

Aug. 20, 1968

S. J. SNYDER

3,397,654

SLIDING HOPPER GATE OPERATING MECHANISM

Filed Feb. 10, 1967

5 Sheets-Sheet 1

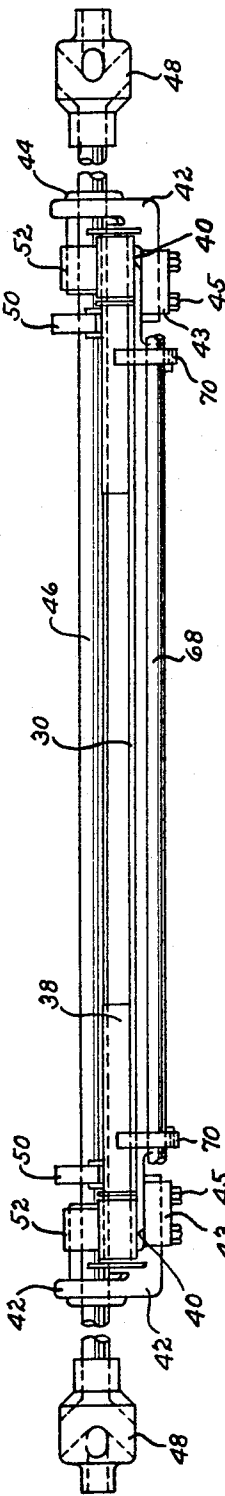


FIG. 5.

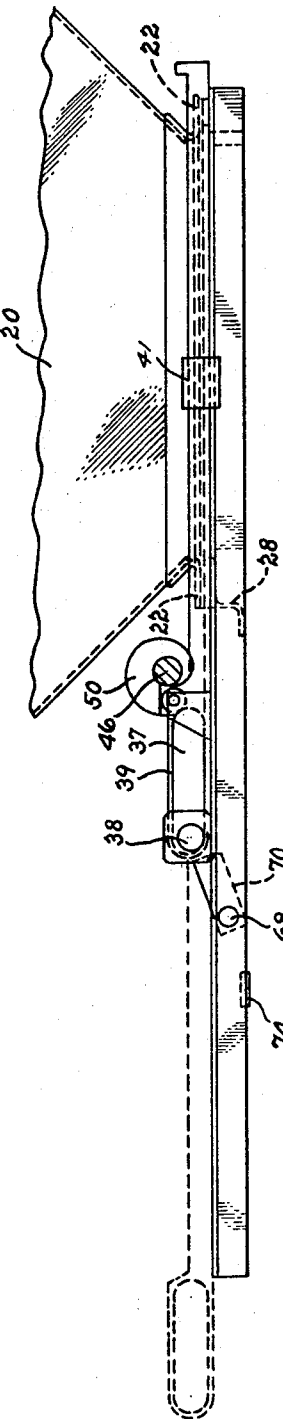


FIG. 2.

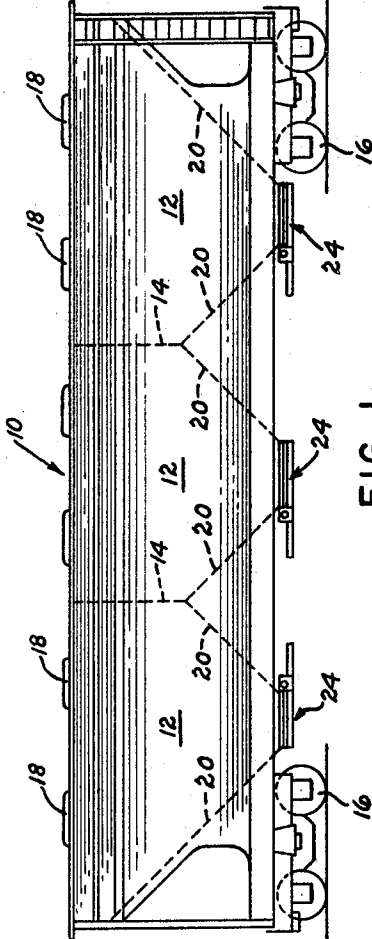


FIG. 1.

