the work of lifting. A test was recently made on a Fairbanks testing machine in New York to determine the liability of balls crushing under normal or extra working strain. Ten balls of two different make were put under crushing strains, and required from 20,000 lb. to 40,000 lb. to break each of them. The working pressure varies from 50 lb. to 125 lb. per ball.

IN the course of a lecture at the Royal Institution, Professor J. A. Fleming described various electric generating stations in this country, including those at Liverpool, Glasgow, and St. Pancras, and the plant used in transmitting 2000-horse power from the Falls of the Anio, at Tivoli, for eighteen miles over the Campagna to Rome. From the upper levels of the Anio an aqueduct has been led which delivers water to the top of an iron pipe 150ft. above the power-house. This power-house is placed about halfway down the declivity on which are situated the famous cascades of Tivoli. The pipe is about two metres in diameter and can deliver 100 to 150 cubic feet of water a second with a head of 150ft., or nearly 2000-horse power. The water is conducted to a series of nine Girard turbines, six being of 350 and three of 50-horse power. The six larger ones are directly connected with Ganz alternators, which generate a current of electricity at a pressure of 6000 volts, while the three smaller ones are used to drive the exciters. The current is conveyed to Rome by four cables carried on 760 posts, which are placed in a straight line across the Campagna. Outside the Porta Pia at Rome it enters a transformer-house, where its pressure is reduced from 5000 to 2000 volts. Part is then used for arc lighting in the streets of Rome, and the rest is distributed by underground cables to various other centres, where it is again transformed down to a pressure of 100 volts for use in houses. About twenty thousand incandescent lamps are thus supplied with current.

AT a recent meeting of the Kaiserliche Akademie der Wissenschaften of Vienna, Prof. Klemencic read a paper on "The Magnetisation of Iron and Nickel Wires by Rapid Electrical Oscillations." From the amount of heat developed in a wire of a magnetic material traversed by electrical oscillations the author calculates, by means of the formula given by Lord Rayleigh and Stefen, the value of μ (the permeability). The heat developed in the wire under observation was determined by means of a thermoelectric couple, and was compared with the heat developed in a non-magnetic wire under similar circumstances. The following are some of the values obtained for μ:—Soft iron 118; steel wire, soft 106, hard 115; Bessemer steel, soft 77, hard 74; nickel 27. These values agree very well with those obtained by Lord Rayleigh and Bauer for very feeble magnetising forces. The results obtained by these observers show that for certain values of the magnetising force the permeability is constant, and that it afterwards rapidly increases. Now the results obtained by the author show that over the range he is employing μ has a constant value. This fact, *Nature* says, may be explained either by supposing that the magnetising forces employed are so small that we are dealing with that part of the curve where μ is constant, or that, although the magnetising forces are much greater than those to which the former supposition limits us, the magnetisation is unable to follow the rapid changes in the magnetising force, so that the magnetisation never reaches that part of the curve where μ is variable and has very much greater values. A rough estimation has shown that, at least on the surface of the wire and at the commencement of the oscillations, the magnetising force exceeds more than a hundredfold the maximum limit within which μ is constant. Thus in these experiments there must exist a time lag in the magnetisation which must not be confused with the hysteresis. It would also appear that Bauer and Lord Rayleigh's results which refer to longitudinal magnetisation, also apply to circular magnetisation.

MISCELLANEA.

MESSRS. NEWTON, CHAMBERS, AND Co. (Limited), have closed one of their pits, working a section of the Thorncliffe thin seam. Their others pits are in full operation.

MESSRS. MAVOR AND COULSON, Glasgow, inform us that they have appointed Mr. H. T. Barnett, of 53, Victoria-street, London, S.W., as their agent for the London district.

MR. JOHN CLAYTON MEWBURN, chartered patent agent, of Chancery-lane, and Mr. George Beloe Ellis, solicitor and patent agent, late of the firm of J. H. Johnson, Son and Ellis, of Lincoln's Inn Fields, have entered into partnership as patent agents, and will practice under the style of J. C. Mewburn and Ellis.

ON Monday afternoon a serious accident occurred in the shaft of a new colliery at Glasshoughton, near Castleford. Eleven men were at the bottom engaged in sinking operations when the scaffolding suddenly fell in. The whole of the men were injured, and two of them buried under the *débris*. While repairing the wrecked shaft on the following day another mishap caused four men to have a narrow escape through having the platform on which they were working carried away by a sudden fall of earth, timber, and brickwork.

THE engineering operations of the South Staffordshire Mines Drainage Commission for the month ending April 27 have been of a steady and satisfactory nature. The Commissioners, at their monthly meeting on Wednesday last, were informed in the report of the engineer to the Tipton district—Mr. Edward Howl—who is also the general manager of the Commission, that the eight pumping engines had raised 8,929,009 gallons, or 39,860 tons every twenty-four hours. But, notwithstanding the low rainfall of 1·81in. of rain, there had been no diminution of water at the principal engines.

A NEW design for wheel-cutting machines, which has been recently introduced by Messrs. G. Birch and Co., of Salford, possesses some special features which it may be interesting to notice. In this machine, which will take wheels up to 2ft. 6in. diameter, the dividing head is traversed along the bed by a screw to suit the different sizes of blanks, the end of the screw being fitted with an adjustable micrometer, which has one edge divided for ordinary rule measurements, whilst the other reads to one thousandth of an inch. This appliance saves considerable time in the cutting of wheels, &c., as it enables the cutter to be fitted into the exact depth of tooth at the first cut.

AT Rheims an electric lighting station has been installed in the gasworks, and the Brown dynamos, constructed by MM. Wheyer et Richemond, are driven by gas engines, two of 50-horse power, two with two cylinders of 80-horse power, and a single-cylinder engine of 45-horse power. The regular working of the engines has permitted, with the addition of an automatic starting arrangement, of suppression of the electric accumulators; and the light is, we are informed, very steady, even when the motors only work with one-fifth of their full charge. The kilowatt costs 1 f. 21 c., or nearly a shilling; but the price is to be reduced as the number of subscribers increases.

A LOCAL Government Board inquiry was held on Thursday, the 26th ult., by Mr. Rienzi Walton, M. Inst. C.E., at the Board Room, Main Drainage Works, Mortlake, with reference to an application by the Richmond Main Sewerage Board to borrow £7500 for additional works. There was no opposition. The plans of the proposed works were explained by Mr. William Fairley, Assoc. M. Inst. C.E., F.G.S., the engineer, and include a triple expansion pumping engine capable of pumping 12 million gallons in 24 hours, additional sludge presses, to be worked on a combined system of air pressure and direct pumping, screening chamber outfall to river, storm overflows, and other works.

THE position of the shipbuilding trade of the Clyde is very encouraging. A number of good contracts have again been placed in the past week. The Admiralty orders have been increased by the addition of half-a-dozen second-class cruisers, and the Government work now on hand is admitted to give the Clyde a fair share of what is going. It is estimated altogether that in the course of April no less than 70,000 tons of new shipping was placed with Clyde builders, compared with 20,000 in the same month of 1893. The output from the Clyde yards in the last four months embraces sixty-five vessels, with an aggregate of 91,183 tons, compared with seventy-three vessels and 67,362 tons in the corresponding period of last year.

THE mechanical perfection which has been reached in the construction of the modern bicycle and tricycle is shown by the long journeys men now take with a feeling of certainty of completing them. On Monday morning, the 23rd, the cyclists, Herr Gerger, of Gratz, M. Perrodile, of the *Petit Journal*, and M. Villaume, described as Secretary or Attaché to the British Embassy in Paris, started from Paris for Vienna and Gratz. The distance is about 1300 kiloms., or 815 miles Next month a run is to be made as between Milan and Munich—590 kiloms.—over the Tyrolean Alps, with a maximum height of 1239 m. The express train covers the distance in twenty-two hours, and the cyclists expected to take twenty-seven hours.

SOME months ago a serious landslip occurred at Gohna, in the Gurhwal district of Bengal, blocking the flow of a considerable river and converting a valley into a huge lake. Since then the water has been gradually rising, and it is feared that when it overtops the dam it will carry it away, notwithstanding the enormous thickness of the latter, and cause a most destructive flood. The *Times* Calcutta correspondent says a temporary telegraph line is now being constructed from Hurdwar to the spot in order to give timely warning to the people inhabiting the threatened tracts; but apparently no measures are being taken to try and avert what may be a terrible disaster. The water is still 200ft. below the top of the dam, but it may now be expected to rise rapidly, as the snow will soon melt with the advance of the season.

THE annual meeting of the South Wales Institute of Engineers was held in Cardiff on Tuesday, Mr. A. Hood presiding. It was announced that Mr. T. Forster Brown had retired from the presidency of the council, and the members appointed Mr. A. J. Stevens, Newport, to the vacancy, Messrs. John Bate, T. H. Riches, M. Lee, vice-presidents. Several interesting papers were read and discussed. At the postprandial proceedings, in responding to the toast of the Welsh coal and iron trades, Mr. Morgan remarked that they were only in their infancy. Cardiff had a great future before it. It had been said that their coal would only last 100 years, but he thought 1500 years nearer the mark. Professor Elliot, commenting, said that in either case the cost of coal must increase, and economy should be studied.

THE yearly report of the Hamburg-American Steamship Company states that four powerful double-screw steamers have been contracted for to be employed in the Atlantic service. Two of them—each 445ft. long, 52ft. broad, and 34ft. deep—are to be built by Messrs. Harland and Wolff, of Belfast, and will be named the Prussia and the Persia. The other two, contracted for respectively with the Vulcan Works, at Stettin, and Messrs. Blohm and Voss, of Hamburg, will have a length of 460ft., a breadth of 52ft., and a depth of 35ft. These steamers, which can, says the report, be fitted up for carrying 2500 steerage passengers, and which, by the full use of their space, will be able to load with close on 7500 tons weight, are, by the use of the newest improvements and inventions, so economical in their working that a speed of thirteen miles an hour on a coal consumption of about 55 to 60 tons per day is guaranteed.

PUBLISHER'S NOTICE.

*** *With this week's number is issued as a Supplement a Two-page Engraving of the Triple-expansion Engines of the Turret Age. Every copy as issued by the Publisher includes a copy of the Supplement, and subscribers are requested to notify the fact should they not receive it. Price 6d.*

CONTENTS.

THE ENGINEER, May 4th, 1894.

TO CORRESPONDENTS.

Registered Telegraphic Address, "ENGINEER NEWSPAPER, LONDON."

*** *In order to avoid trouble and confusion, we find it necessary to inform correspondents that letters of inquiry addressed to the public, and intended for insertion in this column, must in all cases be accompanied by a large envelope legibly directed by the writer to himself, and bearing a penny postage stamp, 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.*

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

*** *All letters intended for insertion in* THE ENGINEER, *or containing questions, 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.*

F.P. (Bedford-row).—*We fear we do not understand what you mean by flat surfaces. If you refer to dead wood, keels, garboard strakes, and such like, our reply to your question is that you have only to refer to any treatise or paper dealing with the resistance of ships to find all the information available. The late Mr. Froude has dealt exhaustively with the whole subject.*

MELVILLE'S TUBE STOPPER.

(*To the Editor of The Engineer.*)

SIR,—I shall be obliged if you can allow me to ask through the medium of your journal the address of the maker of Melville's tube stoppers.

Leith, May 1st. M. P.

MEETINGS NEXT WEEK.

THE INSTITUTION OF CIVIL ENGINEERS.—Tuesday, May 8th, at 8 p.m. Papers: "The Manufacture of Briquette Fuel," by Mr. William Colquhoun, Assoc. M. Inst. C.E.; "Recent Types of Ferry Steamers," by Mr. Andrew Brown, M. Inst. C.E.; "The Birkenhead Ferry Boats Wirral and Mersey," by Mr. William Carson, M. Inst. C.E.

ROYAL INSTITUTION OF GREAT BRITAIN.—Tuesday, May 8th, at 3 p.m. Paper: "Rubies: Their Nature, Origin, and Metamorphoses," by Prof. J. W. Judd, F.R.S., V.P.G.S. Thursday, May 10th, at 3 p.m. Paper: "The Solid and Liquid States of Matter," by Professor Dewar, M.A., LL.D., F.R.S., M.R.I. Friday, May 11th, at 9 p.m. Paper: "English Folk Song," by Rev. S. Baring-Gould, M.A., with musical illustrations. Saturday, May 12th, at 3 p.m. Paper: "Colour Vision," by Captain Abney, C.B., D.C.L., F.R.S., M.R.I.

THE INSTITUTION OF ELECTRICAL ENGINEERS.—Thursday, May 10th, at 25, Great George-street, Westminster, S.W., at 8 p m. Paper: "The Cost of Electrical Energy," by R. E. Crompton, M. Inst. C.E., Vice-president. Continuation of discussion.

THE JUNIOR ENGINEERING SOCIETY.—Friday, May 11th, at Westminster Palace Hotel, at 8 p.m. Paper: "Engineering Experience at Sea," by Mr. G. Lane, Chief Engineer, and Mr. J. Hawthorn, Extra Chief Engineer.

SOCIETY OF ENGINEERS.—Monday, May 7th, at the Town Hall, Westminster, at 7.30 p m. Paper: "A Deep Boring near Freistadt, Austria, by the Canadian System," by Mr. R. Nelson Boyd, of which the following is a synopsis:—Early methods of boring for minerals—Different systems of boring adopted—The free-fall and American methods compared—Description of arrangements and tools used in different systems of boring—Special object of this deep boring—The discovery of coal in the Austrian part of the Silesian coal field—Depth of the boring 2011ft.—Description of the boring operations—Concluding observations regarding the advantages of the Canadian system of boring.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS.—Tuesday, May 8th, at 7.45 p m. Paper: "Basis of Classification of Vessels Proportioned to their Strength to Resist Bending and Vibration," by Mr. Arthur R. Liddell.

THE INCORPORATED ASSOCIATION OF MUNICIPAL AND COUNTY ENGINEERS.—Saturday, May 12th, at 11.30 a.m. Lancashire and Cheshire District Meeting at Chester. Paper: "Steam Road Rolling," by Mr. Allen Greenwell, A.M.I C.E. Visit city walls, cathedral, and markets. 1.30 p.m. Leave the Groves, Dee Steamboat Co., for Eccleston Ferry. Paper: "The Eaton and Eccleston Sewage Precipitation Works," by Mr. Albert Wollheim, A.M.I.C.E. Visit to Eaton Hall, seat of the Duke of Westminster.

SOCIETY OF ARTS.—Monday, May 7th, at 8 p.m. Cantor lectures. "Typewriting Machines," by Henry Charles Jenkins, A.M. Inst. C.E. Tuesday, May 8th, at 8 p.m. Applied Art Section. Paper: "Pewter," by J. Starkie Gardner. Prof. W. C. Roberts-Austen, C.B., F.R.S., will preside. Wednesday, May 9th, at 8 p m. Twenty-first Ordinary Meeting. Paper: "Telegraphs and Trade Routes in Persia," by Colonel Wells. Sir Frederic J. Goldsmid, K.C.S.I., C.B., will preside.

DEATH.

On the 29th ult., at Kaliemaas, Alleyn Park, West Dulwich, WILLIAM WALKER, M.I.M.E., late of Sourabaya, Java, aged 63.

THE ENGINEER.

MAY 4, 1894.

THE COST OF ELECTRICAL ENERGY.

THERE are few subjects familiar to engineers about which less accurate information is possessed than the cost of electric lighting. The consumer knows all that is, in one sense, to be known; his quarterly bills supply the facts. But the producer is in a totally different position for multifarious reasons, on which it would be unprofitable and wasteful of space to dwell. Mr. Crompton has made a determined and praiseworthy effort to impart information, and it will be generally admitted, we think, that he has succeeded in writing and reading one of the most discussion-creating papers ever produced. It was read on the 26th ult. before the Institution of Electrical Engineers, and we have appropriated its title for this article. The paper is very long. Its discussion has only just commenced, and may no doubt be continued with profit and all the pleasure that can be derived from free fighting. It has already appeared in full, or nearly so, in the pages of our numerous electrical contemporaries. Under the circumstances we make no apology for not reprinting it. But there are particular statements in it which it would not be well to pass by in silence, and we are the more urged to notice them by the fact that Mr. Crompton has, doubtlessly inadvertently, attributed expressions of opinion to THE ENGINEER which are not justified by anything contained in our pages.

Mr. Crompton begins his very clever paper by considering the case of an ideal electric supply works intended to distribute 5,000,000 units of energy per annum. The capital represented will be £500,000, and Mr. Crompton holds that the undertaking ought to earn 7 per cent. per annum on the share capital. He further assumes, playing with some dexterity the troublesome *rôle* of a prophet, that it will be possible to sell electric energy to the public at 3d. per unit, or about one-half the existing rates. Now it forms no part of our purpose to deal with the electrical portion of his paper save in very general terms. We may grant that the efficiency of a dynamo is anything from 90 per cent. up, and so on. The portion of the prophecy with which we are concerned is that which specifies the cost incurred in making the dynamos turn round. In other words, with the initial producers of power—the boilers and steam engines. Mr. Crompton gives a table in which he sets forth the expenditure on various items, and we find at the outset, "Fuel cost per unit sold, 2·5 lb. Welsh coal at 20s. 0·27d." This happens to be about one-third of the quantity of fuel needed in exceptionally well managed electric light works. In 1891, as shown by Mr. Raworth, the consumption was 19 lb. to 22 lb. Mr. Crompton states, however, that cases have come within his own knowledge during the winter months—when, as he admits, the economy of fuel was at its best—when a fuel consumption of 5 lb. per unit sold has been attained. Before going further it is proper to point out that Mr. Crompton's estimate of 2·5 lb. is a through and through estimate. It is intended to cover the whole year's working, and because working in winter is more economical than working in summer, it is clear that this means that something very much less than 2·5 lb. must be reached in winter; and it is this something much less that will have to be contrasted with the minimum of 5 lb. now recorded. When we come to examine the data on which Mr. Crompton bases his prophecy, we fail to find sufficient justification for the assumption. In fairness to the author we reproduce his own words—"I have arrived at my new possible or ideal figure of $2\frac{1}{2}$ lb. of Welsh coal per unit sold in the following manner: I find that we can in London count on obtaining this coal having an average calorific value of 14,500 B.T.U. per pound. With proper arrangements for heating the feed-water to nearly boiling point boilers can be obtained which will evaporate 12 lb. of water at our working pressure of 150 lb. I think that the losses due to irregular working and banking fires can be so minimised that $2\frac{1}{2}$ lb. may evaporate 25 lb. of water into dry steam—not on tests only, but as shown on the monthly bills. Condensing steam engines can and will be made for us using not more than 12 lb. of steam at from three-quarters to full load, or 13 lb. of steam at from half to three-quarters load per indicated horse-power per hour. To these engines dynamos can be coupled direct of such efficiency that the combination will not use more than $18\frac{1}{2}$ lb. to $20\frac{1}{2}$ lb. of steam per unit per hour, measured at the dynamo terminals at the corresponding loads, so that an average of 20 lb. per unit generated may be counted on during the time that these engines are actually at work. This allows for 10 per cent. of the steam evaporated being condensed in the pipes, or used in feed pumps or other obscure sources of loss, and a further 10 per cent. for our distribution loss, in order to account for the 25 lb. of water I require to be evaporated by the boilers." It is only necessary that the case should be thus stated to enable us to realise how utopian is the 2·5 lb. estimate. No boiler generally available for electric light work in towns where space is a consideration can be made to evaporate 12 lb. of water per pound of Welsh coal. We very much doubt that it is possible to make such a boiler at all, save for experimental purposes. The highest efficiency ever recorded is that of the boilers of H.M.S. Janus, designed by Lord Dundonald. These are *said* to have evaporated into steam 13·92 lb. of water. The coal used was hand picked Llangenech, and the heating surface was enormous as compared with the evaporation. But whatever may be possible with a boiler worked steadily at its most economical rate for some hours, it cannot possibly represent the fuel required when the boiler has to lie for hours with fires banked. Nor does it include the cost of getting up steam. If we take the total weight of coal delivered in twelve months at an electric light works, and the total pounds of water fed into the boilers in the same period, and divide the latter by the former, the result will be nearer 7 lb. of steam per pound of coal than 12 lb., or than the revised estimate of 2·5 lb. of coal to 25 lb. of steam. If Mr. Crompton has figures to prove that the highest figure, or anything near, it has been obtained, he will, no doubt, produce them. He has not done so yet. His figures are simply an estimate, and we hold that they certainly are not substantiated by any past experience. But the estimate about the engines is scarcely less sanguine than that about boilers. If these last can make 12 lb. of steam with 1 lb. of coal, and if 12 lb. of steam will develope a horse-power, it is clear that we shall have one horse-power per hour per pound of coal burned. No such result has ever, under any circumstances been attained. A horse-power for 1·5 lb. of coal per hour is generally regarded as the maximum practical performance of the steam engine. It has very rarely been beaten under purely experimental conditions, and the figures are open to doubt then. Condensing engines cannot be made under ordinary electric light work conditions that will use but 12 lb. of steam per horse per hour year in and year out. Nothing of the kind has ever yet been produced. Nor is there any good reason for thinking that it may be, and this we say with full knowledge that a few exceptional engines, working under exceptional conditions, have given an indicated horse-power for something less than 12 lb. of steam. Nothing has been done that can justify Mr. Crompton in framing such an estimate. It is, indeed, more than probable that he has simply advanced the figures to evoke discussion, and that he scarcely intends them to be taken seriously.

We come next to the consideration of the boilers, which are to evaporate 12 lb. of water per pound of coal. He begins by speaking of the locomotive type boiler, which has been very largely used for electric light work, and, although he approves of this in a qualified way, he goes on to make the following remarkable statement:—"This type is in most respects satisfactory; but, on account of the level of the grate-bars being so much below the level of the fire-doors, it is difficult to properly clinker the fires—so much so that when a batch of coal is used that contains much clinker it is very difficult to clean the fires in a reasonable time, so that the evaporative efficiency is thereby much reduced. From this cause the average efficiency of locomotive boilers does not much exceed 7 lb. of water per pound of coal when taken from the monthly bills, and under the conditions usually met with in supply works. It is also not an easy matter to bank the fires of a locomotive boiler in an economical manner." If Mr. Crompton, when specifying for a locomotive boiler, would take the trouble to state that clinkers were likely to be produced, he could be supplied with a grate with a drop end which would save him all worry. Indeed, there are half-a-dozen clinkering grates ready to his hand. But furthermore, there is not the least difficulty in so modifying the ordinary fire hole that it becomes as easy to clinker a grate in a deep fire-box as the furnace of a Lancashire boiler.

Mr. Crompton next proceeds to criticise the Lancashire boiler. We are not concerned to defend it; nor the economic; nor the marine boiler. These are all too well known as tried and valuable generators to need defence. Mr. Crompton pins his faith on the Babcock and Wilcox boiler, and he states that he has got with it an evaporation of $9\frac{3}{4}$ lb. with Welsh coal, a figure which is very probably accurate enough—for a trial. In dealing with forced draught he says: "There is another point to which I wish to call attention. A long and interesting series of articles has recently appeared on water-tube boilers in THE ENGINEER, in the course of which the writer more than once states that it is *impossible to force any of the existing types of water-tube boilers*, as any such forcing invariably results in the production of wet steam, and consequent loss of economy. It is difficult to know how the writer could have formed such an erroneous impression. My own experience is that the works where the best results have been obtained are those where the Babcock and Wilcox boilers have been forced the hardest. At works W, the boilers, which are nominally supposed to evaporate 11,000 lb. of water per hour, have frequently been forced to 16,000, or about 50 per cent. in excess of the duty guaranteed by the makers, and at such times of heavy forcing there has never been any trace of priming or wet steam." The italics are ours. No statement of the kind has appeared in THE ENGINEER, as Mr.

Crompton will see if he does us the honour to read the articles in question again. It is very difficult to understand how Mr. Crompton could make such a mistake, considering how much space we have devoted to a consideration of express boilers, such as those of Thornycroft and Yarrow. What we did say was, that boilers of the Root or Babcock type, with several long inclined tubes delivering into a single header, could not be forced without making wet steam. In order to prevent the wetness from reaching the engines, enormous steam drums are imperatively necessary; and any one who has watched the gradual development of these boilers will find that the size of the drums has gone on augmenting, until instead of the small collecting drum at first used, we now have drums 18ft. or 20ft. long and 4ft. in diameter, and not unfrequently two of them are used with each boiler. The statement made by Mr. Crompton, moreover, concerning the boilers at "Works W" in no way controverts what we have said. There are very many water-tube boilers of the type in use on the Continent, for example, which evaporate 3 lb. of water per square foot of heating surface per hour; we suppose that these might easily enough be made to evaporate 50 per cent. more, or 4·5 lb. per foot per hour. Surely Mr. Crompton would not call this "forcing." However, if Mr. Crompton will adduce figures to prove that any Babcock and Wilcox boiler in an electric light works has converted 8 lb. of water per square foot of surface per hour into dry steam, we will acknowledge that we have fallen into an error, and that such improvements have been effected that the type will stand forcing. We may be permitted to point out, however, that Mr. Thornycroft has got an evaporation nearly three times as great, and that 10 lb. or 12 lb. per square foot per hour is in no way excessive, so that 8 lb. of water per foot represents a very moderate amount of forcing. Interest in the question is caused by the suggestion that in forcing lies the best and simplest method of getting over the bad half hour when maximum power is required. A glance at Professor Kennedy's diagrams in our next impression will explain to the uninitiated what this means.

Here we must stop, but before concluding we wish to add that, although we have criticised certain of Mr. Crompton's statements, we are none the less convinced that his paper is a valuable contribution to our commercial electrical knowledge. Anything that the author has to say, indeed, on such subjects is worth consideration. It is long since a paper so suggestive of topics demanding full discussion has been brought before the public, and we believe that its writer's labours will be very fully appreciated, not in Great Britain only, but on the Continent and in the United States.

GAS AND THE ELECTRIC LIGHT.

THE complaint of the London gas companies that the brilliant weather of the last year or two has prejudicially affected the sale of gas, receives a certain measure of support from the fact that the electric light is alleged to suffer in like manner. Evidence to this effect was given at a recent meeting of the Metropolitan Electric Supply Company, when the chairman, Sir John Pender, M.P., stated that, owing to the exceptional brightness of the weather, their receipts for the past year had fallen short of their estimate by £10,000, equal to a dividend of a further 1½ per cent. While the electric light is thus subject to "skiey influences" of an adverse character, gas has a double battle to fight, having both the sun and the electric light arrayed against it. There has been a denial that the electric light has done the gas companies any harm; and the falling-off in the sale of gas in London has been attributed wholly to the unusual extent of daylight. In this matter it is difficult to distinguish between one effect and the other; but it seems inevitable that the spread of the electric light must tend to retard the consumption of gas, whatever may be said as to the influence of the weather. We may admit that the meteorological argument carries the greater weight, and yet we cannot but assign considerable importance to the statement made at the Royal Institution the other day by Professor Fleming, that there are now 700,000 incandescent lamps in use in the metropolis. These have to be taken in addition to the many arc lamps of large candle power employed for street illumination. The estimate given by Professor Fleming seems high, but we can hardly suppose that so good an authority would be far wrong. Concerning the amount of light given by these incandescent lamps, we are perhaps safe if we employ an estimate of ten candles per lamp as the average working intensity. A power of sixteen candles is commonly claimed, but there are lamps with a power of only eight candles, or even less, while some are of high lighting power, considerably exceeding sixteen candles. With regard to the duration of the light, it is usual to reckon on 1000 hours per annum. If the light were obtained from gas, a power of ten candles would require about 3⅛ cubic feet per hour. For 1000 hours the quantity would be 3125 cubic feet. But as it happens that in many cases the electric lamp is only called into action occasionally, it may be necessary to conclude that on an average only half the lamps are burning at one time. This brings the equivalent consumption of gas down to 1562 cubic feet per annum for each lamp, which for 700,000 lamps becomes 1093 million cubic feet of gas in the course of the year.

In considering how far the presence of the electric light is calculated to affect the consumption of gas in London, two or three things have to be borne in mind. The first is that if all the gas corresponding to the 700,000 incandescent lamps were actually superseded, it does not follow that the sale of gas in the metropolis would at once fall off to that extent. While a large number of persons gave up gas and adopted the electric light, a considerable number of new comers would accept gas. The addition of several thousand houses to the metropolis every year brings in a certain number of fresh customers to the gas companies, though gas is not applied to every house. Something also has to be said as to the increased use of gas for heating purposes, and for motive power. If the electric light were not in the field, the consumption of gas in London must increase at a very rapid rate. But as there is this competitor, the progress of the gas industry is simply the excess of a gain over a loss. Using chiefly the figures furnished by Mr. Field in his yearly "Analysis," we observe that between 1886 and 1891 the sale of gas in London increased at a rate exceeding, on the average, 947 millions of cubic feet per annum. But in 1892 the yearly increase was rather less than 35½ millions. This is the more remarkable, seeing that the increase in 1891 exceeded 1313 millions. The check in 1892 was very decided, for while the increase in the aggregate was but small, two of the companies exhibited an actual decline, the Gas Light and Coke Company falling off by more than 115 million cubic feet, and the Commercial by nearly 15 million, the increase in the aggregate being solely due to the South Metropolitan Company. Last year the retrogression was still greater, all the companies showing a decline, the Gas Light and Coke Company undergoing a diminished sale of very nearly 873 million feet, the Commercial nearly 83 millions, and the South Metropolitan above 51 millions, the total deficit exceeding 1007 million cubic feet. At the average price of 2s. 10d. per 1000ft., this represents a decreased revenue of fully £142,000.

