THE ENLARGEMENT OF LIVERPOOL STREET STATION, GREAT EASTERN RAILWAY.

No. V.

Double and single stanchions.—The arrangement of double columns carrying single vertical stanchions, shown in Fig. 23, is continued throughout the whole length of the Parcels Office until the end walls are reached, when a modification of the former design is adopted. Restricting our attention for the present to the far, or railway end wall of the office,

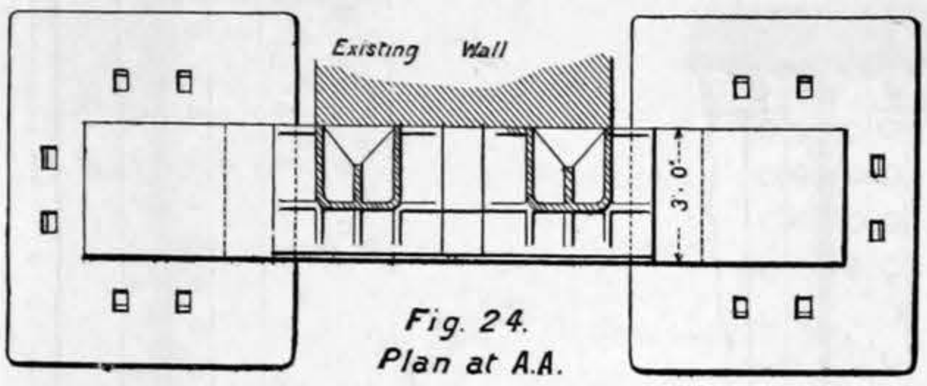
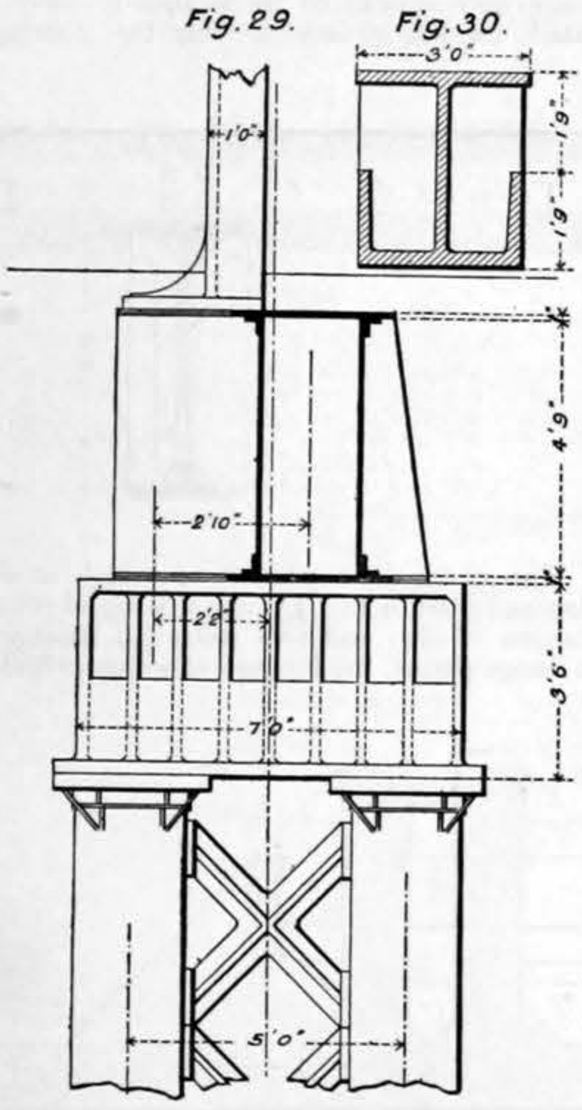


Fig. 24.
Plan at A.A.

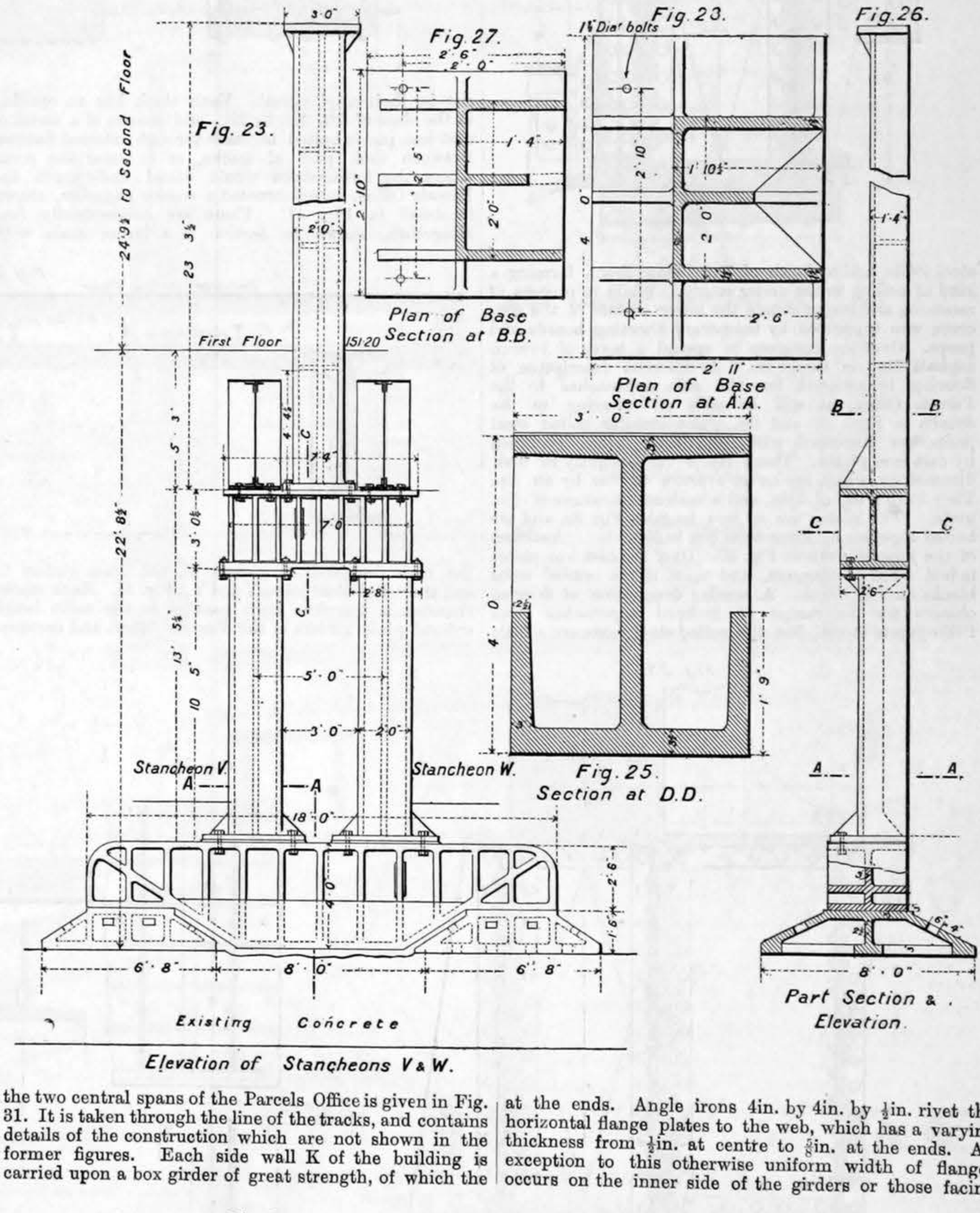
where the fantail gallery and approach from the first part of the terminus joins on to the building, we find that at the junction the double cast iron columns are replaced by twin stanchions, and an upper single one of the same material ranged in both the first and second storeys flat against the wall, something after the manner of a pilaster, or considering the depth of the projection, more like an interior counterfort or buttress. An elevation of these double stanchions, and supports for the first and second floor, is shown in Fig. 23, together with cross sections of the longitudinal plate girders, which will be subsequently referred to. While the general disposition of the various parts is similar to that already described for the twin columns, and includes a table girder, it is to be noticed that the cast iron bed or base-plate is in three parts, and consists of an upper wedge-shaped poly-

Fig. 29. Fig. 30.



ribbed girder, 4ft. deep at the centre, 2ft. 6in. deep at the ends for a length of 3ft. over the bearing plates, and 3ft. in width, as shown in Figs. 23—25. In the last figure it is seen in cross section through D D in Fig. 23, and is practically of almost the same dimensions and form as the table girder, surmounting the twin columns with a trough lower flange 3½in. thick in the horizontal part, and 3in. in the vertical sides, tapering to 2½in. at the upper end. Both the middle rib and the upper flange are 3in. in thickness, diminished in the flange to 2½in. at the horizontal edges. This upper bed-plate is supported by two others, that is, it virtually rests upon a pair of hollow cast iron abutments which stand upon a solid foundation of concrete, as represented in Figs. 23, 24, and 26, and is thus in the position of a girder with a clear span of 11ft. 4in. Each of the under bed-plates consists of a hollow casting measuring over all 8ft. by 6ft. 8in. It has a depth of 1ft. 6in., with flanges 3in. thick, a vertical rib, and sloping faces 2½in. in thickness, and is secured to the concrete by six slotted wedges or bolts. Upon the upper bed-plate or girder, as it virtually is, are bolted the double stanchions shown in elevation in Fig. 23 and in section in Figs. 24 and 28, where they have the appearance of a very large channel iron 2ft. by 1ft. 10½in. by 1½in. thick, and provided with a central rib of one-half the depth of the sides. They are bolted down to the base girder by a pair of bolts 1⅜in. in diameter. To the capitals of the double stanchions is bolted the table girder, Figs. 23 and 26, which is a polyribbed double flanged horizontal cast iron girder, 7ft. long, 3ft. deep, 2ft. 6in. wide, 3in. thick at junction of flanges and web, 2½in. at edges and in the web, and is shown in section at C C in Fig. 26, which also contains an elevation of the single stanchion shown in section in Fig. 27. It is of the same form and of the same dimension in elevation as the pair which support it; but, instead of being 1ft. 10½in. in cross section, it is reduced to 1ft. 4in., and is ⅛in. less in the different thicknesses. It will be evident that where the double columns and single vertical stanchions are placed at right angles to the side walls of the building, some alteration must be made in the relative position of the different members of the supports. It is no longer possible to carry the load or adjust the centres of the box girders in a line with the vertical axis of the columns, so that the *ensemble* of the especial arrangement is represented in Fig. 29, and a section through the centre of the table girder in Fig. 30. The proportions, thicknesses of metal, and general sections are similar to those already described and illustrated.

Box girders.—An enlarged cross section at floor level of the two central spans of the Parcels Office is given in Fig. 31. It is taken through the line of the tracks, and contains details of the construction which are not shown in the former figures. Each side wall K of the building is carried upon a box girder of great strength, of which the



at the ends. Angle irons 4in. by 4in. by ½in. rivet the horizontal flange plates to the web, which has a varying thickness from ½in. at centre to ⅝in. at the ends. An exception to this otherwise uniform width of flanges occurs on the inner side of the girders or those facing each other. The plates—Figs. 31 and 36—next the angle irons in both flanges are 2ft. 3in. in total width, the additional projecting 3in. serving to carry the cast iron flue plates of the smoke chamber, which will be subsequently alluded to. Passing on to the transverse floor girders C C—Fig. 31—they are also of the plate description, as shown in cross-section in Fig. 35, where they are riveted at their junction with the main longitudinal plate girders.

Fig. 31

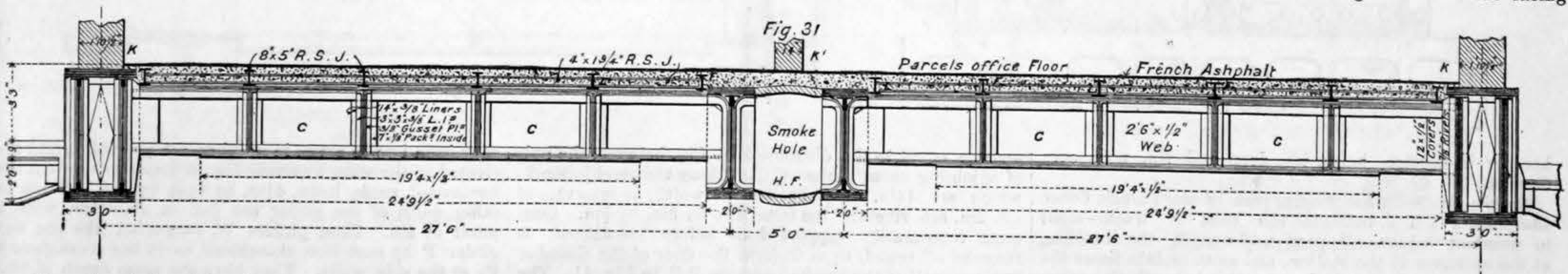
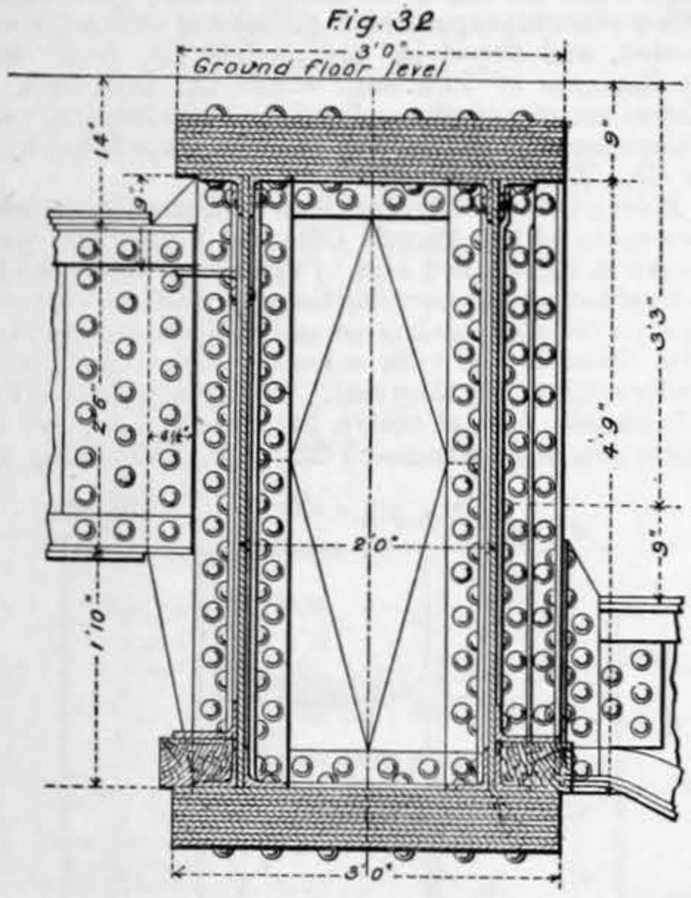


Fig. 32 and 33. At the centre the girder is 5ft. 7in. in depth over all, which dimensions includes a cover-plate ½in. thick in both the upper and lower booms. These cover-plates are each 14ft. in length, and designed so as to cover collectively the separate joints in the different plates, and thus avoid the multiplication of individual wrappers and cover plates of shorter proportions. There are nine plates, 3ft. in width, which quantity is constant throughout the entire length of the girder, which is 51ft. 11½in., and all ½in. in thickness at the centre, diminishing to two plates of the same thickness at the ends over the columns as in Fig. 33, which also shows a portion of the stanchion of the table girder over the twin columns. Of the ½in. flange plates the maximum length is 30ft., which gives rather more than a quarter of a ton for the weight of a single plate. What may be regarded as the common or constant part of the section of the box girder consists, therefore, of two plates 3ft. by ½in. each flange, of four angle irons 4in. by 4in. by ½in., of a maximum length of 34ft. 5in., and a pair of sides or webs placed 2ft. apart from out to out, and varying in thickness from ½in. at the centre to ⅞in. at the ends. In the flanges, the rivets passing through the plates and angle irons, are 1in. in diameter, but only ⅞in. elsewhere, unless otherwise specified. All bearing surfaces are flush riveted, and the rivets are pitched 4in. from centres. At distances of 10ft. 8in., where the transverse floor girders are placed, the webs of the main longitudinal box girders are stiffened by double angle irons 3½in., by 3½in. by ½in. Figs. 32 and 33.

Plate girders.—Dividing for a portion of the height the two spans of the Parcels Office, is a partition wall K, shown in Fig. 31, and 14in. in thickness. Here the longitudinal box girders carrying the side walls are represented by a pair of plate girders whose vertical axes are in a line with those of the twin columns, supporting the table girder upon which they rest. Each plate girder—Fig. 34—is 4ft. 6in. deep at centre, has flanges composed of six plates ½in. in thickness and 2ft. wide, diminishing to one

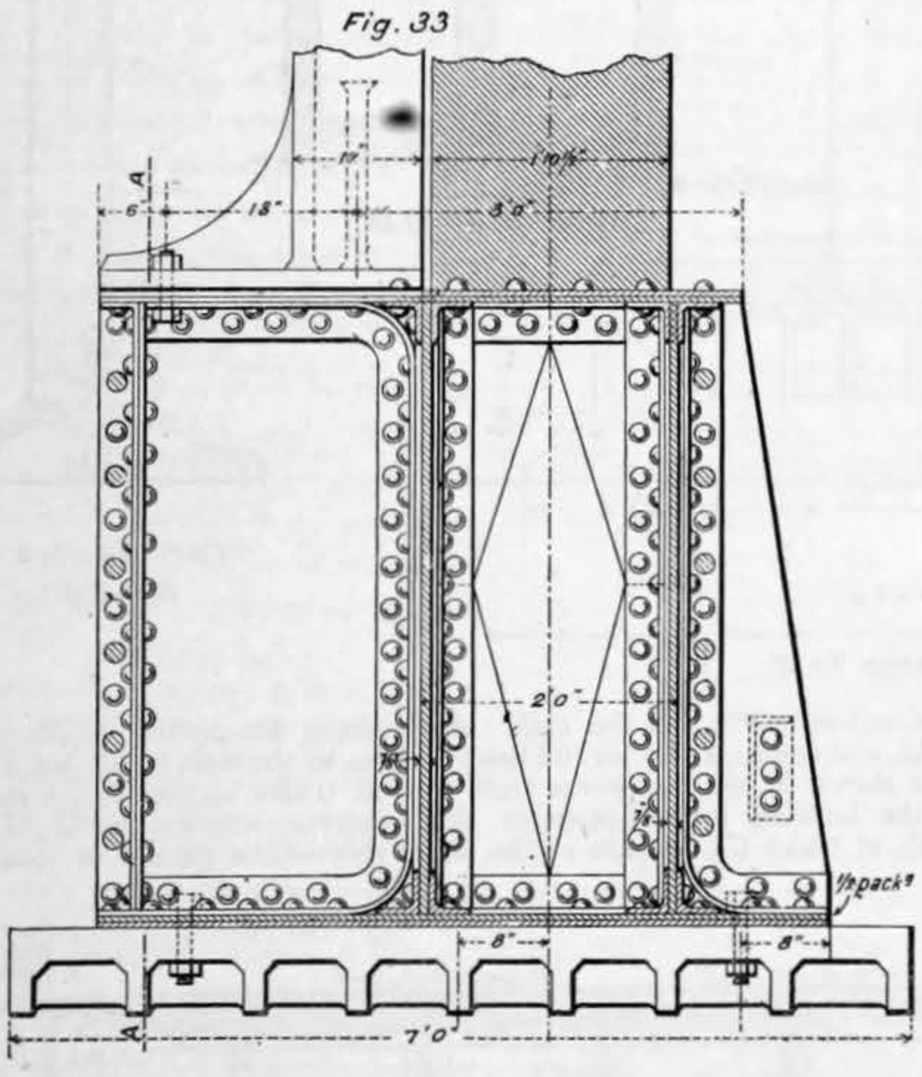
Floor girders and joists.—The general arrangement of the floor of the Parcels Office will be apparent from an inspection of the two Figs. 31 and 36. Upon the cross girders C are riveted at intervals of 5ft. apart the rolled steel joists F F, which have a depth from out to out of 8in., a width over both flanges of 5in., and a weight of 31·25 lb. per foot run. To the lower flanges of these are attached smaller rolled steel joists, spaced 1ft. 6in. apart, and having a section of 4in. by 1¾in., and a weight per running foot of 8·5 lb. Between and around this skeleton steel gridiron flooring framework is well rammed and thoroughly consolidated a mass of concrete composed of coke breeze and Portland cement in proportions of about 5 of the former to 1 of the latter. It will be seen in Fig. 36 that there is a depth of 2in. of this concrete over the larger sized rolled

Fig. 32



steel joists, and a depth of 3in. below them, forming a kind of ceiling to the under storey. While in process of ramming and consolidation the lower surface of the concrete was supported by temporary sheeting boards and props. Over the concrete is spread a layer of French asphalt 1in. in thickness, A different description of flooring is adopted for the side approaches to the Parcels Office, as will be seen on referring to the details in Figs. 37 and 38. The smaller rolled steel joists are dispensed with, and their place occupied by cast iron plates. These latter vary slightly in their dimensions, which are on an average 4ft. 8in. by 4ft. 3in. They have a dip of 2½in. and a uniform thickness of ⅝in. metal. The plates are in two lengths, Fig. 39, and are bolted together by three bolts ⅝in. in diameter. A section of the joint is given in Fig. 40. Over the cast iron plates is laid a bed of concrete, and upon it are bedded wood blocks 5in. in depth. A similar description of flooring obtains for the ramps or inclined approaches from Bishopsgate-street, but the rolled steel joists are a little

Fig. 33



heavier in section, being 9in. deep and 7in. wide over flanges.

Smoke flue.—In the general plan of the Parcels Office the letters T T T indicate the lines of track—eight in number, which all pass underneath the building at the entrance to the station, and as at certain times the engines are passing, and also standing beneath the same spot, it becomes necessary to make some provision for carrying off the smoke, waste steam, and other gaseous vapours emitted by locomotives, which we shall now proceed to describe. It must be premised that a horizontal flue, H, F—in Fig. 31—is carried the whole length of the Parcels Office, between the double longitudinal plate girders, and is built of side walls of brick, with top and bottom curved cast iron plates. This flue or smoke-hole is connected with four smoke stacks S, which are continued right up through the building to a height of about 4ft. above the ridge of the roof. In case the draught should not be sufficient to keep the station and the area below the building clear of smoke, fans can be used; but hitherto there has been no necessity for their employment. Each stack has an opening in the clear of 2ft. 3in. by 2ft., and consist of a series of cast iron plates bolted together through external flanges. Between each pair of tracks, at or near the point where the locomotives would stand underneath the Parcels Office, is constructed a smoke chamber, shown in detail in Fig. 41. There are consequently four altogether, shown in section to a larger scale with

Fig. 34

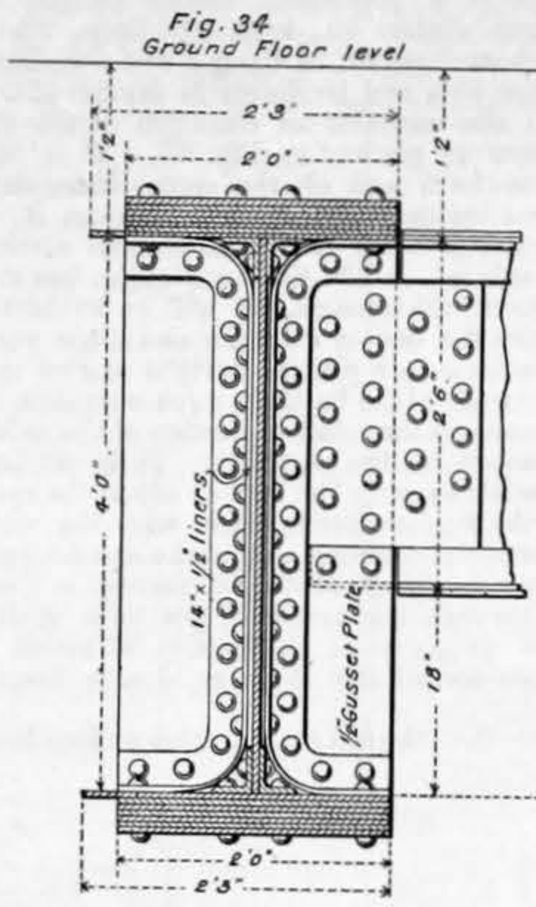


Fig. 35

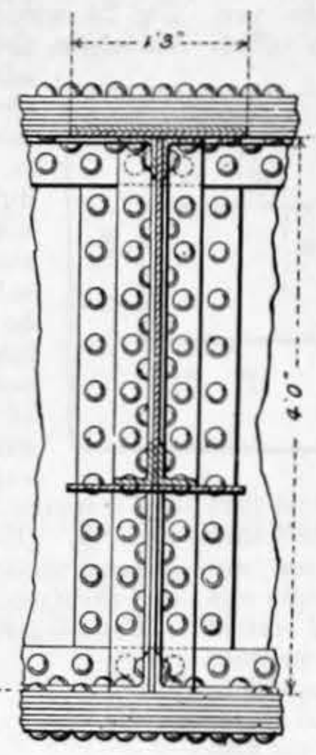
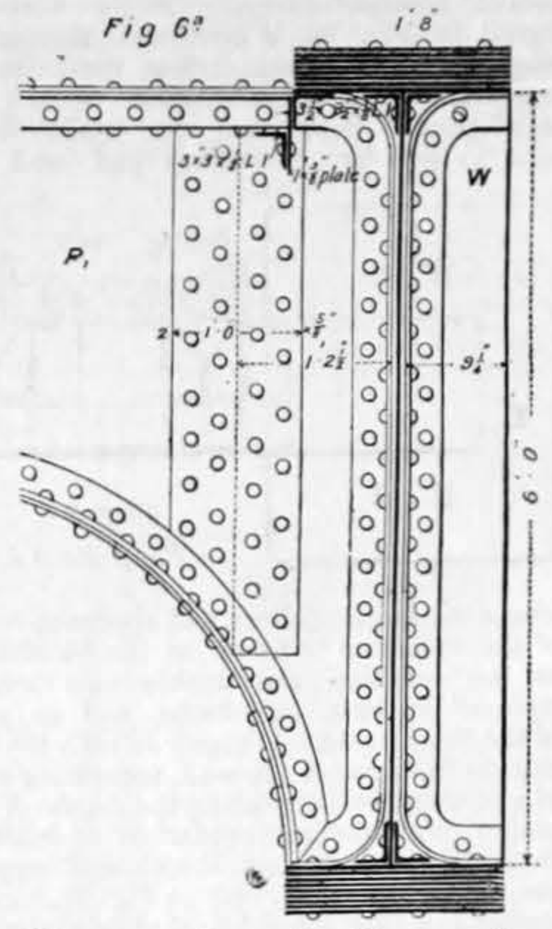
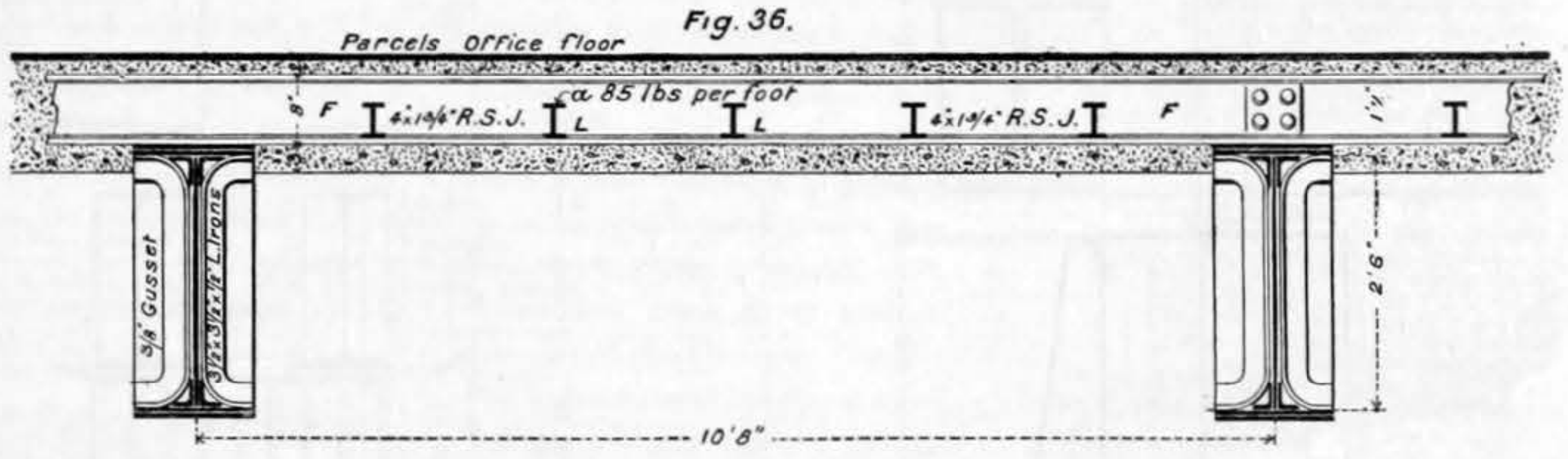


Fig 6ª



manner, which will appear on inspecting the general cross section and Figs. 1A—6A. The first of the last three figures is a cross section to an enlarged scale of one-half, or one span, of the girders and ceiling of the first storey of the building. To the top of the central stanchion is bolted a box girder P, the details of the construction of which are very similar to those already described and illustrated, for the girders carrying the flooring of the

Fig. 36.



the main longitudinal girders M, the cross girders C, and the rolled steel joists V and V_1, Fig. 41. Each smoke chamber is therefore built parallel to the main longitudinal plate girders of the Parcels Office, and occupies a space equal to the distance 10ft. 8in. between the pair of adjoining cross girders C C. Along the steel joists V, which are 14in. deep by 6in. in width, at intervals of 1ft. 2in. are rivetted tee irons 4in. by 3in. by ½in. Concrete temporarily supported as before mentioned, is rammed all round, so as to form the floor of the chamber and one wall of the smoke passages P P, in Fig. 41. The other side wall consists also of a bed of concrete 14in. deep, which connects the cross girders C C with the rolled steel joists V, having a section of 12in. by 6in. The passages P P are open to the air, and through them passes the smoke and steam of the locomotives into the chamber. From hence they find their way over the top of the main girders M into the smoke-hole, Figs. 36 and 41, from which they gain access to the horizontal flue, and finally reach the open by means of the respective smoke stacks.

Second storey.—Although it is possible that the second storey of the Parcels Office may not be subjected to loads of quite the same weight as that immediately below it, yet it is constructed in a similarly strong and substantial office. The girder P, a portion of which is shown in elevation and plan in Fig. 4A, has a depth of 6ft., a width over flanges of 3ft., and two webs ½in. thickness each. All the flange plates, the longest of which is 30ft., which

Fig. 40.

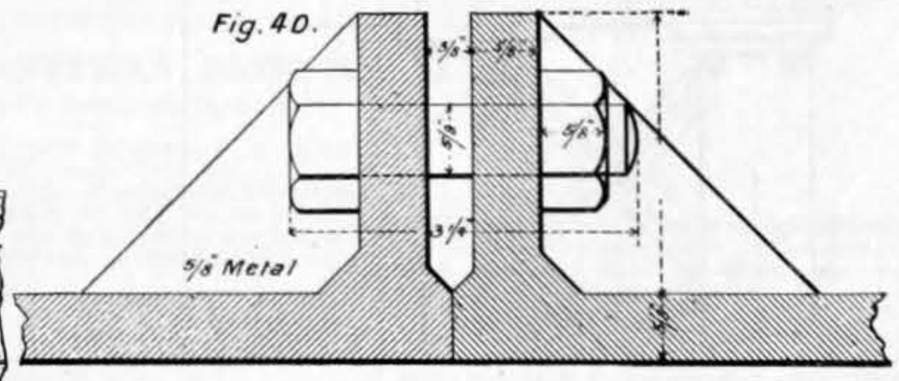


Fig 37

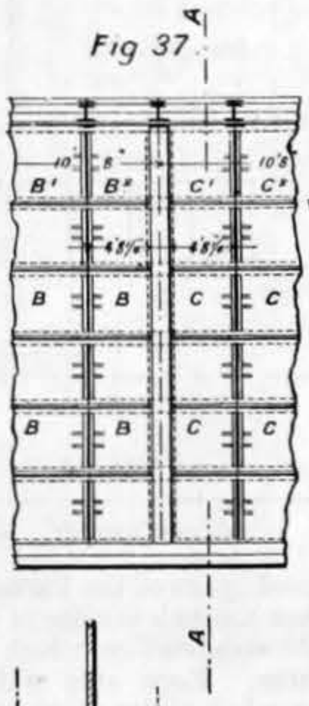


Fig. 38.

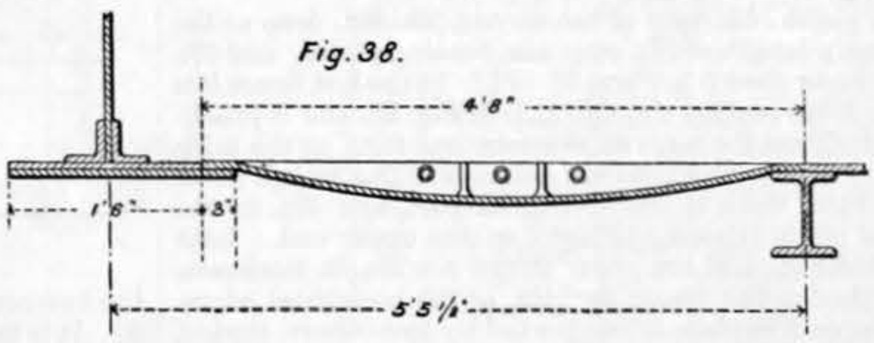
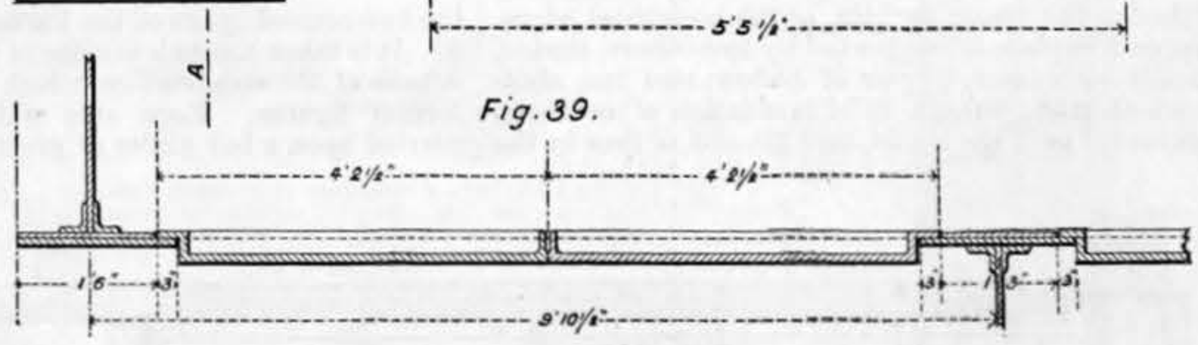


Fig. 39.



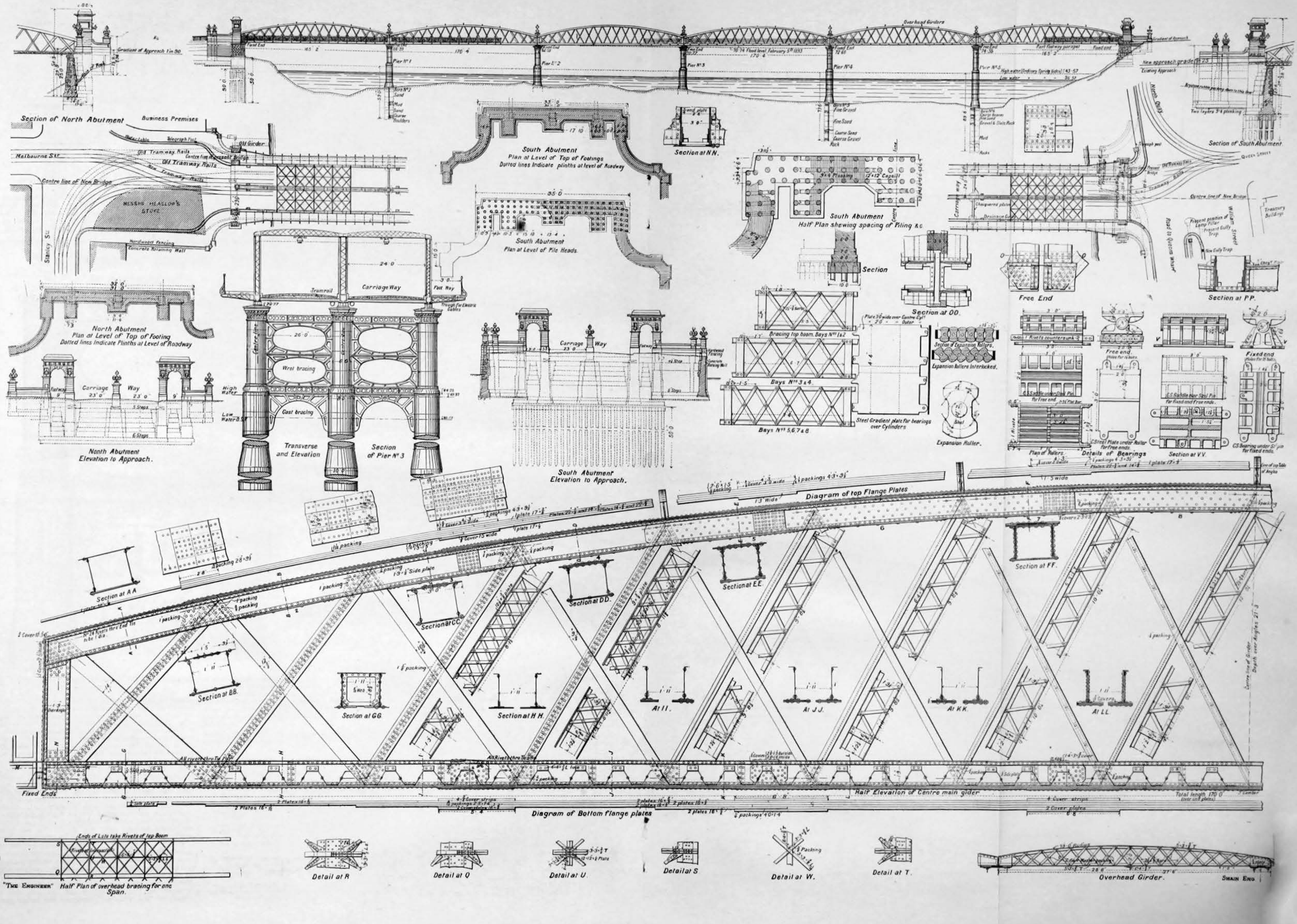
heavier in section, being 9in. deep and 7in. wide over flanges.

