Sept. 7, 1965 J. J. BLACK 3,204,299

PLUG DOOR

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FIG. 1

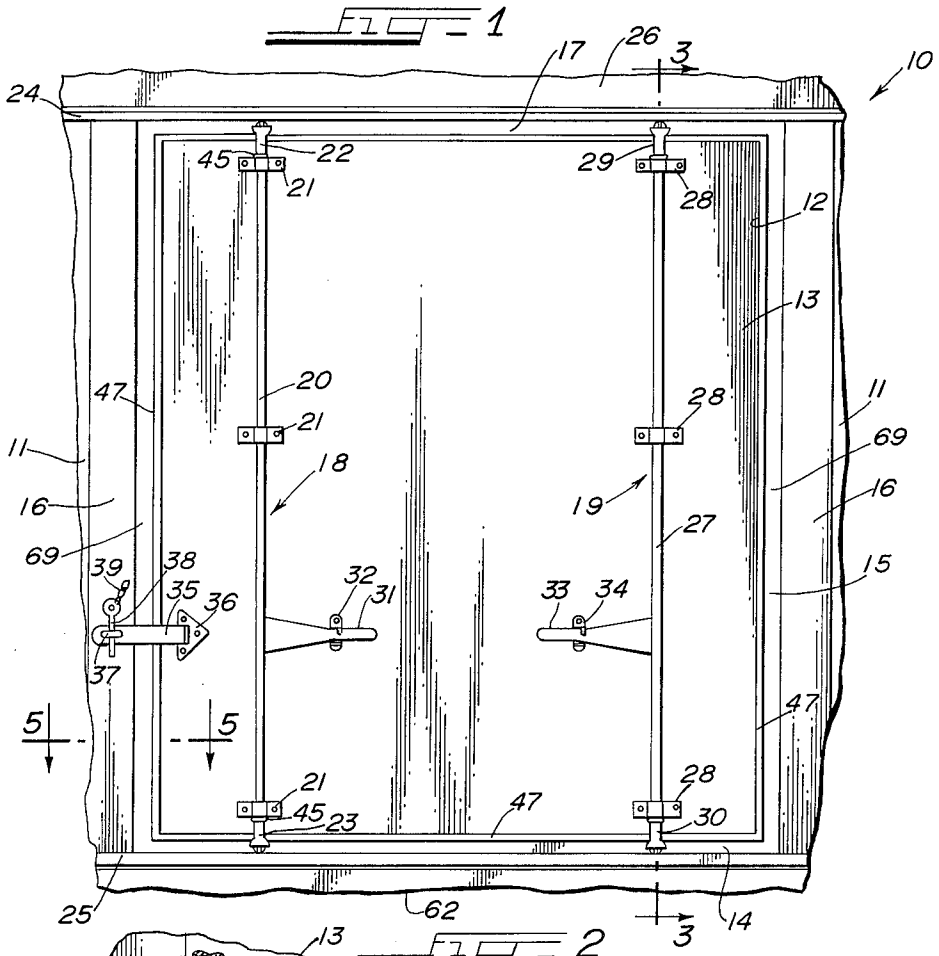


FIG. 2

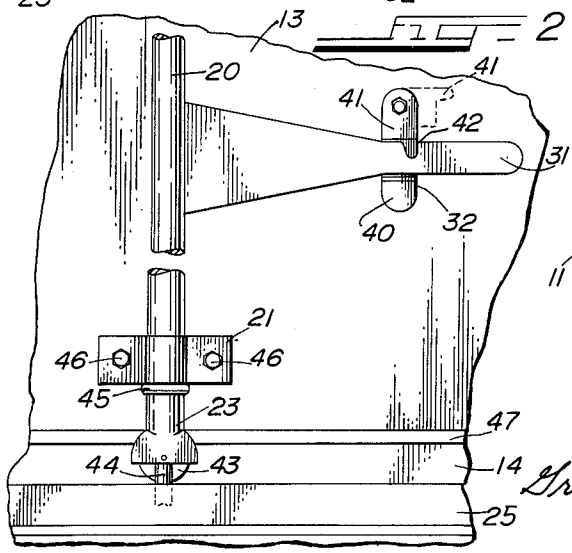
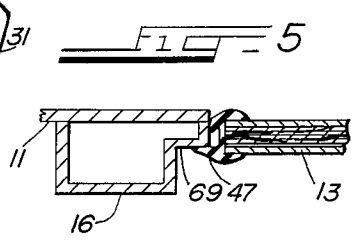


