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 [21] Appl. No. **765,533**
 [22] Filed **Oct. 7, 1968**
 [45] Patented **Oct. 27, 1970**
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[54] **SEQUENTIALLY ACTUATED HOPPER GATE**
10 Claims, 11 Drawing Figs.

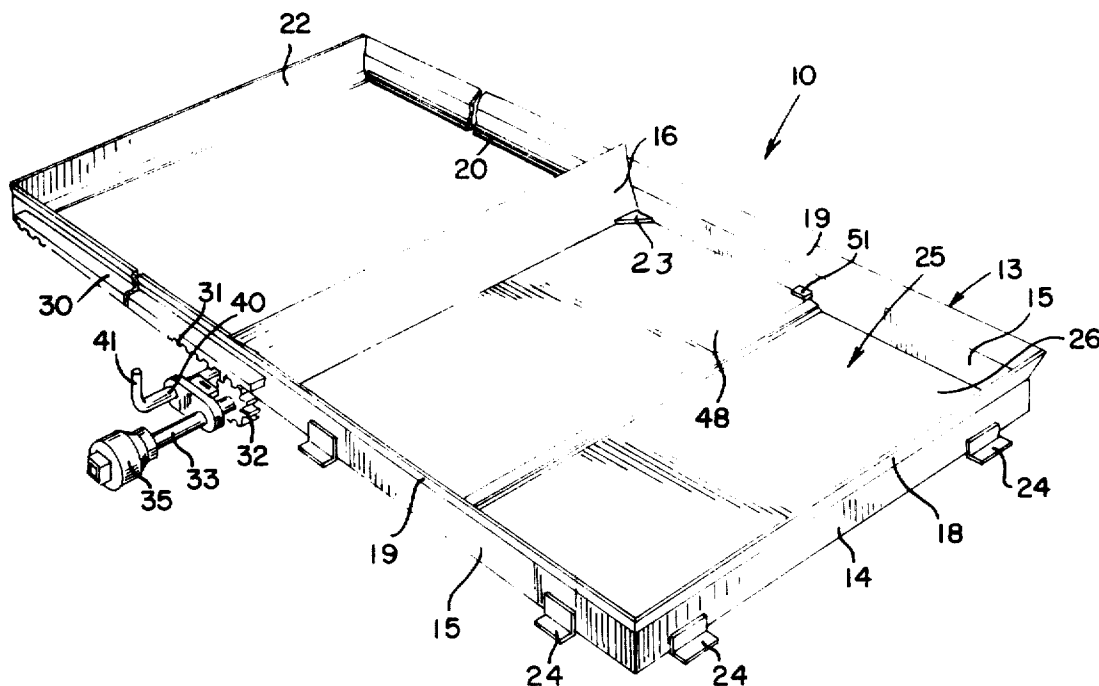
[52] U.S. Cl..... **105/282,**
105/294, 105/305, 105/308, 105/424, 214/83.2,
295/28

[51] Int. Cl..... **B61d 7/20,**
B61d 7/22, B61d 7/26

[50] Field of Search..... **105/247,**
282, 282(R), 282(RP), 293, 294, 304, 305, 308, 424;
214/83.2; 298/28