Smoke flue.—In the general plan of the Parcels Office the letters T T T indicate the lines of track—eight in number, which all pass underneath the building at the entrance to the station, and as at certain times the engines are passing, and also standing beneath the same spot, it becomes necessary to make some provision for carrying off the smoke, waste steam, and other gaseous vapours emitted by locomotives, which we shall now proceed to describe. It must be premised that a horizontal flue, H, F—in Fig. 31—is carried the whole length of the Parcels Office, between the double longitudinal plate girders, and is built of side walls of brick, with top and bottom curved cast iron plates. This flue or a space equal to the distance 10ft. 8in. between the pair of adjoining cross girders C C. Along the steel joists V, which are 14in. deep by 6in. in width, at intervals of 1ft. 2in. are rivetted tee irons 4in. by 3in. by ½in. Concrete temporarily supported as before mentioned, is rammed all round, so as to form the floor of the chamber and one wall of the smoke passages P P, in Fig. 41. The other side wall consists also of a bed of concrete 14in. deep, which connects the cross girders C C with the rolled steel joists V, having a section of 12in. by 6in. The passages P P are open to the air, and through them passes the smoke and steam of the locomotives into the chamber. From hence they find their way over the top of the main girders M into the smoke-hole, Figs. 36 and 41, from which they gain access to the horizontal flue, vary from two to seven in number, are ½in. thick, and are riveted to the webs by rivets 1in. in diameter through the horizontal angle irons, 4½in. by 4½in. by ⅝in. Rivets in other parts of the girder are ⅞in. in diameter, with a pitch of 4in. Plate girders W, supported like the box girder P by cast iron stanchions, carry the cross-girders P_1 at the side walls. They have the same depth of 6ft., but are only 1ft. 8in. in width, while the thickness of flange plates, angle irons, and web is ½in. throughout, but the sides of the angle irons are reduced to 4in. by 4in. The junction of the girders W and the cross girder P_1 is shown in Fig. 6A, and needs no further description. An elevation of the cross girders P_1 and a section of them are given in Figs. 1A, 2A, and 3A. They are spaced, as a rule, 21ft. 2in. apart, although this distance varies in

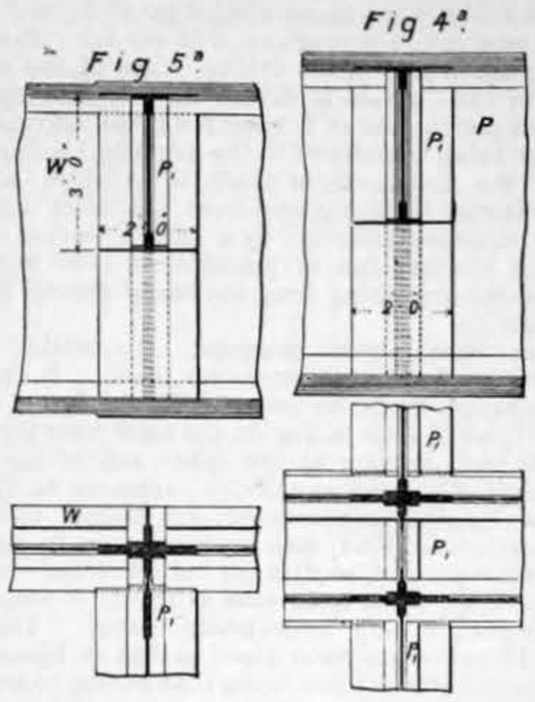
SUPPLEMENT TO THE ENGINEER, OCTOBER 19, 1894

THE NEW VICTORIA BRIDGE OVER THE BRISBANE RIVER

MR. A. R. BRADY, ASSOC. M. INST. C.E., ENGINEER



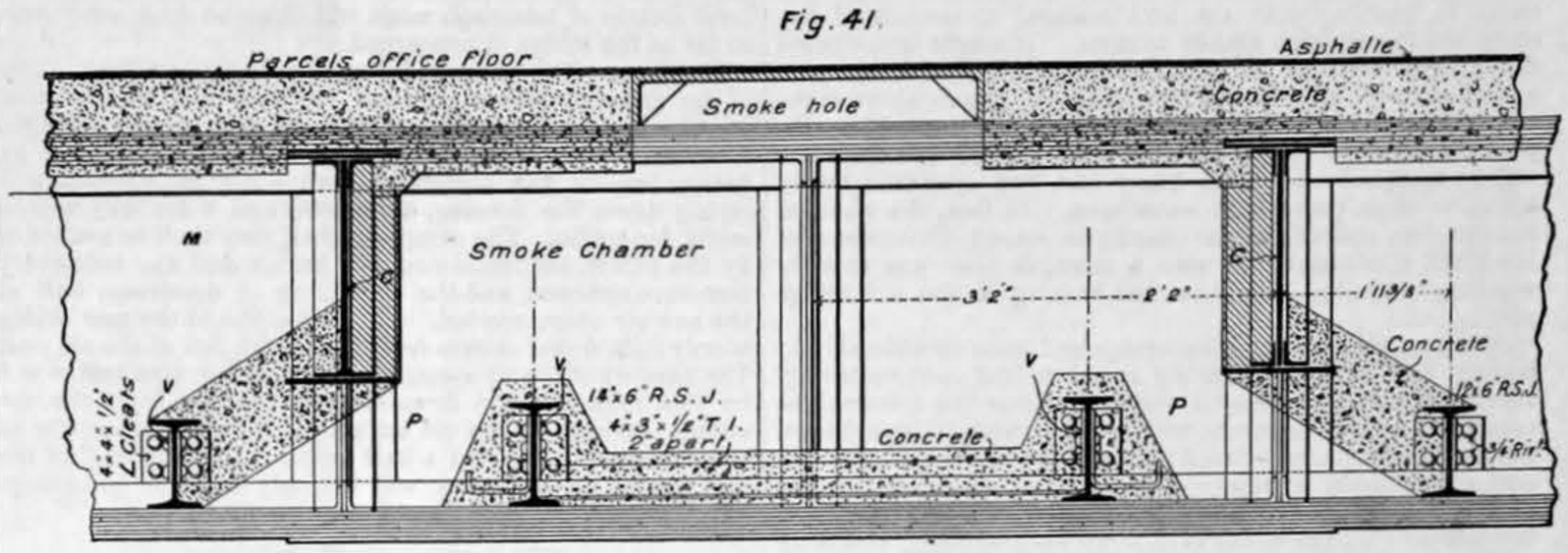
some of the bays, are 3ft. 6in. deep at centre and 2ft. in uniform width. These distances correspond with the spans of the smaller plate girders P_2, which carry the ceiling joists of timber 5½in. by 4in. To these are bolted



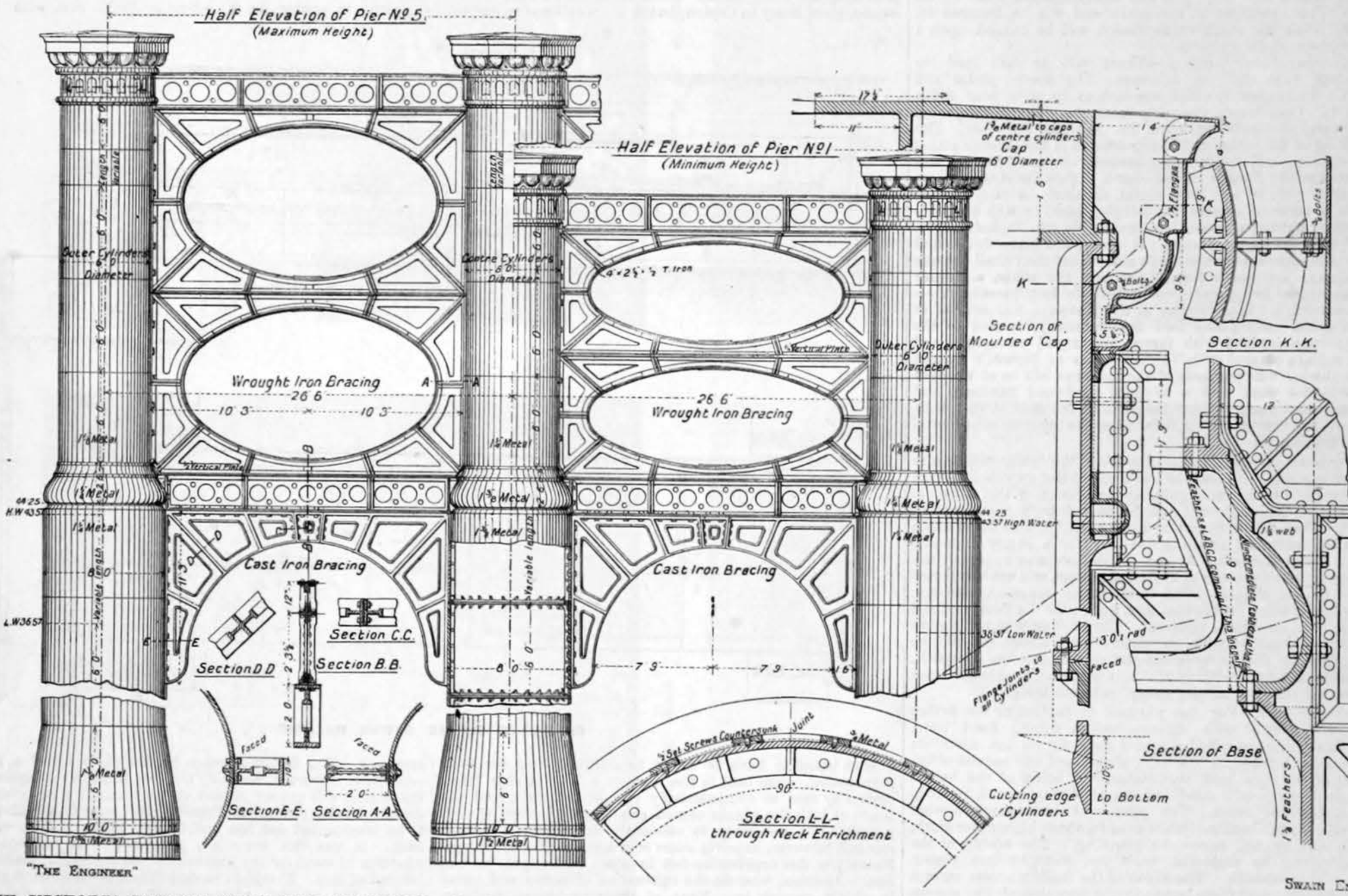
the runners 3½in. by 2½in., to which the sheathing and layer of expanded metal and plaster are attached, as shown by the strong dark line in Figs. 1A and 2A. Upon the upper storey are situated the offices appropriated to the use of the officials and employés of the company, the whole back and front ranges being divided by a corridor running the entire length of the handsome façade erected along the north side of Bishopsgate-street.

The whole of the heavy ironwork in connection with the new building was constructed and erected by the well-known firm, Messrs. Head, Wrightson, and Co., of the Teesdale Ironworks, Thornaby-on-Tees, and of 5, Victoria-street, Westminster. We are indebted to the courtesy of Mr. S. Young, of the firm, for some particulars respecting the work. In the columns, stanchions, and floor plates there were some 620 tons of cast iron used, and the box and plate girders and their accessories accounted for 1230 tons of wrought iron. The heaviest box girders weighed as much as 40 tons, and 100 tons were taken up by the footbridge. They were riveted up complete by machine riveting in the workshops, sent by special train to their destination, and hauled up bodily to their permanent site by a couple of powerful derricks. Some riveting was done necessarily on the premises, all by hand. About 130 tons of steel floor joists were fixed in position. The whole of the materials and workmanship was English, and the contract occupied about sixteen months, the work being carried out from beginning to end without a hitch or accident of any kind whatever. The six hydraulic lifts were provided from the Elswick Works.

Fig. 41.



NEW VICTORIA BRIDGE, BRISBANE—PIERS AND PIER BRACING—DETAILS



"The Engineer" Swain Eng

THE VICTORIA BRIDGE OVER THE BRISBANE RIVER.

By the two-page supplemental engraving which we publish this week, we commence the illustration of the new Victoria Bridge now being erected over the Brisbane River, from the designs of Mr. Alfred R. Brady, Assoc. M. Inst C.E. After the destruction of Victoria Bridge by the great flood of February, 1893, a sketch design for a bridge was prepared by Mr. Alfred B. Brady, who is Engineer for Bridges to the Department of Public Works, and received the approval of the Government, and also the warm commendation of Mr. John Whitton, M.I.C.E., for many years engineer-in-chief of the New South Wales Railways, who at the request of the Premier—the proposed bridge being an engineering work of much magnitude—went carefully over the design, and spent some time in examining the site and the old bridge. The preparation of the working plans was then proceeded with. Of a selection of these we now commence the publication. Invitations for tenders were issued, and a large number received by the 28th March last. The selected tender was accepted on the 10th of April last, the contract time being thirty months for completion.

The bridge will consist of six 170ft. spans, with three main longitudinal girders in each span, the whole carried upon five piers of three cylinders each. The girders will be of the hog-backed-lattice type, 22ft. deep at the centre and 10ft. at the ends, and constructed of mild steel. The cylinders will be of cast iron, and the bridge will have abutments of masonry, backed with concrete. For about half the length of each span the main girders will be braced overhead with light lattice girders and diagonal bars. One end of each main girder will be fixed on cast steel rocker bearings, but the other end will rest on expansion rollers of cast steel, and of an improved interlocking pattern. The bearings of the main girders on the abutments will rest on massive granite bed-blocks.

Brisbane, Queensland.—New Victoria Bridge over the Brisbane River. Alfred B. Brady, A.M.I.C.E., Engineer.—Tenders for the Entire Work.

	£	s.	d.
Geo. W. Kelly, Melbourne, Victoria	130,669	11	0
Watson Bros., Brisbane, Queensland	124 174	0	0
Walkers Ld., Maryborough, Queensland	121,773	6	0
J. F. Carson, Sydney, N.S.W.	120,830	14	2
Brand and Dryborough, Townsville, Queensland	119,962	18	0
Overend and Robinson, Brisbane, Queensland	118,646	8	5
J. Wishart and Sons, Adelaide, S.A.	118,494	6	9
J. Johnstone, Brisbane, Queensland	117,055	6	5
J. Jude, Adelaide, S.A.	116,895	4	4
McArdle and Thompson, Brisbane, Queensland	114 568	2	6
H. McKenzie and Sons, Prahran, Victoria	112,007	16	6
Chamberlain and Wylie, Brisbane, Queensland	111,312	2	7
J. McCormick, Melbourne, Victoria	109,932	2	0
Engineer's estimate	111,987	6	5

Alternative Tender for Piers and Superstructure only.

	£	s.	d.
J. McCormick, Melbourne, Victoria (accepted)	92,952	6	0
Engineer's estimate	94,768	1	0

Alternative Tenders for Abutments and Approaches only.

	£	s.	d.
Chamberlain and Wylie, Brisbane, Queensland	19,309	7	1
A. Midson, South Brisbane, Queensland (accepted)	16,373	16	7
Engineer's estimate	17,354	14	5

The length of the bridge between the faces of the abutments will be 1011ft. 8in., while the width between the parapets of the footways will be 73ft. The level of the roadway above high-water mark will equal 36½ft. at the north end and 25ft. at the south end of the structure, the gradient thus being 1ft. in 90ft. The level of the highest known flood in the Brisbane River, 27·17ft. above high water ordinary spring tides, was recorded on February 5th of this year. In the event, therefore, of a repetition of that disastrous inundation there would be only about 2ft. of slack water on the roadway at the southern approach to the bridge, whilst at the north end of the bridge, where the current was strongest, the roadway would be 9½ft. above the highest flood level. The surface of the roadway on the new structure will be 2ft. higher than the old throughout its length, affording a clear height or headroom above water level of 3ft. more than existed under the superstructure of the old bridge. The weight of the iron and steel work in the new bridge will be about 3265 tons, of which about 1860 tons will represent the weight of steel.

Cylinder piers.—Every cylinder, three of which form a pier, will be sunk to a hard rock foundation, each pier in the direction of the stream having a base of 63ft. Judging from borings made after the February floods, the depth to which it will be necessary to sink the cylinders will vary from 60ft. to 90ft. below high-water mark. The diameter of the cylinders from the foundation to some distance above the level of the river bed will be 10ft. At that level the diameter will be reduced to 8ft. by a tapering cylinder, and again at high-water mark a strong moulded base casting on the cylinder will reduce the diameter to 6ft. From the moulded

base to the cap the cylinders will be 6ft. in diameter. The outer cylinders will be 1⅜in. metal at the base, reduced to 1⅛in. metal above high-water mark. The centre cylinders will be of ⅛in. thicker metal throughout, in order to sustain the extra weight thrown upon the centre girders. The cylinders will be filled to the top with Portland cement concrete, and finished with ornamental cast iron caps and bases in keeping with the architectural treatment of the stone abutments and arches to same. Wrought iron riveted diaphragm bracing of great strength will connect the cylinders, each pier having four elliptical panels above high-water level, with girder ties at top and bottom. The web-plates will be pierced with ornamental design. The cylinders will be further braced with heavy cast iron spandrils firmly bolted to them below high-water level. In fact, the whole of the bracing, apart from the greatly increased dimensions of the piers, is calculated to give a strength that was entirely wanting in the light diagonal bar-bracing of the old bridge piers.

Masonry abutments.—The bridge will gain considerably in beauty and finish by having massive and architecturally treated masonry abutments and arches over the footways at each end. The abutments will be faced with O'Connelltown purple hard stone, rock-faced with margin drafts and V joints, and surmounted by heavy moulded and bracketed cornices of brown freestone. There will be solid piers and archways, the latter of a clear width of 9ft. to each footway, and lamp pillars, built in white and brown stonework, to cover the ends of the centre girder. For the wing walls a quadrant form has been adopted. The walls will run outwards from the archway piers, and terminate with square lamp pillars. The wing walls will be entirely of brown freestone, with heavy moulded copings. The lamp pillars and piers to archways will have alternating bands of brown and white stone upon O'Connelltown-stone plinths, with rusticated joints and moulded bases, copings, and seats for lamps, and moulded imposts under the arches. The arches and the piers at the arch level will be entirely of white freestone, with rusticated joints and moulded panels in the soffits and piers, the latter filled with slabs of polished ornamental granite. Surmounting these will be an entablature treated in the Doric style, enriched with details and triglyphs, and heavy splayed blocking on top. The abutment at the north end will be founded on rock, while the southern abutment will be carried upon a foundation of driven piles.

Roadways and footways.—There will be two road or carriage ways and two footways. The centre girder will divide the roadways, which are each to be of a clear width of 24ft. Cantilevers springing from the outer main girders will carry the footways, each 9ft. wide in the clear. The decking of the bridge will be constructed of steel trough plates 12in. deep, laid transversely between the main girders and riveted to the flanges of the same. This decking will be covered with tarred blue metal, finished on the surface with a layer of mineral asphalt ⅜in. thick, on which a pavement of hardwood blocks 6in. deep, with ⅜in. asphalt joints, will form the carriage-ways. It is intended that vehicles and animals approaching the north side of the river shall use one roadway, and those leaving the city the other, a similar arrangement being made with regard to foot passengers on the footways. The flooring of the footways will consist of corrugated steel plates laid longitudinally, riveted to the cantilevers, levelled with tarred blue metal screenings, and the surface covered with Val de Travers or Seyssel's asphalt 1in. thick. The parapets of the footways will be of wrought iron lattice work with a moulded hardwood handrail, and ornamental wrought iron brackets on the ends of the cantilevers, the brackets being finished at the top with ornamental cast iron finials.

Approaches.—The increased width of the bridge will require a corresponding increase in the width of the approaches. On the north side the lamp pillar at the corner of the Queen's-road and William-street will be moved back a distance of 18ft. That much of the retaining wall will be taken down and the necessary levelling done to give a better approach from William-street. At the South Brisbane approach the shops on the west side of Melbourne-street will not be affected save by the slightly-raised level of the approach roadway, but the building on the east side, known as the People's Cash Store, will have to be removed. The land on which the store is built, together with the right-of-way alongside, will be acquired by the Government and thrown into the approach, making a total width of 132ft. On the north side the tram lines will take an easterly sweep on to the bridge.

Fender piles.—For the purpose of protecting the bridge against contact with floating *débris* during flood time, fenders will be provided opposite each pier on the upstream side. Each fender will be of Λ shape, and will consist of five piles driven to a hard foundation, and being of the height reached by the 1893 flood, and sheathed with muntz metal up to high-water mark. The piles will be strongly braced together, and sheathed on the outside, above high-water mark, with 9in. by 3in. hardwood planking. The nosing of the fenders will be protected with ½in. wrought iron plates, 2ft. 6in. in breadth. The width of the fenders across stream will be 10ft., and their length in the direction of the stream 20ft. In order to reduce the contraction of the waterway to a minimum, the fenders are to be placed in crescent form, the clear space between them and the bridge varying from 28ft. to 68ft.

Lighting of the bridge.—Gas fittings are to be provided for the lighting of the bridge, but if it should at any time be decided to employ the more modern illuminant, they will be suitable for carrying electric lights. The lamps to be used will vary from 20 to 50-candle power. The approaches will be lit by a four-light lamp on each pillar, carried upon ornamental cast iron standards, and on each side of the archways there will be two lanterns fixed to the walls with ornamental wrought iron brackets. At each intersection of the outer girders, over the piers, there will be three-light lamps on ornamental cast iron standards for the lighting of the roadways and footways. In addition, in the centre of each span in each roadway will be suspended a 50-candle power lamp, attached to the overhead lateral bracing by means of an ornamental bracket. Gas will be supplied to the lamps by service pipes from the companies' mains, half the supply being drawn from the city side and half from the south side of the river.

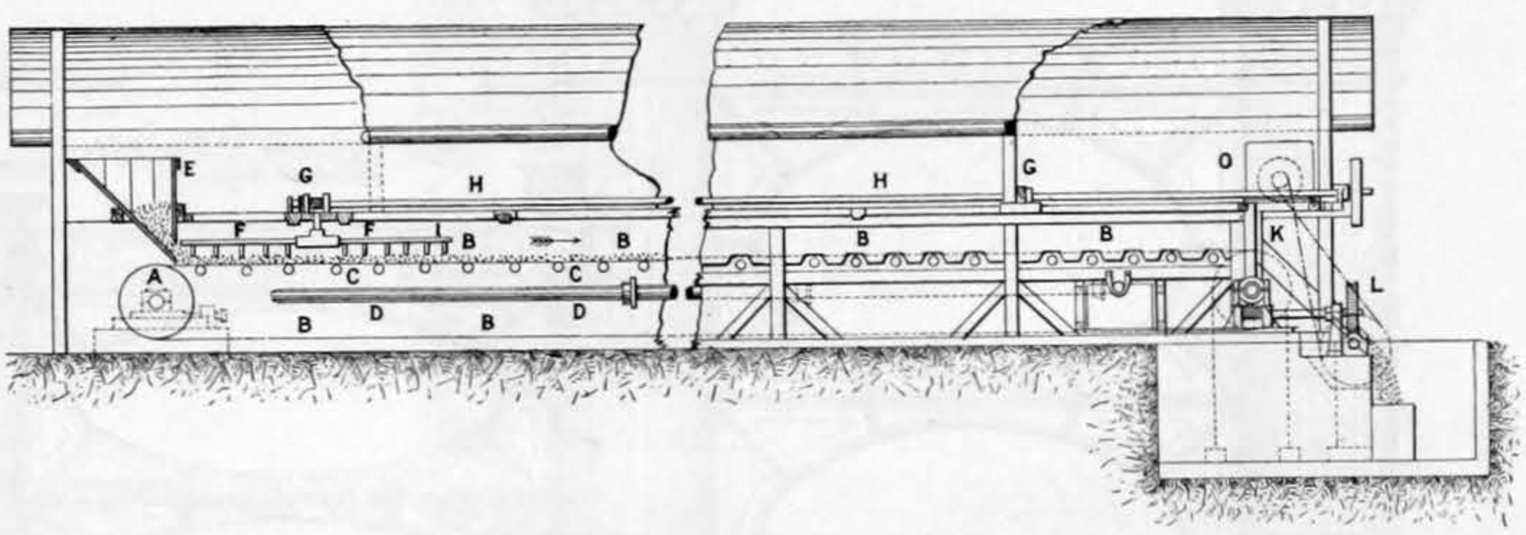
Water pipes, tram lines, and telegraph and telephone cables.—Provision is made to carry water across the bridge by means of two riveted steel 12in. pipes suspended beneath the decking on each side of the centre girder. The Brisbane Board of Waterworks will supply the pipes, which for the sake of convenience will be placed in position by the contractor for the bridge. In the same way the contractor will put down the tram lines, the Metropolitan Tramway Company providing rails and all other necessary material. The tram lines will be laid in each roadway alongside the centre girder. The cost incurred under these heads by the Bridge Board will be refunded by the board of waterworks and the tramway company. Close to the parapets and below the surface of the footways will be wooden troughs, in which the electric telegraph and telephone cables will be laid. The unsightly overhead system of telegraph wires will thus be done away with so far as the bridge is concerned.

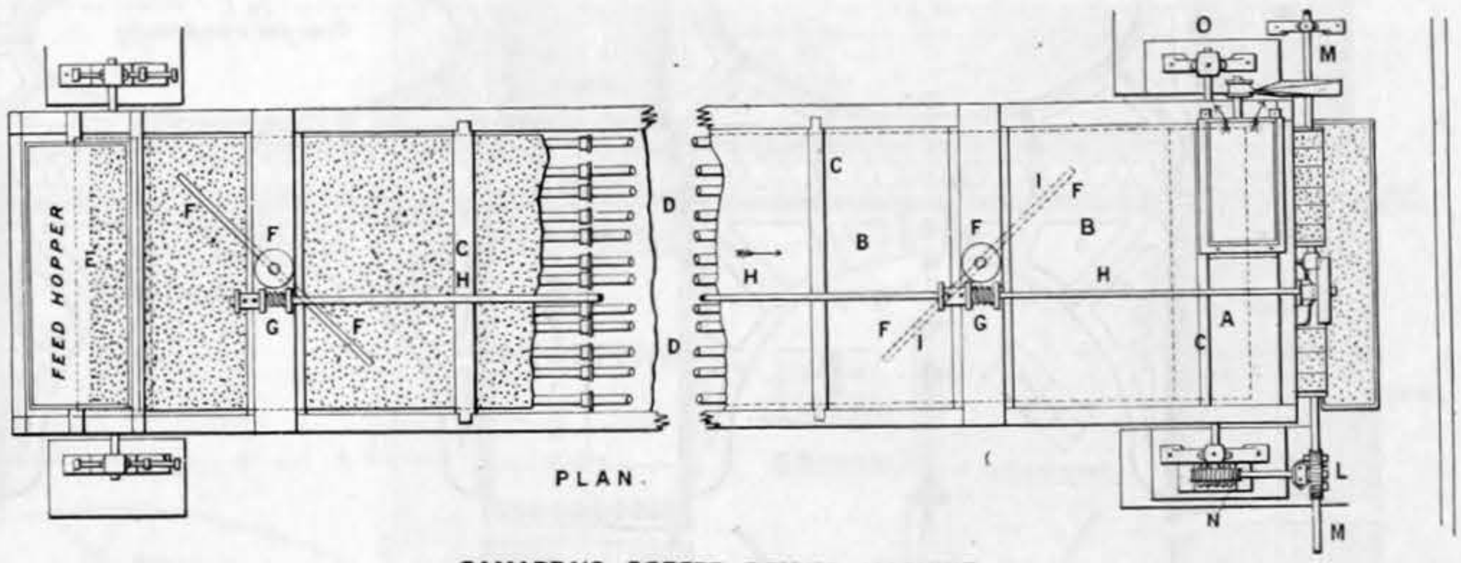
Building.—The bridge is being built in two sections. Two of the three cylinders required for each pier will be sunk on the east or down-stream side of the existing bridge. This will carry one-half of the new structure, and by fixing two of the girders of each span in position and laying down the flooring, a roadway and a footway will be ready for traffic. The completed half may then be availed of by the public, the remaining old bridge and the temporary structure removed, and the remaining or up-stream half of the new structure erected. The centre line of the new bridge is only 32ft. down stream from the centre line of the old one. The parapet of the up-stream footway of the new bridge will be 18ft. removed in a down-stream direction from the up-stream parapet of the old bridge. Although the work is to be completed in two and a-half years, it is expected that the first section of the bridge will be ready for traffic in twenty-one months from the date of the contract.

COFFEE AND CACAO DRYING MACHINERY.

The preparation for market of many items of tropical agricultural production differs materially in several important respects. Those the harvesting of which is in the leaf may usually be subjected without injury to rapid and intense heat, while such as are of the character of beans need to have their moisture expelled far more gradually. Partaking of the nature of these last are the fruits of the coffee and cacao trees, from the second of which the ordinary so-called cocoa of commerce is prepared. Not alone does the difference in the required treatment to which we have above referred exist, but the method of applying it varies in the different countries producing the same plants. Both coffee and cacao, for instance, grow freely in Ceylon, but it is exceptional in respect to that island to have to resort to artificial heat for their preparation. Sun heat in the eastern colony is only interrupted by rain at comparatively regular intervals, and the beans of both the plants named can be safely given the exposure to it necessary to efficiently dry them. Irregular rainfall, however, deprives other countries of this advantage. Notably is this deprivation felt in some of the provinces of South America, wherein the cultivation of coffee and cacao is widely carried on. None of these provinces, perhaps, suffer more seriously from this irregularity than does that of Ecuador, and it is a machine designed by a planter of that province that we were recently afforded an opportunity of seeing in action. Its object, as may be inferred from the foregoing remarks, is to cure the beans, both of coffee and cocoa, by artificial heat, so as to avoid the risk of damage during the drying process which would arise from unanticipated rainfall.

SECTIONAL ELEVATION.





GAMARRA'S COFFEE DRYING MACHINE

The machine illustrated is one of six that have been constructed in this country for shipment to Ecuador by Messrs. Bowes, Scott, and Western, of the Phœnix Wharf Works, Battersea, upon the design of Mr. Juan Gamarra. Its total length is 60ft., and its width 7ft. In its main feature it is a box of these dimensions, built of light iron plates fastened on a framework of either wood or iron. This box is without any internal divisions throughout. Over the drums A A, and given motion to by them, passes an endless band B B B B of woven copper wire of the full width of the containing box or casing. The band is supported at frequent intervals upon transverse rollers C C, while its edges pass along grooved slides extending for its whole length. These slides serve to keep the beans from falling off the band. Below this last a system of hot-water pipes D D is provided. The beans are fed on to the band while in motion through the transverse hopper E, which has its lower orifice so arranged as to ensure delivery of a uniform thickness of charge—usually some 2in. to 2½in.—upon it. The band carrying this layer of beans moves forward in the direction shown by the arrows. During its passage the beans are kept stirred by the stirrers F F, there being six of these throughout the length of the machine. A slow circular motion is imparted to these by the worm gearings at G G G, driven by the shafting H H. The prongs upon the radial arms I I are so disposed throughout the system as to ensure that the whole mass of beans should be repeatedly turned over during its travel to the point of its discharge at K, and so permit the free permeation throughout it of the heat from the pipes, ensuring uniformity in the drying. One of the drums over which the band passes is driven at very slow speed by the screw and pinion gear at L upon the main driving shaft M, the power being transferred to the drum by similar gearing at N. On the intermediate shaft is provided a coupling, whereby it may be disengaged from the main driving shaft and the machine actuated by a handle worked by manual power. A circular fan is provided at O to withdraw the damp heated air arising from the beans during the process of drying.

As has been above remarked, the motion given to the carrying band is extremely slow. It is computed that four hours should be occupied by the beans to be dried from the time of their falling on the band from the hopper E to that of their delivery at the other end of the machine. This time is calculated as sufficient exposure to the heat of the hot-water pipes to thoroughly dry them. It is approximately estimated that each machine can so prepare two tons of beans per day, so that the output of the whole battery of six machines, equal to 12 tons daily, would suffice for the production of a very large estate indeed. The inventor prefers the use of hot-water pipes to that of heated air for a very sufficient reason; this being that having to trust largely to unskilled labour, less risk is run of excessive heating by this method than might result from the employment of that second-named. The power required to drive this seemingly heavy piece of machinery is singularly small. On trial we found this to certainly not exceed half a horse-power, and it was manifest that manual labour could be readily availed of if necessary. We believe it to be Mr. Gamarra's intention to work the whole battery of six machines in line, motion to be given to the driving shafts when coupled up by a mule whim.

From what we heard, these machines are, relatively to their size, very inexpensive, though we have not obtained data sufficient to enable us to estimate their cost with full accuracy. The design appears calculated to afford a large amount of efficiency, while its freedom from any complicated machinery will ensure almost entire immunity from breakdown. In the journey to Eucador, the machines will have to be transported for the last twenty miles of it on mule-back. It was this necessity, no doubt, that induced the adoption of wood for the frames of these particular machines instead of iron. The light roofing shown is designed to guard against the cooling effects of the heavy rains we have named to be so constantly and unexpectedly experienced in Ecuador.

The Development of Field Artillery Fire.—Major Hughes. Royal Artillery Instructor in Field Artillery, read a paper on October 11th, in the theatre of the Royal Artillery Institution, at Woolwich, on "Oakhampton Experiences in 1894," followed by a discussion, in which Colonel Marshall, Chief Instructor of Field Artillery, Colonel Ollivant, R.H.A., and others took part. Without going into the question of fire discipline, which has of late years been developed to an extent which makes artillery fire under service conditions much more formidable than in former years, we may notice one or two features. Success in hitting has been naturally greatly increased, not only by competition and prizes, but by the adoption of various devices to enable the guns to be fired under known conditions as to range and length of force, such as the deliberate advance of officers and markers under favourable circumstances, to take up position for each gun, and ascertain all possible data before the guns come into action, as well as the use of range finders, and of systematic trial firing, not independently, but for the benefit of the battery. On the whole, it has been felt latterly that we have fallen into the mistake of giving too much weight to the effect of infantry fire at long ranges. Tables showing the results of experiments made as to modern infantry fire at dummy guns and men certainly bore out the conclusion that at ranges over a thousand yards it would be absurd for guns to sacrifice any advantage obtained by exposing themselves to infantry fire. As compared with continental Powers, it appears that both the French and Italian field artillery fire more quickly than our own, owing to the circumstance that they carry shells forged, but in the still more important matter of success in hitting under service conditions we appear to compare favourably with them.

GREAT NORTHERN RAILWAY WIDENING WORKS, KING'S CROSS

(*For description see page* 342)

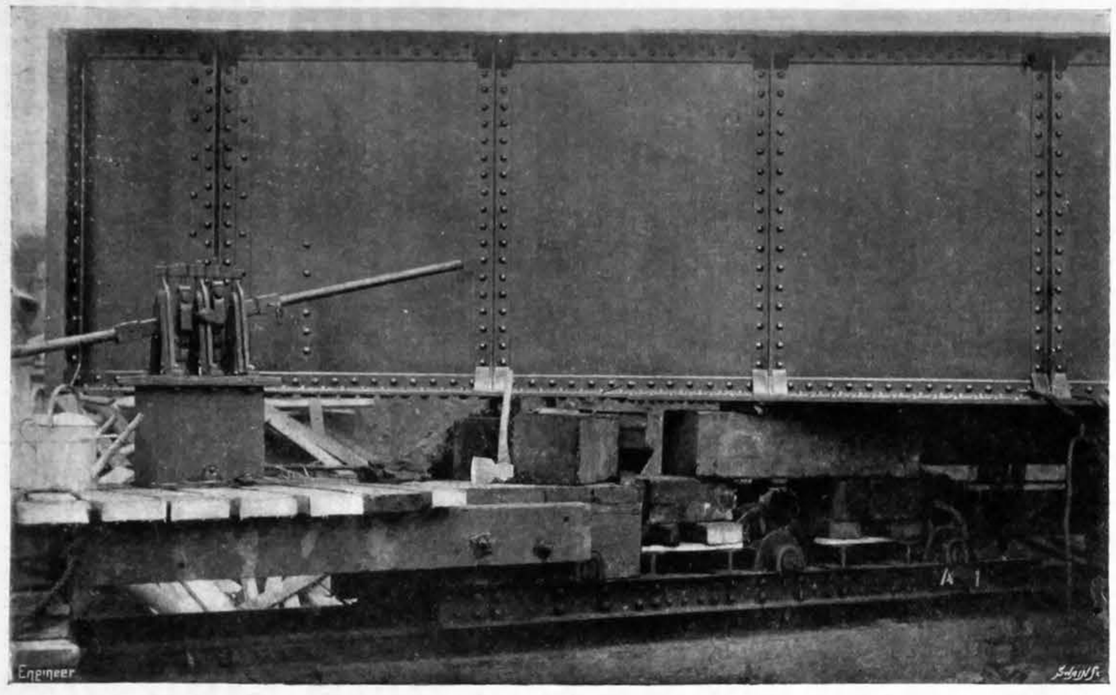


Fig. 5—VIEW OF STEEL TROLLEY AND ONE PUMP

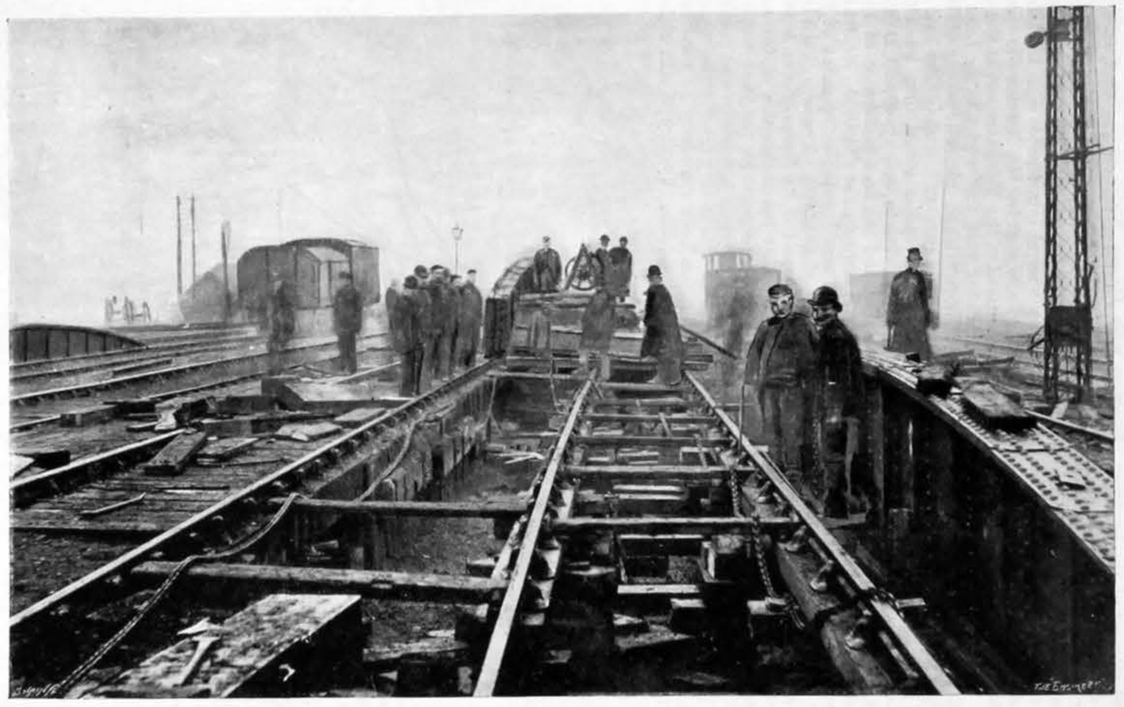


Fig. 8—HAULING SECTION OF BRIDGE TO ITS BEARINGS—SHOWING TRENCH PREPARED TO REVERSE STEELWORK

Fig 4—THE EASTERN SECTION BEING HAULED INTO POSITION

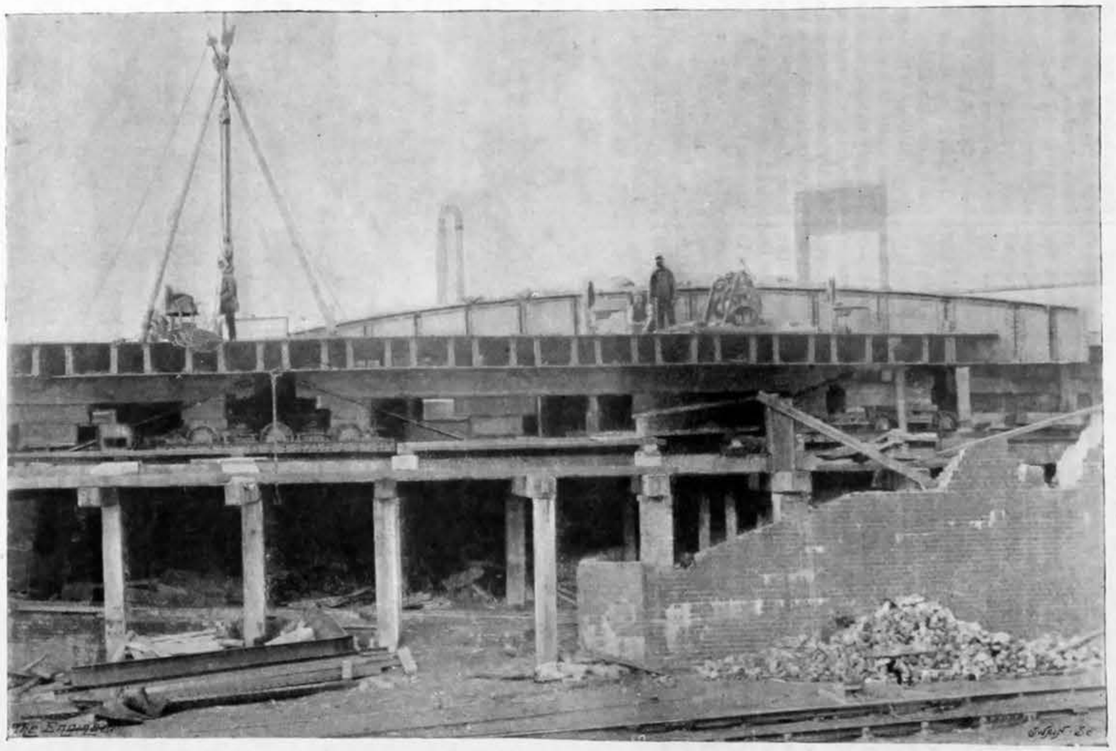


Fig. 2—PART VIEW OF GANTRY AND SECTION OF FLOORING

THE MANCHESTER THIRLMERE WATERWORKS

No. I.

On the 13th inst. the inhabitants of Manchester, and of the district supplied with water from the Corporation reservoirs, entered into possession of the heritage for which they have been working for the last seventeen years. On that day the water from Thirlmere was turned on through a fountain in Albert-square, opposite the Town Hall.

Dr. Tatham, the late Medical Officer of Health, told the Corporation that, "if they would give the city a plentiful supply of water he would be responsible for the health of its inhabitants." Seeing that Manchester is now in a position to command at will a supply of water three times as large as she has hitherto enjoyed, the position of Medical Officer of Health must either be a very pleasant or a still more onerous one for the present holder; at any rate, the Council and ratepayers have placed the responsibility on his shoulders. To accomplish this an immense amount of work has had to be done. As is well-known to our readers, the late Mr. J. F. Bateman, F.R.S., was for many years the chief engineering adviser to the Corporation of Manchester on the question of water supply. He it was who designed and carried out the extensions to the waterworks, and made the Longden Dale Valley the chief source of supply. The Act for this scheme was obtained in 1847, and the works commenced in the following year. The original works have been added to from time to time, and a service reservoir in connection with them was completed only ten years ago.

The valley lies about twenty miles east of Manchester, and the drainage area covers 19,300 acres on the western slopes of the Pennine Range, varying from 500ft. to 1900ft. above Ordnance Datum. From this source Manchester was enabled to draw some 25,000,000 gallons daily, in addition to providing the compensation water demanded.

From these sources the city of Manchester has drawn its supply up to the present, and, in addition, has supplied the inhabitants of Salford and many other suburban towns, as well as the North Cheshire Water Company. The whole area, extending to upwards of eighty square miles, is supplied by gravitation. The total population provided for amounted to about 1,000,000 persons. The authorities outside the city were charged 7d. per 1000 gallons.

Prior to 1847 the water supply of Manchester was obtained from the limited sources of the Manchester and Salford Water Company, who had works on the river Medlock, now one of the foulest streams in the kingdom. These works were obtained from Sir Oswald Mosley, formerly Lord of the Manor of Manchester, and were added to by the construction of works at Gorton, and augmented by a supply from the Stockport Canal. The cost of the above works, including land, reservoirs, pipes, &c., has been £533,561; Longden Dale Works, £2,610,126; total, £3,143,126.

