FOLDING DOOR EQUIPMENT

"NATIONAL PNEUMATIC SYSTEM"
(PATENTED).

The Folding Door Equipment described and illustrated in this Section is intended primarily for use on Tramcars, but the general principles of the design are equally applicable to Railway and Omnibus work.

For the latter applications, the principal parts which may require modification are the Upper and Lower Door Shaft Bearings, the Door Guide Brackets and Door Roller Guides, and the Door Engine Connecting Rods. Numerous designs of these items are available, to suit all car constructions and arrangements of door mechanism; it being understood that only samples of each of the fittings detailed above are illustrated herewith.

It is essential to arrange Folding Doors so as to take the maximum advantage of their adaptability in operation, while at the same time to provide the largest possible door opening with the minimum number of moving parts. Further, the doors must be so arranged that while they are open they cannot come into contact with passing vehicles. These considerations are also affected by the necessity for a door which is rigid when closed, and free from noise and danger to the passengers when closing.

Numerous combinations of door movements and alternative positions are available, as already discussed in Section T., and from the equipment illustrated in this Section, designs of doors to suit almost any traffic conditions will be found.

From a traffic and revenue-earning standpoint, the doorways are unquestionably the most vital points in the vehicle construction. Doorways which are inadequate in size and number produce congestion in the vehicle and on the street or platform around the doors, while doors which are opened and closed with undue slowness prevent the rapid interchange of passengers which is essential to a quick service.

Folding Door Equipment provides the most economical method of safely closing and opening doors and complies in every respect with the most rigid traffic and service conditions.

Referring to Fig. 1 on the opposite page, this shows an outside view of one of the " One-Man " Tramcars which have been in service on the London United Tramways for a number of years. The car is equipped with Single Folding, equally leaved doors, for both Front Entrance and Rear Treadle Plate Controlled Exit. All doors fold outwards and are coupled to Folding Steps.

Fig. 2, page 4, shows a close-up view of the Front Entrance Door and Step on a " One-Man " Tramcar fitted with a different system of Door Control. The illustration shows the door and step in the closed position, and demonstrates the complete safety of such gear, no portion of which provides a foothold in the position shown, while at the same time an unrestricted entry for the passengers is provided when the door and step is unfolded. (See Fig. 2, Section T.4, for view of the door and step in the open position.)

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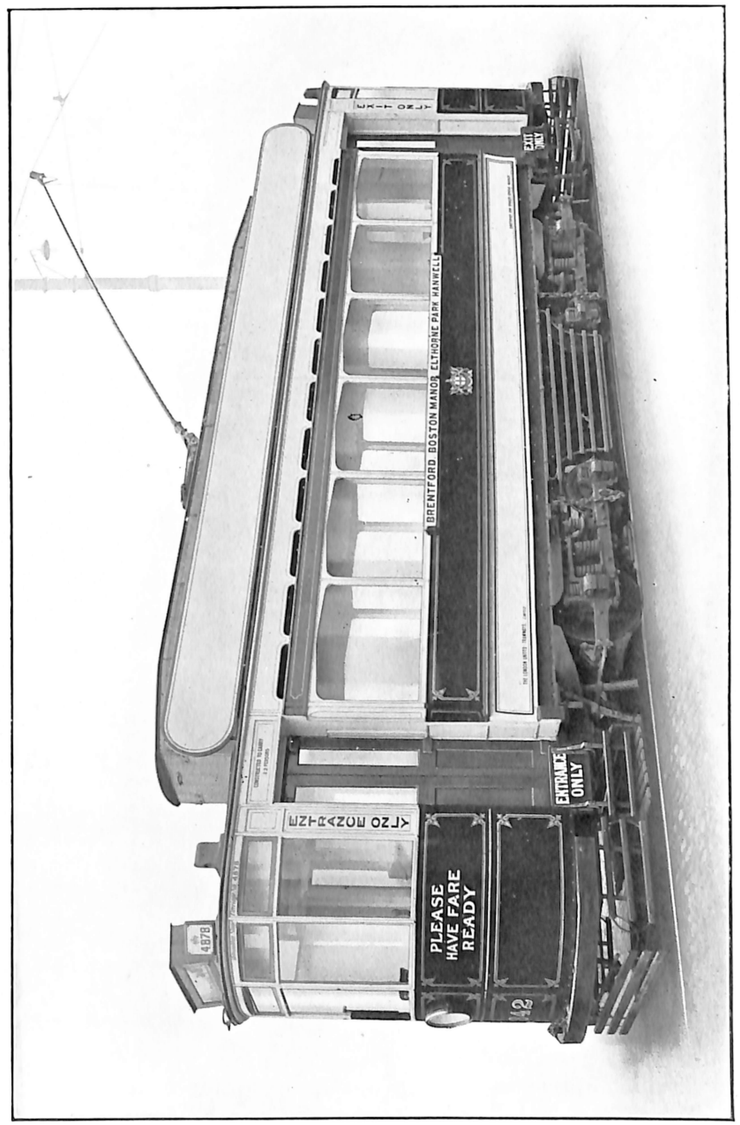

Fig. 1. Outside view of " One-Man " Tramcar, equipped with Automatic Electro-Pneumatic Door Control System (as supplied to the London United Tramways, Ltd.)

Fig. 2. Outside view of "One-Man" Tramcar, equipped with Automatic Pneumatic Door Control System, showing Entrance Door and Step in closed position.

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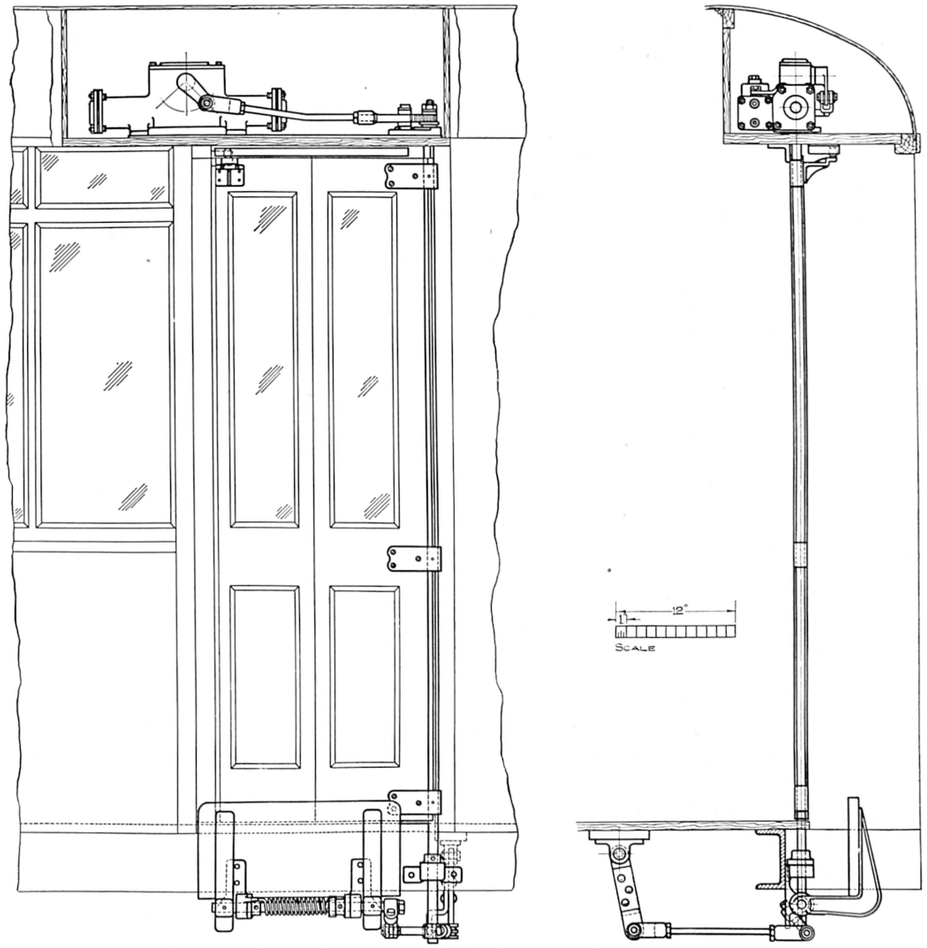

Fig. 3. Diagram showing General Arrangement of Single Folding Door and Step Equipment (part of roof removed to show location of Door Engine).

Referring to Fig. 3, page 5, this shows a diagrammatic arrangement of Single Folding Door and Folding Step Equipment, with the Type " E " Folding Door Engine in a header box over the doorway. The car structure is shown as from the outside, a portion of the car roof being removed to show the location of the Door Engine. Standard equipment is employed throughout. An alternative type and position of Door Engine suitable for operating the door and step shown in Fig. 3, is given in Fig. 7, Section T.7, which illustrates the application of the Type " K " Folding Door Engine, carried underneath the car floor.

The Saloon Tramcar shown in Fig. 4, page 7, is fitted with Double Folding Doors, unequally leaved and without Folding Step Equipment. This car has been equipped for the Bradford Corporation Tramways with a Pneumatically-controlled system, the Door Control Valve (Type C.3620) being operated by the Motorman.

Fig. 5 shows a close-up view of these Double Folding Doors in the closed position. Only a very small inset from the body side is required for the Door Shafts on account of the small difference between the widths of the unequal leaves. No centre pillar is needed, as the Safety Door Rubber Edgings, of the " Vicedge " type, are so constructed as to interlock with each other. A perfectly "cushioned" movement for the door is provided by the Type "E" Door Engine, (see Section T.2).

Fig. 6, page 9, shows an arrangement of Double Folding Door Equipment, generally in line with that shown in Figs. 4 and 5. The Type " E " Folding Door Engine is mounted in a header box over the doorway, and is positioned on an Engine Baseplate, which also serves to locate the exact positions of the Upper Door Shaft Bearings. The Door Shafts have their upper ends tapered and threaded, and on the tapered end of the right-hand door shaft the Adjustable Tapered Terminal (Parts Nos. 28 and 29B, Fig. 3, Section T.4) is located. On the tapered end of the left-hand door shaft, the Geared Segment is located, and this segment meshes with the Geared Terminal located on the Gear Stud, which is positioned on the Upper Door Shaft Bearing.

Door Engine Connecting Rods, bent to suit individual car conditions, connect the Geared or Plain Terminals with the Operating Arm and Quadrant Shaft of the Door Engine. For double folding doors, it is essential to make the link at the engine arm sufficiently rigid to ensure that no backlash can occur in either direction, while at the same time permitting free movement for the ends of the connecting rods in three planes. The desired result is obtained by using a Swivel Pin for connecting the Door Engine Arm to the Door Engine Connecting Rods, and providing Ball-jointed Jaws for attachment to the Adjustable Screws in the geared or plain terminals. These Ball-jointed Jaws are clearly shown in Fig. 6.

From the configuration of the parts shown in Fig. 6, and referring to Section T.2, page 8, the various combinations of Valve Puller and Terminal positions, methods of operation, and designs, respectively, will be appreciated. For example, Fig. 6 shows an arrangement whereby the valve puller is **charged** to **close** the door. To cause the door to **open** when the valve puller is **charged,** the latter may either be moved to the opposite end of the door engine (keeping the whole of the door shaft gear and the door engine piston in the same position while making such a change), or

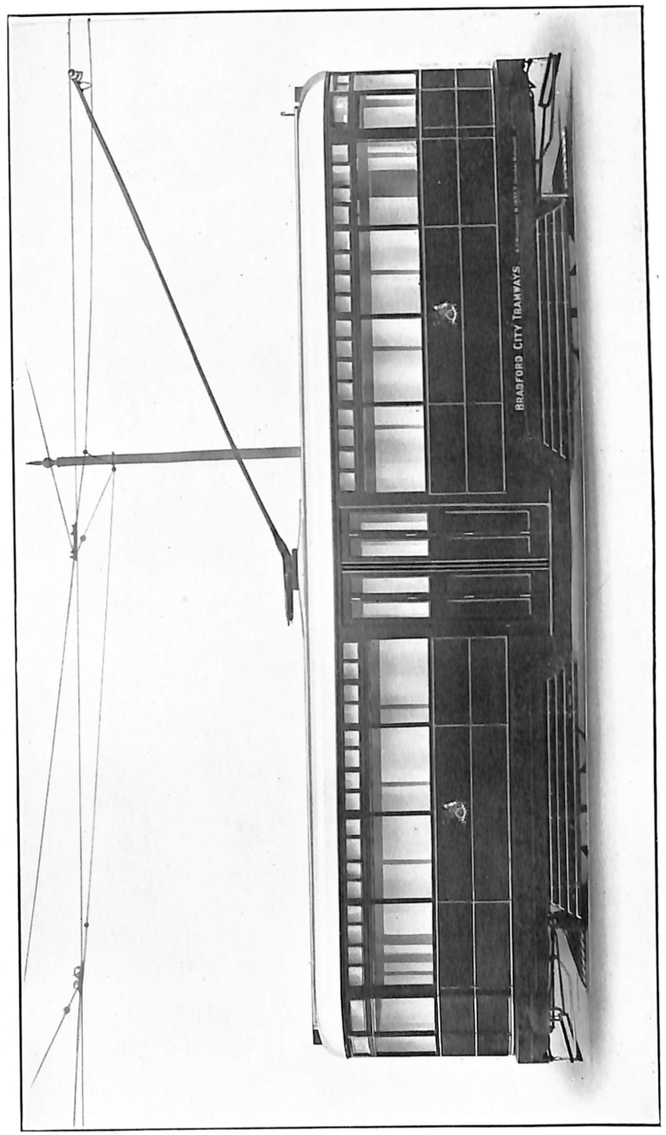

Fig. 4. Outside view of Tramcar, equipped with Pneumatic Door Control System and Motorman's Signal System (as supplied to the Bradford Corporation Tramways).

