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[54] **BULKHEAD CONVEYER BELT DOOR**
8 Claims, 9 Drawing Figs.

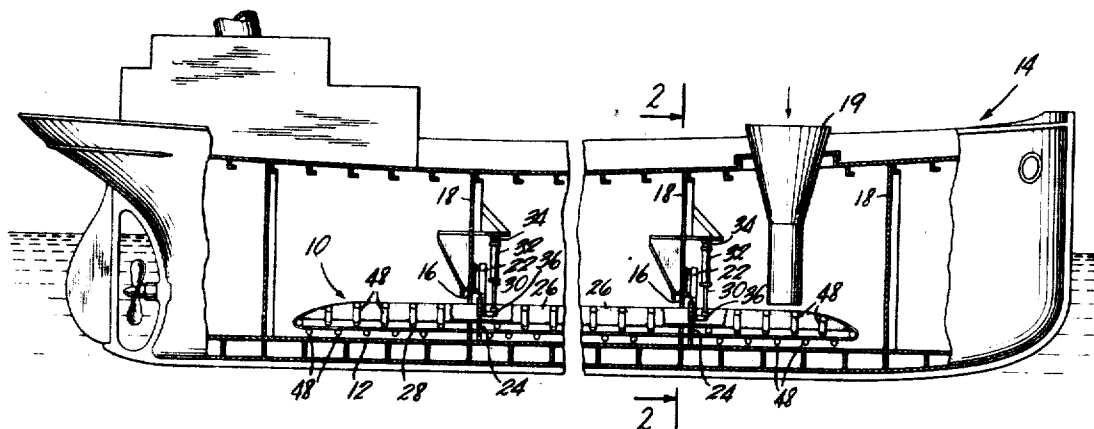
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[50] Field of Search 214/17.4,
15, 14, 152, 15 D, 15 E; 114/73, 78, 116, 72, 120