In 1851 the water was first delivered to Manchester from Longden Dale. The supply from the old works was about 3,500,000 gallons a day; but need for a supply of purer water in ample quantities was soon manifested in a largely extended demand, so that in a few years three times as much water was required. So long ago as 1868, Mr. Bateman sounded a note of warning, stating that the time during which a sufficient supply could be obtained from Longden Dale was limited. No action seems to have been taken until 1874, when, in a report, Mr. Bateman estimated that the annual increase and demand would be at the rate of 1,000,000 gallons a day, and could not be procured in the Derbyshire district. The Waterworks Committee and the Town Council generally took the matter up vigorously in 1875. At that time it was found that in dry weather the consumption was nearly 10,000,000 gallons a day, whereas the supply could only be reckoned at from 24,000,000 to 25,000,000 a day. Allowing for but little annual increase, before long the demand would exceed the supply. This was a serious matter, and required dealing with without delay. Mr. Bateman was called upon to report. He found that the districts east of Manchester had been absorbed to provide for the requirements of the populations near them, and advised that there was no district which could supply a sufficient quantity nearer than the Lake district of North Lancashire, Westmoreland, and Cumberland. He in the first instance recommended Ullswater as the head of the supply, and it being known that the town of Liverpool was in want of additional water, it was proposed that a single aqueduct should be constructed from Ullswater to Chorley, branching from thence to Liverpool and Manchester.

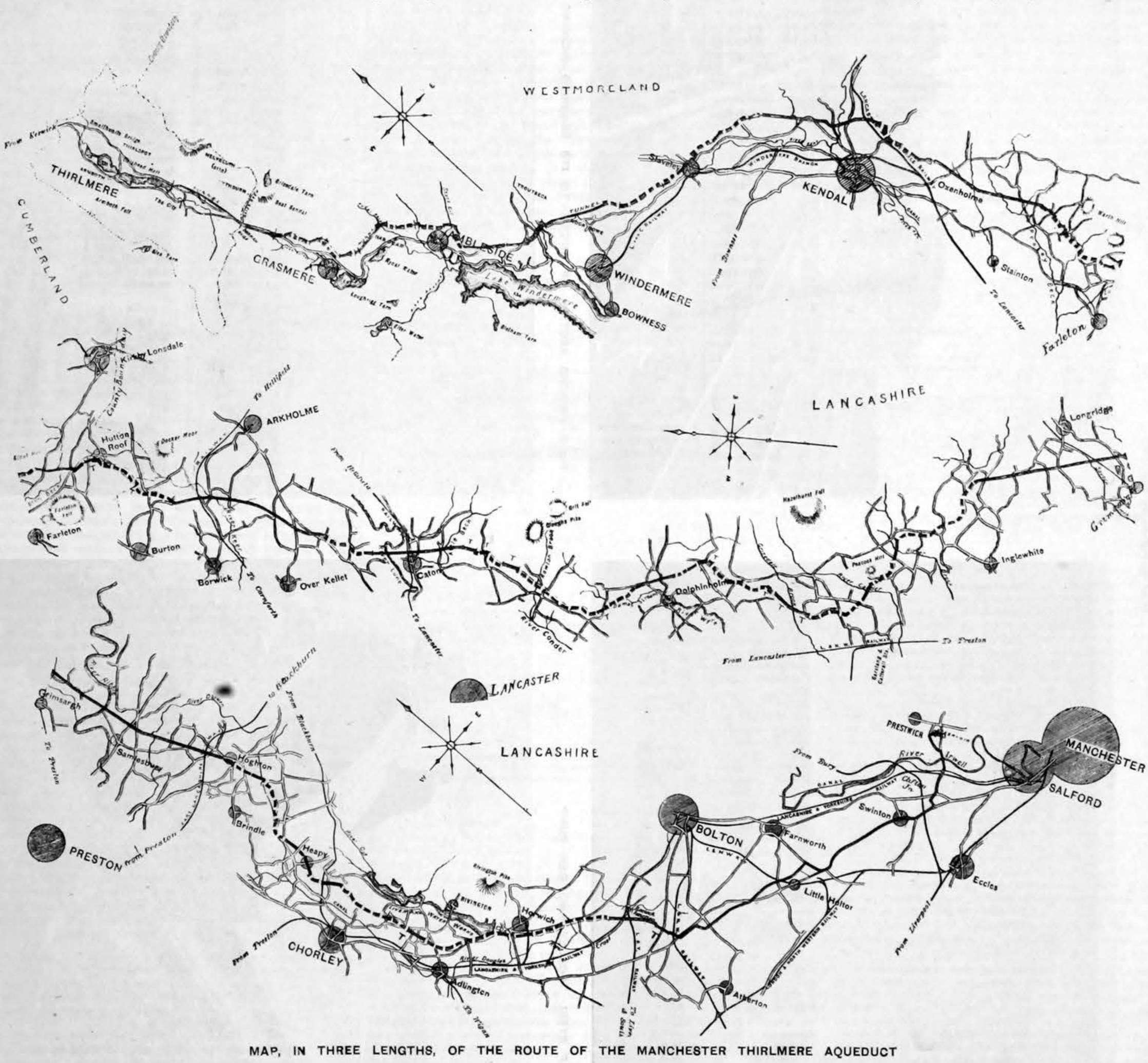
By adding the area of Hawes Water to that of Ullswater, it was estimated that a supply of 80,000,000 gallons a day could be obtained. To provide storage capacity it would only be necessary to vary the level of Ullswater 12ft., viz , 5ft. above, and 7ft. below the ordinary level of the lake. Hawes Water would have required raising 25ft. It would not, however, have been necessary to interfere with Hawes Water until the supply reached 55,000,000 gallons a day. The distance from Ullswater to Chorley is seventy-nine miles, the latter place being eighteen miles from the service reservoirs at Salford. No doubt it was the slight interference with the land on the margin of Ullswater that led Mr. Bateman to recommend this scheme instead of the Thirlmere one at the onset.

It was estimated that the works in the Lake district, and as far as Chorley, for the ultimate supply of 80,000,000 gallons a day, would cost £2,210,000. The half share to be incurred by Manchester would thus be £1,105,000, and the further works, to convey 40,000,000 gallons a day for ten miles, and the first instalment of 10,000,000 gallons a day was estimated at £346,000. Each additional 10,000,000 gallons would require 29½ miles of pipes, at an estimated cost of £352,000. The area of the Ullswater Lake is 2243 acres, and of its drainage area 36,000 acres.

It is understood that the authorities of Liverpool and Manchester had this proposal for the joint water supply under consideration, but no agreement was reached. On economical grounds this is very much to be regretted, for in the interval it has been necessary to construct large works for each city. The Vyrnwy Works of Liverpool are second only to the Thirlmere Works of Manchester, in the length of the conduit, and in both cases large costs have had to be incurred at once, in order that an increased supply may be obtainable in time to come when required. Had this capital expenditure been divided between the two cities, the present saving to the ratepayers would have been considerable. When it was found that the scheme was required for Manchester only, Thirlmere was selected as being a more suitable lake, and in every respect better fitted for the purpose. It is 56ft. higher than Ullswater, namely, 533ft. above O.D., is 335 acres in extent, and has a drainage area of 11,000 acres.

Mr. Bateman's report states that the ground is "exceedingly steep, yields beautiful water, and lies close to, if not in the heart of the heaviest rainfall. In the same year in which 65in. of rain fell at Hawes Water, 81½in. fell at Thirlmere"—an increase of 30 per cent. The estimated cost of Thirlmere to supply Manchester only was £170,000 less than if the supply was drawn from Ullswater.

On this page we give a map of the route of the Thirlmere Manchester Aqueduct. To enable us to give this map to a useful scale, it has been necessary to divide it



MAP, IN THREE LENGTHS, OF THE ROUTE OF THE MANCHESTER THIRLMERE AQUEDUCT

into three lengths. The three parts are accompanied by cardinal point indicators, so that the direction of the parts forming the ninety-five miles of aqueduct made of tunnel, pipe, and cut and cover work, may be seen. To show the relative positions of the first, second, and third parts the name of the towns Farleton and Grimsargh are repeated.

The reservoirs in connection with Longden Dale are as follows:—

Collecting and Storage Reservoirs at Longden Dale.

Name of reservoir.	Area	Capacity.	Depth.	Height of top water level above Ord'nce Datum.
	Ac's.	Gallons.	Ft	Ft. in.
Woodhead	135	1,181,000,000	71	782 0
Torside...	160	1,474,000,000	84	651 3
Rhodes Wood	54	500,000,000	68	574 6
Vale House...	63	343,000,000	40	503 0
Bottoms	50	407,000,000	48	486 0
Arnfield	39	209,000,000	52	540 3
Hollingworth	13	73,000,000	52	554 9

Service Reservoirs Supplied from the Storage Reservoirs

Name of reservoir.	Area	Capacity.	Depth.	Height of top water level above Ord'nce Datum.
	Ac's	Gallons.	Ft.	Ft. in.
Godley	15	61,000,000	21	478 0
Denton, No. 1	7	30,000,000	20	321 6
,, No. 2	6	23,000,000	20	321 6
Audenshaw, No. 1	80	528,000,000	27½	340 0
,, No. 2	69	371,000,000	22⅝	323 0
,, No. 3	102	542,000,000	22⅝	323 0
Gorton Upper	34	123,000,000	26	259 0
Gorton Lower	23	100,000,000	29	244 0
Prestwich	4½	20,000,000	22	347 0
Total	854½	5,985,000,000		

A table was appended to the report giving the levels of various English lakes as under:—

Levels of English Lakes.

	ft.	
Hawes Water	694	above O.D.
Thirlmere	533	,, ,,
Ullswater	477	,, ,,
Buttermere	331	,, ,,
Crummock Water	321	,, ,,
Derwent Water	236	,, ,,
Bassenthwaite	226	,, ,,
Grasmere	208	,, ,,
Wast Water...	204	,, ,,
Rydal Water	181	,, ,,
Coniston Water	147	,, ,,
Windermere...	134	,, ,,

WATER-TUBE BOILERS.—Mr. James Howden, of forced draught reputation, has challenged all makers of water-tube boilers to a thirty hours' trial, conducted by neutral experts, of the respective merits of cylindrical and water-tube boilers. The points to be determined are:—(1) Weight; (2) space occupied; (3) evaporative power; (4) economy, and 5th, waste of heat. The challenge is particularly directed at the Belleville boilers. The stakes are to be the expenses and cost of the boilers.

THE GREAT WESTERN RAILWAY AND THE SOUTH-WEST.—The Great Western Railway has arranged to run on and from Thursday, 1st November—Wednesday midnight—a new train from London to Plymouth for the accommodation of passengers, parcels, horses and carriages. The train will leave Paddington at 12.15 a.m. midnight daily, Sunday midnight excepted, and reach Exeter at 6.15 a.m. and Plymouth at 8.25 a.m, calling at Reading, Didcot, Swindon, Bath, Bristol, Taunton, and Newton Abbot, where it will connect with the 7.30 a.m. train, thence to Torquay and the Dartmouth Branch. The facilities thus afforded will enable business men to reach the West of England with the least possible expenditure of valuable time, the journey being performed during the night, and the new train will no doubt be largely appreciated, particularly as it has been decided to provide sleeping accommodation for first-class passengers. Passengers for Truro, Falmouth, and intermediate stations to Penzance, will proceed from Plymouth at 9.25 a.m., and the time allowed at that station will enable them to have breakfast before completing their journey. A through coach for Oxford will be provided on the new train from Paddington, and will be attached to a new train for Oxford, which will leave Didcot at 1.50 a.m. An additional train will leave Oxford at 1.10 a.m. for Didcot, where it will connect with the new midnight train from Paddington for the West. On and from the 1st November, the company will also run a new express merchandise train from Penzance to London, which will provide for the delivery of merchandise traffic from Cornwall in the metropolis on the day following dispatch. The new train will leave Penzance about 4.0 p.m. daily, Sundays excepted, and it will convey, either from the stations direct or from Truro and Plymouth—to which places feeder trains will be run—traffic from all intermediate stations and branches.

THE HULL AND DISTRICT INSTITUTE OF ENGINEERS AND NAVAL ARCHITECTS.—The first meeting of the present session, 1894-5, was held on Monday evening, the 15th inst., at the Parochial offices, Bond-street, the President, Mr. F. H. Pearson, being in the chair. After the usual preliminary business, which included the election of several new members, was completed, the President delivered a short inaugural address. During the course of his remarks, Mr. Pearson alluded to the extensive adoption of water-tube boilers for marine purposes, especially in vessels now being built for H.M. Navy. Though this type of boiler has only recently been introduced into British boats, it has been extensively used by the French for some years, nearly 100 of their war vessels being thus fitted, and at the present time twenty-four more vessels for that Navy, as well as nine for the Russian Navy and seven new Messageries Maritime steamers are being fitted with them. The British Government has given orders for upwards of thirty of the new vessels to be fitted with water-tube boilers, and several private firms are also trying them, so that it almost seems as if this type had come to stay, although the old tubular or Scotch type will die hard. The use of aluminium in shipbuilding was also commented upon, but the present cost of production is almost prohibitive. The prolonged and costly strikes that have taken place in different parts of the country during the year, the changes that have recently taken place in Hull shipping firms, and the present condition of the engineering and shipbuilding trades, were also dealt with. Following on his address, Mr. Pearson read a further paper on "The History of Hull Steam Shipping," the period being 1840 to 1850. The various descriptions of the vessels, launches, accidents, time of passages, rates of freight and passage money, wages, steamship companies, and the trade of the port in general during this period being most interesting and in many cases amusing, the whole showing that an immense amount of time must have been spent in research to secure such a complete record. The meeting closed with a vote of thanks to the President for his paper and address, moved by Mr. J. Spear and seconded by Mr. F. Somerscales.

THE PARIS METROPOLITAN RAILWAY.

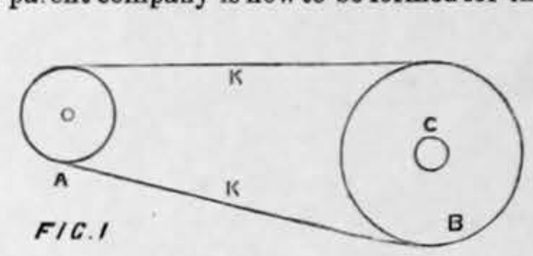
THERE seems to be little doubt now but that the underground railway in Paris will soon be put in hand. After being discussed for twenty years past, it has become absolutely necessary that something should be done to improve the facilities for passenger traffic in the city, since, unless the work is at once entered upon, it will be quite impossible to deal with the enormous traffic that is expected to take place during the period of the Exhibition of 1900. So far, the difficulties have arisen chiefly from the conflicting interests which seemed to place the project beyond the pale of settlement. The Government was in favour of the railways in Paris being constructed and worked by the great companies whose lines already serve the capital, while the municipal council insisted upon the metropolitan being taken over by a separate syndicate. It was only upon condition that the lines should be purely local that the council approved of the extension of the Sceaux Railway to the Place Medicis, which will be put in service in a few months, and the prolonging of the Moulineaux line to the Esplanade des Invalides, of which the works are now being carried out. The council likewise approved of the project for constructing the Berlier tubular tramway from the Bois de Boulogne to the Bois de Vincennes, and this project is now being considered by the Railway Commission of the Chamber of Deputies. If therefore the Government and the Municipal Council could come to an understanding there was every probability of the scheme being carried out, and it seems, indeed, as if the difficulties in this respect have been overcome. After having examined the systems at work in England, M. Barthou, the Minister of Public Works, has drawn up a plan which has just submitted to the Municipal Council with a view of securing from that body a free grant of land necessary for the building of the lines, and an exemption from octroi duty upon the material used in their construction. The project of M. Barthou seems to be the more serious, as it is less ambitious than the schemes previously under consideration. He does not propose to carry out the whole scheme at one operation, but is in favour of constructing two lines, one from north to south, and the other from east to west. When these are completed, it is expected that no difficulty will be experienced in a further extension of the system. The line traversing the city from north to south will leave the northern railway which communicates with the Ceinture, and passing the Nord and Est stations, will touch the Central Markets and will emerge from the tunnel at the Hotel de Ville; it will then take an easterly direction to cross the Seine, and, after passing the Halle-aux-Vins, will enter the tunnel under the Boulevard Saint Germain, and on reaching Cluny will turn to the right to join the Sceaux extension at the Place de Medicis, by which it will be again in communication with the Ceinture. The railway from east to west will utilise the high level line from Vincennes as far as the Gare de Lyon, and, passing by the Gare d'Orleans, will communicate with the north to south line at the Halle-aux-Vins. The section to Cluny will be used in common by both transversal railways, and from Cluny the east to west line will go by another tunnel to the Esplanade des Invalides, whence it will use the Moulineaux line as far as the Champ de Mars Station, at which point it will be connected with the Auteuil line near Muette. The total length of new lines to be constructed will be 15 kiloms, without counting the existing lines that will be used in the system. The cost of carrying out this work is estimated at four millions stetling. The railway companies are to have control of those connecting lines that already exist, but a separate syndicate is to be formed for working the railways to be constructed. As showing the utility of the proposed system, it may be mentioned that since the Compagnie du Nord connected its terminus with the Ceinture the number of passengers travelling between the Ceinture and the Gare du Nord during seven months has increased from 184,000 to 1,060,000.

LONDON ASSOCIATION OF FOREMEN ENGINEERS AND DRAUGHTSMEN.—The usual monthly meeting of this society was held in the K-room of the Cannon-street Hotel on Saturday, the 3rd inst., at 7 p.m., when, in the absence of the president, the vice-president, Mr. R. J. Cook, occupied the chair. After the usual financial and general business was over a paper was read by Mr. H. A. Parker, past-president, on "The City and South London Electric Railway."

BRISTOL CHANNEL INSTITUTE OF MARINE ENGINEERS.—A few years ago, mainly owing to the exertions of Prof. A. C. Powell, D.Sc., and the hospitality of the local University College, a branch of the Institute of Marine Engineers was established in Cardiff—the first branch, it is claimed, set up outside London of any of the professional societies which have the metropolis for their home. Under the title of the Bristol Channel centre, the new association gathered members from Newport, Swansea, and the neighbouring ports, held periodical meetings for the reading and discussion of papers of the same character as those presented to the parent Institute, and in course of time succeeded in making itself a place among the institutions of the district second only to that of the South Wales Institute of Engineers. On Saturday the winter session was opened with the annual dinner, at the Royal Hotel, and members and their guests reached the large and unexpected number of 350. Dr. Elliott, president of the Bristol Channel centre, was in the chair, and there were present the principal and several of the professors of the University College, a large number of engineers, marine and mechanical, and representatives of the shipping interest, together with Board of Trade and Lloyd's surveyors, and Mr. James Adamson, hon. sec. of the Marine Engineers' Institute in London. Dr. Elliott gave an interesting account of the growth and prosperity of the local centre, in responding to "The Institute of Marine Engineers," proposed by Dr. Maccormack, who claimed for this branch of engineering science that it had progressed fifty per cent. more than any other department, and that with the diffusion of knowledge by the papers and discussion of societies like these, it was no longer possible, as in 1867, for a man like Randolph, the maker of compound engines, to say to Mr. Denny, when asked for information, "Go and find out for yourself, and pay for it." A tribute to the services rendered to the Institute by the University College was paid by Mr. Adamson, the London honorary secretary, who mentioned that the local centre was increasing at such a rate that it was possible next year they would have a home and dining hall of their own. Principal Viriamur Jones, who replied for the College, claimed that technical education was being pressed forward in Glamorganshire and Monmouthshire, and particularly in Cardiff, in a manner which would compare favourably with any other part of the kingdom, while the engineering department of the College was being rapidly developed, and the practice of the profession taught to a large number of students. Next week the College would receive the great testing machine, which had cost £3000, and if only a fine building were given them, the authorities would soon challenge comparison with anything that had been done in any part of the world. An adequate building would require a quarter of a million sterling, and it was their intention to ask Government for a grant of £100,000.

BICYCLE MECHANICAL ENGINEERING.

THE makers of the modern "cycle" have afforded mechanical engineers some useful hints in the construction of wheels and small bearings, and perhaps on other points in the construction of light machinery and the machine tools used for the purpose, but every now and then some of the bicycle makers do things and make things which detract very much from their reputation as mechanicians, and make us forget their services. Not long since some firms brought out an elliptical chain wheel for the crank spindle, and it was said that somebody or some shareholders paid a good deal for the patent for this beautiful device for obtaining a variable radius coincident with the variable push on the pedal. When we were explaining the fallacy of this thing to an ardent young cyclist but learner of mechanics at one of the cycle exhibitions, the exhibitor, who loudly claimed for the invention the advantages of greater speed and easier work, seemed to think we were anticipating the adverse proof which was later to be afforded by experience. He did not like the explanation. The last new cycling invention, for which very great things are claimed, is also to secure greater speed with less labour. The claims appear to have about as much to support them as the oval wheel had, and we would not mention this latest mechanical offence were it not that the names of one or two firms usually associated with well accepted machines are mentioned in connection with it, and a parent company is now to be formed for the development



THE ORDINARY AND THE NEW CYCLE GEAR

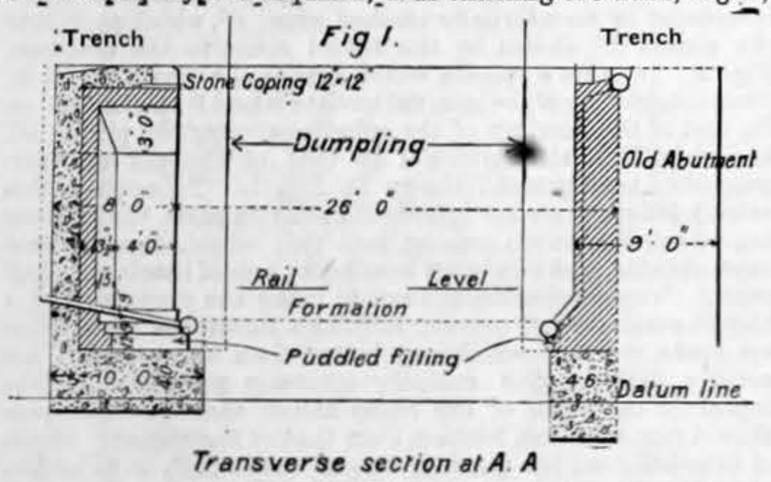
and working of the patents for this thing. It is known as the Boudard gear, and our readers will be almost sufficiently informed to satisfy themselves of the validity of the extraordinary claims made for it, when we tell them that the ordinary single chain wheel on the crank spindle of a bicycle is to be replaced by an internally geared wheel which drives a pinion on a second spindle, the other end of which carries the still necessary chain wheel, but reduced in size. The following diagrams will illustrate the difference. Fig. 1 represents the ordinary simple arrangement with a chain wheel B on a crank spindle C, and by the chain K driving a pinion A on the driving wheel hub. This is about as far as simplicity and directness can go. The Boudard gear neither wants nor has either of these qualifications usually regarded as so desirable in mechanics. In this remarkable device greater mechanical efficiency is obtained by adding to the mechanism by which a given end has hitherto been attained. Fig. 2 shows the arrangement. The chain wheel B of Fig. 1 is replaced by an internally toothed wheel B^1, which gears into the pinion B^2, shown by the dotted circle in the diagram, Fig. 2. It is on a spindle which carries the chain wheel B. Thus the friction of the internal toothed wheel B and the pinion B_2, and of the bearings of the spindle carrying the pinion B^2, and wheel B is all additional to that of the old common patentless arrangement shown in Fig. 1. To acquire this extra friction, there are introduced as extra parts, the internal cog-wheel, the pinion gearing into this wheel, the separate extra spindle, and one extra bearing or pair of bearings or ball races. Why these additions are to make the propulsion of a bicycle easier is not shown, although numerous statements are made, none of which are better than those which are usually used in the ordinary company prospectus. One ingenious supporter of the cause shows that internal gear should run with less friction than that of the ordinary forms of externally cogged gearing, but as that which is to be displaced by the new gear contains neither internal nor external gear, and as the internal gear of the new thing is altogether additional, the proposition as to more or less friction has not to be considered. It seems incredible that such things can be put forward, not only seriously, but in the expectation of attracting large sums of money from the public.

GREAT NORTHERN RAILWAY.—WORKS IN CONNECTION WITH THE WIDENING OF THE LINE AT KING'S CROSS.

IN consequence of the extensive alterations the company have made to their terminus at King's Cross in the way of extra platforms and offices, it has been found necessary through the same occupying room used as sidings, to provide accommodation at Holloway for purposes of making up trains, storing and cleaning coaches, and other work incidental to the general passenger traffic formerly done at the terminal station. In order to carry out the new arrangement, trains of empty coaches have to be taken from the terminus and returned, after being cleaned, &c, at the new sidings. This, as a matter of course, increases the number of trains going to and from the points mentioned above. As the ordinary passenger service is already very heavy, any blocking of the line to enable a train to pass from the down to the up side on the same level would be a serious inconvenience to the working of the trains, and in misty weather, not unattended with some risk. To avoid any such inconvenience, the company have determined to cross from the one side to the other by means of a short subway, parallel with one already existing, and which is used for the service between the North London and Great Northern Railways. It was difficult to construct this subway, and still keep the traffic going without interruption, the most difficult being that part on the eastern side, and forming the approach to the goods and coal shunting sidings.

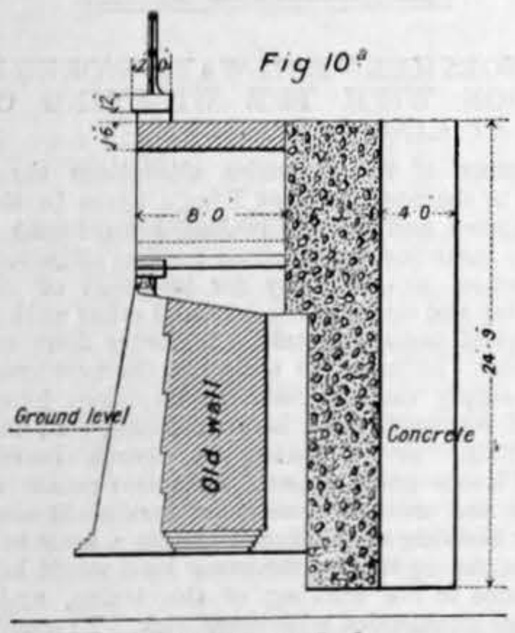
The means adopted to meet the different requirements were as follows: Before doing any part of the permanent structure a

platform of timbers, 8in. by 8in., with an average length of 14ft., was laid under the rails, forming the approach to the sidings directly over the line of the new abutment and also the pier, and some 15in. square longitudinal timbers under each of the main lines. In addition to the longitudinals, cast iron girders were put between the roads with cross timbers under the 15in. longitudes, placed 8ft. apart, as in consequence of the angle of skew, the bearing of the timbers would have been 21ft., although the width of the trench on the square only measured 12ft. In executing the work this proved a great convenience, as no propping of timbers under the lines of way was required, thus enabling the walls, Fig. 1,



Transverse section at A. A

to be carried up to bedstone level without any stoppage. The trenches for the new abutment and strengthening the existing one were then proceeded with and the wall built to coping level. The new abutment is a combination of brick and concrete, the strengthening of the old one being all in brick. They are both faced throughout with Staffordshire blue brick,



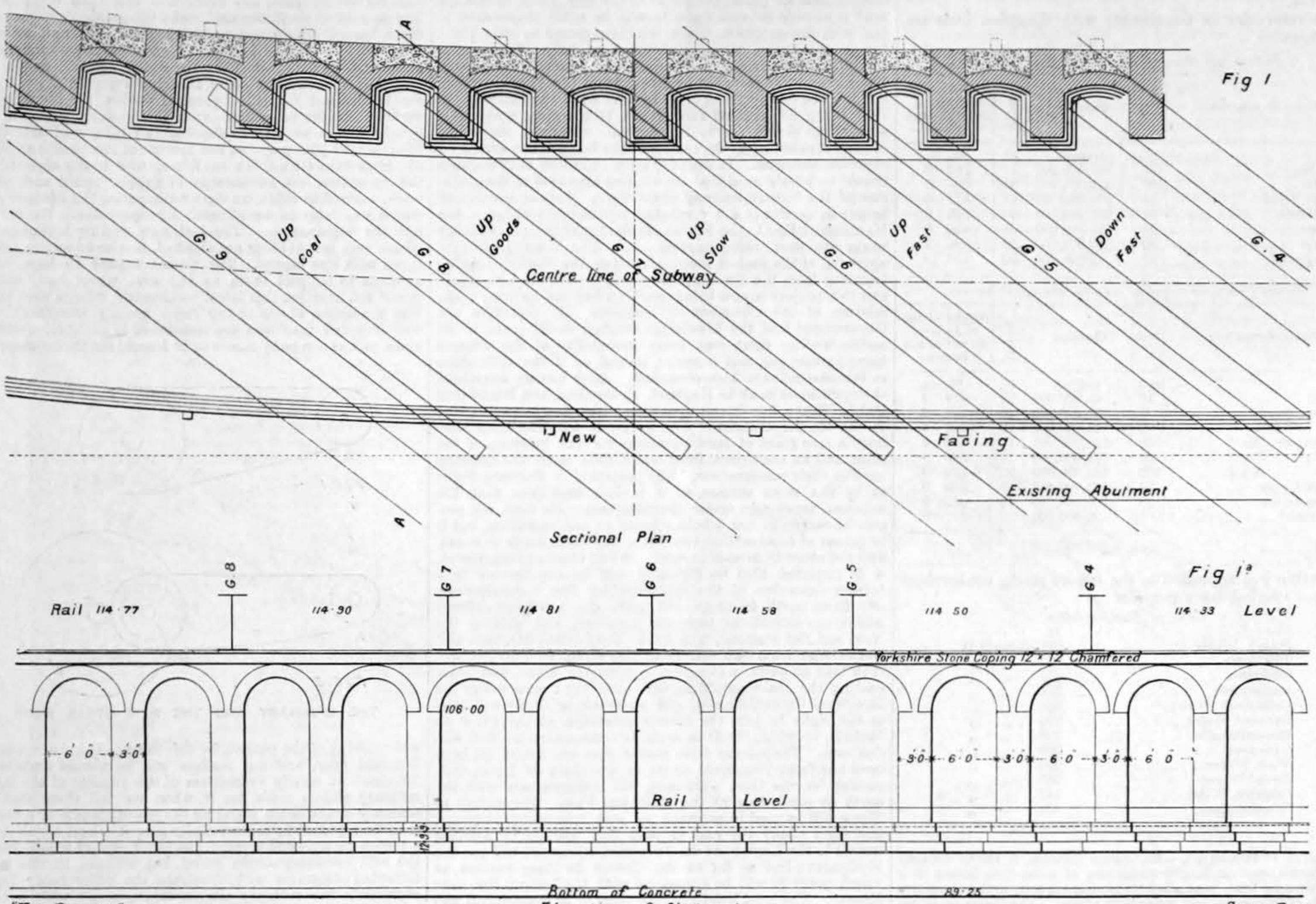
Section at A. A.

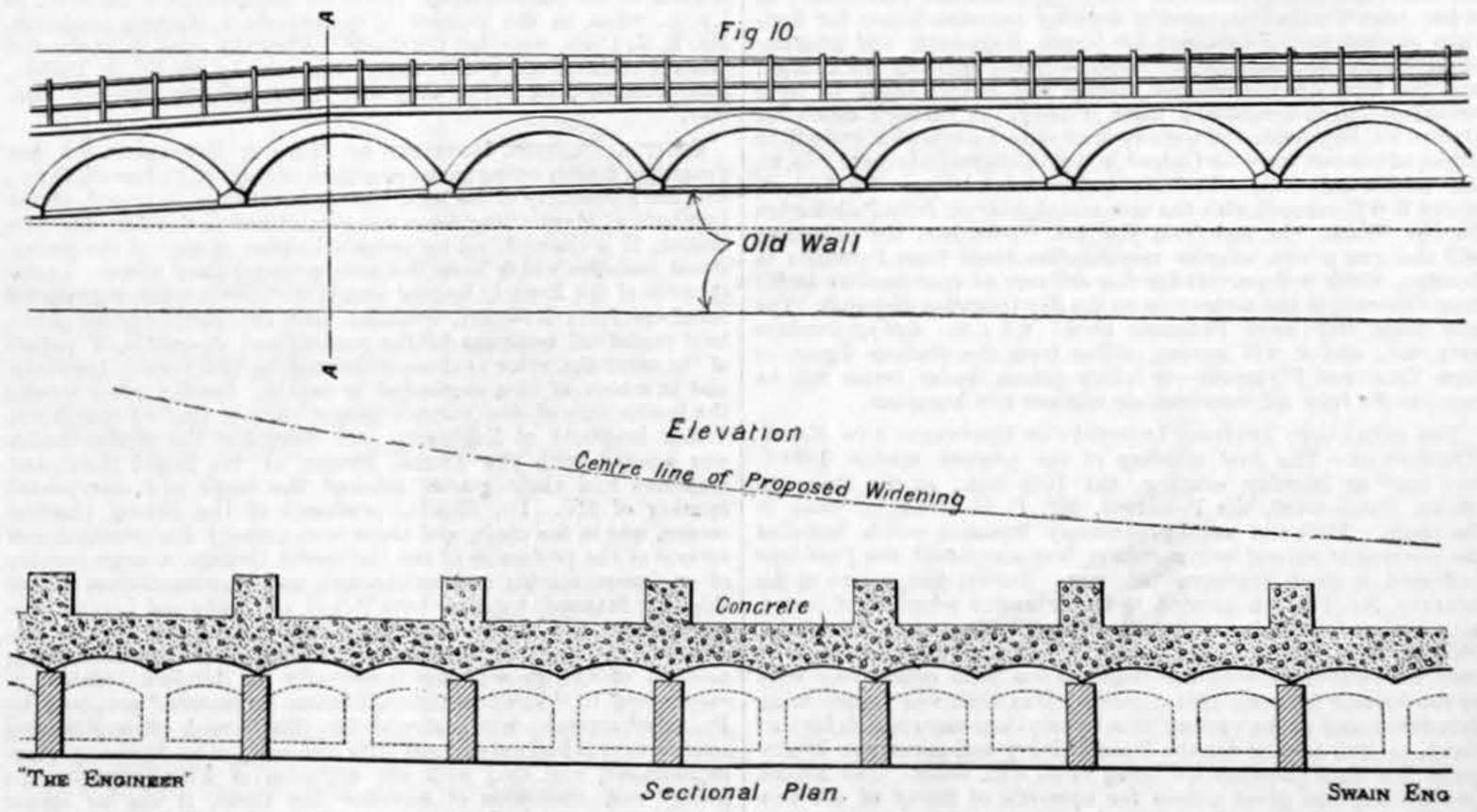
and all the work is set in Portland cement mortar. On the completion of the masonry, the timbers carrying the rails were packed on to the walls and all the cast iron girders removed and trenches cut to receive the permanent steelwork.

As the lines forming the approach to the shunting sidings could not be closed for many hours, and then only on Sunday, a gantry was constructed on the east side of the line—as shown on the plan between A and B. On this eight steel trollies, each carrying two hydraulic jacks, were placed, four on a side, and trussed bearers laid on the jack heads, to form a continuous bed for the steel flooring, as shown by the Figs. 2 and 3. The set of eight jacks were connected with a hydraulic pipe worked from one pump fixed on the end trolley—a view of one of these pumps is given in Fig. 5. The steelwork was then put together, and all riveted up, painted, and asphalted. This portion has an average length of 110ft. by 29ft. wide, and weighs about 200 tons. The time for running it into its final position was fixed for a Sunday, between 8 a.m. and 5 p.m. The heaviest part of the work was taking up the temporary timber flooring, which amounted to 1500 cubic feet, and excavating 300 cubic yards of earth, the materials to be removed representing 500 tons nearly, exclusive of permanent way. The new steelwork was drawn forward by three winches, the earth and timber being removed as the bridge came forward. When in position for lowering on to its bed the pressure was applied, the wedges on which it rested removed, and the whole thing lowered on to the bedstones. The ballast was then distributed, and the rails laid ready for the early Monday trains. The cost of this portion of the superstructure amounted to £18 16s. per ton of steel work fixed.

The remaining section carrying the eight main lines is constructed with ordinary plate girders, with flooring formed with steel troughing. Three methods of erection had to be resorted to in carrying out this part. The first line dealt with was a siding, which could be given up for some days without much inconvenience. The girders for this, together with the flooring, were erected *in situ*—no special feature in the operation presenting itself. The second line being a through goods could not be closed for many hours, therefore this section was put together by the side of the line at C, and when completed the lines were removed and the earth cleared away down to bedstone level, and the steelwork drawn into position and bolted to the part already fixed. This work was performed between 8 a.m. and 1 p.m. The third, fourth and fifth, being the down slow, down fast, and up fast passenger lines, had also to be done quickly. These sections were put together by the side of the line, as shown by Fig. 6, and drawn across to their respective lines, as shown by Figs. 7, 8, and 9, and then transferred to their bearings, the lines being taken up and the ground being excavated, while each portion of bridge was being transferred from the site of erection. The remaining three sections, consisting of the up slow passenger and the two up goods lines, were put together *in situ*, but as the lines could not be stopped for many hours, they could only be erected by degrees, the main girders being put on to their bearings on one Sunday, and the trough flooring in between fixed on succeeding ones. The cost per ton of steelwork fixed in the first portion was £18 4s.; for the second, £17; for the third, fourth, and fifth, £16 12s.; and the sixth, seventh, and eighth, £18; so that building the bridge-work by the side of the line and hauling it into position proved to be the less costly, and interfered with the traffic the least.

The whole of the bridge-work is steel, the main girders being plate and I section. The flooring is made with corrugated





troughing, 8½in. deep and ⅛in. thick. The troughs are filled in with asphalte concrete, with the upper surface covered with J. Cliffe's patent fibrous asphalte. All the bridge-work was made and erected by Messrs. A. Handyside and Co., of Derby.

After passing through the subway described above the lines take a sharp curve to the south, and join the main lines on the up side where it crosses the Hornsey-road. To enable this to be done an old retaining wall had to be strengthened and raised—an elevation and section of which is given in Fig. 10. The raised portion of wall is made with Portland cement concrete, in the proportion of one of cement to eight of Thames ballast, and Fletton brick faced with pressed blue Staffordshire bricks, all set in Portland cement mortar. The banks and filling behind the raised retaining wall and ballasting of permanent way is made of burnt clay ballast obtained from surplus earth from the excavations in trenches, &c.

The whole of the work has been carried out under Mr. R. Johnson, M. Inst. C.E., Mr. H. Lovatt being the contractor.