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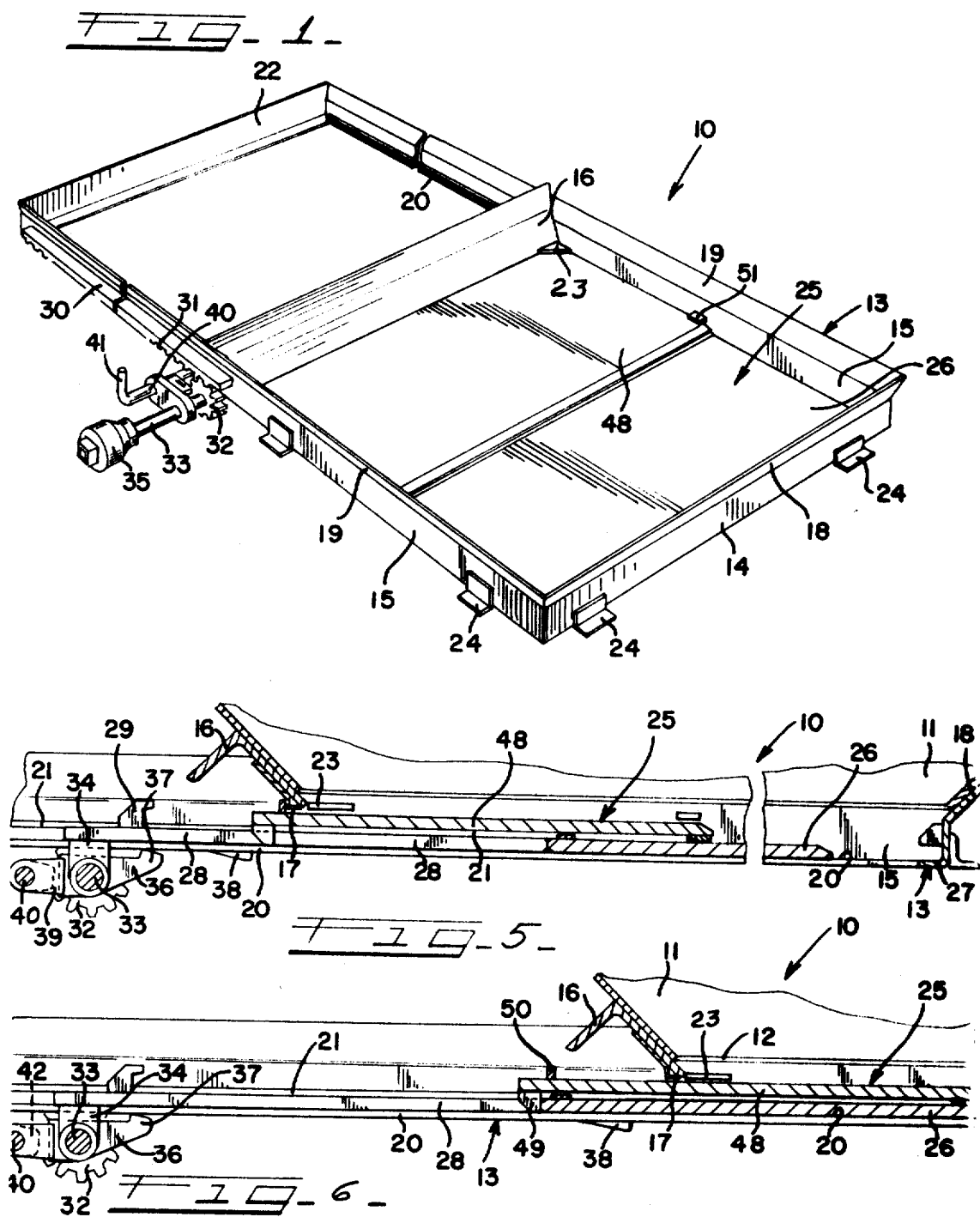
ABSTRACT: A hopper discharge structure including a gravity gate comprising two sections which are sequentially movable between open and closed positions. The sections are positioned one above the other and are both movable to one side of the hopper discharge opening in an open position. A single manually operable gate moving mechanism is connected to move one of the sections which includes suitable stop mechanism cooperating with the second section to move the same.



