HOPPER CAR DOOR OPERATING MECHANISM

Inventor:
Walter L. Floehr

By Wilmer Mecklin
his Attorney

March 25, 1969
W. L. FLOEHR
3,434,433
Walter L. Floehr v
By
"ed. his Attorney

Filed June 1, 1965

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FIG. 3
ABSTRACT OF THE DISCLOSURE

A mechanism for operating in unison a pair of opposed hinged doors of a railway hopper car, the mechanism having a frame fixed to the car between the doors, a pair of levers each having a fixed fulcrum on the frame and linked to one of the doors, a crosshead slideable linearly on the frame and linked to and acting through both levers for swinging the doors between open and closed positions, an operating shaft extending across the car for operation from either side and linked to the crosshead for shifting the latter, and a latch on each end of the shaft for locking the mechanism with the doors in closed position.

This invention relates to mechanisms for operating drop bottom doors of railway hopper cars and has for its primary object the provision of an improved hopper door operating mechanism for operating in unison one or more pairs of opposed hopper doors.

Another object of the invention is to provide a hopper door operating mechanism whereby a pair of opposed hopper doors can be positively driven in unison between open and closed positions through a linearly slideable actuator without imposing upon the actuator lateral forces of the higher order possible in mechanisms in which opposed hopper doors are operated through a toggle joint. A further object of the invention is to provide a hopper door operating mechanism wherein the linear movements of a linearly reciprocable actuator are transmitted to a pair of opposed hopper doors to operate them in unison through a pair of levers having fixed fulcra, with consequent minimizing of the lateral forces upon and ease of shifting of the actuator.

An additional object of the invention is to provide an operating mechanism for a pair of opposed hopper doors which opens and closes the doors in unison through a linearly slideable actuator acting through fixed fulcra levers and can be both operated and locked in door-closed condition from either side of a car.

A further object of the invention is to provide a mechanism for operating a pair of opposed hopper doors in unison, wherein the levers through which opening and closing movements are transmitted to the doors are universally connected to the doors thereby ensuring the full seating of each door despite any non-uniformity in the doors and their frames due to manufacturing tolerances.

Another object of the invention is to provide an improved mechanism for operating in unison a pair or plurality of laterally aligned pairs of opposed, longitudinally swingable hopper doors, which is of such construction and arrangement as to enable the doors to be operated quickly and readily and locked in closed position from either side of a car.

Other objects and advantages of the invention will appear hereinafter in the detailed description, be particularly pointed out in the appended claims and be illustrated in the accompanying drawings, in which:

FIGURE 1 is a side elevational view of a part of a railway hopper car to which there has been applied a preferred embodiment of the door operating mechanism of the present invention;

FIGURE 2 is a fragmentary bottom plan view of the structure of FIGURE 1;

FIGURE 3 is a vertical sectional view on an enlarged scale taken along lines 3--3 of FIGURE 1;

FIGURE 4 is a fragmentary vertical sectional view taken along lines 4--4 of FIGURE 3;

FIGURE 5 is a fragmentary vertical sectional view taken along lines 5--5 of FIGURE 3;

FIGURE 6 is a fragmentary vertical sectional view taken along lines 6--6 of FIGURE 4;

FIGURE 7 is a fragmentary vertical sectional view on an enlarged scale, taken along lines 7--7 of FIGURE 1;

FIGURE 8 is a fragmentary vertical sectional view on the scale of FIGURE 7 taken along lines 8--8 of FIGURE 1;

FIGURE 9 is a vertical sectional view taken along lines 9--9 of FIGURE 7; and

FIGURE 10 is an end elevation view of the structure of FIGURE 9, but with the lock and operating shaft in door-open position.

Referring now in detail to the drawings in which like reference characters designate like parts, the improved door operating mechanism of the present invention is designed for the quick dumping of a hopper car by enabling one or more pairs of opposed drop bottom doors to be operated or opened and closed in unison. As in the illustrated embodiment, the improved mechanism, designated as 1, will usually be applied to a hopper car 2 having laterally aligned pairs of longitudinally swingable, opposed doors 3 at opposite sides of the center sill 4 for enabling the doors of both pairs to be operated in unison or simultaneously from either side of the car by a common operating means. Since in such an installation the mechanisms at opposite sides of the center sill 4 will be counterparts, the illustrated mechanism for operating the pair of doors at one side will suffice for an understanding of the invention.

