DUAL BRAKE TYPE DRIVE MECHANISM

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ABSTRACT

The specification and drawings disclose a drive mechanism particularly suited for plug-type rail car doors and arranged to prevent "overspinning" and "drifting." The mechanism disclosed is a double brake-type mechanism and includes a first rotatably mounted member. The first member is arranged to transmit force in either direction of rotation and is connected with an input drive mechanism and a driven mechanism that, at times, produces forces acting to drive the member in its driven direction at a rate greater than that produced by the input drive mechanism. The drive mechanism includes a rotatable pinion gear carried on a rotatable input shaft extending generally parallel to the axis of rotation of the first member. The pinion gear is connected with the shaft by means which cause it to move longitudinally of the shaft to a first or a second spaced point depending upon the direction the shaft is rotated. At each of the points, there are ratchet wheels which are freely rotatable relative to the shaft except when the pinion gear moves to engage them at their respective points. When engaged, the ratchets permit movement of the shaft only in one direction. The arrangement is such that should the driven mechanism begin moving the member at a rate greater than the pinion, the pinion will move longitudinally of the shaft to engage the other ratchet wheel and prevent movement of the shaft in response to force input from the driven mechanism.

5 Claims, 7 Drawing Figures
DUAL BRAKE TYPE DRIVE MECHANISM

This invention is directed toward the art of drive mechanisms and, more particularly, to a mechanism for transmitting rotary motion in two directions with means for preventing overrunning of the driven mechanism in at least one of the two directions.

The invention is especially suited for use as an operating mechanism for railroad car plug-type doors and will be described with particular reference thereto; however, as will become apparent, the invention is capable of broader application and could be used in many different devices.

Plug-type doors are often used in rail cars. Typically, the doors are carried on vertical shafts provided at their opposite ends with crank members. Rollers are mounted on the ends of the crank members and ride in guide tracks extending along the car. By rotating the shafts, the doors can be moved laterally of the car into and out of the door openings. In the outer position, the doors can be moved longitudinally of the car on the guide tracks.

Generally, the doors are sealed about their peripheries by gaskets which are compressed against the frame of the door opening when the door is moved into the opening. Normally, the gaskets are formed from relatively rigid material and a substantial force is required to compress them into position.

The operating mechanism for these doors has included a manually rotatable lever or handle connected with the vertical shafts through a drive mechanism. Many types of drive mechanisms have been developed with a view toward the convenient transmission of the forces required to open and close the door. All of the prior mechanisms have, however, failed to completely solve certain problems present in plug-type doors.

One of the problems present with plug-type doors is that at the start of an opening cycle, the gasket and the contents, especially bulk contents such as grain, can exert a substantial force acting to move the door outwardly. At times, with the prior mechanisms, the force can be sufficient to accelerate the movement of the manually rotatable lever out of control of the operator. This is often referred to as "overspinning" and can result in serious injuries to the operator.

A second problem present with many plug-type door drive mechanisms has been that the result of the mechanisms being designed to reduce friction for easy in and out movement. The easy in and out movement of the door permits the door, when in the open position, to swing inward and bang against the side of the car. This can scar the door and abrade the side of the car necessitating frequent painting and replacement of worn or damaged parts.

The two above discussed problems have been separately overcome to some extent by some drive mechanisms incorporating various catches, friction members and the like. No mechanism has, to date, satisfactorily met both problems simultaneously.

The present invention provides a drive mechanism that is relatively simple in construction but which satisfactorily overcomes both problems. In particular, the invention contemplates a mechanism including a first rotatably mounted member adapted to transmit force in either direction of rotation and which is connected with a drive mechanism and a driving mechanism that, at times, produces forces acting to drive the member in its driven direction at a rate greater than that produced by the drive mechanism. The drive mechanism includes a rotatable pinion gear carried on a rotatable input shaft extending generally parallel to the axis of rotation of the first member. The pinion gear is connected with the shaft by means which cause it to move longitudinally of the shaft to a first or a second spaced point depending upon the direction the shaft is rotated. At each of the points, there are ratchet wheels which are freely rotatable relative to the shaft except when the pinion gears move to engage them at their respective points. When engaged, the ratchets permit movement of the shaft only in one direction. The arrangement is such that should the drive mechanism begin moving the member at a rate greater than the pinion, the pinion will move longitudinally of the shaft to engage the other ratchet wheel and prevent movement of the shaft in response to the force input from the driven mechanism.