Patented Oct. 27, 1970

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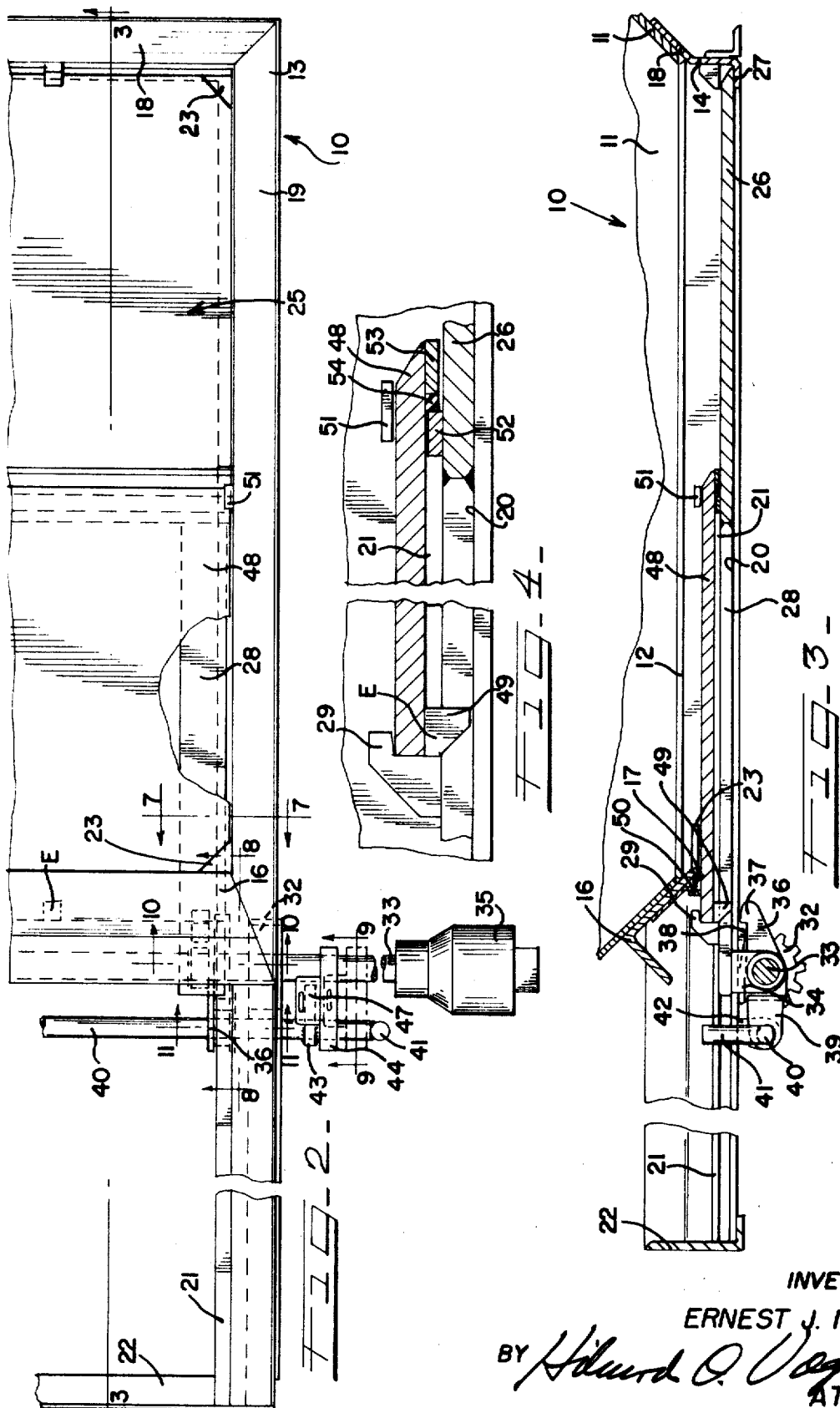
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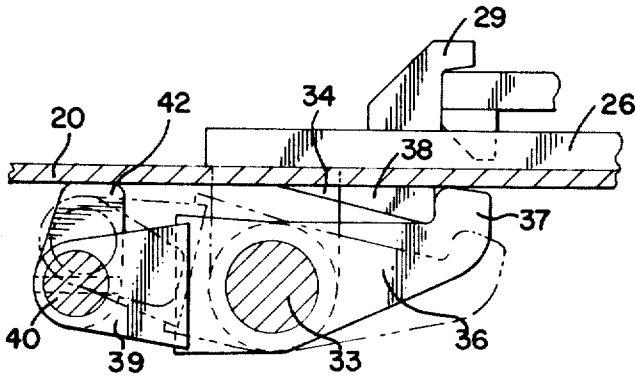


FIG. 8.