A Parliamentary return has been issued, which enables us to make a comparison between the sale of gas by the three metropolitan companies, and by the companies throughout the United Kingdom. The return does not come so far down as to include 1893, but it shows the state of affairs in 1892, in which year the London companies only increased their sale by 35½ million cubic feet, and two out of the three showed a decrease. Deducting the London sale, the increased consumption of gas in 1892 among the companies distributed over the rest of the United Kingdom is found to be 1392 million cubic feet, or 3·7 per cent. Had the London companies increased their aggregate sale in like proportion, their sale of gas would have risen by more than 1000 million cubic feet, instead of 35½. Proceeding, in the next place, to consider the statistics relative to the gas undertakings which belong to local authorities, we meet no signs of retrogression in the consumption of gas, taken in the aggregate, but there is some decline in the rate of advance. The increase in the quantity for the year 1890 exceeded 2039 million cubic feet. In 1891 the increase was under 1840 million, while in 1892 the increase fell to 1536 million. But it should be observed that in 1889 the increase was less than 1105 million; while in that year the increase in the sale of gas by the London companies was 940 million feet, of which the Gas Light and Coke Company accounted for 817. Although the returns from the local authorities indicate something adverse to the growth of the gas supply in 1892, they still show a substantial advance. Both the provincial companies and the local authorities exhibit a smaller advance in 1892 than in 1890, and the drop in that period is particularly large with the authorities. But London companies show much the worst result, their increase for 1892 being less than a twentieth of their increase in 1890, while the authorities maintained three-fourths of theirs, and the provincial companies a yet higher proportion. London thus occupies a peculiar position, andit seems inevitable that this is being brought about by the large extent to which the electric light has been introduced. What the returns for 1893 may reveal with respect to provincial companies and local authorities cannot as yet be apprehended, but it is not likely that they will show in either instance such an extraordinary reverse as a diminished sale of gas to the extent of 1000 million cubic feet. As for the future, when summer skies are clouded and wintry fogs return, it will be interesting to observe how the sale of gas is stimulated, and it will then be easier to find out the extent to which the gas companies are affected by the electric light. The figures which we have worked out with a view to gauge the present situation will probably be challenged; yet at least they will serve as a useful basis on which to found such other conclusions as may be preferred. That the electric light is a competing force must be admitted, but this does not prove that it will conquer the entire domain. There are capabilities in gas which admit of large development, and the London gas companies will know how to turn these to the best account.

WHAT WILL THE MINES EIGHT HOURS' BILL DO?

Now that the Mines Eight Hours' Bill has been read a second time in the House of Commons by a larger majority than was ever secured for the measure before, it may not be out of place, seeing that it has been before the public for five years, to endeavour to form some estimate of what it would secure for the miner where it to be passed into law. In all probability the outside public never knew less about the real merits of any Bill than they do of the one under notice. To those outside the coal trade, it is generally believed that the Bill will do away with serious hardships which miners have to put up with, and secure an eight hours' working day. The Bill, it is known, will do no such thing as secure uniformity in a miner's work, for in almost all instances the distance he has to travel to the coal face underground varies; and where men are employed at collieries which are almost worked out it will seriously curtail their wages, and render it almost impossible for employers working such pits to compete in the market with newly developed collieries where the coal is near the pit bottom. The idea that an eight hours' day could be secured by the men through their own organisations has been scouted; but it is an undeniable fact that eight hours and even less time are marked at present at the coal face in many of the districts connected with the Miners' Federation. The most valuable return on the subject was issued to the various associations in Great Britain in October, 1890. Showing the hours worked at collieries in every mining district in Great Britain, save Durham, Northumberland, and Cleveland, the return shows that in South Staffordshire eight hours at the coal face is almost uniformly observed, there being only two pits which work 8½ hours. In North Staffordshire a pretty uniform time is worked, only one pit running 9½, another 9 hours, and the rest from 7 to 8 and 8½ hours per day. Yorkshire, one of the great strongholds of the movement, cannot be said to work its miners very long hours. The return relates to 145 pits, including the chief pits in South and West Yorkshire, and yet only six firms allow their men to work 9 hours at the coal face, nineteen pits make 8¼, sixteen 8½ hours, whilst thirty-eight make 8, thirty-one 7 and 7¾ hours. The Lancashire and Cheshire districts do not show so well. At the Moss Arley Colliery 12 hours are stated to be worked, and at two other collieries 11 hours are returned. At thirty-eight pits from 10 to 10½ hours are made; at sixty-seven 9 to 9½, at fifty-five 8 to 8½, and at seven pits from 7¼ hours to 7½ hours. Derbyshire, which has a strong miners' organisation, would probably reduce the working hours by the Act; but, according to the return, nearly one-third of the pits given do make only eight hours. One solitary pit, the Church Gresley Colliery, is returned as making 10 hours, ten pits make 9½, fourteen 9, twenty-five from 8¼ to 8¾ hours. In the Forest of Dean, where fifteen instances are recorded, nine work 8 hours and six from 7 to 7¾ hours at the coal face. In Leicestershire one pit is returned as making 9, and seven where the miners work from 8 to 8½ hours at the coal face. Nottinghamshire, a rapidly-developing coal district, demonstrates the fact that at eight pits 9 hours are worked, at one 9½ hours, and at fourteen from 8 to 8½ hours are observed. Warwickshire, so far as eleven firms are concerned, makes less than 8 hours, for eleven pits only allow the miners to make 7¾, and six 7½ hours per day at the coal face. In Shropshire one pit makes 9, and the rest 8 hours per day, whilst in Cumberland still shorter time is worked. Two pits make from 8¼ to 8½ hours, ten make 8 hours, and five from 7 to 7½ hours. The return for North Wales shows that seven pits work 9, eight from 8½ to 8¾, five 8, and one only 7½ hours, The time worked in Scotland varies a good deal. In one instance 10½ hours are spent at the coal face. At three the hours are 10; at three from 9 to 9½, and at five pits from 8 to 8½ hours are registered; whilst in one instance 7½ hours are only accounted for. The South Wales and Monmouth districts allow their miners to work the longest hours. One pit makes 10½ hours, fourteen make 10, fifteen 9½, thirty-one 9, nineteen 8½, and seven from 8 to 8¼ hours. It will thus be seen that in many districts 8 hours and under is now worked at the coal face; in fact, taking Yorkshire and Lancashire, two of the greatest strongholds where the movement is pushed forward, out of about 300 pits quoted in the return 120 were in 1890 working 8 hours and less. So that in some instances the Act would press hardly upon the men themselves where they have a long distance to travel underground.

OVER FACTORY INSPECTION.

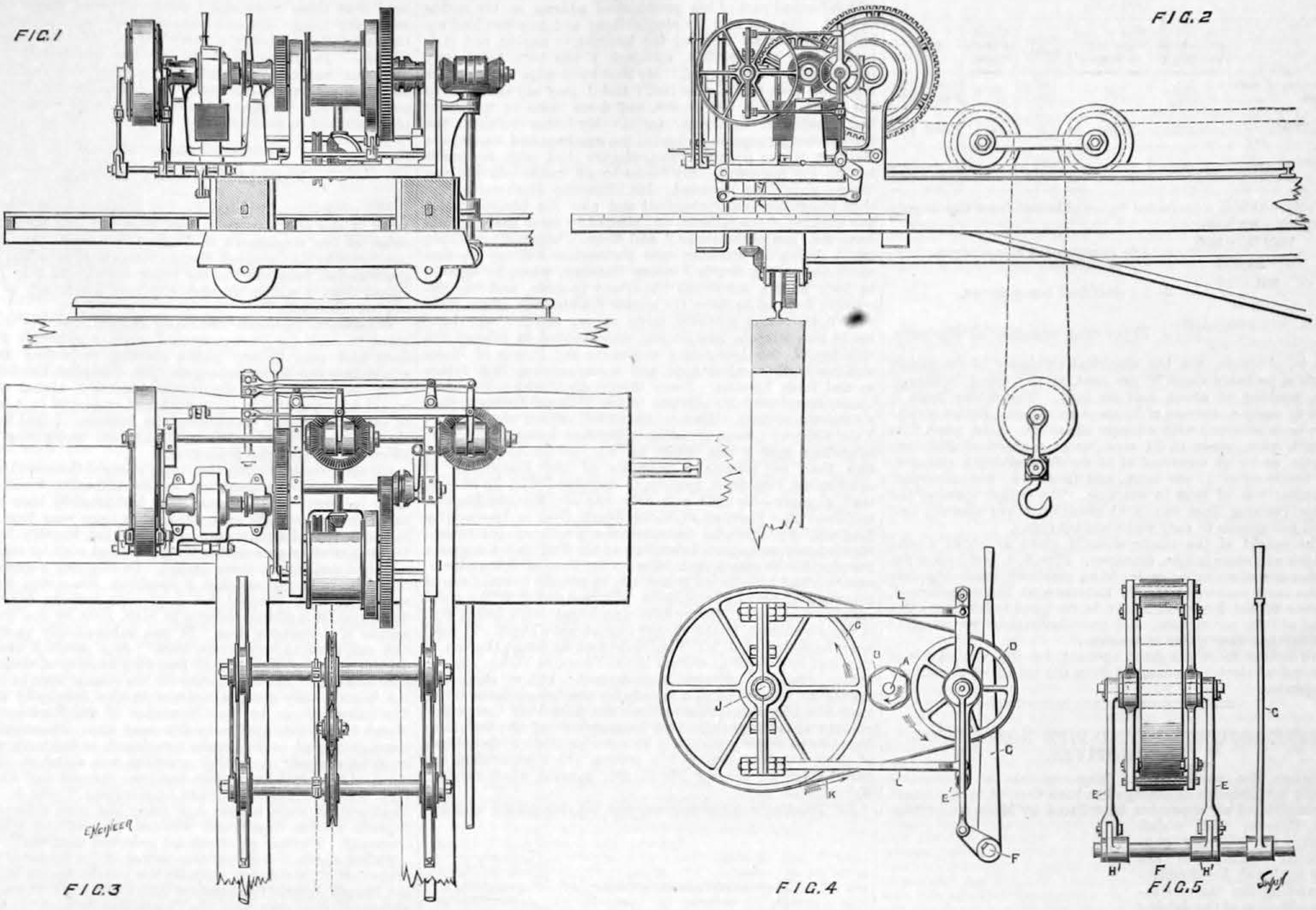
FACTORY inspection is in these days carried to an extent which seriously cripples manufacturers and renders the prosecution of many businesses, in the face of foreign competition free from such harassment, almost impossible. Recent legislation and the multiplication of inspectors of both sexes, who must do something for their salaries, has led to a system of espionage and entrapment most galling to employers striving to act justly toward themselves and those who work for them. This is strikingly seen in the majority of the prosecutions raised in the law courts, which are almost without exception of trivial and technical character, and looked at from a common-sense point of view, certainly not of a nature calling for legislative interference. The Home Secretary, however, apparently sees matters in quite a different light, as he has recently intimated his intention of extending the operation of the Factory Acts by increasing the already formidable army of inspectors and enlarging their powers. The new departure will specially affect work-people who take work to their homes. The inspectors are in future to have the power of paying domiciliary visits to see that the hours of labour and other matters are in accordance with the Board of Trade regulations. What good end is to be served by this excess of inspecting activity it is difficult to see, though doubtless the move will be applauded to the echo by a large class of sentimentalists. It is a curious circumstance, in consideration of the jealousy with which Parliament guards what it regards as its privileges, that the Home Secretary has, by Act of Parliament, been vested with full and absolute authority in such matters; and that he is empowered, without appeal, to schedule any trade, either mechanical or chemical, as "dangerous." He can then instruct the chief inspector to draw up such rules and regulations as he may consider necessary for the carrying on of the particular trade he regards as dangerous. It is true that members of the trade so scheduled may state objections to the prescribed regulations, but generally such objections are practically disregarded. It is a decidedly anomalous position of affairs that any individual should possess such arbitrary powers, and the manufacturing community should strive to prevent their being used at the present time in the creation of further artificial hindrances to industrial progress. There are quite too many of them already.

A NEW DEPARTURE IN FOREIGN COMPETITION.

Too much publicity cannot be given to the following astounding paragraph which appeared in the *Standard* on Wednesday morning:—"Messrs. Cramp and Sons, the American shipbuilders, have been notified by the British Admiralty that they have received their request for permission to tender for the building of two or more British warships, under the strictest conditions regarding the quality of the work and the materials." This is probably a bit of bombast, a something intended to attract attention, and to tell us that the American firm is prepared to build big warships for the world, while Messrs. Cramp have no serious intention of tendering. But we are by no means sure that such an explanation will quite meet the case. If Messrs. Cramp could get an order from the British Government it would pay them well to take it, even at a heavy pecuniary loss, for sufficiently obvious reasons. Now if Free Trade principles are to be pushed to their full extent, is there any reason why the Government should not place a contract in the United States? We fancy, however, that Free Trade principles must in this case take what Messrs. Cramp would term a back seat. Not that the Admiralty authorities are too particular. What, for example, are we to say to the fact that they are ordering torpedo boat dinghies from a German firm, while the German authorities are purchasing Berthon boats in this country? Sir U. Kay-Shuttleworth's assertion that the German boats are the best that can be obtained is, we do not hesitate to say, totally erroneous. We hope that Col. Vincent or some other Member of Parliament will press the First Lord of the Admiralty for a statement or reason for making the assertion, the truth of which we dispute.

ELECTRIC TRAVELLING AND JIB CRANES

MESSRS. WIMSHURST, HOLLICK AND CO., LONDON, ENGINEERS



A NEW TYPE OF ELECTRIC CRANE.

MUCH attention has recently been directed to the question of increasing the day load factor in electric light stations, and some electric supply companies have offered low rates for current used in the daytime for running motors. As yet comparatively little has been done in the application of this form of energy; but there is no doubt that the great convenience and cleanliness of electric supply will commend itself to many consumers of power. At present the chief competitors with electric energy are hydraulic power and gas engines; but some progress has been made in the application of electric motors in London, especially for intermittent work, such as the working of hoists, cranes, hair-brushing machinery, &c. We had an opportunity recently of examining an electric crane which has been supplied to Messrs. F. B. Cameron and Co., at their wharf near Vauxhall Bridge, by Messrs. Wimshurst, Hollick, and Co., of Commercial-road, E. This crane is used for coal-whipping, that is to say, for rapidly unloading the coal barges which come alongside the wharf. It is usual to employ about four coal porters for each barge, and one coal skip is filled by two men. The crane lifts one or other skip alternately and slews it round to the stock heaps, where its contents are emptied by a fifth man. Electrical energy is supplied from off the mains of the Westminster Electrical Supply Company, and as the three-wire system is in use, advantage has been taken of the fact to employ a potential of 200 volts by connecting across the outside mains. The figures which we give in the table below were obtained by means of a standardised ampèremeter, lent for the occasion by Mr. Monkhouse, of the Supply Company. One of the chief difficulties in the application of electric motors to mechanical work is the necessity in almost all cases of employing resistance coils through which the current is sent at starting, and in crane work the shocks which may be brought upon the teeth of the gearing by careless driving are very serious. If, then, some system for transmitting the power from the armature shaft to the winding barrel of the crane can be discovered which, while giving ample driving power, still can be readily switched in or out while the motor is running, such a system would be very advantageous. In the present crane the armature is allowed to run always, whether the crane is actually lifting or not, and the motor is shunt-wound. Of course, if a stop of many minutes takes place during work the current is switched off from the motor entirely, but the armature should always be allowed to revolve at full speed before the gearing is put into action.

Fig. 6 illustrates the crane before the house for sheltering the driver had been put up, and this particular machine is designed for lifting loads up to 25 cwt., at speeds up to 100ft. per minute. The controlling handles are placed very conveniently close together, and a powerful strap brake is used. The motor itself is enclosed in a wooden case, to exclude dust from the bearings. The chief point of novelty in the design of the crane is the friction gear for putting the motor in and out of gear; this is illustrated in Figs. 4 and 5. Fig. 4 is an end elevation looking at the end of the armature shaft, and Fig. 5 is a side elevation. The armature shaft is lettered A, and upon it is keyed a small pulley B, made of compressed paper and turned up smooth. The paper is put on in the form of washers, so that the edge of the paper is used. For driving, C is a cast iron pulley keyed upon a countershaft, carrying a pinion which is in the train of wheels actuating the winding drum, and D is another cast iron pulley carried upon a short spindle, which is supported by the links E and E[1]. The actuating lever G is keyed upon the spindle F, which bears the two short levers H and H[1]; it is therefore obvious that the links E and E[1] will move up or down, according as the lever G is moved. The pulley D and the strap K—which passes round the two pulleys C and D—can be moved around the centre of the spindle J, and thus the pulley B can be gripped tightly between the pulleys C and D, and the power is thus transmitted from the armature shaft A to the spindle J, and so to the winding drum. A pair of adjustable links L at each side of the pulleys allow for adjustment of the pulleys C and D at a proper distance apart. It appears that a cotton belt is preferred to leather for the gearing. The ampèremeter was placed in one of the mains before it reached the crane, and at a distance of about 4ft., so that the whole of the current employed was obtained.

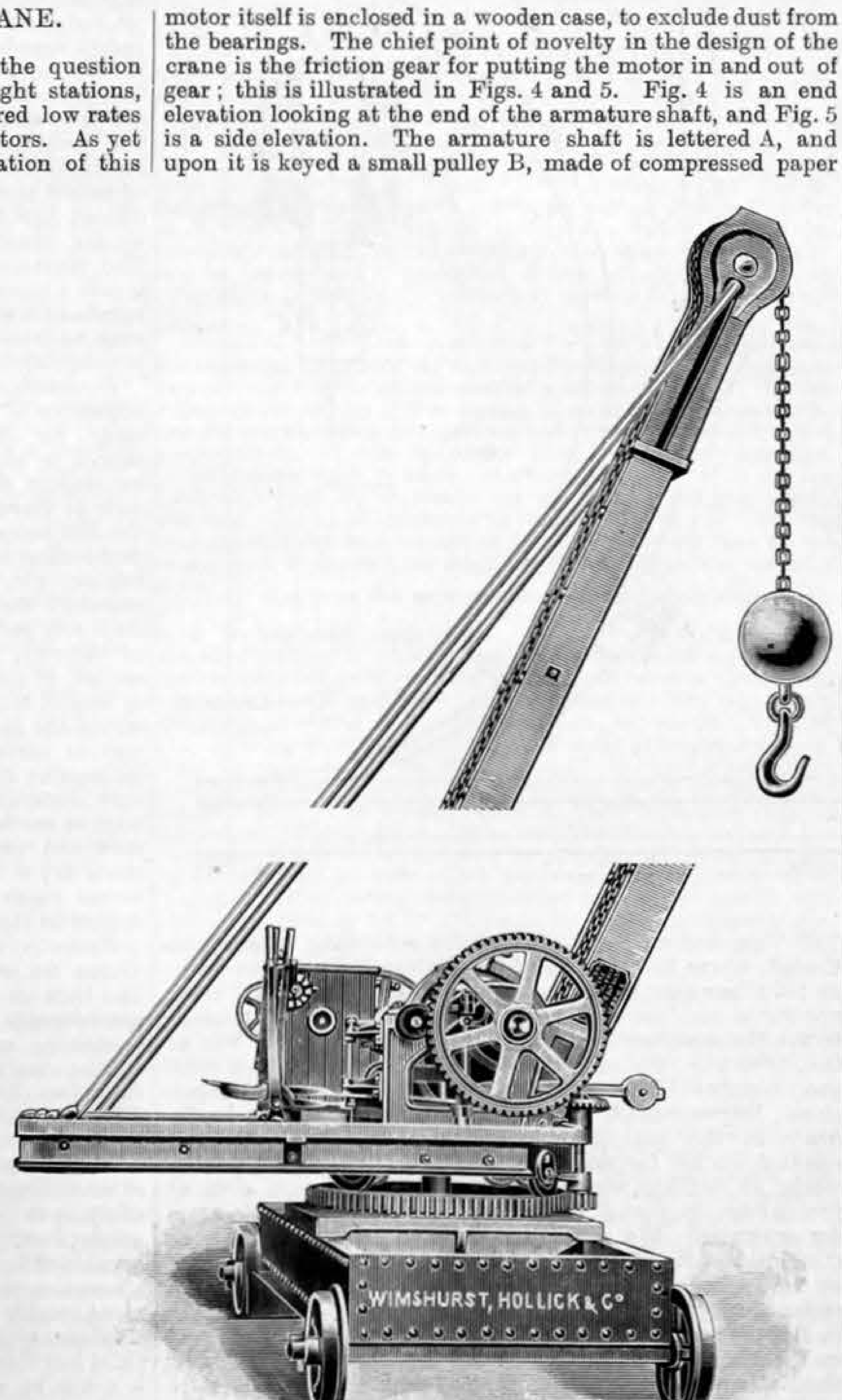


Fig. 6—ELECTRIC JIB CRANE

TABLE I.

Time.	Ampères of currents.	Remarks.
3.50 p m.	2·0	Motor running light.
	21·0	Lifting only, full skip.
	15·0	Slewing " "
	22·0	Lifting " "
	14·0	Slewing " "
	2·0	Motor running light.
	21·0	Slewing only, skip empty, reading taken at starting.
	14.0	" " " " in course.
	27·0	Lifting and slewing at same time, full skip.
	27·0	" " " "
	27·0	" " " "
	29·0	" " " " reading at start.
	27·0	Lifting and slewing at same time, full skip in course.

The skips were both of the same size, and were filled to the same amount each time.

Only the last skip with its load was weighed, with the result that the skip itself was found to weigh 4 cwt., and the contents 14 cwt. 3 qr. 16 lb., and the weight has been taken as accurate for all the loads. With regard to actual efficiency of the cranes, it was considered impossible to calculate this accurately while slewing and lifting were proceeding together; a few special tests were therefore made for speed of lift alone. The readings were uniformly 21 ampères for a lift alone with a full skip. The speed of lift was taken by marking one of the hoisting chain links with a piece of wire round it. The link chosen was one which never passed over the sheave at the end of the crane jib. The skip while being filled rested on the bottom of the barge, and therefore a mark could be put on the side of the jib at the point where the link stood, with the chain taut and the full skip on the bottom of the barge. The lift now took place, and it was easy to note the time when the marked link passed a point at the foot of the jib. The load was lifted in fourteen seconds through 18ft. 9in. vertical height, and this was checked several times. It was found that a vertical lift of 18ft. 9in. and a slew through 180 degrees at the same time could be effected in fourteen to fifteen seconds.

Readings of the electricity meter were also obtained from the maker's fitter in charge of the crane. These are given in Table II.

The constant of the meter is 0·586. The cost for electricity, at 5d. per Board of Trade unit, appears therefore to be about ½d. per ton.

With regard to the efficiency of the motor itself, we do not feel able to give any exact figures, as the friction of the crane gearing renders it impossible to calculate exactly.

There is also the question as to whether the work of the lifting chain and skip should be allowed for. But, taking the actual coal lifted as 14 cwt. 3 qr. 16 lb. at a speed of 80ft. per minute, and the actual current 21 ampères at a pressure of

TABLE II.

	Cost per ton got out, 5d per B.O.T.	Tons of coal got out of barges.	Meter reading	Board of Trade units.	Date.
Beginning of work At end ,,	0·458d.	125	169·2 188·7	11·4	Feb. 5, 1894 Feb. 6, 1894
Beginning ,, End ,,	0·51d.	65	188·7 200·0	6·6	Feb. 7, 1894
Beginning ,, End ,,	0·49d.	63	200·0 210·5	6·15	Feb. 8, 1894

203 volts—this is a corrected figure obtained from the Supply Company—we have :—

$$\frac{1668\text{ lb.} \times 80\text{ft.}}{33{,}000} = 4{\cdot}04 \text{ commercial horse-power.}$$

$$\frac{203 \times 21}{746} = 5{\cdot}7 \text{ electrical horse-power.}$$

$$\frac{4{\cdot}04 \times 100}{5{\cdot}7} = 72 \text{ per cent. commercial efficiency.}$$

This is, of course, not the electrical efficiency of the motor, which is probably about 80 per cent. at the speed, although only working at about half its load. The motor itself is built to carry a current of 75 amperes safely. Better results have been obtained with a longer lift at low water, when lifts of 25ft. were made in 17 secs., or at a speed of 88ft. per minute, and with a current of 21 ampères, giving a commercial efficiency of 77 per cent., and there was a smaller proportional loss of time in starting. The actual speed of the motor running light was 1020 revolutions per minute, and it did not appear to vary when put into gear.

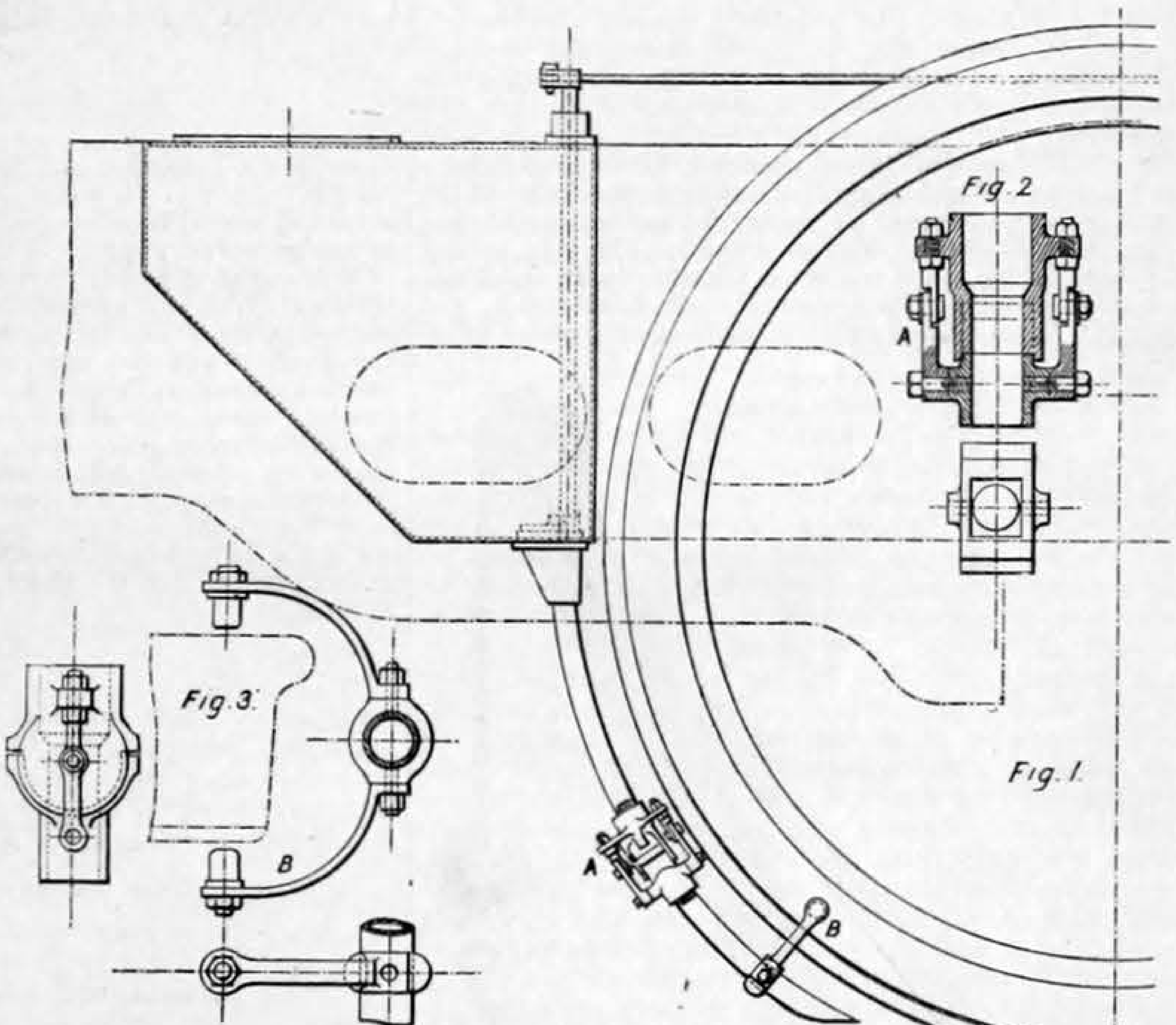
The weight of the motor alone is given as about 8 cwt., and the armature is 9¼in. diameter. Figs. 3, 4, and 5 show the application of a similar motor to an overhead crane supplied by the same makers to Mr. E. Robinson at his timber yard, Quebec Wharf, Limehouse. It is designed to lift 5 tons at a speed of 16ft. per minute, and the illustrations are so clear that further description is needless.

We believe there is a great opening for the application of economical electric cranes, fed from the mains of the supply companies.

SELF-ADJUSTING SAND-PIPE NOZZLE FOR LOCOMOTIVES.

AMONGST the many recent improvements in locomotive details considerable advantage has been derived by the steam or compressed air apparatus introduced by Messrs. Gresham and Craven, with which nearly all recently constructed locomotives are now equipped, for effectively sanding the rails to insure adhesion of the driving wheels.

A further improvement in this direction has been lately devised by Mr. A. T. Grafton, locomotive foreman of the Callander and Oban Railway, by the introduction of a self-adjusting sand-pipe nozzle, which is arranged to deposit the sand, under all circumstances, upon the rails immediately in front of the tread of the wheels, even when the locomotive is running on a curve, which is of paramount importance in preventing slipping of the wheels. With the ordinary arrangement of fixed sand-pipes and nozzles, when the engine is running on a curve the sand is often delivered outside the outer rail and inside the inner rail on to the ballast, and therefore is not of any benefit to the slipping wheels, and the sand is absolutely wasted. Mr. Grafton has ingeniously overcome this defect by the introduction of a flexible pipe, as shown in the illustrations annexed. Several trials of this apparatus have been made on the Callander and Oban Railway—a line abounding in sharp curves and heavy gradients—with very satisfactory results.



"THE ENGINEER" SWAIN ENG

Referring to the illustrations, the apparatus may be briefly described as follows, thus :—Fig. 1 shows the general arrangement of sand-pipe with flexible joint A ; near the bottom of the nozzle a clip is attached to it provided with two arms B, which can come into contact with the sides of the wheel to maintain the pipe nozzle in line with the tread of the wheel, whether on a straight or curved rail. Figs. 2 and 3 show in detail the joint A and arms B.

JOSEPH TOMLINSON.