Hinged at the top for swinging about substantially parallel, horizontal axes extending laterally or transversely of the car 2, on door frames 5 riveted or otherwise fitted to and bounding discharge openings (not shown) of a pair of adjoining, oppositely discharging hoppers 6, the doors 3, when closed, seat in oppositely sloping, downwardly diverging positions against seats (not shown) on their respective frames for closing the discharge openings of the hoppers. In their opening and closing movements, the doors 3 swing from their closed positions toward each other to open positions and, as indicated for one of the doors in dot-and-dash line in FIGURE 5, in process preferably pass through vertical planes containing their hinging axes for maximum freedom of discharge of lading from the hoppers 6.

The improved mechanism 1 by which the opposed doors 3 are swung in unison between open and closed positions, is comprised of a supporting frame 7 which is located laterally between an adjoining side or side sheet 8 of the car 2 and the center sill 4 and projects upwardly into the peaked recess 9 bounded upwardly by the intersecting floor sheets 10 of the hoppers 6. Sufficiently of box-shape with transversely spaced, parallel uprights or vertically disposed side rails 11 at its four vertical corners, the supporting frame 7 conveniently is fixed to the car 2 between the doors 3 by suspending it from and toward one side of a crossbearer 12 formed of an inverted T-beam, which extends laterally between the side sheet 8 and the center sill 4 and is centered longitudinally on the crossridge 13 at which the floor sheets 10 intersect or join. Secured or fixed to the bottom flanges 14 and by diagonal braces 15 to a side of the vertical flange 16 of the
crossecare 12, the frame 7 has its side rails 11 suitably crossbraced and is reinforced or stiffened at the bottom by stiffeners 17 fixed to its inner side rails and the bottom flanges 14 of the center sill 4 and extending across the bottom of the sill to the frame (not shown) on the other side.

With the suspended frame 7 its support, the operating mechanism 1 has for operating the doors 3, a crosshead or actuator 18 vertically shiftable or reciprocable rectilinearly or in a straight line in the frame and guided or directed in its rectilinear movement by vertically disposed guide ribs 19 integral or rigid with and outstanding from its opposite sides 20 and sliding or slidably received in guideways 21 in the frame. The guideways 21 are each formed by a pair of longitudinally spaced, vertically disposed guide bars 22 which are welded or otherwise secured to the inner sides of adjoining crossbraces 23 of the frame 5 and not only define the guideways, but, by sliding engagement of their inner or confronting faces 24 with the sides of the crosshead 18, limit and substantially prevent lateral play or movement of the crosshead in the frame. Inverted T-shape, the crosshead 18 is positively shifted or driven rectilinearly in the frame by a link 25 pivotally connected at its lower end to the crosshead and at its upper end to a crank or crank arm 26 carried by and fixed against rotation to an operating shaft 27. Projecting from the operating shaft 27 when the doors 3 are closed, the link 25 is bent adjacent its upper end both to permit the crank 26 to be turned over or beyond center in closing the doors and, by engagement with the operating shaft, to limit the extent of such turning.

The connections between the operating mechanism 1 and the doors 3 are a pair of jointed or foldable levers 28 which extend oppositely longitudinally of the car 2. Each of the jointed levers 27 is formed of a bellcrank 29 connecting and pivoted between the adjoining side rails 11 of the frame 5 adjacent their lower ends for pivoting or full cranking about a horizontal axis fixed by the connecting pivot pin 30 and extending laterally of the car 2 parallel to the hinging axes of the doors 3. The balance of each jointed lever 28 is formed by a link 31 connected at its inner end for vertical pivoting or upward folding or breaking to the outer end of the outer arm 32 of the relation bellcrank 29 and forming with that arm the outer arm of the lever. To complete the connection between the frame 5 and each door 3, the link 31 of each jointed lever 28 has its outer end universally connected to the adjoining or related door 3 by a universal, conveniently crosspin, connector 33, the connection being in the form of an iron or 34 fixed to the outer face 35 of the door 3 and the point of connection being centered substantially laterally on and adjacent the lower end of the door. The other or inner arms 36 of the bellcranks 29 are connected by pivoted links 37 to opposite ends of the crosshead 18.