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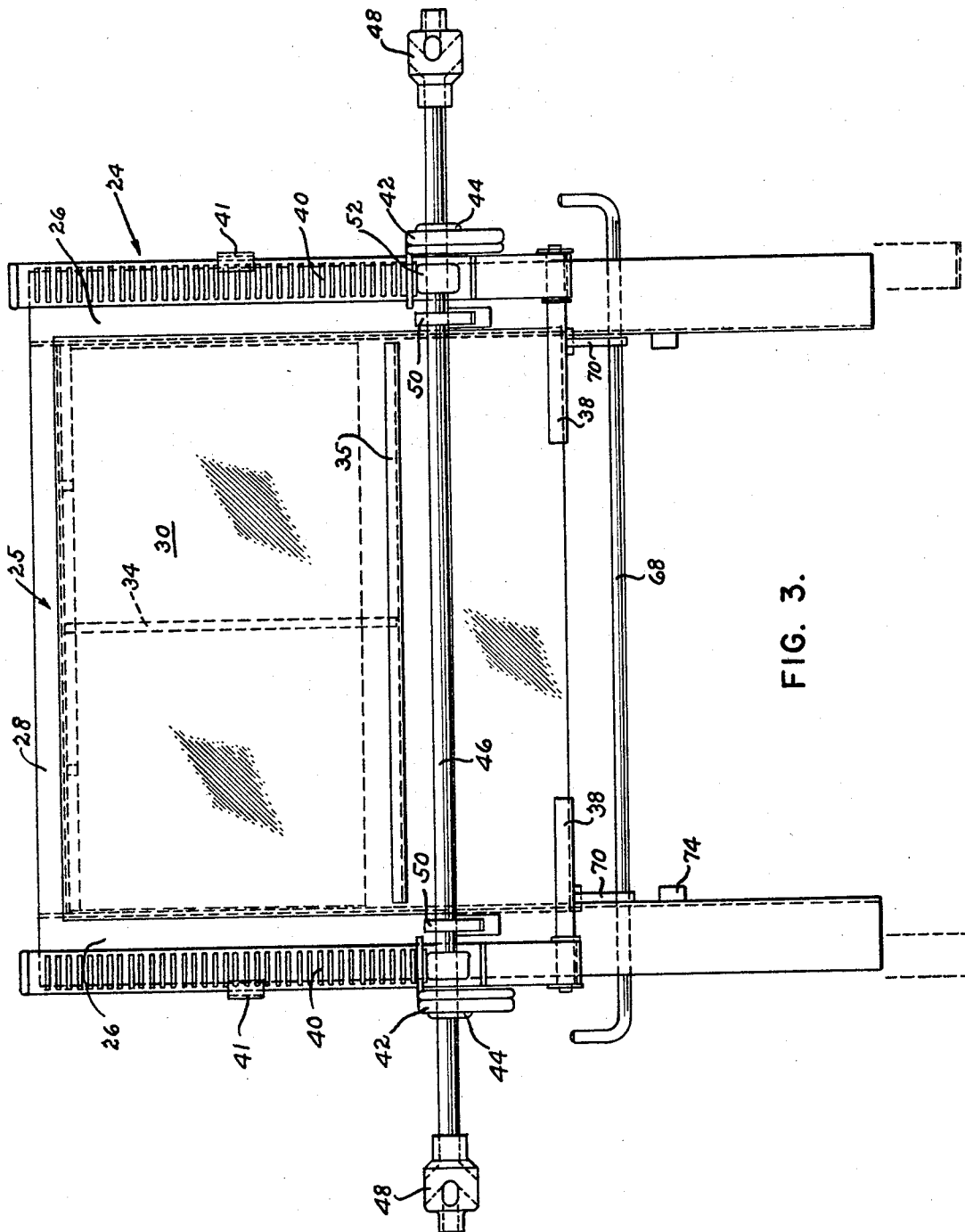


FIG. 3.