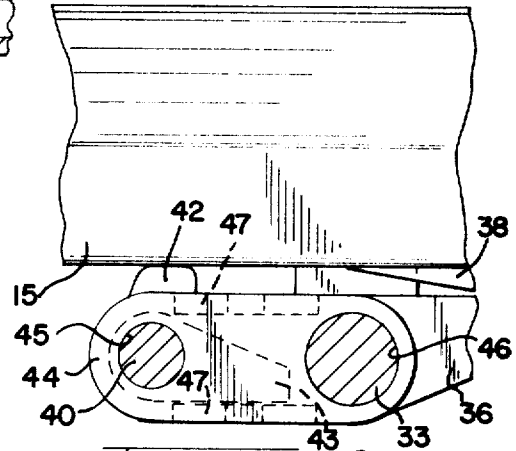


FIG. 9.

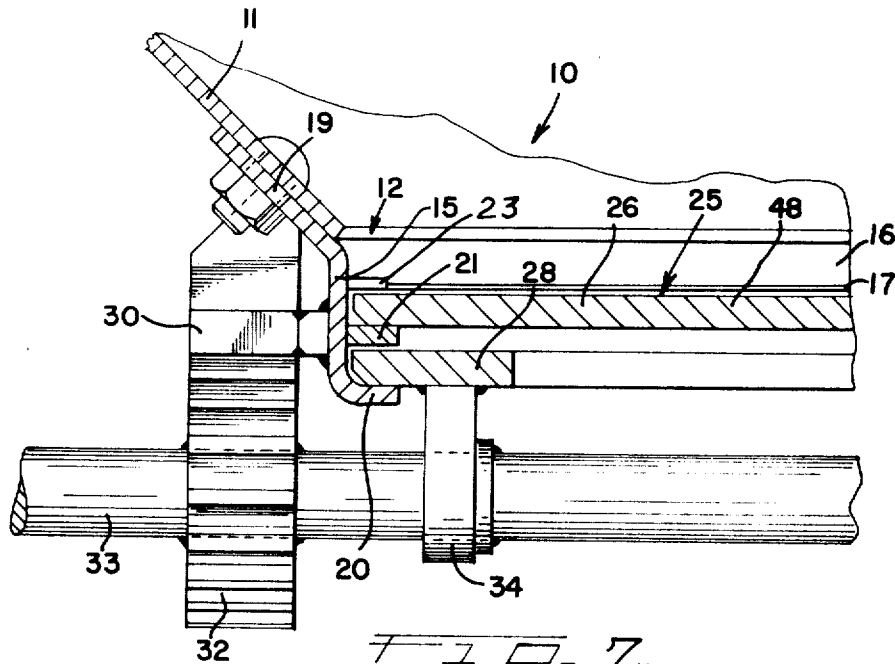
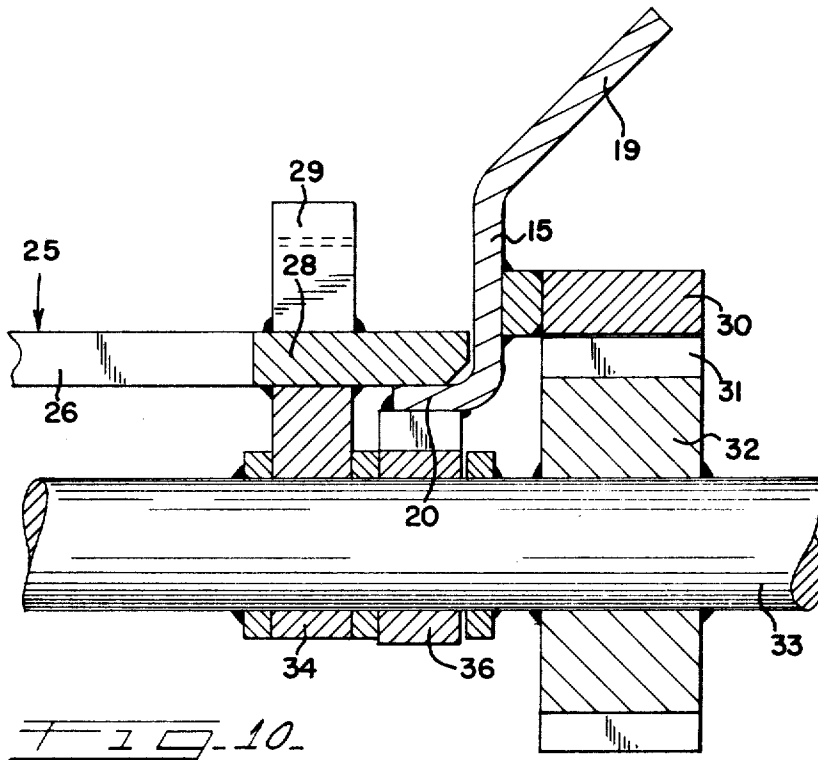
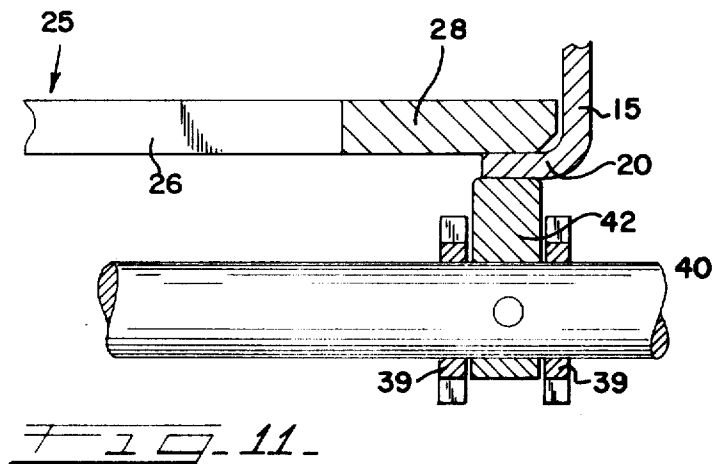