Fig. 5. Outside view of Double Folding Doors (closed).

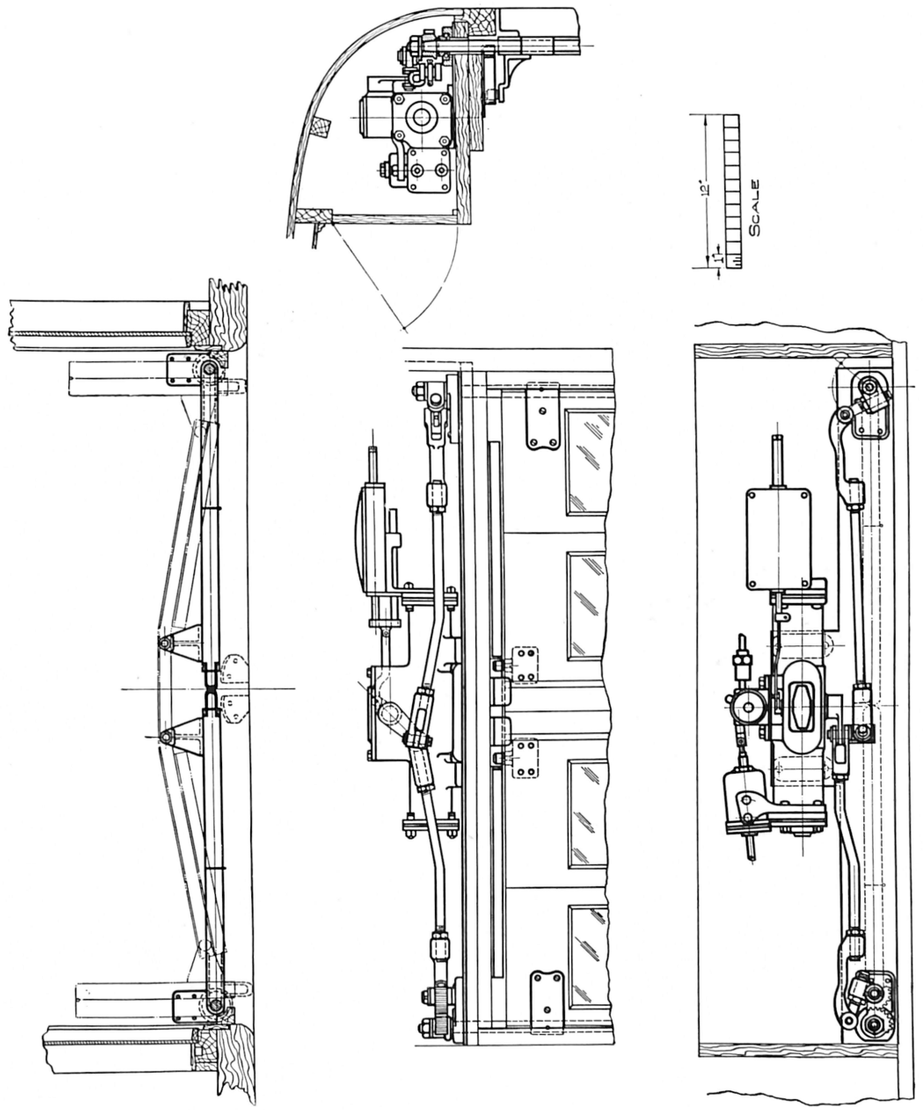

Fig. 6. Diagram showing General Arrangement of Type "E" Door Engine and Double Shaft Folding Door Equipment.

the same result may be obtained by interchanging the geared and plain terminals on the door shaft (keeping the door engine piston in the same position while making such a change). To obtain a further variation, in which the valve puller is **charged** to **open** the door, but retaining the valve puller in the same relative position as that shown in the diagram, the door engine connecting rods may be **inverted** and replaced on the appropriate terminals on the opposite side of the plane of the door (when closed). Many other combinations are possible, but the above will serve as examples of the range of adaptability of the Folding Door Equipment.

The Door Shafts are suspended in Upper and Lower Door Shaft Bearings at their respective ends, the method of suspension being by Thrust Collars taper-pinned to the door shaft and bearing in Ball Thrust Bearings of the cone type.

Many types of door shaft bearings are available, some of which can only be employed for the upper ends of the shafts. Other types, such as the M.54 and M.55, are employed exclusively for the lower ends of the shafts. Another bearing, Type M.52, can be employed at either the top or the bottom of the door shaft. For each individual case, we shall be pleased to recommend the most suitable type of door shaft bearing.

Certain designs of door shaft bearings are arranged to take Dust Caps, which are held in place by means of a Setscrew.

Depending upon the weight of the doors and the type of engine mounting, each bearing may support part of the weight of the door, in which case it is important to ensure that the bearings are accurately positioned; or the bearings may be opposed, in which case it is important to arrange the position of the thrust collars so that they bear **tightly** against the coned surfaces of the inner races of the ball thrust bearings, otherwise the combined annular and thrust effect of these bearings is lost. About $\frac{1}{16}$-in. draw on the bolt or screw holes in the bearings should produce the desired compressive stress on the thrust collars.

The primary leaf of the door is secured to the door shaft by means of Door Straps. The latter are located on the door shaft by means of parallel pins riveted in position. Three $\frac{1}{4}$-in. countersunk machine screws pass through the door strap and the ends are cut off flush at assembly. It is most important to ensure that the door straps are well fitted, in order that the primary leaf of the door may be securely held, and so locate the secondary leaf in its correct position.

The secondary leaf of the door is secured to the primary leaf by means of butt or piano hinges in the usual way. The movement of the secondary leaf is determined by the Door Roller Guides, which guide the Door Roller Bracket in its movement. The latter consists of a bracket carrying a pin on which is located a roller. The roller runs in the angle iron door roller guides which are screwed to the under surface of the door header. The door roller bracket is secured to the door by means of $\frac{1}{4}$-in. countersunk machine screws, which pass through the door and into the bracket.

Several sizes of door roller brackets are available, the local conditions of each design of vehicle governing the size. The 3-in. size of bracket gives excellent results, but it is not always possible to employ this size, hence the $2\frac{1}{2}$-in. or $2\frac{1}{4}$-in. size is provided. In no case should a bracket of less than 2-in. be used, otherwise the secondary leaf will jam at the open position. To obtain the best results, the triangle formed by joining the centre of the door shaft, the centre of the door roller bracket pin, and the centre of the hinge pin, should have its **smallest** angle as **large** as possible, when the door is in the fully opened position.

Door Shoes are employed to guide the secondary leaf of the door into its final position when closing, and to retain it in that position so that the vibration of the vehicle will not cause rattle, due to the clearance between the door roller and the door roller guides. The shoes are provided with curved faces, the upper edges of the brackets being secured to the under surface of the header by means of wood screws. The exact position of the door shoes should be determined on site, but approximate positions are shown in Fig. 6, on page 9.

For retaining the lower corners of folding doors in the correct location, Bottom Door Guides and Catches may be used in conjunction with Door Catch Brackets. The necessity for these fittings arises only in the case of thin doors of large area, and arranged so as to close over the sill plate, since it is necessary for the door catch bracket to be located under the sill plate, and for the roller of the bottom door guide to contact with the edge of same. The bottom door guides and catches are secured to the lower end of the front style of the secondary leaf of the door.

For illustrations of samples of the various designs of certain of the above fittings, see Fig. 7.

Before placing the gear in service, all locknuts and split pins should be carefully attended to, in order to ensure that no rattle or undue movement of the parts is occasioned. The ball races should be well lubricated with yellow grease before the dust caps are secured in position, and a small quantity of similar grease should be placed on the pins and split spheres of the various jaws, on the teeth of the geared segments and gear studs, the inner surfaces of the door roller guides, and door roller bracket pins.

Where Taper Pins are provided for, these should always be employed in preference to parallel pins, as it has been found by lengthy experience that taper pins are preferable for securing certain portions of the equipment.

For detailed and dimensioned drawings of Folding Door Equipment, see Drawings Nos. W.L.2702/4 to W.L.2702/46, and W.L.2751/1 to W.L.2751/15.

SAFETY DOOR EDGINGS.

The front styles of all Sliding Doors and the secondary leaf of Folding Doors should be fitted with a Moulded Rubber Safety Door Edging, to prevent any possibility of damage to the clothing or body of a passenger who attempts to enter or alight from a vehicle during the closing of

the doors, and quite apart from the safety features provided by the " cushioned " movement of the Door Engine. Further, it is essential to provide a draught and rain-proof door, and the most satisfactory method of obtaining these features is to fit a Moulded Rubber Safety Door Edging of the " Vicedge " type.

These edges are formed of a moulded rubber section, covered with weatherproof patent leather, the upper end being provided with a special rubber block which ensures rigidity. Four types are available : right and left hand, male and female sections.

For single sliding and folding doors, the male edge is required. For double sliding and folding doors, one male and one female edge for the contacting styles is required.

Only ½-in. of each of the flat portions of the edge need be secured to the door by means of the Retaining Strips, a tongue ½-in. wide on the door style being ample for this purpose. The retaining strips are of brass and can be provided in copper oxidised, or other finish, to match the interior furniture of the vehicle. The moulded rubber safety door edgings and retaining strips should be so arranged that the outer surfaces of the latter are flush with the door surfaces.

Care should be taken in mounting the safety door edges so as to ensure that the portion of the patent leather covering which is to contact with the door pillar is truly parallel with same, leaving any slight discrepancy in the flat portion of the edge to be covered by the retaining strip. The edges should be mounted **with the doors in position, and not on the bench.**

For dimensioned drawings of the " Vicedge " Moulded Rubber Safety Door Edgings, see Drawings Nos. W.L.2912/1, /2, /3, /4.

PARTS LIST.

(Abridged).

Part No.	Description.
1.	Door Shaft.
2.	,, Strap.
3.	Double Door Shaft Engine Baseplate.
4.	Upper Door Shaft Bearing, Type M.53.
5.	,, ,, ,, Type C.3457.
6.	Geared Terminal.
7.	Double Door Shoe.
8.	Door Roller Bracket complete.
9.	Ball Thrust Bearing.
10.	Thrust Collar.
11.	Short Single Door Roller Guide.
12.	Long Double Door Roller Guide.
13.	Engine Connecting Rod.
14.	,, ,,
15.	Jaw for Ball Joint.
16.	Short Jaw for Pin.
17.	Long Jaw for Pin.
18.	Bottom Door Guide and Catch (Right Hand).
19.	Bottom Door Guide and Catch (Left Hand).
20.	Double Door Catch Bracket.
21.	Lower Door Shaft Bearing, Type M.57 (Right Hand).
22.	Lower Door Shaft Bearing, Type M.57 (Left Hand),
23.	Dust Cap.
24.	Setscrew for Dust Cap.
25.	Assembly of Adjustable Tapered Terminal.
26.	Geared Segment.
27.	Slide Bar and Bracket for Door and Step Connection.

NOTE.—Certain of the above parts are employed in Folding Step Equipment. For List of Parts Nos. 25, 28, 29A, 29B, 30 and 31, see Fig. 3, Section T.4.

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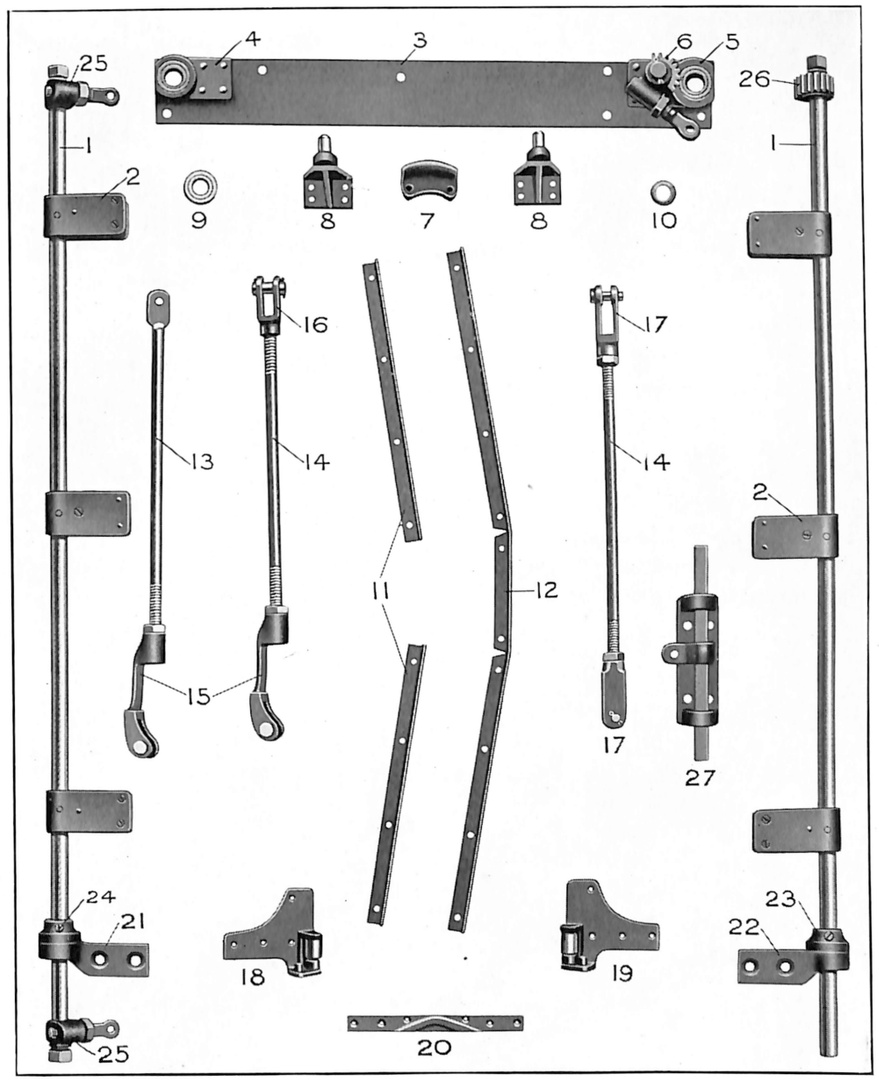

Fig. 7. Assemblies and Details of Folding Door Equipment.

