Sept. 29, 1959 J. E. HANNIGAN 2,906,325

POWER ACTUATED HATCHCOVER

Filed Dec. 23, 1957 2 Sheets-Sheet 1

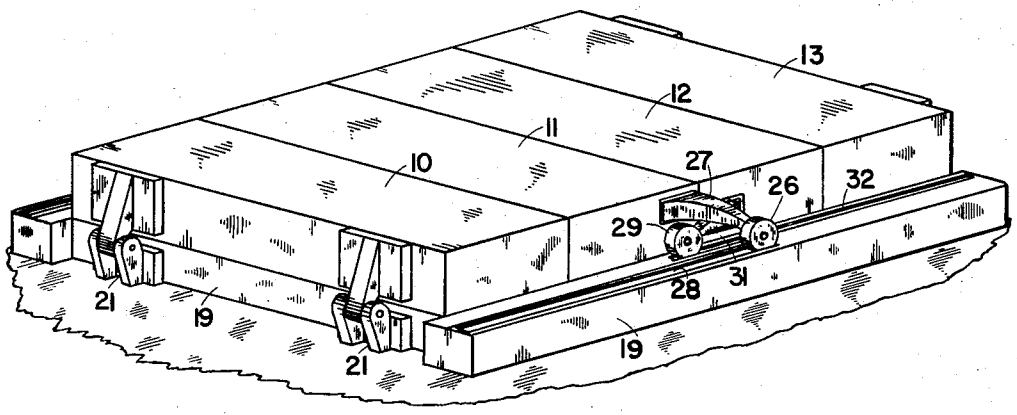

FIG. 1

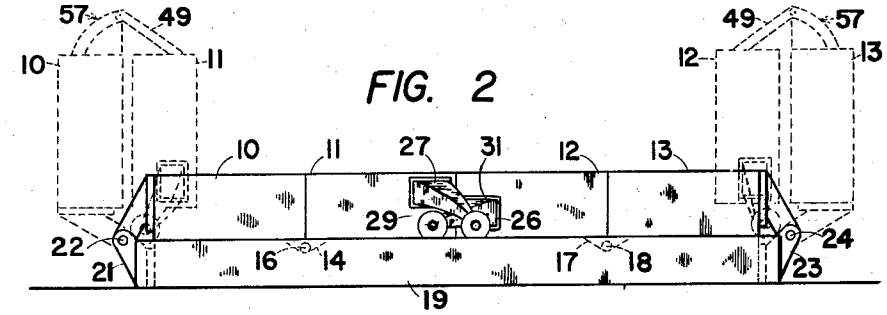

FIG. 2

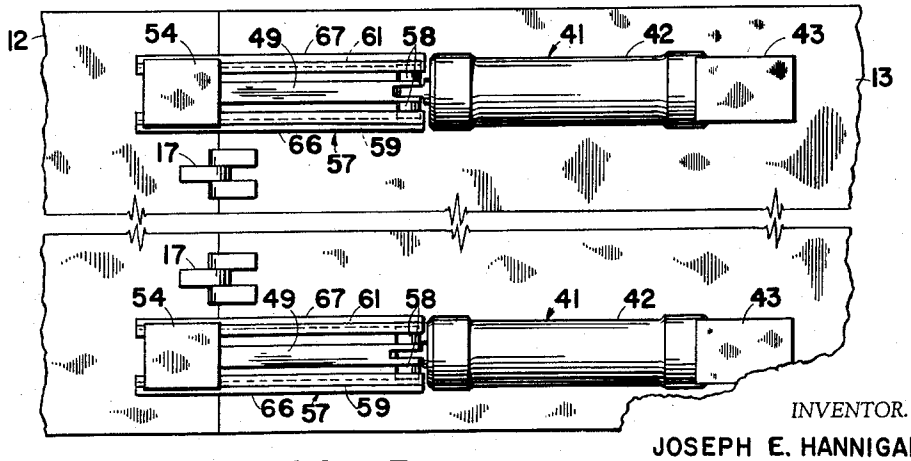

FIG. 3

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POWER ACTUATED HATCHCOVER

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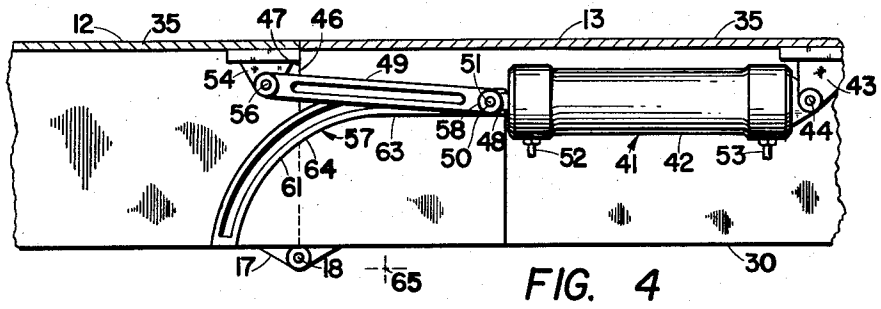