FIG. 7.

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SEQUENTIALLY ACTUATED HOPPER GATE

BACKGROUND OF THE INVENTION

1. Field of the Invention

The invention has to do with hopper discharge structures of the type generally used in connection with railway hopper cars. Such discharge structures include a suitable gravity gate arrangement which regulates the flow of materials from the railway hopper car when the car has reached its destination.

2. Description of the prior Art

The prior art includes gate arrangements for hopper discharge structures wherein the gate is movable from a closed position to an open position by a suitable rack and pinion arrangement. When the hoppers are heavily loaded with certain types of material it is sometimes difficult to open the gates in view of the weight of material resting thereon. Gates have been provided to overcome this problem and these have included sectional gate arrangements wherein the sections are movable from a closed position outwardly in opposite directions, each section being connected to a separate manually operable gate opening mechanism. While such arrangements permit the gates to be more easily opened they are more expensive, and more time is consumed in gate actuation in view of the separate gate opening mechanism. One of the earliest of such structures is shown in U.S. Pat. to Dodd No. 1,484,764 patented Feb. 26, 1924.

SUMMARY

The present invention comprises essentially a hopper discharge structure and a gravity gate which can be readily opened and closed. The gate comprises a pair of sections which in the closed position combine to completely cover the discharge opening the sections being mounted one above the other and being movable sequentially between the closed and open positions.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a perspective view of a hopper discharge structure including a gravity gate mechanism;

FIG. 2 is an enlarged plan view of a portion of a hopper discharge structure and gate arrangement;

FIG. 3 is a cross-sectional view taken substantially along the line 3-3 of FIG. 2;

FIG. 4 is a cross-sectional detail view showing the cooperative engagement of a pair of gate sections of a gravity gate;