The alternative combinations of door movements shown in Figs. 8, 9 and 10, will be self-explanatory. It should be understood, however, that the combinations shown do not represent all the possible forms of door movements—they are merely examples of current practice. Further, the doors are shown at the platform bulkhead of a tramcar; they may be located with equally good results at any intermediate point in the body structure, provided that care is taken in the choice of the door movement. For example, the door movement shown diagrammatically in Fig. 9, Side " A," is also shown in Figs. 4, 5 and 6 of this Section.

Referring to Fig. 11, this shows a diagrammatic plan view of a " One-Man " Car. This door arrangement is definitely located at the platform as shown, the Front Entrance Door on Side " A " being situated at the left-hand of the Motorman, and to the rear of his control position.

A short length of railing prevents the entering passengers from crowding on to the platform, and they are thus caused to flow past the ticket rack and change-giving machine (shown diagrammatically) in that order. This ensures that passengers cannot enter the passenger saloon without having paid their fares and received their tickets and change.

The Treadle Plate illustrated on Side " B " for controlling the Exit Door would be inoperative, and this door would therefore be closed at the front end of the car. At the rear end of the car, however, the Treadle Plate Controlled Rear Exit Door (which is located on Side " A " of the car at the rear end) is in the operable condition, and on passengers stepping on to the treadle plate, the exit door will be opened, as shown at Side " B."

For description of Treadle Plate Mechanism, see Section T.5.

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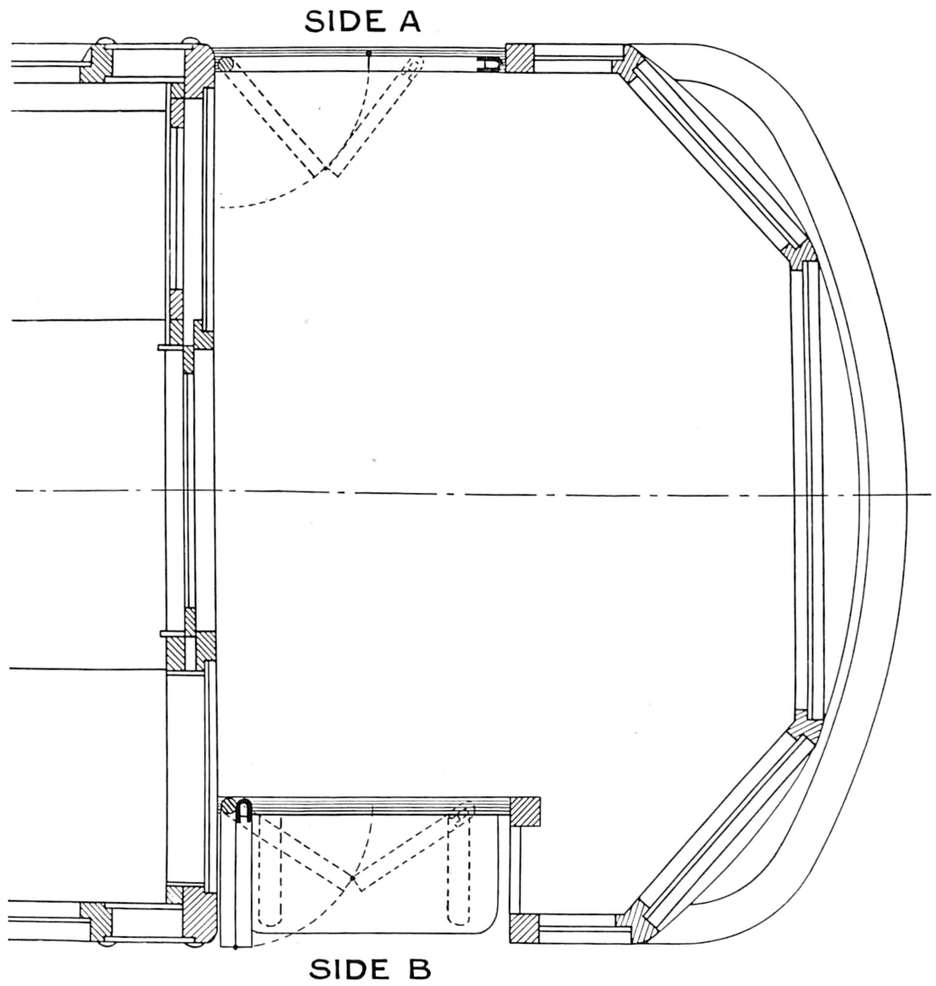

Fig. 8. Diagram showing alternative door arrangements.

Side " A "—Single Folding Door, equal leaves, door folding inwards (without Folding Step).

Side " B "—Single Folding Door, equal leaves, door folding outwards (with Two-Arm Folding Step).

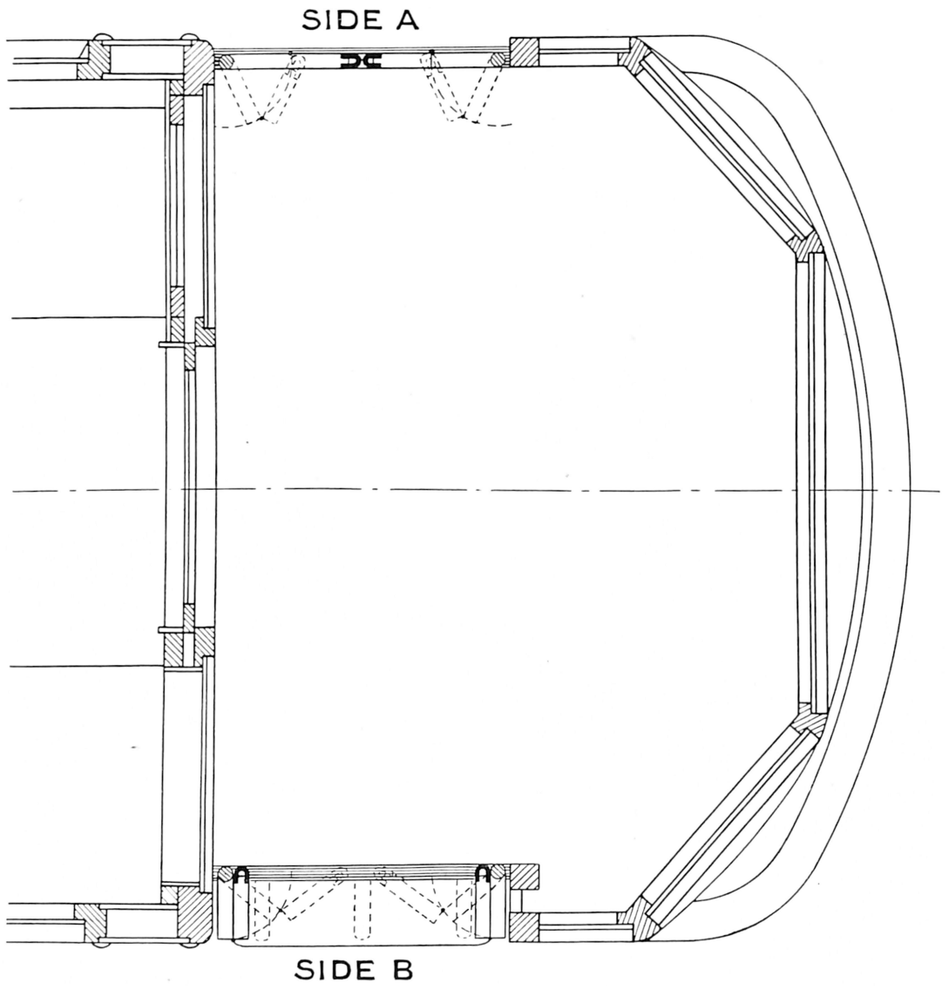

Fig. 9. Diagram showing alternative door arrangements.

Side " A "—Double Folding Doors, equal leaves, doors folding inwards (without Folding Step).

Side " B "—Double Folding Doors, equal leaves, doors folding outwards (with Three-Arm Folding Step).

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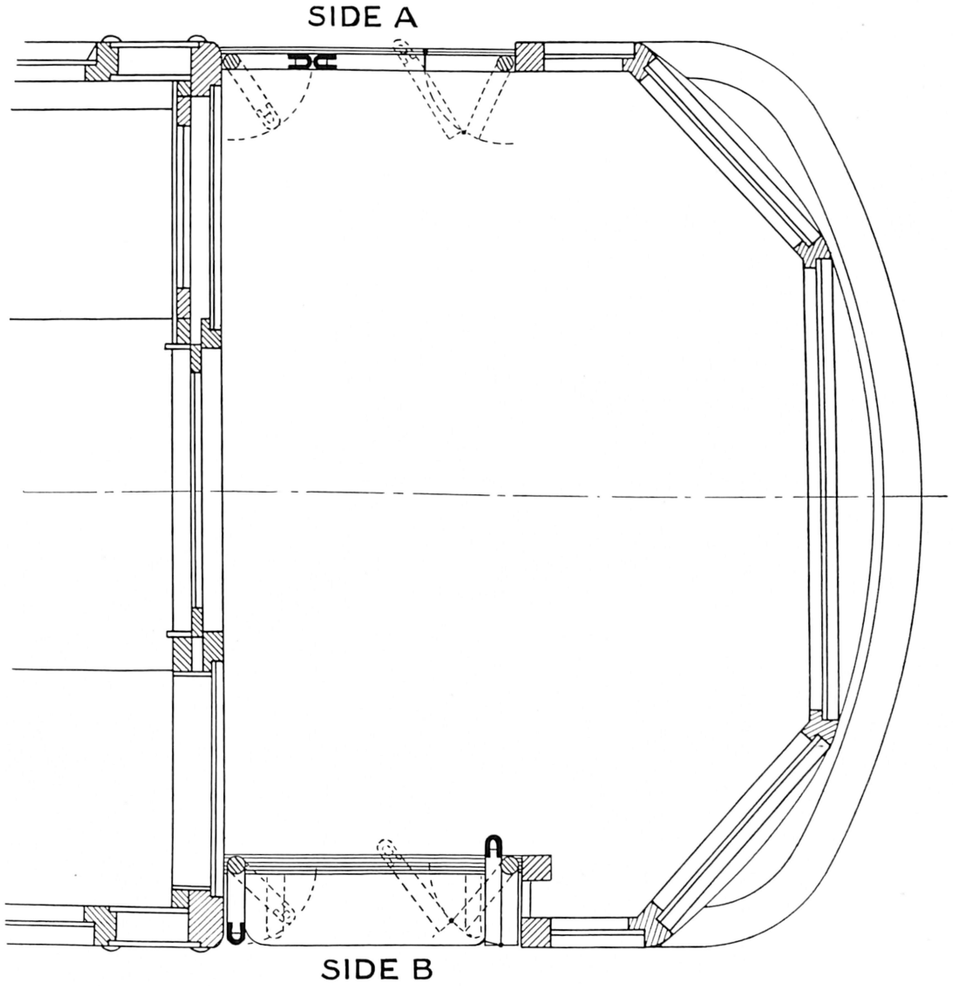

Fig. 10. Diagram showing alternative door arrangements.

Side " A "—Swing Door and Single Folding Door, unequal leaves, doors swinging and folding inwards (without Folding Step).

Side " B "—Swing Door and Single Folding Door, unequal leaves, doors swinging and folding outwards (with Two-Arm Folding Step).