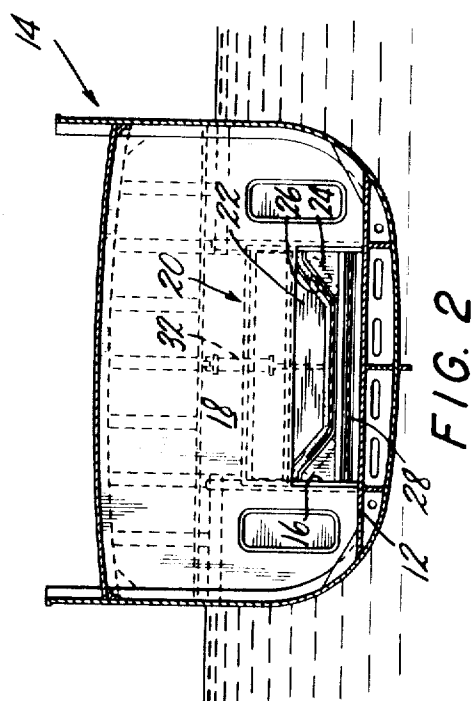
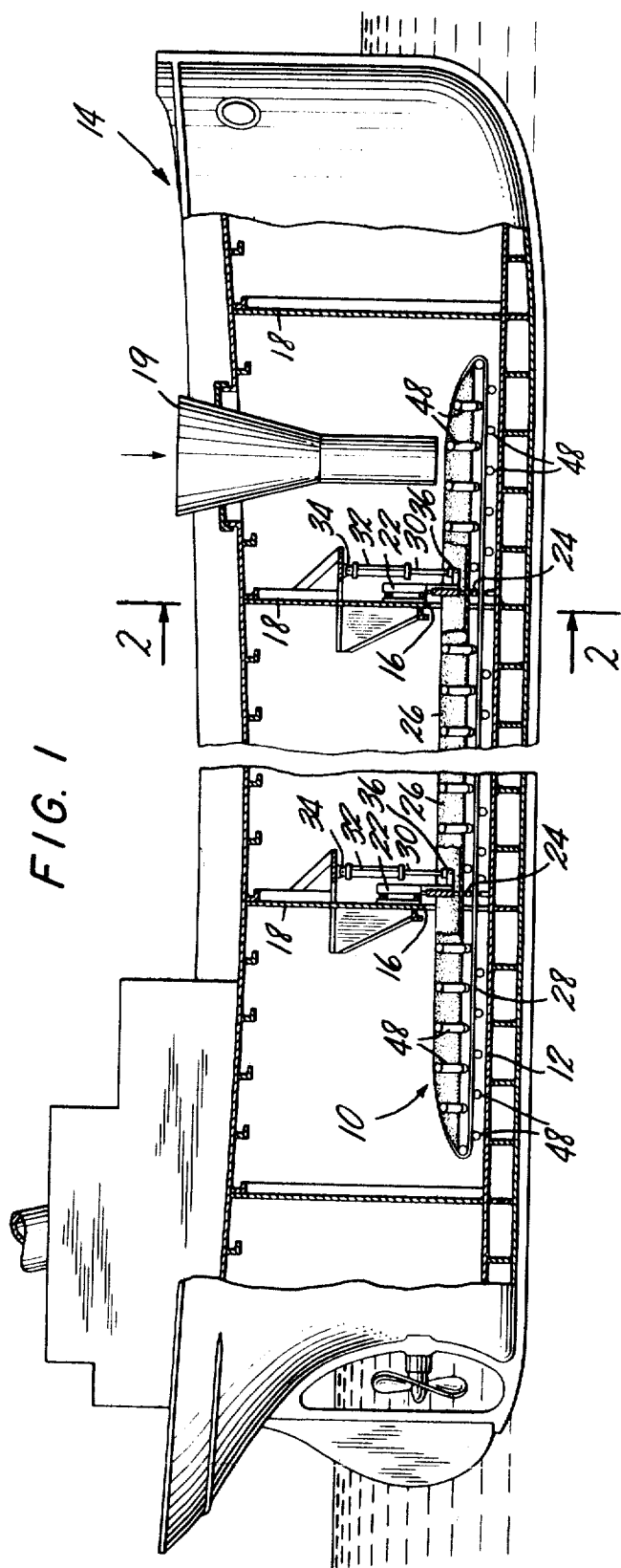
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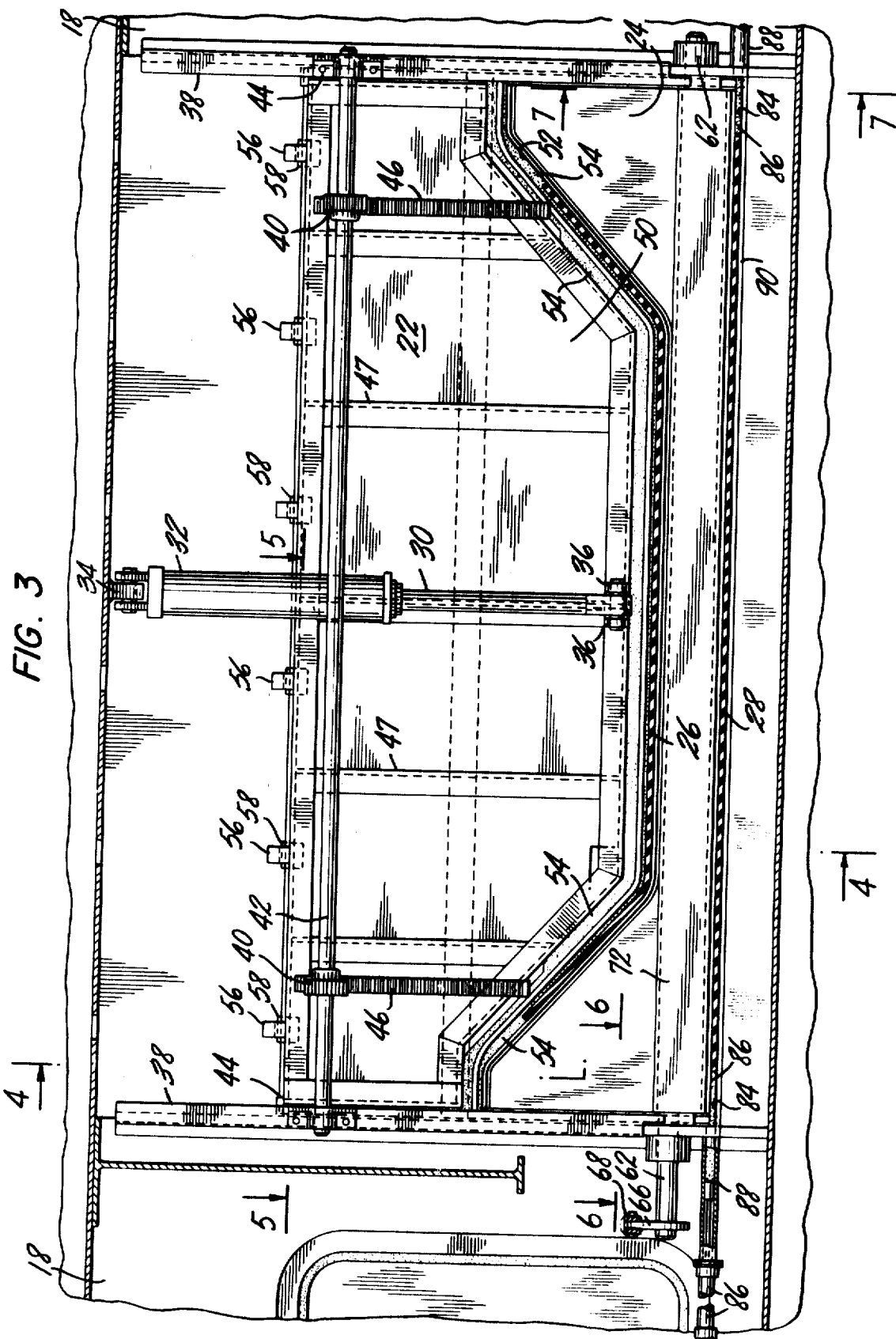
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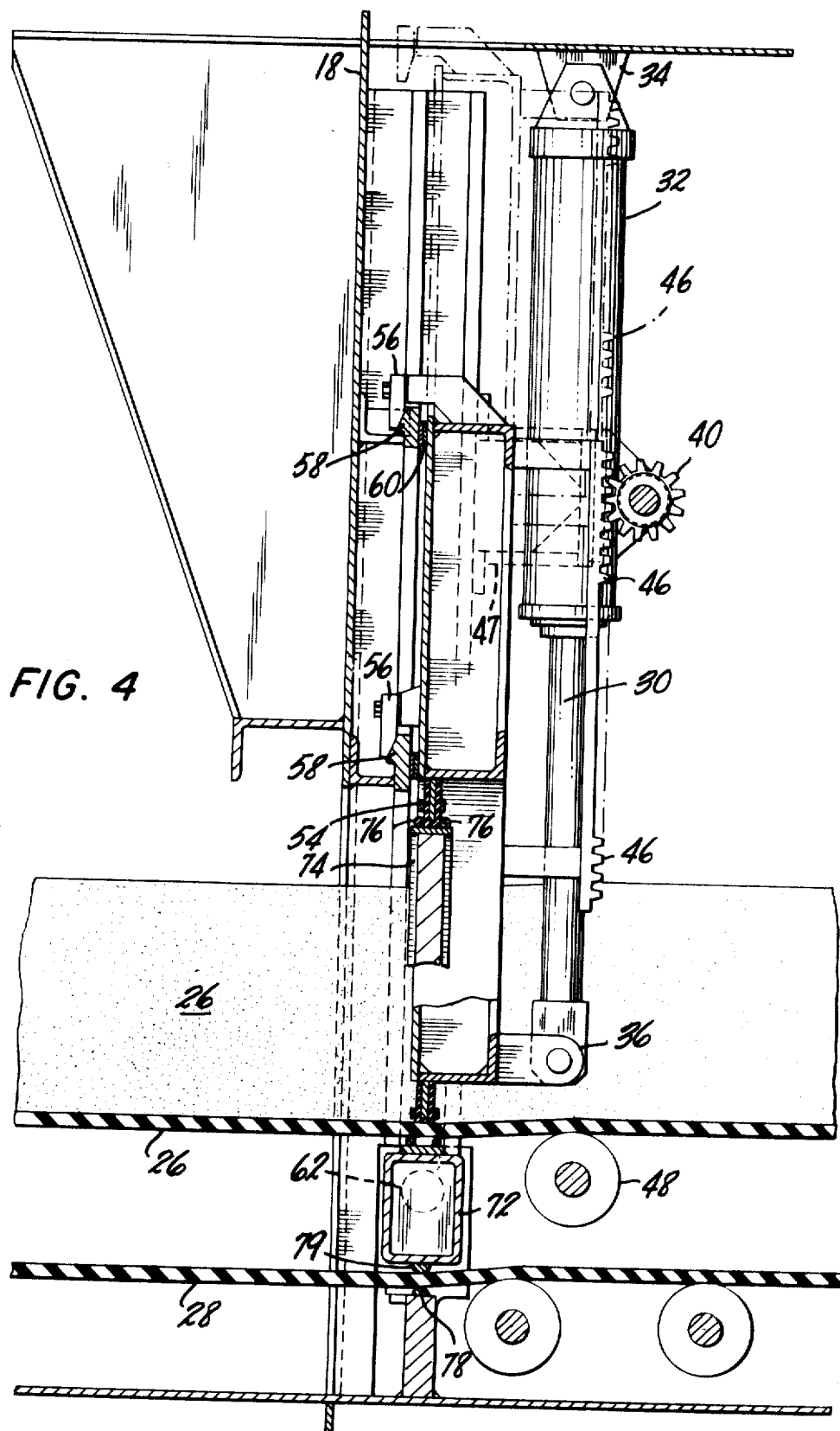
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ABSTRACT: A gate for installation on the bulkhead of a ship, for closing against a continuous conveyor belt which passes through an opening in the bulkhead. The gate is formed by upper and lower sections, mounted respectively above the upper belt of the continuous conveyor belt, and between the upper and lower belts of said conveyor. The gate sections move independently of each other, the upper portion slidably mounted to the bulkhead to move vertically upward and away from the conveyor belt, or downward into a sealed position against the upper surface of the upper belt. The lower section of the gate is pivotally mounted in the bulkhead opening to swivel between a vertically disposed closed position, wherein its upper surface engages the lower face of the upper belt and its lower face forces the lower belt against the floor of the bulkhead opening, and an open position in which the lower section of the gate is pivoted on its mounting to lie in a horizontal plane intermediate the vertical distance between the upper and lower belts. Sealing plugs are slidably mounted at the sides of the bulkhead opening adjacent the lower belt to function as plungers for extending into said opening to seal against the lower belt, thereby compensating for lateral displacement of the belt which makes other types of seals ineffective.