FIG. 4

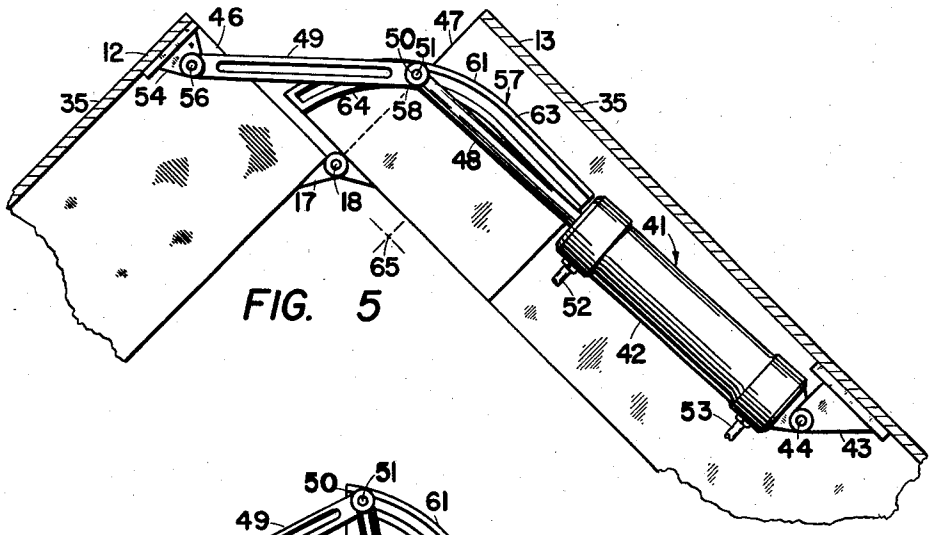

FIG. 5

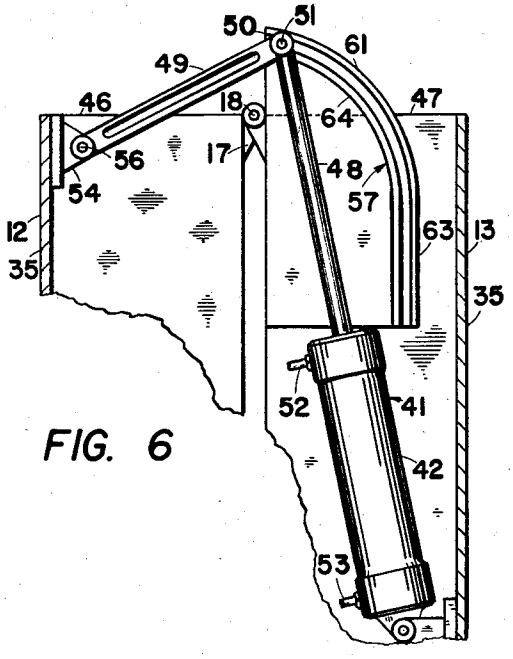

FIG. 6

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POWER ACTUATED HATCHCOVER

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Application December 23, 1957, Serial No. 704,581

10 Claims. (Cl. 160—188)

This invention relates generally to closure operators and more particularly to an actuating system suitable for use in the operation of hatchcovers for ships and the like.

It is an important object of this invention to provide a mechanism for producing relative rotation between two panels or doors through a 180° angle.

It is another objective of this invention to provide a new and improved power actuator folding door system.

A still further objective of this invention is to provide a new and improved power actuator hatchcover system for ship hatchways.

Further objects and advantages will appear from the following description and drawings, wherein:

Figure 1 is a perspective view of a typical hatchcover to which this invention is applicable;

Figure 2 is a side elevation of the hatchcover showing the cover elements in both the closed and open positions;

Figure 3 is an enlarged fragmentary plan view with the top plate removed showing the general arrangement of the actuating mechanism;

Figure 4 is an enlarged fragmentary side elevation showing the position the actuating mechanism assumes when the cover is closed;

Figure 5 is a view similar to Figure 4 showing the position the elements assume in an intermediate opening position and,

Figure 6 is a view similar to Figures 4 and 5 showing the positions the elements assume in a fully opened position.