The advantage of the drive mechanism when used in a plug door is apparent. Note that the input shaft would be driven by the manually actuated lever or handle and if, during an opening cycle the door began moving in response to gasket or contents pressure forces, then the driven member moves at a rate greater than the pinion to cause a reverse longitudinal movement of the pinion and ratchet engagement. Thus, "overspinning" or driving movement of the manually actuated handle cannot take place.

Further, the invention contemplates that friction means between the pinion and the ratchet wheel will permit the reversal of the input shaft only under a substantial initial force input in the reverse direction. Thus, when used in a plug door operating arrangement, the door cannot drift from the open position inward against the side of the car since reverse movement of the mechanism can only be accomplished with a substantial reverse force input to the shaft.

Accordingly, a primary object of the invention is the provision of a simple transmission or drive mechanism wherein overrunning by the driven mechanism is prevented and a reversal of drive direction can be achieved only by a substantial initial force input.

Another object of the invention is the provision of a drive transmission which can be used in plug-type rail car doors to eliminate both "overspinning" and "drifting" as discussed above.

A still further object is the provision of a drive mechanism of the general type described which assures smooth, low friction operation while preventing undesired inputs to the drive from the driven mechanism.

Yet another object is the provision of a drive mechanism which is simple to construct and operate.

These and other objects and advantages will become apparent from the following description when read in conjunction with the accompanying drawings wherein;

FIG. 1 is a front elevation of a plug-type rail car door showing a preferred embodiment of the invention with the door in the closed position;

FIG. 2 is an enlarged front elevation of the door operating mechanism with a portion of the cover plate broken away to show the details of the mechanism;

FIG. 3 is a cross-sectional view taken on line 3—3 of FIG. 2 showing the position of the double ratchet drive mechanism when the door is in the closed position;

FIG. 4 is a front elevation of the door shown in FIG. 1 but showing the door and the drive mechanism in the open position;

FIG. 5 is a cross-sectional view taken on line 5—5 of FIG. 4 showing the double ratchet drive mechanism in the open position;

FIG. 6 is a cross-sectional view taken on line 6—6 of FIG. 5; and,

FIG. 7 is a cross-sectional view taken on line 7—7 of FIG. 4.

Referring more particularly to FIGS. 1 and 6, there is shown a railroad car indicated generally by the reference numeral 10 having a side opening 12 in which is positioned a plug-type door assembly 14. The door 14 is provided with an opening and closing mechanism indicated generally by the reference numeral 18.

The details of the general structure of the railroad car 10 and the general structural details of door 12 form no particular part of the invention; however, the door 12 is shown as formed from a pair of spaced, vertically extending frame members 20 and 22 having a cross-section shown in FIGS. 6 and 7. Members 20 and 22 are joined by somewhat similar, horizontally extending frame members 23 through 26. Joined to the back of the frame members is a rectangular section of sheet metal 28 that closes the spaces between the frame members and provides a rigid door structure.
As is customary with plug-type doors, the door assembly 14 is mounted so that it can move laterally into and out of the opening 12 and be shifted longitudinally of the rail car 10. As best shown in FIG. 1, the door assembly 14 is carried by a pair of vertically extending shafts 30, 32. The lower ends of the shafts 30, 32 are each provided with a laterally extending lever arm or crank 34. At the end of each of the cranks 34, a roller hanger assembly 36 is mounted for pivoting movement about a vertical axis. At the upper ends of the shafts 30, 32, arms 38 are connected to extend laterally outward in the manner shown. The outer ends of each of the arms 38 are provided with a roller 40 which extends outwardly and upwardly for rotation about a vertical axis. The roller hanger assemblies 36 are carried on a track section 42 which extends longitudinally of the car and supports the door for movement therealong. The upper guide rollers 40 are received in a guideway 44 which also extends along the car.

As can be appreciated, rotation of the pipes 30, 32 in the clockwise and counter-clockwise directions, respectively, cause the door to be swung outwardly away from the car, whereas, rotation in the opposite directions moves the door into engagement with the opening 12. Preferably, the door carries a compression gasket seal 46 about its peripheral edge so that when the door is moved into a closed position, (as shown in FIG. 1) the gasket members make inwards extending flanges on the door opening to seal the door.