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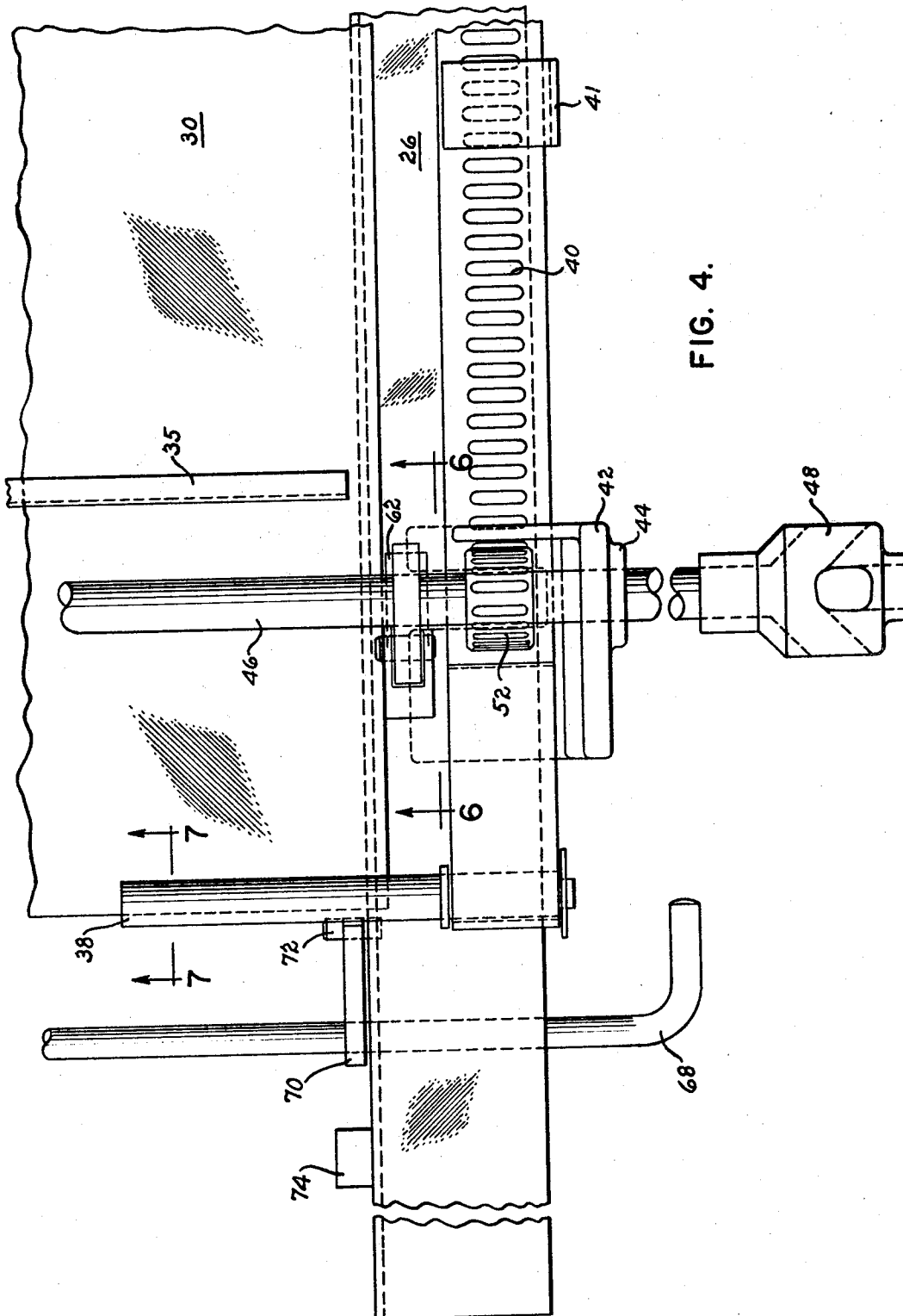


FIG. 4.

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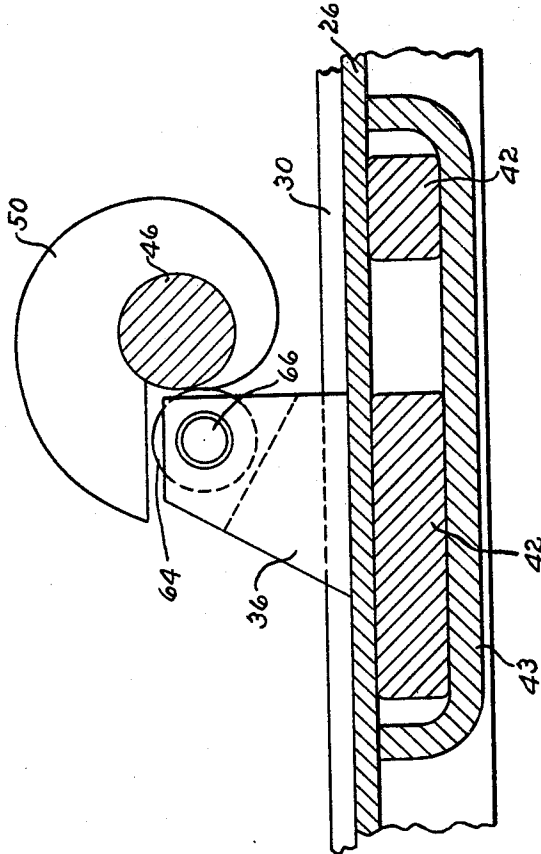


FIG. 6.