THE death of Mr. Joseph Tomlinson, which occurred on the 22nd ult. at his house at West Hampstead, at the age of seventy, has removed from among us a familiar and highly esteemed member of the engineering profession. Mr. Tomlinson was a member of the Institution of Civil Engineers, to which body he was elected in 1871, but it is in the sister institution, viz., the Mechanical Engineers, that his unassuming presence and practical experience will be chiefly missed. The deceased gentleman, who will be best remembered in connection with railway work—although his experience was by no means confined to this branch of engineering—was elected president of the Institution of Mechanical Engineers in 1890, and to him the success which attended the visits of this body for their summer meetings to Sheffield and Liverpool in 1890 and 1891 was largely due. Mr. Tomlinson's connection with railway work commenced at a very early period, as will be gathered from the following paragraph, which formed part of his presidential address in the spring of 1890. He said :—" My recollections and practice lead me back to the early days of the locomotive engine, not, it is true, to the very earliest, although I was born before any public railway was opened. My first knowledge of them as a boy dates back to the year 1837 ; and I may say that I soon fell in love with a *live engine*, and from them to now have had a feeling of 'first love' for it. My father being at the time passenger superintendent of the Stockton and Darlington Railway, it was nothing extraordinary that, with my predilection for mechanics, my desire to go to the old Shildon Works should be gratified. Mr. Timothy Hackworth, the then locomotive superintendent and also the contractor for the working of the railway, was pleased to agree that I should have the 'run of the shops ;' and thus I began my working life." From the Stockton and Darlington Railway his first move was to the South-Western Railway, where he appears to have held a somewhat important position, and was frequently deputed to drive the engine drawing the Royal train to Windsor, and probably some of our readers will have heard him narrate how he has endeavoured to explain the working of the locomotive engine to the Prince of Wales and his brothers when boys, and accompanying their father to and from London. From the South-Western Mr. Tomlinson transferred his services to the Midland Railway, then a congeries of lines. He next identified himself with the Taff Vale Railway Company, being appointed locomotive superintendent, and it was while he was connected with that line that he became a member of the Institution of Mechanical Engineers, namely, in the year 1857. In 1858 he read a paper—his first and only one—to this institution, entitled "The Burning of Welsh Steam Coal in Locomotive Engines," in which he described the results of his experiments made on engines belonging to the Taff Vale Company, burning Welsh steam coal. Up to the time of these experiments it had been found practically impossible to make use of this class of fuel for locomotive purposes owing to the great rapidity with which the fire-bars were burnt out, a defect due, it was considered, to the clinker formed upon them. It may here be stated that Mr. Tomlinson was driven to the use of this coal by a strike of colliers in the Rhondda Valley, whence coking coal had hitherto been derived ; but so successful proved his efforts to find a remedy for the defect above stated, that the Rhondda collieries lost the Taff Vale Company's custom thenceforward. The burning out of the bars was found to be easily preventible by covering them with a layer of small pieces of fire-brick, a process which resulted in the bars having an average life of four months when running 100 miles per day.

Mr. Tomlinson afterwards severed his connection with the Taff Vale Railway, and set up as a consulting engineer in Cardiff, where he interested himself largely in marine work. In 1872, however, he again returned to his "first love," being appointed resident engineer and locomotive superintendent to the Metropolitan Railway, whose locomotive stock was at that time in a very neglected state. The works of this company consisted in what are now the running sheds at Chapel-street, Edgware-road. These premises being utterly inadequate to the requirements of the line, Mr. Tomlinson selected the site for, and designed and carried out the present works at Neasden, which were opened in 1883, and even at present are so placed that there still remains ample room for extension. We should not omit to state here that, as Chairman of the Research Committee on Friction, appointed by the Institution of Mechanical Engineers, he carried out a series of very valuable experiments in 1883 at the old works in Edgware-road. In 1885 Mr. Tomlinson resigned his post on the Metropolitan Railway, and was afterwards engaged by the National Telephone Company in designing and superintending the erection of supports and structures for carrying the telephone wires. Some three or four years ago, in conjunction with Mr. Swarbrick, Mr. Tomlinson was invited to inquire into and report upon the working of the Taff Vale Railway, and it may be within the recollection of many of our readers that, as the result of this report, several of the directors of this company retired, and Mr. Tomlinson himself was offered and accepted a seat upon the board.

Mr. Tomlinson was a very able engineer. While his age, experience, and temperament taught him to be cautious, his confidence in the powers of the engineer shut out the idea of the impossible from his mind. He believed that the engineers of Great Britain could do anything ; but he also held that there were many things proposed which were not worth the doing. He at a comparatively early period earned the reputation of being a "safe" man. He had numerous friends. In many respects he was masterful, a good organiser, and one who made up his mind with deliberation, and then took good care that his orders should be carried out. He will be missed throughout a wide circle, and his place will not be easily filled.

PARLIAMENTARY NOTES.

The whitebait at Woolwich.—The House was perturbed last week by the announcement that whitebait had invaded the tubes of the condensers at Woolwich Arsenal, but it was comforted by Mr. Campbell-Bannerman's assurance that proper gratings had been fitted to the water inlets, and that in the future there would be no obstruction of machinery or waste of good whitebait.

Government workmen.—Mr. Keir Hardie took the Government to task for having warned their workpeople that if they took part in any public meeting respecting factory affairs they would be discharged. Mr. Campbell-Bannerman, with the approval of the House generally, stated that it would be impossible to allow workmen employed in a factory to discuss questions concerning the business of that factory. To do so would bring the workmen into antagonism with those who control the department.

German contracts for the Royal Navy.—Colonel Howard Vincent asked the Secretary to the Admiralty whether an order for boats for the Royal Navy had recently been placed in Germany ; and, in such case, what steps were first taken to insure that the provisions of the English Factory Act and the fair contracts resolution were complied with by the firms who had undertaken these orders. To this, the Secretary to the Admiralty replied that a specimen life-saving boat of special pattern, adapted for service in torpedo boats and destroyers, was offered for trial in May, 1893, by the English agents of a German firm. It was subsequently purchased and subjected to very severe tests. As a result it has been decided to adopt this type of boat in a number of destroyers now building. The contractors for the vessels have to supply the boats ; they are not ordered by the Admiralty direct. The answer given by the Chancellor of the Exchequer on March 14th, 1893, applies to this case also. No steps were taken in regard to the points mentioned, as the work was to be done abroad. A further question was asked as to how many of the boats in question had been ordered, and whether they would be marked "made in Germany." Sir U. Kay-Shuttleworth could not say how many had been ordered. It depends on the contractors whether they will be made in Germany. Further questions are promised next week.

Patent agents.—A Select Committee of the House of Commons met on Monday to consider the Patent Agents Bill and the Patent Agents Registration Bill. Mr. T. H. Bolton was appointed chairman, and the Committee decided to meet to take evidence on the 8th of May. The Patent Agents Bill, as we stated on the 6th April, seeks to amend the law relating to patent agents, by incorporating such patent agents as may be willing, and by empowering all patent agents, whether they join such corporate body or not, to elect from amongst themselves a council to keep the roll of patent agents and to be the governing body of the profession. The Patent Agents Registration Bill provides special facilities for the admission of patent agents to membership of the Chartered Institute of Patent Agents, and seeks to protect the public from deception by the unauthorised assumption of the title of patent agent. The promoters of this Bill state that its object is "not to create a monopoly, but to regulate the profession of patent agents in a manner similar to that in which other professions, such as those of solicitors, veterinary surgeons, and dentists are regulated."

Locomotive Threshing Engines Bill.—The following is the substance of this Bill, which is backed by Sir John Kennaway, Sir William Walrond, and others. After premising that it is expedient that the restrictions upon the use of locomotive threshing engines should be the same as those now in force upon the use of locomotive ploughing engines, the Bill proceeds thus:—"Any provision in any Act contained prohibiting under penalty the erection and use of any steam engine, gin, or other like machine, or any machinery attached thereto, within the distance of twenty-five yards from any part of any turnpike road, highway, carriageway, or cartway, unless such steam engine, gin, or other like engine, or machinery, be within some house or other building, or behind some fence, wall, or screen, sufficient to conceal or screen the same from such turnpike road, highway, carriageway, or cartway, shall not extend to prohibit the use of any locomotive steam engine for the purpose of threshing within such distance of any such turnpike road, highway, carriageway, or cartway, provided a person shall be stationed in the road and employed to signal the driver when it shall be necessary to stop and to assist horses and carriages drawn by horses passing the same, and provided the driver of the engine do stop in proper time."

Factories and Workshops Bill.—Leave was given to the Home Secretary to bring in this Bill, and it is read the first time on Monday. By the Bill, it was proposed to make amendments in the general law relating to factories and workshops as to their sanitary conditions and safety. It defines overcrowding to mean an allowance of less than 250 cubic feet of space per man, and after 8 o'clock in the evening 400 cubic feet. It gives power to the Courts, where premises are structurally unfit for a particular process, to require the necessary alterations to be made, and it prohibits the cleaning of machinery in motion by women and young persons, in addition to children, as at present. Next, as to the time of employment, the Bill provides that overtime, which was now capable of being allowed five days in any week, should not be allowed on more than three days ; and it restricts the employment outside the factory, in the business of the factory, of children, women, and young persons—that is to say, if the child has been employed in the factory during the daytime, it is not to be allowed to take out work to do at home ; and similarly women and young persons are not to be allowed to take out work if they are employed in the factory. The Bill proposes to include in the law as to factories and workshops certain industries which were not at present embraced ; in the first place, laundries. Steam laundries are to be deemed factories, and other laundries are to be deemed workshops ; and special provisions are made for the ventilation of steam laundries and the keeping of the floors, &c., drained. There are exceptions for what were called domestic laundries and laundries belonging to institutions, which would be under the general law. As to docks, wharves, and places where buildings were being temporarily constructed, they are brought for the first time under those provisions of the Factory Act which deals with inspection, fencing of machinery, and notice of accident. Thirdly, and lastly, the Bill proposes in the case of what were called tenement factories, which are common in Sheffield and that part of the country—factories where different parts of the building are let out to small occupiers—to make the owner responsible for the sanitary condition of the factory, the fencing of the machinery, and a number of matters of that kind. In the case of dangerous and unhealthy employments, the Bill gives power to the Secretary of State, in addition to his present powers, to restrict the hours of employment and altogether to forbid the employment of women, young persons, and children. Finally, the Bill proposes to amend, or rather to substitute for what was called the "particulars" clause in the Act of 1891, a new clause, which would apply that enactment to all piece-workers in the textile trades, and which would require employers in those trades to provide to every worker paid by the piece a plain, definite form, in writing, giving such particulars as would enable the operative to compute the wages payable to him in respect of each piece handed over to him to work upon.

THE MINORITY REPORT OF THE LABOUR COMMISSION.

STUDENTS of history find in the French Revolution nothing more remarkable than the astounding foolishness of those who slew their way to power. The Goddess of Reason was enthroned amidst the plaudits of the people; and steps were taken in her name to ruin the nation. Every man and woman became equal—in name. The nation was poor; in paper money lay the panacea for all ills. Work was needed; the Government found it, and paid for it—in paper. Factories on a purely Socialist basis were started. The fraternity of the workers led to free fights, and broke up the establishments. We all know now what the end was. Out of the chaos of contending interests came a master spirit who enslaved a nation which had shed torrents of blood to be free. We look back at these things, and we do not say how criminal the people were, but how foolish. History repeats itself. We see all round us a movement astir which reminds us of the early days of the revolution of a century since. The surrounding and controlling conditions are not quite the same, but human nature is the same, that never changes.

The minority report of the Labour Commission prepared by Mr. Michael Austin, James Mawdsley, and Tom Mann, lies before us. It is a very lengthy document. Its authors have wisely summarised its conclusions; here they are:—

To sum up, we regard the unsatisfactory relations between employers and employed as but one inevitable incident of the present industrial anarchy. The only complete solution of the problem is, in our opinion, to be found in the progress of the industrial evolution which will assign to the "captains of industry" as well as to the manual workers, their proper position as servants of the community. Meanwhile the relations between capitalists and manual workers are enormously embittered by the demoralising conditions in which great masses of the population are compelled to live. Under any conceivable view of social development these conditions demand the serious attention of the Government, and constitute, in our opinion, the most pressing of all the problems of statesmanship. The evil influence of the "sweated trades," the demoralising irregularity of employment, the insanitary condition, both of the workplaces and the homes of large sections of the community, the inadequate wages obtained in all the less skilled grades of workers, the excessive hours of labour which prevail throughout so large a part of the industrial field, all call for immediate action.

We think it high time that the whole strength and influence of the collective organisation of the community should be deliberately, patiently, and persistently used to raise the standard of life of its weaker and most oppressed members. We regard this as one of the primary functions of democratic government, whether national or local; and, while leaving on one side, as beyond our scope, such fundamental matters as the nationalisation of the land and the drastic taxation of unearned incomes, we have suggested in some detail various immediately practicable reforms in this direction. These reforms include:—(a) The explicit and widely-advertised adoption by the Government and all local authorities of direct public employment, whenever this is advantageous, the eight hours' day, trade union conditions, and a moral minimum wage. (b) The extension of the Factory and similar Acts to all manual workers in all trades, and their drastic enforcement in such a way as to discourage home work, and absolutely to prohibit industrial oppression. (c) The securing by appropriate law of an eight-hour day for every manual worker. (d) The thorough investigation and bold experimental treatment of the problem of the unemployed. (e) The provision of adequate sanitary housing accommodation for the whole nation; as well as honourable maintenance for all its workers in their old age. In short, the whole force of democratic statesmanship must, in our opinion, henceforth be directed to the substitution as fast as possible of public for capitalist enterprise; and, where this substitution is not yet practicable, to the strict and detailed regulation of all industrial operations, so as to secure to every worker the conditions of efficient citizenship.

In its way this is a touching production. There is a species of folly which involves contempt. There is another which is simply pitiable. It is impossible to be angry with Messrs. Austin, Mawdsley, and Mann. They are philanthropists pure and simple. They have read history, if at all, to no purpose. They are dreamers of dreams. Their report is beautiful, but it is not business. It is unnecessary to examine their proposals in detail. There are two fundamental obstacles to be attacked. They are insurmountable as well as fundamental. There is an old story, well known, but worth re-telling here. The commandant of a certain fortress was in days gone by, taken to task for not returning the salute fired by one of His Britannic Majesty's men-of-war. His reply was a marvel of diplomacy. He produced a dozen reasons for not firing a salute, all very ingenious. The last on the list was that he could not fire a salute because he had no powder.

In like manner a dozen reasons might be alleged why the scheme proposed by the minority cannot be carried out. One suffices. The nation cannot afford it. The second obstacle is to be found in human nature. The essence of the plan is that Government shall, having regulated the hours of labour and wages, always provide employment all the year round for those who cannot otherwise get it. How this labour is to be paid for Messrs. Austin, Mawdsley, and Mann do not attempt to say. For the rest they seem to believe that men of ability or capacity would be content to bind themselves down to the status of the incompetent, and that Englishmen as a class would consent to be ruled in the way proposed. They have everything to learn of human nature. Their ideas are, as we have said, pretty and benevolent. That their proposals represent so much waste of paper is, perhaps, scarcely to the point. The report will, however, no doubt serve a purpose. But, after all, things will go on much the same as before—for a time at least. The nation has not yet quite lost its senses.

LETTERS TO THE EDITOR.

(*Continued from page* 371)

THE MECHANICAL EQUIVALENT OF HEAT.

SIR,—In THE ENGINEER of April 6th I had shown that the results of Regnault's exhaustive experimental investigation of the data of steam, in conjunction with the theoretic views of Carnot, were consistent with the experimental value of the mechanical equivalent of heat, as determined by Dr. Joule, on the authority of Lord Kelvin, as follows:—"The number, 1390 foot-pounds, Centigrade scale, or 772·2 foot-pounds by Fah., derived from Mr. Joule's experiments on the friction of fluids, cannot differ by $\frac{1}{100}$, and probably does not differ by $\frac{1}{300}$, of its own value from the value of the mechanical effect of the thermal unit.—'Philosophical Transactions,' 1852, notes page 81."

In THE ENGINEER of April 13th Mr. Clarke virtually challenges such statements; and of course his argument, tersely stated, that two relations may be consistent and yet neither be correct, is admitted. The grounds of his objection—variation of gravity at different places, and errors in standardising thermometers—is a somewhat surprising charge to advance against Regnault's deductions. I cannot at present refer to these, but I have a vivid recollection, when they were first published, fully forty years ago, of being impressed by the extreme care which had been taken to remove all conceivable sources of error. Afterwards, at the Conservatoire des Arts et Metiers, at Paris, I had an opportunity of inspecting the extensive and accurate apparatus with which M. Regnault had conducted his researches. I would suggest to Mr. Clarke a much more tenable uncertainty, which would go to diminish the value 772, and by placing it against his reasons for increasing that quantity, I think he will see the conventional agreement on 772 as the value is a practical compromise where experiment and conflicting testimony seem inadequate to yield strict accuracy.

President Lincoln was wont to remark, "That reminds me of a story," and I am tempted to advance a little, not wholly inappropriate, one. The late Dr. James Thomson—father of Lord Kelvin—while insisting upon accuracy in their exercises from his students, deprecated affectation of accuracy, when the circumstances were such as to render uncertainty unavoidable. He quoted, in example, a learned German statist, who, having occasion to estimate the gross population of our globe, condescended upon a strict specific sum. So many hundred millions, thousands, hundreds, and tens, ending with, "and three!" at which point the worthy doctor, with a quiet chuckle, would remark, "The pedantry of that three is very amusing!"

Next, consider the statement by Lord Kelvin in the "Philosophical Transactions," 1852, page 568. "From three separate series of experiments, Dr. Joule deduces the following numbers for the work in foot-pounds necessary to produce a thermic unit Fahrenheit by the compression of a gas, 820, 814, and 760. The largest of these numbers is most nearly conformable with Dr. Joule's views of the relation between such experimental 'equivalents' and others which he obtained in his electro-magnetic researches; but the smallest agrees, almost perfectly, with the indications of Carnot's theory; we should expect, from the temperature in Dr. Joule's experiments, to find a number between 1369 and 1379 as the result"—*i.e.*, for Centigrade scale, for Fahrenheit, these numbers reduce to 763·3 and 766·1. It would seem Dr. Joule was slightly biassed towards giving a high value to this quantity, which Carnot's views, properly applied, will enable us to correct. This will be an obvious deduction from the following statements, in the investigation of the analytical expression for the mechanical equivalent of heat, denoting this by μ, on referring to Lord Kelvin's "account of Carnot's theory" the result arrived at is, $\mu = (1 - \sigma)\,\frac{dp}{dt} \cdot \frac{1}{k}$, with the inference "for the saturated vapours of all different liquids at the same temperature the value of the second member must be the same." In this σ denotes the density of the vapour, of which the latent heat is k, and the corresponding temperature and pressure denoted by t and p respectively. A note is added, "It is, comparatively speaking, of little consequence to know accurately the value of σ, for the factor $(1 - \sigma)$ of the expression for μ. Since it is so small, being less than $\frac{1}{1700}$ for all temperatures between 100 deg. and 0 deg. C., that unless all the data are known with more accuracy than we can count upon at present, we might neglect it altogether, and take $\frac{dp}{dt} \cdot \frac{1}{k}$ simply, as the expression for μ without committing any error of important magnitude." If, however, we descend to minutiæ, such as the differences of the coefficients of expansion of the various kinds of glass which compose the tubes of the thermometers employed, we cannot neglect a quantity which will cause a difference of about half a foot-pound in our result. To take $(1 - \sigma) = 1$ is to suppose $\sigma = 0$; and if we make improper assumptions we must accept the consequences. In my former letter I have pointed out Clapeyron and Holtzmann, misled by the usually accepted value of the specific heat of air under a constant pressure—given as ·267 by De la Roche and Berard—had deduced the value $\mu = 681{\cdot}7$. Now, a variety of phenomena, instead of ·267, by Professor Miller, were found consistent with the value ·2389. Regnault's later careful determination very nearly agreed with this, being given as ·2379. Dr. Joule, by three direct experiments, arrived at a mean value, ·2300. The average of these, ·2356, applied in correction, would have yielded the value

$$\mu = 681{\cdot}7 \times \frac{{\cdot}2670}{{\cdot}2356} = 772{\cdot}5 \text{ foot-pounds.}$$

In my preceding letter, by the relation between temperature and pressure indicated by Regnault's experiments and by Clapeyron's expression for the mechanical equivalent $\mu = \frac{dp}{dt} \cdot \frac{1}{k}$, it was shown we had $\mu = 772$, which, had it been further corrected, as pointed out in the foregoing, for the omitted factor $1 - \sigma$ would have almost exactly agreed with the above result, and hence, from all the known facts, it seems to me 772 is a much more probable value than the 787 of Mr. Donaldson, to which I objected.

Glasgow, April 23rd. ROBERT MANSEL.

TRAIN RESISTANCE—ENGLISH AND AMERICAN.

SIR,—Our American friends must, I think, have followed the precept of the survival of the fittest in compiling that wonderful table, No. II., printed from the *Railroad Gazette* in your edition of April 13th, which goes to prove that this particular goods train ran with a resistance of only 3·51 lb. per ton on the level. You show conclusively in your article of April 20th how utterly their own figures fail to agree with each other, and you add: "Our explanation of the error is that the dynamometer used on the American train was either itself wholly untrustworthy, or was used in such a way that the figures obtained are valueless." I find, however, that by allowing their dynamometer and experiments to be correct, and allowing for the effect of gravity, the results come out very favourably for the English train, and as gravity counts for about 35 per cent. in the American train, against 15 per cent. in the English train of the total work done, it is impossible to make any fair comparison if it is neglected.

By taking from Table I. the total gross or English foot-tons registered by the dynamometer, which are given as 768,855 and 857,578 for the English and American trains respectively, and adding to them the foot-tons due to gravity by the net fall of the two trains, we arrive at the total power actually at work in conveying the two trains their full journey of seventy-seven miles.

We have, therefore, in the case of the English train 777·6 tons by 178ft. = 138,413 foot-tons to be added to the engine traction of 768,855 foot-tons, giving a total of 907,268 foot-tons; and the American train 833·44 tons by 545ft. = 454,225 foot-tons, which, added to the engine traction of 857,578 foot-tons, gives a total o 1,311,803 foot-tons. Reducing these tons totals to foot-pounds, and dividing them by the total ton-miles—reduced to foot-tons—given in Table I. for train only, *i.e.*, 59,876 for the English train, and 64,710 for the American train, we arrive at a train resistance of 6·43 lb. per ton for the former, and 8·60 lb. per ton for the American train respectively.

These are probably very near the truth, and show the North-Western train to have about three-fourths the resistance of the American train, which in view of the sharper curves and steeper grades, causing some power to be lost in the brakes, seems only natural. C. B. PENLINGTON.

Bilbao, April 30th.

SIR,—Referring to the partial report of "Comparative Tests of English and American Railroad Trains" given in your impression of the 13th ult.—perhaps I may venture to express a hope that you will give to your readers the concluding portion of this most interesting report, together with the sections of the roads, and the traction and indicator diagrams necessary to make it complete.

Meantime I trust that you will allow me to remark upon one or two points, which are rather curious. First, the areas of the traction diagrams which should, I take it, represent the net work done, only differ by about 4 per cent.; while the power of the engines, the loads hauled, the traction in mile pounds, the draw-bar pull, and the foot-tons of work registered differ from 9 to 12 per cent., and the water evaporated by 40 per cent. Secondly, in Table No. 2 the first trial of the American train gives the resistance of train and track as only 2·38 lb. per New York ton, and this on the maximum rising gradient of 39·6ft. per mile. In the next trial, on a falling gradient 5·67 lb. are required, on a dead level from 3·20 lb. to 4·30 lb., and on a rising gradient of 26ft. per mile, a pull of 2·60 lb. is sufficient.

If, as the *Railroad Gazette* says, "only a small part of the energy of coasting was used in ascending the grades," how comes it to pass that a draw-bar pull of 5·67 lb. per ton was required to descend them? A CONSTANT READER.

Tipton, May 1st.

[We have already stated that the dynamometer diagrams have not been published, therefore we cannot reproduce them. The portion of the report which we have not given consists mainly of a description of the two engines, and supplies nothing which can throw any fresh light on their performance, or on the figures contained in Tables 1 and 2.—ED. E.]

THE R.A.S.E. TRIALS OF OIL ENGINES.

SIR,—"Another Engineer" seems to be another Russoline advocate, so that he can perhaps inform me if it is true that there are only about three brands of Russian oil sent from Russia to this country, and if Russoline is amongst them? Also where do the London stocks lie? Upon his own argument, Russoline should not be used for the R.A.S.E. trials, for, at present prices, I find the cost per effective horse-power is, with Royal Daylight ·459 of a penny, while with Russoline it is ·473 of a penny, and upon further reference to Prof. Unwin's paper on a petroleum engine, 14 per cent. more power is obtained from a given engine with Royal Daylight than with Russoline.

The above calculation is based upon buying Russoline in Liverpool, and Royal Daylight in London. If I buy both in London Russoline gets further behind. I did not, however, intend to raise a discussion as to the merits of particular brands of oils, but to ventilate the question of what would be best and fairest to use for all competitors at the R.A.S.E. trials; this seemed advisable owing to the vague condition, "Russoline or other well-known brand," which might mean anything in the shape of oil.

Russoline or Russian ordinary would be a good oil to use, but let competitors know it. I would ask "Another Engineer" to realise a trial of steam engines in which the only conditions known beforehand was, that "the cheapest fuel" would be used, this apparently being his argument. Different oils, like coals, act differently, and it seems scarcely fair to leave this question of what oil is to be used undecided. Supposing the R.A.S.E. have decided as to this, but the information is not to be made known, is it not possible for one firm by indirect means to get this knowledge, and so obtain a great advantage over the other competitors. It should be realised that although an oil engine may work on all the ordinary brands of petroleum, yet to obtain the best possible trials with each would require different adjustments. ON TRIAL.

May 1st.

THE GIGANTIC WHEEL.

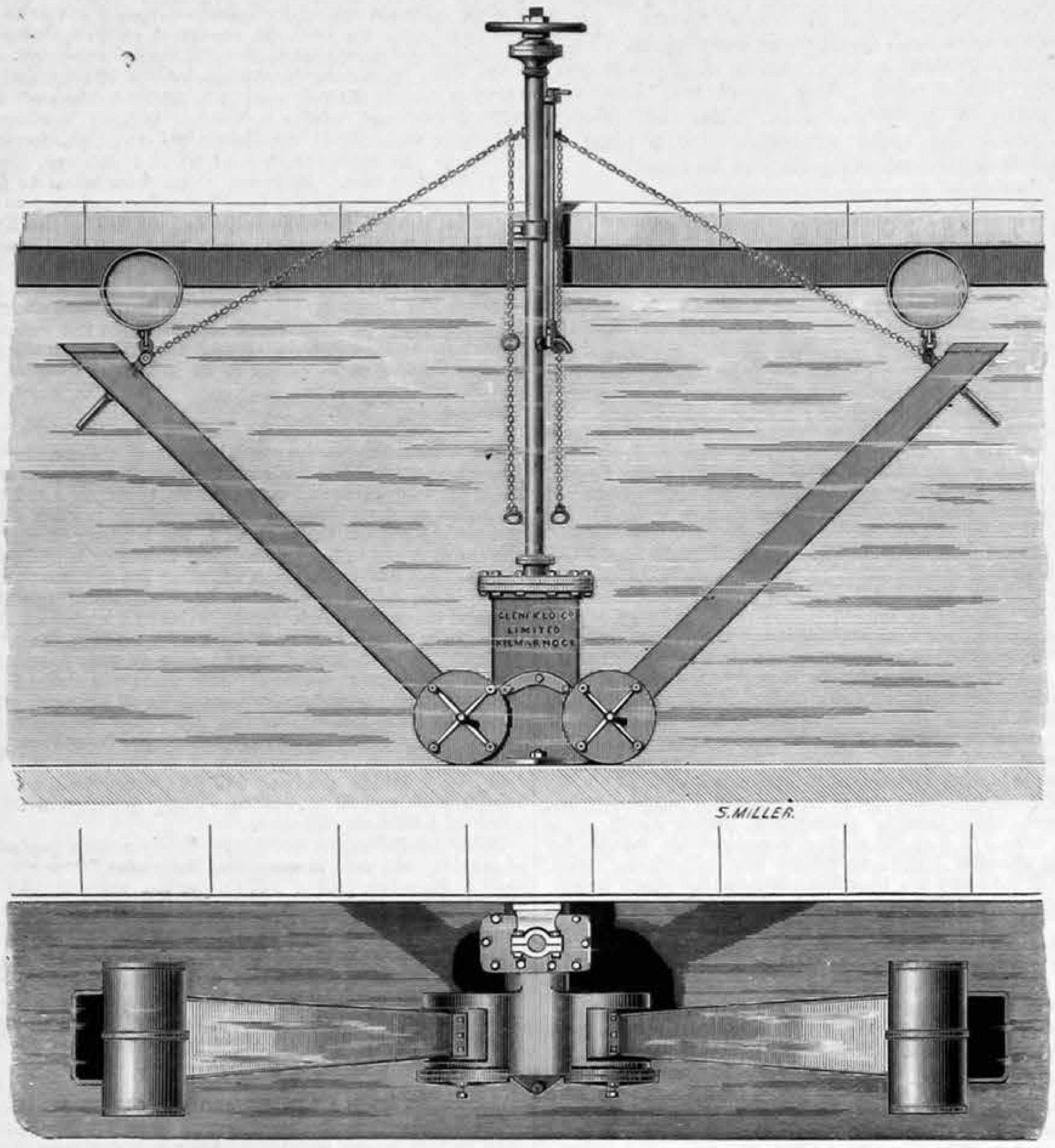
SIR,—Referring to the article on the Gigantic Wheel in your issue of the 20th ult. we find that the statements made in the same are leading to some confusion, as it might be, and is, understood by some of your readers that our company has taken the contract for the construction of the wheel. Mr. Basset, one of our directors, has taken the same, but as a private undertaking on his part, and this company is in no way connected with the matter except that Mr. Basset has been kind enough to place with us the order for the axle and some of the driving machinery.

WALTER H. MAUDSLAY,
Chairman and Managing Director,
Lambeth, May 2nd. Maudslay, Sons, and Field.

BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.—The sixty-fourth annual meeting of this Association will commence at Oxford on Wednesday, August 8th, 1894, with the Marquis of Salisbury, K.G., D.C.L., F.R.S., Chancellor of the University of Oxford, as president; the vice-presidents, the Earl of Jersey, G.C.M.G., Lord Wantage, K.C.B., V.C., the Earl of Rosebery, K.G., D.C.L., F.R.S., the Lord Bishop of Oxford, D.D., Lord Rothschild, Lord Kelvin, D.C.L., Pres. R.S., the Vice-Chancellor of the University of Oxford, Sir W. R. Anson, Bart., D.C.L., Warden of All Souls College, Sir Bernhard Samuelson, Bart., M.P., F.R.S., Sir Henry Dyke Ackland, Bart., M.D., F.R.S., the Master of Pembroke College, Dr. J. J. Sylvester, M.A., F.R.S.; general treasurer, Professor Arthur W. Rücker, M.A. F.R.S.; general secretaries, Capt. Sir Douglas Galton, K.C.B., D.C.L., LL.D., F.R.S., F.L.S., F.G.S., F.R.G.S., Mr. A. G. Vernon Harcourt, M.A., D.C.L., LL.D., F.R.S., F.C.S.; assistant general secretary, Mr. G. Griffith, M.A., College-road, Harrow; local secretaries for the meeting at Oxford, Mr. Gilbert C. Bourne, M.A., F.L.S., Mr. G. C. Druce, M.A., F.L.S., D. H. Nagel, Esq., M.A.; local treasurer for the meeting at Oxford, Mr. F. M. Davis. The first general meeting will be held on Wednesday, August 8th, at 8 p.m. The sections and officers are the following: (A) Mathematical and physical science,; president, Prof. A. W. Rücker, M.A., F.R.S. (B) Chemistry and mineralogy; president, Prof. H. B. Dixon, M.A., F.R.S. (C) Geology; president, L. Fletcher, M.A., F.R.S., F.G.S. (D) Biology; president, Prof. I. Bayley Balfour, M.A., M.D., F.R.S. (E) Geography; president, Capt. W. J. L. Wharton. R.N., F.R.S., F.R.G.S. (F) Economic science and statistics; president, Prof. C. F. Bastable, M.A., F.S.S. (G) Mechanical science; president, Prof. A. B. W. Kennedy, F.R.S., M. Inst. C.E. (H) Anthropology; president, Sir W. H. Flower, K.C.B., F.R.S. (I) Physiology; president, Professor E. A. Schafer, F.R.S., M.R.C.S.

