April 29, 1969 W. L. FLOEHR 3,440,761

HOPPER DOOR OPERATING MECHANISM

Filed Nov. 28, 1967 Sheet 1 of 3

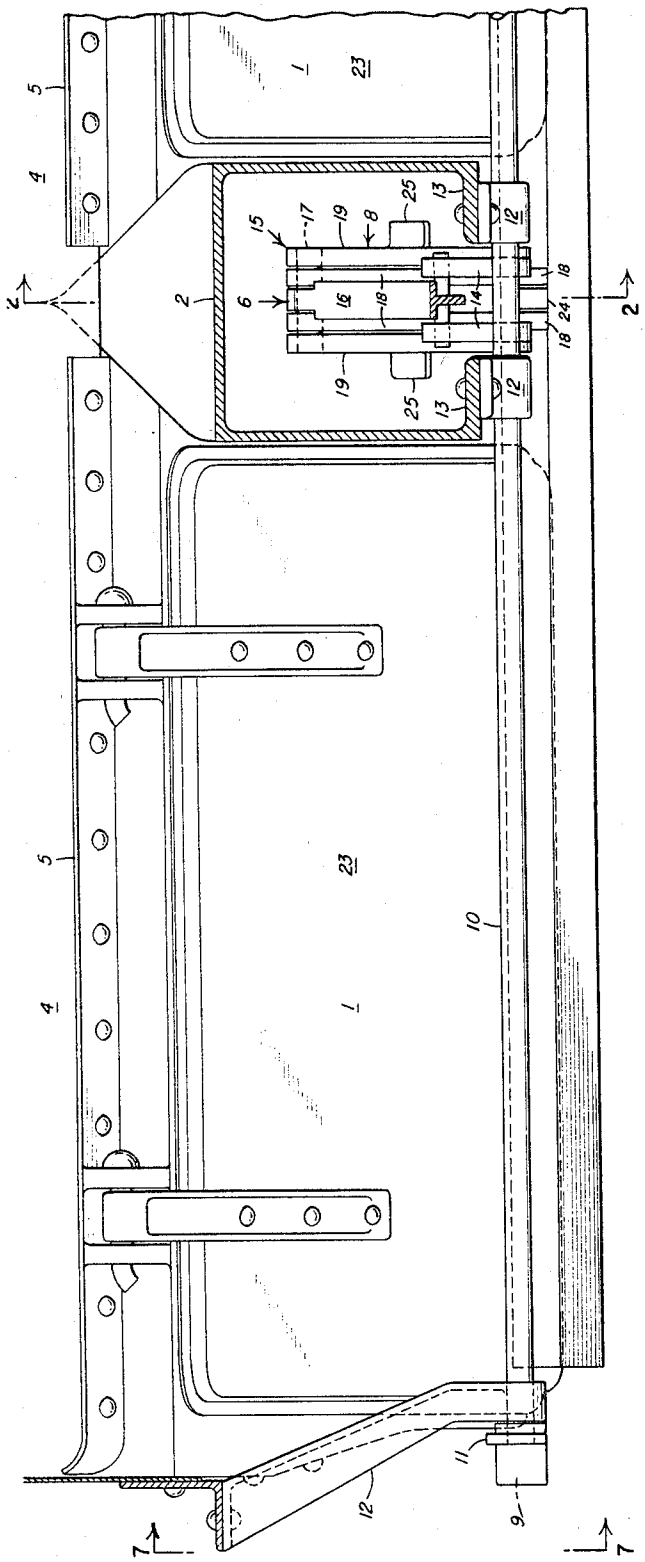


FIG. 1

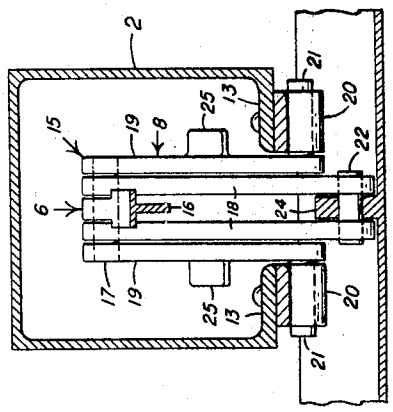