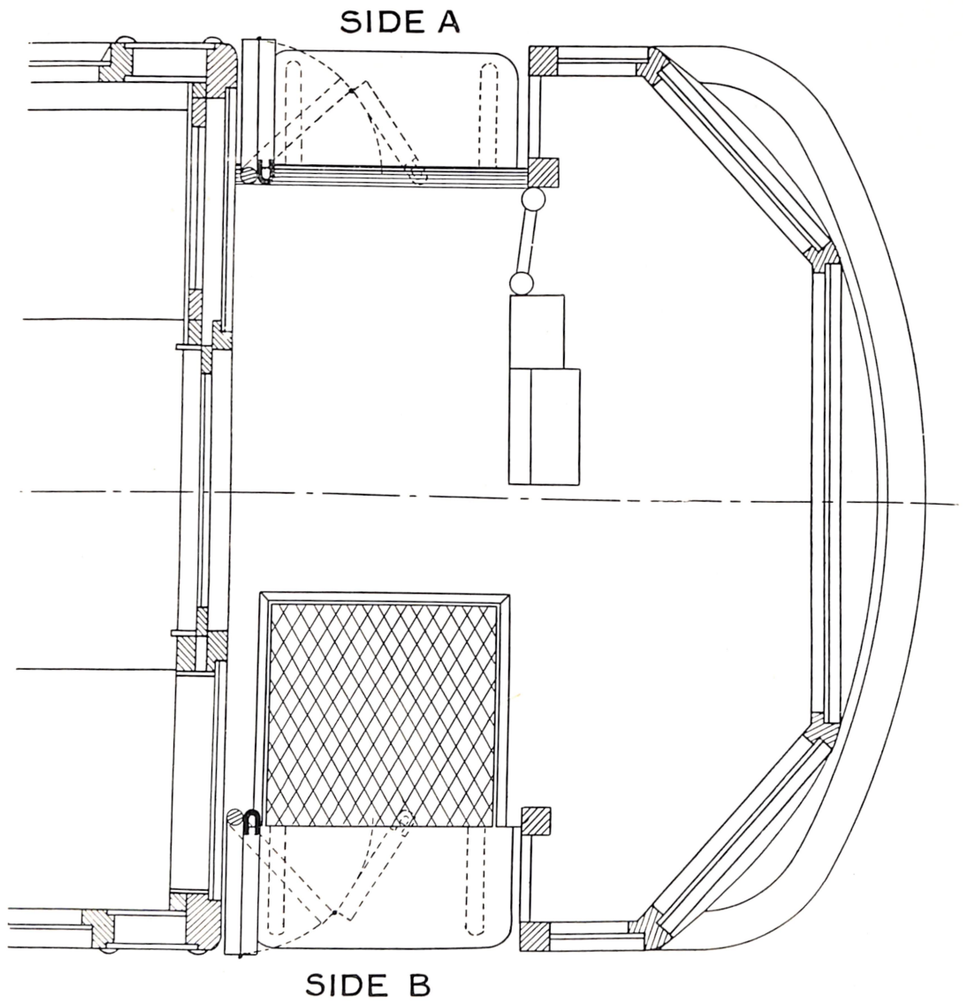

Fig. 11. Diagram showing door arrangements for "One-Man" Tramcar.

Side "A"—Single Folding Entrance Door, equal leaves, door folding outwards (with Two-Arm Folding Step).

Side "B"—Single Folding Exit Door, equal leaves, door folding outwards (with Two-Arm Folding Step and Treadle Plate Control for Exit Door).

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FOLDING STEP EQUIPMENT

"NATIONAL PNEUMATIC SYSTEM"
(PATENTED).

The Folding Step Equipment described and illustrated in this Section is intended primarily for use on Tramcars, but the general principles of the design are equally applicable to Railway and Omnibus work, although in these cases the details of certain of the parts may require slight modification on account of clearance, etc.

The usual height of Tramcar platforms above the street level necessitates some form of step, and the most convenient method of fitting such steps is to provide a system of Step Hangers and Bearing Brackets, suspended from the platform angle of the car ; or, in the case of Exit Doors, from the Treadle Plate.

It is essential to arrange steps so that they may be readily folded up or otherwise prevented from coming into contact with passing vehicles. Where Pneumatically-operated Doors are employed, and it is necessary to fit Folding Steps, the latter are most conveniently operated by means of a mechanical coupling from the Door Shaft. Such Steps are automatically operated, *i.e.*, they unfold with the door and fold up as the door closes, thus presenting no foothold for passengers who might attempt to board the car whilst it is in motion.

Referring to Fig. 1, which shows the general arrangement of our standard Folding Step Gear, it will be seen that the Step Board is carried on Step Arms, which are taper-pinned to the Step Shaft. The latter is provided with a tapered portion at one end, to which is attached the Adjustable Tapered Terminal for rotating the step shaft (see Fig. 3, page 7).

The step shaft is carried in Ball Thrust Bearings of the cone type, the thrust being taken up by means of Thrust Collars, which are taper-pinned to the step shaft.

The bearing brackets which carry the ball bearings and thrust collars are made of a convenient shape for bolting to the platform angle of the vehicle, the inner end of each bracket being provided with a Dust Cap, held in place by a Setscrew. See Fig. 2 for arrangement of this equipment on the car.

It is most essential to arrange the position of the step shaft bearing brackets in such a manner that the thrust collars bear **tightly** against the coned surfaces of the inner races of the ball thrust bearings, otherwise the combined annular and thrust effect of these bearings is lost. About $\frac{1}{16}$-in. draw on the bolt holes in the platform angle should produce the desired compressive stress on the thrust collars.

The step board, together with the step arms, is balanced by means of the Step Spring which surrounds the step shaft. One end of the spring is located in a boss cast integrally with the left-hand bearing bracket, the other end of the spring resting in the slots of the Spring Adjusting Collar, which is secured by a parallel pin to the step shaft. It will be clear that a step of any weight, and having two, three, or even four arms, may be readily balanced by adjusting the torsion on the step spring (or springs). This adjustment should be carried out in such a manner that when the step equipment is disconnected from the door shaft, the step board will rise freely to an angle of 45° with the horizontal.

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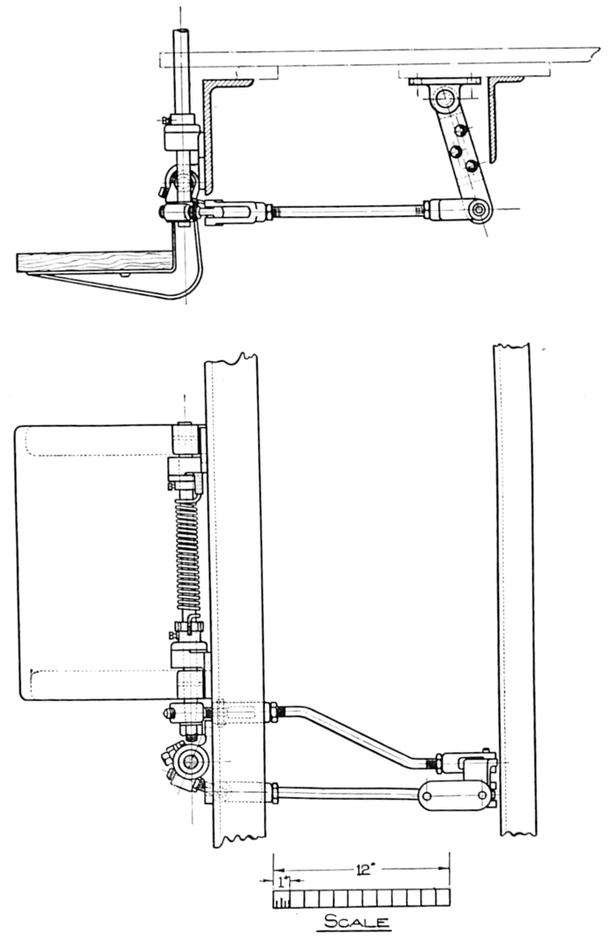

Fig. 1. Diagram showing General Arrangement of Standard Folding Step Gear.

The end of the door shaft is allowed to project sufficiently below the bottom of the Lower Door Shaft Bearing to allow of the movement of the Door Shaft Connecting Rod below the platform angle. (See Fig. 3, Section T.3).

To the lower end of the door shaft an Adjustable Clamp Terminal is fitted (see Fig. 3, page 7). This clamp terminal (which can be adjusted to any desired position on the door shaft, and securely locked in place by means of the Setscrew provided) rotates the Adjusting Screw through an angle of 90°, thereby causing the Door Shaft Connecting Rod to move through a corresponding distance. The opposite end of the door shaft connecting rod is attached to the Link for Door and Step Connection, thus causing the swing link to move through a corresponding angle.

The Step Shaft Connecting Rod, which is also attached to the link in question, is thereby caused to move through the same distance as that of the door shaft connecting rod, and thus rotates the adjustable screw in the adjustable tapered terminal through 90°.

It should be understood that if it is desired to cause the step to rotate through an angle **greater** than 90°, it is only necessary to **decrease** the projecting length of the Adjustable Screw in the Adjustable Tapered Terminal ; similarly, to **reduce** the angle through which the step rotates, it is only necessary to **increase** the projecting length of this Adjustable Screw.

In order to provide for cases which require more adjustment for the inter-relation of the door and step shaft, the Adjustable Clamp Terminal on the door shaft may be employed. To cause the step to rotate through a still **greater** angle, it is necessary to **increase** the projecting length of the Adjustable Screw in the Adjustable Clamp Terminal, while to **reduce** the angle through which the step rotates, the projecting length of the Screw must be **decreased.**

Fig. 3, page 7, shows the assemblies and details of the various sizes of Adjustable Clamp and Tapered Terminals.

It is essential to ensure that the correct relationship exists between the movement of the door and the movement of the step. The door shaft must be so adjusted with relation to the Door Engine that it rotates through 90°, thus ensuring that the doors are fully opened and fully closed at each appropriate position of the engine piston. Even with a correctly adjusted door, it is quite possible to have a badly-adjusted step, if the latter has not been properly fitted up. Thus, the step may move through 90°, but may not register accurately with the machined faces provided on the bearing brackets, or it may fold up in such a manner as to bear against the folded door. A ready means of adjustment for **position** of the folded and unfolded step is provided. The Step Shaft Connecting Rod Jaws are provided with plain pins, and on removal of these pins, the movement of the step shaft can be adjusted by shortening or lengthening the distance between the pins by adjusting the position of the jaws with relation to the step shaft connecting rod.

Fig. 2. Outside View of Single Folding Door and Folding Step Gear (open position).

To cause the step to contact **more** fully with the machined surfaces of the bearing brackets, the distance between the pins of the Step Shaft Connecting Rod Jaws must be **shortened.** This will result in the step not folding up so closely against the door in the closed position.

To cause the step to contact **less** fully with the machined surfaces of the bearing brackets, the distance between the pins of the Step Shaft Connecting Rod Jaws must be **lengthened.** This will result in the step folding up more closely against the door in the closed position.

Ball-jointed Jaws are employed for the Door Shaft Connecting Rod on account of the movements of the rod in question being in three planes. The ball-jointed jaws are readily removable for purposes of adjustment, if necessary, as the two spherical portions are split. It is, however, advisable to make all possible adjustments at the plain jaws.

When erecting Folding Step Gear, care should be taken to ensure that all parts moving angularly make their movements through equal angles on either side of the vertical or horizontal centre lines. Thus the link for door and step connection should be so suspended by means of its Bracket and Pin, with relation to the car structure and the step gear, that it is caused to swing through equal angles on either side of the vertical. The door shaft should move through exactly 90°, hence the adjustable clamp terminal should be so fixed that the centre of the pin in the ball-jointed jaw moves through 45° on either side of that centre line of the door shaft which is parallel to the platform angle. The adjustable screw in the tapered terminal on the step shaft should be so positioned that the centre of the pin in the jaw moves through 45° on either side of the vertical centre line of the step shaft.

All lock nuts and split pins should be carefully attended to before placing the gear in service, in order to ensure that no rattle or undue movement of the parts is occasioned The ball races should be well lubricated with yellow grease before the dust caps are secured in position, and a small quantity of the same grease should be placed on the pins and split spheres of the various jaws.

Where Taper Pins are provided for, these should always be employed in preference to parallel pins, as it has been found by lengthy experience that taper pins are better for securing certain portions of the equipment.

For detailed and dimensioned drawings of Folding Step Equipment, see Drawings Nos. W.L.2702/1 to W.L.2702/33 and W.L.2752/1 to W.L.2752/14.

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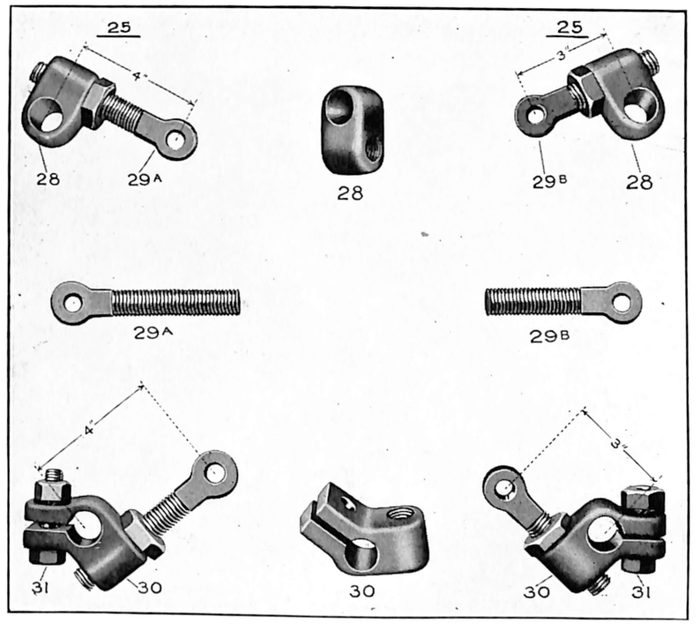

Fig. 3. Assemblies and Details of Adjustable Clamp and Tapered Terminals.