Referring again to the vertically extending shafts or pipes 30, 32, it will be noted that they are pivotally or rotatably connected to the front face of the door by suitable brackets 46 which are bolted or otherwise positively connected to the door frame members 23 through 26.

Means are provided for locking the door in the closed position. In the subject embodiment, these means take the form of a plurality of horizontally movable lock bolt members 50. As shown, each of the lock bolt members is carried by a pair of slide brackets 52 connected to the vertically extending door frame members 20, 22. The upper pair of lock bolt members 50 are driven by horizontally extending drive bars 54 and the lower set of lock bolts is similarly driven by horizontally extending drive bars 56. As best shown in FIGS. 1 and 6, the ends of the lock bolts 50 are arranged to be received within generally cup-shaped keeper members 58 carried at corresponding locations in the door opening 12. Thus, with the door moved into position in the opening, outward actuation of the lock bolts 50 causes their outer ends to engage the keeper plates to firmly lock the door in position.

In the embodiment under consideration, the vertical shafts 30, 32 and the horizontally extending lock bolts 50 are all commonly driven from the door opening and closing mechanism 18. It will be noted that the vertical shafts 30, 32 are provided with clevis brackets 60 and 62 respectively. The clevises each receive the end of a horizontally extending drive rod or link member 64, 66 respectively. The members 64, 66 are driven from the opening and closing assembly 18 in a manner subsequently to be described.

The mechanism for moving the upper lock bolt drive links 54 is also operated from assembly 18 and includes a pair of L-shaped crank members 68 which are each mounted for pivotal movement by pivot pins 70 carried by the door. The upper ends of the cranks 68 are pivotally connected to the inner ends of the drive bars 54 by pins 72. The lower ends of the cranks 68 are pivotally connected by pins 74 to a vertically extending drive bar 76.

The lower lock bolt drive bars 56 are driven in generally the same manner as the upper bars 54. Note that L-shaped crank members 78 are mounted for oscillating movement about pivot pins 80 carried on the front face of the door. The lower ends of the cranks 78 are connected to the inner ends of the drive bars 56 by pivot pins 82. The inner ends of both cranks are connected to a vertically extending drive plate or bar 84.

The opening and closing assembly 18 functions to actuate the horizontally extending drive bars 54, 56, 64, and 66 and includes a relatively large diameter sector gear member 84 positioned generally centrally of the lower portion of the door. Member 84 is mounted for rotation about a pivot pin 86.

Referring in particular to FIG. 2, it will be seen that the sector gear 84 has a toothed outer periphery 88 of an arcuate extent in the range of approximately 120°. The horizontally extending drive bars 64, 66 are secured with the gear 84 by connecting link members 90, 94 respectively. Note that the inner end of the drive bar 64 is pivotally connected to connecting link 90 by a pivot pin 92. The opposite end of link 90 is pinned to the gear 84 at a location relatively close to pivot pin 86. Similarly, the connecting link 94 is connected to the inner end of the drive bar 66 by a pin 96. The innermost end of the connecting link 94 is, in turn, pinned to the gear by pin 97.

FIG. 2 shows the position of the elements when the door is in the closed position. As can be appreciated, rotation of the gear 84 in the clockwise direction causes the drive bars 64, 66 to be pulled inwardly, thus rotating the vertical shafts 30, 32 to swing the door laterally outwardly from the opening 12.

In addition to rotating the vertical shafts, movement of the sector gear in the clockwise direction from the position shown in FIG. 2, also causes the lock bolts 50 to be moved inwardly out of the keepers 58. Note that the lower end of the drive bar 76 for the upper keepers 50 is pinned to one end of a cam crank 98 by a pin or bolt 100. The cam crank 98 is connected to the door for oscillating movement about a pivot pin 102. The cam crank 98 includes a cam finger portion 104 which, when the doors are in the closed position, projects into a recess 106 of a sector gear 84. As the sector gear 84 is rotated in a clockwise direction from the position shown, the recess 106 cams the cam crank 98 in a counterclockwise direction to the dotted line position identified with the numeral 98. The arcuate surface 108 of gear 84 maintains the cam crank 98 in the dotted line position during further clockwise movement of the gear. This maintains the upper lock bolts 50 in their retracted or open position.