GLASGOW SEWAGE WORKS

(*For description see page* 372)



Figs. 7 and 8—FLOATING DRAINERS

ENGINES OF THE S.S. TURRET-AGE.

OUR supplement this week illustrates the main engines of the s.s. Turret-Age, a full description of which novel vessel, along with several illustrations, appeared in our issue for the 16th ult. The engines and boilers, like the hull of the vessel, are the production of Messrs. William Doxford and Sons, of Pallion, Sunderland. The engines, boilers, and coal bunkers are placed right aft, near the stern of the vessel; this position having been fixed upon, as explained in the course of the description referred to, from considerations of trim conditions and facilities and of stowage capacity for bulk cargoes amidships.

The engines are of the usual triple-expansion, surface-condensing type, having cylinders 23in., 37in., and 60in. by 42in. stroke of piston, all supported on cast iron columns, the back columns for the intermediate and low-pressure cylinders being cast on to the condenser. The high-pressure cylinder is fitted with a piston-valve, and the intermediate and low-pressure cylinders with the D-type slide valve. The valve gear is of the link-motion type, and worked by means of a steam reversing engine. The crank shaft is on the "built" principle, being 11¼in. diameter, and is made in three sections, each section being a duplicate of the other, and will therefore fit to either cylinder in case of a breakdown at sea. The engines are fitted with a turning gear, placed between the intermediate and low-pressure cylinders, and worked from the reversing engine. The whole of the hand gear for reversing engine, regulator and throttle valves, drain-cocks, and auxiliary starting valves, are conveniently grouped together on the high-pressure column, so as to be easily controlled by one engineer. The air pump, circulating pump, and feed and bilge pumps are all worked by means of levers, links, and crosshead from the low-pressure engine. The diameter of air pump is 17in., of circulating pump 14in., of feed pump 4in., of bilge pump 4in., all having 30in. stroke. The surface condenser is fitted with 959 brass tubes ⅝in. external diameter, giving a cooling surface of 1977 square feet, the circulating water being directed so as to pass twice through the condenser.

The boilers are two in number, of the single-ended multitubular class, having large combustion chambers. The boilers are each 14ft. 10in. mean diameter, and 10ft. 6in. long, having three corrugated furnaces of 4ft. outside diameter. Each boiler has 262 tubes, 3¼in. external diameter, and 6ft. 11in. long between tube-plates, the total heating surface being 4320 square feet. The working steam pressure is 160 lb. per square inch, and the machinery developes 1320 indicated horse-power in ordinary work at sea on a low consumption of fuel.

A minor, but noteworthy feature—from the point of view of economy of labour and general convenience—of the stokehold arrangements of the Turret steamers is the manner in which the ashes are discharged overboard. Taking the place of the usual hoisting of ash buckets is the hydro-pneumatic ash-ejector, patented and introduced by Mr. Horace See. Briefly described, this apparatus consists of a hopper standing a convenient distance above the stokehold floor, and fitted with a substantial cast iron cover. This hopper opens down into a large pipe, which is thence inclined upward at an angle of about 60 deg., and leading out through a flap discharge valve in the ship's side, above the water-line. Into the bottom of this pipe enters the nozzle of the ejector, from which a jet of water, forced by the bilge pump, is allowed to issue when wanted. With the water-jet flowing through this pipe or conveyor tube and discharging overboard, the cover is lifted from the mouth of the hopper, and the ashes are simply shovelled in, being caught by the stream of water as they fall and carried along with it, aided by the suction caused by the passage of the water. To prevent any risk of clogging, air is admitted with the water, this being accomplished by the presence of an air valve in the inclined conveyor pipe. The ashes are removed as fast as they can be shovelled into the hopper, and the whole operation is simple and cleanly, and a considerable saving of time and labour.

THE CONVERSAZIONE OF THE ROYAL SOCIETY.

LAST Wednesday night at the conversazione of the Royal Society Dr. Alexander Muirhead exhibited at work the latest improvements in the apparatus for sending and recording messages by Atlantic cables, and the signals were sent through an artificial cable, presenting as nearly as possible the electrical conditions of a real one. He also described the new cable to be laid between Valentia, in Ireland, and Heart's Content, in Newfoundland, in the autumn of this year. It is the heaviest cable for the purpose ever made. The deep sea portion, exclusive of the whole of the shore ends, weighs, including its sheathing, over three-quarters of a ton per nautical mile. The copper conductor is extra large, weighing 650 lb. per knot, and the gutta-percha 400 lb. per knot. No. 11 pure copper wire runs through the centre of the cable, and it is surrounded with strands of finer copper wire. The length of the cable is 1850 knots. At present from eighteen to twenty words per minute are sent through Atlantic cables; it is hoped to get fifty words per minute through the new one. The 1865 and 1866 cables between Ireland and Newfoundland have been abandoned. At present the 1873, 1874, and 1880 cables by that route are working; and the 1894 cable, if laid successfully, will make the fourth. The example of making artificial Atlantic cables for home experiments was set by the late Mr. C. F. Varley in early days. The artificial line used on Wednesday by Dr. Muirhead, made of folds of tin-foil with paraffined paper between, consisted of a strip of tin-foil sixteen miles long, 2⅜in. wide, and half an acre in superficial area. He also exhibited Lord Kelvin's syphon recorder, and his own automatic curb transmitter in operation in connection with the artificial cable of the same capacity and conductor resistance as the Atlantic cable, which is to be laid next July by the Anglo-American Telegraph Company. The capacity of the artificial cable is 800 microfarads; and the resistance of the conductor 3350 B.A. units.

The Rev. F. J. Smith, M.A., of Trinity College, Oxford, exhibited a torsional ergometer or work measuring machine, used with a mechanical integrator and as an electrical governor for measuring the angle of torsion of the shafts of steamships, and for other purposes. When the system of pulleys and shafts is rotating, the angular displacement between the ends of the shaft has to be accurately determined. He says that he has used three methods for making this determination. The first depends on the phenomenon of the retention of an image by the organs of vision for a small fraction of a second. The second method depends on the reversal of the motion of the image of a rotating object by means of a combination of mirrors revolving at half the angular velocity of the object, and in the same direction. The third method is by the introduction of differential gear.

Mr. Henry Wilde, F.R.S., of Manchester, has a theory that the exterior of our earth is permanently magnetic; also that an interior one is movable and magnetic, rotating in the plane of the ecliptic, 23½ deg., and loses one revolution in 960 years, or 22·5 of a degree annually; he assumes, also, that the internal sphere is electro-dynamic. He exhibited two globes one within the other, and each containing a coil of insulated wire, through which currents of electricity could be sent, and mounted so that their motions should be such as to agree with his hypothesis. By placing a compass over different parts of the outer globe, he obtains the same variations and dip as are found in nature, so considers that he has proved his case, or at all events has done so until some better hypothesis is brought forward.

Professor Sylvanus Thompson exhibited some illustrations of polyphase electric currents, among which one of the most striking was the revolution of a copper egg in a rotary magnetic field; it could not get out of the field.

Mr. Henry A. Fleuss exhibited a mechanical pump for the rapid production of high vacua, and vacuum tubes exhausted by it. It was a double-barrelled air pump worked by a driving wheel turned by hand, but the essential part of it he keeps secret; all he says is, that in the valvular part is a special heavy oil, totally free from water.

Mr. J. W. Kearton exhibited several of his magic mirrors, on which no image was visible to the eye; but when light was thrown upon them from an electric lantern they cast reflected images upon a screen. His mirrors owe their peculiar properties to curved elevations and depressions in the polished metallic face, the elevations producing figures in shade by scattering of light, and the depressions, figures in light by condensing rays reflected from the mirror on to a screen. The figures in relief and intaglio are first produced by the action of any suitable acid on the metal plate, and are then polished down until they disappear to direct vision, after which the surface of the mirror is electro-gilt.

Mr. Killingworth Hedges exhibited a model of his method of transmitting force by spheres or balls. Instead of water as a medium, balls, each having a crushing strain of fifteen tons, are used; and any pressure on one end of the row of balls is immediately transmitted positively to the other, the tube in which they are contained running round corners, and up and down in the same way as the hydraulic pipe. At the bends the tube containing the row of balls has to be made with care, and to be very smooth inside.

Mr. Hedges had on view a diagram suggesting the application of his invention to the opening and closing of the water-tight doors of a ship from the conning tower. So far, experiments with the method have been carried on up to a distance of 150ft., over which, he states, the friction was slight.

Among the other objects of interest exhibited were an instrument for photomicrography, by Prof. Hunter Stewart and Mr. Henry Cunynghame, in which, for great steadiness, the application of the lathe system is applied to the camera, which slides along an iron bed; the focussing screen is at one end, and does not move, and while the operator is sitting near it, he has the means of making all the necessary but distant, coarse and fine adjustments.

LEGAL INTELLIGENCE.

QUEEN'S BENCH DIVISION.

Before MR. JUSTICE KENNEDY.

28th April, 1894.

MUIRHEAD AND ANOTHER *v.* THE COMMERCIAL CABLE COMPANY.

THIS was a very important action brought by the Messrs. Muirhead, the owners of Muirhead's patents for duplicating submarine cables, to recover royalties from the defendant company in respect of the use by the defendants of the patented inventions upon their two cables joining the United Kingdom and the United States. The claim in the action was for two quarters' royalty, payable under an agreement dated the 2nd January, 1884, and amounting to the sum of about £3000. But the real question to be decided in the action was whether the defendants were liable to pay royalties to the plaintiffs during the whole term of certain American patents, such royalties amounting in the whole to the sum of about £45,000.

The trial occupied eight days, from the 28th February to the 7th March last, and judgment was given on Saturday last by Mr. Justice Kennedy, before whom the action was tried.

The plaintiffs were represented by Mr. Finlay, Q.C., Mr. Bousfield, Q.C., and Mr. Pollard, instructed by Messrs. Trinders and Capron.

The defendants were represented by Sir Richard Webster, Q.C., Mr. Moulton, Q.C., and Mr. Arthur J. Walter, instructed by Messrs. Budd, Johnson, and Jecks, whilst Mr. Carpmael held a watching brief on behalf of interested third parties.

Under the licence granted by the plaintiffs to the defendants, the defendants were entitled to use inventions patented by the plaintiffs in England, the United States, Canada, and France, and the licence was expressed to continue so long as any of the patents should "last."

The term of all the English patents included in the licence expired on the 1st July, 1891; but one of the American patents, which had been granted in 1880, had been granted for the term of seventeen years, and would not expire till 1897, whilst the Canadian patents would not expire till 1895. The contention of the defendants was that the American patent of 1880 and the Canadian patents were granted for inventions which had been previously patented in the United Kingdom, and that hence by virtue of Section 4887 of the revised Statutes of the United States, the American patent of 1880, though on its face granted for the term of seventeen years, expired at the same date as the English patent of 1876, viz., in the year 1890; and that the Canadian patents, by virtue of the American Patent Act of 1870, expired with the corresponding English patents, so that on the 1st July, 1891, when the last of the English patents expired, all the terms of all the patents included in the licence had come to an end, and that no royalties were any longer payable.

The real fight in the case was upon two points:—(1) Was the invention contained in the English 1876 patent the same as the invention in the American 1880 patent? (2) Assuming the identity of these two patents, did the American law cause the American patent, *de facto* and without any decision of any American court, to lapse at the date of the corresponding English patent of 1876?

As will be seen by the judgment of Mr. Justice Kennedy—an extract from which will be found at the end of this report—all the points of law which were raised by the defendants were found by the learned judge in their favour, but he found in favour of the plaintiffs on the question of the identity of the inventions; holding that the American 1880 patent was granted for an invention different to that contained in the English 1876 patent, and that the plaintiffs were therefore entitled to receive royalties during the full term of the American 1880 patent.

In order that our readers may understand the scientific points raised in the case, we have prepared a sketch of a model of a complete installation of Muirhead's duplex cable system, which was used at the trial, and which was designed and personally constructed by Mr. A. J. Walter, the defendants' junior counsel. Put shortly, the 1876 English patent covered Muirhead's invention of reducing the retardation of the current in the bridge arms by substituting for the high resistance formerly used in the bridge arms—to prevent their shunting effect upon the current—split condensers, one in each arm of the bridge, whereby the shunting effect was equally well eliminated, and a much clearer and more sharply defined and quicker signal was obtained.

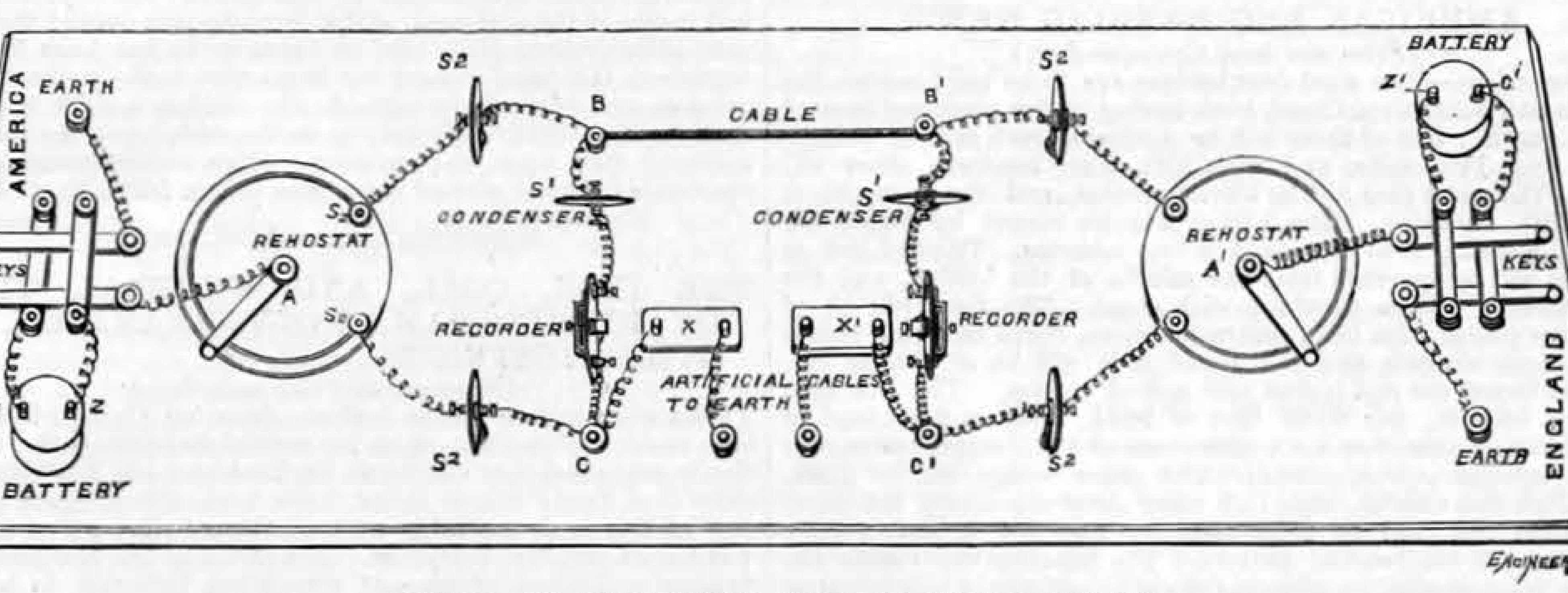
The general principle of the duplex system is probably sufficiently well understood by the general body of our readers; but put shortly it amounts to this.

The cable on the ocean bed, in addition to possessing resistance, has also a Leyden jar effect, viz., it has a "capacity." An artificial cable consisting of a large number of sheets of tinfoil and paraffined paper is prepared, corresponding in resistance and capacity to the real cable. A battery is arranged in connection with two keys, so that, by depressing one or other of these keys, one terminal of the battery is put to earth, and the other terminal is connected with the apex of the bridge. The current flows through both arms of the bridge, and into the real and artificial cables, and through them to earth and back to the battery. As the resistance and capacity of the real and artificial cables are the same, the current divides equally between the two arms of the bridge, so that the potential at the points B and C in the diagram are the same, and hence no current flows between the points B and C through the recording instrument at the sending station, but the current passing through the cable reaches the recorder at the receiving station, and deflects the needle of its galvanometer.

When, of course, operators are at work at both ends of the cable the action will be readily understood. Assuming that the operator at the end marked America has depressed his key and sent a current into the cable and artificial cable, the potential at B and C remains constant, and no deflection of the recorder at the sending end is noticed, but assuming that at the same instant the operator at the English end has sent a current into the cable by depressing his key, the effect of this will be either to raise or to lower the potential at the point B, and hence a flow of current is determined between B and C, and the recorder at the American end of the instrument will move. It will be seen that, of course, a similar effect in the recorder at the English end is produced by the action of the operator depressing his key at the American end, and that hence the recording instruments at each end are only affected by currents sent from the other end of the cable.

The chief point, in which Muirhead's 1876 patent was an advance upon earlier knowledge upon the subject, consisted in the removal from the arms of the bridge of the very high resistance of which they were formerly constructed, and substituting therefor arms of low resistance, and a condenser in each arm of the bridge, each of such condensers consisting of a series of plates of tinfoil insulated with paraffined paper and constituting a series of Leyden jars interposed in each arm of the bridge and causing a break in the continuity of the metallic circuit of the same, as the inside of the Leydon jar is connected with one part of each bridge wire, and the outside with the other part as shown diagrammatically in the model at S^2, which consists of a couple of brass plates insulated from one another by a vulcanite plate, the whole being insulated from the earth.

be for seventeen years, from November 16th, 1880. *Primâ facie*, therefore, it would last until November 16th, 1897; but, being a United States patent, it was governed by American law, which enacted that "every patent granted for an invention which has been previously patented in a foreign country shall be so limited as to expire at the same time with the foreign patent, or, if there be more than one, at the same time with the one having the shortest term, and in no case shall it be in force more than seventeen years." Having also referred to Rule 162 (United Stated Rules of Practice), his Lordship said it had been, in his view, decided by the American cases that, although an American patent had not upon its face been limited, but contained an express grant of the patent rights for the full term of seventeen years, nevertheless, by operation of law, if the invention had, in fact, been primarily patented abroad and the foreign patent had expired before the seventeen years' term had run out, the American patent would expire at the same time. It was also settled law that the United States statutes were not to be interpreted as invalidating *ab initio* a patent wherein, although it is for an invention previously patented abroad, the grant was not limited, but was for the full term of seventeen years. The statutes were to be construed simply as curtailing the effect or duration of the grant. In other words, the patent is a valid grant, but is good only for the shorter term, and expires at the expiration of the foreign patent of which it is a copy. That being the state of the American law as to patents, the defence to the plaintiffs' claim was that the plaintiffs' American patent of 1880 was for "an invention which had been primarily patented in a foreign country"—viz., the English patent granted to Mr. Muirhead in 1876, No. 2564, which expired not later than July 1st, 1891—and that the American patent, being in substance the same as that of 1876, the former, by operation of American law, terminated on July 1st, 1891, though on its face it was expressed to last for seventeen years from November 16th, 1880. In reply to that the plaintiffs raised two set of contentions, one purely legal and the other partly legal and partly of fact and based upon the construction of the English and American patents and the inferences to be drawn from the scientific evidence. First, as to the law. The plaintiffs say that, as between a patentee and a party charged with infringing the patent, the alleged infringer may, according to American law, succeed by proving that the American patent has expired because of the expiration of a prior foreign patent granted for the same invention, although the duration of the American patent has not been limited, as it ought to have been, upon its face to the duration of the foreign patent; yet that line of defence is not open to a licensee as against his licensor, because to establish



MODEL OF MUIRHEAD'S DUPLEX CABLE SYSTEM

It will be of course apparent that with the varying conditions of atmosphere and temperature to which the real cable is exposed, as compared with the artificial cable, changes in the relative electrical resistance and capacity of the real and artificial cables would have to be made from time to time; and though in the 1876 patent no specific directions were given as to the means of adjusting these, it was given in evidence by the defendants' witnesses, and admitted by the plaintiffs' witnesses, that in order to work the 1876 combination, some means of adjusting the resistances of the arms of the bridge would have to be made; and it was proved that this was usually done by the insertion of resistance-boxes of low resistance, in one or both of the arms of the bridge.

In Muirhead's 1880 patent a rheostat for this purpose was introduced at the apex of the bridge, such rheostat being merely a resistance box in a convenient form, but it was alleged by the plaintiffs' witnesses that the great advantage of this form of varying resistance was that, whilst it enabled a ready adjustment of the resistances of the arms to be made by merely turning the handle of the rheostat, it preserved constant the sum of the resistances in the two arms of the bridge, as the effect of moving the arm of the rheostat was to deduct from one arm as much resistance as it put into the other. The introduction of this rheostat, which was included in all the claims in the American 1880 patent, was alleged by the plaintiffs to constitute a great advance in the electrical efficiency of the apparatus, and to differentiate the American 1880 patent from the English 1876 patent.

A large body of scientific evidence was called. For the plaintiffs: Prof. Silvanus Thompson, F.R.S., Lord Kelvin, F.R.S., Sir Fredk. Bramwell, Mr. George Mockeridge, Mr. John Imray, Mr. Herbert Taylor, Professor J. T. Bottomley, Messrs. Muirhead, and Dr. John Hopkinson, F.R.S.

For the defendants there were examined Professor Andrew Jamieson, Mr. J. Swinburne, Mr. H. R. Kempe, of the Post-office, Mr. John Gott, Mr. Frank Jacob, manager to Messrs. Siemens, and Sir H. E. Mance, lately in the Indian Government Telegraph Service.

The learned Judge, at the conclusion of the case, reserved judgment, and on Saturday last delivered a written judgment, from which we extract the following:—

Mr. JUSTICE KENNEDY having outlined the nature of the claim, referred to the written agreement of January 2nd, 1884, under which the plaintiffs had granted the defendants licence to use their patents. The only important part of that agreement for the purpose of deciding the case was, he said, the first article thereof, viz.:—"The inventors grant to the company the right to apply this said patented duplex apparatus to the above-named cables. This grant is made for the whole period during which the patents shall last. . . ." The clause further bound the plaintiffs—the inventors—to give to the defendants all the benefits of any improvements which they might make in their system during the currency of this licence. For the purposes of this action, his Lordship said, it might be taken that this agreement was carried out by both parties up to July 1st, 1891, and it was the quarterly payments due subsequent to that date down to December 25th, 1891, that the plaintiffs now sought to recover. The action had an interest far beyond these amounts, however, for if the plaintiffs were entitled to recover them, it followed that they were entitled to similar quarterly payments for several succeeding years also. The issue which was raised was, Was Mr. Alexander Muirhead's patent, No. 234,490, dated November 16th, 1880, a patent which, in the language of the article of the agreement he had referred to, was "lasting" after July 1st, 1891? The plaintiffs contended that it was, and if it were not, the defendants were entitled to judgment. The determination of that issue involved some important issues of law and some complicated questions of fact of a scientific and highly technical character, the trial of which occupied several days. The plaintiffs' patent of 1880 was granted by the American Patent-office, and was expressed to

it the licensee had to attack the validity of the patent. The learned Judge held that the plaintiffs' view upon that point was wrong, and that the defendants were not estopped from setting up the defence that the American patent had expired with the English one of 1876, if those patents were the same in substance and effect. He also decided that on the evidence the fair inference was that the patent of 1876 had been granted with Mr. Alexander Muirhead's knowledge and consent, and that the United States law was applicable if it was found, in fact, that the English patent of 1876 anticipated that granted in America in 1880. Lastly, he had been asked to hold that he could not, sitting here, find that the American patent had expired without proof of a decision in the United States Court to that effect. This action was, however, he pointed out, brought upon a written agreement, which expressly provided that it was to be construed as an English contract, and that all questions or disputes arising thereout should be determined by a competent English tribunal. How could it, therefore, he said, be successfully argued that he ought to refuse to try the questions raised in this action between the parties? The learned Judge continued:—Having thus dealt with the various legal contentions, he came to the more difficult but most interesting part of the case—viz., Were the defendants right in their allegation that the plaintiffs' American patent of 1880 was the same invention as that for which the 1876 patent had been granted them in England? Unless the defendants were right in that, the defence to the action entirely failed, and the plaintiffs were entitled to judgment. In dealing with this portion of the case, the learned Judge, after some prefatory remarks upon the highly technical nature of the evidence and the very convenient mode in which the American cases and statutes had been laid before the Court, proceeded to deal with the general principles established in these American cases as applicable to this action, and observed that as laid down in "Brush Electric Company *v.* Julien Electric Company (41 Fed. Rep.) if there were any doubt upon a question of the identity of an American patent with that of a foreign one, the patentee was entitled to the benefit of such doubt, as the policy of the law was to support the patentee's rights. The learned Judge also referred to the case of "Siemens *v.* Sellars" (123 U.S. Rep. 276) and Judge Cox's judgment in the "Electric Accumulator Co. *v.* Julien Electric Co., Limited (64 *Off. Gaz.* 559) upon the questions of infringement and as to the true test of identity in patents; and, continuing, asked:—(1) Is the principal invention of the American patent of 1880 found in the English one of 1876? (2) Is the subject-matter of the one the same as that of the other? (3) Could both the patents have been granted in America? (4) Would a person skilled in this art, from reading the description of the English patent of 1876, be able therefrom to construct the apparatus described and claimed in the American patent of 1880? Those questions involved, in his opinion, the principles deducible from all the American cases as to the identity of the patents of 1876 and 1880. The claim of the 1880 patent was one of the narrowest kind, and was for a particular combination only. The elements forming that combination were admittedly old. "My invention," says the patentee, "relates to duplex telegraphs of the class worked on the bridge or differential system." "The object is more especially to reduce the retardation of the signals and increase the speed of transmission of submarine telegraph lines, which ends I attain by certain novel combinations and adjustments of old instrumentalities set out in the claims at the end of this specification." The defendants, in order to succeed, must establish beyond all doubt that this particular combination of old instrumentalities—the working of which undoubtedly, said the learned Judge, produced commercially better results than had ever been obtained before—was to be found in the earlier patent of 1876. Put shortly, the distinction seemed to him to consist in the method and means of adjustment—that was, the maintaining the proper balance. He was satisfied upon the expert evidence that the introduction of the "three-terminal" rheostat of low

resistance placed at the apex of the bridge arms, and therefore in such a position as not merely to afford an easy and sufficient means of varying the resistances so as to get the ratio which gave a balance, but also to maintain the sum of the resistances of the two bridge arms constant, was a very important part of the 1880 combination. On all the evidence he was clearly of opinion that the patent of 1876 did not contain the same combination as was found in the American patent of 1880, and that in his opinion the latter was a good and novel patent. There would, therefore, be judgment for the plaintiffs for £3566 1s. 5d., and costs.

A discussion took place as to whether or not the plaintiffs were entitled to interest on that amount at 5 per cent. It was finally decided that the question should be subsequently mentioned to his Lordship, counsel in the meantime to agree as to the exact amount of such interest, if payable. Execution was stayed for twenty-one days to consider the question of an appeal.

HIGH COURT OF JUSTICE.

APRIL 27TH, 1894.

Before MR. JUSTICE STIRLING.

WISE AND OTHERS *v.* METROPOLITAN ELECTRIC SUPPLY COMPANY.

The hearing of this case was concluded on the 27th ult.