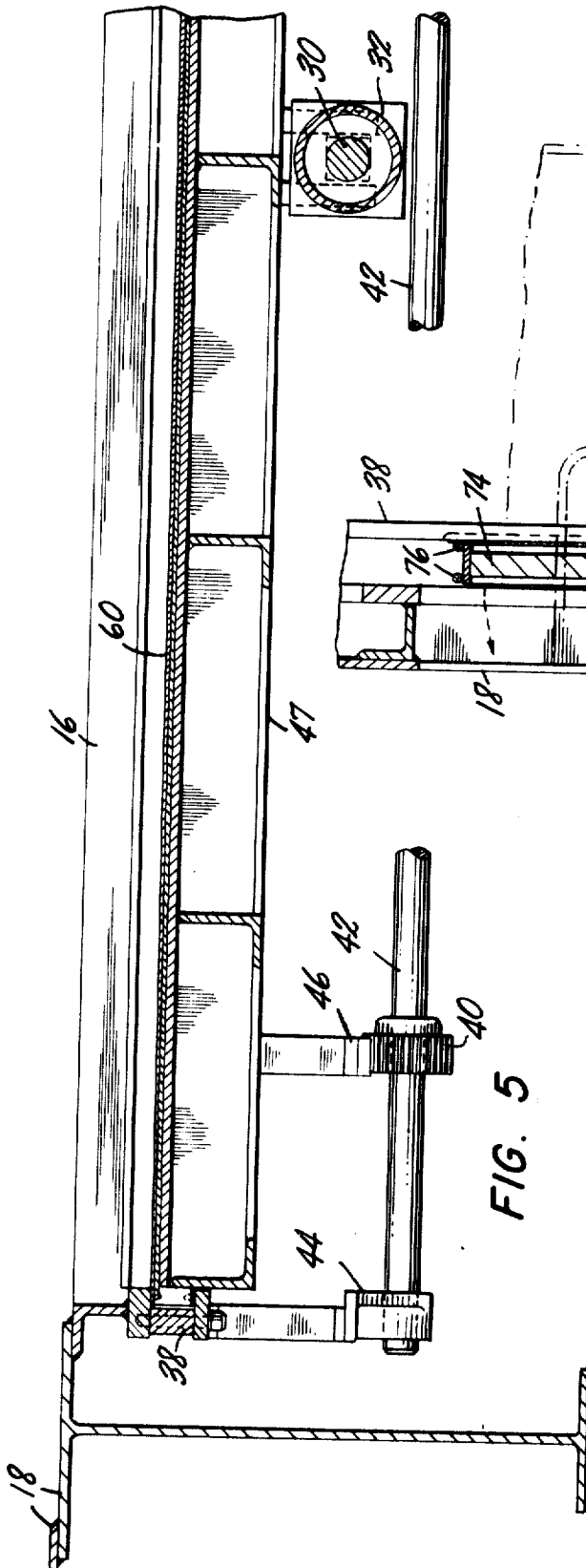


FIG. 5

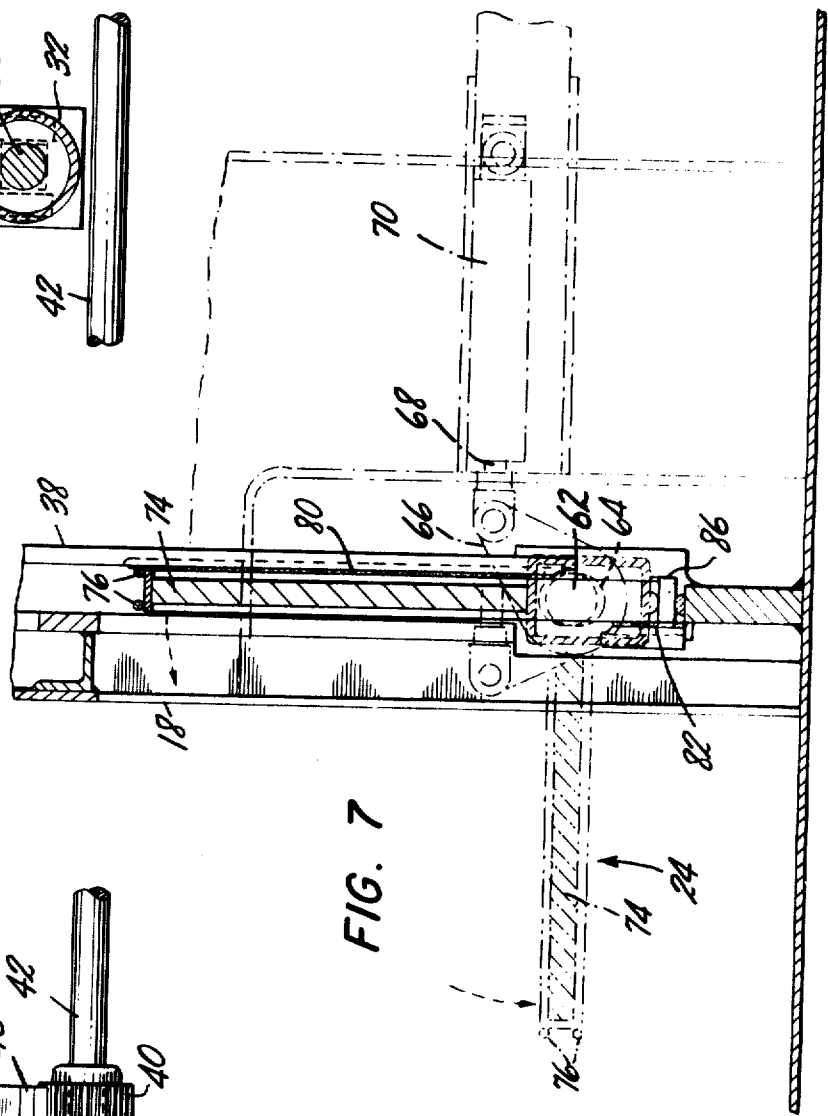


FIG. 7