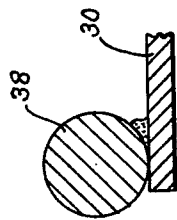


FIG. 7.

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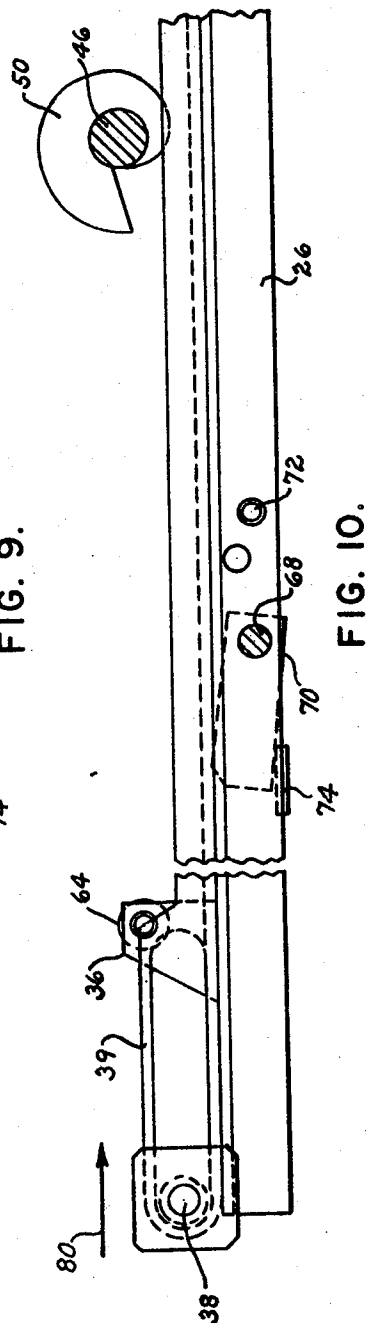
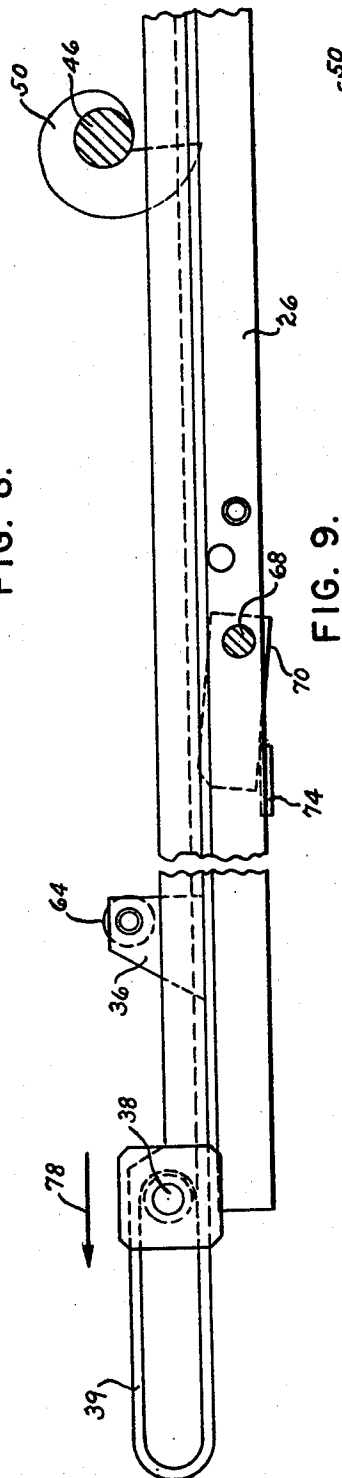
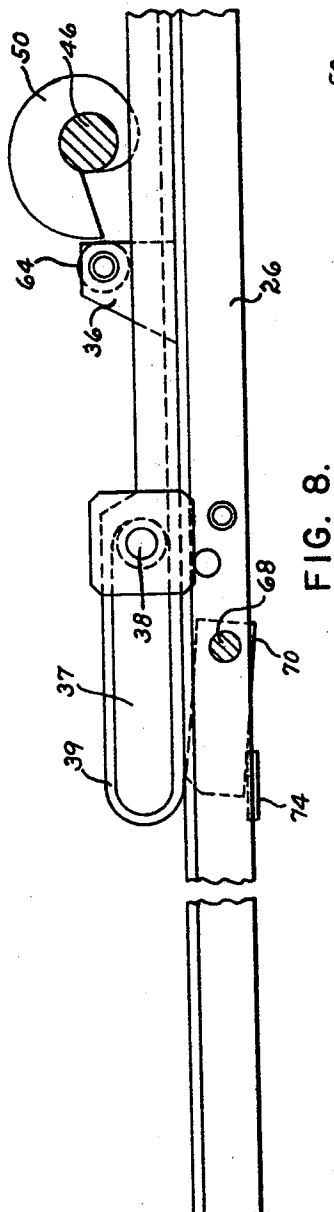
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SLIDING HOPPER GATE OPERATING MECHANISM