Referring to Figure 1 a hatchcover incorporating this invention is normally formed with a plurality of panels or pontoons **10**, **11**, **12** and **13** which are positioned in a side-by-side relationship and cover the ship's hatchway when they are closed. In the illustrated hatchcover there are four panels, however, it should be understood that the size of the hatchway and the stowage clearances adjacent thereto determine the number of panels used in a particular installation. In the embodiment shown the panels **10** and **11** are connected by spaced hinges **14** for relative rotation around a hinge axis **16** and the panels **12** and **13** are similarly connected by spaced hinges **17** for relative rotation about a hinge axis **18**. The panel **10** is hinged to the ship's coaming **19** or the ship's deck, as the case may be, by hinges **21** for rotation around a pivot axis **22** and similarly the panel **13** is connected to the coaming **19** by hinges **23** for rotation around a pivot axis **24**. Thus the panels are divided into left and right pairs wherein the left pair comprising the panels **10** and **11** can be rotated from the closed position to the opened or phantom position of Figure 2 at the left end of the hatchway and the right pair comprising the panels **12** and **13** can be rotated to the phantom position at the right end of the hatchway. As mentioned previously, this structure is merely illustrative of one stowing arrangement and can be modified to move all the panels to one or the other end of the hatchway by a simple re-arrangement of the hinge connections.

The panel **11** is provided with a support arm **27** on either side of the hatchway on which is mounted a roller **26** which rolls along a track **28** on the coaming **19** to guide the right end of the left pair of panels in a horizontal plane. Similarly the panel **12** is provided with support arms **31** on which are mounted rollers **29** which are adapted to roll along tracks **32** mounted on a coaming **19** in offset relationship with the tracks **28**. The opening of the hatchway is accomplished by producing relative rotation between the panels, each pair around their respective hinges **16** and **18**. Since the end panels **10** and **13** are mounted on the coaming **19** for pivotal movement about their respective axes **22** and **23**, it will be understood that the relative rotation of the panels **10**, **11**, **12** and **13** will cause the rollers **26** and **29** to move along their respective tracks until the panels assume the phantom position of Figure 2. A comparison of the closed and open positions will show that the panels of each pair must rotate through a full 180° from the closed to the opened position so the mechanism for the power operating the hatchcover system must be capable of producing 180° of relative rotation between the panels.

Each of the panels is formed with a relatively heavy upper plate **35** which is stiffened by beams and struts, not shown, to give the panels sufficient structural strength. The upper plates **35** cooperate to form a continuous surface when the panels are closed so that it is not necessary to enclose the lower surfaces of the panels. Therefore the lower surface **30** of each panel is formed by an open grid of stiffening beams and struts. It will be understood that these panels will have to be arranged to provide adequate strength and, in addition, provide support for the actuating mechanism. However, since the particular beam structure will vary widely with different applications, it is not critical to this invention and is not shown.

The preferred power actuating mechanism according to this invention is best illustrated in Figures 4 through 6 wherein the mechanism used to fold the panels **12** and **13** is illustrated. It should be understood that as shown in Figure 3 two or more such mechanisms are mounted side by side to operate the panels **12** and **13** and further that similar but opposite mechanisms are mounted between the panels **10** and **11**, but since all mechanisms are alike only one of the mechanisms used to operate the panels **12** and **13** will be discussed in detail. Each mechanism includes a fluid motor **41** having a cylinder **42** pivoted on a bearing pad **43** for rotation around a pivot axis **44**. The bearing pad **43** is in turn supported on the upper plate **35** of the panel **13** at a point spaced from the adjacent ends **46** and **47** of the panels **12** and **13** respectively. A piston **48** extends into the cylinder **42** and is axially movable relative thereto under the influence of fluid under pressure supplied to the cylinder **42** by hydraulic pressure lines **52** and **53**. When fluid under pressure is supplied to the line **52** the line **53** is connected to a reservoir return and the piston **51** moves to the right relative to the cylinder **42**. Conversely when the opposite fluid connections are made the piston **48** moves to the left relative to the cylinder **42**. Normally the two pressure lines **52** and **53** are connected to a source of fluid under pressure such as a pump or accumulator and a reservoir through a 4-way control valve (not shown). A link **49** is pivotally connected to a bearing pad **54** for rotation relative thereto around a pivot axis **56** and the bearing pad **54** is in turn mounted on the underside of the upper plate **35** of the panel **12** adjacent to the edge **46**. The link is also pivotally connected to the piston **48** by a pivot pin **50** for relative rotation about an axis **51**. To complete the actuating mechanism, I provide opposed guide tracks or cams **57** mounted on the panel **13** along which cam followers **58**

roll. Preferably the cams **57** are formed of opposed U-shaped channels **59** and **61** best shown in Figure 3 supported on opposed plates **66** and **67**, and the cam follower **58** comprises opposed bearings mounted on the pivot pin **50**.