FIG. 5



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Fig. 3

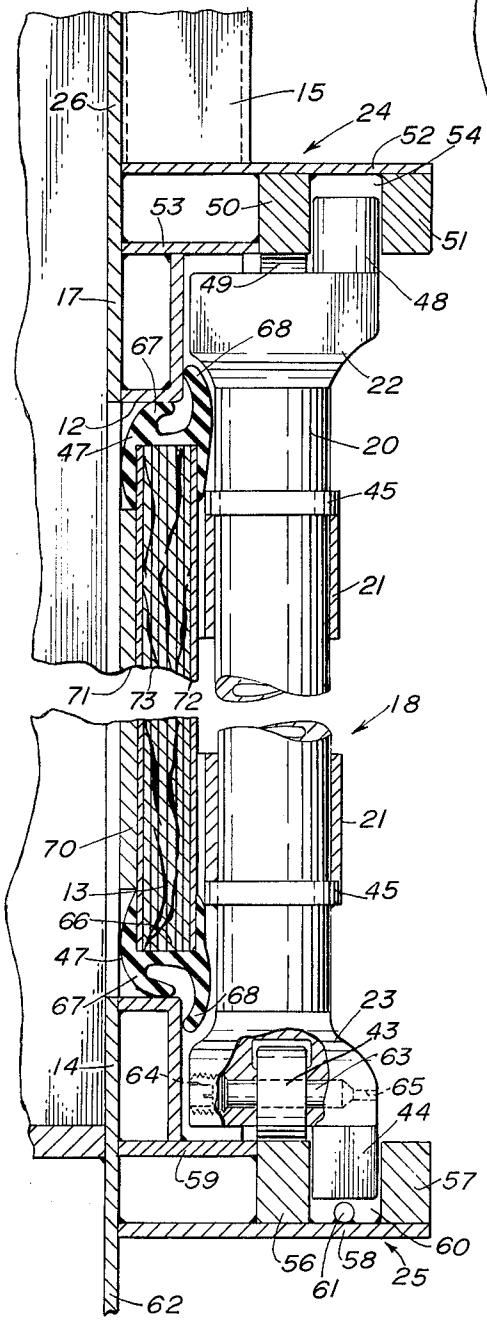
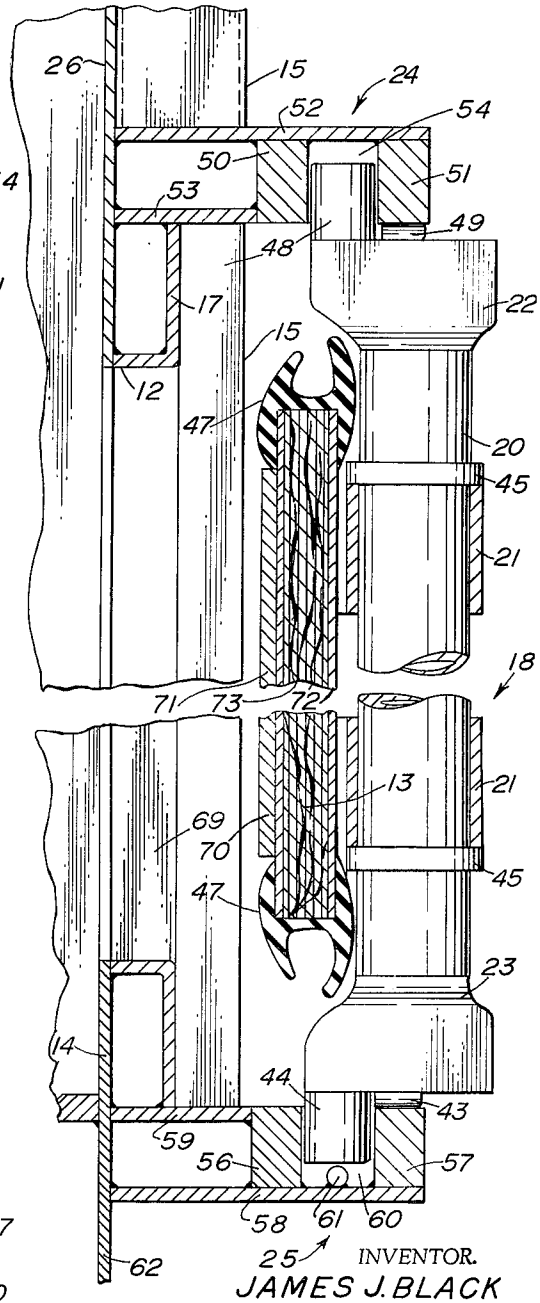