Similarly, the lower lock bolts 50 are simultaneously actuated by the gear 84. For this purpose, a cam crank 110 is carried by a pin 112 which extends outwardly from the door face. One end of the cam crank is connected to the upper end of the vertically extending drive bar 84 by a pivot pin or the like 114. The other end of the cam crank has a cam finger portion 116 which is received in the recess 118 formed in gear 84. As can be appreciated, rotation of gear 84 in the clockwise direction causes the crank 110 to be rotated counter-clockwise to the dotted line position identified by 118'. This causes the drive bar 84 to be pulled upwardly actuating the lower lock bolts 50 inwardly to their retracted or open position.

Of particular importance to the subject invention is the drive means utilized for actuating the sector gear 84. As can be appreciated, the various drive components and the drive links are preferably arranged so that there is a minimum of friction to make the door opening and closing relatively easy.

This can cause problems in that during actuation of the door to the open position, the forces produced by the gasket and the forces produced by the contents of the car can act against the door to drive it open rapidly and cause spinning of the manual actuating handle. Similarly, when the doors are in the open position, the easy in and out movement of the door can allow it to drift and scrape and bang against the car side during movement of the car. The scraping can scar the door and the side of the car requiring frequent painting and replacement of damaged parts. The subject invention provides an arrangement whereby the drive mechanism for the door opening and closing can be frictionally locked in both a closed and an open position. Further, overrunning or spinning during an opening operation is prevented. Referring in particular to FIGS. 2 and 3, the gear 84 is shown as driven by a pinion gear 120 which is carried by a stub shaft 122. As best seen in FIG. 3, the stub shaft 122 is mounted for rotation in bearings 124 and 126 which are carried in the door plate 28 and the drive cover plate 28 respectively. A handle member 130 is connected to the outer free end of the stub shaft 122 in any convenient manner such as through the use of a pin 132.
Referring again to FIG. 3, it will be seen that the pinion gear 120 is provided with internal threads or camming surfaces 136 which mate with the threads or camming surfaces 138 formed on the stub shaft 122. The lateral faces of the gear 120 are each relatively smooth and functional as friction surfaces in a manner to subsequently be described. Also carried on the shaft 122 for simultaneous rotation therewith are a pair of flange members 140 and 142 which are pinned to shaft 122 and have inwardly facing friction surfaces 144 and 146 respectively. Positioned between the flange member 142 and the left-hand friction face of gear 120 (as viewed in FIG. 3) is a ratchet disc 148 which, as best shown in FIG. 2, has a periphery that is provided with teeth formed generally in the manner shown. Each side of the ratchet disc 148 is provided with a resilient friction washer which is bonded to the ratchet wheel. The friction washers 150 are preferably of a diameter substantially equal to the diameter of the flange 142 and the flange portion of the gear 120. Positioned between the flange 140 and the right-hand end of gear 120 is a second ratchet wheel 154 that is substantially identical to the previously mentioned ratchet wheel 148. However, as can be seen in FIG. 2, ratchet wheel 154 is positioned with its teeth extending or facing in the opposite direction. The ratchet wheel 154 also is provided with a pair of resilient friction washers 156 which are bonded or otherwise attached to the lateral faces of the ratchet wheel.

Each of the ratchet wheels 148 and 154 have a ratchet pawl associated therewith. As best shown in FIG. 2, a first ratchet pawl 160 is positioned to engage the periphery of the ratchet wheel 148 and permit it to rotate only in the clockwise direction. The second ratchet pawl 162 is mounted for engagement with ratchet wheel 154 and permits it to rotate only in the counterclockwise direction. As shown, the ratchet pawls 160 and 162 are designed so that in the door's normal vertical position, the ratchet portions are maintained under engagement with their respective wheel through the action of gravity.

The operation of the drive assembly described can best be understood by an explanation of a complete opening and closing cycle of operation. Referring in particular to FIGS. 1, 2, and 3, the positions of the various elements, when the door is in the closed position, are shown by solid lines. To initiate an opening operation, the operating handle 130 is rotated in the counter-clockwise direction. As can be seen from FIG. 3, counter-clockwise rotation of the stub shaft 122 causes the pinion gear 120 to be moved to the right until it engages the ratchet disc 154. Continued rotation causes the pinion to be firmly driven into engagement with the ratchet wheel to clamp the ratchet wheel 154 against the flange 140. At this time, the ratchet pawl 162 prevents clockwise movement of the ratchet wheel. The ratchet pawl 160 is maintained in engagement with its ratchet wheel 148; however, the ratchet wheel 148 can freely rotate relative to the stub shaft since it is not clamped by the pinion 120.