To operate the panels between the closed position of Figure 4 and the open position of Figure 6, it is necessary to supply fluid under pressure to pressure line **53** and connect the pressure line **52** to the reservoir of return. This causes the piston **48** to move to the left relative to the cylinder **42** which causes the cam followers **58** to roll along the cams **57**. This motion is transmitted through the link **49** and produces rotation of the panel **12** in a counterclockwise direction relative to the panel **13** around the axis **18**. As the piston **48** continues to move out of the cylinder the various elements pass through the position of Figure 5 and move to the position of Figure 6 at which time the two panels have rotated relative to each other through 180°. It should be noted that the effective torque for a given force developed by the fluid motor **41** is at a maximum when the elements are in th e closed position of Figure 4 and drop off as the elements assume the position of Figure 6. This is desirable since the torque required to operate the panels between the closed and open positions is at a maximum as the panels initially move away from the closed position and drops off to a relatively low value as the panels assume the open position.

The cams **57** can be a number of different shapes depending upon a particular torque curve desired and the one shown is merely illustrative of one which has desirable characteristics. The illustrated cam has a first straight portion **63** followed by a circular portion **64**, having center of curvature at **65**, which extends beyond the end **47** of the panel **13**. It is necessary to arrange the cam so that the locus of movement of the axis **51** is inclined relative to a line connecting the axes **51** and **56** in all positions of operation, and so that the follower **58** moves beyond the end **47** when the panels move to the open position. If such proportions are used, the mechanism will not move through a dead center and will be capable of producing torque through the entire 180° operational range.

Those skilled in the art will recognize that the above described mechanism with its utilization of a piston and cylinder type fluid motor and simple linkage is relatively immune to damage or wear and will therefore produce a long trouble-free service life which is important in marine applications. In addition the piston rod extends between the two plates **66** and **67** which support the cams **59** and **61** respectively, so the piston rod is protected from the elements and from damage. In addition the cylinder **42** is completely contained within the panel **13** in all positions so it is protected.

When the panels are to be moved from the open position of Figure 6 to the closed position of Figure 4, the hydraulic connections to the cylinder **42** are reversed and the piston **48** moves into the cylinder **42** producing tension in the link **49** which initiates the closing movement. Once the panels have moved away from the fully opened position their weight will assist in returning them to the closed position, so it will usually be desirable to provide metering means in the reservoir return line to control the rate of closing.

Although the preferred embodiment of this invention is illustrated, it will be realized that various modifications of the structural details may be made without departing from the mode of operation and the essence of the invention. Therefore, except insofar as they are claimed in the appended claims, structural details may be varied widely without modifying the mode of operation. Accordingly, the appended claims and not the aforesaid detailed description are determinative of the scope of the invention.

I claim:

1. A closure comprising a pair of panels, a hinge connecting adjacent ends of said panels for relative rotation between a first aligned position and a second position, 90° of relative rotation from said first position, a link pivotally connected to one of said panels at a point spaced from said hinge, motor means connected between said link and other panel operable to effect said relative rotation, and cooperating cam means between said link and the other of said panels maintaining movement of said link within a predetermined locus.

2. A folding closure comprising a pair of panels, a hinge connecting adjacent ends of said panels for relative rotation between a first aligned position and a second position 90° of relative rotation from said first position, a link, a pivot connecting said link to one of said panels at a point spaced from said hinge, a cam on the other of said panels, a cam follower on said link in guided engagement with said cam, and motor means connected to said link operable to move said follower along said cam, a line connecting said pivot and follower being inclined relative to said cam in all positions of said panels.