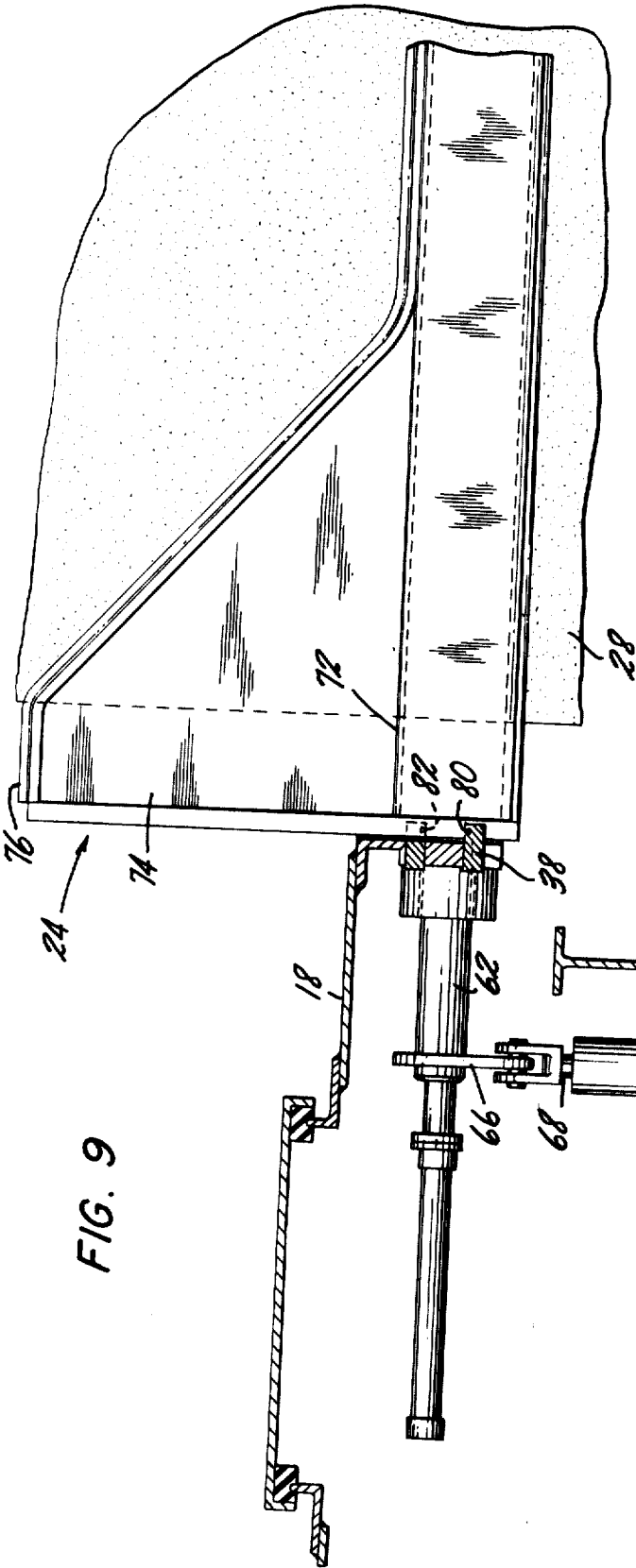


FIG. 9

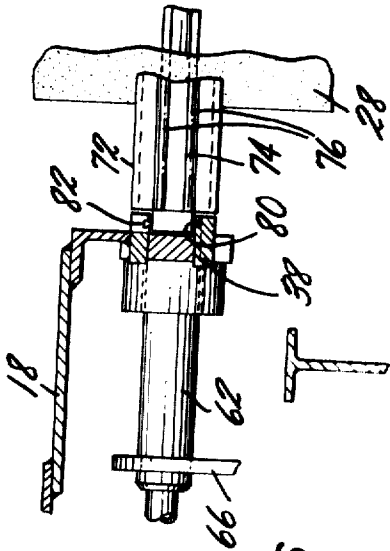
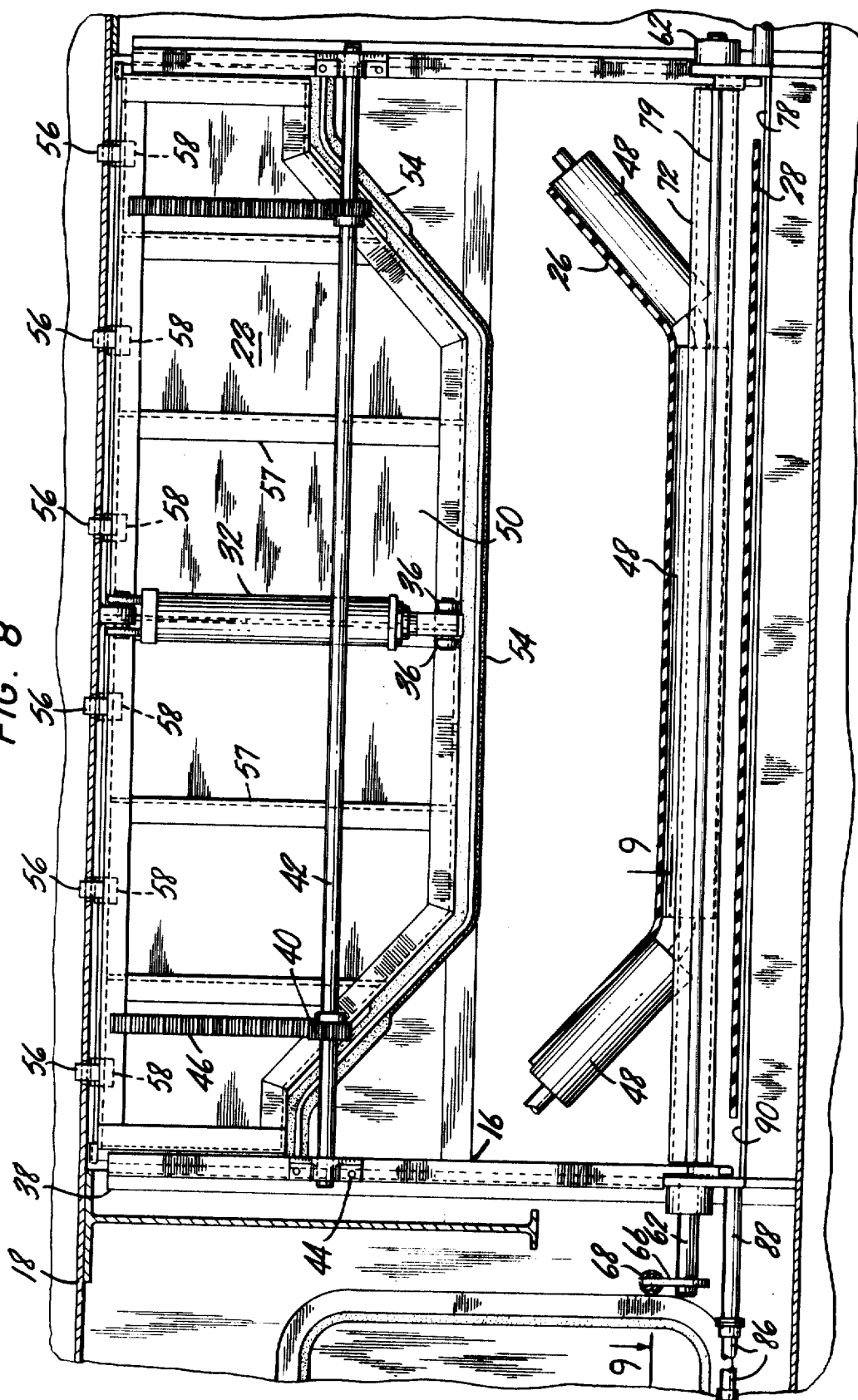