For convenience of operation, the operating shaft 27 mounts a crank 26 for the operating mechanism 1 of each of the laterally aligned pairs of opposed doors 3 at opposite sides of the center sill 4 so as to serve as a common shaft through which the doors can be operated in unison. Also conveniently, the common operating shaft 27 extends across and through the side sheets 8 at opposite sides of the car 2 and has at each end beyond or outwardly of the adjoining side, a capstan 38 for receiving a suitable turning tool (not shown). Thus, by applying the turning tool to one or the other of the capstans 38, all four doors can be operated from whichever side of the car is more readily accessible. Journalled at each frame 5 in a pair of bushings 39 seated in and extending through the frame's diagonal braces 15, the operating shaft 27, adjacent its ends, extends through the car's side sheets 8 and mounting plates 40 secured to the outsides thereof in the ordinary of the capstans 38, turns or is journaled in another pair of bushings 39, each carried by and secured to one of the mounting plates.

Operable from either side of the car through the com-
should be fully unfolded or straight so that any opening forces initiated or generated at the doors will be transmitted practically entirely through the levers directly to the frame 5, rather than in substantial part through the crosshead 18. This is accomplished in part by providing cooperating abutments 55 on each link 31 and the outer arm 32 of the related bellcrank 29 that engage when these members are straight and prevent their downward folding and in balance, by making the outer lever arm they together form, adjustable in length at the time of installation to compensate for both manufacturing and installation tolerances. As in the illustrated embodiment, the desired length adjustment is suitably obtainable by initially telescoping connecting each link 31 and its universal connector 33 for relative longitudinal movement. With this arrangement, it is necessary during installation only to straighten the outer arms of the levers 28, while the doors are jacked or otherwise held fully seated, to cause the outer arms automatically to adjust to the proper length, whereupon each link 31 and its connector 33 are welded or otherwise fixed against relative longitudinal movement. Although the mechanism 1 imparts movement to the doors 3 through the crosshead 18 and the latter therefore will be subject to lateral forces as they are swung between open and closed positions, the fixing of the fulcrums of the levers on the frame so reduces the lateral forces on the crosshead, relative to those at the joint in a toggle mechanism, as to ensure freedom of movement of the actuator in the guideways 21, regardless of any unequal distribution of forces between the doors.

In an opening operation with the doors 3 initially closed and the operating shaft 27 locked against turning, breaking of the wire seal or seals 50 enables the lock or locks 41, through the locking shaft 42, to be swung or turned manually to release position from either side of the car. With the operating shaft 38 then free to be turned in an opening direction, the operator applies a turning tool to the adjoining capstan 38 and turns the shaft in that direction, in process first swiveling the crank 26 out of its overcenter, door-closed position and then, through the drive link 25, shifting the crosshead 18 downwardly in the frame 7. In its downward movement, the crosshead 18, through the links 37 connecting it to the inner arms of the bellcranks 29, swings the bellcranks upwardly and, by the consequent upward breaking of the jointed levers 28, swings the doors 3 toward their open positions, the opening operation continuing until those positions are reached as determined by engagement of the crank 26 with a fixed stop or pin 55 on the frame. A closing operation is simply the reverse of the opening operation with turning of the operating shaft 27 in a closing direction pulling or shifting the crosshead 18 upwardly until the jointed levers 28 are straight, at which time swinging of the or each lock 41 into locking engagement with the related capstan 38, by locking the operating shaft against turning, locks the doors 3 in their closed positions.

Once the doors 3 are closed, any opening force applied from them to the mechanism 1 cannot open them unless it can produce downward movement of the crosshead 18. However, any tendency of the crosshead to so move under such a force would apply a downward force to the drive link 25, which, due to the then overcenter position of the crank 26, could only tend to turn the operating shaft 27 in a closing direction and further turning of the shaft in that direction is stopped by the engagement of the shaft with the side of the drive link. Consequently, the mechanism 1 will effectively hold the doors 3 in closed position against any force exerted through the doors and without placing any strain upon the lock or locks 41.