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3,397,654 SLIDING HOPPER GATE OPERATING MECHANISM

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8 Claims. (Cl. 105—305)

ABSTRACT OF THE DISCLOSURE

The high force often required to open the sliding gate of a hopper of a railroad car or the like is supplied by a cam fixed to the same shaft as is the pinion of a rack and pinion drive for the gate, the cam and the pinion being enabled to turn at the same rate by a lost motion connection between the rack and the gate. Should the gate become stuck at an intermediate point of its travel, the lost motion connection permits an impact to be applied to the gate to restart its movement.

Background of the invention

Sliding hopper gates of a relatively large size, such as twenty-four (24) inches by forty-two (42) inches, require relatively high initial opening forces, especially under severe cold weather conditions and with ladings, such as cement, that tend to bind and adhere to the gates. Heretofore, gear reduction units having mechanical advantages varying from around three-to-one to twelve-to-one have been employed to overcome the high initial opening forces. However, with gear reduction units, the rate of gear travel and the rate of gate movement are reduced by the ratio of the mechanical advantage. Thus, particularly with gear units having a relatively high mechanical advantage, a low opening rate is obtained which results in a long gate travel time. An alternative arrangement disclosed in Reissue Patent 26,093 provides impacting means for starting the opening of the gate.

Application Ser. No. 581,383, filed Sept. 22, 1966 and assigned to the assignee of this application, provides a camming mechanism for sliding hopper gates in which a high opening force at a low gate travel speed is applied for initially opening the gate a distance of around two (2) inches. Then, a fast opening rate for the remainder of gate travel is obtained by a direct drive. Thus, the slow gate travel is employed only when the gate is initially "cracked" open and thereafter, a fast gate travel is obtained to open the gate in a minimum of time. The gate opening mechanism is operated by a continued rotation of the pinion shaft without any separate operations or steps being involved.

Summary of the invention

Briefly described, the present invention comprises a pinion and rack combination for opening and closing the gate, there being preferably two pinions fixed to a pinion shaft for engaging racks on opposite sides of the gate in a direct drive to slide the gate to a full open position at a fast gate travel rate. Separate means, specifically, a cam, is fixed on the pinion shaft for initially breaking the gate open independently of the racks and pinions and is operable only during the initial opening movement of the gate from a fully closed position. Thus, the initial rotation of the pinion shaft from the full closed position of the gate first actuates a mechanism for initially breaking the gate open at a low travel rate and continued rotation of the pinion shaft actuates the pinions for the full opening of the gate at a fast gate travel rate. Lost motion means connect the racks to the gate to permit the initial

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differential movement between the racks and gate. The lost motion means also permits the racks to be used as heavy hammers to impact the gate if it becomes stuck when partially open.

Brief description of the drawing

In the accompanying drawings, in which one of several possible embodiments of the invention is illustrated:

FIGURE 1 is a side elevation of a covered hopper railway car having a plurality of bottom outlet structures comprising the present invention;

FIGURE 2 is an enlarged side elevation of a bottom outlet structure, showing in dashed lines the position of the rack when the gate is open;

FIGURE 3 is a top plan of the sliding gate structure shown in FIGURE 2;

FIGURE 4 is an enlarged top plan of the mechanism for opening the sliding gate illustrating the gate in a fully closed position;

FIGURE 5 is an end elevation of the bottom outlet structure shown in FIGURES 2 and 3;

FIGURES 6 and 7 are sectional views taken along lines 6—6 and 7—7 of FIGURE 4;

FIGURE 8 is a partial view showing particularly the positions of the movable elements after the gate is initially opened;

FIGURE 9 is a view similar to that of FIGURE 8 showing the positions of the elements at the end of the opening of the gate;

FIGURE 10 is a view similar to that of FIGURES 8 and 9 showing the positions of the elements after the beginning of the closing of the gate.