Mr. Graham Hastings, Q.C., having been heard in reply upon the whole case,

Mr. JUSTICE STIRLING proceeded to give his judgment, in the course of which he said that this was an action brought by five plaintiffs, who were tenants and occupiers of houses in Manchester-street, Manchester-square, against the defendant company, who had erected works in the neighbourhood of that street for the supply of electricity for lighting and other purposes to the houses in the surrounding district, and sought to restrain the company from carrying on their business in such a way as to cause a nuisance to the plaintiffs by three different modes, viz., by vibration, noise and smoke, smuts and grit. The defences put forward by the company were twofold—first, it was said that they did not carry on their business in such a way as to cause an actionable nuisance to the plaintiffs; and, secondly, that even if they did the only remedy of the plaintiffs was by compensation under section 17 of the Electric Lighting Act, 1882, and not by way of injunction or damages. With regard to the second of these defences his Lordship considered it unnecessary for him to go into the subject, because it so happened that since the hearing of this action was first commenced the identical question had been raised before Mr. Justice Kekewich in a case decided by him during the present sittings—"Meux's Brewery Company *v.* City of London Electric Lighting Company," reported in the *Times* of April 20. Mr. Justice Kekewich appeared to have fully considered the question, and dealt with all the material points. If a few of the points taken in this case had not been touched upon his Lordship did not think that, had they been taken before Mr. Justice Kekewich, they would have affected the conclusion at which he had arrived. Under these circumstances it would not be right for him—Mr. Justice Stirling—to enter into the question again. He, therefore, should proceed upon the basis of the conclusion at which Mr. Justice Kekewich had arrived upon the question of law, and accordingly must start with the assumption that the defendant company was not entitled to carry on its works in such a way as to cause a nuisance to its neighbours. Upon that two questions arose—first, whether, in fact, the nuisance was caused by the works; and, secondly, what was the remedy of the plaintiffs in respect of it. On the question of what constituted a nuisance his Lordship referred to the case of "Walter *v.* Selfe" (4 D and S., 315), where V.C. Knight-Bruce defined it as "an inconvenience materially interfering with the ordinary comfort physically of human existence, not merely according to elegant or dainty modes and habits of living, but according to plain and sober and simple notions among the English people." That had been referred to and approved of in many cases, and particularly by Lord Selborne in "Fleming *v.* Hislop" (L.R., 11 App. Cas., 691), where he said, referring to "Walter *v.* Selfe," that that case and "all the cases which have followed it have laid down this proposition in substance, and very nearly in words, if I am not mistaken, that what causes material discomfort and annoyance for the ordinary purposes of life to a man's house or to his property is to be restrained, subject, of course, to any question which the circumstances of the particular case may raise, and that although the evidence does not go to the length of proving that health is in danger." His Lordship then referred to the evidence as to the existence of the vibration, and to the means which had been adopted by the defendants to get rid of it, and said that it must be taken upon the evidence that there was, in fact, a substantial amount of vibration in the plaintiffs' houses, due to the working of the defendants' engines. Did that in law constitute a nuisance? The test to be applied was that suggested by V. C. Knight-Bruce, and adopted by Lord Selborne—viz., did it cause "material discomfort and annoyance for the ordinary purposes of life?" The plaintiffs spoke very forcibly as to the vibration. They also mentioned the fact of noise, but it seemed that the real substantial complaint was as to the vibration. The complaint as to the noise might perhaps be regarded as a kind of appendix to the vibration. His Lordship then further examined the evidence upon the question of the effect of the vibration upon the houses, remarking that one of the most remarkable features of it, as pointed out by the scientific witnesses, was its fitfulness. Sometimes it would be felt more in one room and sometimes in another, now in one house and now in another. But taking the evidence of the witnesses as honest statements giving a fair account of what was experienced in the houses, his Lordship came to the conclusion that a case was made out of interference with the enjoyment in the ordinary way of these houses. The ordinary occupation of people living in them was interfered with, and there was evidence that the occupants were unable to enjoy their ordinary rest. The evidence had been given with moderation and without exaggeration, though, perhaps, a little colouring had been introduced; but a substantial case of nuisance from the vibration had been made out. As to the noise occasioned by the machinery, his Lordship did not come to the same conclusion. It was not a serious matter of complaint. Still less so was the complaint as to smoke. He accepted the statement of the defendants' engineer that during the coal strike inferior coal had to be used, which might have caused some annoyance, but there was no case for an injunction or damages as to either noise or smoke. That, however, was not a serious part of the case, and had not materially increased the costs of the action. It followed that the Court ought to grant an injunction and an inquiry as to damages. That injunction and inquiry, however, would be postponed for a time. The company had been unfortunate, and ever since October, 1892, they had done their very best to remove all ground of complaint. If they had not succeeded, it was no fault of theirs. The case presented an engineering problem which was apparently entirely new and very difficult, and the company ought to have a fair opportunity of completing the remedial works upon which they were still engaged. Having regard to the difficulty of the subject, and the uncertainty of the success of the means which could be adopted, it was fair to suspend the injunction for three months. The injunction and inquiry as to damages would be confined to the subject of vibration, and the defendants would not be precluded from applying, if necessary, for a further extension of time. The defendants must pay the costs of the action.—*Times*.

THE landing stage at Braila connecting with the local passenger steamers running to Galatz collapsed on Monday when it was crowded by excursionists. The captain of the British steamship Jersey jumped into the water and saved no fewer than seven lives, but many were drowned.

CATALOGUES.

Jardine, John, Nottingham. Patent Special and General Goods, including Plummer Blocks, Shafting, Collars, Couplings, Pulleys, Brackets, and Belting.

Leeds and London Electrical Engineering Company, Limited, Leeds and London. Lowrie-Hall Electric Converter.

Bagshaw, J., and Sons, Limited, Batley, Yorkshire. Wrought Iron Pulleys, Shafting, and Friction Coupling.

Baldwin, James, Devonshire Brass Works, Keighley. Baldwin's Patent Safety Accessible, Removable, and Renewable Feed Check Valve, &c.

Waterhouse Electrical Manufacturing Company, Limited, 67, Southwark Bridge-road, London. Waterhouse Arc Lamp.

Wilkinson, G., and Sons, Keighley. Engineer's Machine Tools. Lathes, hollow spindle turret lathes, two spindle boring machines, surfacing lathes, dynamo wire lapping machines, wheel lathes, planing machines, slotting machines, drilling, punching, and other machine tools. A nicely got up catalogue with name on back.

Ruston, Proctor, and Co., Limited, Lincoln. Fixed and Portable Engines and Boilers, Winding Engines, and Traction Engines.

Hulme and Lund, Manchester. Pumping Machinery, Valves, &c.

Grantham Crank and Iron Company, Limited, Grantham. Vertical Boilers of various kinds. Locomotive type Boilers, Cornish, Lancashire and Marine type Boilers.

Riehle Bros. Testing Machine Company, Philadelphia, Pa., U.S.A. Designers and Constructors of Special Machinery.

Cole, Marchant, and Morley, Bradford. Corliss Engines with Morley's Patent Gear.

Magnetic Filter Company, The, 32a, Euston-square, London, and Liverpool. Spencer's Magnetic Filters.

Menzies, James, and Company, Glasgow and London. All kinds of Wrought Iron Tubes and Fittings.

Stover Manufacturing Company, Freeport, Ill., U.S.A. Windmills. The ideal feed mill.

Jeffrey Manufacturing Company, Columbus, Ohio, U.S.A., and England; John Davis and Son, Derby. Coal Mining Machines, Elevating and Conveying Machinery, Chain Belting.

Platt Brothers and Company, Limited, Hertford Works, Oldham. Machinery for Opening, Carding, Drawing, and Combing Cotton.

Thornton and Crebbin, Bradford, Yorks. Makers of Iron and Steelworks' Machinery, Shipbuilders' and Boilermakers' Tools, &c.

Caddy and Company, Limited, Nottingham. Caddy's Patent Smoke-consuming Chilled-face Fire Bars for all kinds of Furnaces.

Steward, J. H., 406, Strand, London. Photographic Apparatus, Cameras, "Rectiform" Lenses.

Berend, O., and Company, 61, Fore-street, London. Special Appliances and Materials, Accessories, &c., for Electrical, Mechanical, and General Engineers, Ironmongers, and Chemical Manufacturers.

Electrical Power Storage Company, Limited, The, London. E.P.S. Batteries.

General Export Association of Sweden, Catalogue of Swedish Exports. Edited by Wilhelm Tesch, Managing Director of the Association. Stockholm: the Royal Printing Office. This is a well got up guide which will be found useful by English merchants.

Dell, William R., and Son, 26, Mark-lane, London. The "New American" Turbine and the Fruen Water Wheel Governor; Turbines, Vertical and Horizontal, for low and high heads.

Coward and Ihlee, Engineers, Bath. The Niagara Pulveriser.

Robinson, A. E. and H., 78, Great Bridgewater-street, Manchester. The "H. R." Gas Engine.

Berend, O., and Co., 61, Fore-street, London. Grease and Oil Lubricators, Oil Cans, Grease Fillers, &c.

Whitmore and Binyon, Wickham Market, Suffolk, and London. Roller Flour Mill Machinery. This is a nicely got-up quarto catalogue of the machinery now used in roller flour mills, including the various roller mills, and reduction machines for horse feed, six-roll mills, scalping and dressing machines, reels, brand dusters, flour dressers, most of them being of Messrs. Whitmore and Binyon's own designs. The catalogue also relates to motive power for flour mills, and describes a large mill fitted up for Messrs. James Tucker, Limited, Cardiff.

Vaughan and Son, West Gorton, Manchester. Shafting (Steel and Iron), Couplings, Plummer Blocks, and various kinds of Brackets, Hangers, &c.

Wilson, John H., and Co., Limited, Liverpool and London, Manufacturers of Lifting Machinery, Steam Cranes, Patent Grabs, &c. A nicely got up catalogue, showing fixed and portable jib cranes for light and heavy work up to 70 tons, and with jibs up to 65ft. in length. Harbour cranes, grab dredger cranes, concrete making machinery, and steam winches. The catalogue easily found by the name on the back.

Craft and Perkins, Bradford. Friction Clutches, Shafting, Belt and Rope Pulleys, Gearing, &c.

Wright's Patent Heater Condenser Company, 16, Great George-street, Westminster, London. Wright's Patent Machinery and Combinations. This relates to feed-water heaters, steam and grease separators, evaporators and condensers, water softeners, and to what the makers call their compound cylinder release engine.

Blackwall, Robt. W., 39, Victoria-street, London. Agent for Electric Railway, Light, and Power Specialities. Manufactured by Albert and J. M. Anderson, Boston, Mass., U.S.A.

Hunslet Engine Company, Leeds. Locomotives. A nicely got up catalogue of convenient size of main line and contractor's locomotives and locomotives for light and narrow gauge railways, plantation and agricultural purposes. Some useful memoranda are given at the end of the catalogue. The name is printed on the back.

Smith and Grace, Thrapston and London. Cast and Wrought Iron Pulleys, split and ordinary, with the makers well-known interchangeable screw bush and boss, also Smith's adjustable swivel bearings and coupling for shafting.

Denison, Saml., and Son, Leeds. Denison's Improved Weighing Machines and Weighbridges.

Stone, J., and Company, Deptford, London. Stone's Side Lights. Relates to square and round deck and state-room lights, and rolling scuttles, and the maker's now well-known pivoted deck house scuttle, with air inlet and outlet ventilating arrangements.

Mirrlees, Watson, and Yaryan Company, Limited, The, Glasgow. Patent Toggle Pressure Regulating Apparatus for Cane Crushing Mills. This is a nicely got-up catalogue of cane crushing mills, fitted with toggle pressure regulating apparatus, by means of which springs of the helical and volute form and of comparatively small resisting power, are enabled to control the pressure upon and movement of rolls working under very heavy pressures. This arrangement of spring toggles is one of those simple yet final inventions which come once in a life to inventors. It is remarkably effective, and has now been in use over three years. It is the invention, we believe, of Mr. John G. Hudson, M. Inst. C.E., whose name is well known to our readers.

Sporton, Henry, and Company, Chase Side, Enfield, London. Manufacturers of Semi-Positive, Rotary, and Automatic Registering and Waste-detecting Water Meters—Sporton's Patents—&c.

Lang, John, and Sons, Johnstone, near Glasgow. Lathes, Bolt and Stud Machines, Pulley Turning Lathes, Milling Machine, Milling Cutters, Gear Cutting Machines, and Screwing Machines.

Bagnall, W. G., Limited, Stafford. Locomotives of every description, Light Railway Material, Tipping Wagons, &c. &c. The interest now taken in narrow gauge and light rolling stock adds value to this catalogue, which contains illustrations, particulars, and prices, not only of standard gauge but of all kinds of narrow gauge and light rolling stock suitable for lines from 18in. gauge and upwards. It also contains prices and particulars of permanent way for light railways, and of portable railways for colonial and plantation purposes.

Mavor and Coulson, 57, West Nile-street, Glasgow. Electric Light and Power. A well illustrated catalogue of the maker's electrical machinery and distributing apparatus.

Hayward Tyler and Co., White Cross-street, London, E.C. The "Gordon Duplex Steam Pumps." This relates to the Gordon steam pumps in various sizes, from that suitable to feeding boilers up to the large sizes required for waterworks. It is made as a duplex pump with compound engines both of the horizontal and vertical form.

Dick, Kerr, and Co., Limited, London and Kilmarnock. Gas Engines. Relates to single and double-acting gas engines from about 1-horse power up to 300-horse power in a single cylinder.

Cobbett, W. Willson, 82, Southwark-street, London. "Scandinavia" Patent Cotton Machine Belting and Elevator Webbing. "Saturn" Improved Hair Belting and Belting Accessories.

Worthington Pumping Engine Company, London. Worthington Pumping Engine, Horizontal and Vertical, Direct Acting and Beam Patterns, High Duty, Triple Expansion, Compound Condensing, Compound and Simple. In this catalogue the vertical as well as the horizontal form of Worthington Pump is illustrated and described, and particulars given of both kinds, and of the Worthington hydraulic pressure pumping engine fitted with compensating expansion gear.

Chamberlain and Hookham, Limited, Birmingham. The Continuous Current Meter, the Alternate Current Meter.

Lancashire Belt, Belting, and Hose Company. In the mention in our last impression of this catalogue, the words "bottom belting" should have been "cotton belting."

Wood, Walter A., Mowing and Reaping Machine Company, 36, Worship-street, London. Harvesters, Mowers, and Reapers.

Manning, Maxwell, and Moore, New York, U.S.A. Railway and Machinists' Tools and Supplies. This is a remarkable catalogue of nearly eleven hundred pages, illustrated throughout with excellent catalogue engravings. The catalogue is 13in. by 10in., and contains illustrated descriptions of every class of tool and requisite for not only railway works, but for engineering and manufacturing works of any kind. The tools and appliances for the numerous industries not included in engineering work are also illustrated, and the prices given. Agricultural machinery, tinsmith, road-making machinery, sawmill machinery, and everything in fact that can be required by a great railway company owning not only its own rolling stock building works, but its own plant for road-making, and for conduct of the agricultural operations on farms for the growth of the fodder for its own horses. It is, in fact, the largest catalogue of machine tools and appliances with which we are acquainted, and is exceedingly well got up.

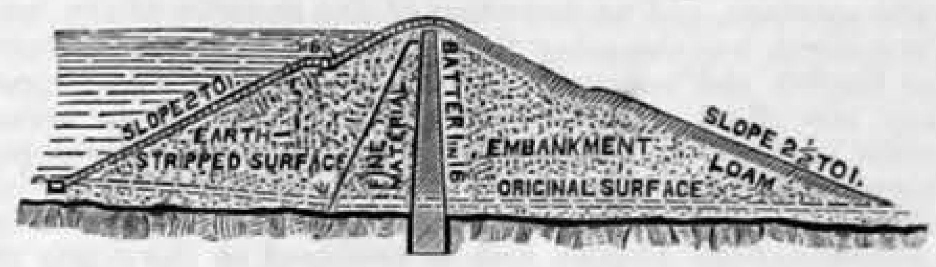
AMERICAN ENGINEERING NEWS.

(*From our own Correspondent.*)

Drawbridges.—Two steel drawbridges are to be built across the Illinois and Mississippi Canal, both having centre piers and arms of equal length. One of these will be a single track railway bridge, 150ft. long, 14ft. wide, and with 20ft. clear headway above rail level. The pivot pier will be 36ft. diameter, and the turntable is to be 20ft. diameter. The bridge will be turned by hand, the gearing allowing it to be opened in four minutes. The end lock or latches will be operated from the middle of the bridge, and the end bearings will be provided with cams. The floor will be of cross ties placed 12in. from centre to centre, bored out and bolted to the track slingers, and the guard rails will be of 6in. to 8in. timbers boxed out and bolted and spiked to ties. The live load will be 5800 lb. per lineal foot of track, with a floor load of 10,000 lb. per lineal foot on a wheel base of 15ft., supported on four equally-spaced pair of wheels. The other bridge will be 126ft. long, 20ft. clear width, with 14ft. clear headway above the floor. The pivot pier will be 28ft. diameter and the turntable 26ft. diameter, of rim-bearing pattern. The gearing will enable the bridge to be swung in a complete circle by one man in four minutes. The floor will have 3in. pine stringers, covered by 2in. pine planks and a wearing surface of 3in. oak planks, and the roadway will have 4in. by 12in. pine guard rails faced with angle iron and raised above the floor to allow of slush and mud being swept from the roadway. A tramway track will be laid on one side. The end bearings will consist of wheel stands with rubber cushions, and will be adjustable as to height. The steel is to be made by the open-hearth process, and contain not more than $\frac{1}{10}$ of 1 per cent. of phosphorus. Test members must show 60,000 lb. ultimate strength, 33,000 lb. elastic limit, and 10 per cent. elongation.

Indicator cards from locomotives.—In a recent discussion upon the distribution of steam in high-speed locomotives, it was shown that in testing stationary engines, the engineer has succeeded in doing away with a large part of the drum cord connecting the indicator with the moving part of the engine, and has eliminated entirely the pipe connection for the indicator. He gets the indicator directly upon the cylinder. It seems impossible to accomplish as much as this in connection with locomotive work. In some experiments to determine the influence of the indicator pipe upon the form of the card, an indicator was attached close to one end of one of the cylinders of an experimental locomotive, and a pipe arranged to connect the same cylinder end with a second indicator, located above the top of the valve-box. The arrangement of the second indicator was in every way similar to that employed in road tests of locomotives. The pipe used was $3\frac{1}{2}$ft. in length and $\frac{3}{8}$in. diameter. It was carefully bent to shape and covered. Series of cards were taken from both indicators simultaneously, and the indicators were then reversed in position and the work repeated. As the speed increased a very noticeable difference was found in the form of the cards, those from the indicator upon the cylinder being always much smoother in outline than the cards upon the pipe. There was also an actual difference in the size of the cards. The pipe enters into the results as a retarding agent upon the action of the indicator, which is attached to it. When the motion of the indicator pencil is slight, as during exhaust, both indicators gave the same record; but when the exhaust valve of the engine closes, and there is an acceleration of pressure to be recorded, the upward movement of the pencil of the pipe indicator is slower than that of the indicator on the cylinder. As a result the compression line from the indicator upon the pipe runs lower than the compression line from the indicator on the cylinder. Again, at the beginning of the stroke, the indicators start out pretty well together, but during the rapid fall of pressure just before and after cut-off the pipe indicator comes down more slowly and gives an expansion line higher on the card as compared with the expansion line from the indicator on the cylinder. The result is that the card from the indicator on the pipe is larger than the card from the indicator on the cylinder. The record shows that for a speed of $56\frac{1}{2}$ miles per hour the mean effective pressure given by the indicator on the cylinder is to the mean effective pressure given by the indicator on the pipe, as 1 is to 1·17; or, if we accept the record of the indicator on the cylinder as true, the showing of the pipe indicator is in error to the extent of 17 per cent. It is evident from the results of the experiments that the pipe affects the accuracy of all data which may be derived from the card. Thus the pipe indicator shows an excess of steam at cut-off, and a still greater excess at release. Its record at the beginning of compression is nearly true, but at the end of compression it shows less steam than it should. Mechanical engineers in charge of locomotives are beginning to realise the practical advantages to be derived from a more general use of the indicator, and it is to be hoped that the arrangements for indicating may be simplified and made as reliable as possible.

Waterworks dams.—In a paper on "Earth Dams and Reservoir Embankments," presented by Mr. D. FitzGerald before the New England Waterworks Association, the practice followed for the Boston waterworks reservoirs was described, and the accompanying sketch represents a typical section of bank about 65ft. high. The slopes are 2 to 1 on the inside, with a berm 6ft. wide about 8ft. below the flood level. These slopes are paved on a broken stone foundation. The slopes on the outside are 2 to 1 down to the berm—which is 20ft. below the top—and $2\frac{1}{2}$ to 1 below the berm. This berm is 5ft. wide. The outer slopes are covered with at least 2ft. of loam. The site is stripped of all soil containing organic matter, and after the core wall has been started the bank is built up in 4in. layers, watered slightly and rolled. The core wall is o concrete plastered with Portland cement on the water side and with an occasional buttress on that side to stop the creeping of the water lengthwise of the dam. The core wall is in some cases carried down 40ft. to the rock, and in other cases is in a comparatively shallow trench when the rock comes nearly to the surface. This wall is 10ft. wide at the bottom and 2ft. on top. Adjoining the core wall on the upstream side is placed selected fine and clayey material. The rest of the embankment is of gravel or whatever material may be convenient. The slopes, however, both inside and outside, should be of loose gravel to prevent the slipping on the water side when the water is rapidly drawn down, and to allow any leakage to pass freely away on the lower slope. This is an important point too often neglected. Where the material on the slope is of a clayey nature a slide is apt to take place, sometimes taking the paving or riprap down with it to the bottom of the reservoir. The width over the top of the dam is 15ft.



One of the advantages of a masonry core wall is that no animal can burrow through it, and it is more difficult for any small leak to grow larger than it is in the case of clay puddle. In the section shown it will be noticed that curved surfaces have been given to many of the exterior angles of the section, as they are more natural and easier to maintain than sharp corners. The berm on the exterior slope is for drainage purposes while the sod is forming. A gutter is formed in the berm, with slight slopes lengthwise of the dam leading to sod gutters running down the bank, to keep the loam from being washed away by heavy storms. At one of the Boston dams the lower outlet pipe, 48in. diameter, is laid in masonry on a rock foundation on the side of the valley. The core wall is carried over and around the masonry; and besides these precautions, frequent cut-off walls have been introduced along the line of the pipe. Another outlet pipe at a higher elevation is placed in a tunnel on a rock foundation, at the other side of the valley. This pipe is placed in a tunnel, because it is to be under pressure. The valve towers or pits are of masonry, and located just inside of the core wall, which is continuous behind them. The most satisfactory puddle used on these works has been that which contained the least water; but it must be made perfectly homogeneous and thoroughly worked. In making a solid bank which shall be free from sediment, more depends upon the rolling and ramming than upon the watering. High embankments for these reservoirs have not settled more than $\frac{1}{2}$in. in 50ft.

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

(*From our own Correspondent.*)

THERE was a rather better business done 'on Change in Birmingham to-day—Thursday—than for several meetings past. Satisfaction is expressed that the South Staffordshire and East Worcestershire Coal Trade Wages Board have been able to agree upon the new sliding scale amicably without there being, as at one time was feared possible, a rupture. The terms of the new scale mean, to some extent, an advance of wages, but it is felt to be better that this should be conceded rather than that the iron and coal trades should be disturbed by fuel difficulties. It is the more necessary that matters should go smoothly in the local coal trade just now, inasmuch as the position is a somewhat doubtful one in the other districts of the Kingdom which are affiliated to the Miners' Federation. By the revised scale, $1\frac{1}{2}$d. per ton, instead of 2d. as at present, rise or fall in the average selling price will vary thick coal miners' wages 1d. per day, the scale affecting thin coal miners remaining the same as now. According to the amended scale, the present basis of 4s. 9d. for the average selling price, and 3s. 4d. and 2s. 8d. for the minimum wages of thick and thin coal miners respectively, will not be altered. But the present average selling price of 7s. 5d. may be reduced to 6s. 9d. without altering the existing rate of wages of 4s. 8d. per day for thick coal men, and 3s. 8d. thin coal. The old scale has been in operation since 1888. The employers have suggested that the new scale should operate automatically every two months, as in the iron trade. The men, however, prefer to continue the present rule, whereby an audit of the books to ascertain selling prices can be made every four months if either side desire it. The colliery proprietors have therefore conceded the point and allowed this rule to remain as at present. The men urge that it appears to them highly probable that in the event of there being compulsory audits every two months some customers would take advantage of the new rule by withholding their orders when they thought the next audit would show a reduction. This, however, does not take place in the iron trade, and there seems to be no valid reason why it should do so with regard to fuel. The real trouble seems to be that the men's representatives have sufficient difficulty already in collecting the men's ordinary subscriptions to the Board, and as each audit costs £20 they do not desire to increase expenses. So comparatively small a matter should not, however, be permitted to prevent the perfectly automatic working of the scale, and doubtless it will not be allowed to stand in the way much longer.

The new arrangement caused sellers to be less inclined to make concessions this afternoon both in coal and iron, though further than this no appreciable effect was observable. Northampton pigs were quoted 43s., Derbyshires 44s. to 45s., and Lincolnshires 45s. to 46s. Good Staffordshire forge pigs were quoted 45s. to 46s., and superior foundry 48s. to 50s.

Messrs. R. Heath and Sons, Biddulph Valley Ironworks, Stoke-on-Trent, have dropped their quotations 5s. per ton, and now quote their R. H. or R. D. Crown bars, £5 12s. 6d.; angles and tees, £6 2s. 6d.; and plates, £6 12s. 6d. These figures are for the ordinary qualities. The Stour Valley Ironworks of the Corrugated Iron Company, Wolverhampton, are to be enlarged by the erection of four more puddling furnaces. The puddled bars will be rolled into sheets and then galvanised. The firm evidently do not believe that steel is going to supersede the older metal entirely for this purpose.

Mechanical engineers will be glad to learn that "the more general use of labour-saving machinery" is one of the chief remedies recommended for the disadvantages sustained by the Birmingham gun trade by reason of foreign competition. This course was suggested by the chairman, Mr. C. Playfair, on Tuesday, at the annual meeting of the members of the Birmingham gun trade, when they met to consider the report of the Guardians of the Birmingham Proof House, and to transact other business. In order to ascertain as far as possible the difference in the two principal seats of the industry, two of the guardians recently visted Liège. They find that the reason manufacturers there are able to sell so much more cheaply, especially in the common descriptions of guns and revolvers, is because of the many hours worked and the very low rate of wages earned by the men, which in most of the branches are from 20 to 40 per cent. less than they would earn in Birmingham for the same class of work. In the machining department about 90 per cent. of the work is done by females, and the inspection is also done by them, and as perhaps four-fifths of the value of a gun is represented by the labour employed upon it, the Liège manufacturers have in this way a great advantage. If the Birmingham makers are to retain their trade in low-priced guns, they will, in the chairman's opinion, have to look to the more general use of labour-saving machinery, and the introduction of more economical methods of manufacture. Birmingham, however, still retains its superiority in the manufacture of the better classes of guns and revolvers. The members of the gun trade have been good customers to mechanical engineers for some classes of machinery for many years past. It is satisfactory to find that prospects are bright, not only for a continuance, but likewise for an augmentation of the demand.

NOTES FROM LANCASHIRE.

(*From our own Correspondent.*)

Manchester. — The opinion very generally expressed on the Manchester Iron Exchange is that the condition of the market here is, perhaps, worse than in almost any other important industrial centre; certainly there are complaints on all sides that practically no business of any weight is coming forward, and the tendency as regards prices continues in a downward direction. The position in the engineering industries remains much as I have reported for some time past; it does not get actually worse, but there is no improvement, except, perhaps, that amongst machinists there is rather more doing.

In the coal trade, as I have anticipated previously, the steadily increasing depression and the downward movement in prices are bringing the wages question again to the front, and the preliminary steps are being taken prior to some proposed reduction being brought before the Board of Conciliation. The Lancashire coalowners held an important meeting on Tuesday with the object of securing the united support of proprietors throughout the district, including those who are not actually under the Board, when the wages question is brought forward, and it is anticipated that this will be done before very long.

The Manchester Iron Exchange on Tuesday was fairly well attended, but the business all through was again reported as extremely slow. In pig iron users still go on buying only in the smallest hand-to-mouth quantities, and in most cases the order books of makers are getting very low, with the result that there is an increasing anxiety to sell. For Lancashire pig iron makers still quote nominally on the basis of about 42s. for forge to 42s. 6d. for foundry, less 2½ at the works, and where they have specially favourable rates of carriage, occasional orders are secured at something like these figures; but the lower prices at which district brands are being offered are gradually driving them out of the market, and to meet this competition local makers are not holding firmly to their list rates. Lincolnshire iron as regards forge qualities is easier, 40s. 6d. net cash being now about the maximum figure that is quoted, and this is not readily obtainable, whilst foundry remains at about 42s. net cash, delivered here. So far as outside brands coming into the market are concerned, Middlesbrough maintains its price fairly well, good foundry brands not being quoted under 44s. 4d. to 44s. 10d. net cash, delivered Manchester, but Scotch iron is easier, some brands having been reduced by makers 6d. to 1s. per ton, and delivered at the Lancashire ports. Eglinton is not now quoted more than 46s. 6d., with Glengarnock averaging about 49s. to 49s. 6d., net prompt cash.

The manufacturers report the finished iron trade as getting gradually worse, and prices continue to give way. Lancashire and North Staffordshire bars are not now quoted at more than £5 10s. to £5 12s. 6d. per ton, delivered in the Manchester district, and at a meeting of the Hoop Iron Makers' Association on Tuesday, it was decided to reduce the official list rates 2s. 6d. per ton, random lengths being now quoted at £5 17s. 6d., and special cut lengths £6 2s. 6d., delivered Manchester or Liverpool.

Business in the steel trade continues extremely quiet, with a general weakness in prices. Ordinary foundry hematites scarcely average more than 53s. to 53s. 6d., less 2½, with ordinary steel billets readily obtainable at about £4 per ton, net cash, delivered here. In manufactured goods makers of steel boiler plates are easier, £6 10s. being now a very general quotation, although some still hold out for £6 12s. 6d., delivered in the Manchester district.

Messrs. Nasmyth, Wilson and Co., of the Bridgwater Foundry, Patricroft, near Manchester, have just received an order from the Ship Canal Company for ten hydraulic cranes, to be erected at the Salford Docks. They have also booked orders for two plants of hydraulic pumping engines and presses of the heavy class for Egypt, the work sent last year, to which I previously referred, having given excellent results. I may also mention that Mr. Thomas Daniels, M.I.M.E., who has been assistant-manager at the works for the last eleven years, has just been appointed a director of the above firm.

I have previously referred to the very successful well-boring operations carried on by Mr. Thomas Matthews, of West Gorton, Manchester, for obtaining water supplies for manufacturing requirements; and a couple of pumping plants he has recently completed for Messrs. Joshua Hoyle and Sons, at their mills in Bacup, deserve some special notice. The above firm commenced to search for water in an old well, and after some months' work found at a considerable depth what they were advised by the engineers would be a permanent supply, but a pump placed in the bore-hole did not produce quite the anticipated result. They, however, commenced again from the surface, boring a 16in. hole, the work being entrusted to Mr. Thomas Matthews, one of his patent pumps of sufficient size being placed in the bore-hole, and the firm have now secured an ample supply. This was followed by boring operations at another of their mill, and they have now, after nearly a year's work, succeeded in coming upon a similar spring, capable of supplying from 30,000 gallons to 40,000 gallons per hour. The first of these pumps has a bucket 9in. diameter, working a stroke of 16in., a ram 6⅜in. diameter, and the engine driving it has 10in. cylinder, with 16in. stroke. The bore-hole is, as already stated, 16in. in diameter, and the pump bucket is placed 120ft. below, the ram 16ft. below, and the engine on the surface. The pump lifts 10,000 gallons per hour when running forty-eight revolutions p r minute, and the water is delivered in a constant stream about 12ft. above the ground. The second pump has a bucket 12½in. diameter, a ram 8⅝in. diameter, and the engine cylinder is 16in. diameter, all working a stroke of 3ft. The bore-hole, in this case, is also 16in. diameter, the pump bucket being placed 120ft. below, the ram 25ft. below, and the engine on the surface. When running thirty revolutions per minute, this pump lifts 2500 gallons per hour, and the water is delivered about 12ft. above the surface in a constant stream. Mr. Matthews, I may add, has introduced special methods for boring through the hardest strata, and his patent arrangement of engines and pumps is specially adaptable for deep borings, where only a small space is available, as a pump capable of lifting 10,000 gallons per hour can be placed in a bore-hole 11in. diameter. With these pumps, which are sometimes driven direct, and sometimes with gearing, expensive sinkings and frequent lowering of the pumps are avoided, and the upper and lower waters can be separated at any given depth, and raised from any portion of the bore-hole.