FIG. 6

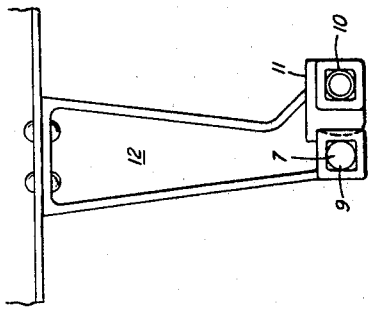


FIG. 7

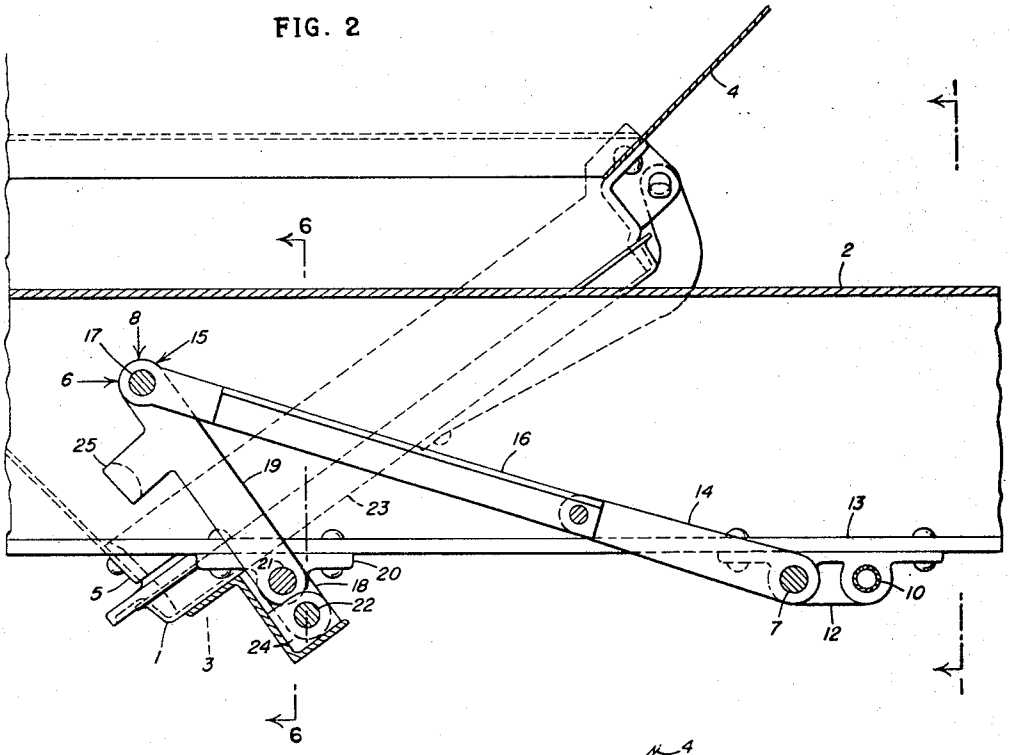
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FIG. 2