Description of the preferred embodiment

Referring now to the drawings, and more particularly to FIGURE 1, a covered hopper railway car is generally designated 10 and has a plurality of hopper structures 12 separated by partitions or bulkheads 14. A truck assembly 16 is arranged at each end of car 10. Spaced along the top of the car 10 are hatch covers 18 for loading of the car. Hopper sheets 20 of each hopper structure 12 slope downwardly to a bottom discharge opening defined by an outer peripheral flange 22. The hopper and gate structure is illustrated and described in application Ser. No. 581,383, filed Sept. 22, 1966 by F. C. Pulcrano and Carl E. Becker, and the disclosure of that application is incorporated herein by reference.

Secured to peripheral flange 22 beneath each bottom discharge opening is a bottom outlet structure generally indicated 24. Each bottom outlet structure 24 comprises an upper generally rectangular peripheral flange 25 formed by the upper horizontal legs of angle-shaped end frame members 26 and side frame members 28. Mounted on the upper surfaces of end members 26 and side members 28 for sliding movement is a gate 30. Spacers on end members 26 and on one side member 28 fit between peripheral flanges 22 and 25 adjacent gate 30 to provide clearance for gate 30 between flanges 22 and 25. Flange 22 is spaced from the other side member 28 adjacent the gate operating mechanism to form a slot to receive gate 30. Suitable bolt and nut combination (not shown) secure bottom outlet structure 24 to flange 22. An intermediate support 34 secured between side members 28 supports gate 30 between its ends. An angle 35 secured to the upper surface of gate 30 is adapted to fit over adjacent flange 22 in the closed position of the gate thereby to prevent the entry of foreign matter between flange 22 and gate 30.

Secured to opposed side edges of gate 30 are blocks 36 positioned above the upper surface of end members 26 and adapted to move therealong with gate 30. Stub shafts 38 are welded to gate 30 as shown in FIG. 7 and each ex-

tends through a slot 37 of a loop 39 of a rack 40 supported for sliding movement along the upper surface of the subjacent end frame member 26, so that shaft 38 and loop 39 form a lost motion connection between the rack and the gate. A rack retainer clip 41 is secured to each end frame member 26 to guide the associated rack 40 as shown in FIGURE 3.

A bearing support bracket 42 having a bearing 44 thereon is secured to the underside of each end frame member 26 by a clamp 43 and bolts 45. A pinion shaft 46 is mounted in bearings 44 for rotation and has a capstan 48 fixed to each end thereof. A suitable handspike (not shown) or the like may be inserted in openings of capstans 48 to rotate shaft 46 for opening and closing gate 30.

To provide a mechanical advantage and a relatively high force for initially opening gate 30, a cam 40 fixed to pinion shaft 46 adjacent each side thereof acts against an adjacent block 36. A pinion 52 adjacent each end of shaft 46 is fixed on shaft 46. As shown in FIGURE 4, an opening 62 in the horizontal leg of each side member 26 beneath cam 50 receives cam 50 upon rotation thereof. Positioned adjacent cam 50 on each block 36 is a roller 64 mounted on an axle 66 for rotation and in engagement with cam 50 for minimizing frictional contact between cam 50 and block 36.

To secure gate 30 in closed position, a latch rod 68 is mounted for rotation on side members 26 and has latch bars 70 thereon adapted to swing behind an adjacent stub shaft 38 when gate 30 is in closed position to prevent opening of the gate. Latch bars 70 are supported on tabs 72 in the closed position of the gate indicated in FIGURE 4 and on tabs 74 in the open position of gate 30.