GREAT NORTHERN RAILWAY WIDENING WORKS, KING'S CROSS

(*For description see page 342*)

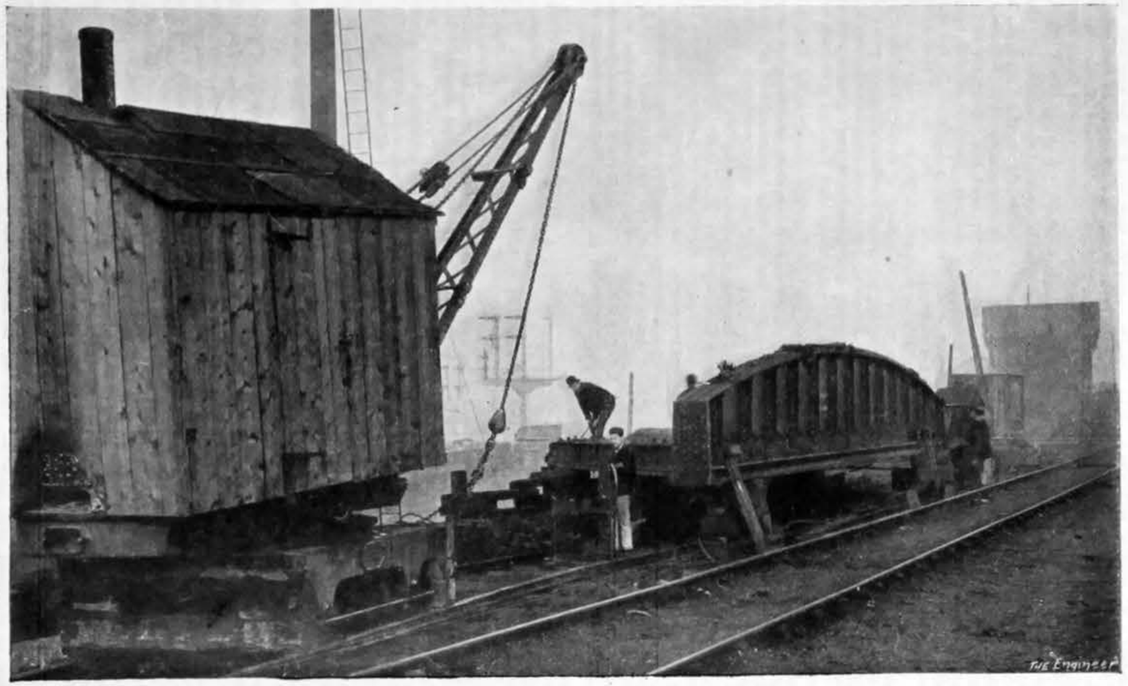


Fig. 6—BUILDING SECTION OF BRIDGE BY SIDE OF LINE

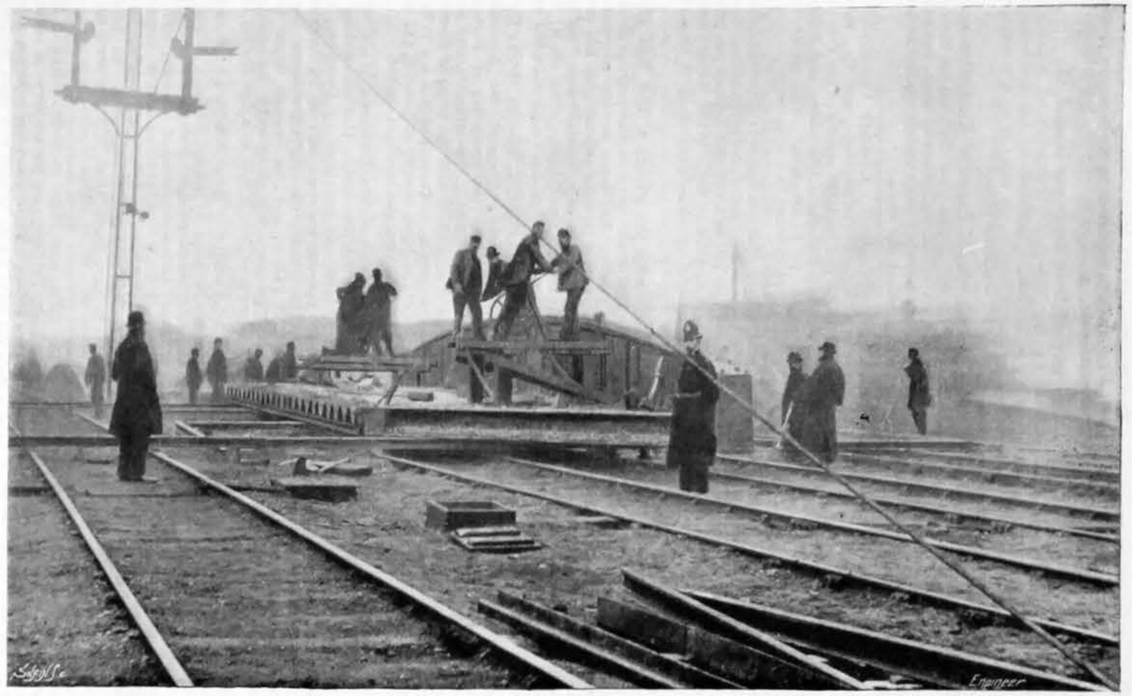


Fig. 7—HAULING A SECTION OF THE BRIDGE TO ITS BEARINGS, FIRST OPERATION

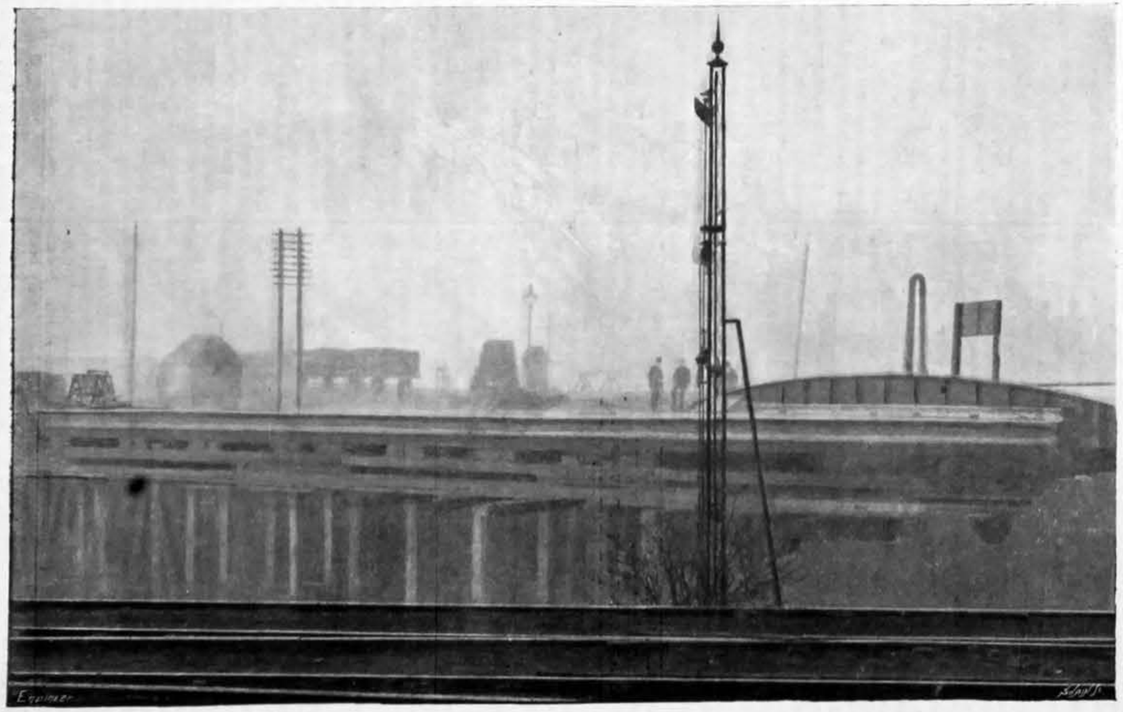


Fig. 3—GENERAL VIEW OF EASTERN SECTION READY FOR MOORING TO ITS FINAL BED

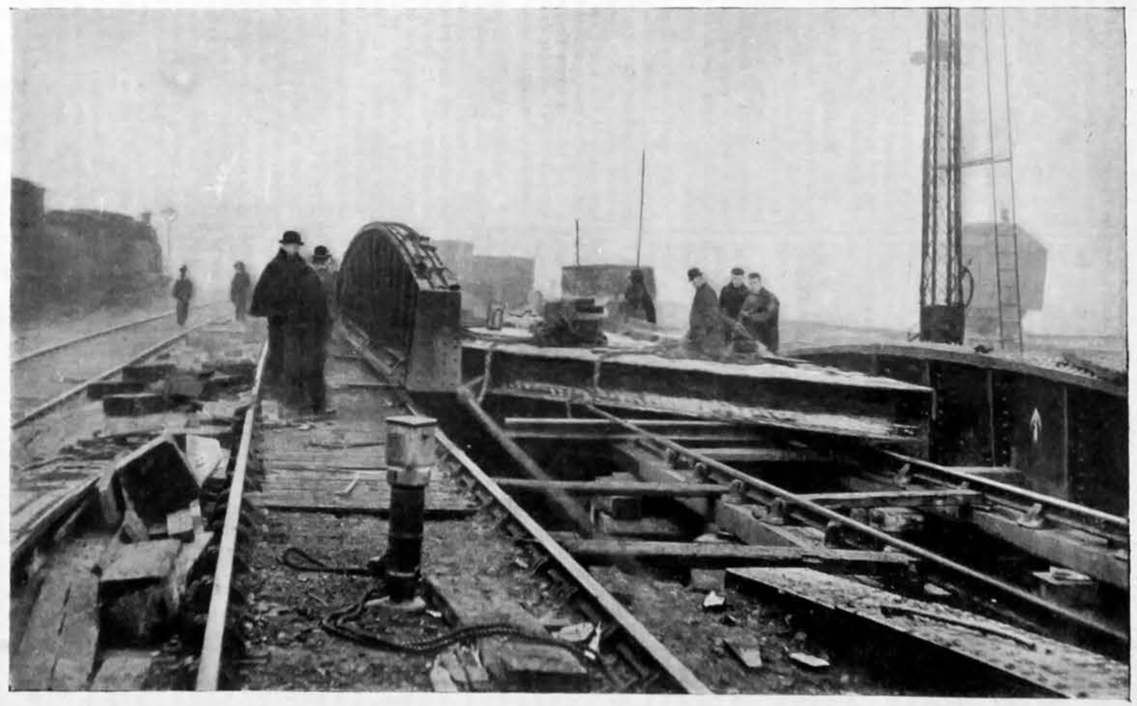


Fig. 9—HAULING A SECTION OF THE BRIDGE TO ITS BEARINGS, SECOND OPERATION

RAILWAY MATTERS.

Fifteen miles of the German railway at Zanzibar have been completed, and the line will shortly be opened for traffic.

The Brooks Locomotive Works have received an order for thirty freight and thirty passenger locomotives for the Central Railroad of Brazil, fifteen of which will have Belpaire boilers. All will have copper fire-boxes, and all the wheels will have Krupp steel tires.

Two new strategic railways, which are to be shortly taken in hand, one leading from the Duchy of Baden into France, and the other from Rufach to Seheim, are calculated to facilitate the concentration of German forces opposite Belfort, which is regarded as a point threatening the whole of South Germany.

The Port Talbot Railway Act, obtained last session in Parliament, provides for making a line of railway sixteen miles long and serving three mineral valleys in Glamorganshire at present served only by the Great Western Railway. Miss Talbot, the owner of the docks at Port Talbot—which are to be considerably improved and enlarged—and of a large portion of the land for the railway, herself provides a large portion of the capital.

A short while ago the mail train on the Bengal and Nagpore Railway ran into a wild elephant which was straying along the line near Guilkhera Station. The engine having carried the animal about a hundred yards, then left the rails with the first five carriages. The elephant was thrown down a bank 60ft. high and was found dead at the bottom. No one in the train was injured, and no damage was done to the rolling stock or to the line. This was "bad for the coo."

A contract has been placed with Mr. Woolley, of Wrexham, for the construction of about eight miles of the Vale of Glamorgan Railway, which portion of the proposed line is at the Bridgend side of the route, and will provide employment for a year or two for a large staff of hands. Messrs. Pethick Brothers, the main contractors, are also approaching completion of the preliminary work at Barry, with a view of commencing the excavation of the large tunnel in Porthkerry Park.

Work on the proposed new line to compete with the Pennsylvania Railroad—the Loyalhanna and Youghiogheny—is to be vigorously pushed. The line, according to the *Railway News*, will run from Mehaffey, in the Clearfield coal region, to Sewickley, on the line of the Pittsburg, McKeesport, and Youghiogheny Railroad, and will connect with the Buffalo, Rochester, and Pittsburg line at Punxsutawney, and with the Shenango and Lake Erie road at Butler, and will make connection with Pittsburg over the Pittsburg and Erie, giving an outlet from the Connellsville region to the seaboard, the Lakes, and Canada.

A new carriage, of a class not in use before on the Great Northern (Ireland) Railway, or any other of the Irish lines, has been completed in the central workshops, Dundalk, and tried. It is constructed on the Pullman system, the outside framework of the carriage being of mahogany, 45ft. in length, and resting upon four couple of bogie wheels, with automatic brakes to all the wheels. The interior of the carriage is divided into five sections, the largest occupying about two-thirds of the space as a drawing-room car, and is fitted throughout in superb style. This carriage is for immediate use on the Dublin and Belfast limited mail.

The new railway from Uppingham to Seaton, 3½ miles long, on the Stamford, Peterborough, and Market Harborough branch of the London and North-Western Railway, at last connects the town of Uppingham, possessing an important public school, and having a weekly cattle market, with a railway system, all traffic having hitherto been by road to Seaton Station, on the London and North-Western Railway, or to Manton, on the Stamford and Oakham section of the Midland Railway. Owing to the altitude of the town, many cuttings and embankments were unavoidable, and in one case a long viaduct has been built. The total cost of construction was £30,000.

Another cable tramway has been recently completed in Australia, namely, the Ocean-street Cable Line at Sydney. A communication from that town, of August 25th, mentions it as about to be tested. The line was commenced in October, 1892, and has, it appears, cost altogether something like £160,000. The line has many curves upon its 2½ miles of length, and it is considered to be one which tests the system very severely. The cables altogether weigh 150 tons, and the working of the several lengths of cable, even without any car upon the lines, will require something like 250-horse power. The engines have been built by Messrs. Hudson Bros., of Granville, and are horizontal compound surface-condensing Spencer-Inglis Corliss engines. The cylinders are 24in. and 45in. diameter, with 5½ft. strokes. There are two of these engines, one being a stand-by. The main shaft carries a fly-wheel weighing 25 tons, and a rope drum, 7ft. in diameter, with thirty-six grooves for 2in. cotton ropes. The boilers are described as three multitubular under-fire boilers, each rated at 250-horse power, and working at 150 lb. per square inch pressure. Mr. Fischer, of the Department of the Engineer-in-chief for Railways, is the engineer of the undertaking.

Since the Dutch-Rhenish railways were transferred to the State on October 15th, 1890, the lines worked by the Maatschappij tot Exploitatie van Staatspoorwegen are the following:—Rotterdam-Dordrecht-Esschen, Amsterdam-Utrecht-'s Bosch-Breda-Esschen, Amsterdam-Gouda-Rotterdam, Den Haag-Voorburg (locaald.), Rotterdam-den Haag, Amsterdam-Breukelen-Utrecht, Amsterdam-Utrecht-Arnhem-Emmerik, Utrecht-Gouda-Rotterdam, Utrecht-Leiden, Rotterdam-Venlo, Moerdijk-L.-Zwaluwe-'s Bosch, Utrecht-'s Bosch-Boxtel, Vlissingen-Breda, Nijmegen-Tilburg, Nijmegen-Maastricht, Eindhoven-Luik, Nijmegen-Arnhem (voll. dienst), Arnhem-Zutphen-Deventer-Zwolle, Arnhem-Zutphen-Zwolle-Leeuwarden, Meppel-Groningen, Groningen-Delfzijl, Zutphen-Salzbergen voll. dienst, Zwolle-Gronau, Harlingen-Nieuweschans. This company was founded in 1863 for working the Dutch State Railways, and the head offices and works are at Utrecht. The office of Rijks Commissaris, or Government Commissioner, is at present vacant; but the Assistant-Commissioner is Mijnheer P. J. Breedveld. The general manager is M. J. L. Cluysenaer; the secretary, M. J. N. Nivel. Superintendent of the line, M. E. J. B. H. M. Engeringh; engineer-in-chief for permanent way and works, M. J. Kalff; and chief engineer for rolling stock, Mijnheer J. W. Stous Sloot.

It is stated that there is now every prospect of the scheme for the construction of an electric railway to the summit of Snowdon being carried out in a very short time. There are two companies formed, and, as owner of the land, Mr. Assheton-Smith, will take a leading part in the promotion of the project. The services of Mr. Duncan Fox, the engineer, have been secured, and his plans will probably be formed on the lines of those adopted for similiar railways on the Continent. Unless unforeseen circumstances arise, it is, says the *Liverpool Post*, confidently anticipated that with the advent of next season this railway will be an accomplished fact, thus adding considerably to the importance of Llanberis as one of the starting points for Snowdon. In conjunction with this interesting project the suggestion is pretty generally made that the North Wales Narrow Gauge Railway Company should extend their line from Rhyddu to Beddgelert, so that people making the ascent of Snowdon on the Llanberis side might descend on the Beddgelert side, and so have direct communication with all places on the London and North-Western Railway. A Bill for the extension of this line has already been passed, and it only requires a like enterprise on the part of the promoters to give to this picturesque district a boon which both the inhabitants and visitors have long looked forward to.

NOTES AND MEMORANDA.

A method of connecting metal to earthenware is given in *The Scientific American* as follows:—The portion of the earthenware with which connection is to be made being unglazed, or the glaze having been removed, it is coated with plumbago, and placed in an electrolytic bath, whereby a firm metallic coating is obtained. The lead pipe is then soldered to this coating by a plumber's "wiped" joint. By this means are avoided the imperfect joints made with india-rubber sleeves, washers or putty.

In order to obtain incandescent lamp filaments which will stand a very high temperature, M. Baum proceeds as follows:—Organic fibres are treated with phosphate ammonia, hydrochlorate of ammonia, calcium chloride and magnesium chloride. At a known temperature, the salts of ammonia are volatilised, and the filament is formed of the precipitated porous phosphates of lime and magnesia. The filaments are afterwards strengthened with a solution of gelatine and dilute carbonate of lime.

Mr. Mondit, of Caen, has published a process for bronzing copper, which is briefly thus:—After the metal has been scoured, it is covered with the following mixture by means of a brush:—Castor oil, twenty parts; alcohol, eighty parts; soft soap, forty parts; water, forty parts. The mixture is left on till the required shade is obtained, then dried with hot sawdust, and coated with a very dilute varnish. The depth of tone can be regulated by the length of time the metal is exposed to the solution.

The new sextuple photographic telescope in the Yale Observatory, used in photographing meteoric displays, has six cameras together covering a field equal to 2400 full moons. Each camera carries a plate covering a space of 10 deg. square in the heavens, and the fields are so arranged as to touch each other at the edges, so that the total field will cover 600 square degrees. It will be used in connection with two single telescopes placed at a distance of two miles from the sextuple instrument, with electrical connections for simultaneous photography.

A recent Austrian patent for insulating material is as follows:—Ozokerite, asphalt, and amber are subjected to distillation in a closed still to a temperature of 400 deg. After the mass has been heated until gases, vapour, or oils cease to escape, it is allowed to cool. In that condition it is of pliable consistency, and may either be used alone or incorporated with other substances for insulating cables, such as resins, fats, or oils, the proportions of these being from 30 to 70 per cent. By this method those substances present in fossil resins which prejudice or deteriorate the insulating properties are removed.

In a paper which he recently read before the Scientific Congress at Paris, M. de Lapparent expressed the opinion that all mountains will vanish off the face of the earth in course of time. He declared that, if the actual natural forces at work upon our globe retain their present intensity, in 4,500,000 years all inequalities of surface will be levelled. He instanced as a striking example the reduction of the Ardennes, which were once a chain of the Alps, but which had already shrunk to their present dimensions at the outset of the Tertiary epoch. The Alps, he said, exemplified the youth, the Pyrenees the maturity, and the mountains of Provence the declining years of mountain ranges, while the central plateau of France was typical of their death and dissolution.

Two methods of covering aluminium with metallic films are given as follows in the *Journal* of the Chemical Society:—"Aluminium becomes covered with a hard film of copper on rubbing it with tin dipped in copper sulphate solution, the deposit increases in thickness if the coated metal is suspended in a dilute copper salt solution. Aluminium is covered with tin by rubbing it with brass moistened with solutions of certain tin salts, such as ammonium stannichloride, $SnCl_4 2NH_4Cl$; in this case, too, the deposit increases in thickness when the metal is suspended in a tin salt solution of suitable concentration. Aluminium which has been coated with copper as above described, when suspended in a solution of a tin salt, receives a coating of tin over the copper."

At the Angleur Company's Steel Works at Sclessin, on the left bank of the Meuse, the *American Manufacturer* says, coke for smelting is made on the ground from the small coal of the neighbouring collieries, partly washed and partly in the rough state, in a battery of 100 Coppee Menier ovens, about 30ft. long, 4½ft. high, and 17in. wide. The use of such very narrow ovens is rendered necessary by the deficient binding properties of the coal, owing to the low proportion of volatile matters present, so that a high heat quickly applied is required to produce a coherent coke. The surplus heat of the ovens is utilised in the firing of seven De Nayer boilers of 200-horse power each, which together with a similar series of Galloway boilers with outside combustion chambers fired by blast furnace gas, supply the whole of the steam for the blast furnace and Bessemer blowing engines.

A method of preparing hematite artificially is the introduction of Mr. H. Arctowski, who proceeds as follows:—"A current of ammonium chloride vapour when passed over oxide of iron, heated to dull redness, converts the oxide into crystalline hematite. Ferric oxide heated at 350 deg. absorbs ammonium chloride vapour, and melts to a black mass, from which ferric chloride soon distils. The residue absorbs water from the air, and is a mixture of ammonium chloride and ferric chloride. At 600 deg. the ferric oxide is partially converted into small crystals, and then mechanically absorbs ammonium chloride without melting. At 700 deg. the ferric oxide becomes crystalline. The crystals are of the same form as the hematite crystals from Elba. The gases of fumaroles contain ammonium chloride, and the fissures in the vicinity are generally covered with crystals of hematite."

In an address delivered before the American Association for the Advancement of Science, at its Brooklyn meeting, August 16th, the retiring president, Mr. William Harkness, said:—"Those who are not familiar with practical astronomy may wonder why the solar parallax can be got from Mars and Venus, and not from Mercury or the sun itself. The explanation depends on two facts—firstly, the nearest approach of these bodies to the earth is for Mars 33,874,000 miles, for Venus 23,654,000 miles, for Mercury 47,935,000 miles, and for the sun 91,239,000 miles. Consequently for us, Mars and Venus have very much larger parallaxes than Mercury or the sun, and of course the larger the parallax the easier it is to measure. Secondly, even the largest of these parallaxes must be determined within far less than one-tenth of a second of the truth; and while that degree of accuracy is possible in measuring short arcs, it is quite unattainable in long ones. Hence one of the most essential conditions for the successful measurement of parallaxes is that we shall be able to compare the place of the near body with that of a more distant one situated in the same region of the sky. In the case of Mars, that can always be done by making use of a neighbouring star, but when Venus is near the earth she is also so close to the sun that stars are not available, and consequently her parallax can be satisfactorily measured only when her position can be accurately referred to that of the sun; or, in other words, only during her transits across the sun's disc. But even when the two bodies to be compared are sufficiently near each other, we are still embarrassed by the fact that it is more difficult to measure the distance between the limb of a planet and a star or the limb of the sun, than it is to measure the distance between two stars; and since the discovery of so many asteroids, that circumstance has led to their use for determinations of the solar parallax. Some of these bodies approach within 75,230,000 miles of the earth's orbit, and as they look precisely like stars, the increased accuracy of pointing on them fully makes up for their greater distance, as compared with Mars or Venus."

MISCELLANEA.

The question of the formation of a Chemical Department for India will be submitted to the Secretary of State during the current season.

The torpedo-boat destroyer Rocket, the first of three building for her Majesty's Government by Messrs. J. and G. Thomson, of Clydebank, attained on her preliminary trial, on Tuesday last at Skelmorlie, on the Clyde, a mean speed of 28¼ knots, equal to 32 53 statute miles.

The sixteenth annual Brewers' Exhibition and Market opens in the Islington Agricultural Hall on the 22nd inst. The number of exhibits will be exceptionally large, and will comprise the many kinds of machinery and various appliances for facilitating the carrying on of the trade.

Three Sheffield firms, Charles Cammell and Co., John Brown and Co., and Vickers, Sons, and Co., have received orders for the citadel and barbette armour of the first-class battleships Mars, Jupiter, Hannibal, Victorious, and Prince George. The total weight is 12,500 tons. The plates are to be Harveyed.

On Tuesday last Messrs. John I. Thornycroft and Co. launched the new torpedo-boat destroyer Ardent. She is 200ft. long, 19ft. beam, and will be fitted with engines and boilers of the same type as those supplied by them to her Majesty's ship Daring—which we recently illustrated—guaranteed to give her a speed of 27 knots.

In accordance with the wishes of the late Mr. Henry Faija, Mr. D. B. Butler will carry on the practice in his name for the benefit of the family. Mr. Butler was formerly associated with Mr. Faija for ten years as his chief assistant, but had subsequently held responsible positions in two cement works. At Mr. Faija's invitation and for the last three months of his life Mr. Butler had the entire charge and conduct of Mr. Faija's office and business.

Upon the completion of the defence works for the protection of the river Medway at Sheerness the Admiralty propose to also construct booms for the protection of Portsmouth and Devonport Harbours. The gunboats Mistletoe and Firm, which are being utilised in connection with the boom at Sheerness, have been completed for service, and arrangements are to be made for testing a section of the boom as early as possible, the boom being constructed of wire hawsers and baulks of timber.

The upper reservoir of the Swansea Waterworks was formally opened on the 12th inst. This undertaking was commenced in May, 1886, and completed by December, 1891, since which time the opening has been delayed by litigation. The water area of the reservoir is thirty-five acres, the contents being 305,464,770 gallons, and the greatest depth 68ft. This important work has been carried out under the superintendence of the borough engineer, Mr. Wyrill, at a cost of £101,185.

In connection with the new American liners St. Louis and St. Paul, now building by Cramp Brothers, it was originally intended that the boilers of these vessels should be fitted with Purves' furnaces. American sentiment, however, with regard to the ships being entirely built at home asserted itself, with the result that corrugated furnaces have been supplied by American makers at what must have been a losing price. On the other hand, the St. Paul is to have Serve tubes, which appears to us a little inconsistent.

An application has been recently made to the Local Government Board for borrowing powers for some additions to the Ossett Sewage Works. Their inspector, however, reported that the sewage was being merely treated with lime, the land filtration having been discontinued. Consequently, the sanction to the loan was withheld, and the Ossett Town Council were requested to submit comprehensive proposals for the improvement of the works. The sewage is one of the very worst in the kingdom, being largely woollen trade refuse of a most changeable and refractory kind. The Council have engaged the services of Mr. M. Paterson, of Bradford, the engineer who nearly twenty years ago carried out the sewage works, with the main drainage of the district.

A meeting of the Consultative Council of the Building Trades Exhibition, 1895, was held on the 12th inst., Mr. Banister Fletcher, F.R.I.B.A., in the chair. The honorary secretary, Mr. T. Freeman, F.G.S., read the report on last year's exhibition, which was satisfactory, and the council agreed that the forthcoming exhibition should be continued on the same lines. It was stated during the course of the meeting that architects were perfectly satisfied with the display at last year's exhibition, and the exhibitors were unanimously of opinion that their exhibits had proved eminently advantageous from a business point of view. The council for the ensuing year had been considerably added to, and it was confidently anticipated that next year would prove one of the finest exhibitions of the kind that had ever been held.

A useful table, showing graphically the dimensions, equivalent conductors, resistances, and weights of pure copper wires and cables, and the fall of potential and approximate rise of temperature of any wire, has been published by Messrs. W. T. Glover and Company, as designed by Mr. A. H. Howard. Messrs. Glover and Company, *i.e.*, Mr. Henry Edmunds, accompany the table, which is large enough for easy reading, with the necessary directions for reading the dimensions or quantities obtainable in figures from the graphic diagram. Every direction seems to be perfectly clear, with perhaps the exception of that for the curves which represent rise of temperature of insulated wires in wooden casings. The table is one which will save a great deal of calculation and time, and affords an excellent check on calculated values.

M. Hospitalier, a well-known French electrician and writer, has drawn attention to the errors of language in French public documents relating to scientific matters. Thus, says the *Globe*, in Acts relating to the sale of land, the superficies is given in metres instead of square metres; the Bureau des Longitudes expresses the value of acceleration due to gravity in a falling body in metres instead of "metres per second." The word force is used for "work," and work for "power." All nations exhibit the same confusion in the use of scientific terms, which are often imperfectly understood, even by so-called experts, and all nations adopt foreign expressions instead of inventing their own. It is nevertheless true that in scientific language there should be no synonyms; one word should be dedicated to one thing, and have a perfectly definite meaning. It is poverty rather than wealth of words that science demands. Where compound words are required, they should be formed according to a strict rule, and always used in their entirety.

After many breakdowns, H.M. cruiser Fox has at last made a successful trip under forced draught She indicated 9063-horse power, or 63 beyond the specification, which gave a mean log speed of 20 knots. During the run a trial was made of Messrs. Cutmore's system for effecting audible voice-pipe communication between the bridge and the engine-room. The orders, notwithstanding the noise of the machinery, were distinctly heard. In this invention the sound is magnified first by means of a cone fixed in the mouthpiece, and secondly by silver tongues placed in every angle and bend of the voice pipe. Various subsidiary inventions have been utilised, such as by means of a commutator, which works on the pistol-revolver principle, converging orders from twenty different points of the ship to the engine-room; but the primary advantage of the apparatus is that the sound of the human voice can be transmitted with certainty. It is probable that this system will now be generally adopted in H M. ships.

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*** *With this week's number is issued as a Supplement a Two-page Engraving of the Victoria Bridge over Brisbane River. 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.*

CONTENTS.

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.***

J. W. H (Brixton).—*(1) The engines are identical save in the cylinders. (2) Yes.*

J. D. AND CO. (Traction Engines).—*The author of the letter to which you refer gave his name and address—see page 275.*

T. E.—*You do not require any piping. If you turn down the end of your exhaust pipe over the water in the tank so that the exhaust steam blows down on it, you can heat the water 180 deg. to 200 deg.*

A. B. (Blomfield-street).—*Have you considered the cost? Have you considered what would happen to the plates of a boiler into which you pumped a strong saline solution as feed? The idea is wholly unpractical from first to last.*

ENTROPY.—*Many persons have wasted money in forcing air into boilers. There is no economical advantage to be obtained even in theory, and practice has in this case always proved the truth of theory. There are references to the subject in back numbers of* THE ENGINEER, *which are out of print.*

CORROSION OF BOILERS.

(To the Editor of The Engineer.)

SIR,—Can any correspondent refer me to any case of boiler corrosion due to sulphate of soda in water taken from a river?

London, October 10th. HIGH-PRESSURE STEAM.

FISH HOOK MAKING MACHINERY.

(To the Editor of The Engineer.)

SIR,—I shall be much obliged to any reader who will tell me where I can obtain the necessary machinery for making fish hooks. S. F. O.

October 17th.

CHROME ORE.

(To the Editor of The Engineer.)

SIR,—Would any correspondent kindly answer the following questions?—(1) Who are the best firms who purchase chrome ore? (2) What is the present current price landed c.i.f. for chrome ore showing from 65 per cent. to 78½ per cent. of chromite? (3) Is there a good demand? (4) What ores are the chief constituents in (*a*) yellow metal, (*b*) anti-friction metal? W. C. W.

Wellington, New Zealand, August 27th.

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

MEETINGS NEXT WEEK.

INSTITUTION OF MARINE ENGINEERS.—Wednesday, October 24th. Formal opening of the extension of premises by the President. Members will assemble at 7.30 p.m. in the Lower Room, where the inaugural address will be delivered.

INSTITUTION OF MECHANICAL ENGINEERS.—Wednesday and Thursday, October 24th and 25th at 25, Great George-street, Westminster, at 7.30 p.m. Papers: "The Manufacture of Standard Screws for Machine-made Watches," by Mr. Charles J. Hewitt, of Prescot, on Wednesday; "Drilling Machines for Cylindrical Boiler Shells," by Mr. Samuel Dixon, of Manchester, on Thursday.

THE ENGINEER.

OCTOBER 19, 1894.

RAILWAYS AND THE BOARD OF TRADE.

RIGHTLY or wrongly, many persons traders and others, hold that the action of the Board of Trade in all that relates to railways, their construction and working, is prejudicial to commerce, oppressive and unsatisfactory. Such charges are made by persons of sufficient influence to give them importance. The railway companies and their officials hold their peace and refuse to express an opinion. It is worth while to consider some of the facts which are more or less beyond dispute, and so arrive at the reasonableness or emptiness of the charges in question. These charges imply that the Board of Trade or its inspectors insist on an unnecessary and costly method of working branch and narrow gauge lines; that hard-and-fast rules are applied without intelligence or discrimination; and that there is no sympathy between the Board on the one hand, and the railway companies and trading community on the other. There are besides questions concerning bye-laws, terminal charges, rates, and other money matters, with which it would be to some extent beyond our province to deal. We propose to confine ourselves to the consideration of the action of the Board of Trade in what may be termed matters mechanical, and we may say at the outset that while we are very far from echoing the complaints so freely made, not unfrequently by wholly irresponsible persons, we hold on the other hand, that it is advisable that the position as it stands should be examined and revised.

The action of the Board of Trade is mainly exerted by its inspectors. A line cannot be opened for traffic until it has been passed by one or other of these gentlemen; and it seems to us beyond doubt that they demand for a small branch line the same general excellence that is needed on a main road. Dozens of examples of this might be cited—as, for instance, a case in which there was only one engine and train used on a branch line. This had been worked for years, without accident and with perfect success, with three trains each way per day, until one day an inspector insisted that the little terminal station should be provided with an elaborate system of signals at a very considerable expense. When the signals were completed and had been passed, they were fixed at "danger," and no one ever troubled his head about them subsequently. Roads on which the speed is never intended to exceed thirty miles an hour have to be sleepered and ballasted and made with all the heavy expenditure needed on a main line over which express trains thunder at sixty miles an hour. The result is that the cost of a railway becomes prohibitive. In other countries—notably in the United States—cheap lines are made which serve an excellent purpose; but there is no Board of Trade there to interfere. It may be that the officers of the Board have no choice. On the other hand, it is possible that they exert their authority just as they please, without the smallest consideration for the wants of the country. They virtually tell farmers and traders, "You shall have a first-class line or no line at all." Whether a line is to cost £5000 a mile or £15,000 is all one to them. They care nothing for the outlay. All that they demand is the nearest approach to perfection. With nothing less will they be satisfied. In its way no doubt this is all very well, but it is carrying the demand for excellence so far that it may be ruinous. It is as though Government insisted that we should all use Turkey carpets or go without carpets altogether. After everything has been said that need be said about the rules and the Acts of Parliament under which the Board of Trade discharges its functions, the whole ground is far from having been covered. Beyond question a great deal of power rests in the hands of the inspectors. To all intents and purposes they are all-powerful. No railway company thinks of appealing against the decision of any one of these gentlemen—possibly because it is so difficult to know to whom the appeal can be made. Ultimately we suppose it could be addressed to Parliament, which is tantamount to saying that it cannot be made at all. Now it so happens that for some reason not very easily comprehended all the inspectors are Royal Engineers. They rank as majors, colonels, or generals. In a word, they are military men with a military training, and not possessed of any special knowledge of railways or railway working other than that which they pick up in the course of the discharge of their functions. It goes without saying that they are one and all highly honourable men. What they think, and the general nature of their methods of reasoning about railway matters and railway men, can easily be gathered from the published reports of inquiries into railway accidents. Reading them as they come out for a series of years teaches the reader a good deal about those who wrote them. We learn, for example, that whenever a railway accident occurs, some one must be in fault. The preconceived idea is that a species of crime has been committed, and the criminal must be sought and found. In some of the reports we find it admitted now and then in a very hesitating fashion, that it is possible a man may make a mistake without being guilty of aggravated manslaughter; but such a concession to public opinion is rare. Again, it will be found that one inspector always takes it for granted when a collision occurs that an engine driver has been in fault; another throws the blame on a signalman. We have, indeed, before reading a report only to look at the signature to be able to say what the drift of the inquiry will be, and what the verdict. When it is obviously impossible to say that either a driver or a signalman is in fault, then the railway company must be blamed, and the blame is not infrequently absurd. Not long since a collision occurred of no great importance. It arose from a number of small causes all contributing to the same end. The inspector was hard up to find anyone in particular to blame, so he laid the fault on a lofty distant signal, which had been in work for more than twenty years, and "advised" its instant removal to another place. The fact that the existing position had been sanctioned by the Board of Trade, and that no complaint had been made for twenty years, went for nothing. Recently some of the inspectors found in long hours an excuse for everything. This long hour idea is worked in a most unintelligent way. An express driver takes his engine 120 miles down the country in the morning. The run accomplished, he has little or no further work to do until the evening, when he takes an up train to town with the same engine. From the time when he came on duty until he signs off is, say, ten hours, his actual working time is not five hours. If an accident occurs towards the end of the day we are told directly, or by implication, that it was brought about by the fatigue of the overworked driver. As regards the question of continuous brakes nothing can be more unsatisfactory than the attitude assumed by the Board of Trade. The continuous brake is evidently still regarded, after twenty years of service, as something dangerous and untrustworthy, and an absurd regulation is in force that no driver shall ever use the continuous brake on entering a terminal station. At first sight it seems that the Board of Trade inspectors believe that a hand brake on a tender, and two or three others in guards' vans, can do that which the automatic brake applied throughout a train cannot do. This, however, is not really the belief of the inspectors. What they mean to say is that trains should not be allowed to enter terminal stations at high speed, but for some inscrutable reason they prefer to use the elliptical method of phrasing, and say that only the hand brake shall be used to stop a train in a terminal station.

The railway companies assert, and not without reason we think, that the action of the Board of Trade is often vexatious, and that it entails a great and useless outlay. We have no reason to doubt that the accusation is largely well founded. We do not see how it can be otherwise. Officers in the Royal Engineers however considerable their professional attainments and keen their sense of duty, can scarcely be in touch with either traders' or railway companies. They may, and no doubt do, insist on taking care of the public to an extent which is not wanted or warranted by the facts. They are apparently impressed with the notion that a railway company is a more or less dangerous and wicked institution, which, unless carefully watched, will destroy immense quantities of it own property by gross or even criminal carelessness. They hold that signalmen are as a class so vicious that unless watched with precaution they will rather wreck a train than lose their supper. Engine drivers are so depraved that they think nothing of running past signals, even though they thereby incur the imminent risk of a dreadful death. In a word, the theory of the railway department of the Board seems to be on all fours with that of the marine department, which holds that the shipowner can do no good thing. We in no way blame the Royal Engineer officers who now look after our railways. They represent a system, and the system is bad, but they are not in fault. They act conscientiously according to their knowledge and training. That their influence is repeatedly exerted for good is quite beyond question, but we hold that the time has arrived for inquiry into the relations of the railway companies and the Board of Trade. There is a clamour for greater facilities of transport, and it is asserted that the Board of Trade stops the way. The truth or falsehood of the statement ought to be made plain by inquiry and investigation. Select committees are the rule. Let us have one to inquire into the relations of the railways and the Board of Trade. For ourselves, we hold that a large infusion of the civilian element would prove of great advantage. In the natural course of events, most of the officers now acting as inspectors will have to retire within the next few years, full of years and of honour. They should be replaced by those possessing experience in railway working, and able to discriminate between what is necessary for the safety of the public and that grandmotherly carefulness which insists, as we have said, that it is better to have no railways whatever than incur such risks as no other nation on earth hesitates to face.

THE INSPECTION OF RAILWAY BRIDGES IN INDIA.

LAST year the Government of India issued rules as to the strength and loading of iron and steel bridges, for the guidance of officers entrusted with the duty of inspecting new railways. These rules were adopted after prolonged consideration, and were submitted for criticism to all the principal railway engineers in India as well as to the Secretary of State's advisers at home. They deserve the attention of English engineers both because Indian bridgework will have to be built under these rules, and also because some move in the same direction will probably be made on the part of our Government sooner or later. The present Board of Trade rules are so antiquated as to be practically useless. The new Indian rules are as follows:—(1) For any member of a railway bridge of wrought iron or steel, the total working load is to be taken as the greatest moving load, multiplied by a coefficient and added to the actual fixed load. (2) The coefficient to be used for this purpose is 2·0 in

all cases, except for the upper and lower booms of triangulated girders, for which a coefficient of 1·5 may be used. (3) The stress per square inch, either in tension or compression, due to the total working load thus calculated, is not to exceed the following :—Wrought iron, 7 tons; steel, 9 tons. (4) The working stress per square inch given above, whether for tension or compression, is to be taken on the net available area at the weakest part of the member of the structure to which it is applied, after deducting all holes for rivets, pins, bolts, &c. (5) For members in compression, the working stress given above is subject to such reduction as may be necessary according to column formula. (6) For the purposes of this rule, "fixed load" is to be taken to mean the weight of the structure itself, with roadway, flooring, ballast, permanent way, &c., complete. (See also "wind-pressure" below.) "Moving load" to be taken as follows :—(*a*) A train load for each line of rails calculated as specified under "train load" below. (*b*) If there be a road or footway in addition to, and distinct from, the railway, an additional moving load of four tons per 100 sq. ft. of such road or footway. For the purpose of calculating the train load to be allowed for on each line of rails, the "type train" is to consist of two engines with a train of loaded wagons taken at a uniform weight per foot run on the 5ft. 6in. gauge, 1·2 tons; on the metre gauge, 0·8 tons. The engines are to be taken as running either in the ordinary way or coupled head to head, and occupying any position in the train. To facilitate the determination of the stresses which may be produced by the "type train," a diagram of a "type engine" is given in an appendix. It is to be understood that this diagram does not represent any actual engine, but an imaginary engine so designed as to produce on a bridge the most severe effect practicable under the specification. The amount of wind pressure on a railway bridge is to be calculated on the assumption that the maximum normal pressure may be one and a-half tons per 100 square feet of surface exposed, the surface exposed to be reckoned as follows :—(*a*) A train surface calculated on a height of 13ft. 6in. on the 5ft. 6in. gauge, or 11ft. on the metre gauge, multiplied by the total length of the girder. (*b*) The actual surface—as seen in elevation—of that portion of one girder which may be below rail level, or at a height above rail level of more than 13ft. 6in. on the 5ft. 6in. gauge, or 11ft. on the metre gauge. Also (*c*) In the case of triangulated girders, the actual vertical surface—as seen in elevation—of that portion of the leeward girder which may be below rail level, or at a height above rail level of more than 13ft. 6in. on the 5ft. 6in. gauge, or 11ft. on the metre gauge. The total wind pressure thus calculated is to be provided for by a proper system of wind-bracing or floor-plating, and its effect taken into account as forming a part of the stress on the chords of the main girders. Proper arrangements must also be made at the girder ends to secure sufficient stiffness to resist racking action, where diagonal stiffeners are not used. Wind pressure is to be treated as "fixed load," and its effects on the different members of the structure is to be allowed for as provided in the rule for "Maximum Permissible Stress."

In the appendices following the rules, particulars are given of the engine loads allowed, and a "type" tank-engine is represented, which is to be used for the purpose of calculation. For the 5ft. 6in. gauge this engine has eight coupled wheels, with 15 tons on each axle; it measures 32ft. over buffers. For the metre gauge the engine has eight coupled wheels with eight tons on each axle, and measures 24ft. over buffers. It would facilitate calculation, without any sacrifice of accuracy, if a uniform load per foot extending over a given distance, corresponding to the length of two engines, had been prescribed instead of definite axle loads. Cross girders would then have required a specification of the load they should be designed for to vary with the spacing. No one can say what the distribution of loads on engine wheels will be twenty years hence, and it is a useless pretence to imagine an exact distribution of the load on axles at definite distances. Assuming, for the moment, that it was the right policy to issue rules laying down hard-and-fast maximum limits of stress under given assumed loads, and that these rules had to be compressed within the compass of so many lines, we are inclined to think that the rules above quoted are about as reasonable and clear as such conditions would allow. This, we take it, is the meaning of the approval expressed by a large majority of the engineers consulted on the subject. We may observe, in passing, however, that this approval should not be made too much of. A set of draft rules were drawn up by the Government, printed, and sent round for remarks. The criticisms and proposed amendments were not, so far as we know, submitted to the same body of engineers for consideration, but the approval of the rules as originally drafted was inferred from the fact that, taking the rules one by one, each rule was approved by a large majority. It does not follow, however, that some of the amendments would not have been carried if they had been submitted in the same way. The most important questions raised by these rules, to our mind are, firstly, whether it is wise to lay down definite limits of stress and load applicable to all railways independently of the nature of the traffic, the nature of the iron or steel employed, and other circumstances; and secondly, whether, if such rules are necessary, they do not need, for efficiency, to be much more elaborate and particular.

