

Oct. 17, 1950

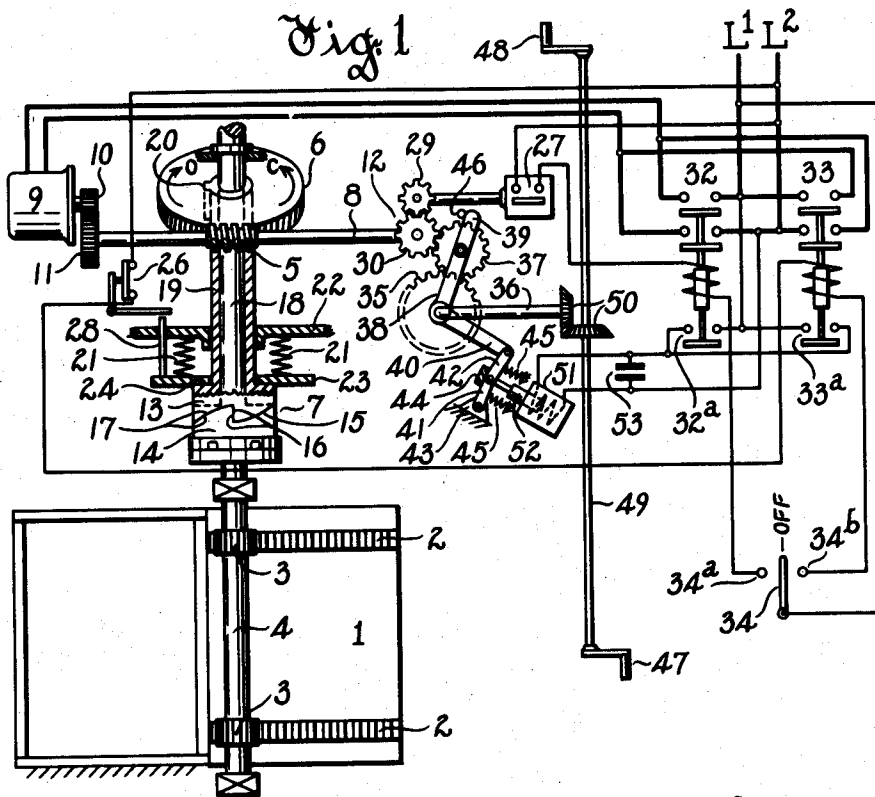
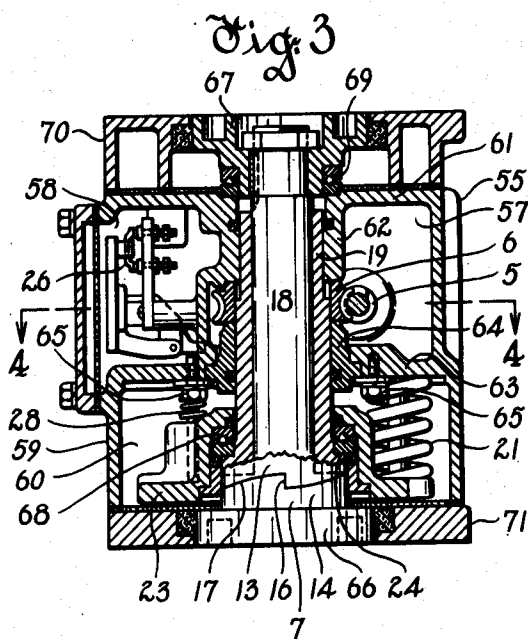
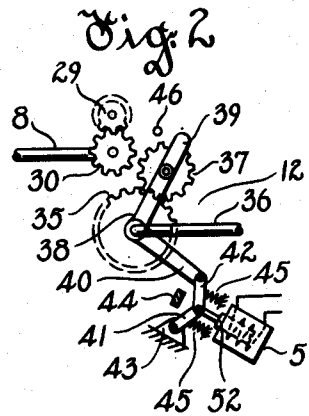
C. W. KUHN