Although, in the coal trade, no general reduction in prices marks the beginning of the month, the Lancashire Coal Sales Association not having made any official alteration in their list rates, there is in other directions some easing down in prices. On one or two descriptions of round coal the Manchester firms have levelled down their pit and wharf prices 5d. per ton, and colliery proprietors here and there, in other Lancashire districts, are also making slight reductions. At the pit mouth prices still average, however, about 11s. to 11s. 6d. for best Wigan Arley, with seconds Arley and Pemberton four-foot averaging 10s. to 10s. 6d., and common round coals 7s. 6d. to 8s. 6d. per ton. Engine classes of fuel still move off fairly well, but supplies are more plentiful, and prices as a result not quite so firm. At the pit mouth common slack averages 5s. to 5s. 6d.; best slack, 6s. to 6s. 6d.; and burgy and through-and-through coal, about 6s. 9d. to 7s. 3d. per ton.

For shipment the demand is very unsatisfactory, and Lancashire steam coal does not average more than 8s. 6d. per ton, delivered at the Mersey ports; whilst coal at under even this low figure is coming in from other districts.

Barrow.—There is an improved tone in the hematite pig iron trade this week, and sales have increased, especially on local account. Makers, however, do not report any accession of business from foreign, continental, or colonial sources, but home sales are greater, and there is, generally speaking, a fuller consumption of Bessemer qualities of iron. This to a great extent is attributable to the fact of briskness in the shipbuilding and engineering trades, largely on account of Admiralty orders and the increased consumption of Bessemer metal. There is, however, practically no trade in forge and foundry qualities of metal, and smelters produce very little now of this class.

Prices are easier at 44s. 8½d. sellers net cash, and 44s. 7½d. buyers. Makers are quoting 45s. 6d. for mixed Bessemer numbers net f.o.b. There are thirty-six furnaces in blast, one having been lighted during the week at Cammell's works at Workington. In the corresponding week of last year thirty-three furnaces were in blast. Stocks have increased during the week to the extent of 1647 tons, and now stand at 136,980 tons, or an increase of 42,357 tons since the beginning of the year.

The iron ore trade is quiet, although there is undoubtedly an increased local consumption consequent on additional furnaces having been lighted. There is still a small export of iron ore to Scotland, Wales, and elsewhere. Prices of ordinary qualities are still 8s. 6d. to 9s. per ton net at mines.

Steel makers are busier in the Siemens-Martin departments. The Barrow Steel Company have booked an order during the week for 10,000 tons of ship-plates from Messrs. Nelson Bros., Glasgow, through their Barrow agents, Messrs. Hannay and Clarke. They have also booked 1500 tons of plates from Messrs. Laird Brothers, Birkenhead. This is in addition to 5000 tons of plates booked by the same company last week from the Naval Construction and Armaments Company. Prices are steady at £5 7s. 6d. for ship-plates, £5 10s. for angles, and £6 for boiler-plates. A few new orders for steel rails have been placed during the past few days. Tin bars, hoops, billets, and steel castings and forgings are in request. Other branches of the steel trade are quiet.

Shipbuilders and engineers are very busy, and in all departments greater activity may be expected. The town of Barrow is, however, deluged by men seeking work.

The shipping returns show that the exports of pig iron during last week from West Coast ports amounted to 5722 tons, as compared with 3216 tons in the corresponding week of last year, an increase of 2506 tons. The shipments of steel last week only reached 8602 tons, compared with 13,603 tons in the corresponding week of last year. The exports of pig iron this year to 30th April represented 133,825 tons, compared with 87,478 tons in the same period of last year, an increase of 46,347 tons. The shipments of steel to date this year represent 114,898 tons, compared with 147,539 tons in the corresponding period of last year, a decrease of 32,641 tons. Freights are low, and only a few cargoes are offering.

The coal and coke trades are steady, and there is an increased consumption to note. Prices are unchanged, but deliveries are rather more full than of late.

THE SHEFFIELD DISTRICT.

(*From our own Correspondent.*)

THE coal trade still continues as depressed as ever. Although it is reported that the cooler weather has slightly improved the demand for household sorts, there is no perceptible difference in the Metropolitan and Eastern Counties or local business. Merchants, however, have got the idea that values will not go much lower after the 1s. per ton reduction usually made in May has come into effect. Stocks are said to be rather less, owing to the reduced output. South Yorkshire coalowners working gas coal seams have been endeavouring to come to a common agreement about prices. They are, of course, naturally reticent in giving information about the private conferences that are held, but it is no secret that the intention is to endeavour to obtain an advance of 1s. 6d. per ton, which was arranged for last year, when, owing to the defection of one or two colliery owners, the movement was abandoned. If the coalowners could obtain this advance, with a prospect of a corresponding improvement in locomotive fuel, the situation would be very much improved from their point of view. Complaint is freely made as to the unprofitable nature of work in the thin seams, and Messrs. Newton, Chambers, and Co., of Thorncliffe, gave notice on Tuesday to the people employed at Tankersley and Newbiggin with a view to closing these pits. The notices will affect nearly 500 hands. Mr. Chambers told a deputation of the workmen that they were compelled to take this step, as latterly they had been working Tankersley and Newbiggin at a loss. It is believed that other proprietors working the thin seams will be obliged to take a similar course.

Silkstone house coal is now quoted at 10s. 6d. to 11s. 6d. per ton at the pits; Barnsley house from 8s. 6d. to 9s. 6d.; other qualities from 7s. 6d. per ton lower. House coal varies very much at present, owing to the competition of such orders as are in the market. There is a good deal doing in steam coal from Barnsley, the consignments forwarded to Hull and other Humber ports being larger than is usual at this period of the year. Still, the demand is not brisk or great enough to secure an advance in prices. Barnsley hard coal does not make over 7s. 6d. to 8s. 6d. per ton, while other qualities can be had from 7s. to 8s. per ton. This class of coal will no doubt be in better request when the uncertainty in price has settled down. In manufacturing fuel, good slacks command from 4s. 6d. to 5s. 6d. per ton, which is rather a poor price, owing to the supply being far in excess of requirements. Smudge and small coal remain as dull as ever. Generally not more than two to three days a week are being worked at the pits, yet the weight brought to bank is more than is needed. Work is now going at the Canklow pit of Messrs. John Brown and Co., who have recently completed a new shaft at their Aldwarke Colliery. There is some expectation, too, of the Swallow Wood mine, which was closed more than a year ago, being shortly re-opened.

A fall of 5s. per ton in Staffordshire iron, the result of severe competition, lowers quotations below the rates of January last year. North Staffordshire common bars are now quoted at £5 12s. 6d.; best bars, £6; and angles, bridge, and tee plates, £6 2s. 6d.; best angles, £6 12s. 6d.; hoops, £6 10s. 6d.; best plates, £7 2s. 6d. This heavy drop is not likely to affect Sheffield prices to any great extent, as iron is largely made in our district to meet local requirements. It is noteworthy that while the Staffordshire makers are lowering their prices, those in Cleveland and the North are increasing theirs. In the Sheffield district prices rule from £5 10s. to £5 15s. for bar iron at makers' works, merchants requiring the larger quotation for good lots. The demand for steel is again duller, owing to various causes, chief amongst which are the unsettled condition of the coal trade and the lack of orders from the Continent, the Colonies, and more distant markets. From Germany and several other continental parts some good orders have recently been received for the higher class of crucible steel. Generally, however, the manufacturers report that the demand is lighter than it was at the corresponding period of last year. Bessemer billets are quoted at £5 10s. per ton; Siemens-Martin acid steel, £6; hematites, 53s. to 54s., delivered in Sheffield; forge iron, 40s. 6d. Increased work is now going on at the Parkgate Ironworks. Some good orders continue to come in for railway material, but there can be no full employment for the plant until the home demand is helped by a revival in foreign markets.

In the lighter industries the Sheffield cutlery and plate firms are but indifferently employed. In the latter trade there has been a large expansion of the silver and electro departments during the last six months, Sheffield having taken a decided advance in this business. In general, cutlery trade appears to be getting even worse. It is noteworthy, however, that several foreign and colonial markets are beginning to order pretty freely once more. South Africa is becoming an important customer for common cutlery; as that great land gets opened up a higher class of goods will undoubtedly follow. Superior grades of files, cutlery, and good tools are being sent to South America, and there are better accounts from Australia. The American demand is still paralysed by the uncertainty associated with the Wilson Tariff Bill. Makers of spades, shovels, edge tools, and circular saws report that they are very well off for orders. New Zealand has recently sent some good work to Sheffield for cutlery and tools, and considerable quantities of low-priced goods are being forwarded to the Gold Coast to be bartered for with the Kaffirs. Several houses are extremely well employed in files, particularly for Russia and Germany.

Messrs. Newton, Chambers, and Co. opened their new premises at the Moorhead, Sheffield, on Monday, when Mr. T. C. Newton, J.P., presided over the luncheon in the large room of the establishment, the other directors present being Mr. A. M. Chambers, J.P., Mr. George Dawson, J.P., and Mr. J. Y. Cowlishaw. There were also present the Mayor—Alderman Foster—the Master Cutler—Mr. George Howson—and about 150 other gentlemen representing the professional and commercial life of the Sheffield and South Yorkshire districts. The building has been erected after the Moorish style, and is a practical recognition of the utility of iron as an architectural material. This point was recently forcibly urged by Mr. Aitchison, Professor of Architecture at the Royal Academy, and Messrs. Newton, Chambers, and Co., as large iron-founders, have been amongst the first to introduce it. The whole of the iron used in the construction was made by the firm. During the proceedings it was mentioned that Messrs. Newton, Chambers, and Co. had been in existence more than 100 years, that their output of coal reached a million tons per annum, and the produce of pig iron in the same time about 30,000 tons. Mr. Chambers stated that at Thorncliffe the company, through the ingenuity of Mr. Thomas Smith, had practically overcome the smoke question. They turned their smoke into oil, and the incondensible portions of it were carried to their boilers and burnt. By this means steam for a large amount of work was raised, and it was done without any sign of smoke. The building is practically a complete framework of iron and steel filled in with brickwork for the external walls of the upper floors, and left open on the ground floor, thus securing the greatest available width for show window, and at the same time revealing the iron construction, the latter being prominently displayed as a striking feature in the general architectural effect.

It has already been stated in THE ENGINEER that Messrs. John Crowley and Co., Meadow Hall Works, and Messrs. J. Grayson Lowood and Co., of Sheffield, Deepcar, and Middlesbrough, are to exhibit at the Antwerp Exhibition, which is to be opened by the King of Belgium in person on the 5th of May next. Two other local firms are also to exhibit, viz., Messrs. Atkinson Bros., of the Milton Works, in cutlery, files, wood horseshoe, and cabinet rasps, &c. The Hardy Patent Pick Company, will show their patent "Devil" disintegrator, "Multiple" grinder and magnetic separator in motion. At another stand the latter firm also exhibit a collection of picks, hand-boring machines, hammers, shovels, forks, spades, and various kinds of agricultural and general tools.

THE NORTH OF ENGLAND.

(*From our own Correspondent.*)

THE condition of the market cannot be described as satisfactory at present, there being a decided lack of animation, and a tendency in prices that induces consumers and merchants to hold off from further purchases, as they expect to be able to place their orders on more favourable terms than those at present ruling, as contracts are getting cleared off the producers' books, and there will apparently before long arise the necessity for securing others; indeed in some departments this has already come to pass, for there are not enough contracts on the books to keep the mills in full operation. As a rule, however, no complaint can yet be made of any lack of employment, and the production is on a larger scale than it has been for several years. The pig iron exports from the Tees last month reached 81,378 tons, which is more than has been recorded in the corresponding month of any year since 1889, and is above the average. Of manufactured iron and steel, the exports were good last month, reaching 35,086 tons, as compared with 34,409 tons in March, and 30,546 tons in April, 1893. Another good feature which affords also testimony of the scarcity of Cleveland pig iron in makers' hands is the large decrease of the stock in the public warrant stores—10,958 tons last month, Connal's stock being reduced to 100,587 tons on April 30th, yet in spite of this warrants are weak in price. That there is great activity in production and deliveries is also apparent from the traffic returns of the North-Eastern Railway, which show a much larger increase this half-year than any other of our railways, there being an increase last week of £7956, bringing the increase so far this half year up to £110,999. But all this has no influence in strengthening the market, for consumers hold that it simply shows how good trade has been, and is no criterion of what it may be in the future. The general idea is that trade will be quiet in the summer, with prices more in favour of the buyers. Shippers have bought nearly all the iron they will need to deliver during the spring navigation season, and are indifferent about making further purchases, when they expect that by waiting they will have less to pay for what they buy. Thus there is an absence of new business, which is very disappointing after the promise of better times, which seemed a short time ago almost certain to be realised.

The price of No. 3 Cleveland G. M. B. pig iron is generally somewhat less than it was last week, and not only has less been offered, but less has been taken both by merchants and makers. Most of the latter hold to 36s. 3d. per ton for this and next month's delivery, and some of the leading brands are maintained at 3d. to 9d. above that; but, as a rule, buyers have only offered 36s., and have found that they could purchase at it both from merchants and some of the producers, though the latter have sold at that to old customers only. Cleveland warrants, in spite of the large withdrawals from store, have further declined, and holders who at the beginning of the week were asking 36s. 1½d. cash, were offering at 36s. 1d. at the close on Wednesday. The scarcity of the commoner qualities of Cleveland pig iron is as great as ever, and as much is realised for No. 4 foundry as for No. 3, viz., 36s., while for grey forge 35s. 6d. has to be paid, for mottled 35s. 3d., and for white 35s. 6d. The relatively high prices which the producers are getting for these commoner qualities renders the position more tolerable for the producer than it otherwise would be, but even under the most favourable circumstances there cannot at present be much profit in the manufacture of pig iron. Hematite pig iron is in quieter request, and lower prices are taken. The production appears to be in excess of the requirements, because Connal's stock of Cleveland hematite increased by 3963 tons last month, or 5750 tons in March and April together, the quantity held at 30th ult. being 41,298 tons. Of course the situation in this branch cannot be accurately gauged, because no particulars are available as to the stocks of hematite in makers' hands. M. Nos. of East Coast hematite iron are quoted at 45s. per ton, but 44s. 9d. and even 44s. 6d. are accepted, and consumers are reluctant to give even the last-named, because warrants are lower, though East Coast warrants have not fallen so much as West Coast. The adoption of the eight hours' day at the Seaton Carew blast furnaces appears to be attended with success, and on Wednesday next the representatives of the Cleveland Blast Furnacemen's Association will have a conference with their employers at Middlesbrough to discuss the question of the general adoption of the system. On Tuesday the Skinningrove Iron Company commenced the erection of two more furnaces at their works near Loftus-in-Cleveland. Situate in the extreme east of Cleveland, fully twenty miles from Middlesbrough, the company were not well placed for getting rid of their iron advantageously until they constructed a shipping place in the bay opposite their works about two years ago, and now they can dispose of a good deal more iron than their existing two furnaces are making, all they produce being shipped.

The exports of iron and steel from the Tees last month were very satisfactory, reaching 116,464 tons, as compared with 114,226 tons in March, and 111,683 tons in April, 1893. In manufactured iron and steel 35,086 tons were exported, against 34,409 tons in March, and 30,546 tons in April last year, and of last month's nearly half—16,240 tons—were sent to India alone, while Italy had 2000 tons. Of pig iron 81,378 tons were shipped, this being above an April average, and the best April return that has been made for five years. Germany and Scotland together took nearly five-eighths of all the pig iron sent from the Tees, Scotland taking 25,975 tons, and Germany, direct and *viâ* Holland, 22,377 tons. But if we add the 6951 tons of iron shipped at Skinningrove last month to the quantity sent from Middlesbrough to Scotland, it would appear that Scotch consumers received 32,926 tons of pig iron made in this district. To Italy the deliveries were above the average—6076 tons. It is satisfactory to see such a good business done with Japan, 3570 tons of iron and steel were sent from Middlesbrough, of which 2750 tons were pig iron.

The finished iron trade of the North of England is becoming slacker, and some of the bar manufacturers are so badly off for contracts that they cannot keep their establishments in full operation. They report that the inquiry is very small, smaller in fact than it was at any time last year, and the spurt has entirely died away. This is so in the steel trade also, but there are still plenty of contracts on the books, and the mills are kept fully going. The improvement in the early part of the year was chiefly confined to the steel plate and angle branches. Common iron bars are quoted £5, but may be bought at 2s. 6d. per ton less; iron ship angles are at £4 12s. 6d.; iron ship plates, £4 17s. 6d.; iron boiler plates, £5 17s. 6d.; steel ship plates, £5; steel ship angles, £4 15s., all less 2½ per cent. f.o.t. at producers' works. Heavy steel rails are offered at £3 12s. 6d. net at works, but buying is almost at a standstill.

Engineers are fairly well situated, but the strike of moulders which is still going on is hampering their operations. The Mayor of Stockton has been offering to act as mediator, but neither masters nor men are yet in a mood to tolerate outside interference. The men stick to their demand for considerably increased wages, and the employers declare that they cannot see their way to give any advance, for the improvement has been chiefly in the amount of work received and not in the price realised. They consider the demand of the men premature, and not warranted by the state of trade. The inconvenience caused by this strike will probably result in some of the other works having a prolonged holiday at Whitsuntide.

Mr. J. R. Crosthwaite, ironfounder, Thornaby-on-Tees, has patented another form of register stove or fire-grate. By means of a cowl or hood, the rapid flow of the air up the chimney is ingeniously, though not entirely, checked, and a lessened consumption of fuel yields a much greater heat.

Though the North of England has not been successful in securing any of the orders for vessels just given out to private shipbuilders by the Admiralty, Messrs. Hawthorn, Leslie, and Co. have got the order for the engines of the battleship Victorious, which is being built at one of the royal dockyards. These engines will cost over £100,000.

The coal trade is generally dull, even in Northumberland, where it should be very active, now that most of the Baltic ports are open, but it is somewhat affected by the refusal of the miners to agree to the 3¾ per cent. reduction in wages claimed by the employers, and which their own Executive Council have advised them they have no other honourable course but to accept. The representatives of the owners and of the men will meet again on Saturday to further consider the situation. Meanwhile nothing appears to be doing towards establishing the Conciliation Board that is proposed. In Durham it is likely that such a board will be established before long, as all sections of the men are in favour of it. At the Newfield Colliery, near Hunwick, Messrs. Bolckow, Vaughan and Co., have for some time been carrying on boring operations, and have at last come upon what is recognised as the Harvey seam of coal 2ft. 9in. thick. The coke trade is not so active as it was, but the prices are maintained.

NOTES FROM SCOTLAND.

(*From our own Correspondent.*)

THE Glasgow pig iron market has been quiet this week, with a declining tendency in the prices of warrants. On most days the transactions have been few and comparatively small in amount. Scotch warrants have sold from 42s. 8d. to 42s. 5½d., and Cumberland hematite from 44s. 10d. to 44s. 7½d. Comparatively little attention has been paid to Cleveland warrants, which are nominally 35s. 11d. cash. Middlesbrough hematite is 44s. cash.

There is a steady, although not a very large business in makers' pig iron for the home trade. Several of the special brands are 3d. to 6d. per ton higher. G.M.B., f.o.b. at Glasgow, No. 1, is quoted 44s. 3d.; No. 3, 43s.; Carnbroe, No. 1, 45s. 6d.; No. 3, 44s. 6d.; Clyde, No. 1, 49s. 6d.; No. 3, 46s. 6d.; Gartsherrie, No. 1, 51s.; No. 3, 48s.; Summerlee, No. 1, 52s.; No. 3, 48s.; Calder, No. 1, 52s. 6d.; No. 3, 48s.; Coltness, No. 1, 56s.; No. 3, 51s.; Glengarnock, at Ardrossan, No. 1, 50s.; No. 3, 47s.; Eglinton, No. 1, 47s. 9d.; No. 3, 44s. 9d.; Dalmellington, at Ayr, No. 1, 47s.; No. 3, 45s.; Shotts, at Leith, No. 1, 54s. 6d.; No. 3, 50s. 6d.

The shipment of pig iron from Scottish ports in the past week amounted to 6480 tons, compared with 8257 tons in the corresponding week of last year. There was dispatched to the United States 30 tons; South America, 530; India, 105; Australia, 70; France, 130; Italy, 694; Germany, 160; Holland, 570; Belgium, 30; Spain and Portugal, 50; other countries, 82; the coastwise shipments being 4039, against 4577 tons in the same week of 1893. The total shipments for the year to date amount to about 88,000 tons, compared with 106,000 tons in the first four months of last year, and of the total about 54,000 tons, or rather over one-half are coastwise shipments. The foreign trade, it will thus be seen, has not so far made any improvement upon this time last year; and the coastwise shipments show a decrease of about 9000 tons. But while the outgoing trade is thus limited, there are substantial increases in the imports into Scotland of both Cleveland and Cumberland iron.

An additional furnace has been put on hematite pig iron at the Clyde Ironworks, and there are now 73 in operation, compared with 72 in the preceding week, and 71 in the corresponding week of last year. The gradually increasing output of hematite pig iron is indicative of an increasing consumption. Stocks of this iron have no doubt been accumulating in the North of England, but the supplies on the part of Scotch makers are understood in most cases to be made almost direct from the furnace. The prices of hematite are steady, and very moderate compared with what they have been in former times.

The steel trade is active and continues o expand, the demand for mild steel for manufacturing purposes being now exceptionally good, and certain to expand still further, owing to what may now be almost described as the boom in the shipbuilding trade. There appears to be a rather firmer tendency in prices, although competition is almost as keen as ever.

The progress of the malleable iron branch in the direction of improvement is slow; indeed, some merchants and makers do not report any improvement. Inquiries for shipment are unsatisfactory. Several departments of the manufactured iron trade are exhibiting signs of improvement. In the foundry trades there is more doing, especially in general castings, some of the pipe-founders being still, however, much in need of orders. The reduction in the prices of Staffordshire iron is unfortunate for the Scotch makers as far as their trade with the West of England is concerned. There is a good deal of restlessness among some grades of workmen on the question of wages, and partial strikes have occurred here and there; but it is hoped that these difficulties will be overcome without any serious consequences.

The shipments of iron and steel manufactured goods from Glasgow in the past week embraced locomotives, worth £1440; sewing machines, £1986; other machinery, £7427; steel goods, £8176; and miscellaneous iron goods, £18,614.

As regards the coal trade, the shipments in the past week reached 153,293 tons, compared with 152,550 in the corresponding week, being a full average for the season. The aggregate shipments since the beginning of the year give an increase over the corresponding period of 337,140 tons. The volume of the shipping business is thus fairly satisfactory, but prices have been gradually receding, and the output all over is difficult to absorb. The absence of large contracts for the Continent this season, which have been held in former years, is felt to be a serious disadvantage. With the present week, a reduction of 1s. per ton has been made in the price of household coals for domestic consumption. The prices f.o.b. at Glasgow harbour have also been reduced, main coal being quoted 6s. 10d. to 7s.; splint, 7s. 9d. to 8s.; ell, 8s. to 8s. 3d.; and steam, 9s. to 9s. 3d. per ton.

Meetings of the coalmasters of Ayrshire, Lanarkshire, and Airdrie and Slamannan were held in Glasgow on Wednesday, when it was agreed to reduce the colliers' wages 1s. per day from Monday next.

WALES AND ADJOINING COUNTIES.

(*From our own Correspondent.*)

THE coal trade generally has been quiet, and the price both of steam and house coal continues to droop. So far the decline is very gentle, yet when prices at present are contrasted with those of a few months ago, the contrast is marked, and compared with the highest prices obtained since the turn of the coal tide, very perceptible. The leading figure now for best steam is 11s. to 11s. 6d., and it may be remembered that 15s. and even 16s. has been touched by best coals. The astuteness of coalowners in concluding very large contracts, some at a price exceeding present quotations, will now be admitted, even by the colliers, who once held the opinion that in arranging contracts they ought to have a hand. Coal exports last week were large, as usual, and will continue, it is expected before the Whitsuntide holidays set in.

On 'Change, Cardiff, the principal topic this week was that coal orders were coming in tardily, making the future outlook rather gloomy. The result of the quietness has been an idle day now and then at the collieries: and sidings have presented a more crowded look than is pleasant to note.

Big cargoes continue to be in evidence. On the last day of April there was a large number of steamers dispatched with cargoes of over 3000 tons, and on the 1st of May one notable cargo of 7400 tons for Bombay.

The following prices ruled this week in Cardiff:—Best steam, 11s. to 11s. 6d.; seconds, 10s. 6d. to 10s. 9d.: inferior, 9s. 9d. to 10s.; small, 5s. to 5s. 3d.; best house coal, 11s. to 11s. 3d.; No. 3 Rhondda, 10s. 9d. to 11s.; brush, 9s. to 9s. 3d.; small, 7s. to 7s. 3d.; No. 2 Rhondda, 9s. to 9s. 3d.; through, 7s. to 7s. 6d.; small, 5s. to 5s. 3d. Most of these prices are low, but I have a strong impression, especially as regards large and small steam, that, as a coal broker expressed himself this week, "the bottom has been touched." I should not like to venture on the same prediction as regards house coal.

In coke the state of things is voted bad. The stoppage of Rhymney and Tredegar Works was a great misfortune, as the make now comes into competition with that of the Rhondda and other districts. The Rhymney coal and coke wagons are being energetically worked. Cyfarthfa, formerly a large buyer, now turns out a considerable quantity. Hence, it is no wonder that coke prices are low. Quotations are down to 14s. 6d. for furnace, and even lower prices are named, and foundry is at 16s. to 16s. 6d. Patent fuel manufacturers are reducing their quotations, and best brands are selling at Cardiff at 11s. to 11s. 3d. Swansea prices from 10s., and only a small trade doing last week. The only cargoes despatched were to France 1380, Austria 1500, home ports 120 tons. Pitwood prices maintained.

The outlook in iron and steel is better. A cargo of 670 tons of rails was dispatched to Drammen this week from Cardiff, and ironmasters say that a few moderately-large rail orders have been placed within the last few days in the district. Steel sleepers, small goods, and even Bessemer bars—considering the slackness at the tin-plate works—are in better demand. At Cyfarthfa works there was a very good make last week of round and ordinary tin-plate bars. There has been a considerable quantity of foreign ore brought in this week, Blaenavon and Dowlais taking a prominent place amongst the importers. Quotations are firm, and the selection offered at Cardiff will be seen to be a varied one:—Best Rubio, 11s. 6d. to 12s.; Almeria Campanil, 14s. 9d.; Bilbao Campanil, 15s.; Tafna, 11s. 3d.; Garucha, 11s. 3d.; Red Seriphos, 13s.; Porman, 10s. 9d. to 11s.

On 'Change, Swansea, this week, it was remarked that the pig iron warrant trade was stationary and little doing, but a decrease in the stocks of Middlesbrough and Scotch. For ship-plates there was an improved demand, but the condition and prospects of the tin-plate trade occupied the first attention. Scarcely a week of late has passed by without one or more stoppages taking place, and the effect of this is beginning to be seen in an increased anxiety to lay in stock ready for the settlement of the tariff. It was stated on 'Change, Swansea, that inquiries had been made for storage room for the purpose. If a boom should occur, it will find would-be buyers in a dilemma, and fancy prices would naturally be a result. At present stocks only consist of 276,161 boxes, a very poor total to meet a rush; and what is more alarming, the make last week only consisted of 49,291 boxes. Exports last week were very small—30,140 boxes. At Briton Ferry there was an average make of pig iron, steel bars, and tin-plate; but there, as elsewhere, the complaint of employers as to the small demand was marked. The labour difficulties continue, the 36-box rule being still to the front, and the lock-out extending.

I note that the Royal Hungarian Navigation Company has just begun to run a new line of steamers from London and Swansea to the Mediterranean and Adriatic ports. The Swansea agent is Mr. Geo. Lennard. The first steamer, the Mattekoritz, 1905 tons net, left last week with a general cargo of 500 tons, 1500 tons patent fuel, and 454 tons coal; the Zrimji is to follow.

Swansea quotations this week were as follow: Glasgow pig, 42s. 7d.; Middlesbrough, 35s. 11d.; hematites, 44s. 11d. for mixed numbers. Steel: Rails, heavy, from £3 15s., light from £4 10s.; Welsh bars, from £4 15s.; sheets, from £6 5s.—iron the same. Tin-plate bars, Bessemer, from £4; Siemens from £4 5s. These are the low quotations ruling in consequence of the keenness of rivalry with the North of England.

Tin-plates are hardening, and present quotations are not likely to remain.

Bessemer steel coke, 10s. to 10s. 3d.; Siemens, 10s. 3d. to 10s. 6d.; best charcoal, 11s. 9d. to 12s. 6d.; ternes, per double box, 28 by 20 c., 20s., 21s., 22s., to 24s.

Anthracite coal from 9s. to 13s.; coke, furnace, from 13s.; foundry, from 18s. Block tin, £71 7s. 6d. to £71s. 17s. 6d.

The sliding scale of the iron and steel trades decrees the continuance of the present wages. The meeting of the committee was held at Abergavenny on Saturday. Present: Messrs. E. V. Martin, in the chair, W. Evans, W. G. Dowden,—Franklin, R. Colquhoun, and G. Dash. The working members were Messrs. Williams, Jenkin Jones, Rudman, John Jones, W. Davies, Geo. Davies, and Messrs. B. Edwards and E. Jones, secretaries.

A ballot is to be taken amongst the whole of the South Wales colliers in order to obtain their opinion upon the "Eight Hours' Bill."

A case occurred lately at the Albion Colliery which is worthy of notice, as showing that colliers are indicating more common-sense views, and are not so ready in taking holidays as they used to be. The hauliers at the colliery asked the colliers to support them in getting a half-day's holiday on the Tuesday succeeding the last Mabon's Day. This they refused to day, and as the hauliers remained from work, did the driving amongst themselves. The fact was commented upon at the Cambrian Miners' Association meeting on Saturday, and a resolution was passed complimenting the Albion workmen upon the attitude they had taken.

There is a dispute at the Mardy Colliery as to the identity of the seam being worked, the officials contending that it is the "five-foot seam," the men that it is the same as the Bute seam, for which 2s. 2½d. per ton is paid, the "five-foot" scale being 1s. 5½d. Hopes are held out for a peaceable settlement.

Mr. Thomas Lewis, of Hill's Dry Dock Company, Cardiff, has just patented an invention for lowering boats into the water with facility and speed.

Labour disputes are not confined to tin-platers or patent fuel men. The latest are a carpenters' and joiners' dispute at Barry, the stone masons of the Barry district, and the Neath carpenters and joiners. On Tuesday the Tredegar enginemen and stokers, with few exceptions, stopped work, having given a month's previous notice. The complaint is about the hours of labour. At Swansea the masons are on partial strike.