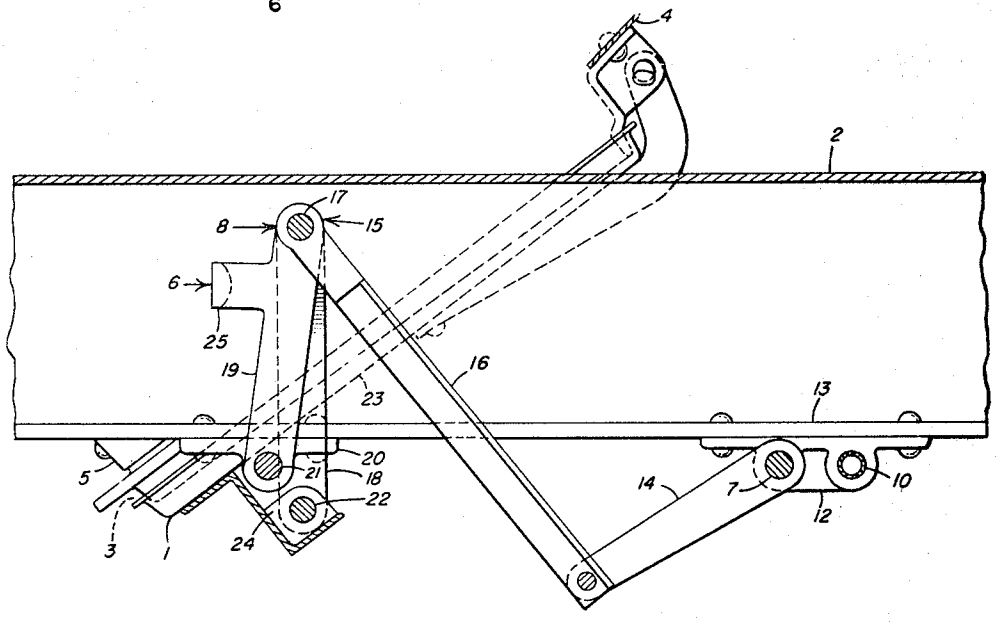


FIG. 3

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HOPPER DOOR OPERATING MECHANISM

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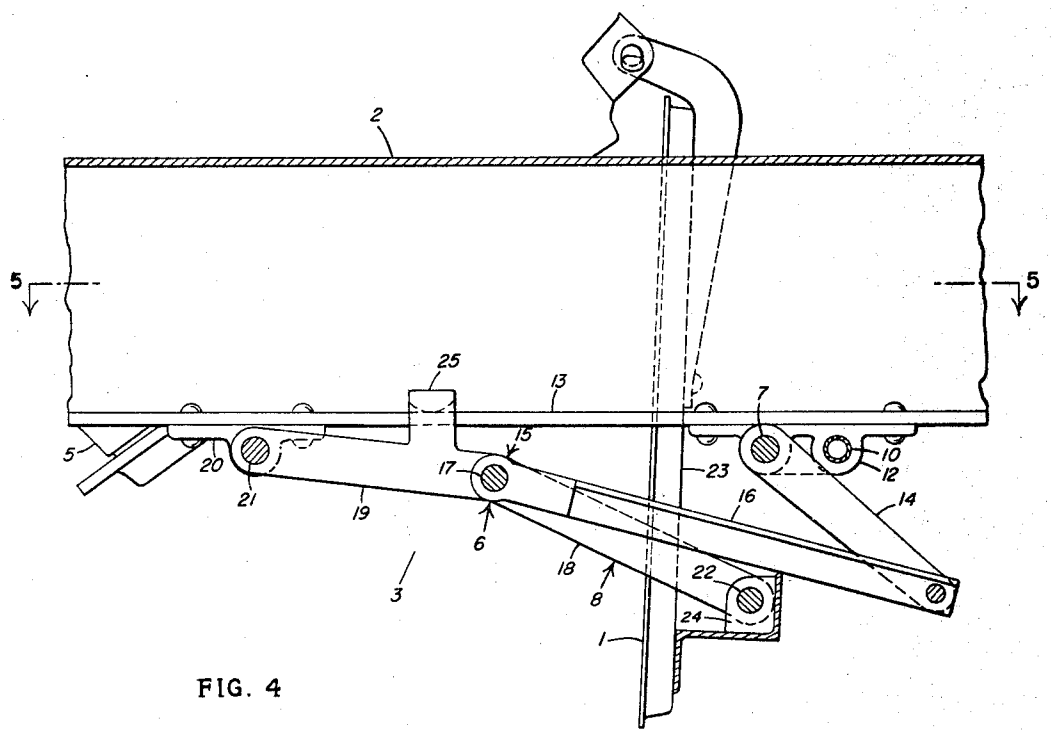