FIG. 5 is a view similar to FIG. 3 showing another operative position of a gravity gate;

FIG. 6 is a view similar to FIG. 5 showing still another operating condition of a gravity gate;

FIG. 7 is a cross-sectional view taken along the line 7-7 of FIG. 2;

FIG. 8 is a cross-sectional view taken along the line 8-8 of FIG. 2;

FIG. 9 is a cross-sectional view taken along the line 9-9 of FIG. 2;

FIG. 10 is a cross-sectional view taken substantially along the line 10-10 of FIG. 2; and

FIG. 11 is a cross-sectional view taken along the line 11-11 of FIG. 2.

DESCRIPTION OF THE PREFERRED EMBODIMENT

A hopper discharge structure generally designated at 10 includes a hopper 11 having a discharge opening 12. The hopper 11 usually forms part of a railway hopper car which may transport granulated and other types of material. A rectangular frame 13 is disposed above the discharge opening 12 and includes an end wall 14 and side walls 15. As best shown in FIGS. 5 and 6 an end wall 16 is formed from an angle member suitably connected to the side walls 15. The lower end of the end wall 16 is spaced upwardly to provide a transversely extending opening 17. The end wall 14 and side walls 15 are respectively provided with sloping flanges 18 and 19.

As best shown in FIGS. 7, 10, and 11, support means in the form of an inwardly extending ledge 20 is provided on each of the side walls 15. As best shown in FIG. 7 each side wall 15 is also provided with a second ledge 21 disposed above the ledge 20. As best shown in FIGS. 1, 3, 5, and 6, the frame members 13 extend to one side of the discharge opening 12 and are interconnected at their ends by means of a transversely extending support 22. Positioned at opposite ends of the wall 16 and connected to the walls 15 are guide elements 23. As shown in FIG. 2, similar guide elements 23 are provided adjacent the wall 18 at the forward end of walls 19. The frame 13 is also provided with a number of conventional attaching brackets 24.

A gravity gate is generally designated by the reference character 25 and includes a section 26 extending substantially the width of the frame 13 but having a length somewhat greater than one-half the length of the discharge opening 12. The section 26 is slidably supported on the support ledges 20 and has its leading edge resting upon a ledge 27 projecting inwardly from the end wall 14. As best shown in FIGS. 2, 3, 5, and 6, a pair of transversely spaced extensions 28 are connected to and project longitudinally from the section 26. A pair of stops 29 are connected to and project upwardly from each of the extensions 28. The side walls 15 are each provided with an outwardly projecting rack 30 having rack teeth 31 as best shown in FIG. 10. Pinions 32 engage the rack teeth 31 and are suitably connected to a shaft 33 which is pivotally supported in brackets 34 which are, as best shown in FIG. 10, rigidly connected to the extensions 28. While only one side of the structure is disclosed, it is of course understood that one side of the structure is symmetrical to the other. The shaft 33 is provided at its ends with operating heads 35 which serve to rotate the shaft 33 for moving the pinions 32 in cooperation with the racks 30.

A pivot catch 36 is pivotally mounted on a shaft 33 and includes a hook end 37 which is adapted to engage a catch element 38 provided on the underneath surface of each of the side walls 15. Each pivot catch 36 is also provided at its rear end, as best shown in FIG. 11, with ear portions 39 through which a rod 40 extends. The rod 40, as best shown in FIGS. 1 and 2, is provided with a handle element 41 and a lock block 42, as best shown in FIGS. 3 and 11, is adapted to be pivotally moved into the underneath surface of the ledge 20, as best shown in FIG. 8 wherein the pivot catch 36 is in locking engagement with the catch element 38 and is held in this position by means of the lock block 42.

An arm 43 is also securely connected at each end of the rod 40 to pivot therewith, the said arms 43 being held against movement, as shown in FIGS. 1 and 2, by means of a slidable seal element 44. The seal element 44 includes openings 45 and 46 and may slide longitudinally relative to the shaft 33 and rod 40. As best shown in FIG. 9, plate extensions 47 project outwardly from the seal element 44 and in the position shown in FIGS. 2 and 9, the rod 40 is locked against rotation since the arm 43 is held captive between said extensions 47. A suitable car seal may be inserted through the extensions 47 for sealingly locking the rod 40 against rotation in the position shown in FIG. 8.