I am glad to notify the favourable opinion of the House of Lords Committee upon the Bute Docks Bill up to the present, and the decision was announced to go on with the other parts of the Bill. The diversion of the river Taff was directed to be struck out.

"From Bristol Channel ports to Birmingham" is the project now under discussion. By the improvement of the river Severn vessels of 400 tons can now proceed from sea to Worcester. Now it is seriously intended, I learn, to convert the present Worcester and Birmingham navigation into a ship canal, whereby 400-ton steamships will be able to pass from tidal water to Birmingham, without discharging bulk. The cost is roughly given at £600,000. The project has a more practical air than one discussed some years ago in the colliery district, upon the feasibility of getting waterways to some of the large collieries, and so load at the pit's mouth. This was evidently suggested by the method adopted in early coal days of running small canals to the face of a coal seam, and loading barges there. But the only way to load at the pit's mouth would be to flood the valleys, which are great hives, the Taff valley the principal, with over 200,000 inhabitants.

NOTES FROM GERMANY.

(*From our own Correspondent.*)

IN all parts of this country the iron and steel trades continue in a very satisfactory condition, the demand being well sustained, while prices exhibit considerable firmness. With the increasing inquiry for most sorts of pig iron, there is prospect that quotations may finally improve; in some instances this has already been the case during the past week, but it was due mainly to temporary causes. Export demand for pig iron does not improve to any appreciable extent; the only orders of some weight that have been secured during the last few weeks were given out by Russian firms.

Changes of importance have not taken place on the Silesian iron market, but the reports that come in from the various departments state the business generally doing to be of a decidedly satisfactory description. Pig iron is quiet but firm, while in the manufactured iron trade much activity is to be noticed. Bars and girders are in lively request; for the first-named article some very good orders from Russia have been booked lately. One works, for instance, has exported no less than 9250 t. bars during last week, and large lots of drawn wire have also been delivered by the same works. Plates and sheets are likewise in particularly good request. The steel works continue but moderately occupied, rails being decidedly weak. The Silesian rolling-mill convention has raised the price for bars on M. 145 p.t., free station.

Regarding the development of the general iron industry in Austria-Hungary most favourable accounts continue to be coming in. From week to week the demand for most articles has been steadily improving, and the works are, without exception, well employed. This is specially the case in the malleable iron department, pig iron being in comparatively moderate request. The business done in the smaller articles of manufactured goods continues rather limited on the Vienna market, while in Hungary as well as in Bohemia quite a lively inquiry is experienced.

There is not much to note in connection with the iron and steel trade in France, demand and employment being, on the whole, satisfactory. Inquiries on home as well as on foreign and colonial account have rather increased upon the week. Returns just published show the average prices for forge pig to have been 57f. p.t. during the first quarter of the present year; for foundry pig it was 59f. p.t., and for castings 115f. p.t. Compared to last last year, average prices show a decrease of 4f. p.t. for forge pig, and 5f. p.t. for foundry pig, while for castings it amounts to 20f. p.t.

The Belgian iron trade is still remarkably quiet, and very few orders are offering in any branch of the trade. List quotations for the different sorts of iron show almost no change against those of February of present year.

The general tendency of the Rhenish-Westphalian iron market is a firm one, and there is every reason to expect that it will continue to be so for the future. The activity formerly noticed in the pig iron trade is undiminished, a number of fresh orders having come in recently; there is generally much firmness to notice in prices. Spiegeleisen is quoted M. 52 p.t.; Rhenish-Westphalian forge pig, No. 1, is paid with M. 44 to 45; No. 3, M. 40 p.t. Hematite stands at M. 63 p.t.; foundry pig, No. 1, is noted M. 63 p.t.; No. 3, M. 54 p.t.; basic, M. 44 to 45 p.t.; Bessemer, M. 47 to 48 p.t.; Luxemburg forge pig still stands at 44f. p.t., free Luxemburg. A healthy business is done in the malleable iron department, and most of the rolling mills are in brisk employment.

Prices for bars are at the present moment very firm, and showing much inclination to rise, inland demand being good; on foreign account there is still but little doing. The girder trade is fairly occupied as regards the greater part of the works, but hitherto consumers have firmly and successfully refused to pay higher prices, and there is consequently still much cause for complaints. Hoops continue in lively request at stiffening prices. A lively activity marks the plate business, and there is also much animation noticeable in the sheet department. Prices are fairly satisfactory, buyers paying, though most reluctantly, the slight advances lately agreed on. With regard to the engineering industries, no specially new feature can be noticed, most of the works having been but moderately employed upon the week. The following are the latest list quotations per ton at works:—Good merchant bars, M. 105 to 110; angles, M. 115 to 120; girders, M. 87·50 to 92·50; hoops, M. 115 to 120; billets in basic and Bessemer, M. 81; heavy plates for boilermaking purposes, M. 150; tank ditto, M. 140; steel plates, M. 140; tank ditto, M. 130; sheets, M. 135 to 140; Siegen thin sheets, M. 120 to 125; iron wire rods, common quality, M. 112 to 116; drawn wire in iron or steel, M. 100 to 120; wire nails, M. 125; rivets, M. 140 to 150; steel rails, M. 112 to 115; steel sleepers, M. 106; fishplates, M. 108 to 110; complete sets of wheels and axles, M. 270 to 280; axles, M. 220; steel tires, M. 215 to 230; light section rails, M. 95 to 100.

The total production of pig iron in Germany, including Luxemburg, has been during month of March, 1894, 440,320 t., of which 125,056 t. were forge pig and spiegeleisen, 30,249 t. Bessemer, 214,862 t. basic, and 70,153 t. foundry pig. Production in March, 1893, amounted to 419,737 t.; in February, 1894, it was 403,374 t.; from January 1st to 31st of March, 1894, 1,270,112 t. were produced, against 1,171,247 t. during the same period the year before.

AMERICAN NOTES.

(*From our own Correspondent.*)

New York, April 25th.

The great bituminous coal strike has unexpectedly introduced a new factor into the badly enough complicated situation throughout the States. This is the first general strike attempted, and if successful in its organisation, it will affect regions producing 60 per cent. of all the coal mined. At present the anthracite region is not affected. The public has been taken unawares. Rumours were common of a contemplated strike among the coal miners, but these have become so common that hardly any one seriously regarded them. The coke regions are affected, and the first trouble will come from this quarter, as outside of one or two large consumers there is no coke in consumers' yards. The iron trade will not be immediately affected; but dull as trade is, the country is not in any condition to endure a protracted contest with coal miners. The iron business seems to be on the eve of improvement; but as in other industries, much depends on the result of the Tariff Bill discussion. All the large consumers of mill products are waiting. The only evidences of activity were shown in heavy purchases during the past week of large blocks of Bessemer pig for mills in Pennsylvania. This promises to be followed by large contracts for steel billets.

Freight reductions have been made on all the leading lines of road hauling iron and steel products. There is a lack of harmony between the New York banking interests and the National Administration, due to the understood purpose of putting through legislation in favour of coining silver based on bonds. This measure is to be passed to enable Congressmen to return to their constituencies without fear of political decapitation, for the masses are in favour of silver.

LAUNCHES AND TRIAL TRIPS.

Messrs. Vosper and Co., of Portsmouth, launched last week a handsome oil launch for the Sultan of Zanzibar. This launch was 40ft. long by 7ft. 8in. beam, and on her trial trip attained, we are informed, a speed of 8 knots. She is very elaborately fitted with nickel-plated fittings and plush cushions. The machinery consisted of a four-cylinder, 12 brake horse-power engine, and, we are informed, the results are highly satisfactory to all those concerned.

The s.s. Torwood, built by Messrs. R. Craggs and Sons, of Middlesbrough, for Messrs. Whiteway and Ball, of Torquay, was taken out for trial at the measured mile on the 25th April, the result proving very satisfactory to Mr. Ball and his superintendent engineer, Mr. Summers, of Middlesbrough, who were on board. The dimensions of the vessel are 178ft. by 28ft., by 14ft. 2½in. moulded. The engines are by Messrs. Westgarth, English, and Co., Middlesbrough, with cylinders 14in., 22½in., 37in., by 27in., with large steel boiler. Messrs. Westgarth's "Cleveland" feed-heater and evaporator are fitted.

On Saturday, the 28th ult., the s.s. Macedonia, built by Messrs. Craig, Taylor, and Co., of Thornaby-on-Tees, to the order of Messrs. A. C. De Freitas and Co., of Hamburg, for their Hamburg and South American trade, was taken to sea for her trial trip, which proved highly satisfactory, a speed of 11 knots being maintained. The vessel is of the following dimensions:—288ft. by 41ft. by 24ft. 7½in. depth moulded, the engines being 21in., 35in., 57in., by 39in. stroke, by Messrs. Blair and Co., Stockton. The owners were represented by Mr. Heinr. Wiengreen and Captain H. F. Rörden, the latter of whom will take command of the vessel.

The s.s. Garton went on her trial trip a few days back. She is a fine screw steamer built by Messrs. Wm. Gray and Co., for the Deddington Steamship Company, of Hull (Messrs. H. Samman and Co., managers), and engined at the Central Engine Works, West Hartlepool. Her length is 316ft. over all; breadth, extreme, 43ft.; depth moulded, 20ft. 10in.; and she takes Lloyd's highest class. The engines are of the triple expansion type, the cylinders being 23in. by 36½in. by 62in. in diameter, with a piston stroke of 39in., and steam is supplied by two large steel boilers, working at a pressure of 160 lb. per square inch. The vessel left the harbour about 2.30, and, after adjusting compasses, was run for an hour at full speed, when it was found she made about 12 knots on 75 revolutions of the engines per minute. Everything worked admirably and without the slightest hitch or trouble, the boilers maintaining the steam steadily at blow-off point. Amongst those present were Mr. Samman, the managing owner, Mr. Watson, Mr. Gibson, of Hull, and Mr. Walter Sage, under whose superintendence the ship and her machinery have been constructed. The shipbuilders were represented by Mr. Geo. Jones, the manager, and Capt. J. H. Murrell; and Mr. T. Mudd represented the engine builders. The vessel is under the command of Capt. Care, and immediately on the conclusion of the trial she steamed away to Cardiff to load for the Persian Gulf.

The powerful twin-screw hopper dredger No. 9, recently launched by Messrs. W. Simons and Co., of Renfrew, to the order of the Russian Imperial Government, has just completed on the Clyde a series of steaming and dredging trials, and will in a few days proceed to Libau. It has a capacity in its hoppers for 700 tons of dredgings, and the ladder frame is fitted with an endless chain of steel buckets, which are adapted to work at a depth of 35ft. under water. The buckets are arranged to work at different rates of speed to suit the nature of the soil they are dredging. The dredging gear is specially designed with a view to avoid damage to it when dredging boulders and rocks. For this purpose the upper end of the bucket ladder has a recoiling motion should the buckets be suddenly brought to a standstill when working, besides which friction appliances are fitted to the main dredging and hoisting gear. The winches at the bow and stern are triple-barrelled, each barrel working conjointly or independently, as may be required. The vessel has two pairs of compound surface-condensing steam is supplied by two steel boilers working at 100 lb. pressure, either pair of engines being engines indicating fully 800-horse power, and capable of working the dredging machinery to its full capacity. The trials were carried out in the presence of representatives of the Russian Government and the builders, everything working smoothly and satisfactorily. The speed of the dredger when loaded during a six hours' steaming and running trial on the measured mile proved fully a knot beyond that contracted for, and its dredging capabilities were also in excess of the contract.

Messrs. Alex. Wilson and Co., Vauxhall Ironworks, London, have just completed for Messrs. Page, Son, and East, Nine Elms-lane, London, a new tug, which has been named by them the Orient, and which is intended by them for their railway traffic. The Orient is 65ft. long over all, 14ft. beam, and draws 8ft. aft, and 5ft. 6in. forward; and has been built of extra strength throughout to withstand the blows to which Thames tugs are exposed in their daily work, the plates being of steel. The engines are of the compound surface condensing type, with two cylinders 14in. and 28in. diameter respectively, with a stroke of 18in., and are replete with every improvement in detail, the crank shaft and working parts being of steel, and having phosphor bronze bearings of the best quality. One important feature is the patent type of slide valves which have been used by Messrs. Alex. Wilson and Co. for so many years with signal success on all their compound engines. These valves are cylindrical instead of rectangular, and balanced so that they work without friction, and the driver can thus reverse them instantaneously with one hand. The propeller is 6ft. 6in. diameter, having three adjustable blades with large surface for towing. Steam is supplied at 100 lb. pressure by a steel return tube boiler 8ft. 10½in. diameter by 8ft. 6in. long, with two furnaces, each 3ft. diameter. This boiler has the most modern fittings, including a patent filter for the purpose of cleansing the water from all impurities after it comes from the condenser and before it is passed back into the boiler. At the trial trip, which took place on the 26th April, the engines when working at full power developed 216 indicated horse-power, and in ordinary every-day work may confidently be relied on to develope 200 indicated horse-power with a consumption of 3½ cwt. of fuel per hour.

THE EGYPTIAN IRRIGATION SCHEME.

Mr. Somers Clarke, who has been spending the winter in Egypt, has written a letter to the Society of Antiquaries, of which the following is a summary, as given in the *Times*:—

A project which would involve a fearful and wholesale destruction of many of the ancient monuments in Egypt has just been made public. The irrigation engineers have recommended a vast reservoir, the base of which would be formed by a dam placed at a short distance below the island of Philæ. The dam will create a reservoir of enormous extent, not only drowning the island of Philæ, but extending southward into Nubia for nearly a hundred miles. When full, the waters of the reservoir will rise several feet above the highest level of the pylon of the Temple of Isis at Philæ. The rocks surrounding the island are full of hieroglyphic inscription; these will spend many months under water, and there is yet much to be discovered in the immediate neighbourhood.

At Debôt is a Ptolemaic temple, which retains its original girdle-wall, three great standing doorways, the first being the entrance through the girdle-wall, the second being the doorway in a ruined pylon, and the third standing more immediately before the temple. At Dimri are the remains of ancient structures still to be explored. At Kertassi there is, in fair preservation, a small hypæthral temple with Hathor-headed columns; a little south are extensive quarries, part of the surfaces covered with graffiti, chiefly Greek votive inscriptions. Surrounding the village of Kertassi is a great wall enclosure. At Tafeh a small temple, very perfect, is still standing in the middle of the village, and near it are some remarkably interesting specimens of Roman masonry, but built in the Egyptian manner. They are the lower parts of houses, rectangular structures with their internal subdivisions still to be traced. At Kalabsheh is the most magnificent structure in Lower Nubia.

Overhanging the Nile are the remains of a grand quay pierced by two stairways leading on to a great platform. On this is a long terrace of approach from which we rise to another terrace, parallel with the course of the river and lying in front of the pylon. The walls of the temple are very perfect, the roofs only having fallen in. Surrounding the temple is a girdle-wall of masonry. The entrance court of the temple is full of graffiti of the greatest historic interest, and between the crannies of the fallen masonry can be seen many more now inaccessible. At Abu Hor are ancient remains and a quay standing by the river side; a place that needs careful exploration. At Dendûr are the remains of a temple dating from Roman times. The names of many native gods and princes are carved upon the walls. At Koshtemneh are the ruins of a great brick fort, and in one corner of it are the bases of the temple columns.

At Dakkeh is a particularly interesting temple. Stones of an early building of Thothmes III. and Seti I. have been found, but the existing structure was begun under Ergamenes, a native king, and completed under a Roman emperor, presumably Augustus. The pylon is absolutely perfect. This building would be engulphed. At Kobban, opposite Dakkeh, are the remains of a very large rectangular fortress of Egyptian crude brick, some 370ft. by 350ft. The remains of a temple of the middle empire can be traced, and outside are the remains of temples of the XIXth dynasty. At Maharakah are the ruins of a very late temple. Its plan is unique. In addition to the places above-mentioned there are traces of buried towns and of tombs in great abundance. The whole of these things will be submerged, and the inhabitants transported I know not where.

THE PATENT JOURNAL.

Condensed from "The Illustrated Official Journal of Patents."

Application for Letters Patent.

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

19th April, 1894.

7750. Boot Menders, J. F. H. Betts, London.
7751. Organs, &c., C. P. M. Gavioli, London.
7752. Thermometers, W. P. Thompson.—(*A. Frank, Germany.*)
7753. Supplying Water to Cisterns, J. Flockhart, Glasgow.
7754. Making of Lap-welded Tubes, J. Symington, Glasgow.
7755 Developing Dish, E. Holden, Rawtenstall.
7756. Fog Signalling for Railways, H. M. Campbell, London.
7757. Golf Club, A. Gray, London.
7758. Induction Electr.cal Machines, F. Tudsbury, Sheffield.
7759. Boot Sole Sewing Machine, J. and J. Cutlan, London.
7760. Fastening Device for Doors, &c., G. B. Pretty, London.
7761. Polo Mallet, J. Lawler, London.
7762. Racks for Umbrellas and Sticks, C. S. Snell, Cornwall.
7763. Wheel Tires, T. S. Marshall and A. H. Storey, London.
7764. Shelf, &c., for Use on Doors, E. W. Timmis, London.
7765. Kilns for Burning Bricks, &c., J. Bates, London.
7766. Feeding Coin Sorting Machines, M. Hearn, London.
7767. Stoves, M. Lee, London.
7768. Apparatus for Weighing, &c., W. D. Allen, London.
7769. Auriferous Solution, A. B. Glen and T. Lockerbie, London.
7770. Locking the Wheels of Cycles, H. A. Lamplugh, London.
7771 Pince-nez Frames, R. Lyons, London.
7772. Artificial Fuel, G. S. Cory and C. Cory, London.
7773. Strengthening Strap Hinges, W. B. Deming, United States.
7774. Spokes of Cycle Wheels, R. Kronenberg, London.
7775. Surgical Irrigator or Syringe, S. Kovacs, London.
7776. Gratings or Strainers for Sinks, C. E. Challis, London.
7777. Trouser Stretchers, H. J. Townsend, London.
7778. Railway Buffers, G. W. Willford and F. Cocking, London.
7779. Cigarette Machines, A. P. and E. P. Scaramanga, London.
7780. Photographic Cameras, M. E. Dunscombe, London.
7781. Pneumatic Tires for Vehicles, W. Edwards, London.
7782. Coin-freed Apparatus, A. Clare, London.
7783. Lubricators, F. Trier, London.
7784. Washing Wool, W. McNaught and T. W. Hawkins, Manchester.
7785. Driving Chains for Velocipedes, J. Bardet, London.
7786. Colouring Matters, H. H. Lake.—(*Messrs. Wirth and Co., Germany.*)
7787. Socks, J. J. Belisha, London.
7788. Destroying Birds and Vermin, G. G. Blane, London.
7789. Gates, G. G. Blane, London.
7790. Lasts for Finishing Boots, &c., H. Manfield, London.
7791. Coal Boxes or Receptacles, T. P. Perks, London.
7792. Separating Devices, T. G. Martyn, London.
7793. Steam Generators, P. Smit, jun., London.
7794. Steam Boilers, T. Herald, London.
7795. Germination, &c., of Grain, O. Hentschel, London.
7796. Combined Step-ladder and Chair, J. C. Pieh, London.
7797. Bandage Rolls and the like, H. C. Quelch, London.
7798. Exercising Apparatus, R. H. Bath and J. Bland, London.
7799. Haulage Cables, F. R. Simms, London.
7800. Finger-nail Cutters and Trimmers, H. La Casse, London.
7801. Electrolytical Apparatus, C. Kellner, London.

20th April, 1894.

7802. Envelopes, R. A. Swarbrick, London.
7803. Water-jacketted Air Bridge for Boilers, W. Freakley, Staffordshire.
7804. Power Feed Band Sawing Machines, J. Hall, Nottingham.
7805. Direct-acting Rim Brake, D. E. Marvin, Isle of Wight.
7806. Bottling of Aerated Waters, W. Barker, Durham.
7807. Venetian Blind Lath, W. Cole, Ilfracombe.
7808. Economic Fog-signalling Machine, G. F. Foster, Liverpool.
7809. Water-proof Fabrics, J. Markus, Manchester.
7810. Fuel by Utilising Waste Products, A. F. Davey, Essex.
7811. Studs, &c., A. W. Metcalfe, Belfast.
7812. Actuating Ventilators, C. P. Kinnell, London.
7813. Combing Fibrous Material, J. Cooke and A. Stephenson, Bradford.
7814. Making Hatchets, E. Wright, London.
7815. Lighting Velocipedes by Electricity, T. J. Tomlinson, jun., and O. Robson, Newcastle-on-Tyne.
7816. Scarf Slides or Fasteners, A. Haseler, Birmingham.
7817. Velocipedes, J. A. Norberg, Leicester.
7818. Walking Figure, W. H. Clemart, Manchester.
7819. Cyclists' Bag, A. Timpe, Manchester.
7820. Aerated Water Machines, J. Meadowcroft and W. Meadowcroft and Son, Halifax.
7821. Shedding and Drop-box Mechanism, A. Sowden, Halifax.
7822. Hair Curlers, G. Grice, jun., Halifax.
7823. Wringing Machines, H. L., H. L., and A. Wilson, Halifax.
7824 Combination Self-acting Air-valve, &c., E. T. Dunkley, West Bromwich.
7825. Decorating Metallic-boxes, E. A. Jahncke, London.
7826. Piled or Napped Fabric, R. Richardson, Manchester.
7827. Manufacture of Briquettes, C. E. Jolly and H. J. Reid, London.
7828. Apparatus for Preparing Fibres, J. W. Smith, Bradford.
7829. Pins for Holding together Sheets of Paper, C. Bürgin, Manchester.
7830. Cameras, M. Ballantine, Glasgow.
7831. Children's Mail-carts, J. Harrop, Manchester.
7832. Checking the Tendency of Nuts to Work Loose, H. Simpson, Sheffield.
7833. Tobacco-jar, F. Vendrell, Glasgow.
7834. Buttons, A. G. Dunning, Liverpool.
7835. Fastenings for Gloves, F. R. Baker, Harborne.
7836. Cowl, B. Nicklin and G. N. Milward, Smethwick.
7837. Collecting Clear Rain Water, J. W. Gibbs, Liverppol.
7838. Fire-arms, G. Raschein, Manchester.
7839. Watering Cans, G. A. Farini, London.
7840. Door Closers, G. A. Farini, London.
7841. Indicators, C. Chivers, Bath.
7842. Waterproof Bearing for Cycles, E. W. Timmis, London.
7843. Unbreakable Wooden Pulley, M. W. Smith, London.
7844. Producing Intensely Brilliant Pictures, &c., on Glass, A. Corlitz, London.
7845. Compound Steam Engines, M. W. Ash.—(*F. Furse, Italy.*)
7846. Clarifying Oils and Fat, W. B. Leachman, London.
7847. Fasteners for Window Sashes, T. P. Inge, Kent.
7848. Reeds of Looms, D. Smithies, Manchester.
7849. Gear Case for Cycles, J. Ward, Birmingham.
7850. Making Moving Spanners, H. Ball, Birmingham.
7851. Window-sash Locks, S. E. St. O. Chapleau, J. N. Fulton, and F. Hurtubise, London.
7852. Working Sewing Machines, W. A. Plunkett, London.
7853. Base Metal Alloys, W. A. Thoms and W. H. Burgum, London.
7854. Coating Metals, W. A. Thoms and W. H. Burgum, London.
7855. Stucco Ornaments, C. H. Krieger and H. L. A. Puff, London.
7856. Brakes for Cycles, B. J. B. Mills.—(*P. Fageot, France.*)
7857. Target for Shooting Practice, H. Fuchs, London.
7858. Manufacture of Spirits, J. J. Murphy, London.
7859. Colouring Matters, C. D. Abel.—(*The Actien Gesellschaft für Anilin Fabrikation, Germany.*)
7860. Advertising, M. J. Jones, Eccles.
7861. Wire Fencing, C. Smith.—(*F. W. Birch, India.*)
7862. Purification of Anthracene, H. E. Newton.—(*The Farbenfabriken vormals Friedrich Bayer and Co., Germany.*)
7863. Valve Gear of Motors, G. M. D. Clench and T. S. King, London.
7864. Alarms, &c., for Buildings, J. and T. Dew, London.
7865. Galvanic Batteries, D. G. Fitz-Gerald and A. W. Southey, London.
7866. Horse Rakes, J. H. and G. Howard and G. Gibbs, London.
7867. Instruments for Writing Purposes, J. Tough, Birmingham.
7868. Caps, W. Cole, London.
7869. Vulcanising Toy Balloons, &c., J. O. Martin, London.
7870. Carbonic Acid Baths, A. J. Boult.—(*F. A. J. Kaiser, Germany.*)
7871. Pipe Wrenches, A. S. King and R. Beardsley, London.
7872. Swinging and Rocking Beds, M. Reynolds, London.
7873. Bearings for Metal Plates, C. D. Garbutt, London.
7874. Money Bag, J. G. Tuchnitz and J. T. Joppich, London.
7875. A Curative Galvanic Chain, F. Fritsche, London.
7876. Riveting the Bottoms of Ships, G. B. Hunter, London.
7877. Fire-escapes, T. Boothby and W. J. Dean, London.
7878 Heating Railway Carriages, J. E. Howard and J. C. Taite, London.
7879. Reflectors for Electric Lamps, C. Coerper, London.

21st April, 1894.

7880. Flush Drawer Handles, P. E. Ayton, Birmingham.
7881. Retaining the Shape of Trousers, J. Bandell, Longport.
7882. Safety Burner for Oil Lamps, A. W. Lucas, Chester.
7883. Locomotive Engines, M. Reynolds, London.
7884. Measuring Head Coverings, H. Knowles, Manchester.
7885. Machines for Washing Yarn, J. S. and G. Lord, Manchester.
7886. Steering Machinery, A. B. Brown, Glasgow.
7887. Clips for Endless Chains, D. Stewart and C. Ronie, Glasgow.
7888. Metallic Vessels, G. W. Anderson and W. M. Eckersley, Manchester.
7889. Sanitary Cigarettes and Holder, W. E. Teschemaker, Teignmouth.
7890. Portable Studio, M. Watts, Birmingham.
7891. Wire-stretchers, J. L. Crain, London.
7892. Tag, J. D. Parrott, London.
7893. Apparatus for Bleaching Smoke, J. T. Sands, London.
7894. Outyego, S. J. Hunt, London.
7895. Invalid Carriages and Tricycles, S. Kemp, London.
7896. Brake for Flexible Safety Ladder, E. Bauer, Bradford.
7897. Appliances for Ball-driving Games, R. Ramsbottom, Manchester.
7898. Horseshoes, J. E. Platt, Manchester.
7899. Prepayment Mechanism, T. Thorp, T. G. Marsh, and J. Haynes, Manchester.
7900. Pillow Shams, G. H. Brown and W. McMurray, Glasgow.
7901. Valves of Musical Instruments, J. Müller, Glasgow.
7902. Ballasting Vessels and Boats, E. C. F. James, London.
7903. Sliding Blade Penknife, E. C. Close, Oxford.
7904. A New Egg-boiling Apparatus, R. G. Nash, Dublin.
7905. Arc Lamp, R. J. Canavan, London.
7906. Door Bolt, R. Easton and H. Wilson and Co., Ld., Liverpool.
7907. Textile Fabrics, W. Pickstone and A. Greenhalgh, Radcliffe.
7908. Wool-combing Machines, J. Moore, Bradford.
7909. Clamp for Holding Stereotype Plates, J. Hill, Glasgow.
7910. Inflator for Tired Wheels, M. W. Matthews and A. W. Briscoe, Dublin.
7911. Fuel for Smelting Purposes, R. Middleton, Leeds.
7912. Devices for Boots and Shoes, H. T. Hendy, Bristol.
7913. Steam Engines, T. Keene, Liverpool.
7914. Testing Gas Cylinders, The Scotch and Irish Oxygen Company, Ld., and H. Brier, Glasgow.
7915. Window Sashes and Frames, H. J. Ford, London.
7916. Rubber Waterproof Fabrics, T. Birnbaum, London.
7917. Safety Lock, R. W. Duncan and J. Graham, Liverpool.
7918. Guards for Vessels, W. Lowrie, Liverpool.
7919. Art of Aerostation, J. Hofmann, Liverpool.
7920. Lead Sheath Cables, J. B. Atherton, Liverpool.
7921 Railways, W. J. Bennett, London.
7922. Holding Sash Lines to Sashes, F. W. Piper, London.
7923. New Apparatus for Drying Linen, C. Sears, London.
7924. Self-closing Bung for Beer Barrels, S. Miller, London.
7925. Necktie Holder, F. Lamacraft, London.
7926. Pulleys for Window Cords, G. M. Pilgrim, London.
7927. Mowing and Reaping Machines, E. G. Paine, London.
7928. Separating Flexible Films, W. Cuthbertson, Glasgow.
7929. Puzzle Game, A. E. Harker, London.
7930. Crate or Case, F. T. Howell and J. C. Schulz, London.
7931. Velocipede, A. Bodding, London.
7932. Presses for Cutting Leather, W. P. Brough, Manchester.

7933. HEATING WATER by ELECTRICITY, W. Corin, London.
7934. GAS PRODUCER, J. M. While and J. Timmins, London.
7935. ELECTRIC TELEGRAPHY, &c., K. O. A. Gulstad, London.
7936. BALL BEARINGS, I. M. W. Bourke, London.
7937. METAL PIPES, H. F. Yorke, London.
7938. FASTENERS for CORSETS, H. Eschen, A. Perry, and B. Showler, London.
7939. TIRES for BICYCLES and CARRIAGES, J. Graham, London.
7940. ARTIFICIAL TEETH, E. T. Starr, London.
7941. BRASS FITTINGS for BASINS, M. B. Bounds, London.
7942. TELESCOPES, J. Y. Johnson.—(*The firm of Carl Zeiss, Germany.*)
7943. SCRAPING OUT TOBACCO PIPES, E. Boggis-Rolfe, London.
7944. MATCHES, &c., L. de Stein and J. Joscht, London.
7945. OVENS for BAKING and ROASTING, J. B. Cox, London.
7946. MANUFACTURE of BRUSHES, &c., J. Stauder, London.
7947. WORKING FACING LOCK BARS, H. Tunbridge, London.
7948. HAND PLANES, G. A. Brown and J. Brown, London.
7949. REMOVING FIBRE from COTTON SEED, R. Silcock, London.
7950. APPARATUS for ELECTROLYTICAL PURPOSES, H. Guthrie, London.
7951. SORTING MACHINES, J. K. Gore, London.
7952. MEANS of OFFENCE in WARFARE, G. H. Jones, London.
7953. WAXING, &c., THREADS, H. and L. Rogez, London.
7954. COMBINED EGG-BOILER and STAND, A. B. Gehrke, London.
7955. ELECTRIC MEASURING INSTRUMENTS, J. Thomson, London.
7956. MACHINES for UNHAIRING HIDES, M. C. Chapal, London.
7957. BRIDLE BITS, A. Friedl, London.
7958. HOLDER for NEWSPAPERS, &c., H. Volkmann, London.