PARTS LIST.

(Abridged).

Part No.	Description.	Part No.	Description.
25.	Assemblies of Adjustable Tapered Terminals (3-in. and 4-in.).	30	Clamp Terminal.
28.	Tapered Terminal.	31	Clamp Terminal Bolt.
29A	Adjustable Screw (4-in.).	29B	Adjustable Screw (3-in.).

NOTE.—Certain of the above parts are employed in Folding Door Equipment. For List of Parts Nos. 1 to 27 inclusive, see Fig. 7, Section T.3.

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TREADLE PLATE EQUIPMENT

"NATIONAL" PNEUMATIC SYSTEM" (PATENTED).

Horrocks Roxburgh Pty. Ltd.
General Managers.

The Treadle Plate Equipment for controlling Exit Doors described and illustrated in this Section, is designed exclusively for use on Tramcars, where the platform of the vehicle is not fitted with a fixed step well. Other designs of Treadle Plates are described in Section O.5.

Treadle Plate Equipment provides the neatest and simplest form of control for Exit Doors, whether the latter are used for increasing existing passenger interchange facilities, or for producing the " flow " of passengers, which is so important a feature in the equipment of a " One-Man " Tramcar.

Referring to Fig. 1 on the opposite page, this shows an interior view of the Driver's position at the end of a " One-Man " Tramcar. (Fig. 11, Section T.3, shows a diagrammatic plan view of such a Driver's position.) Both ends of the vehicle are equipped in a similar manner, *i.e.*, when looking from the interior of the car towards either end, the Entrance Door is on the left-hand side, and the Treadle Plate Controlled Exit Door is on the right-hand side.

When the end of the car shown in Fig. 1 is **leading,** the Treadle Plate shown in the bottom right-hand corner of the illustration is inoperative (except for the emergency feature) and passengers may walk across the plate without opening the exit door at that point. Under these circumstances, passengers having entered the car at the front, by means of the Entrance Door situated on the left-hand side, must pass the Driver in order to enter the saloon.

The Ticket Issuing and Change-giving Apparatus shown at waist level, enables the Driver to collect the fares as the passengers enter the car, and while they are passing his position, without the slightest loss of time.

Simultaneously, passengers are enabled to leave the car by means of the Rear Exit Door. Assuming that the arrangement shown in Fig. 1 represents the **trailing end** of the car, the Entrance Door situated on the left-hand side is inoperative (except for the emergency feature), but the Treadle Plate is in a condition for controlling the Exit Door. While the apparatus is in this condition, passengers have only to step on to the Treadle Plate in order to cause the Exit Door to open. The whole of the Treadle Plate Controlling Mechanism is inoperative whilst the car is in motion.

The construction of the Treadle Plates shown in Figs. 1 and 3, is illustrated in Fig. 2.

The upper portion of the diagram shows a section through the platform end of the car, along the line " A "–" A " of the lower portion of the diagram. The chequered Treadle Plate is made to replace a part of the platform flooring, and is located by means of Back Supports and Gusset Plates, with reference to the Lower Members, which are pivoted at the inner surface of the web of the opposite platform angle. Suitable Brackets and Pins are provided for retaining the whole of the Treadle Plate Equipment in its correct relationship with the platform flooring.

The treadle plate is guided at its sides by Surrounds. These are of angle iron and should be so fitted that their upper surfaces are flush with the floor level. About $\frac{3}{32}$-in. clearance must be allowed between the edges of the surrounds and the edges of the treadle plate, in order to permit of free movement, and prevent dust and other foreign matter from jamming the plate.

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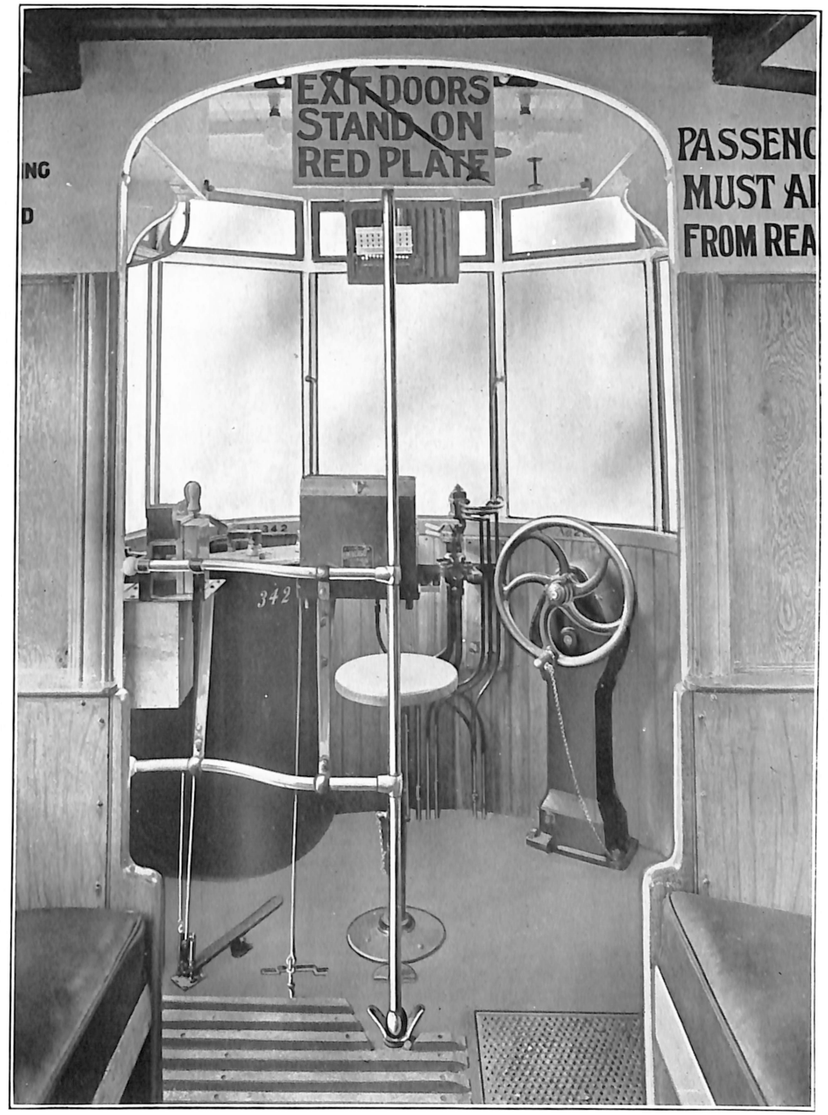

Fig. 1. Interior View of Driver's Position on "One-Man Car," showing Treadle Plate.

Since it is generally necessary to provide a Folding Step for the Exit Door, the treadle plate is made to form an anchorage for such equipment. Plates are fastened to the stiffeners of the treadle plate and termed Top Stops and Ties. At their upper ends, the latter are dimensioned so as to limit the downward travel of the treadle plate to the desired amount, namely, $\frac{3}{8}$-in., of which the first $\frac{1}{16}$-in. movement has no effect on the Valve or Switch operated by the treadle plate. The Folding Step Equipment is attached to the lower ends of the top stops and ties. For full particulars of this equipment, see Section T.4.

The whole of the treadle plate mechanism is balanced by means of two Balance Springs. The upper ends of these springs are held in Fixed Eyebolts, which pass through the platform angle. The lower ends of the springs are located in Adjustable Eyebolts which pass through a lug cast integrally with the Step Bearing Brackets, which, in the case of exit step gear, are provided with tailpieces to bolt to the lower member of the treadle and also to carry the spring lugs mentioned above.

Depending entirely upon the design and method of suspension of the treadle plate equipment, balance springs can be supplied to give any desired reaction. For example, the treadle plate may be so balanced that a weight of 15 to 20-lbs. placed at the rear edge, will completely depress the plate and cause an operation of the door.

The $\frac{3}{8}$-in. downward movement of the mechanism due to the weight of a passenger standing on the treadle plate, is utilised by means of a Spring Plunger, located at the centre of the underside of the plate and provided with adjustment. This plunger is caused to depress a Valve-operating Plunger or a Switch Lever, depending on the system of control employed. (See Sections T.1, and T.6.).

The cycle of operations of the treadle plate equipment are as follows :—

On a passenger stepping upon the treadle plate, with the door in the closed position, the step folded, and the control equipment in the operable condition, the entire unit (consisting of treadle plate, supporting members, folded step gear, and step connecting rod) travels downwards $\frac{3}{8}$-in. about the pivot pin in the opposite platform angle bearing bracket. The step connecting rod pivots about the pin in the jaw attached to the link for door and step connection (see lower portion of Fig. 2). The controlling mechanism for the Door Engine is thereby set in operation ; the door unfolds, at the same time unfolding the step ; the passenger then passes across the treadle plate to alight.

This condition is shown in Fig. 3, in which a treadle plate controlled exit door and step is shown in the open position.

By the time that the passenger has stepped from the plate on to the step, the latter is fully unfolded, and the weight of the passenger upon the step retains the controlling and operating mechanism in the " door open " position. As soon, however, as the passenger removes his weight from the step, the latter rises $\frac{3}{8}$-in., together with the entire treadle plate unit, at

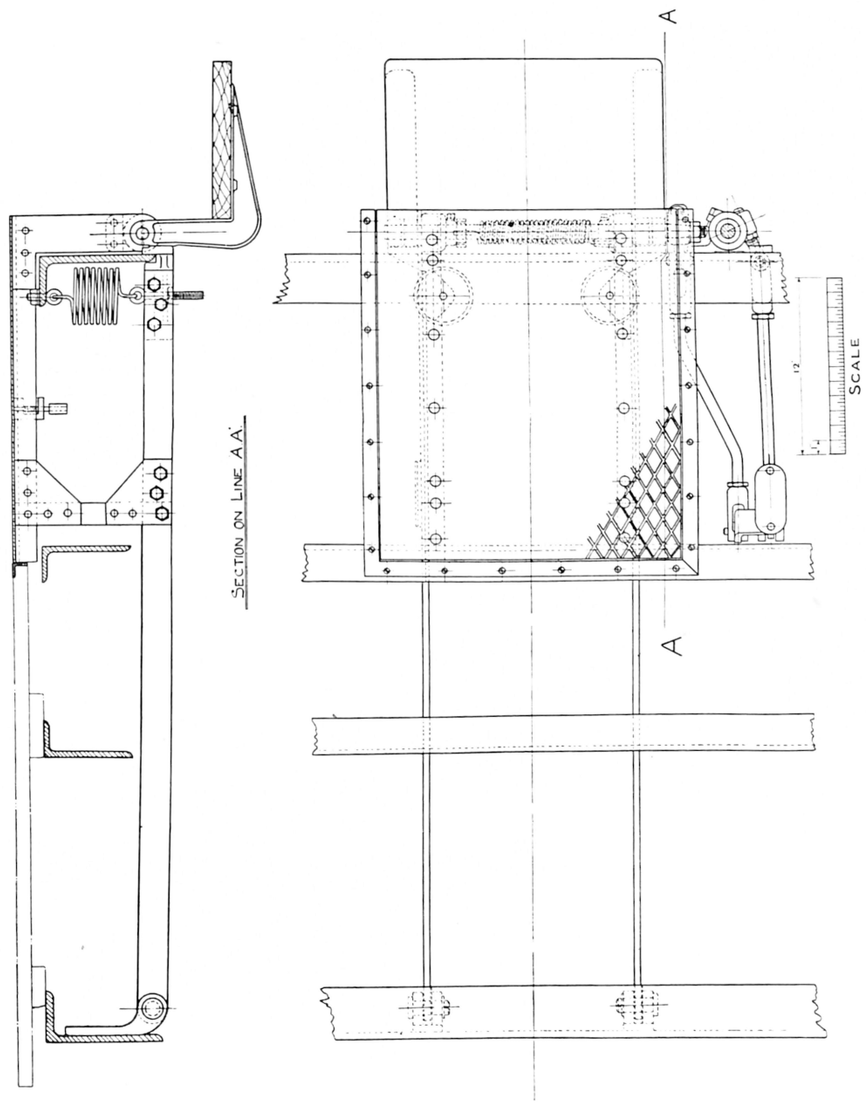

Fig. 2. Diagram showing General Arrangement of Single Treadle Plate for Exit Door Control, together with Folding Step Gear.

the same time re-setting the controlling and operating mechanism in the " door closed " position. The door engine then closes the door, at the same time folding the step. These operations take place immediately and allow no time for a person to enter the vehicle by the exit door.

When a number of alighting passengers are passing out through the exit door, the rate of discharge is such that one person is on the plate while the preceding person is on the step ; thus the exit door and step does not close until the last of the stream of passengers has alighted.

It will be appreciated that this equipment is of great value in providing a perfectly safe **Extra Exit** door control for Tramcars having the usual " Two-Men " staff. The operation being entirely automatic, no attention is required on the part of either the Driver or the Conductor.

A modified form of equipment is also available, in which the treadle plate is not only pivoted and sprung from the opposite platform angle of the car, but is also pivoted at the upper ends of the top stops and ties. Spring-pressed back supports are provided in this case, so that a weight of only 10-lbs. is necessary to depress the plate at its rear edge.