Fig. 4



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PLUG DOOR

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This invention relates to plug door assemblies in general, and is directed primarily to a plug door assembly having a new and improved form of actuating and support mechanism. Plug doors have found widespread acceptance in the freight hauling industry because they form a substantially weather tight barrier to close off the door opening, allowing the car to be used to carry a wide variety of commodities including granular materials in bulk such as grain, salt and like products without requiring conventional grain boards. In addition, commodities which are susceptible to damage by water and the like may also be carried in railway cars having plug doors since they are generally weather tight when compared to the older forms of sliding doors.

The major problem encountered in existing prototypes is the complex nature of the operating mechanisms. Considerable effort has been directed toward the development of an economical, yet easily workable mechanism which will be operable under all types of climatic conditions. Additionally, any new actuating mechanism for a plug door must be capable of moving the door directly into and out of the opening in a path generally perpendicular to the plane of the frame defining the opening to insure that weather stripping or the sealing means around the opening will not be damaged by being pinched between the frame and the plug door. Further, when the door is moved to the outermost position, it must be freely slidable laterally of the opening.

The present invention not only overcomes the problems encountered in existing designs, but in addition presents a plug door construction which will be completely weather tight. The unique uncomplicated actuating mechanism permits the use of a more flexible seal design which provides excellent sealing action to resist the elements. The simplicity of the actuating mechanism insures long life and high operational performance under the punishing conditions common to the freight hauling industry. Several other advantages are present in the form of reduced cost of manufacture, and the attendant reduction in weight promoted by a minimization of working parts. In addition, the actuating mechanism will remain well within the side clearance limits to avoid the hazardous situation presented by former mechanisms which project from the side of the freight hauling vehicle.

Under circumstances involving the carrying of bulk granular or fluent materials, the present plug door moves directly out of the opening with the load force assisting such movement. Sufficient clearance exists along the sides and bottom to allow a portion of the load to begin draining beneath the door member. The force exerted against the door by the load is normal to the path of rolling movement, and little effort is required to move the door laterally to provide complete access to the opening.

A fuller understanding of the present invention and the advantages thereof may be had from a perusal of the objects and the description to follow:

A fuller understanding of the present invention and the advantages thereof may be had from a perusal of the objects and the description to follow:

It is a principal object of this invention to provide an improved actuating mechanism for a laterally movable flush type plug door on a freight vehicle.

It is a further object of this invention to provide a new and improved actuating and support mechanism for a

laterally movable door wherein the door is mounted for movement on rollers and the rollers are housed within the operating shafts carrying the crank means to withdraw the plug door from the opening.

It is a further object of this invention to provide an actuating mechanism for effecting lateral movement of a roller supported plug door with the actuating and support mechanism carrying roller means which is rotatable to an outer portion of a track, with the crank means serving as an axis of rotation for the roller as well as a guide means to co-operate with a central guide channel in the track during lateral movement of the door.

It is a further object of this invention to provide a new and improved plug door assembly having a special type of weather tight sealing strip therearound and including an actuating mechanism to insure that the door will be moved directly into the opening provided in a manner to obviate the possibility of damage to the sealing strip.