FIG. 6

FIG. 8



BULKHEAD CONVEYER BELT DOOR

BACKGROUND OF THE INVENTION

A concept has been devised and carried out for permanently mounting a conveyor belt longitudinally along a lower deck of an ore ship for use in unloading the cargo by self-contained apparatus. Ships are built, however, with transverse bulkheads which divide the ship into several compartments so that water which flows through a damaged part of the hull will be isolated by the bulkheads to a single compartment and will not flow to other sections of the ship. Therefore, the permanently installed conveyor belt must pass through the bulkheads, and when the conveyor is not in use the bulkhead openings must be sealed in a watertight manner so that their purpose is not defeated.

One method of sealing such bulkhead openings, which has been tried in the past, is to provide vertically slidable sections above and below the upper or load-carrying section of the continuous belt. However, such load carrying section of the belt must assume a troughlike cross section so that it may be effectively used for carrying ore. Thus, the upper section of the gate must have a downwardly projecting tongue section for extending into and sealing against the trough-shaped upper belt. Similarly, the lower section of the gate must have a troughlike cross section itself for sealing against the underside of the load-carrying belt. When this type of gate is opened, the upper section is raised to provide sufficient clearance for the ore being carried on the conveyer, and the lower section is raised until it is disposed between the load-carrying and return sections of the belt, to provide a clearance between said lower gate section and the belt sections. Difficulties have been encountered with this type of gate, however, in that the lower section must be small enough when it is in a raised position to provide sufficient clearance for the belts, but it must be large enough when it is in its lower position so that the upper section of the gate need not deflect the upper belt too far to bring said upper belt into contact with the lower gate section when the gate is to be sealed. It has been found, however, that this is an impossible compromise. That is, if the lower gate is made much shorter than the spacing between the two belts, so that when it is raised it will provide sufficient clearance between its upper face and the upper belt and its lower face and the lower belt, then the upper belt must be deflected an amount equal to the sum of the two clearance dimensions. An adequate seal is not feasible with the deflection requirement; and on the other hand, if the clearances are decreased until adequate seals are feasible, then the clearance is not sufficient between the lower gate section and the belts, thereby resulting in excessive wear and damage to the belt and the gate. Therefore, it is an object of this invention to provide a gate which may be reliably sealed in a watertight condition.

SUMMARY OF THE INVENTION

In accordance with the invention we provide a gate for sealing a conveyor belt opening in the bulkhead of the ship. A gate is formed in two sections comprising an upper section held in guides mounted on the bulkhead above the upper belt of a continuous conveyor belt, and vertically slidable from a raised open position to a lowered sealed position; and a lower gate section disposed between the upper and lower belts of the conveyor and mounted to the bulkhead walls at the opening for pivotal movement from a closed vertical position to an open horizontal position.

The upper load-carrying belt is supported in a troughlike configuration and travels in an interference free manner when the gate is opened, since the upper section of the gate is raised high above the belt; and the lower gate section has a sufficiently thin cross section to lie horizontally between the upper and lower belts without interfering with either of said belts. When the gate is to be closed, however, the lower section of the gate is pivoted into a vertical position where it contacts both the upper and lower belt sections. The lower section of

the gate is pivotally mounted in slots at the sides of the bulkhead opening so that when the upper section of the gate is lowered it will force the lower section of the gate downward, thereby forming a tight seal between the lower surface of the lower belt and the floor of the opening; between the upper surface of the lower belt and the lower surface of the lower gate section; the upper surface of the lower gate section and the underside of the upper belt; and, the lower edge of the upper gate section and the load-carrying side of the upper belt. The upper edge of the bulkhead opening is sealed by the upper gate section which is wedged against the bulkhead as it is lowered into a sealed position. Finally the lower edge of the upper gate section is provided with a rubber channel gasket for sealingly filling the voids between the upper and lower gate sections at their respective ends since the conveyor belt does not extend all the way to the sidewalls of the bulkhead opening. Furthermore, the conveyor belt may be, for example, about 10 feet wide and have a lateral play of about 10 inches either side of center, thereby making it difficult to seal against the edges of the lower belt section. If a gasket is placed on the underside of the closed lower gate section, and is sufficiently flexible to seal the openings at the edges of the lower belts, such gasket will wear out rapidly since the pivotal movement of the lower gate section causes a great stress on the gasket as it bears against the lower belt and the bulkhead opening floor during such rotational movement. Therefore, according to the invention, an adjustable plug is provided at each end of the lower gate section and such plug is extendable through a guide housing to seal the opening defined by the edge of the lower belt, the guide housing and the gap between the lower edge of the lower gate section and the floor of the bulkhead opening.