We shall be pleased to submit designs of Treadle Plate Equipment to suit all types of car construction.

Little maintenance is required for Treadle Plate Equipment. A small quantity of yellow grease should be placed on the pivot pins before putting in service and the equipment should be freed from grit at monthly intervals.

Details of the various valves and switches employed for controlling the movements of Exit Door Engines by means of Treadle Plates, are given in Sections T.6 and R.4.

For detailed and dimensioned drawings of Treadle Plate Equipment, see Drawings Nos. W.L.2702/19 to W.L.2702/72, also W.L.2889.

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Fig. 3. Outside view of Treadle Plate Controlled Exit Door and Folding Step. (Open.)

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ELECTRICAL AND ELECTRO-PNEUMATIC FITTINGS

"NATIONAL PNEUMATIC SYSTEM"
(PATENTED).

Railways & Rolling Stock Equipment Pty. Ltd.
Sheffield House,
517-519 Little Collins Street,
Melbourne, C1. Australia.
Horrocks Roxburgh Proprietary Limited
General Managers.

For use in the various systems of Pneumatic Door Controlling Apparatus for Tramways, as described in Section T.1, electrical and electro-pneumatic fittings are required.

Each system of control necessitates apparatus adapted for working in conjunction with the particular type of Door Engine employed, and also with the Air Brakes (if the latter are fitted).

Electrical and Electro-Pneumatic Apparatus is often of great value in a system of door control, since its action is practically instantaneous, prime cost is not high (provided that the quantity of wiring is kept within reasonable limits), while the cost of maintenance is lower than that of pneumatic control equipment. Further, certain functions can only be performed by electrical and electro-pneumatic apparatus (without excessive complication of parts) and finally, by reducing air pipe lines to the minimum and substituting wiring, leakage of compressed air and consequent wastage of power is reduced in direct ratio.

Samples of various types of apparatus are described and illustrated in this Section. It should be understood, however, that these items do not represent all the types and modifications of the available fittings.

Certain of the fittings normally provided for use in connection with Tramcars are also suitable for Railway work. Reference is made in Section R.1 to the items which are capable of such application.

Referring to Fig. 1 on the opposite page, which shows a front view of the Electro-Magnetic Air Lock employed in the Automatic Pneumatically-Controlled System for Tramcars, the apparatus consists of a Base, which supports a Double Coil Pot, carrying the Operating Coils, and also the Pneumatic Relay Valve, shown at the top of the coil pot. Each Coil surrounds a brass Plunger Tube, in which moves a Plunger. The plungers are connected together at their lower ends by means of a Crossbar, the lower ends of the plungers resting on Adjusting Screws which are secured in place by means of Locknuts. To the centre of the crossbar is attached a Push Rod, which acts upon Pin Valves situated in the small cylindrical portion of the valve body on the vertical centre line of the Air Lock. The Pneumatic Relay Valve is virtually a " Valve Puller " connected to a " D " Slide Valve. A spring-pressed piston moves within the large cylinder shown at the top of the coil pot, thereby moving the slide valve across the inner face of the three ports shown at the extreme left-hand side of the cylinder.

The coil leads are connected to the Terminals located in the Terminal Box shown at the front of the coil pot. One coil, termed the " Shunt " Coil, is connected to the traction control circuit, and energised during the whole of the time that power is being supplied to the car motors. The other coil, termed the " Series " Coil, is connected to the car motors so that it receives the regenerative current produced when the vehicle is coasting with power shut off. Hence, either one of the two coils is energised during the whole of the time that the vehicle is in motion, the windings of the series coil being arranged so that it will not be energised when the speed has dropped below approximately two miles per hour.

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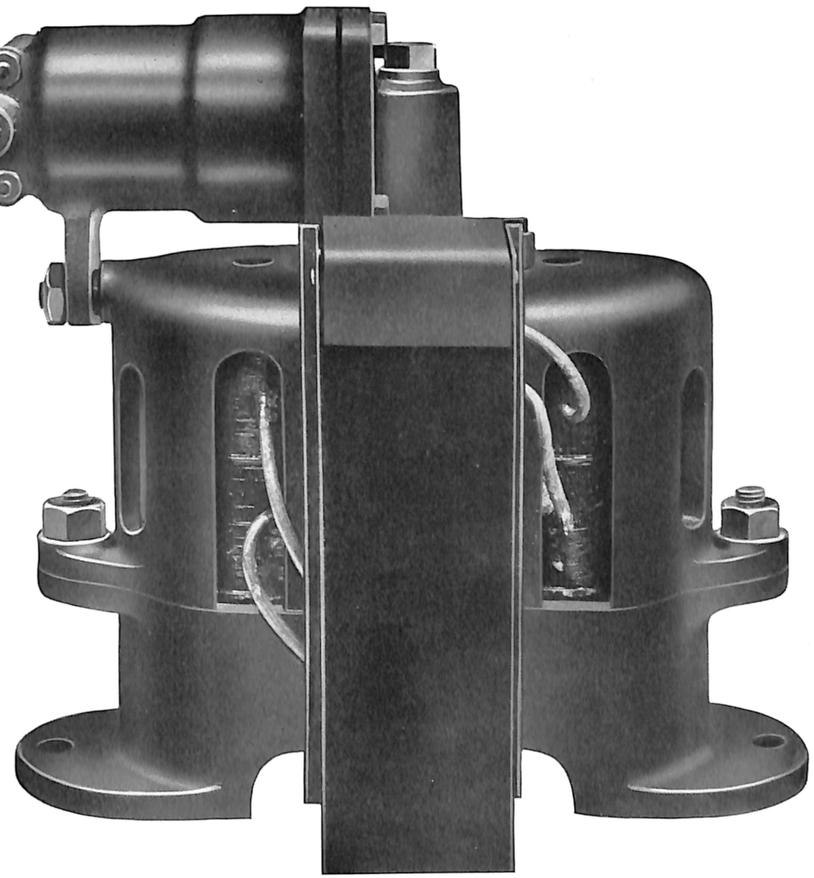

Fig. 1. Electro-Magnetic Air Lock.
Patent No. 254,347/26.

When either coil is energised, the push rod is forced upwards, thus closing the Exhaust Pin Valve, and permitting pressure air to flow into the Cylinder of the Relay Valve. This results in the Piston moving over towards the left, carrying the Slide Valve with it, and thereby connecting the left-hand port with the centre port. In the de-energised condition of the coils, the relay valve is exhausted, and hence the centre port is connected to the right-hand port. According to the manner in which the ports are piped to the Door Control System, the Air Lock is caused to prevent the control air from flowing into, or out of, the valve pullers while the car is in motion.

The only parts of the Air Lock which should require attention are the pin valves and slide valve, which should be cleaned, lubricated, and lapped in, occasionally. " Paragon " grease or tallow should be employed as a lubricant.

For dimensions and details of construction, see Drawing No. W.L.2745.

A modification of the general design of the Air Lock is provided for use in connection with Electro-Pneumatic and Electrical Control Systems for Tramcars. The modified apparatus is termed the Electric Door Lock, and consists of the same arrangement of base, double coil pot, plungers, crossbar, push rod, etc., but the pneumatic relay valve is replaced by a Single Contact Switch Box, generally in line with Fig. 3, Section R.4. A Bell Crank Lever is connected to the Crosshead of the switch contact pole mechanism, the other end of the bell crank lever being connected to the push rod.

When either of the coils is energised, the bell crank lever pulls the contact pole mechanism so as to break the line circuit, and this circuit can only be made when both coils of the Electric Door Lock are de-energised.

See Section T.1 for applications of the Electric Door Lock.

For dimensions, and details of construction, see Drawing No. W.L.2882.

A further modification of the general design of the Air Lock is termed the Positive Locking Relay. This apparatus is very similar to the Electric Door Lock, except that the switch box is usually provided with Double Contacts, so arranged that when one contact is made the other is broken.

See Section R.1 for applications of the Positive Locking Relay.

For dimensions, and details of construction, see Drawing No. W.L.2905.

The Double-Pole Key-Operated Change-Over Switch, shown in Fig. 2 on the opposite page, is one of a large range of such switches.

Depending entirely upon the arrangement of the system in which they are required to operate, these switches may be provided with any number of contacts, which may be made or broken when the Operating Key is in the non-removable position, and vice-versa. The boxes may be made to bolt at the side, as shown, or at the rear. As required, the Operating Spindle may be carried beyond the side of the box and provided with a Boss having a slot or square, for operation by means of another key. For example, the boss shown in Fig. 2 is arranged for operation by means of the Motorman's Reverser Key, from the **outside** of the vehicle (see Section T.1, Fig. 3).

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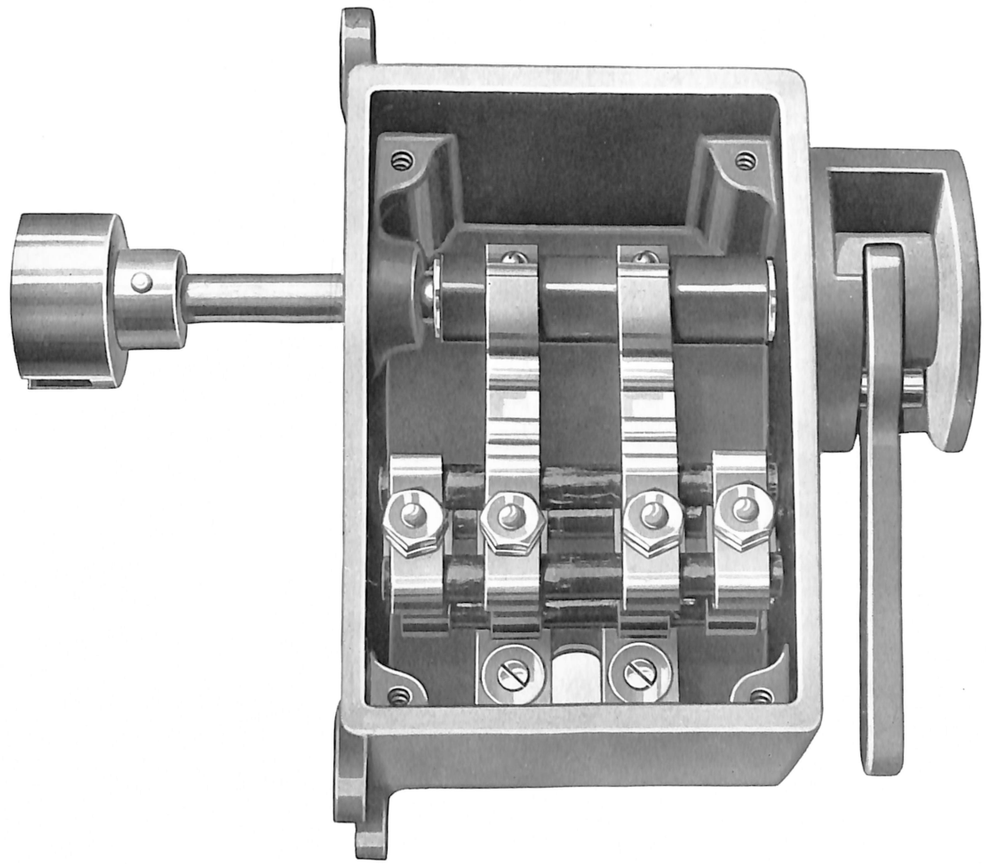

Fig. 2. Double-Pole Key-Operated Change-Over Switch.

The operating key can only be removed in one position, namely, the correct position for the switch contacts when the operator (Driver, Conductor, or Guard) is at some other control position. Hence, no crossing of connections is possible.

A Four-Pole Switch of similar design is shown in Fig. 4, Section R.5.

The Switch Box is of cast iron, provided with bosses tapped for suitable conduit or gas-threaded tube, or with rounded edge holes, and carrying Micanite Covered Steel Rods by means of brass Clamps. Further Clamps are employed for locating the Contact Fingers, which are of phosphor bronze, and fitted with copper Contacts. Backing Springs are arranged to ensure satisfactory contact.

The moving contacts consist of brass Segments, held in place on the Micanite Covered Operating Spindle by means of Clamps.

The Housing for the Spindle Collar is arranged so as to permit of 90° or 180° movement for the operating key, and to cause the required circuits to be made or broken in either the removable or non-removable position of the key. The latter may be placed on the spindle collar in either of the two alternative positions, as both sides of the key are provided with bosses.

Suitable Covers are provided for the various designs of switch boxes, either of chequered and pointed aluminium, or of steel plate.

For dimensioned general arrangement drawings of these Switches, see Drawings Nos. W.L.2808, W.L.2817, W.L.2828, and W.L.2885.

Referring to Fig. 3, this shows a type of Single-Pole Controller-Operated Drum Switch. This design of switch may be provided with any number of poles, depending on the complexity of the circuits to be controlled.

The switch illustrated is employed in the control system shown in Fig. 3, Section T.1, and is caused to complete the door control circuit only when the traction controller is in any magnetic brake position, or in the " off " position.

Double contact switches of this character are employed for energising the Controller-Operated Interlocking Switch described in connection with Fig. 2, Section T.1. In this case, one of the moving segments is caused to energise the " Power Coil " of this apparatus, when the traction controller handle is moved from the " off " position **towards** a power position, the other moving segment being caused to energise the " Brake Coil " of the Controller-Operated Interlocking Switch, when the traction controller handle is moved to a specified position of the magnetic brake.