FIG. 4

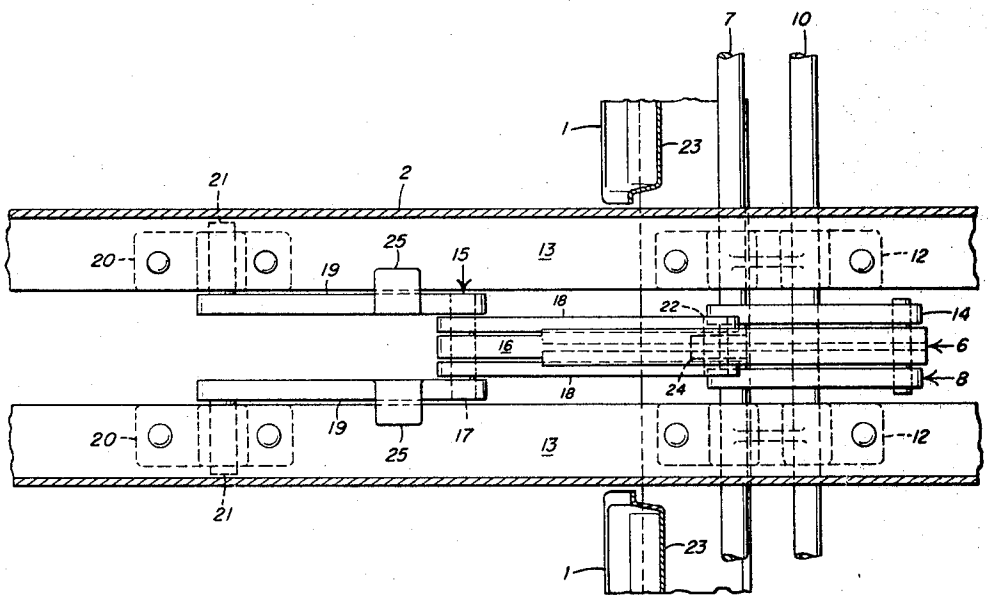


FIG. 5

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HOPPER DOOR OPERATING MECHANISM

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U.S. Cl. 49—109 10 Claims

ABSTRACT OF THE DISCLOSURE

A mechanism for operating a hinged hopper door of a railway hopper car in which a linkage operatively connecting the door to an operating shaft includes a toggle connected at its joint to the shaft and at its ends to the door and having a fixed pivot on the car's underframe, the toggle joint in a closing operation being swung over and beyond the fixed pivot for supporting the door against opening on the underframe over a substantial portion of the range of movement of the linkage at the closed end of that range.

Background of the invention

Numerous manually operable operating mechanisms have been developed for swinging hinged hopper doors between open and closed positions and a closing operation in which a door is swung against gravity to closed position after the lading has been discharged from the associated hopper, usually presents no problem. In an opening operation, the only function required to be performed by the operating mechanism is to release the door from locked position, after which the door will swing by gravity to open position. Both the closing and the release on opening usually are produced manually through a lever applied to an operating shaft of the mechanism and in prior mechanisms the load of the door and any lading are imposed on the operating shaft the moment the operator begins to turn it. The subsequent turning of the shaft and the manual lever in response to the load can be too violent for the operator to control, depending on his strength and the weight of the particular lading being discharged, and, once control is lost, the operator runs the risk of being seriously injured by the lever. It is to a solution of this problem, without resort to a clutch or other lost motion connection between the shaft and the lever, that the present invention is particularly directed.

Summary of the invention

The primary object of the present invention is to provide an improved operating mechanism for a hinged hopper door which in an opening operation delays imposition upon an operating shaft of a load initiated at the door until the mechanism has moved through a substantial portion of its range of movement between open and closed positions.