For initially opening gate 30 from the fully closed position shown in FIGURES 2 and 4, latch rod 68 is rotated to the position of FIGURE 8 and pinion shaft 46 is rotated manually by a suitable handspike in capstan 48 from either side of gate 30. Initial rotation of shaft 46 rotates cams 50 in clockwise direction as viewed in FIGURES 8 to 10. Cams 50 are in engagement with rollers 64 and urge blocks 36 outwardly to move gate 30 in an opening direction. Pinions 52 move racks 40 much more rapidly than gate 30 moves, so that loop 39 moves relative to pins or stub shafts 38 until the elements reach the positions shown in FIGURE 8. Upon rotation of cams 50 around three-hundred-fifty degree (350°) as shown in FIGURE 8, gate 30 opens a distance of around two (2) inches, and pins 38 completely traverse slots 37. The mechanical advantage of cams 50 is around five-to-one so a large opening force is obtained for initially breaking gate 30 open.

When the gate 30 is fully opened upon extreme movement in the direction of arrow 78, the elements attain the positions shown in FIGURE 9. When it is desired to move the gate toward a closed position, shaft 46 is rotated in the opposite direction and pinions 52 move racks 40 in the direction of arrow 80, until the left hand side of loop 39 encounters pin 38, as shown in FIG. 10. Thereafter, upon continued rotation of shaft 46, gate 30 moves with racks 40 until the gate is closed, and the rack moves to the solid line position in FIGURE 2, from the dashed line position.

The positioning and dimensions of rollers 64 and cams 50 are such that cams 50 move into the position of FIGURE 2 upon the full closing of gate 30. Therefore, when gate 30 is fully closed, cams 50 are in proper position for again opening gate 30.

From the foregoing, it is to be understood that the present invention provides a gate opening mechanism which has a high force for initially breaking the gate open and then has a high rate of travel for moving the gate to fully open position after the initial opening of the gate. If the gate becomes stuck or very hard to move at an intermediate point of its travel, shaft 46 may be reversed for a part of a turn, and then shaft 46 may be given a hard turn so that the racks acquire a high velocity and, in view of their considerable mass, impart a heavy blow to pins 38 to move the gate. It is apparent that if the camming

mechanism were omitted, the lost motion connection would permit impacts to be applied to open the gate initially.

In view of the above, it will be seen that the several objects of the invention are achieved and other advantageous results obtained.

As various changes could be made in the above constructions without departing from the scope of the invention, it is intended that all matter contained in the above description or shown in the accompanying drawings shall be interpreted as illustrative and not in a limiting sense.

I claim:

1. In a railway hopper car having a frame defining a bottom discharge outlet, a gate mounted for sliding generally horizontally on said frame for closing said outlet, a rotatable shaft mounted close to said frame, a horizontal rack slidably mounted on said frame, pinion means fixed to said shaft and engaging said rack, a lost motion connection between said rack and said gate, whereby the rack moves the gate after a predetermined amount of lost motion therebetween, and force multiplying additional drive means on said shaft positioned to engage said gate when said gate is closed or slightly open for sliding said gate horizontally to a partially open position before said gate is moved by said rack.

2. The structure defined in claim 1, wherein the lost motion connection is dimensioned to provide a movement of the rack relative to the gate produced by a major portion of one turn of the pinion.

3. The structure according to claim 2, wherein the lost motion connection includes a pin and a slotted member surrounding the pin, one of which is fixed to the rack and the other of which is fixed to the gate.

4. The structure according to claim 1, wherein the lost motion connection includes an impactable member fixed to the gate and an impacting member fixed to the rack.

5. The structure according to claim 1, comprising a pair of racks on opposite sides of the gate, said pinion means including a pinion engaging each rack, and a lost motion connection between each rack and the gate.

6. The structure according to claim 5, wherein each lost motion connection includes an impactable member fixed to the gate and an impacting member fixed to the rack.

7. The structure defined in claim 1, wherein said additional drive means includes a cam fixed to said shaft and a member fixed to said gate and engaging said cam when the gate is in its closed position or is only slightly open.

8. A hopper comprising a chute-like enclosure having a bottom discharge opening, a gate for said discharge opening movable in a generally horizontal direction between opened and closed positions relative to the discharge opening, support means on opposite sides of said enclosure on which said gate is movable beyond one side of the enclosure to opened position, a rotatable shaft mounted on said support means, drive means fixedly coupled to said shaft for moving the gate between opened and closed positions, a lost motion connection between said drive means and said gate, whereby the drive means moves the gate after a predetermined amount of lost motion therebetween, and additional drive means connected to said shaft to initially open the gate a predetermined amount independently of said first mentioned drive means from the fully closed position of the gate, said additional drive means having a relatively high opening force and a relatively small opening rate.

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