The Switch Box is of cast iron, having fixing lugs at its upper end, and conveniently placed for fastening to the underside of the platform floor, beneath the traction controller.

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Fig. 3. Single-Pole Controller-Operated Drum Switch.

The sides of the box are provided with tapped holes, suitable for conduit or gas thread, as desired.

The Operating Spindle, which passes through the fibre Insulating Barrel in the centre of the switch, has a steel Sleeve at its upper end. Two holes are drilled and tapped in the lower end of the traction controller spindle, and screwed pegs inserted therein. The parallel portions of these pegs bear in the slot shown at the top of the sleeve. The latter is capable of considerable movement vertically and rotationally, so that the switch box may be mounted in any convenient position, and the sleeve adjusted to suit. The exact position for the traction controller handle having been determined, with reference to the switch contacts, the Grub Screw seen on the right-hand side of the sleeve is tightened, so as to lock the sleeve in its correct relation to the traction controller. The switch box is then removed from its location, and the taper pin hole drilled and reamed, and the taper pin fitted. The apparatus may then be replaced under the traction controller, with assurance that correct functioning will ensue.

The Segment mounted on the barrel is of copper, and turned to produce a good finish. The Contact Fingers and methods of insulating same are identical in all respects with those described in connection with Fig. 2.

The Controller-Operated Drum Switches are watertight, within certain limits, being provided with a cover having a rubber gasket. Care should be taken in mounting, however, to keep wheel-wash and floodwater away from the switches, as far as possible.

For dimensioned general arrangement drawings of these Switches, see Drawings Nos. W.L.2890 and W.L.2840.

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LOCATION OF DOOR EQUIPMENT

"NATIONAL PNEUMATIC SYSTEM" (PATENTED).

The location of the various items of Pneumatic Door Equipment on a Tramcar requires careful attention, if the most satisfactory results are to be obtained from the functioning of the combined apparatus when installed.

The portions of those items which are normally visible to passengers, depend largely upon the type of control and the door arrangements. For example, in the " One-Man " Tramcar illustrated in Fig. 1 on the opposite page, the only portions of the apparatus which are normally visible to the passengers, are the Treadle Plates, Entrance and Exit Folding Steps, and the Door Roller Guides and Brackets over the doorways, apart from the Traction and Air Brake Equipment shown in Fig. 5.

It is essential to enclose all moving apparatus, or to locate it below the floor level.

With a view to the guidance of customers in designing the layout of Tramcars fitted with Pneumatic Door Equipment, the following particulars as to the location of the various pieces of apparatus should be of service :—

DOOR SHAFTS are fastened to the doors by means of Door Straps. The leaves are swung from the door shaft, which is located in Ball Thrust Bearings at its upper and lower ends. Thrust Collars are secured to the Door Shaft by means of Taper Pins, and the Bearing Brackets which form a housing for the Ball Thrust Bearings, support the weight of the door. For very light doors, bearing brackets of the opposed type may be used, so as to keep the ball thrust bearings in compression, irrespective of the weight of the door. It is most important that the ball thrust bearings should be held tightly in compression, otherwise slackness of the door shaft will result. For heavy doors, the weight of the door alone is sufficient, and hence the bearing brackets need not be of the opposed type. Full particulars of Door Shafts, Bearings, and Fittings, are given in Section T.3.

DOOR ROLLER GUIDES are mounted on the under surface of the door header, and must be arranged so that they guide the secondary leaf of the door to the fully open and fully closed positions without any binding. In allowing for the minimum height of a doorway, 1-in. should be deducted on account of the Door Roller Guides, in addition to the usual clearance. For illustrations, see Section T.3, and also Figs. 1, 3 and 4 of this Section.

DOOR ROLLER BRACKETS are fitted to the secondary leaf of the door, and may be sunk flush if desired. For doors which fold **outwards,** the Door Roller Bracket must be on the **outside** surface of the secondary leaf, while for doors which fold **inwards** the Bracket must be on the **inside** surface. Various designs of Brackets are available, but it is essential to make the distance from the back surface of the Door Roller Bracket to the centre of the Roller Pin as large as possible, and in no case less than 2-in. For full particulars see Section T.3. Figs. 1, 3 and 4 of this Section illustrate positions of Door Roller Brackets on Tramcars fitted with Pneumatic Door Equipment.

DOOR SHOES (which are made right and left handed, and also of the double pattern for double folding doors) are secured to the underside of the door header, and serve to pick up any slackness between the door roller and its guides, at the door closed position. This slackness, which is essential to easy movement of the door, would otherwise result in a rattle during motion of the vehicle. The positions of the Door Shoes are shown in Fig. 1, and they are further described and illustrated in Section T.3.

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Fig. 1. Outside view of Treadle Plate Controlled Rear Exit Door and Folding Step (closed).

BOTTOM DOOR GUIDES AND CATCH BRACKETS (which are made right and left handed) are secured to the lower end of the secondary leaves of lightweight double folding doors, which fold outwards to an open position, and in the closed position project below the sill plate outside the platform floor. See Section T.3, for illustrations.

SAFETY DOOR EDGINGS (which are of the "Vicedge" Moulded Rubber Type, covered with Patent Leather) are secured to the front style of the secondary leaf by means of brass Retaining Strips. For Single Folding Doors, male edges only are required, but for Double Folding Doors, one male and one female edge per doorway is required. It is most important that the portion of the edging which is to contact with the door pillar shall be set in line with same, and that any slight irregularity in the back edge of the rubber shall be covered by the retaining strip. If this precaution is taken, a perfectly watertight and draught-proof door will result. Full particulars and instructions for fitting are given in Section T.3.

The Moulded Rubber Safety Door Edgings are illustrated in Figs. 3 and 4, dimensioned sectional views being shown on Drawings Nos. W.L. 2912/1, /2, /3, and /4.

FOLDING STEP EQUIPMENT is usually fitted to the platform angle of a Tramcar. The Step Bearing Brackets, which carry the whole of the step mechanism, are made to suitable dimensions and shape, as required for each particular platform angle and car construction.

The essential features of Folding Step Equipment are fully described and illustrated in Section T.4.

Fig. 1 of this Section shows an Exit Step in the closed position.

TREADLE PLATE EQUIPMENT for controlling Exit Doors, is built to conform to the design of the vehicle and the Exit Door arrangements. The Treadle Plate is sunk flush with the car platform at the exit doorway, and should be of such a size that passengers can readily open the exit door by standing on the plate at some little distance from the door.

For description and illustrations of Treadle Plate Equipment for Tramcars, see Section T.5.

Fig. 1 of this Section shows a Treadle Plate Controlled Exit Door and Folding Step in the closed position.

CHANGE-OVER AND DOOR CONTROL VALVES OR SWITCHES are mounted on a panel, or directly on the waist rail of the car, depending on the type of control employed, and whether the Driver or Conductor is required to operate the Valves or Switches.

Referring to Fig. 5, this shows a Driver's Change-Over and Door Control Valve mounted on a panel. In this case the Valve is only operated at the termination of each trip (see Section T.1), and hence it is not necessary to place it within easy reach of the Driver when he is seated at his control position. The valve spindle is prolonged so as to pass through the car side, and enable an operation of the valve to be made by means of the Traction Reverser Key from the outside of the vehicle. A small sliding cover is fitted to the hole in the car side, as shown in Fig. 2, Section T.4. Referring to Fig. 2, Section T.6, this shows the general arrangement of the prolonged spindle end on such fittings. The Double Pole Change-Over Switch, shown in the latter illustration, is fitted in precisely the same position as that of the Valve shown in Fig. 5, of this Section, and fulfils a similar purpose.

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Fig. 2. Interior view showing Type "E" Folding Door Engine mounted in header box over Single Folding Rear Exit Door. (Note the change-giving machine in foreground.)

The Type C.3620 Door Control Valve shown in Fig. 3, Section O.3, is also shown in Fig. 6 of this Section, and is piped so that the handle can only be removed when the door is shut (as shown). The Valve is bolted directly to the waist rail of the car.

A similar location may be employed for Door Control Switches, used in the Electro-Pneumatically Controlled System (without automatic feature). It is essential that all such control valves and switches shall be placed within easy reach of the Driver or Conductor, so that operation may be carried out with the maximum facility.

DOOR ENGINES must be located so as to provide the best possible operation for the door, ease of inspection, and simplicity of piping, wiring, and connecting rod design.

For Folding Doors, the Type " E " Door Engine should be located in a header box wherever possible, as shown in Figs. 2 and 4 of this Section, but for those cases in which the car design prohibits this method of fitting, the Type " K " Door Engine is available. The latter may be conveniently slung underneath the car platform on bearers, as shown in Fig. 7. Care should be taken, however, to protect the Door Engine from grit and wheelwash as much as possible. It is sometimes possible to locate the Type " K " Door Engine in a header box, immediately over the door shaft, and so avoid all connecting rods, terminals, etc.

When fixing the dimensions of header boxes, care should be taken to examine the door shaft arrangements, with reference to the system of Door Engine Control employed (see Sections T.2. and T.3). Not only can the Door Engine, complete with its appropriate Control Valve (Rotary or Ball Checked), be located in the header box, but the Valve Puller and Electro-Pneumatic Valve may also be accommodated, together with Interlocking Switches and Release Valves (see Sections R.3, R.4, and R.5).

For Sliding Door Equipment on a Tramcar, the Type " F " Engine is employed. This is fully described in Section R.2, and may either be located in a header box as shown in Figs. 2, 3 and 4, Section R.6, or may be fastened to the car platform ; the engine arm being caused to work above the centre line of the engine cylinder. Drawing No. W.L. 2771/9 shows a method of carrying out this location.

ELECTRO-PNEUMATIC VALVES for the control of Door Engines, should be located as close as possible to the engines which they have to control ; this ensures an instantaneous action of the engine.

EMERGENCY RELEASE VALVES AND AIR STRAINERS, should always be located in the header box or close to the appropriate engine. If it is desired to provide a rod or chain for operation of the former, the Valve should be securely held to a pattrass. Care should be taken to ensure that the $\frac{1}{4}$-in. size Air Strainer (Drawing No. W.L. 2749A) is placed **between** the Release Valve and the Door Engine. This enables the engine to be removed without losing the air pressure in the system, since the $\frac{1}{4}$-in. Air Strainer also forms a union. $\frac{3}{4}$-in. Air Strainers (see Fig. 2, Section R.3) should be placed in the pipe line between the Air Compressor and the Reservoir.

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Fig. 3. Outside view of Double Folding Doors (open).

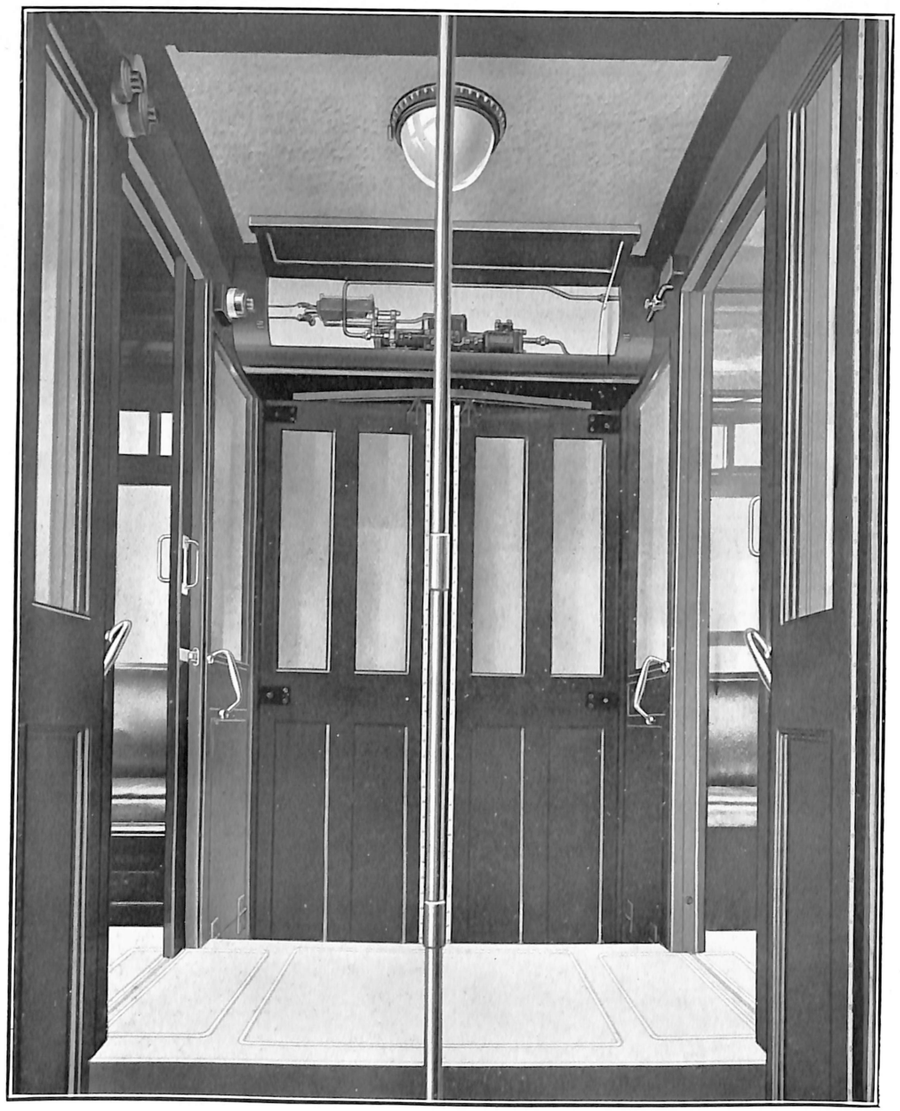

Fig. 4. Interior view showing Type "E" Folding Door Engine mounted in header box over Double Folding Entrance and Exit Doors.