The improved mechanism attains the foregoing objective by supporting the load of a door and any lading on the body of the car when the door is closed, independently of the operating shaft, and continuing this support over a substantial portion of the opening movement of the mechanism. In its preferred form the improved mechanism is adapted to operate not just one but a pair of laterally alinged doors on opposite sides of a car's center sill, has an operating shaft extending across the car and journaled intermediate its ends on the underside of the sill and drivably links the shaft to the joint of a toggle connected at one end to the doors and at the other to the sill, the latter for pivoting about a fixed pivot spaced from the shaft. Folded when closed and extended when open, the toggle, as it approaches closed position, is swung over-center

above the fixed pivot and, while over-center, imposes on the sill any load initiated at the door. The operating shaft preferably is drivably connected to the toggle by a crank and link, the former keyed to the shaft, and the toggle is stopped with an upward break in open position to ensure that it will fold upwardly under a force applied through the shaft in a closing operation. The preferred mechanism is centered laterally on the center sill and in closing swings upwardly thereinto for protection against damage in transit.

The above and other objects and features 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 description

FIGURE 1 is a fragmentary vertical sectional view of the bottom portion of a railway hopper car taken along lines 1—1 of FIGURE 2 and incorporating a preferred embodiment of the improved door operating mechanism of the present invention;

FIGURE 2 is a fragmentary vertical sectional view taken along lines 2—2 of FIGURE 1 with the mechanism and a door operated thereby in closed position;

FIGURE 3 is a view of the structure of FIGURE 2 on the same section, with the operating mechanism in the position at which the load is transferred between the center sill and the operating shaft;

FIGURE 4 is a view of the structure of FIGURE 2 on the same section, with the operating mechanism and door in open position;

FIGURE 5 is a fragmentary horizontal sectional view taken along lines 5—5 of FIGURE 4;

FIGURE 6 is a fragmentary vertical sectional view taken along lines 6—6 of FIGURE 2; and

FIGURE 7 is a fragmentary side elevational view taken along lines 7—7 of FIGURE 1.

Detailed description

Referring now in detail to the drawings in which like reference characters designate like parts, the improved mechanism of the present invention for operating hinged or drop bottom doors of railway hopper cars, has been applied for purposes of illustration to a pair of laterally aligned hopper doors 1 hinged laterally or cross-wise of a hopper car, of which only the parts of the body have been shown that are necessary for an understanding of the invention. The illustrated doors are positioned at opposite sides of a center sill 2 for closing downwardly opening discharge openings 3 of a pair of similarly positioned hoppers 4. In closed position, the doors 2 seat at an oblique angle against frames 5 bounding their respective openings and upon release are swingable downwardly from that position to a substantially vertical open position.

The improved door operating mechanism, designated as 6, is comprised of an operating shaft 7 and a linkage 8, which, for the illustrated pair of laterally algined doors 2, extend, respectively, laterally or transversely and longitudinally of the car. The preferred operating shaft 7 is horizontally disposed and mounted on and extends to opposite sides of the body of the car for manual operation from either side by application of a lever or other suitable turning tool (not shown) to one of its ends 9. A similarly extending and operable lock shaft 10, paralleling the operating shaft, mounts a lock 11 adjacent either end for locking the operating shaft against turning in the closed position of the doors. Both the operating and lock shafts 7 and 10 conveniently are journaled and supported intermediate their ends on mounting brackets 12 fixed to and suspended from the preferably inturned bottom flanges 13 of the center sill 2.

When unlocked, the operating shaft 7 is rotatable or

turnable in opposite or opening and closing directions and applies corresponding forces to the doors **1** through the linkage **8**. Centered laterally on and swingable into the center sill **2**, the preferred linkage is a jointed linkage formed of a crank arm or lever **14** welded or otherwise fixed against rotation to the operating shaft **7**, a toggle **15** and a link **16**, the last connected for vertical pivoting at an inner end to an outer or distal end of the crank arm and at an outer end of the joint **17** of the toggle. Vertically swingable, all of these members or parts ofthe linkage **8** preferably are formed of a pair of laterally spaced duplicate elements straddling or straddled by the elements of the adjoining member, for eliminating torque or twisting in the joints therebetween. The toggle **15** is connected at opposite ends for relative vertical pivoting to the doors **1** and the center sill **2**, the former by a door arm **18** and the latter by a sill, support or guide arm **19** and both of these arms are double elements in accordance with the preferred construction.