We do not intend here to enter on the very wide question of whether Government inspection of such structures is a desirable thing. For good or evil it exists, and is likely to continue. We should like to see it made more of a real safeguard to the public, and less of a harassing and expensive burden to railways of small traffic. These two objects are not, we believe, incompatible, but such rules as these now in force in India serve neither one purpose nor the other. A bridge might fully comply with these rules, and yet be dangerously weak in a dozen different ways. On the other hand, a bridge might be absolutely safe for the traffic it was built to carry, and yet require a large additional expenditure to bring it up to the standard of the rules. India is the last country in the world where extravagance in railway expenditure is justifiable, and a policy which compels every line to be built and equipped on a standard only really required by the most important roads involves extravagance of the most serious kind. We quite admit, however, that inspecting officers are not to be left to their own devices in such a matter as bridge stresses. The rational way, it seems to us, of securing the safety of the public would be to establish some such requirements as the following:—(1) Before a railway is opened for traffic, copies of the working drawings of each bridge, with complete calculations of stress, copies of tests of materials, and all other necessary data, shall be supplied to the Government, and certified as correct by the chief engineer of the railway, and shall be verified by the inspecting officer, who shall also make such tests as may be desirable. (2) Before the work on any bridge is commenced, the drawings may be submitted for approval, so that it will only remain, when the work is finished, to verify that it has been properly carried out n accordance with the approved design. (3) The permissible loads and speeds on any new railway will be determined before sanction is given to the line; and for the guidance of the engineer in preparing bridge designs the Government will, if requested, decide beforehand what stress, as a fraction of the breaking strength of the material, will be sanctioned for the various parts of the bridges on the line, under the loads agreed on at the maximum permitted speed.

For the purpose of carrying out these regulations the Government should have a competent officer specially deputed to the task of making a really effective and independent examination of the designs submitted. It would not be his business to criticise or amend in any way, unless where there was actual demonstrable weakness. His task would be immensely simplified by being able to call on the railway engineer to provide him with stress diagrams and calculations, since it is far easier to check the correctness of such calculations than to make them afresh. If, however, each of the many railway inspectors in India is to calculate the strength of each bridge on the line he inspects and certify to its strength, and if rules for stress and loads are to be given him, such rules, in our opinion, should go much more into detail than do these Indian rules. The author of them appears to make the common mistake of confounding brevity with simplicity. Suppose, for instance, some separate rules had been given for plate girders, would the rules then have been less simple? Not in the least. The plate-girder rules would simply be non-existent for the purpose of inspecting triangulated girders. If the inspector had to carry these rules in his head we could understand the sacrifice of efficiency to brevity, but we understand it on no other ground. These rules govern the design of all railway bridges in India—where bridgework forms a larger item in railway construction than it does in most countries—and one would have thought that the object of securing the most efficient bridges at the lowest cost was far more important than that of cutting down the rules to as few words as possible. To pick out one or two of the most conspicuous disadvantages of this process of compression, we observe, first, that nothing is said about the strength of fastenings. The inspector, we presume, will have to examine the bridge as regards the proper design of joints if he examines the design at all. Why is it more necessary to give him a rule for the stress on bars than to give him one for rivets? Then Rule 2 seems to us much too rough-and-ready. It draws an unjustifiable distinction between, say, the end diagonal of a triangulated girder and the adjoining length of boom. The cross-girders and the end diagonals of the main girders are assumed by it to be in the same condition as regards the dynamic effect of moving load, which is far from being the case. The materials of which the bridge is built are not alluded to at all except as "wrought iron" and "steel." To be effective, such rules ought to be a complete specification such as is issued by an American railway company in inviting designs and tenders for a bridge. Such detailed rules would assist and not hamper the inspector. The present rules may probably be regarded as a step in that direction.

COAL MINING MACHINES.

In the reports of the State Inspectors of Mines for Illinois there are some facts given that should be of interest to this country, and that carry further forward the figures we gave a year ago in The Engineer. They refer to the use of mining machines in the coal mines of the State named. Last year it appears that the number of the mining machines in use in the coal mines of Illinois had increased to 310, or an increase of 69 in the two last years. There are seven kinds of machines in use, the Harrison type being by far the most numerous, and next the Ingersoll-Sergeant seems to be numerically preferred. These machines are in use in forty-one mines, so that there are on the average more than thirteen machines in each of the mines. The yield of coal was just about one-fourth of the total produced in the State—over 4,595,000 tons in the year, so that there was an output that is now large enough to give at least some idea of the relative cost of machine mining. The first of the facts that are given is that the number of men employed at the machine-operated mines was last year 4314, and the percentage being taken, there is the further fact that whilst a little over 12 per cent. of the total men employed in the coal mines of Illinois were thus employed, yet the output, as we have just said, was 25 per cent. of the total—a very striking contrast. A table is given of the average production of each kind of machine, which shows that they vary in output from 6239 tons to 17,784 tons. But the number of the men employed in operating the machines varies—some kinds needing 6·4 men on the average, and others up to 20·1 men each, so that the actual yield is not to be taken from the mere average only. For the whole number of machines in Illinois, there is now need for an average of 14·2 men each, which is an increase on the number in the previous year, possibly due to the variation in the types of the machines. It is to be observed that the yield of the machines was on a working that on the average was a fraction over 250 each per year; and taking the mines where machines are exclusively employed, it is found that they vary in size, one producing only 21,000 tons in the year, whilst other collieries rise in output to as high as 304,000 tons, which is produced by 206 men in 255 working days, about eighteen Harrison machines being in use. Differences in the kind of seam, the nature and working of the coal, and other variations may influence the use of machine or hand labour, but the facts that are above summarised are of interest, and may have value to those who have the oversight of coal mining in this country.

NEW WATER SCHEME FOR EDINBURGH.

For many years an improved water supply for Edinburgh and the district has been regarded as highly essential, and if the increase in population of the capital had been anything like as rapid as in the case of Glasgow, definite steps to this end must have been taken long ago. As far back as 1871 an attempt was made to appropriate the waters of St. Mary's Loch in Selkirkshire. A strong opposition to any utilitarian tampering with a lake of such historic and poetic interest immediately arose, and speedily attained such strength that the scheme had to be abandoned; and the whole matter of water extension was allowed practically to rest. Within the last few years, however, it has been made abundantly evident that a large extra supply of water must be obtained somewhere, and without much delay. The members of the Edinburgh and District Water Trust accordingly bestirred themselves, and have now, after due deliberation, fixed upon what is called the Tweed scheme. This practically means the utilisation of the water of a Dumfriesshire tributary of the Tweed, known as the Talla-waters. The only other source of supply seriously considered was the Manor water, a stream flowing through the Manor Valley in Peeblesshire and entering the Tweed about two miles above Peebles. This was reported upon and strongly recommended in 1891 by Messrs. Hill, Gale, and Mansergh, as being ten miles nearer Edinburgh than the Talla, and as affording a remarkably pure supply. However, borings with a view to the necessary embankments showed in some places a depth of 150ft. before rock was reached. The expense and risk which such a depth of soil entailed caused the engineers to withdraw their recommendation, and finally they advised the Trustees to adopt the Talla supply, boring in the valley having proved rock at an average depth of 28ft. The Talla water rises in three head streams in Dumfriesshire, and is also fed by the Gameshope Loch. After a course of seven miles in a northerly direction it runs into the Tweed at Tweedsmuir Church. The stream will afford an abundant supply of excellent water, and the full scheme proposed by the Trustees provides for the construction of tunnels and aqueducts to convey 24 million gallons per day to the capital, a distance of thirty-six miles. Application for parliamentary powers accordingly will be made. As a first instalment it is proposed to lay pipes capable of conveying 10 millions of gallons per day. This is estimated to cost about £646,000.

MILD STEEL FOR STRUCTURAL ENGINEERING.

Whilst, as we last week showed, Bessemer steel is gaining ground as a material for use in manufacture outside steel rails, great progress can also be recorded of Siemens-Martin steel. This, indeed, has been gaining ground in the steel race during the last few years, and it has now passed its Bessemer rival, the output of open-hearth steel in the first six months of 1894 being not less than 1,026,469 tons, while the make of Bessemer steel was only 810,392 tons. We may observe, by the way, that the combined output of the two sorts is at the rate of 3,673,722 tons per annum, or higher than any annual total ever yet registered in the history of the British steel trade. Our chief concern lies, however, with the fact that open-hearth steel has for the first time gained the ascendancy. There has, in fact, lately been a greatly increased consumption of mild steel for all kinds of bridge and roofing, gasometer, and pier, and other departments of constructive engineering, also in the machinery trades, and among the steam boiler engineers, the tube firms of the kingdom, and other large consumers. One of the drawbacks to the use of steel in these trades is still asserted by some engineers to be its increased liability to corrosion, as compared with iron, particularly when exposed to the atmosphere or in damp or wet situations. The recent reports of some of the railway companies concerning the behaviour of steel bridges erected on British lines afford further evidence in support of those who have contended that this increased corrosion does occur, and some engineers are also seriously opposed to putting steel into piers for sea and ocean work. It is in steel designed for high tensile stresses that this corrosion is said to be most rapid. This fact is being increasingly recognised by engineers in some directions as regards both home and foreign contracts, and this tendency to prefer soft steel is likely to become more marked.

THE MIRABEAU BRIDGE.

The work of constructing a steel bridge across the Seine at Paris, between Grenelle and the Pont du Jour, is making satisfactory progress. This bridge is interesting from the fact that it is of an entirely new type, and is intended to overcome the difficulty of facilitating traffic over the river without interfering with the passage of vessels underneath. It is to be built level with the embankment on either side, and the centre of the bridge is to be 7·50 metres above the water level. Its total length is to be 170 metres, with a central span of 100 metres. In building the two piers, a great deal of trouble has been met with owing to the shifting character of the river bed at this point. The caissons employed in sinking the piers were supplied by the Compagnie de Fives-Lille, whose system has been much improved since the accident which took place some years ago at Nantes, when a workman was blown thrown through the discharge pipe. Before reaching a solid foundation of chalk, at a depth of 16·20 metres, it was necessary to dig through layers of sand and marl, and this work was made difficult by the presence of heavy flint blocks. A great quantity of this material had to be raised before the foundation could be laid. At the present moment both piers are completed, and work has been in progress during the past three months upon the superstructure on the left bank of the river. The steel used in its construction is supplied by the Anzin Works, in the Nord, and the Imphi Works, in the Nievre, and about 2500 tons of this material will be employed. It is not expected that the bridge will be finished before the middle of 1896, owing to the difficulty of employing many hands at a time. The cost of the bridge is estimated at £140,000. Designed by M. Résal, chief engineer of the Ponts et Chausées, the new bridge is not only interesting from an engineering point of view, but is likely to prove one of the most picturesque erections across the Seine.

RAILROADING IN AMERICA.

By An English Railway Engineer.

CARS.

In my previous article comparison of English and American practice in locomotive building was avoided as being undesirable; but when dealing with the subject of cars or rolling stock, one cannot help remarking the great difference in the two prevailing systems, and at times comparing the comforts and conveniences of the relative styles. The American car in its own country is a vastly different article to the "corridor" imitations attempted on this side of the Atlantic. and must at once be acknowledged superior in many respects; one of the greatest helps to its successful adoption in the States being, no doubt, the practical employment of one "class" only. In America, as probably many of your readers are aware, the holder of an ordinary ticket has a free run of the entire train, notwithstanding the provision of the superior accommodation of the Pullman and Wagner Company. It is also pretty generally known that the ordinary fare is about one penny per mile, or equal to our third class for accommodation in many cases equal to that given at home as first class, the additional charge for "sleepers," drawing-room cars, or limited trains, being about one farthing per mile extra.

It is often urged in this country that American cars are heavier and more costly than carriages for a given carrying capacity; but there are several points to be considered in favour of the cars which only become apparent upon closer acquaintance. For instance, in English trains the heavier carriages are usually hauled with few passengers, the first and second classes being often practically empty. With carriages, too, some may be crowded whilst others in the same train and of similar class lack passengers. In the American train all are utilised, and each car takes its fair proportion of passengers. Here lavatories are provided for first and second-class and perhaps a few favoured third-class passengers, but although there may be possibly a dozen lavatories in the train, they are only available to the occupants of twice as many compartments—unless fitted in corridor carriages—out of perhaps a total of over sixty. The lavatories, moreover, are awkwardly placed, are liable to affect the sanitary conditions of the compartments, and are rarely used when passengers of both sexes are present. Here then is a typical example of maximum weight and cost with the minimum of convenience. In the American cars seating sixty, and in some cases eighty passengers, two lavatories are provided, available for all the passengers, and being located at the ends of the car, and not under the continual notice of the passengers, more general use is made of them. Another important advantage of a continuous passage is apparent on "through" trains when a dining car is attached at meal-times and run for those times only, being detached at the first convenient stopping place. In the carriage system, on the contrary, kitchen and saloons are run continuously, and form a useless augmentation to the weight of the train during a considerable portion of the journey, and in cases where the saloon is not connected by a gangway with the other carriages, the passengers in America have not the privilege accorded them universally of changing cars after dinner has been served. Before quitting this

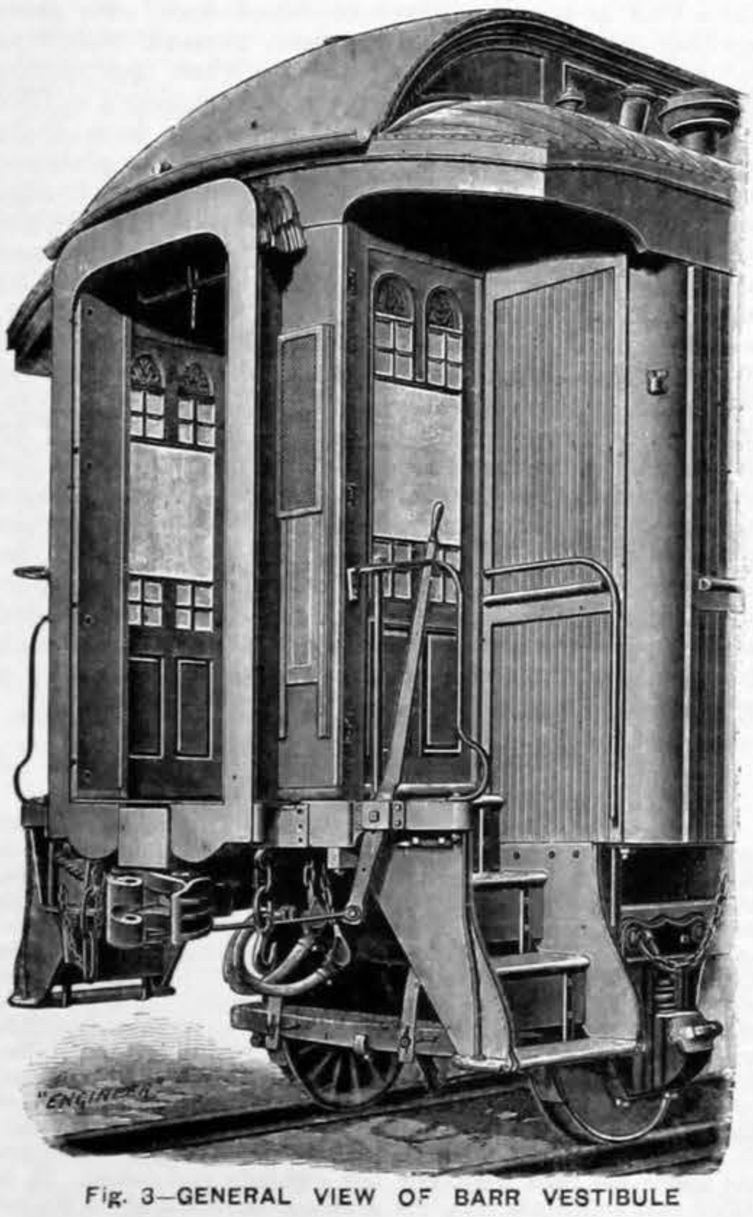


Fig. 3—GENERAL VIEW OF BARR VESTIBULE

part of the subject, I should like to say a few words on a point often urged in this country as being an advantage possessed by the carriage system over that of the cars, viz., that greater facility exists for ingress and egress by a door being provided for every ten passengers, against only one for thirty in America. This may be substantially correct in theory, but it makes no allowance for the only too familiar old lady who sometimes keeps a whole train waiting whilst she runs from one end of the platform to the other to select a suitable compartment, or for a group of passengers waiting at the wrong portion of the platform for the particular class of carriage they require. One trip on the Chicago Elevated Railway is sufficient to cause one to modify this opinion considerably. On this line the average speed attained is fifteen miles per hour from terminal to terminal, including stoppages at the rate of three per mile; while on the underground railway in London the average speed is only twelve miles per hour, including only two stops per mile, similar service engine requirements being involved in each instance. On the cars the passengers are directed by the conductors to alight at one end while newcomers enter at the other, thus preventing delay on the platforms by passengers in search for vacant seats, distribution taking place largely *en route*. There is, moreover, no alighting from or entering the train while in motion, as the conductors control the gates on the car platforms in a manner similar to that employed on the South London Railway. There are, however, exceptions to the car system, even in America. On the Brooklyn Bridge, and at Chicago during the Exhibition period on the Illinois Central Railroad, the carriage style was adopted. But in both these cases crowds had to be carried between two points only, and consequently the side doors were used to great advantage.

As regards the construction of American cars, these differ from our carriages in having no separate body and underframe. The sides form the frame and approximate two girders, strongly braced and trussed, resting on trucks at either end. In modern cars the framing is of timber and iron or steel combined. The sides present a flat furface about 10ft. wide, and have no projecting handrails or steps. As there are no raised platforms at main line stations, a miniature staircase is provided at each end, leading on to the platform. The plan, Fig. 1, gives the arrangement of an ordinary day car. The seats have reversible backs, usually reversed by the conductor or train men, and locked, so that all passengers face the engine. They are comfortable, and when "reclining" chairs are used, are very easy. The seats are of braided wire, upholstered in brown or crimson plush. The windows are large, and are invariably clean, many ingenious little contrivances being employed for raising and lowering them. Each car is provided with iced water, and also glass-fronted cupboard containing a number of useful tools in case of mishap, such as an adze-saw, hammers, &c.

Vestibules are rapidly becoming universal, and have received considerable attention. Apart from the convenience of affording a covered communication between the cars, doubtless a good vestibule as constructed in the States offers very considerable resistance to telescoping, and this has been recognised to such an extent that in some cases a cast steel frame is placed at the rear of the engine tender to receive the first vestibule, thereby ensuring a continuous connection throughout, and a few words describing them may prove acceptable. The "strings," bolts, and catches of the English gangway are unknown features of the American vestibule. Two vestibules can be simply "bumped" together as they couple up automatically, while one movement of a lever on the platform of the car is generally sufficient to uncouple them. The framework of the car end has provision for four buffing springs. The spindles passing through these are attached to a strong flat iron frame faced with rubber, the connection between this frame and the car body being made with a rubber bellows. The folding doors of the vestibule open on to a stairway on most cars, but as tramps have been found to make use of these for free transport, in later practice the vestibule is brought out to the full width of the car, and the steps are covered by a trap door opening upwards by means of a handle. A sketch of such an arrangement is shown in Fig. 2 herewith. In the Barr vestibule timber is used exclusively, the joints only being provided with a rubber cover. In Fig. 3 is depicted a general view of one of these vestibules, and Fig. 4 shows a plan thereof.

Fig. 5—VIEW OF PULLMAN CAR "MAUD"

A train shown by the South Pacific Railroad Company at Chicago had the Krebel vestibule. This is a connection the full width of the cars, so that the train is practically one width from end to end, with flexible joints. Pullman cars appear to be run on nearly all "through" trains; and as they are well patronised, the attendance, cuisine, and conveniences are excellent. Each car has five sections on each side, or seats for forty, and a state-room for four—some without the state-room accommodate forty-eight passengers, berths being provided for the same number. The lower berths are formed by drawing out the opposite seats—in the Pullmans all seats face each other—and the upper are pulled down from above; these when closed and occupying a slanting position have sufficient space to contain all the bedding for both upper and lower berths. A wooden panel fits in between the back of each seat and the car roof, and effectually divides the berths, whilst curtains are provided to secure privacy. Hooks are conveniently placed in each, and a net may be slung for loose apparel. At one end of the car a small smoking-room either adjoins the lavatory or forms one apartment, and at the other a ladies' dressing-room is provided. Fig. 5 shows a view of the Pullman car Maud.

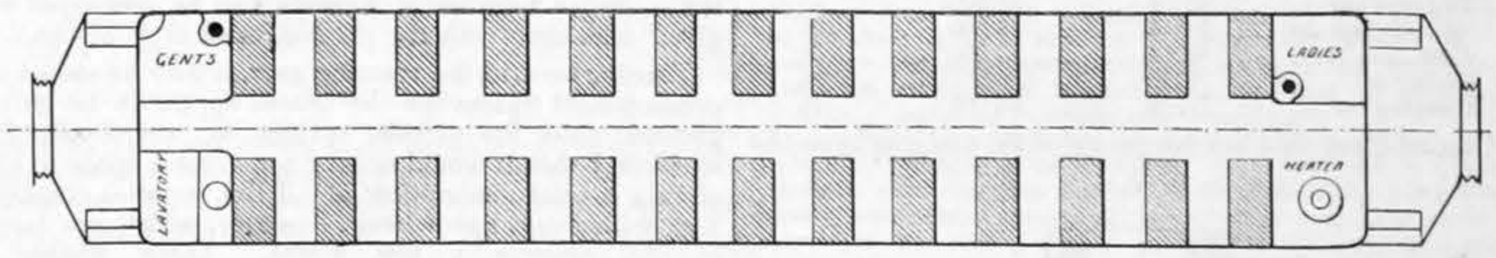


FIG 1.

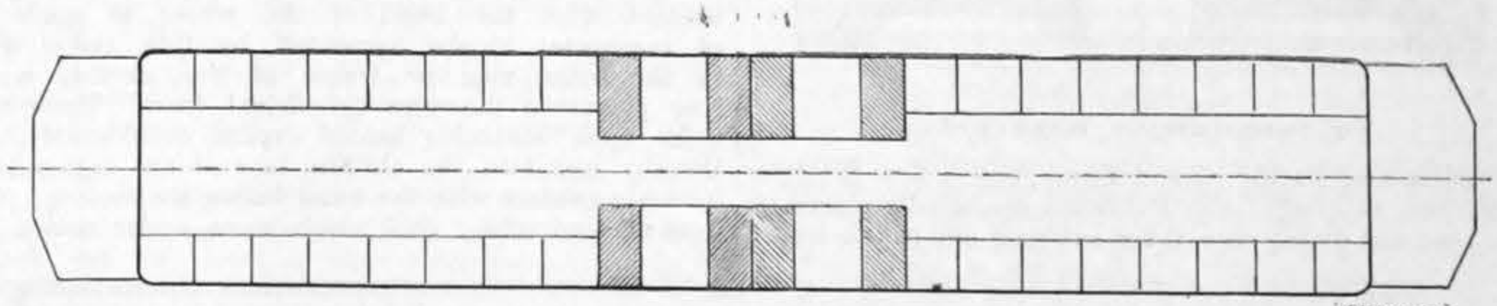


FIG 6.

Returning to the railway companies' cars, the New York Central have recently built for their famous Empire States Express some very large cars, 80ft. long and 10ft. wide, just over 9ft. inside, on six-wheeled trucks with wheels 36in. diameter. Seats are provided for eighty-four passengers, and the weight of each car is 95,400 lb.

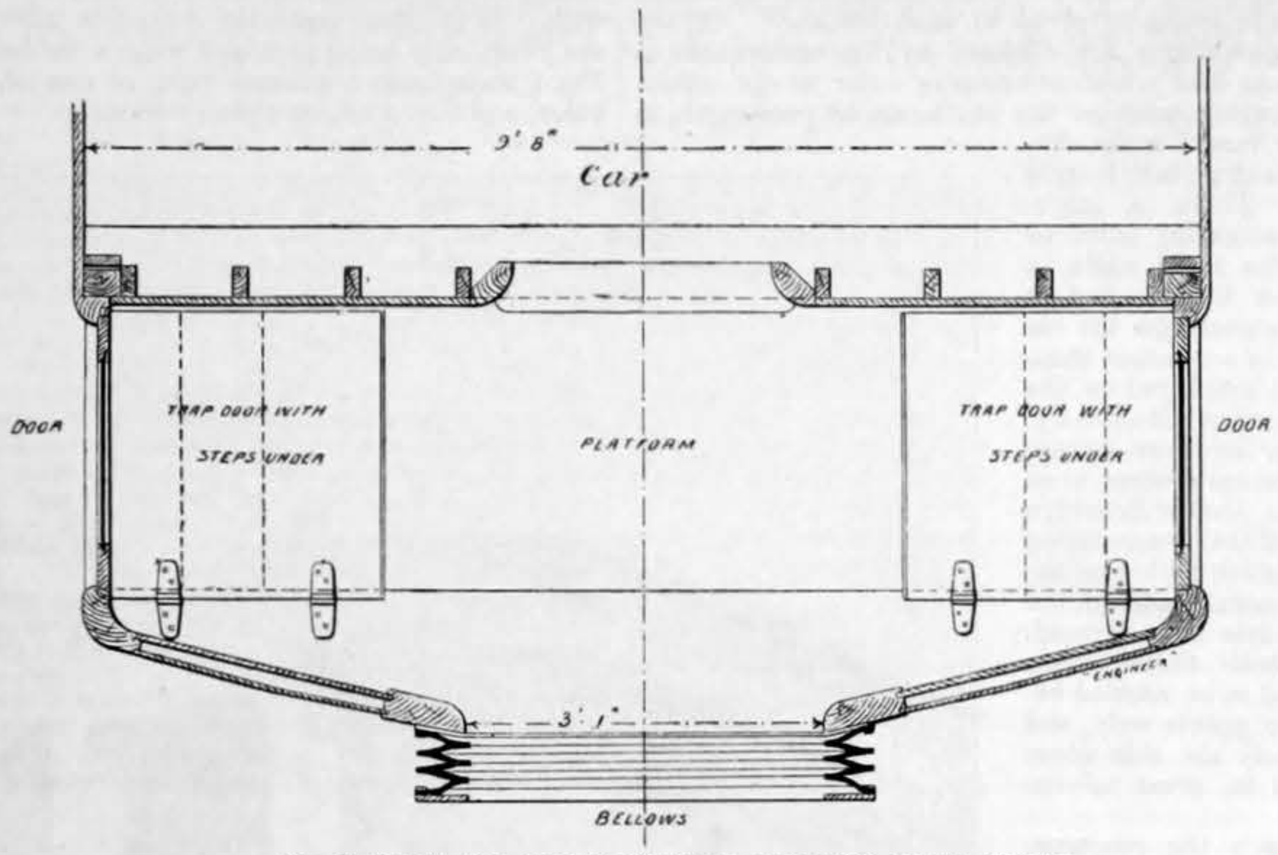


Fig. 2—PLAN OF CAR VESTIBULE SHOWING TRAP DOORS

Private cars are much used in the States, very magnificent vehicles being owned by some wealthy families, while on trains running into New York and other big cities from outlying suburbs, club cars are attached subscribed for by parties of city gentlemen resident in the district. The train exhibited by the Canadian Pacific Railway Company at Chicago was one of their standard patterns, used on the trans-continental services, and consisted of five vehicles as follows :—

	Length. ft. in.	Weight in pounds.	Seating capacity. Persons.
Baggage car	63 8	59,600	—
Second-class car ...	64 4	65,200	64
First-class car... ...	64 4	65,300	56
Dining car	70 10	85,000	44
Sleeping car	77 2	94,000	44

Second-class vehicles are provided for emigrants on the Canadian and Pacific, Grand Trunk, and a few Western American railroads; but Pullmans are usually placed in the rear and dining cars at the extreme end of the trains in America. Fig. 6 represents a plan of one of the cars employed on the Chicago Elevated Railroad. It is 46ft. long, 8ft. 6in. wide, weighs 28,000 lb., has a double door at each end, and accommodates forty-eight passengers. These cars are lighted on the Pintsch system, and the

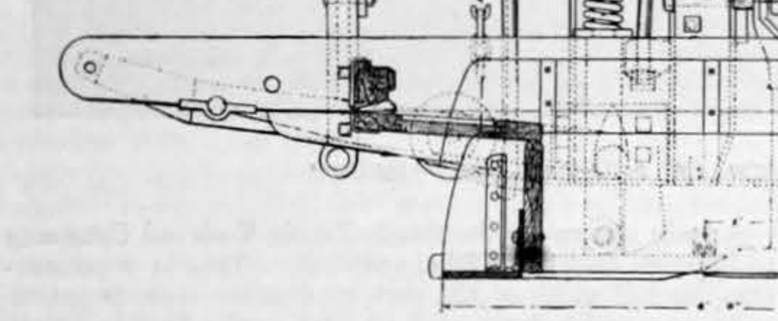


Fig. 7—SECTION OF BOIES WHEEL

trucks have wrought iron wheels. The cars employed by the Illinois Central Railroad for exhibition traffic were convertible into their standard freight cars, 35ft. long, and supported on two four-wheeled trucks. They had seats arranged transversely, with panels and windows at the sides but no doors, sliding bars only being provided across the doorways, and could be moved from either end by the conductor. Each vehicle had eight compartments or sixteen seats, and carried eighty passengers.

A type of vehicle which is coming into very general use in the States is the Harrison postal car. In this car the floor space can be utilised as required, as the tables can be raised, lowered, or detached at will. Part of the racks are simply portable, and each section, as a whole or in part, may be taken down or folded away in a very brief space of time. In the design of these vehicles special attention has been devoted to their lighting and ventilation, while the arrangement of the fittings is such that a larger number of persons can be employed in a given area than with the old-fashioned style of van.

Fig. 4—PLAN OF BARR VESTIBULE

Turning now to the running gear, it may be stated that pressed steel frames for the trucks appear to be gaining ground, while the wheels, springs, &c., employed, differ so largely that it would occupy too great a space to allow of only a brief description of all the varieties employed. The chilled cast iron wheels, however, which are largely in use, deserve a few words. These wheels are usually 33in. diameter, and are cast by some makers in contracting chills, wherein the chilling ring in contact with the tread of the wheel is made up of segmental blocks connected by thin radial webs to the outer ring or frame of the mould, which ring preserves the true cylindrical form. These thin webs upon becoming heated expand considerably, and thereby maintain the chilling face of the segments in intimate contact with the tread during the cooling. One form of contracting chill which came under notice had three surrounding rings, alternate segments of the chill surface being connected by webs to the first and second, and second and third rings alternately. Fig. 7 represents a transverse sectional elevation of the Boies wrought iron wheel, with steel tire. The retaining lip A is headed down into the groove shown after the pressed iron body is dropped into position in the tire, and to remove the tire the wheel is placed in a lathe and this ring turned out. Couplers offer an immense field for invention, and the varieties appear to be legion. They are all made to couple in the vertical plane, and have suitable arrangements for working with a link and pin if required. A defect, however, is apparent on many roads where the coupler head takes all buffing as well as draft stresses. Some companies provide their cars with cast iron buffer blocks, so that as soon as the jaws are attached these blocks come in contact.

In the description of the locomotives attention was called to the air communication means between the cars and engine in use on many of the chief trains. This comprises a small ¾in. air pipe, which runs the entire length of the train, and is charged with air under pressure from the locomotive. On the latter is placed a "signal valve," which is so constructed that a reduction of pressure in the train pipe, caused by opening cocks in any of the cars, opens a passage leading to a miniature whistle, through which air is allowed to escape, thereby giving an audible signal to the attendants.

In no country, probably, has the heating of railway cars received more attention than in the States. On some of the small roads old-fashioned stoves prevail, but on trunk roads some form of steam heater is generally used. In the Baker steam-heating system each car is rendered independent of its neighbours, a small stove being fed with coal from a hopper arrangement, and causes hot water to circulate through radiating pipes. In the Gold system, steam is conducted from the locomotive through storage heaters in the cars, charged with brine. These retain their heat for a considerable time after losing their steam supply.

In the external finish of the cars there is as great a variety as at home, the colours ranging from cream of the "ghost" train to dark blue of the Wagner cars. The Pullmans are uniformly painted a dark green and black, lined in gold, and each car is named for convenience of recognition. They are well kept, and present a fine appearance. The Pennsylvania Railroad favour a chocolate brown colour for their cars, but other roads use yellow and brown chiefly. The Canadian Pacific Railroad imitate English practice in adopting varnished wood.

Freight cars are of large size, usually running on two four-wheeled trucks, while 25,000 lb. to 30,000 lb. is a customary tare for a car of 60,000 lb. capacity. Box cars are more extensively used than in this country, but a "sheeted" truck is never seen. For mineral traffic open cars or "gondolas" are provided, whilst many roads having a large coal traffic provide hopper cars for this purpose. The Baltimore and Ohio Railroad have some unique cars, which require a few words of description. The body is made up of three intersecting cylinders, with hopper bottoms, on two four-wheeled trucks. All cars are furnished with brake blocks on each wheel. These are operated by means of a hand-wheel on the top of the car, or are brought up on a spindle 3ft. or 4ft. long in the case of platform and "gondola" cars. The brakesmen under the orders of the conductor manipulate these brakes when the train is not fitted with continuous air brakes. These men travel in the "caboose"—equivalent to the English guard's brake van—and which has a kind of conning tower or raised deck with doors opening on to the roof of the cars, suitable stairways being provided for reaching this. When approaching down grades or upon the receipt of the engineer's audible signal the "crew" of brakesmen emerge from these upper doors and run down the train on a platform arranged along the centre line of the roofs, each man braking a certain number of cars. The roofs of all freight cars are of gable pattern, not curved. For horses and cattle several car companies have special cars on hire which have suitable provision made for feeding, watering, and attending to the stock *en route*. The Burton Palace Horse Car Company provides very good equipment in this respect. The horses are placed across the car, as shown in Fig. 8, each horse being railed off from its neighbour, while a manger running along the side of the car is accessible to the men in charge by a passage between it and the car side. Special cars are also provided for fruit, meat, &c., the arrangements for refrigerating, &c., being excellent. For ballasting purposes plain platform cars are used, which can be unloaded with mechanical unloaders, resembling a snow plough drawn along the train of cars by the engine or by a winding appliance worked from it.

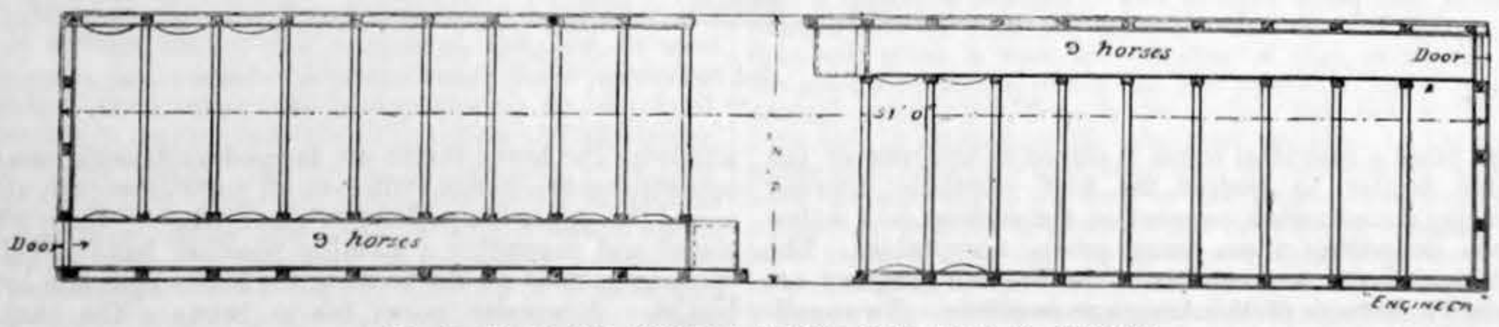


Fig 8—PLAN OF BURTON HORSE CAR FOR 18 HORSES

Public Works in Algeria and Tunis.—Five miles of a line constructed by a French society for working the phosphate beds at Tebesah, a town situated on the frontiers of Algeria and Tunis, have been recently opened for traffic. At this distance from its starting point it joins up to the existing branch line, which connects Bône-Guelma with Ain-Kissah, the principal locus of the whole undertaking, although the greatest quantity of phosphate is procured at Ain-Dibah, to which place the present railway will be subsequently extended. At Mustaphah, fifteen thousand pounds are to be expended in the building of workshops and other premises attached to the Arsenal. Towards the end of last month the first line in Algeria, constructed by the company of Algerian railways, was inaugurated, and the first train run between El-Affroun and Marengo. Since then the traffic in both passengers and goods has been constantly and regularly maintained. It is stated that notwithstanding the advanced condition of the marine works, the new town at Bizerta is not provided with any water supply, nor with any buildings of the character absolutely indispensable to the welfare of the place. The sources of the water supply of Ain-Bourras sink away into the sand. Public edifices, such as schools, post-office, law courts, town hall and others, promised since last April, are still in the clouds. Great delay attends the sale of the lands belonging to the Harbour Company, and the period of stagnation presses severely upon all branches of local trade and commerce, without taking into consideration that the present state of uncertainty and indicision may exercise a very injurious effect upon the future prosperity of the port. It is satisfactory to be informed that the inauguration of the Bizerta-Djedeidah railway will probably take place at the end of the present month although that event in itself is a reason for hurrying up with the water supply.

LETTERS TO THE EDITOR.

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

THE PORT OF MANCHESTER.

Sir,—In your issue of the 12th instant you quote from "Fair Play" a series of questions which, you say, Baltic men and others have been led to ask on consideration of circulars issued by the Ship Canal Company. The tone of these questions, and the evidently hostile spirit in which they are propounded, might lead one unacquainted with the subject to suppose that they were indeed very awkward posers for the supporters of the canal, and that it would be impossible to answer them save in the damaging sense which is suggested by the questions. Lest any of your readers should be thus deceived, allow me very briefly to deal with the "series" seriatim, with the object also of imparting to "Baltic men and others" the information of which they stand in need.

First, then, with regard to the saving to importers to Manchester direct, as compared with *vid* Liverpool. It is evident that in his remarks the questioner has in mind the cargoes of cotton which arrived in the Manchester Docks in the early part of the year. I may remark that the canal was not open for traffic last year, so I am at a loss to understand what is meant by "the freight last year."

It is quite true that on the cotton cargoes imported in January and February last there was not a very great saving as compared with cotton brought from Liverpool, owing principally to the railway companies not having then fixed a shipping rate between the Manchester Docks and inland towns, charging inland rate on the imported cotton, and owing partly to the backward state of the arrangements for storing and handling the cotton. Now, however, these initial difficulties have been overcome, and a through rate has been fixed inclusive of all charges from the ship's hold to the mill, which shows a considerable saving on cotton brought to Manchester direct, as compared with cotton ex warehouse at Liverpool, in the case of over 90 per cent. of the Lancashire cotton mills. As a further proof that there are substantial advantages in importing cotton to Manchester direct, comes the fact that at the present moment steamers are loading cotton in America and the Levant for this port, and this in spite of the alleged failure of the experiment last season. As to goods other than cotton, one instance will suffice. The Wholesale Co-operative Society, which has invested a large sum in the undertaking, stated within a few months of its opening that even though it was never to see a penny of their investment back again they would be no losers, in view of the amount they had saved by importing direct to Manchester.

Secondly, as to warehousing. The impression that Manchester is unable to warehouse cotton and other cargoes is entirely erroneous. The Canal Company has ample warehouse accommodation within easy reach of the docks, to which cargoes are easily and cheaply conveyed by barge from the ship's side, in addition to the extensive storehouses owned by private warehousemen. These are equipped with every facility for handling goods in bulk.

Thirdly, "What cargoes which usually come in bulk has Manchester a market for? Timber, grain, and cotton perhaps." Yes, timber, grain, and cotton; and, to name only some of those which have already arrived in full cargoes in the few months during which the canal has been open: Iron pyrites, ore, pig iron, boiler-plates, stone, china clay, dyewoods, wood pulp, paper, oil, green fruit, dried fruit, and fish. An excellent wholesale market, second to none in the country, exists in the city for cattle, dead meat, provisions, &c.; and Manchester does expect, and the experience of the past months proves it a reasonable hope, that general cargoes will come freely to her docks for distribution amongst the enormous population of seven millions of which she is the natural centre and nearest seaport, and to serve which she is already provided with a system of railway and canal communication with all parts of the kingdom which will bear comparison with that of London itself.

Fourthly, as to outward business: Manchester can find coal cargoes for an unlimited number of vessels, being the nearest shipping port for the collieries of Lancashire, Yorkshire, and Derbyshire; and coal can be shipped either in the Manchester Docks or at the coaling basin at Partington more cheaply than either at Liverpool or Garston. There are already a number of colliers trading regularly between the canal and English, Scotch, and Irish ports, besides numerous vessels which bring timber and other cargoes, and take out coal. Salt cargoes can also be readily obtained in the canal, one vessel having taken out 4000 tons of this mineral to Calcutta from Saltport, whilst as an instance of bulk cargoes of another kind, one of the continental lines running from Manchester has at present a contract for some 10,000 tons of carbon refuse.