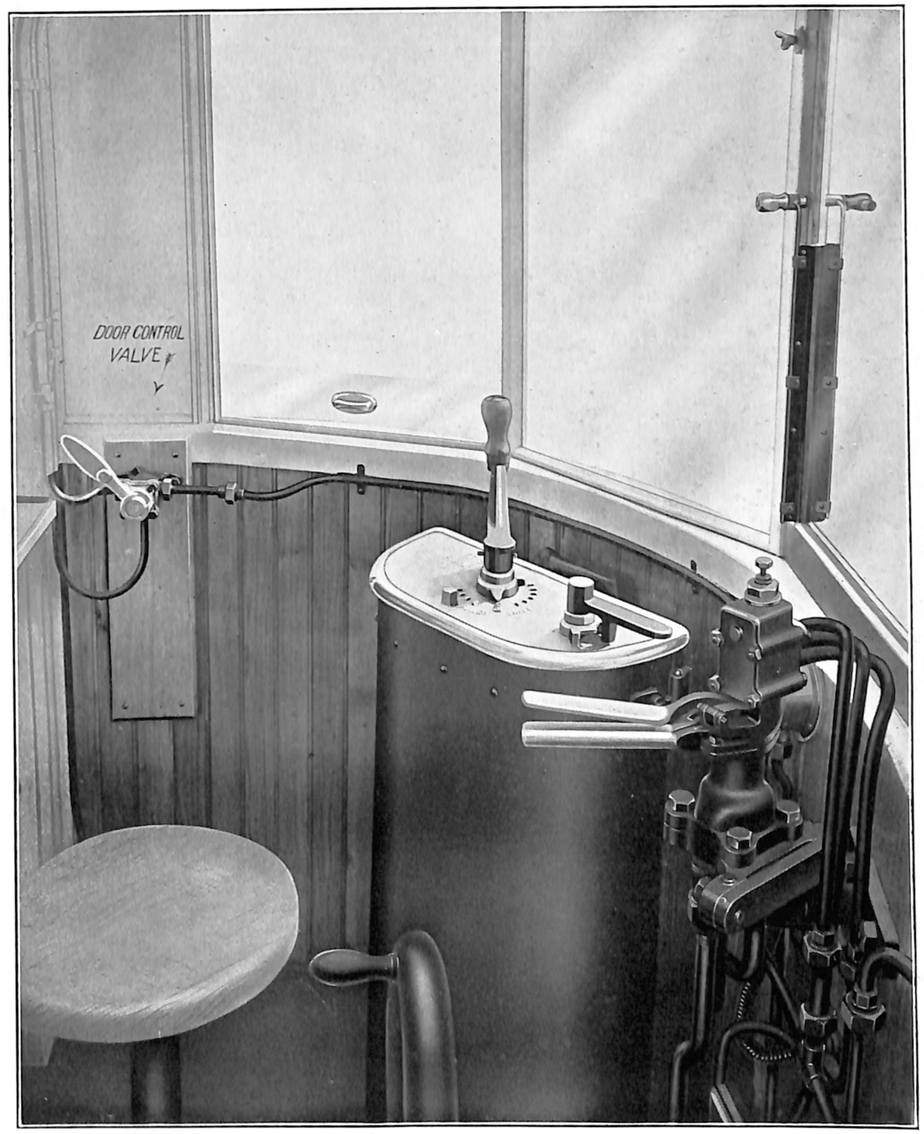

Fig. 5. Interior view of Driver's position on a "One-Man" Tramcar having Automatic Pneumatically-Controlled Door Equipment.

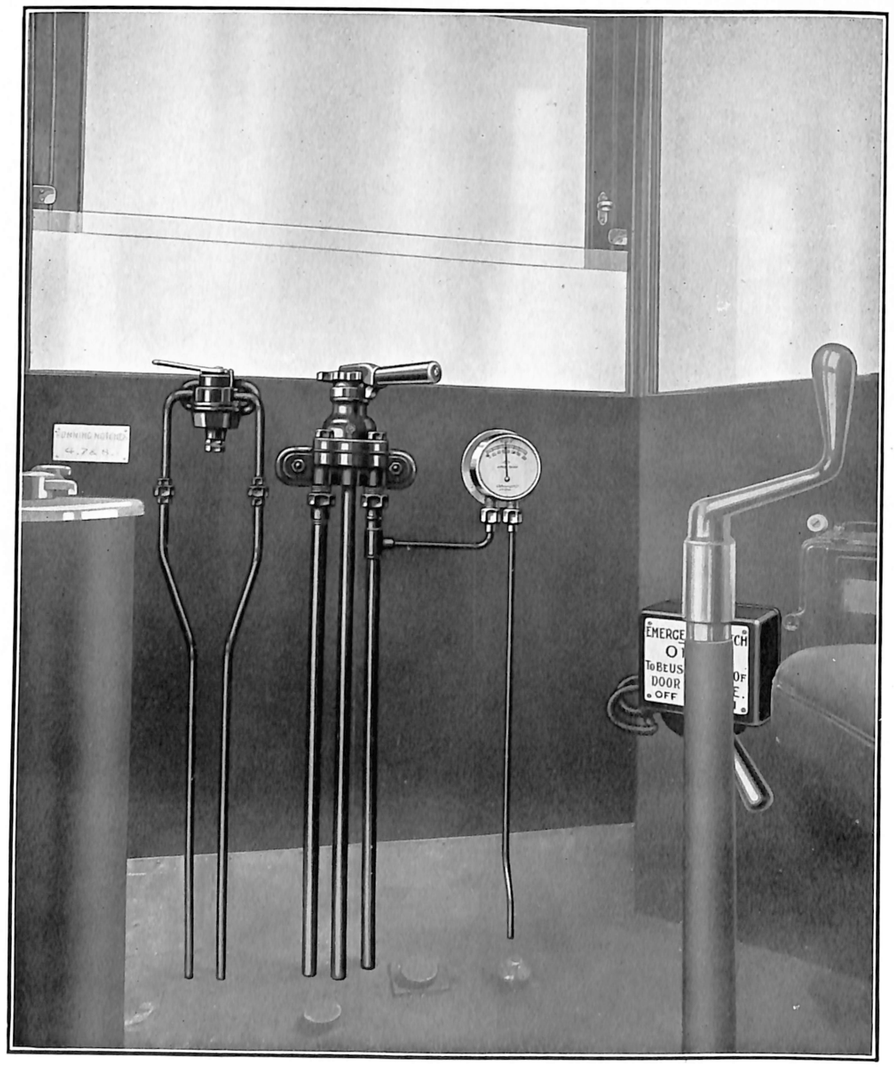

Fig. 6. Interior view of Driver's position on a "Two-Men" Tramcar having Pneumatically-Controlled Door Equipment.

AIR RESERVOIRS AND WATER TRAPS may be placed underneath the car, or in the case of single decked cars, on the roof, in a suitable covering box. Care must be taken to provide a drain point at the lowest portion of the air pipe system, and to avoid " U " shaped piping (which may collect water) at points between the Compressor and the Water Trap.

AIR-OPERATED SWITCHES may either be located under seats, or on the roof of the car, in the case of single decked vehicles. It is important to arrange the location so that the contacts of the switches may be cleaned from time to time.

AIR LOCKS, CONTROLLER OPERATED INTERLOCKING SWITCHES, AND NO-VOLT VALVES may all be located under seats, on the platform end (if space permits), or on the roof, in the case of single decked cars. They must not be placed in an exposed position, as they are not watertight fittings, and contain electrical parts which may become damaged by excessive water.

CONTROLLER OPERATED DRUM SWITCHES must be located immediately below the traction controller (see Section T.6). Care should be taken to arrange the operating spindle in its correct location with regard to the controller drum shaft, and also to provide protection from wheelwash, grit, etc. A canvas shield is quite satisfactory for this purpose.

SIGNAL LAMP BOXES should always be mounted in such a position at the platform end that the Driver is able to detect the signal to proceed immediately it is given. The boxes should be out of the line of direct sunlight at all times, so that the Driver is not confused by a false signal. Generally, the underside of the canopy forms the most suitable location for this item of equipment.

RESISTANCE BOXES may generally be mounted on the underside of the canopy. The boxes are fully ventilated, and to take the maximum advantage of this feature, they should be placed in a position where a current of dry air will circulate freely around the elements.

EXHAUST VALVES of the type shown in Fig. 2, Section T.1 (Item 7) should always be placed at the waist rail of the car, on the platform end. An exhaust pipe must be carried below the car floor in order to minimise the noise of exhaust, produced when the whole of the Pneumatic Door System discharges to atmosphere through this Valve. **Such an occurrence can only take place in an emergency.**

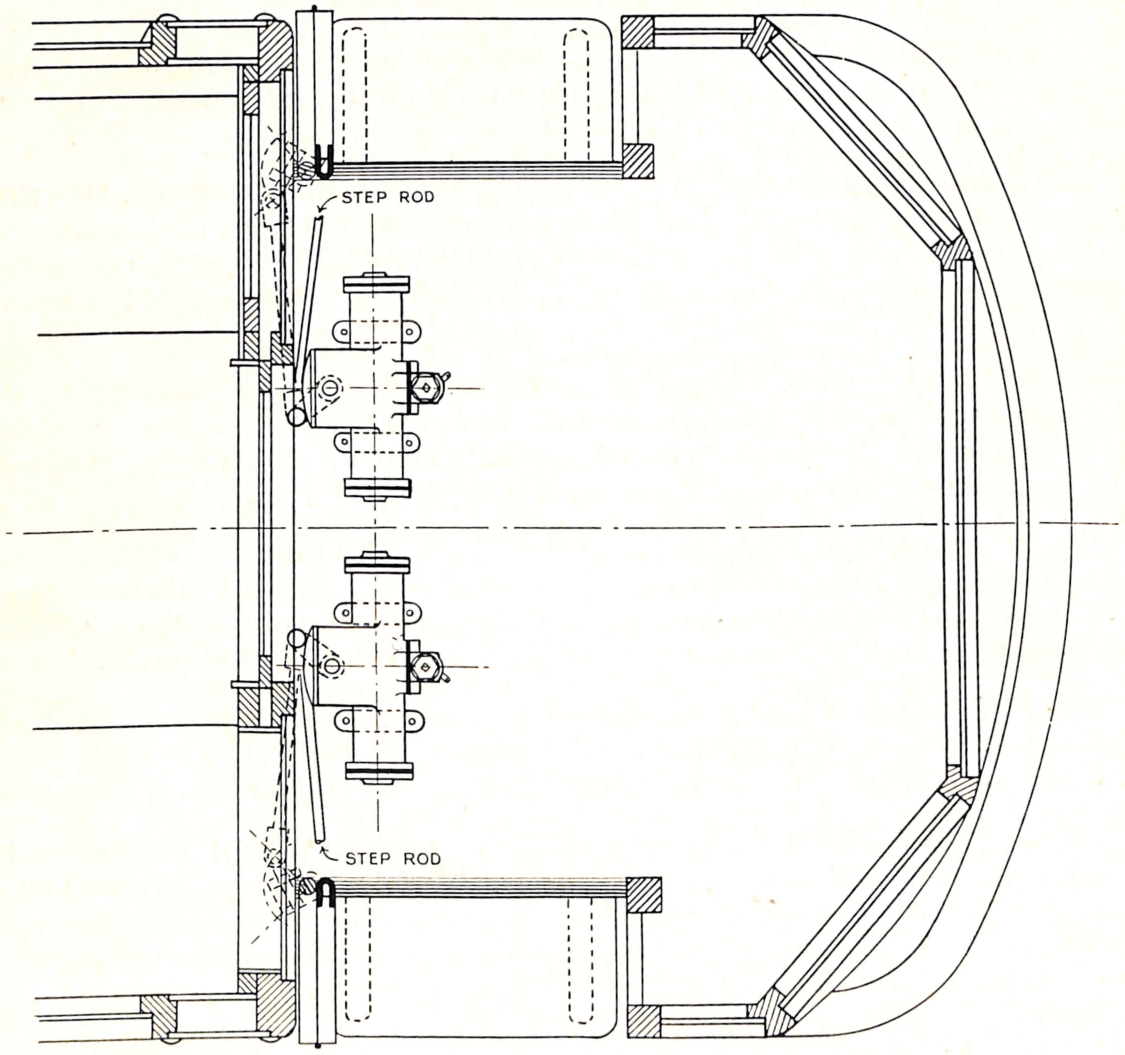

Fig. 7. Diagram showing location of Type "K" Folding Door Engines, and method of attachment to Folding Door and Step Equipment.

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