Straddling or embracing those of the door arm **18**, the elements of the support arm **19** are connected to the center sill **2** for swinging, pivoting, or hinging about a fixed axis parallel to and spaced forwardly from the rotative axis of the operating shaft **7**, conveniently by brackets **20**, each fixed to and suspended from one of the bottom flanges **13** of the center sill and journaling a trunnion or pivot pin **21** pivotally connecting it to the adjoining arm element. In turn, the elements of the door arm **18** conveniently are pivotally connected at their outer ends by a cross-shaft **22**, extending or projecting parallel to the operating shaft **7** over the faces **23** of the doors adjacent their distal ends and mounted on brackets **24** rigid with and outstanding from the faces. In the trunnions **22** and the cross-shaft and their mountings, the toggle **15** thus has at its opposite ends a sill or body pivot or pivotal axis about which it fulcrums and a door pivot or pivotal axis, the former fixed against movement relative to the sill **2** and the latter movable with the doors and both horizontal and parallel to each other.

The relative positions or dispositions of the members of the linkage **8**, in the doors' and their own closed and open positions, are very important to the operation of the improved mechanism **6** and this is particularly true of the toggle **15**. In closed position, the toggle joint **17** must be above the toggle's fixed sill pivot and also must be longitudinally beyond or spaced forwardly of that pivot and, in swinging between open and closed positions, must swing above and over or across that pivot, through and substantially beyond opposite sides of a plane centered vertically thereon. Swinging vertically about the fixed pivot the center sill **2**, the toggle joint **17**, which also is the joint between the toggle **15** and the link **16**, in closed and open positions is longitudinally disposed, respectively, substantially beyond the fixed sill pivot and between that pivot and the rotative axis of the operating shaft **7**.

As the toggle **17** and crank arm **14** are connected not directly but through the link **16**, the toggle joint **17** between the toggle and the link, in a closing operation under a force applied through the operating shaft **7**, could swing below rather than, as required, above the fixed sill or car body pivot and is prevented from so doing by stop means suitably in the form of stop lugs **25** on the elements of the support arm **19** beyond the fixed pivot. At all times contained in the center sill **2** above the bottom flanges **13**, the stop lugs **25**, in the open position of the linkage **8**, engage or abut against the flanges and hold the linkage with a slight upward break in the joint between the toggle and the link **16**, so that the force initially applied to the joint in an opening operation will be the necessary upward force.

In its closed position, the toggle **17** preferably is fully folded and obliquely disposed with its longer door arm **18** projecting or extending below and laterally aligned or in juxtaposition with the support arm **19** and the fixed sill pivot formed by the pinions **21** radially centered between and aligned with the toggle joint **17** and the door pivot formed by the cross-shaft **22**. While longer than the support arm **19**, the door arm **18** preferably is only sufficiently longer to enable the cross-shaft **22** to fit below and longitudinally rearwardly or inwardly of the toggle mounting brackets **20**, so that in the toggle's closed position its door and sill pivots are in closed adjacency. At this time the load of the doors **1** and any lading in the hoppers **4** thereabove will be applied or imposed through the toggle on the center sill and, relieved of such door-initiated forces, the operating shaft **17** need only hold the toggle in closed position against service shocks in transit, and this does with a minimum of effort if, as preferred, the crank arm **14** and link **16** are at that time longitudinally aligned with the joint between them straight.