Manchester, one of the greatest engineering centres in the world, can find plenty of heavy cargo for the bottom of ships' holds, and can fill them up with press-packed bales of cotton goods, &c., the most sought after and profitable cargo which shipowners can obtain.

It has been characteristic of the two cities during the past decade, that whilst Liverpool has been bragging and scoffing, and showing to her own satisfaction the utter impossibility of making a ship canal from Manchester to the sea, her elder sister has quietly gone to work and proved to the world that it could be done, by doing it, *solvitur ambulando*. Now Liverpool, trying to forget all the foolish things said about engineering impossibilities, still talks in a complacent way about the inevitable failure of Manchester's efforts to create a traffic. The latter, however, is less concerned to notice such windy verbosities than to disprove them by results, and can already point, after nine months' work, to established regular lines of steamers to British, European, Asiatic, African, and American ports, whose sailings aggregate over 100 per month, increases being announced nearly every week, and this without taking into consideration the large number of specially chartered vessels which enter the canal weekly. T. M. Y.

Manchester, October 16th.

THE THEORY OF THE STEAM ENGINE.

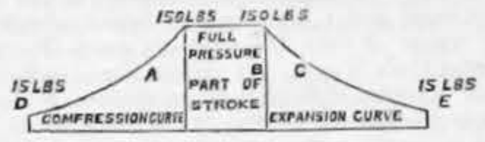
Sir,—It would be waste of time to discuss thermodynamics with a gentleman who holds that there is no difference between a permanent gas and steam, so I take leave of Mr. Cherry.

It is worth while to state more clearly than is usually done, the reasons why so much is lost in the making of the working fluid, steam. Dr. Lodge, I think, has even said that there is no loss at all. To settle questions of this kind by algebraical formulæ is only to mislead. A numerical example goes straight to the root of the matter. I shall take one pound of steam at 148 lb. absolute pressure, and consider the work which it would do with expansion between two limiting temperatures. Mrs. Glass told us long since that, before you can cook a hare you must catch it; in the same way, before you can expand steam you must make it. Let us see what the manufacture of one pound of this kind of steam involves. I will assume that we make it from feed-water at 100 deg.; then we must supply 1122 units, representing 866,184 foot-pounds. The steam is caused to work a piston loaded to 148 lb. on the square inch. The piston has 144 square inches of area, and 1 lb. of 148 lb. steam occupies precisely 3 cubic feet, consequently the piston 1 square foot in area must rise 3ft., and $150 \times 144 \times 3 = 64{,}800$ foot-pounds. That is to say, we get less than $\frac{1}{13}$ of the whole heat expended in making the steam returned.

In my last letter I showed that when the steam made under these conditions was supposed to expand down to 15 lb. on the square inch, we got back about 21 per cent. of all the heat expended in producing the steam. This, of course, includes the $\frac{1}{13}$ mentioned above, and we shall then have left about $\frac{1}{8}$ of a pound of steam, and $\frac{7}{8}$ of a pound of hot water, the two together containing the rest of the heat, and this is to all intents and purposes thrown away in the condenser. It is the enormous quantity of heat expended in converting water into steam that is the main source of loss in the steam engine.

I do not know what the latent heat of air is. I do not suppose that any one does, but I imagine it must be pretty high, because the volume of a vapour or a gas depends largely on the latent heat. Thus the steam of ether is small in volume as compared with that of water, but the latent heat of ether vapour is less than half that of water. Whatever it is, it is supplied by Nature ready to our hands. The weight of the working fluid in a gas engine remains the same throughout a stroke; it diminishes as the stroke proceeds in a steam engine.

Two points occur to me here as claiming further elucidation. A correspondent of The Engineer whose name I forget, raised a question a year or more ago about the work done during the making of steam. He was not very clear, but I think I know what he meant. His idea was that as steam falls in pressure by expansion, giving out work, so it must rise in pressure as it is made in a reverse curve, and the work expended by the heat in compressing it ought to be all got out during expansion. Thus, then, we should have a diagram like this.



The area of A should be identical with that of C, and the full pressure part speaks for itself. Now, it seems to me that this result could only be got by starting with boiling water at D, and say 15 lb. pressure, and ending with E 15 lb. and boiling water. How this could be worked out in practice I do not quite see, nor does it matter. The only point I want to raise is this:—Would such a mode of working possess any advantage? And what is much more interesting, supposing that we generate steam under a pressure of 150 lb., what occurs to the feed-water before it changes into steam? Its temperature runs up. I suppose that as it runs up some force of repulsion is developed among the molecules. Could this force be graphically depicted by a curve?

The other question of interest is this:—Supposing it was possible to generate a pound of steam at 150 lb. pressure, without doing external work. Less heat would be required than is needed to generate it in the normal way. Is this taken account of in the normal steam tables? Do the figures in the normal steam tables give the quantity of heat which can be got back by condensing a pound of steam, or the quantity expended in producing it? Obviously, the two quantities cannot be identical.

October 15th. Maurice Cross.

Sir,—Writers on thermodynamics are much to blame for misrepresenting the teaching of Carnot. Either through ignorance or through carelessness, they lead their readers to understand that Carnot intended his "reversible cycle" as one to be aimed at and approximated to in actual heat engines. That he did not so intend is made quite clear by the following extracts from his work:—"The question has often been raised whether the motive power of heat is unbounded, whether the possible improvements in steam engines have an assignable limit—a limit which the nature of things will not allow to be passed by any means whatever; or whether, on the contrary, these improvements may be carried on indefinitely. . . The phenomenon of the production of motion by heat has not been considered from a sufficiently general point of view. We have considered it only in machines the nature and mode of action of which have not allowed us to take in the whole extent of application of which it is susceptible. In such machines the phenomenon is, in a way, incomplete. It becomes difficult to recognise its principles and study its laws.

"In order to consider in the most general way the principle of the production of motion by heat, it must be considered independently of any mechanism or any particular agent. It is necessary to establish principles applicable not only to steam engines, but to all imaginable heat engines, whatever the working substance, and whatever the method by which it is operated.

"Machines which do not receive their motion from heat, those which have for a motor the force of men or of animals, waterfall, an air current, &c., can be studied even to their smallest details by the mechanical theory. All cases are foreseen, all imaginable movements are referred to these general principles, firmly established, and applicable under all circumstances. This is the character of the complete theory. A similar theory is evidently needed for heat engines. We shall have it only when the laws of physics shall be extended enough, generalised enough, to make known beforehand all the effects of heat acting in a determined manner on any body."

This states quite plainly, that what Carnot proposed to do was to find out the theoretical principles of thermodynamics, not their practical application to actual heat engines. His cycle of operations he uses as a new mathematical mode of investigation. That he never could have intended it as a model for the actual working of heat engines will be made quite clear from the fact that the operations of no actual heat engine can possibly be subject to the following conditions assumed in Carnot's cycle:—(1) The working body must, at every instant, have the same temperature throughout all its parts. (2) The working body must, at every instant, have the same pressure throughout all its parts. (3) The transformations through which the working body passes must take place so slowly, that the densities of all its parts may, at any instant, be the same as they would be if the temperatures and pressures of the parts at that instant were constant. (4) The transformations must take place so slowly, the visible kinetic energy of the working body be so small as to be negligible.

These are quotations from page 26 of my treatise. It will therefore be evident that the efficiency $\frac{T - t}{T}$ of Carnot's ideal heat engine cannot be attained to, nor even closely approximated to, by any actual heat engine unless it be permitted to work so slowly as to waste time of much more value than the heat we are attempting to economise.

With regard to the superheating of steam by free expansion, Rankine—"Steam Engine," section 253—says that it has been proved experimentally by Mr. C. W. Siemens.

Glasgow, October 13th. Peter Alexander.

GOVERNING ELECTRIC LIGHT ENGINES.

Sir,—I do not know whether there are any electric light engines fitted with the Proell or other single-valve automatic trip-expansion apparatus of like construction, but if there are, I fancy I can account for some of the difficulties of governing likely to be encountered in their use. There is a peculiar feature in the action of these apparatus that is never mentioned in the published descriptions of them, and that is, that for a certain period of the stroke, these apparatus exercise no control over the engine, and "hunting" of the governor is the only feature that makes regulation of any sort possible.

I am not aware whether this peculiarity has been pointed out previously or not, but it will be easily understood from the following:—Suppose the apparatus in its mid position, and that tripping takes places there. Then at the same instant the active trip edges clear each other, the idle trip edges will line with each other, and it is only a question of condition of the edges how far the apparatus will have passed its mid position before the falling valve will be arrested by the idle edges, and only allowed to close when these edges have travelled sufficiently far in that direction. If the edges are sharp and in good condition a movement past mid position of the apparatus equivalent to 3 or 4 per cent. of the stroke may be the position at which, when tripping takes place, the falling valve will be arrested by the idle edges, and prevented from closing until the period determined by the excentric motion. If, on the other hand, the edges are somewhat blunted, 6 to 8 per cent. may represent the movement past mid position at which the valve is arrested, but the period of closing will be as before. When tripping occurs later than the period of closing by the excentric motion, the engine is again under control.

The extent of this lapse in the control of the engine may be ascertained thus:—The angle of the crank from the commencement of the stroke until the trip apparatus is in mid position is equal to the negative advance angle, and the angle of the crank from the commencement of the stroke at which the valve, when arrested, closes by the excentric motion in that direction, is equal to twice the negative advance angle plus the lead angle. The apparatus are generally stated to have an automatic range of cut-off from 0 to $\frac{3}{4}$ of the stroke, which allowing 6 per cent. for clearance of trip edges, is equal to 38 deg. negative advance angle. The apparatus is therefore in its mid position when 10 per cent. of the stroke is completed, and allowing 6 per cent. for condition of edges, &c., any trip that takes place at 16 per cent. of the stroke will not be followed by a cut-off until $(2 \times 38 + 6) = 43$ per cent. of the stroke is completed, that being the position at which the valve closes by the excentric motion. Nor will any trip between 16 per cent. and 43 per cent. of the stroke be followed by any other cut-off but 43 per cent. of the stroke, as between these positions the valve will be arrested at every trip. Instead, therefore, of the range of automatic cut-off being from 0 to $\frac{3}{4}$ of the stroke, it is only from 0 per cent. to 16 per cent. and from 43 per cent. to 75 per cent., and the "hunting" of the governor is relied on to cross the interval between 16 per cent. and 43 per cent., during which no control can be exercised.

If the range of cut-off were limited to 55 per cent., and with the allowance of 6 per cent. for condition of edges, the negative advance angle for this range would be such that there would be no break in the control throughout; but 35 per cent. of an automatic range may be obtained from a positive advance excentric, and it is questionable whether the extra 20 per cent. is worth an independent negative advance excentric, when the positive advance slide valve excentric is ready at hand for the lesser range.

240, Wallgate, Wigan. Jas. Dunlop.
October 13th.

Sir,—I have read with much interest what has appeared in The Engineer on this subject. The letter of Mr. Robinson may be taken as an example of the difference in method of treatment which exists between the engine builder and the electric light engineer. Mr. Robinson evidently does not grasp what it is we want. A heavy fly-wheel may help us in some respects, but in others it is just the thing we do not want; everything depends on the system of working employed.

I know by experience that the average engine builder goes on the "one man one vote" system, to have one engine drive one dynamo and work one circuit, and provision must be made for variations in the demand for current in that circuit. I devoutly wish that this was the case. Without going into minute details, I may give Mr. Robinson and others of your readers a comparatively elementary case, and ask how they would deal with it. There are two engines and two dynamos; each will indicate, say, 600-horse power. During the daytime one of these supplies current, and works up to 250 or 300-horse power; as the night comes on more and more load is put on, until the power reaches 600-horse power. Then the second engine is started, and its dynamo has to send current into the same main. Obviously it must run at such a speed that the voltage shall be the same in both. At the proper moment the switch is thrown over, and both engines are now doing the work that a moment before was done by one. But the total work wanted from the two is for the time only 600-horse power, not 1200. What does Mr. Robinson suppose a governor has to do then? How would the heavy fly-wheel help?

Messrs. Robey and Co. are nearer the solution of the difficulty than any other of your correspondents, but it is easy to see that they have not quite got it. The use of current to regulate a throttle valve has been tried over and over again, and it has never yet achieved permanent success. I think the best chance lies in combining an electro-magnet with a governor of the Pitcher type, using the magnet, in fact, to hurry up the governor, and also to establish a definite relation between the engine, the current, and the number of revolutions. The centrifugal governor takes no account of current, but only of revolutions. The current ought to have a voice in the matter.

I may say incidentally that all your correspondents talk of throttle valves. What about governing Corliss engines? There is something peculiar about their action which I do not quite understand. There seems to be a considerable range of speed at certain ratios of expansion when they do not govern at all. Thus a governor will do very well at ranges between no admission and 14 or 15 per cent. and within 50 and 63 per cent., and very badly indeed at other ranges. I should like to have this point cleared up. It has something to do with the trip faces, I fancy.

Bolton, October 16th. P. K.

OIL-FIRED STEAMERS FOR HARBOUR USE.

Sir,—I have read with much interest your leader which appeared in your issue of 21st ultimo in relation to "Oil-fired Steamers for Harbour Use;" the only objection I take to it is that it stops short at the advantages and utility to "steamers for harbour use," and therefore I now propose to demonstrate that this is only a very restricted sphere for oil fuel, inasmuch as all that you have written is equally applicable to ocean-going steamers.

I proceed to analyse the possible objections which "vested interests" may see in this assertion. Firstly, it will be asked by those in opposition, Can the oil fuel be obtained in sufficient and easily procurable supplies at the respective ports of call? My answer is emphatically "yes;" for from the moment that a regular demand for oil fuel manifests itself contractors for delivering the same at any desired point or points can be found in the same manner as is done with coal now. Anybody who has studied the question of the possibilities of the oil production of the world can determine for himself that eventually the supply would be equal to any demand the markets might make on it, subject only to ordinary trade fluctuations in price. It is a well-known fact that large tracts of country in various parts of the world are known to be oil bearing, and only require the stimulus of a commercial demand to enable these new fields to come into actual working. Secondly, it has been widely asserted that, so far, no system of working has been discovered which would bear the daily wear and tear of a long ocean trip; ample proof to the contrary is available.

Now I come to the question — Will the underwriters of the hull or the cargo raise any difficulties, or in any manner penalise the oil system as against coal?

From all the inquiries I have made from responsible quarters, I can with safety answer this in the negative. All that will be required is that the oil system of firing be carried out under proper rules and regulations, which will be formulated by the recognised insurance authorities to meet the case; and, from what I have ascertained, such would in no way be drawn up so as to make the adoption prohibitive or in any way disadvantageous in competition with coal. Doubtless, on the other hand, at the first set-off, merchants' minds would have to be set at rest as to a possible prejudice to their cargoes from the new system of firing, and this factor, no doubt, weighs heavily with the shipowner, who otherwise has an open mind on the subject.

I am confident that the prejudice existing on this score would very soon vanish by practical experience, inasmuch as it has already on various occasions been demonstrated that it has no existence in fact. For example, it is well known to all concerned in the oil trade that oil tank steamers have carried cargo—such as sago and other fine freight—in their empty tanks without any

damage or injury which would be ascribed to their mode of carriage.

The comfort of all on board, be they passengers or crew, would under all conditions be greatly enhanced. As a professional man, I can only hope that some far-seeing commercial mind will grasp and vitalise what appears to me so patent as this superseding of coal by oil fuel in ocean steamers and in other important trading and industrial enterprises. That it must come about, notwithstanding all opposition, I feel sure.

Edwin N. Henwood, N.A.

22, Great St. Helen's, London,
October 13th.

LABOUR AND LUXURIES.

Sir,—I was much amused by the letter of your correspondent, "X. Y.," published in your issue of the 12th inst. In it he defines the science of political economy, a science intimately connected with human affairs, as "knowing nothing of morals."

Such a science may be interesting as a curiosity, but it can be of no practical value. It is as if an engineer were to propound a theory of boiler furnaces which took no account of the draught. Further, I would ask "X. Y." to consider whether it is employment that men desire, or whether it is food, clothing, and the means of developing their minds and bodies to the full. I think he will agree with me that man cannot live by work alone. In fact, all the tendency of recent improvements in machinery is to reduce the amount of human labour required by the world. If, then, food, clothing, and the development of mind and body is what men want, any labour spent otherwise, which might have been employed in obtaining these, is a dead loss to the community.

Again, as to low wages. Let us, for example, take a collier and a distributor of coal, each of whom receives one-half of the price of the coal paid by the consumer. Now, suppose that the collier's wages are reduced by 50 per cent., the cost of the coal to the consumer, and therefore, arguing on the lines of "X. Y.," the cost of all commodities to the collier will only be reduced by 25 per cent. Thus he is very distinctly a loser.

Finally, shall I be considered rude if I recommend to "X. Y." a careful study of the writings of Carlyle, Ruskin, and Solomon before he writes again on "Labour and Luxuries." Hirn.

Owens College, October 15th.

Sir,—It is difficult to reconcile "X. L.'s" views with the writings of the authorities he names. Perhaps none of them use the actual noun *benefactor;* but in treating of a similar question, Adam Smith uses the word *generous*. Ricardo speaks of sympathy with, and desire to benefit the working man, and Mill speaks of doing good to the labouring classes. Indeed, the Woolwich labourer might gather powerful arguments from Mill.

"For practical purposes, political economy is inseparably intertwined with many other branches of social philosophy. Except on matters of mere detail, there are perhaps no practical questions—even among those which approach nearest to the character of purely economical questions—which admit of being decided on economical premises alone. And it is because Adam Smith never loses sight of this truth—." But I need not extract the rest of Mill's praise of his predecessor from his eloquent preface, for no more is needed to show that both regarded political economy as the study of man's well-being. So far nothing has been advanced to show that the labourer's economics were hazy, however shaky he may have been as to matters of fact. W. A. S. B.

October 16th.

ALUMINIUM TORPEDO BOATS.

Sir,—Referring to the letter which appeared in your last issue regarding the aluminium torpedo boat, lately constructed by us for the French Government, in which a comparison is made with a similar type of boat also built by us—described in your issue of December 11th, 1891—we have the pleasure to explain what seems to be a discrepancy in the results. The speed obtained in the earlier-constructed boat was 20·03 knots, being the mean of six runs on the measured mile; and the trial was conducted in light trim, while in the case of the French boat a load of three tons was carried, and the trial for speed was the mean obtained during a continuous run of two hours, consequently the earlier boat was tested under much more favourable conditions—partly due to the shorter duration of the trial, and partly to the lesser weight carried. If the aluminium boat had been tested in the same manner as the earlier boat, as regards the load carried and duration of trial, there would have been no difficulty in obtaining 22 knots. The gain of 3½ knots—referred to in your recent description—has reference to a comparison between the latest boats of the same class built by us for the British Government, which were furnished with locomotive boilers. These boats obtained 17 knots, under the same conditions of load and duration of trial as the aluminium boat; therefore, in comparing the two, the statement is quite correct that the aluminium boat is the faster to the extent of 3½ knots. This gain is due partly to the adoption of aluminium, partly to the superiority of the water-tube over the locomotive boiler, and partly to the correct balancing of the machinery. We trust this explanation will make the facts clear to your readers.

Poplar, October 13th. Yarrow and Co.

MODERN LOCOMOTIVES IN THE RECENT COLLISION.

Sir,—The statistics given as to weight of train in the recent collision seem to show, either that the six-wheeled rolling stock still used by the East Coast lines run with more friction than the bogie carriages as running all over the Great Western and Midland railways, or that the ponderous compound locomotives recently built by the North-Eastern Railway cannot haul a train of only fourteen coaches over easy gradients without a pilot engine. The approximate weight of train was as follows:—

	Tons.	
1st engine	40	162 t., engines and tenders.
Tender	35	
2nd engine	52	
Tender	42	
13 6-wheelers	169	194 t. train.
1 Pullman	25	
Total weight	356	

There is no doubt whatever that one of Mr. Macdonnel's engines, weighing 39 tons, and tender with pick-up, weighing 15 tons, altogether weighing 54 tons—equal to only 28 per cent. of carriage weight instead of 84 per cent. as above—would easily have hauled the train in question.

I venture to think that some information from railway men as to the above question would be of interest, not only to shareholders, who are annually met with the tale that increased working expenses have more than swallowed up all profits from increased traffic, but also to that constantly increasing class of travellers who, like your humble correspondent, follow eagerly all that appears in the press as to railway developments, &c. F. Bowles.

34, Queen-street, London, E.C., October 15th.

FRENCH CRUISERS.

Sir,—The French cruisers you illustrate excel British cruisers of the same displacement in armament and armour. Surely there is something *per contra*; is it such as a naval officer would prefer to the heavier guns? Also, I note, comparing your notices of the Antwerp Exhibition with that of the late sea fight, that the Japanese had at least three very heavy guns. I presume that they made worse practice than the Royal Sovereign did the other day. W. H. E. B.

October 16th.

THE IPSWICH SEWERS AND ELECTROLYTIC SANITATION.

At the meeting of the Ipswich Town Council, held on the 10th inst., the Sewerage Committee, in the course of a lengthy report, remarked that to lessen the danger of the escape of deleterious gases from the sewers, they had been obliged to pursue a policy of closing the old sewer gratings, and erecting at considerable expense ventilating shafts and columns. A report presented on the 1st of March last by the Borough Surveyor showed that the sum provided for flushing and ventilating the sewers, by a loan raised in October, 1889, was exhausted, and that in all £963 had been spent. The surveyor considered that it would still require some 200 or 300 shafts and columns to deal with those yet unenclosed, at an expenditure of about £1000. Having these facts before them, the Committee deemed it desirable to make a trial of the Hermite process. The drain selected for the trial was the old sewer discharging itself by the Great Eastern Railway Company's bridge over the river approaching the main station, and running from the Cattle Market. This sewer has connected with it twenty-nine water-closets, and it also receives the drainage of a number of houses, the drainage and washing of the Cattle Market, a slaughter-house, and a malting and brewer's store, besides the condensing water of the Grey Friars'-road Foundry and the Mineral Water Co.'s Works. At various times samples were taken, and on each occasion a distinct improvement in the condition of the sewer was traceable. On the 6th of September it was deemed unnecessary to continue the experiment further, the whole of the drain having been purged of offensive odour and disinfected. As a result of the experiments, the Committee were able to state:—(1) That the fluid known as electrolysed sea water has proved itself to be a most valuable agency for the disinfection and deodorisation of sewage; and (2) that it could be produced at a smaller cost than any other disinfectant or deodoriser.

It was computed that the average daily dry weather flow of sewage for the borough amounted to about one million and a-half gallons, and it was estimated that it would be necessary, in order to deodorise this quantity of sewage, to electrolyse about 23,000 gallons of sea water to the strength of 2·25 grammes of chlorine = 35 grains of chlorine per gallon. This quantity would, in fact, suffice to deal with a population and its manufactories of 57,000 inhabitants at the rate of 1 gramme of chlorine = 15·5 grains per head of the population per twenty-four hours; but the population of the borough using the sewer was only estimated to be some 45,000, showing a large excess of electrolysed sea water to the actual head of population. The committee were of opinion that the electrolysed sea water should be allowed to fall into the main sewers, at all events for a few months, at different points along the line by means of pipes which can be laid within the sewer itself. It was fully to be expected that after a short period had elapsed, say six months, the power of the present accumulations in the sewers would have become so paralysed, if not sterilised in regard to their germ, and consequently gas-producing power, that the chlorine of the solution would travel greater distances, and in time it might be unnecessary to have more than one or two points of discharge into the sewer. It was believed that in the adoption of this process and its proper application, considerable sums would be saved which were at present expended on disinfection in other forms, and that the necessity for any further expenditure on the erection of ventilating columns or shafts would be entirely removed, and that the cost of water for flushing by lessened consumption would be very largely diminished.

The committee anticipate that the final question of dealing with the solid matter at the outfall would be very considerably assisted by the adoption of this process. It was believed that not only will disagreeable odours not be traceable at the outfall tanks and works, but that, on the contrary, chlorine would be found to be present there, and that all discharges into the river at the outfall will be absolutely inodorous within a reasonable period. The question of dealing with the solid matter had not escaped the committee's attention, and suitable screens are now in course of erection to intercept it at the outfall. From experiments which had been made it had been proved that the animal life in salt water could not be affected by the discharge into it of electrolysed sea water.

The committee reported that the total cost of the plant for Hermite disinfection would be £2000, the annual expenditure would be £443, with an annual saving under other headings of £147, making the net annual expenditure £296. Mr. Napier presented a lengthy report, giving as his conclusions:—(1) That sewage is instantly deodorised when mixed with a sufficient quantity of Hermite electrolysed solution. (2) That the decomposition of the sewage is retarded by the said mixture for a length of time, depending upon the strength and quantity of solution added, and that during this time no offensive smell is given off. (3) That if this solution, giving 40 grammes of active chlorine per minute, is discharged into the main and various arterial sewers, the offensive smells at present escaping from the manholes will be prevented, and the sewage made sterile—as far as consumption goes—for several days, sufficient for it to get well out to sea before becoming offensive. (4) That if the proposed installation produces more active chlorine than is required to oxidise the sewage, a portion of the excess chlorine will be in the form of gas, and, escaping into the air, will form an aërial disinfectant, and where sewers and drains are not properly trapped, instead of offensive sewer gas going into houses, there will be this chlorous gas acting as a disinfectant. (5) That of the processes for treating sewage that I know of, all do so at the outfalls, the object being to utilise the precipitates from the sewage, or to keep, say, a river free from pollution. A process may be adopted at an outfall for precipitating objectionable matter, or for preventing pollution, but no benefit from that will be derived by the town; but with this Hermite process the solution is distributed in the arterial sewers, the disinfection takes place there, and the sewage rendered inoffensive on its passage through the town, and is kept so for a number of days, sufficient for it to get through the whole system of sewers into the Orwell. I am of opinion that if this process is adopted, and a sufficient quantity of solution manufactured, Ipswich will benefit greatly, because by having the drains and sewers disinfected, and a flow of deodorised—perhaps sterilised—sewage through the town, the health of the inhabitants will be considerably improved.

Alderman E. R. Turner moved the adoption of the report, which he said he did with very great pleasure and satisfaction. They had had a full report, he said, from the surveyor as to other systems, but none of them were thought so applicable to the town as the Hermite process.

Mr. Goddard was surprised that a matter which had previously provoked so much difference of opinion should have provoked so little discussion that morning. He supposed that the Council had come to the conclusion that the Sewerage Committee had thoroughly investigated the matter, and placed confidence in their report. As to the cost, the previous information before the Council was that a capital expenditure would be required of from £8000 to £9000, and an annual expenditure of £1200, and the cost of the Hermite process was very considerably less. This process was said to be a speculation, and it was to a certain degree a speculation, but one which had been as highly tried as any system could be tried. First of all, it had been tried experimentally by many experts, and there were sheafs of information by those experts. As a means of dealing with sewage, he believed this process compared most advantageously with anything else that had ever been suggested. He should be very sorry to lead anyone to expect that if they adopted this process there would never be any unpleasant smell from the river, for he believed that in a river so full of weeds as theirs was this was impossible. He thought this process had this great advantage over all other processes he had looked into, namely, that of being a liquid process. Only a small labour would be involved in removing what was caught on the screens at the outfall. Besides dealing with the main sewer, the process would give the advantage of providing the borough with a powerful disinfectant which they could, at a small cost and very little trouble, convey to any part of the town. The resolution was adopted.—*East Anglian Daily Times.*

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

(*From our own Correspondent.*)

A new application of steel in this district is just now being made by Messrs. Lysaght Limited, of Wolverhampton. The step they have taken is considered hereabouts one of great importance, as signifying the successful attempts which are being made to adapt steel to purposes which have hitherto been carried out by the utilisation of iron. For some time past it has been an open secret that a firm who are one of the largest galvanised sheet producers in the Midlands have been experimenting with the newer metal, with the result that in the future they will most probably entirely abandon the use of iron for galvanised sheet manufacture. To provide for the new departure, one of the finest steel rolling plants to be found in the country has been laid down. It is found that greater economy is secured by the lower cost of the steel as compared with iron, and the lessened quantity of spelter absorbed on account of the closer grain and extra smoothness of surface. Whether or not other galvanised iron concerns will generally follow the example which has been set them by Messrs. Lysaght remains to be seen. Certain it is, however, that ironmasters recognise the increased prominence with which steel is now coming to the front, and to keep abreast of the times it is not unlikely that they will consider it desirable to early alter their present mode of production.

Business is unaltered on the week at last week's prices. The only new fact to communicate is, that preparations are being made to restart some of the blast furnaces at the Corngreaves Ironworks almost immediately.

An electrical engineering undertaking that has cost between £45,000 and £50,000 has been opened at Worcester. This is the new electric lighting works which have been erected by the Worcester Corporation. Water power is derived from a fall on the Teme at Powick, and is developed by four inward flow turbines of the Victor pattern, two 54in., one 48in., and one 30in., the total turbine power being 500-horse power. There is also sufficient steam plant to generate the whole of the electricity, should the water supply fail. There are three vertical compound engines of the marine type, the cylinders being 15in. and 25in., and the stroke 16in., each of 290 indicated horse-power. The turbines and engines are connected by cotton driving ropes with the four Mordey Victoria alternators, each having a capacity of 125,000 watts, and absorbing about 200-horse power. The engine-room has a travelling crane, lifting 12 tons. In the boiler-house are four Babcock and Wilcox water-tube boilers, equal to about 900-horse power, fed with the river water by two duplex feed pumps. The current is taken to Worcester by two pairs of copper mains, at a pressure of 2000 volts. The Brush Electrical Engineering Company is the contractor for the machinery and electrical plant, and Messrs. Rowbottom for the building of the generating station; Mr. Leonard Wigan, A.M.I.C.E, being clerk of the works. Mr. Preece is the expert who has advised the Council. Worcester is the only municipal body supplying electricity by water power, and the new station is the largest water-generating station in the kingdom.

Railway engineering schemes continue to increase in number. The latest is a movement to induce the Midland Railway to extend its system in the immediate neighbourhood of Birmingham. The railway authorities at Derby have before them a proposal. It is suggested that, using the present rails to Water Orton, the Midland Company should from that place construct a line to skirt the town of Coleshill, and then proceed through Maystoke to Meriden and Allesley, and enter Coventry on its western side. From Water Orton to Coventry is 21 miles, as against 18½ from Coventry to New-street. It is proposed that the line should go thence to Rugby and on to Northampton, where there are Midland branches, and that to Bedford could be used as the line to London. The Midland journey from Birmingham to London would thus be shortened by 30 miles. The matter is, however, so far a suggestion only.

It is rumoured that a large consignment of guns and ammunition, all of the latest improved type, has been purchased and sent away from the Midlands by a roundabout route to Japan, being first consigned to another country in order to evade the Foreign Enlistments Act. The same firm is said to have been approached by emissaries of China for a similar purpose almost at the very time that Japan was negotiating.

Messrs. G. Kynoch and Co., Witton, Birmingham, are understood to have obtained a contract from the Government for the supply of 600 tons of cordite, the delivery to extend over three years. The firm have mills in Yorkshire, but will probably also erect new ones in another part of the kingdom. Hitherto cordite has been manufactured exclusively at the Government works at Waltham Abbey, and this obtaining of a portion of their supplies from the trade is a new departure.

Local engineers express satisfaction at the announcement that the Government has decided to spend 520 lakhs of rupees this year and 500 in each of the following two years on railway construction and irrigation works.

Birmingham manufacturers of copper wire have good reason for their complaints this week of the rapid development of French competition in this country. Several leading French companies, acting as a syndicate, recently effected extensive contracts with American firms for copper at £3 per ton below existing rates. Fortified by this advantage, the agents of the syndicate's firms are now offering copper wire for telegraph and other purposes wherever needed in England at less money than Birmingham manufacturers can produce it, and contracts are being accepted for the whole of 1895.

NOTES FROM LANCASHIRE.

(*From our own Correspondents.*)

Manchester.—A continued absence of any improvement in the position throughout the engineering and iron trades of this district is again the general report, and any hopeful prospect would seem now to have disappeared altogether, so far as the present year is concerned. For the immediate future a slow dragging trade is all that is looked forward to; but, there are apparently some sanguine expectations that the spring of next year may bring forward a revival of activity. In the meantime, makers and manufacturers of iron are finding it difficult to secure business to keep them even partially going at anything like remunerative rates, and the present position is about as unsatisfactory as it could well be. The coal trade also continues in a depressed condition, so far as all descriptions of fuel for general manufacturing purposes are concerned, and the tendency as regards these would seem to be rather in the direction of even still lower prices, owing, not only to the excessive local supplies, but to the keen competition from other districts.

Only a very slow business continues to be reported on the Manchester Iron Exchange, and although there was a full average attendance at the market on Tuesday, a dull, depressed tone prevailed generally. For pig iron business continues to be restricted to the smallest possible quantities, consumers and merchants being in most cases more than sufficiently bought for present requirements, and the tendency of prices—where there is business offered to really test them—is in a downward direction. Lancashire makers still quote nominally on the basis of about 39s. 6d. and 40s. for forge to 42s. for foundry, less 2½ at the works; but the business they are doing at these figures is restricted to only occasional small

parcels, sold to regular customers. District makers are generally in the position that their books are practically full for the next month or two; but in some instances iron is being thrown upon their hands, owing to customers not taking their full deliveries, and consequently they have to seek for orders in the market. Makers who prefer to go on simply with contracts are, of course, holding firmly to full recent quotations, but where they do come upon the market they have to give way to secure orders, and 39s. now represents the full average selling figure for forge Lincolnshire, with foundry quoted about 40s. 6d. to 41s., and Derbyshire foundry about 45s. up to 46s. net cash delivered Manchester. Outside brands offering here are decidedly easier; good foundry Middlesbrough can now be bought readily at 44s. 4d., with good-named brands quoted at 44s. 10d. net cash delivered Manchester, whilst as regards Scotch iron, it is difficult to get more than 48s. net prompt cash for Eglinton, delivered at the Lancashire ports.

The position in the finished iron trade still shows no improvement, very few forges having work sufficient to keep them running more than about four days per week, and although makers still quote late rates, these are difficult to maintain where new business is concerned. The very small orders just now coming upon the market offer, however, no inducement to give way, but if anything like good specifications were put forward there is little doubt some concessions would be forthcoming to secure them. Delivered in the Manchester or Liverpool district, quotations for Lancashire and North Staffordshire bars remain at £5 7s. 6d. to £5 10s.; Lancashire and Staffordshire sheets, £7 to £7 5s.; and for Lancashire hoops, £5 17s. 6d. for random, and £6 2s. 6d. for special cut lengths. With regard to hoops, I may mention that a fairly large South American order, which it was generally anticipated would be placed in this district, has been secured by German manufacturers, and this has given rise to the question whether the Association list rates should be made binding only as regards home trade, leaving makers free to compete for foreign business. Nut and bolt makers report only very few orders giving out, and these are competed for at very low figures, the effect of foreign competition being also complained of in this branch of industry.

In the steel trade only a very quiet business continues to be reported with low prices ruling. Ordinary foundry hematites do not now average more than 52s. 6d. to 53s., less 2½; ordinary basic billets, £4 net cash; steel bars, £6 to £6 2s. 6d.; and boiler plates, about £6 5s. per ton, delivered in the Manchester district.

In the metal market list rates for manufactured goods remain unchanged, but buyers continue to purchase only in the smallest possible hand-to-mouth quantities.

The position as regards the engineering industries still shows no indication of improvement; in the locomotive building trade especially the outlook is most discouraging, and I hear that one of the largest firms in Lancashire may possibly have to close altogether before very long, owing to the entire absence of new orders coming forward.

The reports of the engineering trades union organisations show no appreciable change in the position, except that the returns of unemployed members are rather more favourable than they were last month. The returns issued by the Amalgamated Society of Engineers show a slight decrease in the number of members in receipt of donation benefit, but there are still very nearly 9 per cent. of the total membership in receipt of out-of-work support. In the Manchester district there has been a steady but small decrease in the number of unemployed members during the past fortnight; the position is, however, still anything but satisfactory, as very nearly 10 per cent. of the local membership continue in receipt of out-of-work support.

The Steam Engine Makers' Society also reports a slight decrease in the number of unemployed members, although not sufficient to have any appreciable effect, as there are still over 5½ per cent. of the total membership in receipt of donation benefit. With regard to the general condition of trade, the reports from the various districts continue very unsatisfactory so far as any immediate prospects of improvement are concerned; in some important districts the tendency is even towards a further decline, and it is only here and there that any increasing activity is reported. The general conviction amongst the leading officials of the trades union organisations is that no improvement in the engineering industries can be looked forward to, at any rate during the present year, but the executive of the Amalgamated Society of Engineers are, I understand, in possession of information which is regarded as of a very trustworthy character, that with the ensuing spring there is every probability of decidedly improved conditions.

The winter discussion session of the Manchester Association of Engineers should prove an attractive one for the members, as the syllabus contains a number of specially interesting papers. Mr. J. Holliday, of Dublin, is to contribute a paper on "The Cost of Steam Raising," and this will be followed by a contribution by Mr. James Atkinson, M.I. Mech. E., on the "Modern Development of the Gas Engine." Mr. Joseph Nasmith will deal with the recent considerable developments of "Prepayment Meters," which are now so largely adopted by gas-users in small dwellings. A specially interesting paper will be one by Messrs. D. Selby-Bigge and G. H. Firth on "Electricity as the Future Motive Power in the Textile Industries." Mr. J. West, M.I.C.E., of Manchester, who is an authority on all questions connected with the application of gas, is to read a paper on "Gas-lighting for Workshops," and Mr. R. H. Tweddell, M.I.C.E., will contribute a paper on "Hydraulic Machine Tools," with regard to which he is also a well-known authority, whilst one evening is set apart for an open discussion, to be opened by a communication from Mr. A. Saxon, on "Steel Castings."

The coal trade still shows no appreciable improvement, except so far as the season of the year brings forward the usual increased demand for housefire consumption. This is enabling many of the collieries to get into more regular work, and tending to stiffen up prices for the better qualities of round coal, but there is no really upward move, except that list rates are being more firmly adhered to, best Wigan Arley now fetching 11s. up to 11s. 6d., with Pemberton four-foot and seconds Arley quoted at 10s. to 10s. 6d., and common house-fire coals about 8s. to 8s. 6d. at the pit mouth. Other descriptions of fuel for iron-making, steam, and general manufacturing purposes still meet with only a very slow sale, with supplies plentiful, engine fuel being if anything even more of a drug upon the market, owing to the increased production of slack, resulting from the larger inquiry for house-fire coals. Steam and forge coals at the pit mouth do not average more than 7s. to 7s. 6d. per ton, and the outlook with regard to this class of fuel is anything but encouraging, as there would seem to be a probability when the shipping season to the Baltic ports is closed that a considerable quantity of common round coal from the Yorkshire district may be forced upon this market, and already there are indications that some of the Yorkshire coalowners are seeking for inland business at prices under their current quoted rates. There are also large supplies of engine fuel coming in from other districts at extremely low figures, Derbyshire slack being offered at as low as 1s. 6d. to 1s. 9d. at the pit mouth, and prices generally show a weakening tendency. At the pit mouth, Lancashire slack averages 3s. 6d. to 4s. for common sorts, 4s. 6d. to 5s. for medium, up to 5s. 6d. for the best qualities, and to effect clearance sales specially low rates are frequently quoted.

In the shipping trade a moderate business is still reported, with ordinary Lancashire steam coal ranging from about 8s. 6d. to 9s. per ton, delivered at the Garston Docks or the High Level, Liverpool.

Barrow.—During the past week smelters of iron in North Lancashire have not done a very big business; in fact, rather the reverse is the case. Although there has been a certain amount of firmness in the market towards the end of the week, there has been no appreciable difference in the demand. Consumers on every hand have few requirements, and are only placing small orders. Steel makers are using fair supplies, and are likely to want more; in the meantime, however, the trade doing is small, and the same inertness that has been so noticeable for so long is very prominent. Prices are much about the same, being easy. Makers are asking 44s. 6d. to 45s. 6d. per ton for parcels of mixed numbers of Bessemer iron, and in the warrant market holders are asking 43s. 4d., with buyers offering 43s. 3d. per ton, net cash. Thirty-three furnaces are blowing, and their output is quite sufficient to cover the wants of consumers, for the stores of iron had been added to during the week to the extent of 20 tons, making the total held 158,510 tons.

The steel trade is still quiet. The demand for steel shipbuilding material continues to be small. Some fair orders are held for Barrow and Belfast builders, and the mills at Barrow are likely to be fairly employed for a while yet. In the meantime there are some orders in the market. Ship-plates are at £5 7s. 6d., angles at £5 10s., and boiler-plates at £6 per ton. The inquiry for rails is without change, and little is doing. Heavy sections are at £3 15s., light rails at £5 5s., and colliery sections at £5 10s. per ton. There is a fair demand for tin-plate bars, and it is expected that this inquiry will be considerably strengthened in the immediate future. The current quotation is £3 17s. Other sections are very poorly inquired after, and next to nothing is doing.

There is a fair amount of activity noticeable in the shipbuilding and engineering trades. Shipowners are, however, not very much disposed to place orders just at present.

The demand for iron ore is quiet, especially on general account. Average sorts are at 8s. 6d. to 9s. per ton net at mines.

East-Coast coke is in fair demand at 17s. per ton delivered.

The shipments of iron and steel from West-Coast ports for the past week reprecent 9100 tons, as compared with 13,325 tons in the same week of last year, a decrease of 4225 tons. The shipments to date stand at 591,086 tons, as compared with 596,167 tons last year, a decrease of 5080 tons.

THE SHEFFIELD DISTRICT.

(From our own Correspondent.)