As counter-clockwise rotation of the pinion 120 takes place, the sector gear (see FIG. 2) is rotated in a clockwise direction to first retract the latch bolts 50 and thereafter begin rotating the vertical shafts 30, 32 to move the door to an open position. If the rail car is filled with grain or the like, the action of the grain against the door could cause the door to move outwardly suddenly and rotate the shafts in the direction to cause a sudden rotation of the sector gear 84 in the opening direction. As can be appreciated, if the handle 130 were directly connected through the pinion to the sector gear, the handle could be suddenly rotated out of the operator's grasp with substantial overspinning. In the subject arrangement, however, if a force is present in the driven mechanism (i.e. the door) which could tend to cause the sector gear to be rotated, the rotating of the sector gear will rotate the pinion 120 in a counter-clockwise direction at a rate greater than the rate in which it is being rotated by handle 130. This causes the pinion to be driven on the threaded portion 138 to engage with the ratchet wheel 148. Upon engagement with ratchet wheel 148, further rotation in the counter-clockwise direction is prevented by the action of pawl 160. It should be appreciated that the total distance which the pinion must move to engage the ratchet wheel 148 is quite small.

When the force acting to cause overrunning of the pinion has been released, the handle 130 can again be rotated in a counter-clockwise direction to drive the pinion 120 back into engagement with ratchet wheel 154 and normal door opening continued.

When the door is moved outwardly; the entire distance laterally, the pinion 120 is, of course, firmly wedged against the innermost friction disc 156. The pawl 162 acts to prevent reverse movement of the pinion to bar drifting of the door inwardly against the side of the car. However, should it be desired to close the door, a clockwise rotation of the handle 130 causes the pinion 120 to be rotated back to the point of engagement with the ratchet wheel 148. This frees ratchet wheel 154 so that clockwise rotation of the pinion can take place to move the door to its closed position. When the door has been completely closed, the pinion 120 is still wedged or jammed against the inner friction disc 120 and opening of the door can only take place with the application of a substantial input force in a counter-clockwise direction.

As can be appreciated, the arrangement completely overcomes any problems of overspinning or drifting. Further, the door is maintained in both the open and closed positions in a manner which prevents opening and closing except with the input of a slightly higher starting force.

The invention has been described in great detail sufficient to enable one of ordinary skill in the rail car art to make and use the same. Obviously, modifications and alterations of the preferred embodiment will occur to others upon a reading and under standing of the invention and it is our intention to include all such modifications and alterations as part of our invention insofar as they come within the scope of the appended claims.

What is claimed is:
1. In a railroad car door, the combination comprising:
   a pair of rotatable shaft means secured to the door;
   crank means on said shaft means for supporting the door on the side of a railway car;
   operating means for rotating said shaft means to cause said door to be moved toward or away from the car;
   said operating means comprising:
   a first rotatably mounted member adapted to transmit force in either direction of rotation and connected with a manually operable drive mechanism and a driven mechanism connected to rotate said shafts in a manner such that the door and forces acting thereon can, at times, produce force acting to drive the member in its driven direction at a rate greater than that produced by the manually operable drive mechanism;
   said manually operable drive mechanism comprising a rotatable pinion gear engaged with the first member and carried on a rotatable input shaft extending generally parallel to the axis of rotation of the first member;
   means connecting the pinion gear to the shaft for causing it to move longitudinally of the shaft to a first or a second spaced point depending upon the direction of shaft rotation;
   ratchet wheels positioned at each said first and second points and freely rotatable relative to the shaft except when the pinion gear moves to engage them at their respective points and,
   engaging means associated with each ratchet to permit movement of the shaft only in one direction when the respective ratchet is engaged whereby when force acts to move the first member at a rate greater than the pinion, the pinion moves longitudinally of the shaft to engage the other ratchet wheel and prevent movement of the shaft in response to the force input from the driven mechanism.
2. The invention as defined in claim 1 including friction means between the pinion and each ratchet wheel to permit reversal of the input shaft only under a substantial initial force input.
3. The invention as defined in claim 1 wherein said ratchet wheels are positioned on opposite sides of said pinion and in axial alignment therewith.

4. The invention as defined in claim 1 wherein the means connecting the pinion gear to the shaft comprise cooperating cam surfaces formed on the shaft and the pinion.

5. The invention as defined in claim 4 wherein said cam surfaces comprise spiral threads.

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