In an opening operation, the load of the doors **1** and any lading at some time will be imposed upon the operating shaft **7**, but this will not occur so long as the toggle joint **17** is forwardly beyond or overcentered relative to the toggle's sill pivot. Not only is there a substantial delay in the imposition of the load on the operating shaft, some 35° out of the full swing of about 130° in the illustrated embodiment, but the imposition is gradual because the unfolding of the toggle **17** and the relative angularity of its door and support arms **18** and **19** are slight at the transfer point at which the support arm is vertical. Even though he cannot control the load when it is fully imposed on the operating shaft, the operator thus is given fair warning of the imposition and, as soon as he feels the shaft responding to the load, can release the manual lever and move back out of arm's way. The preferred slight relative angularity of the arms **18** and **19** at the point at which the support arm is vertical of course progressively decreases between that point and the closed position of the toggle and, over that portion or segment at the closed end of the range of movement of the linkage **18**, radial spacing between the fixed sill and movable door pivots remains substantially constant, with consequent minimum permissive movement between the doors and their frames **5**. Thus, it will only be after their load has been imposed on the operating shaft in an opening operating that the doors will open to any considerable extent.

Accordingly, as opposed to a conventional door operating mechanism in which the door begins to open immediately upon its release and the load of the door and any lading is suddenly imposed upon the mechanism as a whole, the improved mechanism **6** of this invention in an opening operation delays both the opening of the door and the imposition of the load and resultant turning force on the operating shaft and, even when the force is imposed, makes the imposition gradual so that the operator has ample time to release his manual lever and step out of harm's way before the turning of the operating shaft under force of the lading has reached a dangerous stage. In a closing operation the operator simply turns the operating shaft in a closing direction, using the leverage provided by the manual lever or other turning tool to overcome the force of the gravity on the doors.

From the above detailed description it will be apparent that there has been provided an improved hopper door operating mechanism in which an operating shaft is so linked to one or more doors operated thereby as to eliminate any risk of injury to an operator in an opening operation. 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 inveniton.

Having now described my invention, I claim:

1. Door operating mechanism for hinged doors of railway hopper cars, comprising an operating shaft rotatably mounted on a body of a hopper car, and linkage means operatively connecting said shaft to hinged door

means of the car for swinging the door means between open and closed positions, said linkage means including toggle means connected at a joint thereof to said shaft and at ends thereof through door and body pivots respectively to said door and said body, said toggle means in closed position being obliquely disposed and having said toggle joint positioned above and over-center beyond said body pivot.

2. Door operating mechanism according to claim 1, wherein the operating shaft is horizontally disposed, the body pivot is fixed and spaced horizontally from the operating shaft, the axis of the body and door pivots and the toggle joint are parallel to the axis of the shaft, and the linkage means swings vertically between open and closed positions.

3. Door operating mechanism according to claim 2, wherein the linkage means includes crank means mounted on the shaft for rotation therewith and link means connecting the crank means to the toggle means at the toggle joint thereof.

4. Door operating mechanism according to claim 3, wherein the toggle means includes door and support arms connected for relative vertical pivoting at the toggle joint and having outer ends thereof connected to the door means and the body respectively at the door pivot and the body pivot.

5. Door operating mechanism according to claim 4, wherein the toggle joint in the closed position thereof is beyond the body pivot in a direction away from the operating shaft and swings from closed position about and over the body pivot to an open position intermediate the body pivot and the shaft.

6. Door operating mechanism according to claim 5, wherein in the closed position of the toggle means the door and support arms are substantially laterally aligned, and the door and body pivots and the toggle joint are substantially in line.

7. Door operating mechanism according to claim 6, wherein the door means are a pair of laterally aligned transversely hinged doors mounted on opposite sides of a center sill of the car, the linkage means is centered laterally on and swingable into said center sill, there is a door pivot for the door arm of the toggle means on each door, and the operating shaft and body pivot are mounted in longitudinally spaced relation on an underside of said center sill.

8. Door operating mechanism according to claim 7, wherein the linkage means in closed position projects above the operating shaft and the door and body pivots into the center sill with the crank and link means thereof in substantially a straight line.

9. Door operating mechanism according to claim 7, including stop means for holding the linkage means in open position with the joint between the toggle and link means broken upwardly.

10. Door operating mechanism according to claim 9, wherein the stop means are stop lug means on the door arm outwardly of the door pivot, and said stop lug means are contained in the center sill and abut inturned bottom flange means thereof in the open position of the linkage means.

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U.S. Cl. X.R.

49—345; 105—304