The variable weather we have had during the last ten days has unfavourably affected the house coal trade, but there are now evidences of its becoming firmer. The advance of 6d. to 1s. per ton has been generally obtained, and at the date of writing the cold has set in, accompanied with damp, which is certain to cause householders to complete stocking for the winter. Although the demand in the Barnsley district has fluctuated considerably, business has now become somewhat steadier, and a considerable number of collieries are working the full time. New sinkings are being proceeded with at Hickleton Colliery, which, with the commencement of the work at Grimethorpe, will materially increase the output of the district. The Mitchell Main Colliery Company, to which the new workings at Grimethorpe belong, has taken over the Darfield Main pits, and when the new collieries at Grimethorpe are completed, the company's operations will extend to an area of underground work of three miles. With a yearly output of marketable coal increased to one million tons, the Mitchell Main Company will take its place in the front rank of English collieries. Other owners are at present employing colliery engineers to test the coal boundary of their land with a view to extension. These investigations are mainly confined to the Silkstone bed. The metropolitan demand is reported to have been merely moderate. Silkstones fetch from 8s. 6d. to 11s.; Barnsley House from 8s. 9d. to 9s. 6d. per ton; second qualities, from 7s. per ton upward—all prices at the pit. In steam coal values continue steady, Barnsley hards making 7s. 9d. to 8s. 9d. per ton; inferior slacks from 7s. 6d. per ton. Heavy deliveries are being made to railway companies on account of contracts. Gas coal is quoted at from 7s. to 8s. 6d. Manufacturing fuel is somewhat depressed, owing to the small demand in the textile districts. Good slacks are from 4s. 6d. to 5s. 6d. per ton; pit slack, from 3s. 6d. per ton.

The position taken up by the colliery enginemen, boilermen, and firemen is not quite so acute as it was last week. Although their Union, which is not associated with the Miners' Union, had decided to adhere firmly to their demands, and to stand by the notices they sent out a fortnight ago, a more conciliatory attitude prevailed at the last conference with the coalowners held at Sheffield on Monday. It was then arranged that the notices which would have expired this week should be withdrawn and work continue, pending another meeting of the coalowners to be held a fortnight hence at Sheffield. Had this arrangement not been made, and the men still adhered to the position taken up at Barnsley, a serious rupture was inevitable at the Yorkshire coalfield, for the pits could not possibly go on working without the colliery enginemen and their colleagues. It is not expected that the difficulty will lead to any stoppage in the coalfield.

A better demand for crucible steel is reported from the Continent, but the fresh business is not evenly distributed, several firms being well employed, while others complain of want of work. Taken all round, however, the crucible steel trade is reported to be more active than in the corresponding period of 1892. Last year, of course, very little was doing owing to the stoppage of the collieries.

Bessemer billets are quoted at £5 10s.; bar iron, £5 10s. to £5 15s.; wire rods, £5 5s.; and rope rods and high carbon rods, £8 8s. per ton. The iron market is very much as last reported, hematites being at 50s. to 52s. 6d. per ton, according to brand; while common forge iron is quoted at 38s. 6d. per ton in Sheffield, with supplies considerably in excess of the demand.

An important order for armour-plates was received in Sheffield this week from the British Admiralty. If these orders for armour-plates were followed by a revival in the shipbuilding yards and some signs of activity in the construction of foreign railways, Sheffield would soon be extremely busy. As it is, the war material branches are about the only departments in which full employment is given. No doubt the low freights for cargoes militate against shipowners adding to their fleets, and the unsatisfactory traffic returns are responsible for the holding back of orders for railway material. A good deal of wagon work has been locally placed, but the facilities for production are so great that even large orders are soon completed. Engineering firms report that business is not as good as it ought to be. Boilermakers, on the other hand, are well off for work, and there is, perhaps, no branch of our heavy trades in which more progress has been made of late years.

In the lighter industries both the silver and cutlery trades are feeling the season demand for goods adapted for Christmas and New Year. With the setting-in of the winter demand many novelties in electro-plate, silver and Britannia metal have been placed upon the market. Some of the leading firms are working extra time, and will continue to do so up to the end of the season. A distinct feature of the silver trade is the demand for sterling silver goods. The low price of silver narrows the difference between these goods and the best quality of electro-plated nickel. Customers therefore prefer to pay the extra cost to have their table appointments of silver. There is more doing in cutlery, and the next returns of the United States Consulate will maintain, if not exceed, the satisfactory increase reported on the 30th of September last. It is said that the American market is taking an unusual quantity of second-rate cutlery from Sheffield. This is rather against the usual way of the Americans, and may probably be but a temporary feature of the trade. Orders are undoubtedly coming in very freely, and prospects are decidedly more encouraging. The Tariff favours the commoner grades of cutlery more than the expensive brands, and this probably accounts for purchases running so much in the cheaper qualities. There is more doing in our own home markets, season orders having come to hand earlier than in previous years.

In addition to the Antwerp awards already announced, Messrs. William Lockwood and Co., Ocean Works, St. Mary's-road, Sheffield, have been awarded two silver medals for their patent flangeless piston rings. This is the highest and only award for piston rings.

The Liverpool ivory sales have been held this week. There were only about seventeen tons on offer. The American buyers were present in force, and purchased freely. Prices went up from £10 to £12 per cwt.

Mr. Emerson Bainbridge, J.P., of the Nunnery, Blackwell, and other collieries, and who is also chairman of the East to West Coast Railway, has contributed a thoughtful and effective article to the *Contemporary Review* this month, bearing on the eight hours question. Mr. Bainbridge, since its publication, has received a number of letters on the subject. One is from Mr. Henry Simon, of Mount-street, Manchester, who informs Mr. Bainbridge that amongst the instances which he gives of foreign, especially Belgian work, introduced into this country, there is omitted what he—Mr. Simon—considers to be the most glaring instance of this foreign competition, viz., the fact that the comparatively new railway station at Middlesbrough is, as a local ironmaster told him some time ago when there, "every pound of it Belgian iron." "What are we to say," asks Mr. Simon, "if the capital of that iron district which produces the cheapest gets its station ironwork from Belgium?" Mr. Simon adds that while his personal inclinations, wishes, and moral feeling are distinctively in favour of allowing the labouring classes, and everybody else, the largest possible share of the comforts of this life, he cannot but entirely admit, with Mr. Bainbridge, that the way in which this eight hours movement is now progressing is simply hastening the inevitable moment at which England's pre-eminence in trade will begin to rapidly decrease. "All large strikes," he holds, "are so many invaluable helps to foreign industries. Considered from a continental and humanitarian standpoint, the advantage may probably be seen in this policy; but do the working classes really intend thus unselfishly to help their foreign competitors?" Most people will think with him that they do not; the explanation being their utter incapacity to see the folly which they are perpetrating. They have some capable, intelligent men amongst their leaders, and surely the time cannot be far distant when the more thoughtful of these people will declare the doctrine of sound business plainly to their constituents, whether it offend them or whether it please them.

THE NORTH OF ENGLAND.

(From our own Correspondent.)

More cheerful reports are this week given by iron and steel manufacturers relative to the state of trade, and certainly there is not that amount of pressure to sell that has been shown hitherto this month and for a part of September. The speculative fraternity, who have been operating in iron, appears to have recovered confidence, and are not disposed to further depress prices by putting so much iron upon the market. It is pretty well recognised that there has been no change in the condition of trade to justify the relapse in prices that has recently taken place, and that if speculators had not rushed their iron upon the market, prices might have been kept up. Trade is undoubtedly better than it was last year, as may be seen from the railway traffic returns, and the production and shipments of pig iron; indeed, it may be said that this year's production and exports of pig iron exceed those of any previous year, while the increase of stock has been only small, and is very much less than it was in almost every year of the past ten; in fact, in one year at the end of September North of England pig iron makers and the warrant stores held four times as much iron as they do at present—nearly 730,000 tons. The average quoted price of No. 3 Cleveland pig has also this year exceeded that of last year by fully 1s. per ton, being this year no less than 35s. 10d., which is considerably above the figure that has ruled in at least half of the last ten years. The finished iron and steel trades have not been anything like so good this year as they might have been if business had not been hampered by the strikes of the engineers, moulders, and patternmakers, which has seriously affected the output of the shipyards, and consequently of the plate and angle mills, which in this district depend upon them for the bulk of their work. Work has been thrown back so much that there are now vessels that have been waiting for their engines four months or more.

Sales of Cleveland pig iron have been more numerous this week than they have been for some time past, the chief demand being for No. 3, which is scarce, and which is needed for export. In this month the shipping demand is always extra brisk, as it is the last of the northern navigation season, and consumers abroad who get their supplies through Baltic ports have to get in what they will need in the winter. But the exports are not nearly so good as they were last year; thus this month to Wednesday night the pig iron exports from the Tees reached 46,310 tons, as compared with 37,915 tons last month, and 58,142 tons in the corresponding month last year to 17th. Makers have generally this week been quoting 36s. per ton for prompt f.o.b. deliveries of No. 3 Cleveland pig, and some of the leading firms whose stock is almost *nil* have asked and secured even 3d. more. But merchants and some producers have been selling at 35s. 9d., and they were ready to accept 36s. for forward delivery. Cleveland warrants have not been largely offered, and the extent of the fluctuations in price this week has only been 1½d. per ton.

The stock of Cleveland pig iron held by Messrs. Connal and Co. on Wednesday night was 89,067 tons, or 678 tons decrease this month.

No. 4 Cleveland foundry pig has shown considerable improvement in demand, and as the supply is hardly equal to the requirements the price has advanced 3d. per ton, thus restoring the ordinary difference between the prices of No. 3 and No. 4 foundry, which is 6d. per ton, but which difference has not existed for a very considerable period, the commoner quality being relatively cheaper than No. 3, as it has been more plentiful. Forge qualities have not advanced because the supply is in excess of the requirements, and these qualities have again become "a drug upon the market." Grey forge can be bought at 34s., and is thus 1s. 3d. cheaper than No. 4 foundry pig, though the usual difference is no more than 6d. The supply of East Coast hematite pig iron is greater than the consumption, and the price of mixed numbers has dropped to 42s. 9d. per ton, though ore prices are tending upwards, and it does not appear likely that any reduction in the cost of production will be effected.

At the quarterly meeting of the Middlesbrough Chamber of Commerce a communication was read from Mr. Jeremiah Head, of Middlesbrough, which showed that in a certain district in the United States pig iron was being produced at less cost than in Cleveland, and was sold at a lower price than has ever been touched for Cleveland iron, 29s. being the lowest ever reported for No. 3. Mr. Head has been in the United States for some time on professional business, and has visited the region in question. It is in Alabama, and Mr. Head says of it that it is the "Cleveland" or cheap common iron centre of America. Pig iron containing half the phosphorus that there is in Cleveland pig iron is being made there at a cost price at works, including all except debenture interest, of 24s. 2d. per ton, and is being sold at from 26s. to 29s. per ton on trucks at works; 28 lb. per ton extra over 2240 lb. is allowed for sand. This pig iron is finding its way into every part of the United States, even into Pittsburg. As yet it has not been used for steel. Large cast iron pipes up to 60in. diameter are being made and sold at £3 15s. 6d. per ton at works, and are forwarded to all parts of America. They are not quite so well finished as Ormesby pipes, but are good enough. Under circumstances like these there does not appear much chance for England exporting pig iron or pipes to the United States, notwithstanding the more favourable Tariff Act that has been passed.

A rather better demand is reported by some of the finished iron and steel manufacturers. It is satisfactory that Messrs. Dorman, Long, and Co. have this week recommenced operations at their West Marsh and Britannia Iron and Steel Works, Middlesbrough, after a stoppage of about two months, during which they have added considerably to their plant. On the other hand, the Dar

lington Steel and Ironworks have been entirely closed, and the directors, at their meeting on Monday, stated that the condition of trade did not encourage them to look forward to an early resumption of operations. It is, therefore, thought advisable to realise the floating assets of the company, without, however, disposing of any of the loose plant or tools, which would be needed to re-start the works. Out of the money thus obtained the liabilities will be met, and the meeting was adjourned for a month to permit this to be completed. Ship-plate makers are fairly well employed, notwithstanding the dulness in the shipbuilding industries. At the shipyards on the Tees and at Hartlepool at least 40 per cent. of the men usually employed at the shipyards are idle, and a hard winter is looked for; as Lloyd's returns show there is much less work booked now than there was in the early part of the year. Thus on the Wear there are only 32 vessels of 85,653 tons, against 43 vessels of 112,025 tons a year ago; on the Tyne 53 vessels of 131,773 tons, against 51 of 121,956 tons; on the Tees, 21 vessels of 45,252 tons, against 25 of 65,170 tons; and at Hartlepool and Whitby, 13 vessels of 37,259 tons, against 18 vessels of 47,630 tons. Still at present the steel-plate and angle makers are fairly well employed, and maintain their prices. The same figure is quoted for iron as for steel plates —£4 17s. 6d., less 2½ per cent. f.o.t.—as it costs more now to produce iron plates than to roll steel plates. Iron ship angles are £4 12s. 6d., and steel ship angles £4 15s., both less 2½ per cent. and f.o.t. Heavy steel rails are at £3 12s. 6d. net at works, and a rather better inquiry is reported. Many of the moulders who have been on strike are still unemployed, the masters being unable to find work for them, as orders have been driven to other districts. A considerable proportion of the engineers are likewise unable to work.

Some of the ironmasters are again, as is usual in the autumn season, being put to inconvenience owing to lack of trucks, and the question has been under the consideration of the Middlesbrough Chamber of Commerce, who have asked the firms to keep a record of the short supplies, together with details of delay, loss, and expense incurred, so that definite evidence may be forthcoming in case an appeal has to be made to the Railway Commissioners. The North-Eastern Railway managers have asked some of the firms to give them an idea as to what they will require in the way of goods wagons over the next five years, and other questions as to the probable lives of their collieries, &c.

At the meeting of the North-East Coast Institution of Engineers and Shipbuilders, held at Newcastle on Tuesday, the Council reported that the number of members was 954. The President—Mr. Thomas Richardson—delivered his inaugural address, in which he dealt with the question of economical production and the competition of foreign countries. He deprecated the doctrine which is so often made use of, as to our superior capacity as handicraftsmen, and stated that the extended and universal adoption of machinery had enabled the foreigner to compete with us—and especially was this so in the engineering industry. The President also touched upon the application of electric driving of machinery at home and abroad, and showed that there was a large saving in steam power by the use of the electric system of working, as well as a considerable reduction of labour.

The coal trade continues active, notwithstanding that there is less required for Scotland, but the export demand is strong, and merchants are anxious to get as much coal away as possible this month. Wages in the Northumberland coal trade are not to be changed this quarter, as the Conciliation Board has found that though trade was so brisk last quarter, prices were not materially raised. The Northumberland collieries generally are working eleven days per fortnight, which is full time, and in Durham there are very few pits which are not in full operation.

NOTES FROM SCOTLAND.

(From our own Correspondent.)

There is a rather better feeling in the iron market, with still much room for improvement. Scotch warrants have been fairly steady, with only a moderate business. Buyers are acting with caution, for although the miners' strike is now practically over in the West of Scotland, it is not yet quite clear whether business is likely to come away with anything like activity. Transactions have taken place at 42s. 6½d. and 42s. 6d. cash. There is very little inquiry for Cleveland warrants, which are worth nominally 35s. 5½d. cash. Cumberland hematite has been weaker, declining from 43s. 5½d. to 43s. 3½d. cash.

The blast furnaces are now being steadily relighted, about twenty having been added to the active list within the last ten days; the number blowing is, however, still much smaller than at this time last year. Several weeks must elapse before the furnaces now going in will be in a position to make their full complement of pig iron. Several brands continue very scarce, and the prices of these are fairly steady, but the general tendency of values is downwards, some brands having fallen from 6d. to 2s. 6d. per ton in the course of a week.

The following are the current prices of makers' pig iron:—G.M.B. f.o.b. at Glasgow, No. 1, 44s. per ton; No. 3, 42s. 6d.; Monkland, No. 1, 47s. 6d.; No. 3, 42s. 6d.; Carnbroe, No. 1, 47s. 6d.; No. 3, 46s.; Clyde, No. 1, 50s. 6d.; No. 3, 47s. 6d.; Gartsherrie, No. 1, 52s. 6d.; No. 3, 48s. 6d.; Calder, No. 1, 53s. 6d.; No. 3, 49s. 6d.; Summerlee, No. 1, 55s.; No. 3, 50s.; Coltness, No. 1, 56s.; No. 3, 51s.; Glengarnock at Ardrossan, No. 1, 54s. 6d.; No. 3, 49s. 6d.; Eglinton, No. 1, 48s.; No. 3, 46s.; Shotts at Leith, No. 1, 57s. 6d.; No. 3, 51s. 6d.

The market for hematite pig iron is a little more active as far as regards business done direct with the producers; while there seems no inducement to speculation, it is evident that the requirements of consumers are bound steadily to increase. The import trade in Spanish ore has been resumed, and freights are very moderate, enabling smelters to obtain supplies at comparatively easy rates.

The pig iron shipments are extremely small, amounting in the past week to only 1859 tons, compared with 3455 in the corresponding week. Of the total there was sent to Australia 155 tons, Germany 128, United States 100, Canada 80, Italy 100, Holland 50, Belgium 10, Spain 20, other countries 30, and coastwise 1186, against 1022 same week of 1893.

The finished iron and steel branches are getting into a rather more encouraging attitude, the works are being put in operation more fully, and makers are preparing for any demand that may arise; meantime business is on a restricted scale, and prices are nominal.

The export trade in manufactured goods is quiet. The past week's shipments from Glasgow embraced sewing machines worth £256; other machinery, £5321; steel goods, £3943; and miscellaneous iron goods, £13,952.

Reports with reference to the locomotive engineering branch are favourable, the principal firms have good orders in hand both for home and foreign railways. General engineers are but moderately employed. In the tool making branches business is irregular, some houses doing next to nothing, while others are fairly busy.

The strike of miners in the West of Scotland may now be said to be over, for although companies of men here and there still hold out in expectation of obtaining support from the English Federation, the great majority of the men have given up the struggle as hopeless, and made a rush for employment. This many of them are unable to find, owing to the roads and workings of the collieries being out of repair. While the quantity of coals raised is still limited, it proves more than equal to the demand, so that a further reduction has taken place in prices. The fall in the retail price of household coals in Glasgow in the course of the last three weeks has been about 40 per cent. Of course, by-and-bye, the public works will absorb much larger quantities, and the shipping trade is likewise expanding gradually. A fair demand is springing up for the Mediterranean from Glasgow, the clearances there in the past week amounted to about 22,000 tons. The loss in exports, owing to the strike, amounts to upwards of 2,000,000 tons, and this, it need hardly be said, will never be made up.

WALES AND ADJOINING COUNTIES.

(From our own Correspondent.)

A significant fact of the week is that steamers in the course of a day or two will be loading no less than 5000 tons of tin-plates at Swansea, principally for the United States. This is not only encouraging for the great tin-plate centres, notably, Swansea, Llanelly, Briton Ferry, and the Newport district, but also for the iron and steel works. Ironmasters are quite satisfied that until new countries are opened out rails must play a very secondary part; and it is to tin-plates and to the increasing uses of steel in the country that they look for business. I lately saw in Radnorshire terne plates adroitly used as garden fences, and reported to be cheaper than brick or stone masonry. The artisan placed them himself, and saved the labour of mason.

Last week the Swansea shipment of tin-plates was 60,469 boxes, make received from works 69,201 boxes, showing a good deal of activity, and proving that a more settled condition of things exists amongst the workmen. So far prices have not moved, but a few consignments such as will be recorded next week will leave stocks much below an ordinary level, and lead to improved quotations.

In the Newport district a better tone prevails amongst tin-platers, and I note that in the Briton Ferry district a good average make is recorded. This week the Earlswood Tin-plate Works, Briton Ferry, which have been idle for a year or so, were re-started. These give employment to 140 hands.

Dowlais steel works this week were as busy as I have seen them for some time, both the upper and lower works, and at Cardiff not only is a good make of pig maintained, but steady progress made in completing the works. Probably in two or three months this will have been accomplished.

There has not been much doing in rails, with the exception of some despatches to Highbridge. The make of steel bar has been moderately good. Blaenavon, Cyfarthfa, and Ebbw Vale maintain fair activity in mills and furnaces. Tredegar and Rhymney are putting forth their best efforts in coal development, and in the manufacture of coke; and as I note this week but few arrivals of pig iron—only one small one coming in from Ardrossan—there is a prospect that the heavy stocks I saw lately at various works will have a chance of being lessened. Swansea imported this week 200 tons steel scrap, and 2600 tons of iron ore. Of the latter Ebbw Vale and Dowlais also received large cargoes.

Swansea quotations this week are only slightly altered from those of last week. Glasgow pig is a little improved, 42s. 5½d. to 42s. 6½d.; Middlesbrough, 35s. 5½d.; Middlesbrough hematite, 42s. 4½d. Welsh bars remain at £5 2s. 6d.; steel rails, heavy, £3 15s. to £3 17s. 6d.; light, £4 10s. to £4 15s. Cardiff quotation for rails, heavy, is £3 12s. 6d.

Other Swansea quotations are:—Sheet iron, £6 to £6 10s.; steel sheets, £6 5s. to £6 7s. 6d., with usual extras for higher gauges; Bessemer steel bars, £4 to £4 2s. 6d.; Siemens tin-plate bars, £4 to £4 2s. 6d.; tin-plates, makers' quotations, Bessemer, 10s. 3d. to 10s. 6d.; Siemens, 10s. 6d. to 10s. 9d.; ternes, per double box, 28in. by 20in., 20s. to 24s.; best charcoal, 12s. to 12s. 6d.; wasters, 6d. to 1s. less in each class. Block tin £69 7s. 6d. to £69 10s. Anthracite coal, 8s. 9d. to 12s. 6d., according to quality.

The coal trade continues vigorous, and shipments have been considerable at all ports. Good healthy vitality is very noticeable in the Newport district. Some labour troubles have affected the output of certain collieries, and perhaps kept prices up more firmly. On Saturday best steam was quoted at 12s.; the latest quotation now is 11s. 6d. to 11s. 9d., Cardiff. Other prices are:—Seconds, 11s. to 11s. 3d.; best Monmouthshire, 10s. 3d. to 10s. 9d.; dry sorts, 10s. to 10. 3d.; small, 4s. 9d. to 5s. 3d. House coal has kept up remarkably well, and now a good season is evidently before this class of coal. Even now, before the autumn has disappeared, there is a pressure of business, and prices may be expected to advance. Best household commands 11s. to 11s. 3d.; No. 3, Rhondda, 10s. 3d. to 10s. 6d.; brush, 8s. 6d.; small, 6s. 6d. No. 2 Rhondda, 8s. 6d. to 8s. 9d.; through, 6s. 9d. to 7s.; small, 4s. 6d. to 4s. 9d.

Cardiff quotations for pitwood are 15s. to 15s. 3d., demand good, but market glutted. Patent fuel active, 11s. to 11s. 6d. Coke tolerably brisk; furnace, 15s. to 16s.; foundry, 17s. to 17s. 6d.; special, 21s. Swansea exports of patent fuel only moderate; principal cargoes last week were, 2470 tons to France, 1300 to Italy, 1290 to Algiers. Iron ores quieter, prices remain—Cardiff, 10s. to 11s. 3d., according to quality. Swansea to 12s.

A new labour difficulty has cropped up amongst the tin-plate men, not this time against employers, but against their doctors, who are agitating for increased fees. Present rates are, men, 8d. per month; boys, 4d. The doctors now demand 1s. adults, and 6d. boys, and the ballot box is to be brought into requisition to settle the dispute.

The prominent subject at Cardiff of late has been the probability of the Bute Docks being acquired by the Corporation and then of the formation of a Harbour Trust. A leading official of the Docks is reported to have said that the "one man rule" is coming to an end. With all respect for the official I do not believe it. The Taff Vale Railway objection to join has to be considered, and leading authorities at Cardiff urge that the amount required by the Bute Docks Company is such that in borrowing money to meet it no limited liability company could float. A few weeks will see whether anything will come of it. The Barry Docks' directorate have written to inquire the particulars of the Harbour Trust, as suggested by the Corporation.

The Birmingham water scheme continues to make good progress amongst the Radnorshire hills. Over 600 men are now comfortably hutted for the winter, and in the spring this number is to be increased considerably. The district is well wooded, and one of the initiatory steps is being taken in levelling the trees, many of which are very fine. Nantgwilt, where the principal engineer resides, was surrounded with a belt of wood, which is nearly cleared. Shelley the poet made this a place of exile, and we see that a local contemporary has suggested that Birmingham—in keeping with her traditions—should utilise some of the timber in making mementoes of the poet.

The dispute of the National Colliery Company, Wattstown, has been brought to trial. A fortnight ago the company summoned twelve of its men for absenting themselves without notice. The men's contention was, that the company had introduced new method of screening, and the result was one thousand men left work. The summons of twelve of these was an initiatory step. On Monday the trial took place before the stipendiary magistrate, Mr. Ignatius Williams, at the Tonypandy Police Court. Employers and men were ably represented, and at the close the magistrate ruled that the employers had violated a clause of the sliding scale agreement —No. 20 A—and that the men were entitled to refuse to work under the new system. Verdict for men, with solicitors' fees and costs.

Four hundred men at Rudry are at stop, but it is hoped that the slight difficulty will soon be removed. The Llanbradach men, No. 2 seam, continue to refuse filling trams until there is a revised price list.

The Llancriach Collieries Company has been registered with a capital of £15,000 in £10 shares.

The Institute of Marine Engineers, Bristol Channel Centre, had their annual gathering in Cardiff on Saturday. There was a large attendance, Professor A. C. Elliott in the chair. Capt. Pomeroy, responding to the toast of the port of Cardiff, said that imports and exports were advancing. The former now totalled two million tons per annum.

NOTES FROM GERMANY.

(From our own Correspondent.)

A moderate business continues to be done on the continental iron market, and prices are fluctuating, with a downward inclination here and there. The position of the iron and steel trade in Silesia has not in any degree improved upon the week. Offers are being made at extremely low quotations, but still buyers show little inclination to come forward with their orders. The bar trade forms an exeeption to the rule, being in comparatively good activity, and there is also a tolerably fair business done in tubes.

Since previous letters very slight changes only can be noticed on the Austro-Hungarian iron market. In pig iron prices have stiffened a little, owing to the scarcity of that article. The rolling-mills are, as a rule, in fair employment, merchant bars meeting with a satisfactory demand. The girder trade is tolerably lively, while makers of steel plates and rails complain of a poor employment. Quotations for the different sorts of iron and steel are the same as last given.

The returns as to the condition of the French iron trade generally continue quite satisfactory. There is an undeniably increasing demand coming in for most sorts of iron, though several large contracts which had been counted upon as quite certain have not been given out at all; but there is, nevertheless, a sufficient amount of new work offering to keep the works in fairly regular activity. The tendency of prices is firm, but makers have, as yet, not ventured upon an advance, because they fear to be met with a strong resistance on the part of consumers. In the Department Nord the situation of the iron business is less hopeful, and some firms even fear that they will have to reduce quotations, at least for some articles. Hardware is generally neglected. In the Department Meurthe et Moselle pig iron is well maintained in spite of the exceedingly firm quotations for coke. Forge pig meets with a particularly good inquiry, while foundry pig is but weakly called for.

Business on the Belgian iron market has slightly increased in firmness, pig iron, as well as most sorts of malleable iron, meeting with a tolerably fair request. Prices of pig iron are rather easy on account of the large quantities of Luxemburg forge pig that is still thrown on the Belgian iron market, but for most sorts of finished iron quotations are well maintained, and a pretty confident tone generally prevails.

On the Belgian coal market prices have not altered for several weeks, only in the Liége district an upward inclination was to be perceived. With regard to the Belgian coal trade during the first eight months of last and of present year, import in coal is reported to have been 869,079 t. this year, against 865,810 t. for the same period the year before. Of these 397,082 t. were imported from Germany, against 366,462 t. in 1893. French and English import, on the other hand, has decreased. In coke, 214,862 t. were imported, against 162,959 t. for the same period the year before, which shows an increase of 52,000 t. This may chiefly be accounted for by the increasing import of coke from Germany, which was 158,460 t. in 1893, against 208,376 t. this year. Export in coal amounted to 2,748,820 t., against 2,735,237 t. in 1893, of which 141,187 t. were sent to Germany, against 149,877 t. in the year before; 2,166,830 t. were exported to France, against 2,161,075 t. for the same period in previous year. In coke, 577,161 t. were exported, which, compared to 605,062 t. in last year, shows a decrease of about 28,000 t.

There is no change, generally speaking, in the Rhenish-Westphalian iron business. The demand remains quiet, and quotations are still far from satisfactory, but makers show a fair confidence in the future, and are, for the present, content if they can secure sufficient work to keep their concerns going. The position of the iron ore trade is not favourable, most sorts being in very moderate request. Prices are the same as formerly quoted; for spathose ore M. 7·40 to 7·70 p.t. is given, while roasted ditto is paid with M. 10 to 11·20 p.t. at mines; inferior sorts cost M. 9·80 to 10 p.t. net at mines, and for Nassau red iron ore the old price of M. 9·20 p.t. is given. In Luxemburg and Lorraine, minette, 40 p.c. grade, is still to be had at M. 3·20 p.t., while for minor qualities M. 2·40 to 2·60 p.t. is quoted. On the pig iron market prices are, without exception, very firm. In the Siegerland the demand for present quarter is pretty regular; from abroad there has also been quite a fair inquiry experienced lately, and a large contract for forge pig has already been secured for the first two quarters of 1895. Spiegeleisen, 10 to 12 p.c. grade, still stands at M. 52 p.t., forge pig No. 1 is paid with M. 46 to 47 p.t., while for No. 3, M. 40 p.t. is given. Siegerland, good forge quality, quotes M. 44 p.t.; hematite, M. 63; foundry pig, No. 1, M. 63 p.t.; No. 3, M. 54 p.t. Basic is still paid with M. 45 p.t., while German Bessemer fetches M. 49 to 50 p.t. at works. Luxemburg forge pig costs M. 48 p.t. free Luxemburg. So far as prices are concerned, the situation of the malleable iron trade is less favourable than that of the pig iron business. Prices continue extremely depressed, and if an actual reduction does not take place, it is simply because prices have reached the very lowest point, covering not even the cost of production. Some works will have to suspend operations altogether unless an improvement in quotations sets in. The bar trade is in poor employment generally. If it was not for orders previously booked, the mills could hardly be kept going. Girders are in tolerably good demand, and so are hoops, for which a rising tendency in prices can be noted. Plates are still without improvement, and sheets have in some instances even decreased in demand. From abroad next to no orders are coming to hand. The state of the wire business continues extremely unfavourable. Only a small number of the iron foundries and machine factories are in good employment, the majority of the mills complaining of an almost total absence of fresh orders.

The following are the latest list prices per ton at works:—Good merchant bars, M. 105; rivet iron, M. 125; angles, M. 120; girders, M. 90 to 95; hoops, M. 108 to 115; billets in basic and Bessemer, M. 87; heavy plates for boilermaking purposes, M. 150; tank ditto, M. 130 to 135; steel plates, M. 125; tank ditto, M. 115 to 120; sheets, M. 140; Siegen thin sheets, M. 125 to 130; iron wire rods, common quality, M. 115 to 120; drawn wire in iron or steel, M. 103 to 120; wire nails, M. 125; rivets, M. 150; steel rails, M. 112 to 115; steel sleepers, M. 106; fish-plates, M. 115; complete sets of wheels and axles, M. 270 to 280; axles, M. 220; steel tires, M. 215 to 230; light section rails, M. 95.

New Bridge over the Welland—An Engineering Feat.—The new bridge which has been built for the Midland and Great Northern Railway Companies by Messrs. Handyside and Co., of the Britannia Ironworks, Derby, and London, was on Sunday, the 7th inst., placed in position over the river Welland at Spalding. The line being a single one, it was necessary to keep the old bridge in position for the working of the line up to the very last moment, and the new bridge had therefore been erected by the side of the old one. The last train passed over the old bridge at 9.30 a.m., and it was then lifted by hydraulic jacks and moved bodily away in seven minutes. It was shifted in the direction of Spalding Town by steam power, being run along a set of rails placed on either side of the river bank. The new structure, which is of three steel lattice bar girders, was then wheeled into its permanent position. The new bridge weighs over 200 tons, has a total span of about 111ft., is 34ft. wide, and was shifted into its present position in five minutes. The new bridge was tested by two fully loaded engines, each weighing about 80 tons, and about 4.30 a cattle train from Lynn passed over. The whole of the work was completed, and the roadway made good, within four hours. The bridge was designed by Mr. Richard Johnson, M.I.C.E., and its erection was carried out under the supervision of Mr. C. A. Kirby, M.I.C.E., of Boston.

AMERICAN NOTES.

(*From our own Correspondent.*)

New York, October 11th.

The business situation is discouraging. Bank clearings are 22 per cent. below last year at this date, and 28 per cent below 1892 for same nine months. During the past three weeks there has been a fall in iron, steel, lumber, cotton, cloth, wool, coal, and coke. Numerous wages reductions have been made. The banks are overloaded with money, and speculation is at a standstill. Manufacturers are slow to contract for raw material. Consumers are covering present requirements. For iron there is increased activity at lower prices for girder rails, sheet and bar iron, but makers regard it only as a spurt. A steady improvement is not anticipated until after November 15th. New work of all kinds is freely projected for prosecution next year, and money is liberally subscribed under conditions. The improvement in trade and manufacturing will probably be slow during the winter, but an expansion of demand to unusual proportions is regarded as the inevitable result of prolonged restriction.

LAUNCHES AND TRIAL TRIPS.

On Saturday Messrs. Caird and Co., of Greenock, launched a large new passenger steamer, built to the order of the Peninsular and Oriental Steam Navigation Company. The steamer, which is named the Simla, is intended for their India, China, and Australia mail services. She has a gross register tonnage of nearly 6000 tons, and, besides having accommodation for 145 saloon passengers, has a large cargo capacity.

On the 15th inst., Messrs. Ropner and Son launched a steel screw steamer of the following dimensions:—Length over all, 328ft.; breadth, 42ft. 10in.; depth moulded, 20ft. 11in. The vessel will be classed 100 A1 at Lloyd's, and carry over 4000 tons deadweight on Lloyd's freeboard. She has been built off the part awning-decked rule, with break poop and raised quarter-deck; cellular bottom for water ballast. Her triple-expansion engines are by Messrs. Thos. Richardson and Sons, Hartlepool, of 1100 indicated horse-power, with two large steel boilers working at 160 lb. She has been built for Bristol owners, and the name of Dovedale was given to her by Miss Ropner, of Preston Hall.

On Saturday last the steel screw steamer Kirkwall, recently launched by Messrs. the Blyth Shipbuilding Company, of Blyth, for the Kirkwall Steamship Company, of Cardiff, Messrs. Stephens, Mawson, and Goss being the managing owners, was taken to sea for her official trial trip. On the speed trials the machinery gave every satisfaction. The Kirkwall is designed to carry a large cargo on a light draught of water, and is fitted with the latest machinery for working both vessel and cargo. The Kirkwall will be commanded by Captain Hesketh, and has been under the supervision of Mr. Brewer, superintendent engineer to the company, during construction. The engines are of the triple-expansion type, and have been fitted by Messrs. the North-Eastern Marine Engineering Company, of Wallsend-on-Tyne. This is the fourth ship the Blyth Shipbuilding Company have built for Messrs. Stephens, Mawson, and Goss.

There was launched on Monday afternoon from the West Yard of Messrs. C. S. Swan and Hunter, of Wallsend-on-Tyne, a fine cargo steamer of special type and well-known design, being an improved description of partial awning deck steamer. The dimensions of the vessel are 324ft. by 41ft. by 23ft. 1½in. moulded, and she has been designed by builders to carry a deadweight cargo of 4350 tons on a moderate draught. She will also carry an exceptionally large measurement cargo, rendering the vessel very suitable for Indian trade. The steamer has been built to the order of Messrs. J. J. and C. M. Forster, of Newcastle-on-Tyne, and is the fourth vessel which has been built by Messrs. C. S. Swan and Hunter for the same owners. On leaving the ways the steamer was named the Newlyn by Miss Dorothy Forster, of Newcastle, and was then taken down to the works of the Wallsend Slipway and Engineering Company to receive her propelling machinery, which will be of the latest type, cylinders 23in., 38in., 51in., by 39in. stroke. During the construction the vessel has been surveyed by Captain Sarah on behalf of the owners, who, together with a large party, witnessed the launch.

On the 15th inst. Messrs. Irvine and Co., West Hartlepool, launched a steel screw steamer of about 4000 tons deadweight carrying capacity, built to the order of Messrs. Evan Thomas, Radcliffe, and Co., Cardiff. The vessel will take Lloyd's highest class, and has been built under special survey. Her dimensions are 315ft. by 42ft. 6in. by 20ft. 9in. The deck erections consist of poop, quarter-deck, and partial awning deck. The saloon and cabins for captain and officers are fitted up in the poop. The engineers are berthed in house at after end of bridge, and the crew at fore end. The hull is built on the web frame principle, and besides being fitted with ordinary water ballast tanks in cellular double bottom, she is fitted with a new arrangement of deck water-ballast tanks, which is a patent of Mr. M. Hill's, of Newcastle-on-Tyne. With this arrangement the difficulty of getting sufficient ballast into vessels of this class, without displacing cargo space, is got over. The construction of these deck tanks also forms an effective means of strengthening such vessels having a break in their decks, and the top of the tank forms a means of communication between the bridge and poop, thereby obviating the necessity of going into the well. Large hatchways are fitted, five steam winches, steam steering gear amidships, screw gear aft, one large multitubular boiler, and direct steam windlass. The boats are placed on beams overhead, and appliances will be specially fitted to comply with the Grain Carrying Act. Engines of the triple-expansion type are being supplied by Messrs. Blair and Co., Stockton-on-Tees. The hull and machinery have been built under the supervision of Mr. Maxwell Hill, Newcastle-on-Tyne. The vessel was named Ethel Radcliffe by Miss Clarice Radcliffe.

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.

4th October, 1894.

18,768. Parallel Ruler, W. H. L. Mariner.—(*W. Pigott, England*)
18,769. Roller Axle, J. Phelan, Mountrath.
18,770. Tires, H. Smith, Nottingham.
18,771. Twisting Fibrous Material, &c., C. Briggs, Bradford.
18,772. Railway Carriage Doors, T. Hobson, Manchester.
18,773. Mitre-cutting Machinery, W. G. Gass, Great Lever.
18,774. Hot-water Boilers and Pans, R. Crowther, Halifax.
18,775. Washing and Wringing Machines, J. Thornton, Halifax.
18,776. Water Regulator and Valve, H. Watson, Devizes.
18,777. Cycle Gear, T. Staines, J. Leadbeater, and A. Preston, Leeds.
18,778. Preventing Abstraction of Letters, H. Bessell, Bristol.
18,779. Improved Case for Pencils, J. Greaves, Oldham.
18,780. Stoppers for Bottles, E. O. Loach, Birmingham.
18,781. Holder for Roller Window Blinds, H. P. Miller, London.
18,782. Door-closing Appliances, F. Dakin, London.
18,783. Indestructible Cone Castor, J. E. P. Proud, Dublin.
18,784. Trouser Guards for Cycles, G. D. Sampson, London.
18,785. Hat and Bonnet Protector, E. H. Höbling, London.
18,786. Hingeing the Picking Arms of Looms, J. Dodds Galashiels.
18,787. Non-twisting Ribbon Bodkin, E. Yates, Manchester.
18,788. Bag Fastenings, J. G. Beddoes and T. Allen, Birmingham.
18,789. Regulating Street Lights, M. Cummings, Glasgow.
18,790. Appliances for Clipping Hair, W. Bown, Birmingham.
18,791. Ammonia, W. McD. Mackey and J. F. Hutcheson, Glasgow.
18,792. Ammonia, W. McD. Mackey and J. F. Hutcheson, Glasgow.
18,793. Windows, H. Kerr, Glasgow.
18,794. Gas Fires, J. F. Brown, Glasgow.
18,795. Manufacture of Pneumatic Tires, P. Mercier, London.
18,796. Line Screens, G. G. Ward and M. Cohn, Belfast.
18,797. Fire-screen and Trivet Combined, S. S. Crisp and H. Grice, London.
18,798. Cork Separators, L. W. Sutcliffe, Manchester.
18,799. Attaching Pneumatic Tires to Rims, H. Kesterton, Manchester.
18,800. Valve Mechanism for Atmospheric Hammers, E. Skinner, Sheffield.
18,801. Construction of Trunks, &c., W. H. Eyre, Sheffield.
18,802. Letter Files, W. H. Morden, London.
18,803. Lock for Photographic Dark Slides, H. Ransom, London.
18,804. Beetle Trap, J. Pollock, London.
18,805. Lifts, &c., C. Musker and A. Musker, Liverpool.
18,806. Syphon for Water-closet Cisterns, C. H. Kitching, London.
18,807. Rotary Engine, L. Vojacek, London.
18,808. Cars for Roundabouts, P. Collins and F. W. Savage, Birmingham.
18,809. Electric Storage Batteries, F. King, London.
18,810. Letter Cards, H. Jones, London.
18,811. Figures for Decorations, A. Tuck and W. H. Ellam, London.
18,812. Control of Lifts, J. S. Stevens and C. G. Major, London.
18,813. Rulers, A. Benda, London.
18,814. Electric Batteries, B. A. Balasny, London.
18,815. Steam Engine, J. D. Gray, W. B. Price, and A. Sharp, London.
18,816. Railway Car Wheels, J. Printz, C. F. Anderson, and V. H. Stromberg, London.
18,817. Lining for Hats, P. F. Allen, London.
18,818. Lamp Extinguisher, C. W. Cummings, Birmingham.
18,819. Typewriting Machines, C. Coote, London.
18,820. New Hoisting Apparatus, H. George, London.
18,821. Method of Stoppering Bottles, J. Spring, London.
18,822. Cutting Patterns, H. H. Lake.—(*C. E. Reed, United States*)
18,823. Ink-wells, H. H. Lake.—(*S. O. Johnson, United States.*)
18,824. Cartridges, J. G. Accles and J. Pinfold, London.
18,825. Rope Grips, J. Whitall, London.
18,826. Manufacture of Spoons, &c., A. Alexandre, London.
18,827. Tubes for Fishing Rods, &c., J. Thomas, London.
18,828. Apparatus for Condensing Fluids, E. Theisen, London.
18,829. Automatic Machine Gun, H. T. Ashton, London.
18,830. Fastening Spurs to Boots, H. Hardtke, London.
18,831. Manometers, W. P. Thompson.—(*The Maschinen and Armaturenfabrik vorm. C. L. Strube, Aktiengesellschaft, Germany.*)
18,832. Injector for Steam Engines, &c., L. Deprez, London.
18,833. Private Postcards, J. S. Morriss, London.
18,834. [No Application so numbered.]
18,835. Lining of Piece Goods, A. Kenealy, Watford.
18,836. Measurement of Piece Goods, A. Kenealy, Watford.
18,837. Water-tube Boilers, F. T. Marshall, London.
18,838. Water-tube Boilers, J. I. Thornycroft, London.
18,839. Lubricating Cups for Axles, C. W. Brown, London.
18,840. Fastening for Door Handles, G. McCarthy, London.
18,841. Game, W. May, London.
18,842. Preventing Destruction of Vessels by Torpedoes, D. Grant, London.
18,843. Seats for Cycles, G. Butwell and E. Roberts, Birmingham.
18,844. Treatment of Iron and Steel, &c., R. Stone, London.
18,845. Device for Securing Scarf Pins, A. Oldcorn, London.
18,846. Suspending Brushes in Bottles, G. Musgrave, London.
18,847. Sash Fastener, C. Patient, London.
18,848. Lamp Globe, W. T. Woolley, London.
18,849. Cooking Utensils, A. M. Pinks, London.
18,850. Fastening Boots and Shoes, W. E. Page, London.
18,851. Table Leg, &c., Castors, G. N. Witkowski, London.
18,852. Signalling Apparatus, L. B. Stevens, London.
18,853. Driving Gear for Cycles, G. White, London.
18,854. Ascertaining the Description of Leads, &c., C. W. G. Little, London.
18,855. Manufacture of Tickets, M. Vezzosi, London.
18,856. Locks, C. Shaw and F. J. J. Gibbons, London.
18,857. Construction of Hats, F. M. Rogers.—(*J. T. Todman, Ceylon*)
18,858. Umbrellas, Z. Wirt, London.