A second section of the gate 25 is designated at 48, the said section also being of substantially the same size as the section 26. The section 48 also includes a downwardly extending stop 49 as best shown in FIG. 4. The section 48 is supported for sliding movement on the support ledges 21, as best shown in FIG. 7. One end of the section 48 is provided with a sealing strip 50 in the closed position of said section 48 as best shown in FIG. 3, the said strip 50 covering the opening 17. Outwardly projecting guide elements 51, as best shown in FIGS. 1, 2 and 3, project inwardly from the side walls 15 above the section 48.

As best shown in FIG. 4, a transversely extending seal strip 52 is suitably secured to the upper surface of the section 26 adjacent its rear end, and a seal strip 53 is connected to the underneath surface of section 48 at its leading end. A flexible

seal element 54 is connected to the section 48 adjacent the seal strip 53 for engaging the seal strip 52 in sealing relation, as best shown in FIG. 4, when the gate 25 is in its closed position.

THE OPERATION

The closed position of the gate 25 is best shown in FIGS. 1, 2, and 3. In this closed position, the seal element 44 is in the position shown in FIG. 2 wherein the rod 40 is held against rotation and as shown in FIG. 8, the hook elements 37 of the pivot catch 36 are in locking engagement relative to the catch element 38. Thus the section 26 cannot move rearwardly and the gate is locked. The section 48, as best shown in FIGS. 3 and 4, also cannot move away from the discharge opening 12 since the end of the section 48 is against the stop 29. The adjacent ends of the sections 26 and 48 are suitably sealed by the arrangement of the seal strips 52 and 53 as best shown in FIG. 4. Thus the gate 25 is disposed over the discharge opening 12 and the hopper 11 containing the material is firmly sealed during shipment of the same to its ultimate destination.

When it is desired to open the gate 25 the slidable seal element 44 is moved outwardly with respect to the arm 43 and the handle 41 is now grasped by the operator who pivots the same thereby rotating the rod 40 whereupon the lock block 42 is moved into a clockwise direction to the dotted line position shown in FIG. 8 whereupon the pivot catch 36 is moved out of engagement with respect to the catch element 38.

The operator now utilizes a conventional tool for rotating the operating head 35 and by virtue of the pinions 32 and rack arrangement 30, the gate section 26 is moved from the position shown in FIG. 3 to the left underneath the gate section 48. Since only one-half of the gate is being opened the section 26 does not support the whole weight of the discharge opening area and therefore section 26 can easily be moved by the retraction of the extensions 28 by the operation of the pinions 32. Thus the section 26 is moved underneath the gate section 48 until, as best shown in FIG. 6, the rear edge of the section 26 engages the stops 49 of the section 48 whereupon the section 48 then travels with the section 26 to an out-of-the-way or open position to one side of the discharge opening 12. Thus, the rear edge of section 26 and stops 49 act as gate section coupling means for sequential opening of the gate sections 26 and 48. Since the ledges 20 and 21 extend rearwardly on the members 15, the two sections 26 and 48 are now positioned one on top of the other in an out-of-the-way position. The section 48 also moves quite easily since it is supporting only a part of the interior load of the hopper 11. With the gate 25 now fully opened the hopper 11 may discharge entirely by gravity and thereupon the gate 25 is again closed. In closing, the section 26 is initially moved until the stop 29 engages the rear face of the gate section 48 whereupon section 48 is also moved into the position shown in FIG. 3 combining with section 26 to completely close the discharge opening. Thus, the stop 29 and the rear face of gate section 48 act as further gate section coupling means for sequential closing of the gate sections 26 and 48.