Further and fuller objects will become readily apparent when reference is made to the accompanying drawings wherein:

FIG. 1 is an outer surface elevational view of a laterally movable plug door applied to the side wall opening of a fragmentary portion of a freight vehicle including the novel actuating and support means before mentioned;

FIG. 2 is an enlarged fragmentary elevational view of the lower left-hand portion of the door illustrating the operating handle and lower portion of the operating shaft;

FIG. 3 is an enlarged fragmentary vertical section taken along the lines 3—3 of FIG. 1 illustrating the door in the closed position with a portion of the operating shaft broken away to illustrate the details of the roller assembly;

FIG. 4 is an enlarged sectional view similar to FIG. 3 with the actuating mechanism rotated to the out position to pull the door member out of the opening where it may be moved laterally; and

FIG. 5 is an enlarged fragmentary cross sectional view taken along the lines 5—5 of FIG. 1 illustrating the side frame detail and door co-operation therewith.

In FIG. 1 reference numeral **10** represents a freight vehicle such as a railway car having a side wall **11** and an opening **12** therein receiving a plug door **13**. The opening **12** is formed by a plurality of frame members including a threshold **14**, side posts **15** and **16**, and an upper frame or header member **17**. Interposed between the frame members and the door **13** is a weather strip or seal means **47** to insure the weather tightness of the joint between the door **13** and frame members.

A pair of actuating mechanisms indicated generally at **18** and **19** include shaft members **20** and **27** respectively disposed in substantial parallelism with respect to each other and rotatably fixed to the doors by means of a plurality of shaft bracket members **21** and **28**. The shaft **20** has an enlarged housing **22** and **23** at the upper and lower extremities thereof, each of which is disposed in close proximity to an upper and lower track assembly **24** and **25** respectively. The upper track assembly **24** is positioned above the frame member **17** and connected to the header panel assembly shown fragmentarily at **26** and the lower track assembly **25** is supported on the car body also shown fragmentarily at **62**. Shaft **27** of actuating mechanism **19** is also provided with upper and lower housings **29** and **30** adjacent the track means **24** and **25**. Each of the actuating mechanisms is provided with an operating handle **31** and **33** respectively which is attached to the operating shafts **20** and **27** by means of welding or the equivalent with each being disposed flat against the door **13** when the door is in the closed position. Suitable means such as a swing latch **32** and **34** may be provided to lock the handles in juxtaposition to the outer surface

of the door **13** to securely lock the door in the closed position shown.

On the lower left-hand portion of the door, a hasp-type latch **35** is provided. The latch **35** is pivotably or hingedly connected by means of a plate **36** to the door and swings over an eye member **37** with sufficient clearance to allow drop bolt **38** to lock the members together. The drop bolt **38** may be provided with a chain **39** attaching the same to the car body in order to prevent loss thereof. In addition, the drop bolt **38** may be provided with a suitable slot in the lower end thereof to receive a conventional car seal of known type. The hasp-type latch also serves to prevent lateral movement of the door **13** as the actuating mechanisms are operated to move the door into the opening **12**. The details of this function will be given hereinafter in connection with a full description of the operation of the device.

The enlarged fragmentary view of FIG. 2 shows the operating handle **31** lying flat against the door **13**, being held in this position by the swing latch indicated generally at **32**. The swing latch **32** includes a lower support bracket **40** affixed to the outer skin of the door **13** by any suitable means, and an upper pivoting latch member **41** attached by means of a bolt or the equivalent. The pivoting latch **41** has a tongue member **42** which overlies the outer surface of the operating handle **31**. In order to allow the handle to be pulled outwardly, the swing latch **41** is moved to the position indicated in phantom at **41'** and the handle may be pulled outwardly in order to withdraw the door **13** from the openings. If desired, the swing latches and associated supporting bracket may be provided with apertures to accommodate car seals to prevent unauthorized tampering with the handles **31** and **33**.