From the above detailed description, it will be apparent that there has been provided an improved mechanism for operating opposed hopper doors in unison which not only enables the doors to be opened quickly when quick dumping is desired but can itself lock the doors in closed position and will operate freely despite any inequality in the forces upon the doors. It should be understood that the described and disclosed embodiment is merely exemplary of the invention and that all modifications are intended to be included that do not depart from the spirit of the invention.

Having described my invention, I claim:

1. In a railway hopper car having a pair of opposed hinged doors for closing adjoining hoppers, a door operating mechanism comprising frame means fixed to said car between said doors, jointed lever means for and each connected to one of said doors and having a fixed fulcrum on said frame, actuating means rectilinearly shiftable on said frame and connected to said jointed lever means for through entrance swinging said doors between open and closed positions, and drive means for shifting said actuating means and thereby operating said doors.

2. In a railway hopper car having a pair of opposed hinged doors for closing adjoining hoppers, a door operating mechanism comprising frame means fixed to said car between said doors, jointed lever means for and each connected to one of said doors and having a fixed fulcrum on said frame, actuating means rectilinearly shiftable on said frame and connected to said jointed lever means for through entrance swinging said doors between open and closed positions, and drive means for shifting said actuating means and thereby operating said doors.

3. In a railway hopper car having a pair of opposed hinged doors for closing adjoining hoppers, a door operating mechanism comprising frame means fixed to said car between said doors, jointed lever means for and each universally connected to one of said doors and having a fixed fulcrum on said frame, actuating means rectilinearly shiftable on said frame, and universally connected to said jointed lever means for through entrance swinging said doors between open and closed positions, and drive means for shifting said actuating means and thereby operating said doors.

4. In a railway hopper car having a pair of opposed hinged doors for closing adjoining hoppers, a door operating mechanism comprising a frame fixed to said car between said doors, levers connected to said doors and having fixed fulcrums on said frame, an actuator rectilinearly shiftable on said frame and universally connected to said jointed lever means for through entrance swinging said doors between open and closed positions, and drive means for shifting said actuator and thereby operating said doors.

5. In a railway hopper car having a pair of opposed hinged doors seatable in closed position against seals on adjoining hoppers for closing discharge openings thereof, a door operating mechanism comprising a frame fixed to said car between said doors, a pair of levers each for one of said doors and having a fixed fulcrum on said frame, a universal connector fixed to each door for connection thereof to the related lever, each connector being connected initially for and thereafter against relative longitudinal movement to an end of the related lever for adjusting the seatings of said doors in the closed positions thereof during installation of said mechanism, an actuator connected to arms of said levers and for relative rectilinearly shifting said frame, and drive means for shifting said actuator and through said levers swinging said doors to open and closed positions.

6. In a railway hopper car having a pair of opposed hinged doors seatable in closed position against seats on adjoining hoppers for closing discharge openings thereof, a door operating mechanism comprising a frame fixed to said car between said doors, a pair of levers having fixed fulcrums on said frame, said levers each having an arm universally connected to one of said doors, means for initially varying and thereafter fixing lengths of said arms for adjusting the seatings of said doors in the closed positions thereof during installation of said mechanism, an actuator connected to other arms of said levers and for relative rectilinear shifting to said frame, and drive means
7. In a railway hopper car having a pair of opposed hinged doors seatable in closed position against seats on adjoining hoppers for closing discharge openings thereof, a door operating mechanism comprising a frame fixed to said car between said doors, a pair of levers having fixed fulcrums on said frame and each having an arm connected to one of said doors, an actuator connected to another arm of each lever and for relative rectilinear shifting of said actuator and through said arms swinging said doors to open and closed positions.