5th October, 1894.

18,859. Roundabouts, W. Parker, Bury.
18,860. Automatic Connection of Conductors, G. K. Chambers, London.
18,861. Construction of Padlock Cases, W. Wakelam, Willenhall.
18,862. Safety Appliance for Paraffin Lamps, F. A. Jackson, Leeds.
18,863. Roll-up Spring Mattress, C. Newey, Birmingham.
18,864. Charging Liquid into Bottles, G. Dawson, Barnsley.
18,865. Measuring, &c., Liquid into Bottles, G. Dawson, Barnsley.
18,866. Machines for Cleaning Knives, J. M. Sellers, Keighley.
18,867. Rain Shields for Cycles, H. Frankenburg, Manchester.
18,868. Vegetable Masher, R. Heaton, Birmingham.
18,869. Wheel Tire for Road Vehicles, A. Strange, Chippenham.
18,870. Ice Manufacturing Machine, J. C. Parminter, Dublin.
18,871. Wheels for Road Vehicles, W. Bowden, Manchester.
18,872. Water-heating Apparatus, A. H. Smith, Bristol.
18,873. Carriage Wheel Construction, W. Swain, London.
18,874. Boot Wiper, A. M. H. Walrond and J. Row, Exeter.
18,875. Tea-pots, W. Wade, Burslem.
18,876. Hand Protector for Bottles, W. C. Miles, Wolverhampton.
18,877. Inflator Clip for Cycles, L. Frankenburg, Manchester.
18,878. Hair Clasps or Binders, E. Moore, Birmingham.
18,879. Grain-drying Apparatus, W. Holland, Birmingham.
18,880. Tab for Braces, G. Buckley and F. Buckley, Halifax.
18,881. Oil Lamps, A. Eckford, Leith.
18,882. Sliding School-room Divisions, W. F. S. Holt, Wakefield.
18,883. Wad, W. D. Hawdon and J. T. Hawdon, Newcastle-on-Tyne.
18,884. Cartridge Cases, W. D. Hawdon and J. T. Hawdon, Newcastle-on-Tyne.
18,885. Construction of Pneumatic Tires, A. Maltby, London.
18,886. Appliances for Washing Clothes, F. J. Money, London.
18,887. Fire-arms, C. Stier, Glasgow.
18,888. Cleaning Tobacco Pipes, C. R. Hughes, Longsight.
18,889. Machinery for Making Fuel into Blocks, R. Middleton, Leeds.
18,890. Saddle Connections, J. and H. J. Brookes and P. L. Renouf, Smethwick.
18,891. Detergent Compounds, R. Armstrong, Lancashire.
18,892. Stand for Warming Stoves, J., J., and J. D. G. Lind, Liverpool.
18,893. Pipe Appliance, T. S. Forbes, Glasgow.
18,894. Advertising Tablets, J. Forrest, Glasgow.
18,895. New Parlour Game, B. J. Millar, Glasgow.
18,896. Atmospheric Gas Burners, T. Fletcher, W. Russell, and Fletcher, Russell, and Co., Manceester.
18,897. Edge-setting Machines, R. W. and L. H. Bateman, Halifax.
18,898. Spiral Wire Spring Mattress, T. M. Hewitson, Birmingham.
18,899. Cement for Dental Purposes, T. R. Reddeholm, Derby.
18,900. Pliable Spatula, B. Cunningham, Belfast.
18,901. Rollers for Furniture, H. Berg, Germany.
18,902. Folding Boxes and Fastening Them, M. Pohle, London.
18,903. Cabinets, &c., for Stationery, T. B. Vernon, London.
18,904. Treating Fibrous Peat, G. A. Cannot and J. Burke, London.
18,905. Internally-stoppered Bottles, F. J. Tolchard, London.
18,906. Composition with India-rubber, P. Mercier, London.
18,907. Arrangement for Tires of Cycles, L. P. and R. A. Vogt, Glasgow.
18,908. Fire-arms, P. Sheckler, London.
18,909. Trap for Beer-engine Nozzles, A. G. Thatcher, London.
18,910. Vessels for Electrolytical Purposes, P. Jensen.—(*H. and D Cappelen, Norway.*)
18,911. Apparatus for Knife Cleaning, F. W. R. Anderson, London.
18,912. Fitting for Umbrellas, E. Dance and D. Lambert, Birmingham.
18,913. Cycles, T. Cresswell, Birmingham.
18,914. Ratchet Brace, T. Bass, London.
18,915. Horse Collars, A. J. Boult.—(*V. van Damme and P. Michiels, Belgium*)
18,916. Apparatus for Setting, &c., Type, A. E. Vorreiter and E. Müllendorff, London.
18,917. Apparatus for Sweeping Streets, T. Glazebrook, Manchester.
18,918. Balanced Slide Valves, J. Cooper, London.
18,919. Manufacture of Steel, B. Talbot, London.
18,920. Scarf-pin and Brooch Grip, E. Eglington, London.
18,921. New Explosive, O. Imray.—(*F. C. Glaser, Germany*)
18,922. Hydraulic Capstans, W. Carter and The Hydraulic Engineering Company, London.
18,923. Distributing Advertisements by Post, J. Bear, London.
18,924. Velocipedes, G. L. Morris, London.
18,925. Electric Lamp Holders, F. C. B. Robinson, London.
18,926. Gas and Air Burning Apparatus, J. Armstrong, London.
18,927. Mounting the Gear of Cycles, J. Holcroft, London.
18,928. Emulsifying Machine, W. B. Cowan, Ontario, Canada.
18,929. Indicator for Railway Stations, G. Wehe, Berlin.
18,930. Marking Linen, T. O'Neill, London.
18,931. Door or Gate Closing Device, A. Jenner, London.
18,932. Egg-carrying Boxes, S. Cropper, London.
18,933. Breaking Electric Currents, H. T. Harrison, London.
18,934. Economising Power in Bicycles, G. Wilton, London.
18,935. Range Finder, H. H. Lake.—(*The American Range Finder Company, United States.*)
18,936. Driving Mechanism of Cycles, H. H. Lake.—(*J. Marty, France.*)
18,937. Cycle Saddle Springs, R. C. W. Duerre, London.
18,938. Castor, J. McEwen, London.
18,939. Treating Clays for Aluminium, J. Y. Johnson.—(*N. Basset and W. de Baranoff, France.*)
18,940. Separation of Arsenic, W. Whitehead and C. Gelstharp, London.
19,941. Steam Engines, E. S. Ross, London.
18,942. Typewriters, G. P. Harding, London.
18,943. Propellers for Ships, G. M. and E. A. Hoyland, London.

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18,944. Type-setting Machines, G. C. Downing.—(*J. Salomon, Germany.*)
18,945. Picking Bands and Pickers of Looms, W. H. Blood, Manchester.
18,946. Mooding and Tanging Files, J. and A. Powell, Sheffield.
18,947. Removable Curtain Hooks, I. Robinson London.
18,948. Cycle Fittings, J. M. and W. Starley, London.
18,949. Hydraulic Forging Machines, D. Clerk, London.
18,950. Screw Propellers, The Hon. C. A. Parsons, London.
18,951. Curtain Rods, E. Dorman, Stafford.
18,952. Advertising on Umbrella Ribs, R. S. Mason, Birmingham.
18,953. Advertising, M. E. Steedman, Glasgow.
18,954. Tug Stops for Shafts, H. H. Dixon, Birmingham.
18,955. Brake, J. Jackman, Bradford.
18,956. Safety Point-and-Crossing Block, H. J. Fuller, Dublin.
18,957. Box for Mineral Water Bottles, J. Samson, Bolton.
18,958. Seamless Metallic Tubes, R. F. Hall, Birmingham.
18,959. Illuminating Buoys and Beacons, J. Wigham, Dublin.
18,960. Ornaments, H. T. Parr and C. E. Parr, Birmingham.
18,961. Heating and Cooling Buildings, R. Pye, Halifax.
18,962. Traveller's Rest, F. S. Balls, Cambridge.
18,963. Locking Gear for Hydraulic Lifts, J. P. Annett, London.
18,964. Spinning Machine, W. Fisher and W. E. Duckworth, London.
18,965. Spinning Machine, W. Fisher and W. E. Duckworth, London.
18,966. Metal Grinding Machines, C. Oxley, Sheffield.
18,967. Hollow-ware, J. Ridge.—(*E J. Smith, United States.*)
18,968. Perpendicular Whistle, W. J. Rawson, Radcliffe-on-Trent.
18,969. Forced Draught System, A. M. Lawson, Newcastle-on-Tyne.
18,970. Turning Lathes, R. Wagner, Glasgow.
18,971. Centrifugal Machines, F. Hugershoff, Glasgow.
18,972. Nails and other Small Articles, G. B. Parkes, Birmingham.
18,973. Tapping Barrels, M. Morton and E. Morton, Birmingham.
18,974. Corrugated Plates for Floors, S. Strickland, Derby.
18,975. Weaving, C. Berisford, D. Birchenall, H. Berisford, W. Gorton, and C. Wood, Manchester.
18,976. Eyed Hooks, A. Morriss, Redditch.
18,977. Water Waste Preventer Cisterns, T. Atkins, Wolverhampton.
18,978. Candlesticks, J. and H. Smith and T. W. Hemingway, Sheffield.
18,979. Pneumatic Tires, J. Clinch, Manchester.
18,980. Detecting Imitation Diamonds, T. Thorpe, Whitefield.
18,981. Elevator Safety Appliances, S. G. Bennett, Smethwick.
18,982. Foot Brakes for Velocipedes, N. E. Craig, Plymouth.
18,983. Cannon or Guns, F. L. Tulip and J. H. Link, London.
18,984. Pneumatic Tire, E. J. Delday and H. C. Adams, Scarborough.
18,985. Covering for Football Fields, J. T. Seddon, Manchester.
18,986. Pencil-point Protector, M. Illfelder, Birmingham.
18,987. Hot-water Heating Apparatus, J. T. Softly, London.
18,988. Envelopes, E. S. and E. S. d'Odiardi and M. and E. Marx, London.
18,989. Scaffold-board Binder, J. M. Kimber, London.
18,990. Chandeliers for Burning Oil, D. Lambden, London.
18,991. Calendars, H. Grueber, London.
18,992. Softening Waters, H. L. Doulton and A. W. Manger, London.
18,993. Heating Calender Rollers, G. E. Payne, London.
18,994. Cycle Handles, M. B. Ryan, London.
18,995. Pen-wipers and Pincushions, W. H. Jackson, Liverpool.
18,996. Brush Mechanism for Dynamos, A. Ramsay, Liverpool.
18,997. Railway Carriage Windows, M. E. Elder and R. Bell, Liverpool.
18,998. Evaporating Soda Solutions, J. J. Crosfield and K. E. Markel, Liverpool.
18,999. Electric Fuses, W. P. Thompson.—(*La Société M. Gaupillat and Co., France.*)
19,000. Collapsible Boats, L. Höhnke, London.
19,001. Station Indicators, H. H. Leigh.—(*J. F. O'Brien, Canada*)
19,002. Hair Waving and Curling Pins, E. M. Gaskell, London.
19,003. Making Illuminating Gas, A. W. Pickering, London.
19,004. Burner Galleries of Lamps, O. Wollenberg, London.
19,005. Slate Frame, J. H. Rudolph, London.
19,006. Flue Cleaners, D. W. Dart, London.
19,007. Prevention of Lamp Explosions, J. Hall, London.
19,008. Railway Signalling, S. A. Varley and R. Burn, London.
19,009. Making Mosaic Floorcloth, W. Mather, London.
19,010. Making Mosaic Floorcloth, W. Mather, London.
19,011. Buffer Springs, A. G. and A. Spencer, London.
19,012. Mail-carts and other Vehicles, W. Legge, London.
19,013. Measuring Curved, &c., Lines, W. Ule, London.
19,014. Washing Fabrics, L. Crosset and J. Debatisse London.
19,015. Stovepipe Elbow Machine, R. W. Barker.—(*E. Blix and W. N. Gunderson, United States.*)
19,016. Window Fasteners and Latches, T. R. Wing, London.
19,017. Regulating Furnace Draughts, W. Magoolagham, London.
19,018. Rail Joints, J. W. Thomas, London.
19,019. Fastening for Boots and Shoes, C. H. Moulds, London.
19,020. Horse Collars and Saddles, D. S. Turner, London.
19,021. Velocipedes, J. Barratt, London.
19,022. Locks and Latches, W. Elder.—(*J. W. McKee, United States.*)
19,023. Toy, E. Savor, London.
19,024. Holder, &c., for Golf Clubs, T. Walters, London.
19,025. Material for Buildings, D. Young.—(*La Compagnie des Constructions Démontables et Hygiéniques, France.*)
19,026. Synchronising Attachment, J. W. Paige, London.
19,027. Album, J. Hutson.—(*E. W. Smith, United States.*)
19,028. Home Trainer for Cyclists, J. Hutson.—(*E. W. Smith, United States.*)

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19,029. Hydraulic Intermittent Motors, G. Threlfall, London.
19,030. Tubulous Steam Generators, E. White, Isle of Wight.
19,031. Horse Bridles, J. Emmett and H. Emmett, Dukinfield.
19,032. Ball and Socket Castor, &c., M. W. Dent, Blackburn.
19,033. Kettles for Lamps, J. E. Whiting, Bombay Presidency.
19,034. Braid or Binding, A. Nicholson and J. Hall, Leek.

19,035. Skirt Suspender, A. Nicholson and J. Hall, Leek.
19,036. Music Holder, S. Liddiard and T. E. Rickerby, Cheltenham.
19,037. Preventing Food Destruction, J. Pumphrey, Birmingham.
19,038. Traction Engine Wheels, F. J. Burrell, Thetford.
19,039. Self-fastening Vessels, C. Livesey and E. W. Banner, Southport.
19,040. Pantographic Carving Apparatus, W. Merl, Manchester.
19,041. Wagon Tarpaulin Cover, A. and W. Purvis, Glasgow.
19,042. Heat Non-conductors, J. C. S. McLay, London.
19,043. Inking Apparatus, A. Watkinson and F. W. Musgrave, London
19,044. Watch Keys G. Bottely, Birmingham.
19,045 Game, F. G. Paynter Newcastle-on-Tyne.
19,046. Regulating Water Supply, W. P. Theermann, Manchester.
19,047. Heating Soldering Irons, &c., G. Skinner, London.
19,048. Method of Braking Cycles, W. Saunders, Bristol.
19,049. Tops, J. Linkleter, Tynemouth.
19,050. Mounting Trays, J. C. Bailey and H. Podmore, Longport.
19,051. Frames for Sawing Machines, A. Smith, London.
19,052. Brakes for Wheeled Vehicles, W. E. Kay, Manchester.
19,053 Pneumatic Tire Inflators, H. Frankenburg, Manchester.
19,054. Chimney Water Heaters, &c., J. Syme, Monastereven.
19,055. Athletic Horizontal Bars, T. B. Sharp, Birmingham.
19,056. Curing Smoky Chimneys, W. J. and P. C. Wheeler, London.
19,057. Securing Fish-plates on Rails, J. T. Drew, London.
19,058. Pulley Blocks and other Lifts, W. T. Eades, London.
19,059. Button Fastener for Clothing, W. Halliday, London.
19,060. Window-blind Pulleys, A. F. Borradaile, London.
19,061. Cycle Handles, J. W. McEwen and T. B. Richards, London.
19,062. Uppers for Boots and Shoes, C. C. Eisenberg, London.
19,063. Blower for Fire-grates, R. Rose, London.
19,064. Milk Sterilisers, E. Leslie, London.
19,065. Producing Electricity, H. A. Tobias, W. H. Cadman, and R. J. Crowley, London.
19,066. Dough Mixing Machine, J. T. O'Callaghan, London.
19,037. Anchors, W. T. Honess, London.
19,068. Sel-acting Window Fastener, E. Seaman, London.
19,069 Hat Bands, F. W. and B. Franklin and P. E. Taylor, Birmingham.
19,070. Velocipedes, E. A. Jeffreys, London.
19,071. Tobacco Pipe, W. B Wallace, London.
19,072. Screw-nuts, F. F. Ganly, Manchester.
19,073. Steering Lock, W. F. Taylor and G. Philpott, Croydon.
19,074. Method of Repairing Slating, R. J. Spreadbury, Bournemouth.
19,075. Jewel Fastenings, E. T. B. Woodley and H. E. Humphry, London.
19,076. Bicycles and Tricycles, A. L. Bricknell, London.
19,077. Knitting Machines, E. Buxtorf, London.
19,078. Stoppering of Bottles and the like, J. Jones, London.
19,079. Domestic Water Supply Apparatus, J. Bark, Liverpool.
19,080. Constructing Transparent Walls, G. Falconnier, London.
19,081. Writing Device for the Blind, D. Goldsmith, London.
19,082. Eating Buttered Bread, H. M. Conrad, London.
19,083. Small-arms, J. Courrier, London.
19,084. Bearings, H. Kirschbaum and A. Schnitzer, London.
19,085. Absorption of Gases by Liquids, A. Müller, London.
19,086. Implements for Cultivating Land, J. E. Ransome, London.
19,087. Apparatus for Purifying Sulphur, R. Tervet, jun., London.
19,088. Syphon Cistern, T. B. Jack, London.
19,089. Eye-shades, H. Reichardt, London.
19,090. Wedding Cake Boxes, &c., E. Guttentag, London.
19,091. Purification of Iron and Steel, S. Trivick, London.
19,092. Churns, T. Bradford, London.
19,093. Fastening Device, A. Wood, J. S. Walter, and W. M. Walter, London.
19,094. Fireplaces, J. Clemence, H. A. Leverett, and T. H. L. Bake, London.
19,095. Water-lift and Bucket, M. S. M. S. Bahadur, India.
19,096. Feeding Bottle, F. W. Edridge-Green, London.

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19,097. Garments, A. G. Brookes.—(*M. M. Dunn' United States*)
19,098. Fuses for Projectiles, A. G. Brookes.—(*W. J. Smith, United States*)
19,099. Water-level Indicator, R. H. N. Lindley and F. J. Mudford, London.
19,100. Cots, J. E. Hoskins, Birmingham.
19,101. Stopper or Plug for Bottles, A. D. Jackson, Portsmouth.
19,102. Artificial Lighting Apparatus, G. Houghton, London.
19,103. Rubber Hose, T. Sutcliffe, Lancashire.
19,104. Dish for Holding Meat, &c., F. G. Wallis, Kettering.
19,105. Shield for Protecting Garments, F. Hughes, London.
19,106. Making, &c.. Chains and Bridle Fronts, J. Richards, Birmingham.
19,107. Framings of Velocipedes, R. F. Hall and R. H. Anderson, Birmingham.
19,108. Simple Crank Motion, H. W. Nickson and A. E. A. Edwards, Birmingham.
19,109. Non-conductor of Heat, C. Clarke, Birmingham.
19,110. Wheels for Railway Vehicles, J. A. Craven and T. Foster, Sheffield.
19,111. Toy Saving Banks, R. B. Roll, South Shields.
19,112. Oil Motor Engines, D. Clerk and F. W. Lanchester, London.
19,113. Paper for Catching Flies, &c, J. W. Dougal, Glasgow.
19,114. Lifting Apparatus, R. Middleton, Leeds.
19,115. Broiler, C Coleman, Welford, near Rugby.
19,116. Woven Belting, W. M. Martin, Glasgow.
19,117. Fire-extinguishing Apparatus, H. B. Barlow.—(*C. R. Macomber, United States*)
19,118. Employe's Time Recorder, J. S. Morse, London.
19,119. Pulley Casing for Window Frames, J. H. Foote, London.
19,120. Clamps for Pipes, C. Hall, London.
19,121. Electric Arc Lamps, J. E. Woolverton, Glasgow.
19,122. Sewing Machines, A. Anderson.—(*The Singer Manufacturing Company, United States*)
19,123. Letter Files, W. O. Gottwals, Canada.
19,124. Letter Files, W. O. Gottwals, Canada.
19,125. Knitting Machines, G. W. Beach, London.
19,126. Construction of Golf, &c., Bats, B. J. Maloney, Edinburgh.
19,127. Production of Ozone, J. T. Donovan and H. L. Gardner, London.
19,128. Hydrometers, W. Hood, London.
19,129. Railway Signalling Apparatus, A. G. Evans, London.
19,130. More Perfect Combustion of Coal Gas, R. H. Courtenay, London.
19,131. Adjusting the Seats of Carriages, F. W. Milligan, London.
19,132. Brick Kilns, W. A. Wilford, Birmingham.
19,133. Novel Eyed Fly Holder, J. Richardson, London.
19,134. Sewing Machines, W. H. Harrop, London.
19,135. Tie, C. Cox, London.
19,136. Boots, C. Cox, London.
19,137. Toy Shooting Galleries, A. W. Carley, London.
19,138 Lift for Sashes of Greenhouses, A. C. Bright, London.
19,139. Manufacture of Socks, H. T. Hines, London.
19,140. Sprocket Wheels, P. D. Murphy and E. Kolb, London.
19,141. Apparatus for Cable Tramways, E. Neil, London.
19,142. Hat-stretching Machines, G. Atherton.—(*R. Eickemeyer, United States.*)
19,143. Machines for Dressing Type, W. W. Farmer, London.
19,144. Securing the Corners of Boxes, A. A. Wood, London.
19,145. Valves, H. H. Lake.—(*F. C. Weir, United States.*)
19,146. Mechanism for Looms, J. T. Bolton and G. Grime, London.
19,147. Advertisements, G. F. Zimmer and J. Hutson, London.
19,148. Exhibiting Figures, Pictures, &c., M. Vollmer, London.
19,149. Fastenings for Trousers, &c., R. L. Weiss, London.
19,150. Electro-deposition of Metals, W. H. Beck.—(*C. R. Fletcher, United States.*)
19,151. Fastenings of Brooches, Pins, &c, R. Synge, London.
19,152. Speed Apparatus for Swimmers' Use, L. Pedrazzolli, London.
19,153. Spinning Mechanism, J. Neale and W. O. Shadbolt, London.
19,154. Tobacco Pipes, W. E. Trott, London.
19,155. Arc Lamps, A. J. Boult.—(*P. Laminne, Belgium.*)
19,156. Pencil Sharpener, W. P. Thompson.—(*J. Deutschbein, Germany.*
19,157. Electric Battery Plates, H. Le R. Bridgman, London.
19,158. Railway Fences, &c., A. Stevenson, Liverpool.
19,159. Pneumatic Tires, G C. Nesbitt, London.
19,160. Harvesters, W. P. Thompson.—(*B. F. Stewart, United States*)
19,161. Calking Vessels, A. J. Brooks, London.
19,162. Cotton Gloves, &c., J. E. Cowell.—(*G. Neuhaus, Germany*)
19,163. Calendar Clocks, C. W. Feichtinger and S. Shearer, London.
19,164. Oil Stoves, E. Rippingille and W. Porter, London.
19,165. Apparatus for Cutting Coal, J. B. Alliott, London.
19,166. Treating Peat, A. McLean, London.
19,167. Hooks and Eyes, A. Clorius and C. Schwartz, London.
19,168. Tooth Brushes, H. Besson and G. H. Kent, London.
19,169. Preventing Incrustation in Boilers, G. L. F. Edeline, London.
19,170. Apparatus for Rousing Liquors, H. Prince, London.
19,171. Textile Fabrics for Pneumatic Tires, J. F. Palmer, London.
19,172. Retaining Corks in Bottles, J. W. and F. H. Butler, London.
19,173. Tree for Boots, The Honourable R. T. D. Brougham, London.
19,174. Treatment of Natural Phosphates, D. Levat, London.
19,175. Paper Coated with Celluloid, A. Gray, London.
19,176. Telephone Annunciators, L. M. Ericsson, London.
19,177. Apron Holders, L. Byron-Peters and W. McLaren, London.
19,178. Means for Cleaning Rice, &c, E. Kallsen, London.
19,179. Gas Chimney Protector, F. A. Seigel and F. A. Solbrig, London.
19,180. Fireproof Floors, C. A. Balph and E. P. S. Wright, London.
19,181. Submerged Roads, &c., M. A. de Palacio, London.
19,182. Pipes, &c., for Water-closets, H. I. Dakin, London.
19,183. Lathing, E. F. Stimson, London.
19,184. Electric Heaters, J. R. Davis, London.
19,185. Electric Switches, F. Stevens and R. R. Kesteven, London.
19,186. Electric Fire-alarms, L. G. Rowand, London.
19,187. Alkyl-ethers, J. Y. Johnson.—(*C. F. Boehringer and Soehne, Germany.*)
19,188. Lactyl-*p*-Phenetidine, J. Y. Johnson.—(*C. F. Boehringer and Soehne, Germany*)
19,189. Chlorate of Soda, T. T. Best and G. Brock, London.
19,190. Dust-trap, W. H. Steel and W. H. Steel, London.
19,191. Securing Battery Wires, F. A. and N. von Alimonda, London.
19,192. Fixing Fastenings for Boots, J. G. Paterson, London.
19,193. Floats for Fishing, &c., J. R. Richardson, London.
19,194. Brace Buttons, J. O'Rorke, London.
19,195. Securing Laces of Boots, &c., W. Thomas, London.
19,196. Suspending Hooks, R. D. Moody, London.
19,197. Railway Car Couplings, R. D. Moody, London.
19,198. New Match Holder, J. Richter, London.
19,199. Fermenting Apparatus, A. D. Currie, London.
19,200. Setting Printing Type, G. C. Downing.—(*J. Salomon, Germany.*)
19,201. Distributing Printing Type, G. C. Downing.—(*J. Salomon, Germany.*)
19,202. Syruping Aerated Liquids, E. S. Chavasse, Birmingham.

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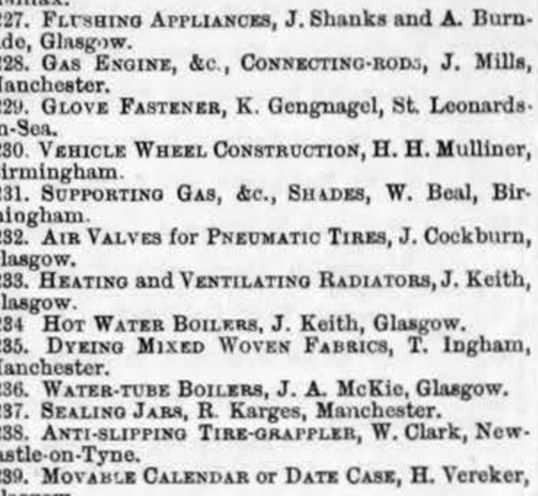
19,203. Pneumatic Tires, T. R. Piner, London.
19,204. Cleansing and Polishing Soap, C. J. Goodland, Bridgwater.
19,205. Self-closing Bag Frame, P. B. Hollick, London.
19,206. Graining Machine for Oil Colours, H. J. Probyn and T. Wood, Gloucester.
19,207. Releasing the Backs of Watches, J. S. Wilday, Birmingham.
19,208. Pneumatic Tires, A. Maltby, London.
19,209. Cycle Gear, F. W. Briggs, London.
19,210. Splitting Cottar Pins, T. W. Lench, M. A. and T. Robson, Birmingham.
19,211. Profiling Machines, R. F. Hall and C. Taylor, Birmingham.
19,212. Commercial Blotting-pad, T. M. Markham, Manchester.
19,213. Chimney Ventilators, R. Morris, Gateshead-on-Tyne.
19,214. Cranes, B. B. Dadley, London.
19,215. Constructing Entree Dishes, R. Stevenson, Sheffield.
19,216. Lathes for Polishing, &c, A. Davidson, Sheffield.
19,217. Pneumatic Tires for Carriages, J. Hopper, London.
19,218. Flexible Hose Pipe, E. L. Pease, Stockton-on-Tees.
19,219. Fastening for Hats, W. Stevenson, Nottingham.
19,220. Electric Ship Logs, W. D. Whyte and D. Muirhead, Glasgow.
19,221. Protecting Pneumatic Tires, J. Alverti, Cheshire.
19,222. The Safety Hair-curling Pin, R. Glossop, Redditch.
19,223. Photographic Plate Carriers, A. J. Mason, Birmingham.
19,224. Billiard Table Cushions, J. R. Jackson, Manchester.
19,225. Boots and Shoes, R. W. and L. H. Bateman, Halifax.
19,226. Machinery for Dyeing Yarn, W. H. Thorpe, Halifax.
19,227. Flushing Appliances, J. Shanks and A. Burnside, Glasgow.
19,228. Gas Engine, &c., Connecting-rods, J. Mills, Manchester.
19,229. Glove Fastener, K. Gengnagel, St. Leonards-on-Sea.
19,230. Vehicle Wheel Construction, H. H. Mulliner, Birmingham.
19,231. Supporting Gas, &c., Shades, W. Beal, Birmingham.
19,232. Air Valves for Pneumatic Tires, J. Cockburn, Glasgow.
19,233. Heating and Ventilating Radiators, J. Keith, Glasgow.
19,234 Hot Water Boilers, J. Keith, Glasgow.
19,235. Dyeing Mixed Woven Fabrics, T. Ingham, Manchester.
19,236. Water-tube Boilers, J. A. McKie, Glasgow.
19,237. Sealing Jars, R. Karges, Manchester.
19,238. Anti-slipping Tire-grappler, W. Clark, Newcastle-on-Tyne.
19,239. Movable Calendar or Date Case, H. Vereker, Glasgow.
19,240. Spring Mattresses, O. Ransford, Glasgow.
19,241. Collapsible or Folding Wardrobes, W. H. Vaughan, London.
19,242. Collapsible, &c., Furniture, W. H. Vaughan, London.
19,243. Preparation for Curling Hair, G. H. Hill, London.
19,244. Mudguards for Cycles, W. Cunningham, London.

SELECTED AMERICAN PATENTS.

From the United States Patent Office Official Gazette.

523,998. Dynamo-electric Machine, *G. Rennerfelt, Lynn, Mass.—Filed March 6th*, 1894.

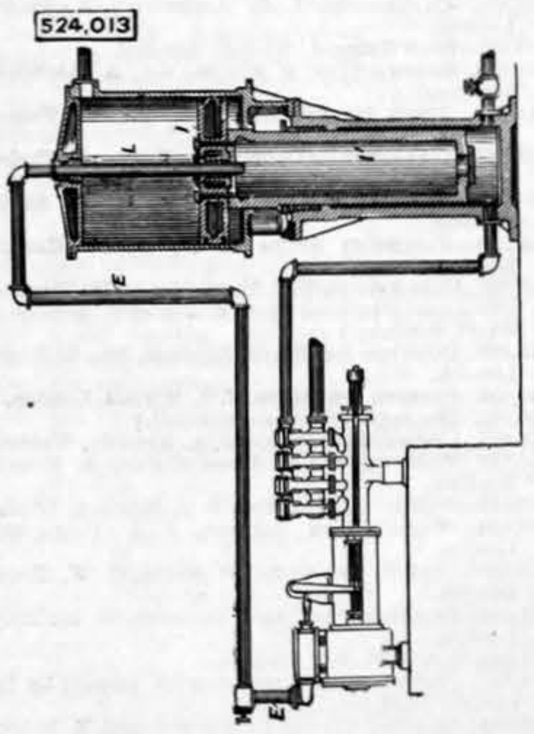
Claim.—(1) The combination of a magnet with a divided core, a series of rotating conductors interposed between the parts thereof, and means for electrically connecting said conductors in series, substantially as described. (2) The combination of a magnet with divided core, a series of rotating conductors



interposed between the parts thereof, and means for electrically connecting said conductors in series, consisting of a series of suitably connected liquid collectors, substantially as described. (3) The combination of a magnet with a divided core, a rotating conductor interposed between the parts thereof, and annular vessels containing mercury suitably arranged for collecting the current generated on said conductor, substantially as described.

524,013. Pressure Accumulator, *C. C. Worthington, Irvington, N.Y.—Filed February 26th*, 1894.

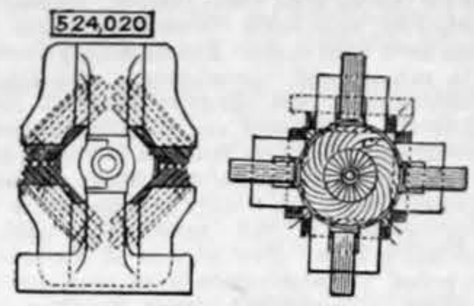
Claim.—The combination with a steam engine, of a steam accumulator forming part of the steam connections between the steam supply and engine, and means for varying the supply of steam to the engine in accordance with the movement of the accumulator piston, substantially as described. (2) The combination with a pressure accumulator having a differential piston I, I', the piston I' being hollow, of perforated exhaust pipe L passing through the piston I into the hollow piston I', closed pipe O in said hollow piston I', and a non-heat-conducting packing about said pipe O, substantially as described. (3) The combination with a pressure accumulator connected with an elastic fluid supply, of pipe E connecting with the accumulator chamber by a series of openings arranged in the line



of movement of and opened and closed by the accumulator piston, substantially as described. (4) The combination with a pressure accumulator connected with an elastic fluid supply, of pipe E, and exhaust pipe L connecting the accumulator chamber with the pipe E and having a series of openings opened and closed by the movement of the accumulator piston, substantially as described. (5) The combination with a pressure accumulator connected with an elastic fluid supply, of pipe E, and perforated exhaust pipe L in the accumulator chamber connecting with the pipe E and passing through the accumulator piston, whereby the perforations in the pipe are opened and closed by the piston, substantially as described.

524,020. Dynamo-electric Machine, *R. Eickemeyer, Yonkers, N.Y.—Filed October 7th*, 1891.

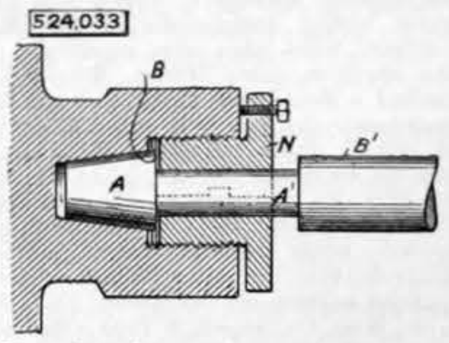
Claim.—(1) In a dynamo-electric machine, the combination with an armature, of separate electro-magnets arranged with their similarly polarised cheeks closely adjacent to each other, but separated by narrow spaces, parallel with the armature winding, and counterfield coils in circuit with the armature winding, but receiving electric current, in a direction opposite to that in the adjacent portion of said winding, and having portions of said coils located at said spaces parallel with said adjacent portions of the winding, the air spaces affording resistance in those magnetic circuits which are induced by said adjacent portions of the armature winding, and the counterfield



coils inducing a magnetic flow, opposite to that which is induced by said portions of the armature winding. (2) In a dynamo-electric machine, the combination, substantially as hereinbefore described, of an armature, separate U-shaped electro-magnets, each having its own field coil or coils, and provided with appropriate cheek pieces, and having the several similarly magnetised cheeks located closely adjacent to each other, but separated by air spaces parallel with the armature winding, and a counterfield coil on each magnet, in circuit with the armature winding, and having portions thereof located in said spaces, and parallel with the armature winding.

524,033. Device for Securing Piston-rods to Crossheads, *C. G. Turner, Wilmington, Del.—Filed May 3rd*, 1894.

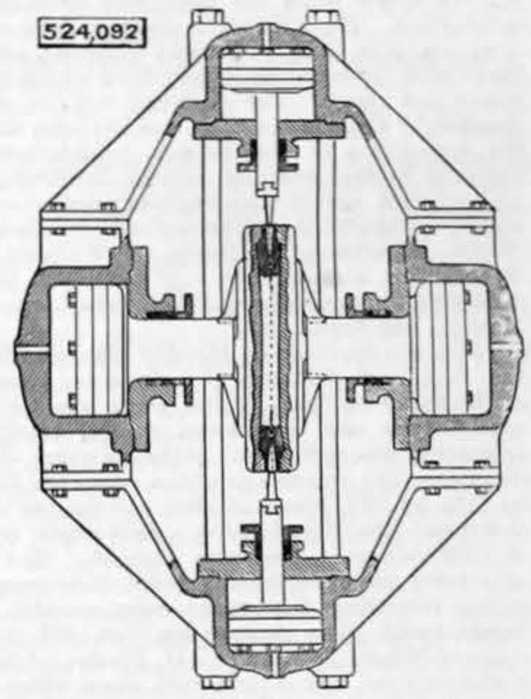
Claim.—The combination of a crosshead having a socket therein, of a piston-rod having a head A and a reduced portion A^1 behind the head whereby shoulders



B and E^1 are formed, a nut N divided into two or more segmental parts adapted to embrace the reduced portion of the rod and engage with threads on the crosshead so that by screwing or unscrewing the nut the head on the rod can be forced in or out of the socket in the crosshead.

524,092. Machine for Making Axles, *C. Mercider, Braddock, Pa.—Filed July 6th*, 1893.

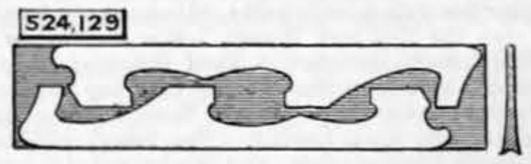
Claim.—In a machine for making axles, the combination with a pair of matrix dies for forming and clamping the axle blank, of two piercing dies at



right angles to the matrix dies and arranged to enter the open ends thereof, and force the metal laterally to form the collars, and mechanism for operating said dies, substantially as described.

524,129. Skate Blade and Art of Manufacturing Same, *T. W. Bryant, Torrington, Conn.—Filed March 24th*, 1894.

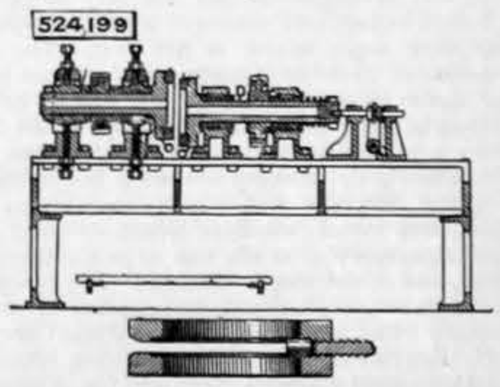
Claim.—(1) A skate blade having a cold rolled polished outer skin of metal, which is exceedingly thin, formed on its opposite sides, which serve as



cutting edges for the intervening metal of the tread, substantially as set forth. (2) The method of manufacturing skate blades, which consists in cold rolling a metal plate, thereby forming thereon an exceedingly hard and smooth outer skin, then cutting or punching the blank from the plate, and finally finishing the tread by grinding, substantially as specified.

524,199. Apparatus for Forging Screws, *C. Fairbairn and M. Wells, Manchester, England.—Filed October 28th*, 1892.

Claim.—(1) In a screw-forging machine, two opposed rollers each having on its face a narrow raised annular band, containing spiral screw forming grooves, and a flat feeding band concentric with and



adjacent to said raised groove band, substantially as described. (2) In a screw-forging machine, a roller having on its face a narrow raised annular band, containing spiral screw forming grooves and having bevelled edges, and a flat feeding band concentric with said raised band, substantially as described.