Each of the actuating mechanisms **18** and **19** is of uniform construction with the exception of the positioning of respective operating handles thereof and therefore further description will be limited to the actuating mechanism **18**, it being understood that actuating mechanism **19** is of like construction.

As previously noted, the shaft **20** of actuating mechanism **18** has a housing **23** at the lower extremity thereof. A pair of collars **45** are integral with the shaft and disposed in rotatable abutting engagement with the adjacent shaft bracket **21** to limit the longitudinal movement of shaft **20**. The bracket members may be fixed to the outer skin of the door **13** by means of bolts indicated at **46** or any suitable equivalent. The lower housing **23** carries a crank member **44** which projects downwardly into the track assembly **25**. In addition, the housing carries a roller **43** rotatable about an axis transverse to the longitudinal axis of the shaft **20**.

A better understanding of this structure can be had with reference to the enlarged cross section view of FIG. 3. The upper track assembly **24** has an inner roller track **50** and an outer roller track **51** affixed in spaced relation to each other to a base plate **52** supported by the upper header assembly **26**. Inner and outer roller tracks **50** and **51** together with base plate **52** define a guide channel **54**. A track spacer member **53** extends from the header assembly **26** and the upper frame member **17** to the inner track member **50**. Roller track assembly **25** is of like construction and includes an inner roller track **56** mounted to the car body through track spacer member **59** and base plate **58**. An outer roller track **57** is attached to the base plate by means of welding or the like in spaced relation to the inner roller track **56** to define a lower guide channel **60**. Disposed within the lower guide channel **60** centrally thereof is a ball pivot member **61** which may be attached to base plate **58** or carried by the crank member **44** for purposes to become apparent hereinafter.

The actuating mechanism **18** is supported by the track assemblies by means of a lower roller **43** and upper roller **49** carried by the respective housings **23** and **22**. The broken away portion of lower housing **23** illustrates roller **43** as being mounted therein by means of a roller support

shaft **63** received with a sliding fit in a suitable bore in the roller housing. A locking plug **64** maintains the roller shaft positioned in the bore to provide continuous support for the roller **43** with the plug being removable to allow withdrawal of the shaft **63** in the event it becomes necessary to replace the roller. In order to facilitate expeditious removal of the roller shaft **63**, an opening **65** (shown in dotted lines) is provided to allow insertion of a suitable tool such as a drift punch to drive the roller support shaft **63** outwardly to allow removal of the roller **43** from the housing **23**.

Lower housing **23** is also provided with a crank member **44** which is generally cylindrical in cross section and projects into the lower guide channel **60**. The central axis of the crank member **44** is eccentric with respect to the central or rotational axis of the shaft member **20**. In a similar fashion upper housing **22** is provided with a crank member **48** which is received in the upper guide channel **54**. The collar members **45** on the shaft **20** co-operate with the mounting brackets **21** to transfer the support from the upper and lower rollers **43** and **49** through the actuating mechanism to the door **13** to maintain it centrally positioned with respect to the opening **12** during insertion and removal therefrom.

The door **13** may be of any desired construction, however, in the preferred embodiment, it is composed of inner and outer skins or plate members **71** and **72** held in spaced relationship by a central core **73** which may consist of plywood, chipboard, foamed polyurethane or any other satisfactory form of strengthening and insulating medium. The outer perimeter of the door **13** is provided with a weather strip or seal means **47** formed with a U-shaped mounting portion to overlie the outer and inner skins or plates **71** and **72**. The seal means **47** includes a pair of outwardly projecting lips **67** and **68** which co-operate with the frame members in the following manner.

As the door **13** is moved into the opening, the inner lip **67** is rolled to the position shown, with the inherent resiliency thereof biasing the lip into tight engagement with the lateral portion of the frame defining the opening **12**. The outer lip **68** overlies the vertically extending portion of the framing members to form a weather tight barrier. It is obvious that the seal member means could be carried by the frame member, or partially on the frame and partially on the door, however, in the preferred embodiment it is desirable to provide the seal means on the door so that during unloading and loading operations it is shifted out of the way to prevent possible damage thereto. If the particular application should warrant, a removable plywood backing member **70** may be attached to the inner skin **71** on the door **13** to protect the door from damage in the event of lading shifting and like causes. In one specific embodiment the backing member **70** comprises a panel of plywood ¼ inch thick affixed to the door by means of screws.