Both sections of the gate are operably by fluid controlled cylinders. The upper gate section has its cylinder mounted centrally thereof, and has a pair of spur gears fixed on a shaft which is rotatably mounted to brackets at the bulkhead opening, said spur gears being for cooperation with a pair of racks mounted at opposed ends of the upper gate section, so that the upper gate does not become jammed when operated by the centrally mounted cylinder. Similarly, the lower gate section is operated by a cylinder which is attached to a crank on the end of a shaft extending from the pivotal mounting of one end of the lower gate section. The pivotal mounting of such lower gate section is at the centerline between the upper and lower belts, so that when the lower gate section is opened it lies very close to the center of the vertical distance between the upper and lower belts, thereby providing adequate clearance when open and adequate sealing qualities when closed.

BRIEF DESCRIPTION OF THE DRAWINGS

The accompanying drawings illustrate one embodiment of the invention. In such drawings;

FIG. 1 is a longitudinal section view of a ship having a conveyor belt installed therein, and showing a bulkhead door embodying our invention;

FIG. 2 is a sectional view taken along line 2—2 of FIG. 1;

FIG. 3 is a front view of the bulkhead door shown in FIG. 1, in a closed position;

FIG. 4 is a sectional view taken along the offset lines 4—4 of FIG. 3;

FIG. 5 is a sectional view taken along the line 5—5 of FIG. 3;

FIG. 6 is a sectional view taken along the line 6—6 of FIG. 3;

FIG. 7 is a sectional view taken along the line 7—7 of FIG. 3;

FIG. 8 is a front view similar to FIG. 3 but showing the door in an open position; and

FIG. 9 is a sectional view taken along line 9—9 of FIG. 8.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

A continuous conveyor belt 10 mounted on a lower deck 12 of a ship 14 must pass through openings 16 in the bulkheads 18 of the ship, as shown in FIGS. 1 and 2, and must be provided with sealing means for closure against the conveyor belt at the opening 16 when the ship is under way. Thus, a cargo of ore, for example, may be stored in a hopper 19, and unloaded automatically by the ship's self-contained apparatus by releasing the ore into the moving conveyor. The ore is then carried to one end of the ship where it is lifted out by means not shown. According to one embodiment of this invention, the sealing means comprises a two-section gate 20 having a vertically movable upper section 22, and a pivotally movable lower section 24 disposed between the upper and lower belts 26 and 28 of the continuous belt 10.

The gate 20, as shown in a closed position in FIGS. 1-7 has its upper gate section 22 raised and lowered by operation of means such as a fluid-actuated piston 30 and cylinder 32. The end of the cylinder is mounted to a fixed bracket 34 on the upper portion of the bulkhead, and the end of the piston is mounted to a pair of lugs 36 at the lower portion of the upper gate section, so that the piston 30 may be extended to force the upper gate downward into a sealed position against the load-carrying face of the upper belt 26. The ends of the upper gate section slide in, and seal against, guide rails 38 mounted at the sidewalls of the bulkhead opening, and said upper gate section is held in a properly aligned position

and prevented from binding against the rails 38 by a pair of rack and gear assemblies. A pair of spur gears 40 are fixed to a shaft 42 which is held rotatably at a fixed height in a pair of brackets 44 mounted at the sidewalls of the bulkhead opening. The spur gears cooperate with racks 46 fixed to reinforcing members 47 mounted on the face of the upper gate section, so that the gate cannot become jammed as it is raised or lowered by the cylinder. The upper belt 26 of the conveyor is supported in a troughlike configuration by a plurality of idler rollers 48 mounted in groups along the conveyor. Thus, the upper gate section 22 has a downwardly projecting tongue 50 which extends into the troughlike portion of the upper belt and seals against its load-carrying face.

As seen in the drawings, when the upper and lower gate sections are both closed, voids 52 remain between the two gate sections at the edges of the upper belt. A flexible channel gasket 54 is effective for sealing the voids between the gate sections, at said upper belt edges, since the gasket is subjected only to a vertical deflection. The channel gasket is fixed to the sealing edge of the upper gate in a manner which will permit it to extend into and seal the voids 52, while being sufficiently flexible to compress against the upper belt immediately adjacent the voids, and provide an adequate seal at the transitions between the voids 52 and the upper belt.

Finally, to complete the sealing action of the upper gate section 22 a plurality of fingers 56 are provided at the upper edge and sides of the upper gate section 22, extending toward the bulkhead 18 for cooperation with a corresponding plurality of lugs 58. The engaging faces of the fingers and lugs are slanted so that a wedging action occurs drawing the upper edge of the gate against an upper bulkhead-sealing surface 60 to seal such upper edge when the gate is closed. Thus, the upper gate section 22 seals its lower edge against the upper belt and the lower gate section by means of the channel gasket 54; the gate section 22 has its side edges sealed within the guide rails 38; and said section 22 has its upper edge sealed against the bulkhead-sealing surface 60 under pressure of the wedging action of the fingers 56 and lugs 58.

The lower gate section 24 also has a trough-shaped configuration for sealing against the underside of the upper belt 26, and said lower gate section is pivotally mounted by stub shafts 62 which extend from the opposing ends of the lower gate section for pivotal reception in openings 64, as shown in FIG. 7, in the guide rails 38 mounted at the sidewalls of the bulkhead

openings. The openings 64 in the guide rails are slightly elongated in the vertical direction so that the lower gate section may be moved vertically over an extent to seal the lower belt against the floor of the bulkhead opening. A crank 66 is fixedly attached to the end of one of the stub shafts 62 and said crank is pivotally mounted to the end of the piston 68 of a second cylinder 70 which is disposed horizontally and in parallel with the conveyor belt 10. Thus, the lower gate section 24 may be pivoted about its shaft mounting between an open horizontal position intermediate the upper and lower belt sections, and a closed vertical position wherein its upper and lower edges respectively abut said upper and lower belts.