3. A folding closure a pair of panels, a hinge connecting adjacent ends of said panels for relative rotation between a first aligned position and a second position 90° of relative rotation from said first position, an elongated link, a pivot connecting said link to one of said panels at a point spaced from said hinge, a cam on the other of said panels extending beyond said adjacent end thereof, a cam follower on said link in guided engagement with said cam, and fluid motor means including piston and cylinder elements movable relative to each other under the influence of fluid under pressure, one of said elements being connected to said link and the other to said other panel, a line connecting said pivot and follower being inclined relative to said cam in all positions of said panels.

4. A folding closure comprising a pair of panels having spaced inner and outer surfaces, a hinge connecting adjacent ends of said panels for rotation around an axis adjacent to said inner surfaces between a first aligned position and a second position 90° of relative rotation from said first position, an elongated link, a pivot connecting said link to one of said panels adjacent to the outer surface and adjacent end thereof, a cam on the other of said panels extending beyond said adjacent end thereof, a cam follower on said link in guided engagement with said cam, and fluid motor means connected between said link and other panel operable to move said follower along said cam, a line connecting said pivot and follower being inclined relative to said cam in all positions of said panels.

5. A folding closure comprising a pair of panels having spaced inner and outer surfaces, a hinge connecting adjacent ends of said panels for rotation around an axis adjacent to said inner surfaces between a first aligned position and a second position 90° of relative rotation from said first position, an elongated link, a pivot connecting said link to one of said panels at a point spaced from said hinge, a cam on the other of said panels extending beyond said adjacent end thereof, a cam follower on said link in guided engagement with said cam, and fluid motor means connected between said link and other panel operable to move said follower along said cam, a line connecting said pivot and follower being inclined relative to said cam in all positions of said panels, and said pivot and follower being substantially adjacent to said outer surfaces when said panels are in said aligned position.

6. A folding closure comprising a pair of panels, a hinge connecting adjacent ends of said panels for relative rotation between a first aligned position and a second position 90° of relative rotation from said first position, a link, a pivot connecting said link to one of said panels

at a point spaced from said hinge, a cam on the other of said panels extending beyond said adjacent end thereof, a cam follower on said link in guided engagement with said cam, and motor means connected between said link and other panel operable to move said follower along said cam, said cam being formed with a substantially straight portion adjacent to said motor and an arcuate portion remote therefrom extending away from said pivot.

7. A folding closure comprising a pair of panels, a hinge connecting adjacent ends of said panels for rotation between a first aligned position and a second position 90° of relative rotation from said first position, a fluid motor including piston and cylinder elements movable relative to each other under the influence of fluid under pressure, an elongated link, a first pivot connecting said link to one of said panels at a point spaced from said hinge, a second pivot connecting one of said elements to the other of said panels, a third pivot connecting the other of said elements to said link, and guide means on said other panels engaging said third pivot constraining it to move along a predetermined locus, a line connecting said first and said second pivots being inclined relative to said locus in all positions of said panels.

8. A power actuated hatchcover comprising a horizontal hatchway, first and second panels, a first hinge connecting adjacent ends of said panels, a second hinge connecting said first panel to one edge of said hatchway, guide means on said second panel movable along said hatchway, a link pivotally connected to one of said panels at a point spaced from said hinge, a cam on the other of said panels extending beyond said adjacent end thereof, a follower on said link in guided engagement with said cam, and a motor operably connected to said follower operable to move it along said cam and produce relative rotation between said panels through 90°.

9. A power actuated hatchcover comprising a horizontal hatchway, first and second panels, a first hinge connecting adjacent ends of said panels, a second hinge

connecting said first panel to one edge of said hatchway, guide means on said second panel movable along said hatchway, a link pivotally connected to said second panel at a point spaced from said hinge, a cam on said first panel extending beyond said adjacent end thereof, a follower on said link in guided engagement with said cam, and motor means operably connected between said follower and first panel operable to move said follower along said cam and produce relative rotation between said panels through 90°.

10. A power actuated hatchcover comprising a horizontal hatchway, first and second panels, a first hinge connecting adjacent ends of said panels for rotation between a first aligned horizontal position and a second vertical position, a second hinge connecting said first panel to one edge of said hatchway, guide means on said second panel movable along said hatchway, a fluid motor including piston and cylinder elements movable relative to each other under the influence of fluid under pressure, an elongated link, a first pivot connecting said link to one of said panels at a point adjacent to said adjacent end thereof and spaced from said hinge, a second pivot connecting one of said elements to the other of said panels, a third pivot connecting the other of said elements to said link, and guide means on the other of said panels engaging said third pivot constraining it to move along a predetermined locus, a line connecting said first and said second pivots being inclined relative to said locus in all positions of said panels.

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