The co-operative relationship of the vertical edge of the plug door **13** and associated seal means **47** to the side post members **15** and **16** is better understood upon examination of the enlarged cross sectional view of FIG. 5. The seal means **47** co-operates with the door framing member in a similar fashion to the upper and lower frame members, overlying a transverse portion thereof. A shoulder **69** is formed in the framing member **16** which permits the outer lip **67** to overlie the same in the manner described with respect to the upper and lower frame members. This construction permits the door posts **16** to be of increased thickness which is necessary to support the upper structure of the car **10** without adversely affecting the sealing action.

The operation of the plug door can be best understood with reference to FIGS. 1–4. As seen in FIG. 3, the door **13** is snugly received within the opening **12** to insure weather tightness and prevent loss of lading, par-

ticularly if the lading is granular or fluent material which is oftentimes shipped in bulk. When it becomes desirable to gain access to the car, the seal is broken and swing latches **32** and **34** are rotated to allow the operating handles **31** to be pulled outwardly. Since each of the operating mechanisms **18** and **19** operates in identical fashion except the direction of rotation is reversed, description will be limited to mechanism **18**.

Handle **31** is pulled outwardly causing rotation of the operating shaft **20**. The shaft **20** rotates about the common axis of the upper and lower crank members **44** and **48**. As a consequence, roller assemblies **43** and **49** being offset from the axis of the crank members are rotated across the guide channels **54** and **60**. When the lower roller **43** is transverse of the guide channel **60**, as is the case after handle **31** is rotated 90°, it would have a tendency to drop therein, however, the ball pivot member **61** abuts the end of the crank member **44** to prevent the plug door assembly from dropping a substantial amount into the channel **60**. As rotation of the handle is continued through the final 90°, the upper and lower rollers are moved to the position seen in FIG. 4 to ride on the associated outer portions **51** and **57** of the track assemblies **24** and **25**. When the roller member **43** engages outer roller track **57** of the track assembly **25**, sufficient clearance will exist between the ball pivot member **61** and the end of crank member **44** to allow lateral movement of the door. Throughout this operation the plug door **13** has moved straight out in a line substantially perpendicular to the plane of the opening. The plug door is now positioned outwardly of side frame member **15** and it may be easily rolled along the track so as to overlie the car body **62** exposing the opening.

Although each of the upper and lower housings **22** and **23** are shown as including roller members, it is obvious that the upper roller member could be omitted without detracting from the operativeness of the invention since it serves more of a guiding function than supporting function. However, it is desirable to provide the upper housing with such a roller to enhance the freedom of lateral movement of the door and actuating assembly when it is moved to the out position illustrated in FIG. 4. In addition, it limits the upward movement of the door to insure that the lower crank member will remain in the associated guide channel at all times. It is obvious that two rollers could be provided in each housing which would ride on opposite sides of the guide channels if desired.

The car may now be loaded or unloaded as the case may be, and the plug door may then be rolled back into alignment with the opening. Crank members **31** and **33** are rotated to the position shown in FIG. 1 to cause the associated roller assemblies to be rotated from the outer roller track to the inner roller track such as seen in the cross sectional view of FIG. 3. Prior to rotating the handles it is desirable to attach the hasp member **35**, shown in FIG. 1, to insure that the door will move in a direction perpendicular to the opening, rather than attempt to shift laterally when the crank members are rotated.

Throughout the entire operation of insertion and withdrawal, the plug door **13** is maintained in alignment with the opening **12** so that damage to the seal means, door or frame member cannot occur. With the door positioned as shown in FIG. 3, the lower roller assemblies support the entire weight thereof through the collar **45** on the shafts abutting the shaft mounting bracket **21**. The entire hardware employed in the actuating mechanism and the like will be disposed inwardly of the outer edge of the outer track members **51** and **57** so as to not present any projecting portions which would be dangerous to life and limb of railway workmen.