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7959. VALVES for PNEUMATIC TIRES, Capon, Heaton, and Co., Ld., and H. Heaton, jun., London.
7960. SAW-BENCHES, N. Tailby, London.
7961. APPARATUS for CLIMBING ROPES, L. Gülzow, Manchester.
7962. CANVAS POSTAL ENVELOPES, G. Lawson, King's Lynn.
7963. STEAMING WOVEN FABRICS, J. Sharp and T. W. Stead, Halifax.
7964. CRANES, W. Purdy, Leeds.
7965. NETS for AUTOTYPY, J. B. Howard.—(*K. Hammer and A. Selzsam, Germany.*)
7966. WOODEN TAPS, J. B. Howard.—(*G. Graumann, Germany.*)
7967. CASE for PROTECTING WATCHES, J. B. Howard.—(*O. Busster, Germany.*)
7968. CONSTRUCTION of CHAIRS, A. Paice, Gloucester.
7969. CORK FASTENER, F. J. Davis and O. J. H. Davis, Plymouth.
7970. QUADRICYCLE, G. Whyte, Guernsey.
7971. CHIMNEY TOPS, D. Curr, Stretford.
7972. GUARD for CARVING FORKS, O. Oxspring, Shire Green, near Sheffield.
7973. COLOUR PHOTOGRAPHY, J. M. Gillies, R. M. Inglis, E. E. F. d'Albi, and W. C. Nixon, Dublin.
7974. APPARATUS used in TWISTING YARNS, J. R. Cudworth, Halifax.
7975. CLEANSING WOOL, &c., FIBRES, O. Reichenbach, London.
7976. STEAK BEATERS, G. Paley, Preston.
7977. CRANKS for BICYCLES, A. Abrahamson, London.
7978. ATMOSPHERIC REGULATORS, W. Bruce, Leeds.
7979. LADIES' STAY BUSKS, P. Samuels, London.
7980. COMBINED CUP and STOPPER for BOTTLES, H. C. Blackwell, Bristol.
7981. PULLEYS, R. B. Davidson and Barry, Henry, and Co., Glasgow.
7982. FIRE-PLACES, W. Robb, T. Scott, and L. R. Russell, Glasgow.
7983. SIGHT-FEED LUBRICATORS, J. F. Bennett, A Firth, and T. H. Firth, Sheffield.
7984. CUTTER for MANUFACTURE of DOG CAKES, J. H. Clark, Crabbs Cross, near Redditch.
7985. PROCESS of PRODUCING CAUSTIC SODA, T. Drake Huddersfield.
7986. SAFETY SPREADERS for HORSE CHAINS, J. Draydon, J. Draydon, jun., and G. Draydon Cornwall.
7987. RING SPINNING FRAMES, J. and W. N. Wilkinson, Manchester.
7988. PREPAYMENT GAS METERS, W. and W. H. Cowan, Glasgow.
7989. LUBRICATOR, W. Trautmann, Berlin.
7990. APPARATUS for ROLLING IRON or STEEL BARS, W. Neilson, Glasgow.
7991. ADJUSTABLE STEPS, J. H. Bailey, Barnsley.
7992. UTILISATION of REFUSE, R. Schneider, London.
7993. OIL LAMPS, H. Defty, London.
7994. ELECTROLYTIC CELL, E. de Pass.—(*H. Thofehrn, France.*)
7995. FITTINGS for ELECTRIC LAMPS, H. Hirst, London.
7996. SAUCE CRUET, W. H. Courtenay, Worcester.
7997. HORSESHOES, T. N. Jones, G. W. Currier, and E. C. Smith, London.
7998. SLATE FRAME, D. Macdonald, London.
7999. GRAPNEL, J. Skinner.—(*H. Skinner, West Indies.*)
8000. HAND PRINTING DEVICE, C. A. Allison.—(*R. H. Smith and W. F. Tripp, United States.*)
8001. PROMOTING COMBUSTION in FURNACES, J. B. Davids, London.
8002. HARNESSING, &c., TIDAL POWER, W. Horsfall, London.
8003. ROOFING BUILDINGS, W. H. Heywood and W. Curbstone, London.
8004. FLOOR PURIFIERS and GRADERS, S. D. Hoole, Birmingham.
8005. REPRODUCING PICTURES on PAPER, E C Marks, London.
8006. STICK or UMBRELLA HOLDER, F. Bauch, London.
8007. SWITCH TELEPHONES, G. L. Anders and W. Kottgen, London.
8008. SHOE PROTECTOR, W. Gillies, T. Lethbridge, and R. Pope, Bristol.
8009. A POCKET METRONOME, W. F. Howe, London.
8010. SCHOOL DESKS, O. André, London.
8011. ELECTRIC ARC LAMPS, F. Jehl and Fritz von Hardtmuth, London.
8012. TOYS, E. F. am Bach, Germany.
8013. MANUFACTURE of HAIR-PINS, R. R. Beard, London.
8014. SAFETY PINS, I. I. Becker, London.
8015. PLATEN PRINTING MACHINES, A. Godfrey, London.
8016. PHOTOGRAPHIC APPARATUS, &c., B. J. Edwards, London.
8017. BILLIARDS, C. Ormerod and A. W. Cooper, London.
8018. LUBRICATORS, T. Kahle, London.
8019. HOLDER for VALANCE HANGINGS, A. Lolling, London.
8020. CYCLES, M B Carbonnel, London.
8021. FASTENING DEVICES for HATS, A. J. Boult.—(*O. Schiller, Germany.*)
8022. SOAP, J. H. Iredale and J. W. W. Huddleston, Liverpool.
8023. POWER HAMMERS, A. Beaudry, Liverpool.
8024. TRIMMING HAT BRIMS, H. H., A., and A. Turner, Manchester.
8025. BOOTS, T. P. Eves, London.
8026. HEATING and COOLING APPLIANCES, P. Pfleiderer, London.
8027. CHESS and DRAUGHT BOARDS, &c., C. Whelpton, London.
8028. MINERS' LAMPS, A. Morris, London.
8029. APPARATUS for AUTOGENOUS SOLDERING, L. Longuemare, London.
8030. SADDLE-BARS, L. Leclercq, London.
8031. WATER-TIGHT BULKHEAD DOORS, S. Matthews, London.
8032. HEATING and VENTILATING APPARATUS, S. Holman, London.
8033. BUNDLING MACHINES, H. H. Lake.—(*The International Woodworking Machine Company, United States.*)
8034. HOLDING the COVERS of TIRES, W. Howard, London.
8035. SAWING APPARATUS, S. Mundey, London.
8036. COLLAR STUD, E. Hughes and E. Everett, London.

24th April, 1894.

8037. HULLS of VESSELS, &c., G. W. Schermerhorn, London.
8038. APPARATUS for PREPARING CHINA, D. Radclyffe, London.
8039. LABORATORY BUNSEN GAS BURNER, J. J. Pilley, London.
8040. SMOKE PREVENTER for CHIMNEYS, A. Clifford, Dartford.
8041. EXPLODING CHAMBER for ENGINES, S. H. Adams, York.
8042. SETTING-ON MOTIONS, R. T. Howard and J. Collier, Farnworth.
8043. CLEAT, &c., H. B. Wyman and A. C. Goodwin, London.
8044. STREET DRAINAGE RECEPTACLES, W. H. Sladdin, Brighouse.
8045. ELECTRIC BELLS for BICYCLES, W. G. Woolf, London.
8046. DOUBLE SECURE ENVELOPE, J. D. Suthren, Cheshire.
8047. UMBRELLA HOLDER and STAND, E. M. Clarke, Nottingham.
8048. APPARATUS for MAKING SALT, R. Hodgson, Birmingham.
8049. PRODUCING COTTON SEED MEAL, G. H. Croker, Liverpool.
8050. PORTABLE TABLES, T. G. Blood, Birmingham.
8051. COAL PIT CAGE SUSPENDER, &c., J. W. Scott, Maesteg.
8052. DETACHING GEAR for SHIPS' BOATS, C. Gardner, Stockton-on-Tees.
8053. LAP-WELDED TUBES, H. Symington, Glasgow.
8054. GOLF CLUB HEADS, R. Winton, Glasgow.
8055. SKIVING MACHINERY, A. G. Brooks.—(*C. H. Bayley, United States.*)
8056. BALING and other PRESSES, W. McArthur, Glasgow.
8057. PRIVIES, J. George, Manchester.
8058. WINDOWS, W. G and J. B. Leatherbarrow, Manchester.
8059. CARDING ENGINES, E. and S. Tweedale and J. Smalley, Castleton.
8060. TWISTING MACHINES, E. and S. Tweedale and J. Smalley, Castleton.
8061. ELECTRO-CHEMICAL DECOMPOSITION, H. Carmichael, London.
8062. COAL CUTTING, T. B. A. and R. W. Clarke, Sheffield.
8063. CLOTHES' HORSE and LINEN RAIL, J. Truman, Sheffield.
8064. ATTACHING TIPS of BILLIARD CUES, R. Robinson, Sheffield.
8065. SELF-LUBRICATING PULLEYS, G. and E. Smith, Northampton.
8066. RAILWAY CARRIAGE DOOR INDICATOR, J. Nicholson, Londonderry.
8067. SMOKE PREVENTION, N. Chandler and H. Rallings, Hednesford.
8068. TYPE WRITERS, J. L Cantelo, Liverpool.
8069. SOOTHING TEAT and TEETHING RING, F. Millward, Bristol.
8070. PHOTOGRAPHIC HAND CAMERAS, T. H. Algate, Bristol.
8071. FASTENING SHANKS to KNIVES, B. W. Ramsden, Sheffield.
8072. WINDING YARNS, S. Hey.—(*W. A. Smith, United States.*)
8073. PREPARING and SPINNING FIBRES, J. W. Smith, Bradford.
8074. TEXTILE MACHINERY, J. McQueen, T. Thompson, and J. Heywood, Manchester.
8075. CYCLE PEDALS, J. Ferguson, Glasgow.
8076. ORNAMENTING CHINA ARTICLES, D. Jones, W. W. and F. C. Wardle, and A. W. Beech, London.
8077. BALING PRESSES, H. Shield and J. Howarth, Liverpool.
8078. APPARATUS for WEAVING FABRICS, R. N. W. Smith, Glasgow.
8079. CYCLE LAMPS, S. T. Richardson, Birmingham.
8080. SURGICAL BEDSTEAD, J. A. Smallbones.—(*L. W. Bickle, Australia.*)
8081. SHIPS, I. Spy, Liverpool.
8082. GRATERS, A. M. Sternfeld, Manchester.
8083. POWDER-BLOWERS, ATOMISERS, &c., B. Stern, Manchester.
8084. HOIST SAFETY GUARD MOTIONS, W. H. Hoskin and A. Pickering, Blackburn.
8085. PRODUCTION of METALLIC ZINC, P. C. Choate, Glasgow.
8086. ALARM for PRESSURE GAUGES, W. H. Bradt, Glasgow.
8087. MANUFACTURE of ARMOUR, A. A. Ackerman, London.
8088. CONSTRUCTION of KILNS for BRICKS, E. Howl, London.
8089. PORTIERE RODS and APPARATUS, C. Wilson, London.
8090. SWIVELLING WINDOWS, J. and W. McLoughland, London.
8091. KNICKERBOCKERS, B. Smolansky and A. P. Bateman, Manchester.
8092. BODY ROLLERS for HORSES, &c., J. J. Wilson, Birmingham.
8093. APPARATUS for MARKING BILLIARDS, P. Rödel, London.
8094. STEAM GENERATORS, J. E. Gresty, London.
8095. KNIFE CLEANING MACHINE, W. Ayton, London.
8096. ICE MAKING APPARATUS, A. J. Boult.—(*G. Schacke, Germany.*)
8097. MINERS' SQUIBS, J. R. Powell, London.
8098. SOLID COMBUSTIBLE, L. Dardel and H. Bécoulet, Liverpool.
8099. FILTER PRESSES, H. Farmer, London.
8100. WATCH CASES, C. K. Colby, Liverpool.
8101. TABULATING SYSTEMS, H. Hollerith, London.
8102. BASKETS or SIMILAR RECEPTACLES, E. M. Hudgin, London.
8103. FASTENING CARDBOARD BOXES, J. A. Causton, London.
8104. BUNG, N. Fuchs, T. Craney, and T. C. Stokes, London.
8105. BRAKE, J. F. Shepard, C. Bartholomew, and S. H. Carroll, London.
8106. STONE CARVING MACHINE, A. Zanardo, London.
8107. ROPE COUPLINGS, B. Kirsch, London.
8108. OPENING, &c., GREENHOUSE SASHES, G. Paine, London.
8109. SYPHON HEADS, S. Triller, London.
8110. PILLAR WATER-CLOSET, A. and F. G. Johnson, London.
8111. PNEUMATIC TIRES, C. Dierickx and C. Belot, London.
8112. MAKING ANIMAL CHARCOAL, C. W. Kriens, London.
8113. PNEUMATIC TIRES, J. G. Moomy, London.
8114. VELOCIPEDES, C. E Ford, London.
8115. TUBES of CIRCULAR SECTION, F. E. Elmore, London.
8116. PEDALS for CRANK POWERS, A. J. Hoyt, London.
8117. TREATMENT of SEWAGE, and REFUSE, J. Posno, London.
8118. MECHANISM for FEEDING OPENERS, E. Buckley, Manchester.
8119. HAULING-ROPE CLIPS, J. Green, London.
8120. MACHINES for DRILLING PURPOSES, W. A. Pearn, Manchester.
8121. PNEUMATIC TIRES of CYCLES, J. V. Pugh, London.
8122. OIL CUP for VEHICLE WHEELS, J. A. Garvin, London.
8123. UMBRELLAS and like SUNSHADES, J. Forbes, London.
8124. PORTABLE ALARUM for BATHS, I. Bamberger, London.
8125. DYNAMO-ELECTRIC MACHINES, H. N. Prentice, London.
8126. FITTING PARTS of MACHINERY, H. N. Prentice, London.
8127. INDICATING POSTAL SCALE, I. S. McGiehan, London.
8128. PRACTISING SHORTHAND, The Honourable Sybil Margaret Tyssen Amherst, London.
8129. PROTECTING LAMPS, E. J. Frost and M. P. Stevens, London.
8130. MUSIC and BOOK-LEAF TURNERS, J. W. Neumann, London.
8131. STEAM and HOT-WATER RADIATOR, H. Flint, London.
8132. LOUNGES, INVALID COUCHES, &c., W. J. Collins, London.
8133. DEVICE for HOLDING REINS, B. Seymour, London.
8134. CYCLISTS' CAPS, C. W. and P. W. Shepherd, London.
8135. COLLAPSIBLE TEA CHEST or BOX, T. V. Macleod, London.
8136. HARDENING STEEL PLATES, H. W. Gabbett-Fairfax, London.
8137. PNEUMATIC SADDLE or PILLOW, R. F. Hall, London.
8138. ORNAMENTAL SURFACES, F. Lucchesi, W. Maitland, and D. J. Williams, London.
8139. FIRE-ESCAPES, F. W. Hoar, London.
8140. AUTOMATIC HOSE JACKETS, H. H. Leigh.—(*J. B. Cooper, United States.*)
8141. TOBACCO PIPES, J. W. Hinton, London.
8142. SPINNING TOPS, J. A. Cave.—(*E. P. Lehmann, Germany.*)
8143. BICYCLES and TRICYCLES, W. F. Williams, London.
8144. HOSE REEL, W. Lee Van Horn and M. Yount, London.
8145. METALLIC PACKING, F. A. Ives, London.
8146. HORSESHOES, F. W. Bach, A. E. Schatz, and E. Rinke, London.
8147. TREATING FIBROUS MATERIAL, G. Walker, London.
8148. TICKET PUNCHES, A. Warner, London.
8149. ELECTRICAL MEASURING INSTRUMENTS, H. H. Lake.—(*J. V. Vleck and E. Weston, United States.*)
8150. PROPELLING TRAMCARS, G. G. M. Hardingham, London.
8151. ROLLER SKATES, F. Sabel, London.

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8152. PIPES, H. Dinn, London.
8153. EARTHENWARE PIPE MACHINERY, R. Ewing, London.
8154. CUFF ADJUSTER, H. Wardle, Manchester.
8155. SIZING MACHINES, J. S. Hargreaves, Heywood, Lancashire.
8156. CHIMNEY COWLS, C. Hitchcock, London.
8157. RINGS for STEAM ENGINE PISTONS, G. Timmis, Southampton.
8158. CYCLE GEAR CASES, S. Stone and C. H. Genders, Nottingham.
8159. CONSTRUCTION of BALL TAPS, I. Barnsley, Sheffield.
8160. PORTABLE LUNCHEON LOCKER, R. W. Banner, Bristol.
8161. STOPPERS for BOTTLES, M. Weber and M. Lietha, Manchester.
8162. POSTAL ENVELOPES, G. Davis and J. L. Lloyd, Aberystwyth.
8163. AERATED WATER BEVERAGE, G. Davis, Aberystwyth.
8164. HAY PRESSING MACHINERY, C. and W. Stephenson, Newark.
8165. BOTTLE SPOON and STIRRER, C. Sheather, London.
8166. STEAM GENERATOR, J. E. Green, London.
8167. CALCULATING CUBES for SCHOOLS, J. H. Towers, Southsea.
8168. AUTOMATIC EXHAUST VENTILATOR, W. J. Baker, Scarborough.
8169. GAS BURNER, J. H. Butterworth.—(*A. Carter and W. Sweetman, Australia.*)
8170. WATER-TUBE STEAM BOILERS, F. J. Rowan, Glasgow.
8171. PAPER-MAKING MACHINES, J. Wyllie, Glasgow.
8172. BEER PUMPS, H. Harper, Birmingham.
8173. SPILE or VENT PEG for CASKS, G. C. Churchward, Southsea.
8174. PORTABLE WATER CONTAINER, T. B. Tyson, Longport.
8175. ENERGY SAVER for BICYCLES, F. J. Boulton, Hereford.
8176. COMBINED TRAVELLING BAG, &c., J. Frankenburgh, Glasgow.
8177. PAINT CANS, S. N. Ashworth, Manchester.
8178. PRODUCTION of COPPER COLOURS, C. M. Pielsticker, London.
8179. INCREASING the ILLUMINATING POWER of OIL LAMPS, R. H. Courtenay, London.
8180. PLOUGHS, W. P. Thompson.—(*F. W. Unterilp and F. Lehmann, Germany.*)
8181. BICYCLE SADDLES, S. Seligmann, Liverpool.
8182. PIPES of HEATING APPARATUS, W. P. Thompson.—(*A. Dumas, France.*)
8183. EXTRACTING METALS from ORES, W. P. Thompson.—(*L. R. Bonehill and E. T. Gautier, Belgium.*)
8184. PRECIPITATING METALS from SOLUTIONS, J. S MacArthur, London.
8185. MACHINE for HULLING COFFEE, J. W. Gordon, London.
8186. CONTROLLING the DIALS of CLOCKS, R., J., and J. Potts, London.
8187. MALLETS for PLAYING GAMES with BALLS, F. H. Ayres, London.
8188. POTENTIOMETERS, F. H. and H. Nalder, C. W. S. Crawley, and A. Soames, London.
8189. DRAWING-OFF LIQUIDS, F. H. Nalder, H. Nalder, C. W. S. Crawley, and A. Soames, London.
8190. MOUNTING CANNON, J. Eastwick and I. A. Timmis, London.
8191. SPRING MOTOR, W. Martin, London.
8192. COIN-FREED MECHANISM, A. G. Macculloch, London.
8193. DESTRUCTION of SEWER GAS, &c., J. E. Webb, London.
8194. COMBINED SAW and PLANER, G. Szekely, London.
8195. FLY and CAST-BOX for ANGLERS, J. Boyce, London.
8196. LUBRICATORS for BASSINETTES, J. Whitehead, Birmingham.
8197. AUTOMATIC OIL GAUGE, W. H. and A. F. Ross, London.

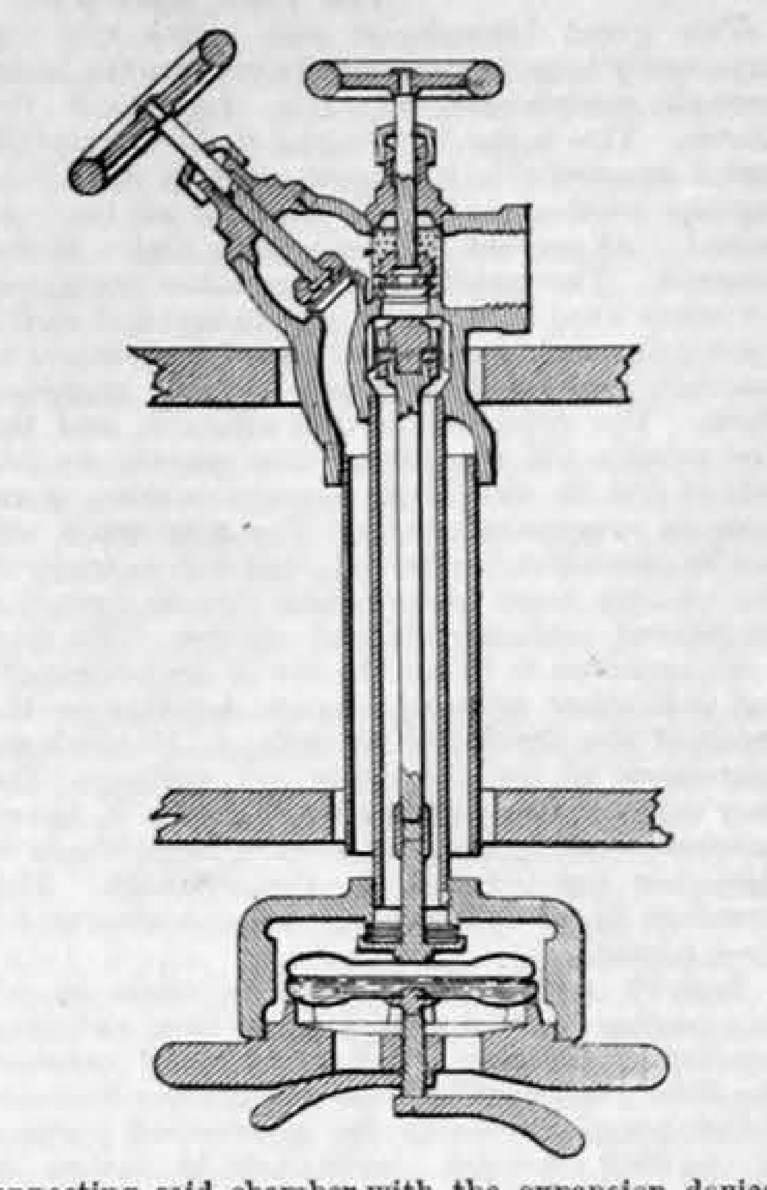
SELECTED AMERICAN PATENTS.

From the United States Patent Office Official Gazette.

511,943. STEAM TRAP, *E. H. Gold, Chicago, Ill.—Filed March 27th*, 1893.

Claim.—(1) In a steam trap, the combination of an automatically operated valve located within the space to be heated, an expansion device situated outside the space to be heated, and connections between said valve and expansion device, of a hand-operated valve for closing the port normally controlled by said automatic valve, substantially as described. (2) In a steam trap, the combination with an automatically operated valve located within the space to be heated, an expansion device located outside the space to be heated in a chamber communicating with the automatic valve chamber, and a connection between said valve and expansion device, of a hand-operated valve adapted to close the port normally controlled by the automatic valve, and a second hand-operated valve controlling a passage opening to the air and surrounding the automatic valve chamber and the passage

511.943

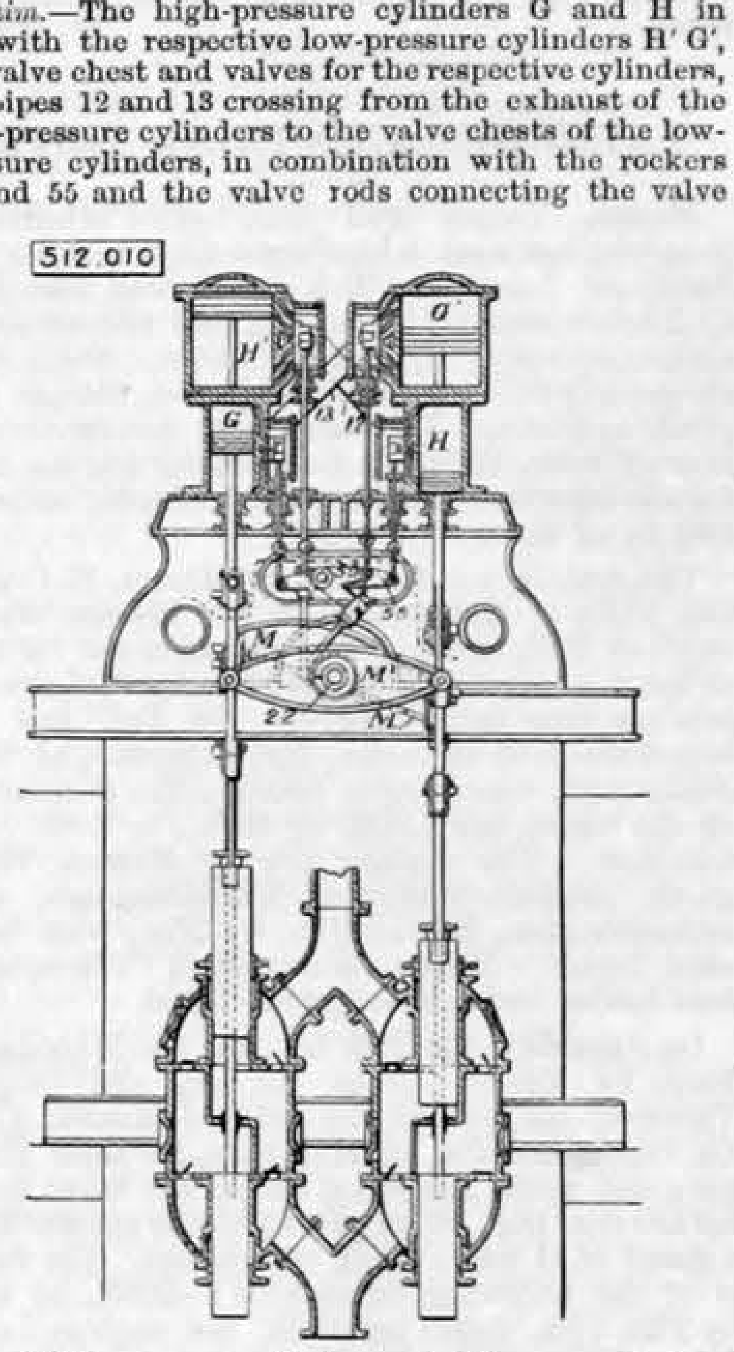


connecting said chamber with the expansion device chamber, substantially as described.

512,010. PUMPING ENGINE, *E. E. Clark, Northampton, Mass.—Filed February 20th*, 1893.

Claim.—The high-pressure cylinders G and H in line with the respective low-pressure cylinders H' G', the valve chest and valves for the respective cylinders, the pipes 12 and 13 crossing from the exhaust of the high-pressure cylinders to the valve chests of the low-pressure cylinders, in combination with the rockers 50 and 55 and the valve rods connecting the valve

512.010

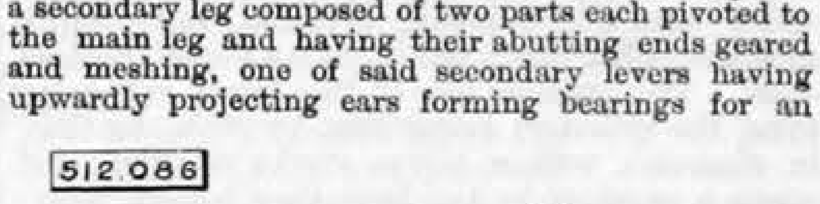


of one high-pressure cylinder and of the opposite low-pressure cylinder, the walking beams M' M' and M and the shaft 22 for supporting such walking beams, the pistons, the piston-rods, crossheads and links connecting the respective pistons at opposite ends of the walking beams, and the double-acting pumps with their plungers axially in line with the compound engines and connected to the respective piston-rods and crossheads, substantially as set forth.

512,086. PLIERS, *J. V. Ashcroft, Dunkirk, Ind.—Filed April 1st*, 1893.

Claim.—A pair of pliers consisting of a main leg and a secondary leg composed of two parts each pivoted to the main leg and having their abutting ends geared and meshing, one of said secondary levers having upwardly projecting ears forming bearings for an

512.086

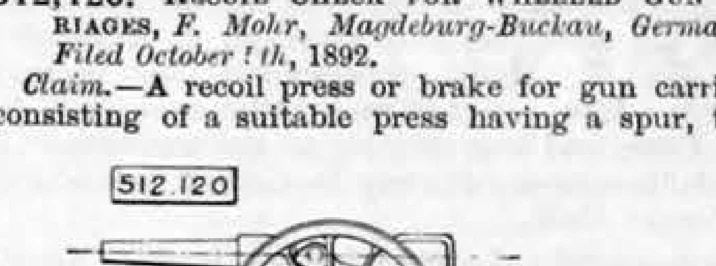


adjustable locking device consisting of a pivoted lever having a pin attached thereto, said pin being arranged to pass through a hole in said secondary lever and to play in a lateral slot in the main leg when the pliers are operated as and for the purpose set forth.

512,120. RECOIL CHECK FOR WHEELED GUN CARRIAGES, *F. Mohr, Magdeburg-Buckau, Germany.—Filed October 7th*, 1892.

Claim.—A recoil press or brake for gun carriages, consisting of a suitable press having a spur, to be

512.120



driven into the ground, projecting from the side of the press cylinder, and a piston having a rod passing through one end of the cylinder and connected with the trail, whereby the gun and carriage will have a limited recoil for the purpose specified.

TRIPLE-EXPANSION ENGINES OF THE TURRET-AGE

MESSRS. DOXFORD AND SON, SUNDERLAND, ENGINEERS

"The Engineer"

Swain Eng.