It is thus believed clear that the sequential opening of the gate sections permits the gate to be rapidly withdrawn from the discharge opening with a minimum of effort. Only a single manual moving or operating device need be utilized as exemplified by the rack and pinion arrangement. It is of course contemplated that a greater number, than a pair of sections, may be utilized to achieve the benefits of the invention.

I claim:

1. A hopper discharge structure comprising:

a frame having side walls and end walls forming a discharge opening, first support means and second support means vertically spaced from each other on each of said side walls, each of said support means extending toward each other along opposite sides of said discharge opening;

a closure gate including first and second sections respectively slidably supported on said first support means and second support means;

moving means on said frame for moving said sections to open and closed positions;

said sections in the open position of said gate being disposed to one side of said opening in vertical relation with respect to one another;

said sections being movable to a closed position wherein said sections have their major portions thereof disposed in endwise relation to one another over said opening and combinedly close the same;

said sections in the closed position having adjacent horizontally extending edges disposed in overlapping relation; and

said adjacent edges including cooperating seal means disposed therebetween and engageable with one another in the closed position.

2. The invention according to claim 1, and said first section including transversely spaced horizontally elongated extensions having a space between them, said space being vertically removed from said second section during the closed position of said gate, said moving means including means on said frame and means carried by said extensions adapted to engage said means on said frame, whereby during cooperative operation of said means carried by said extensions and said means on said frame, said gate is moved.

3. The invention in accordance with claim 1:

said first section including stop means engaging said second section during movement to a closed position; and second stop means on said second section engaging said first section during movement of said first section to the open position.

4. A hopper discharge structure comprising:

a frame having side walls and end walls forming a discharge opening, first support means and second support means vertically spaced from each other on each of said side walls, each of said support means extending toward each other along opposite sides of said discharge opening;

a closure gate including first and second sections respectively slidably supported on said first support means and second support means;

moving means on said frame for moving said sections to open and closed positions;

said sections in the open position of said gate being disposed to one side of said opening in vertical relation with respect to one another;

said sections being movable to a closed position wherein said sections have their major portions thereof disposed in endwise relation to one another over said opening and combinedly close the same;

said moving means moving one section to partially open said opening and said first and second sections having gate section coupling means where upon continued movement of said one section said gate section coupling means coacts with each section and said second section is sequentially moved to complete the opening of said gate; and

said first section including transversely spaced horizontally elongated extensions at one end thereof defining a space vertically removed from the second section during the closed position of said gate, said moving means including means on said frame and means carried by said extensions adapted to engage said means on said frame, whereby during cooperative operation of said means carried by said extensions and said means on said frame, said gate is moved.

5. The invention in accordance with claim 4, and said extensions in the closed position of said gate being substantially parallel to and disposed in longitudinal spaced adjacent relation to said second section.

6. The invention in accordance with claim 4, including:

locking means for maintaining said sections in the closed position comprising a stop carried by said extensions engageable with one end of said second section;

said second section having its opposite end positioned in overlapping relation relative to a portion of said first section; and

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sealing means disposed on said opposite end and said portion for sealing the sections with respect to one another in said closed position.

7. The invention in accordance with claim 4, locking means including keeper means on the frame and a latch element carried by said extensions engageable with the keeper means on said frame releasably locking said sections in the closed position.

8. The invention according to claim 4, and said gate section coupling means comprising an end portion of said first section and a stop on said second section, said stop engaging with said end portion whereby portions of the sections are spaced above one another attendant to sequential movement of the gate sections.

9. The invention according to claim 4, and said sections in the closed position having adjacent horizontally extending

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edges disposed in overlapping relation, said adjacent edges including cooperative seal means disposed therebetween, engaging one another in sealing relation in the closed position.

10. The invention according to claim 4, and said gate section coupling means including a first section coupler on each gate section, said first section couplers engaging each other upon movement of the first section toward the gate opened position for sequential opening of the gate sections, said gate coupling means having a second section coupler on each section, each second coupler being engageable with one another upon movement of the first section from the gate open position to the gate closed position for sequential closing of the gate sections.

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