It can be readily appreciated that the simplicity of the operating mechanism of the plug door represents a significant advance in the art since it requires a minimum number of parts promoting economy in manufacture as well as being uncomplicated to preclude fouling of the operating mechanism due to the elements which is a common occurrence in plug door operating mechanisms of more complex construction.

It will become obvious to those skilled in the art that numerous departures can be made from the construction shown and described, and therefore it is intended that any limitations imposed be within the spirit and scope of the appended claims.

I claim:

1. In combination, an opening defined by upper, lower and side frame members, a pair of tracks adjacent said upper and lower frame members, a plug door in said opening, actuating means to move said plug door out of said opening, said actuating means including first and second shafts connected to an outwardly facing side of said door and rotatable about a vertical axis, crank means at opposite ends of each of said shafts, said crank means being received in a guiding channel in each of said tracks, a roller at the lower end of each of said shafts, each of said rollers engaging a portion of the lower tracks inwardly of said guiding channel when said plug door is snugly received in said frame, and being adapted on rotation of the associated shaft to be moved to a portion of said lower track outwardly of said guiding channel when said plug door is moved out of said frame.

2. The combination of claim **1** wherein a sealing strip is provided around the periphery of said door, said sealing strip having inner and outer lip portions projecting therefrom, said inner lip engaging an edge portion of said frame members and said outer lip overlying a face portion of said frame when said door is positioned in said opening.

3. A plug door assembly comprising a door member adapted to fit in an opening, an actuating mechanism for said door member, said actuating mechanism including first and second shaft members arranged in substantial parallelism with respect to each other and rotatably connected to said door member, each of said shaft members having a housing at opposite ends thereof, a crank member attached to each of said housings eccentric with respect to the longitudinal axis of said shaft member, each of said crank members being received in a guide channel formed in upper and lower track assemblies, a roller assembly carried in each of said housings, each of said roller assemblies being offset with respect to the associated one of said crank members, each of said roller assemblies being rotatable about said crank member to move said roller from an inner portion of the associated track to an outer portion of said track during rotation of said shaft members, and said door member simultaneously being moved from within said opening to a position outwardly thereof whereby said door may be moved laterally of said opening on said roller assemblies.

4. A railway car having a framework defining an opening, track means positioned slightly above and below said opening, each of said track means having a guide channel therein outwardly spaced from said opening, a plug door adapted to fit in said opening, actuating means to move said plug door into and out of said opening, said actuating mechanism including first and second shafts rotatable connected to said plug door, crank means at the opposite ends of each of said shafts, each of said crank means being received in the guide channel in the associated track means, roller means at the lower end of each of said shafts, said roller means being adapted to ride on a portion of said track means inwardly of said guide channel when said plug door is fitted in said opening, said roller means being rotatable about the axis of said crank means so as to be disposed on a portion of said track means outwardly of said guide channel to move said plug door outwardly of said opening whereby said door may be moved laterally with each of said crank means

maintaining the associated one of said rollers on said track means.

5. The railway car of claim 4 wherein pivot support means is provided between the end of said crank means and a bottom portion of said lower guide channel for supporting said crank means during a portion of its rotary movement.

6. A plug door assembly comprising a door member adapted to fit in an opening, an actuating mechanism to withdraw said door from said opening to permit lateral movement thereof, said actuating mechanism including shaft means rotatably held by said door and extending therebeyond, crank means at opposite ends of said shaft means, each of said crank means being eccentric with respect to the rotational axis of said shaft, roller means at the lower end of said shaft means, track means having an inner portion and outer portion defining a guide channel to receive said crank means, said roller resting on said

inner portion of said track means when said door member is within said opening and being rotatable about said crank means to said outer portion of said track means when said shaft means is rotated to pull said door member from said opening whereby it may be rolled laterally thereof.

7. The plug door assembly of claim 6 further including means to limit the longitudinal shifting of said shaft means with respect to said door member.

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