8. In a railway hopper car having a pair of opposed hinged doors seatable in closed position against seats on adjoining hoppers for closing discharge openings thereof, a door operating mechanism comprising a frame fixed to said car between said doors, levers connected to said doors and having fixed fulcrums on said frame, an actuator rectilinearly shiftable on said frame and connected to arms of said levers, an operating shaft mounted on said car, a crank fixed against relative rotation to said shaft, and a link connecting said crank and actuator for shifting said actuator and through said levers swinging said doors to open and closed positions on operation of said shaft.

9. In a railway hopper car having a pair of opposed longitudinally swinging hinged doors at a side of a center sill thereof for closing discharge openings of longitudinally adjoining hoppers, a door operating mechanism comprising a fixed frame suspended from said car between said doors and projecting upwardly into a recess between said hoppers, a pair of levers having fixed fulcrums on said frame and each having an arm connected to one of said doors, an actuator connected to another arm of each lever, and shiftable rectilinearly in said frame in one direction for opening and the other direction for closing said doors, an operating shaft extending laterally through said recess beyond and selectively operable from opposite sides of said car, and crank and link means drivenly connected said shaft to said actuator for shifting thereof in said frame and through said levers swinging said doors to open and closed positions.

10. In a railway hopper car having a pair of opposed longitudinally swinging hinged doors at a side of a center sill thereof for closing discharge openings of longitudinally adjoining hoppers, a door operating mechanism comprising a fixed frame suspended from said car between said doors and projecting upwardly into a recess between said hoppers, a pair of levers having fixed fulcrums on said frame and each having an arm connected to one of said doors, an actuator connected to another arm of each lever and shiftable rectilinearly in said frame in one direction for opening and the other direction for closing said doors, an operating shaft extending laterally through said recess beyond and selectively operable from opposite sides of said car, and lock means selectively operable from said opposite sides of said car for locking said shaft against rotation and said doors in closed position.

11. In a railway hopper car having a pair of opposed longitudinally swinging hinged doors at a side of a center sill thereof for closing discharge openings of longitudinally adjoining hoppers, a door operating mechanism comprising a fixed frame suspended from said car between said doors and projecting upwardly into a recess between said hoppers, a pair of levers having fixed fulcrums on said frame and each having an arm connected to one of said doors, an actuator connected to another arm of each lever and shiftable rectilinearly in said frame in one direction for opening and the other direction for closing said doors, an operating shaft extending laterally through said recess beyond and selectively operable from opposite sides of said car, lock means selectively operable from said opposite sides of said car for locking said shaft against rotation and said doors in closed position, and interfitting means on said lock means and shaft for preventing said lock means from locking said shaft against rotation except when said doors are in their closed positions.

12. In a railway hopper car having a pair of opposed hinged doors swingable oppositely for opening and closing discharge openings of adjoining hoppers, a mechanism for operating the doors in unison comprising a frame fixed to said car between said doors, a pair of upwardly folding jointed levers having fixed fulcrums on said frame and each having an arm connected to one of said doors, an actuator linked to other arms of said levers and rectilinearly shiftable vertically in said frame for folding and unfolding said levers respectively to open and close said doors, an operating shaft mounted on said car, a crank nonrotatably mounted on said operating shaft, a link connecting said crank to said actuator for shifting thereof and thereby swing said doors to open and closed positions on operation of said shaft, and lock means operative in the door-closed position of said shaft for locking said shaft against turning in an opening direction, said crank and link in said closed position respectively being overcentered and engaging said shaft for preventing accidental opening of said doors under forces thereon without strain on said lock means.

13. In a railway hopper car having a pair of opposed hinged doors swingable oppositely for opening and closing discharge openings of adjoining hoppers, a mechanism for operating the doors in unison comprising a frame fixed to said car between said doors, a pair of bellcranks mounted on opposite sides of said frame for pivoting about fixed axes, a link pivotally connected for upward folding to an outer arm of each bellcrank and universally connected to an adjoining door substantially on a lateral centerline thereof, a crosshead shiftable vertically in said frame, links connecting opposite ends of said crosshead to inner arms of said bellcranks, an operating shaft mounted on said car, and crank and link means connecting said operating shaft to said crosshead for enabling operation of said shaft to swing said doors to open and closed positions.

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ARTHUR L. LA POINT, Primary Examiner.
H. BELTRAN, Assistant Examiner.
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