The lower gate section 24 has a tubular support member 72 having said stub shafts 62 attached to its ends, and having a flapper section 74 attached to its upper surface for forming the trough-shaped edge required to seal against the underside of the upper belt 26. Said upper edge of the lower gate section is provided with a pair of spaced rods 76 which extend longitudinally thereof and provide a slot for receiving the channel gasket 54 on the upper gate section 22. Similarly, the floor of the opening 16 and underside of the support member 72 have sealing rods 78 and 79, respectively, for sealing against the lower belt 28. As the lower gate is swung closed, the side edges of its flapper section 74 engage sealing surfaces 80 mounted on the guide rails 38. Similarly, on the opposite face of the flapper 74, at its lower portion, which extends past the ends of the tubular support member, said flapper engages another sealing surface 82 mounted on the guide rail 38 in opposing relation to the surface 80.

Finally, the edges of the lower belt 28 are spaced from the sides of the bulkhead opening 16, and leave voids 84, similar to voids 52 at the edges of the upper belt. A channel gasket comparable to that shown at 54, however, would not be effective in sealing the voids 84 since such gasket would be subjected to rotational stresses and would become damaged in a short time. Furthermore, the gasket could not be designed accurately to avoid such rubbing contact with the lower belt, as it filled the voids 84, since the conveyor belt may be subject to a lateral movement or play of 6 or more inches each side of center. Therefore, in accordance with the invention, we provide a slidable plug 86 at each side edge of the lower gate for extending through the guide rails 38 to fill the void 84 at each side of the belt 28. The plugs 86 are rectangularly shaped, and are retractable into tubular protective housings 88 when the gate is open. When the gate is to be sealed, the plugs 86 are ejected from their housings 88, and have sufficient lengths to fill the voids 84 as defined by the floor of the bulkhead opening, the guide rails 38, the edge of the lower belt 28, and the lower edge of the lower gate section 24, regardless of the lateral displacement of the belt.

In operation, when the gate is to be closed, the lower gate section 24 is pivoted by actuation of the cylinder 70 into a closed vertical position. As stated above, said lower gate section then engages both the upper and lower belts and forms a seal therebetween. The dimensioning of the lower gate section is such that it causes the two belts 26 and 28 to separate an additional one-quarter inch, with most of the separating movement being realized by an upward movement of the upper belt. The upper gate section 22 is then lowered by means of its cylinder 32, and its rack and gear guides, so that when the piston 30 is fully extended, the upper gate 22 is pushed down on the load-carrying surface of the upper belt 26 and forces such upper belt and the lower gate section 24 downwardly against the lower belt section 28, which in turn is forced against the lower edge of the bulkhead opening 16. Normally, the clearance gap as shown at 90, is provided between the floor of the bulkhead opening and the lower belt, and therefore the upper gate section must move downward an extent equal to this clearance gap after it first engages the load-carrying surface of the upper belt, so that the lower belt is forced downwardly a corresponding extent to its engagement with said floor of the bulkhead opening. Finally, the plugs 86 are ejected from their housing 88 to fill the voids 84 and complete the seal.

We claim:

1. A gate for a bulkhead opening having a conveyor belt passing therethrough, wherein the conveyor is continuous and has an upper load-carrying belt portion and a lower return belt portion, said gate comprising

upper and lower gate sections; guide means connected at the sides of said bulkhead opening, said upper gate section being slidably connected to said guide means above said upper belt for vertical movement to an open position upward and away from the upper belt, and downward to a closed position in contact with the upper belt, said lower gate section being pivotally connected to said guide means and disposed between said upper and lower belts for pivotal movement between a horizontal open position between said upper and lower belts, and a closed vertical position engaging said upper and lower belts; and means for sliding said upper gate section between its said open and closed positions, and for pivoting said lower gate section between its said open and closed positions.

2. The invention as set forth in claim 1, in which said pivotal connections of said lower gate section are disposed centrally of the vertical space between said upper and lower belts.

3. The invention as set forth in claim 1, in which said upper gate section has a channel gasket attached thereto for sealing against said upper belt, and against said lower gate section at the edges of said upper belt, when said upper gate section is disposed in its said closed position.

4. The invention as set forth in claim 1, in which a pair of plugs are slidably mounted one at each side of said lower gate section for sliding through openings at the lower portion of

said guide means to sealably engage the edges of said lower belt.

5. The invention as set forth in claim 4, in which a plurality of racks are mounted in vertical parallelism on said upper gate section and a corresponding plurality of gears are fixedly connected to a rotatable shaft mounted on said bulkhead, said gears being aligned with said racks to cause said upper gate section to move evenly when it is raised and lowered.

6. The invention as set forth in claim 1, in which a plurality of racks are mounted in vertical parallelism on said upper gate section and a corresponding plurality of gears are fixedly connected to a rotatable shaft mounted on said bulkhead, said gears being aligned with said racks to cause said gate section to move evenly when it is raised and lowered.

7. The invention as set forth in claim 6, in which said means for sliding said upper gate section between its said open and closed positions comprises a cylinder and piston assembly mounted between said bulkhead and upper gate section for actuation to slide said upper gate section.

8. The invention as set forth in claim 1, in which said pivotal connections for said lower gate section comprises shafts extending from the sides of said lower gate section and passing through slots in said guide means, and in which said means for pivoting said lower gate section comprises a cylinder and piston assembly, a crank on one of said shafts, and fixed means, said assembly being interconnected between said crank and fixed means for actuation to pivot said lower gate section.

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