2,525,915

HAND OR POWER DRIVING MECHANISM

Filed March 18, 1946

2 Sheets-Sheet 1



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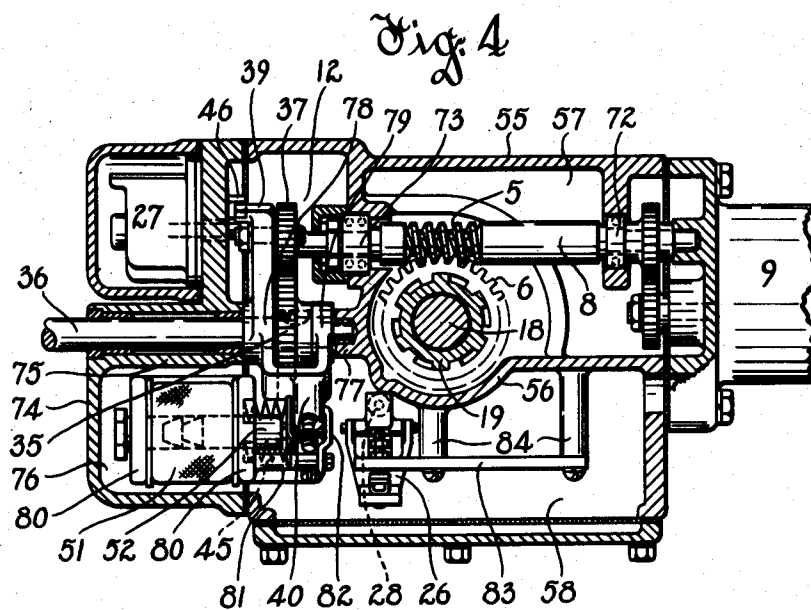
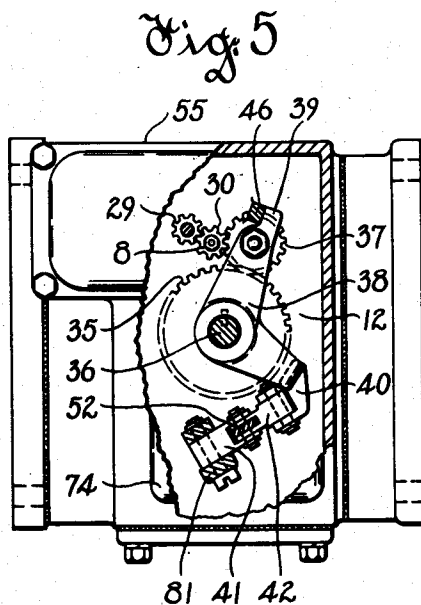
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UNITED STATES PATENT OFFICE

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HAND OR POWER DRIVING MECHANISM

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4 Claims. (Cl. 74—625)

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This invention relates to driving mechanisms for apparatus such as bulkhead doors.

The invention relates more particularly to bulkhead door operators of the automatically controlled motor driven type wherein provision is made for effecting manual operation of the door in an emergency.

The invention has among its objects to provide an improved unitary bulkhead door operator of the aforesaid type which provides a limited torque drive for closure of the door, and a positive drive for opening thereof.

Another object is to provide a unitary bulkhead door operator of the aforesaid type in which the manual operating mechanism is normally connected to the motor drive and is automatically controlled to provide for disconnection thereof from the motor drive upon energization of the driving motor and for re-connection thereto after a predetermined interval upon de-energization of the driving motor.

Another object is to provide a unitary bulkhead door operator of the aforesaid type which is exceedingly compact and rugged in construction, positive and reliable in operation and which is capable of being readily applied to bulkhead door installations in various positions to suit different drive arrangements.

Various other objects and advantages of the invention will hereinafter appear.

The accompanying drawings illustrate an embodiment of the invention which will now be described, it being understood that various modifications may be made in the embodiment illustrated without departing from the spirit and scope of the appended claims.

In the drawings,

Figure 1 is a schematic and diagrammatic view of a bulkhead door operating system embodying the invention;

Fig. 2 is a fragmentary view illustrating certain of the parts shown in Fig. 1 in another position;

Fig. 3 is a vertical sectional view of a unitary bulkhead door operator embodying the operating mechanism illustrated in Fig. 1;

Fig. 4 is a sectional view taken substantially on lines 4—4 of Fig. 3; and

Fig. 5 is a side view of the operator illustrated in Fig. 3 with parts of the enclosing casing broken away.

Referring to Fig. 1, an operating mechanism embodying the invention is shown in connection with a slidable bulkhead door 1 having a pair of operating racks 2—2 fixed thereto which

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are driven by pinions 3—3 fixed to an operating shaft 4. As shown the operating mechanism includes a worm 5 and an associated worm wheel 6 which is coupled to shaft 4 through the medium of a clutch 7. Worm 5 is provided with an operating shaft 8 which is operatively connected to a driving motor 9 through the medium of spur gears 10 and 11. As hereinafter set forth, shaft 8 is also provided with a manual operating mechanism 12.

More specifically, clutch 7 includes driving and driven elements 13 and 14 having opposing faces provided with a plurality of interfitting serrated teeth 15. The teeth 15 on said elements are shaped to provide cooperating axially disposed faces 16 and cooperating inclined cam faces 17. Driven element 14 is coupled to operating shaft 4 of the bulkhead door and is provided with an upwardly extending shaft extension 18. Driving element 13 is provided with an upwardly extending sleeve extension 19 which surrounds shaft 18 and is connected to worm wheel 6 by a spline driving connection 20 to permit upward axial movement of said driving element with respect to driven element 14. Driving element 13 is yieldingly held in engagement with the driven element 14 by a plurality of helical springs 21 which are held under compression between wall 22 and a non-rotatable thrust plate 23 which rides upon a shoulder 24 on sleeve 19 of driving element 13.

From the foregoing it is apparent that when motor 9 is energized to operate worm wheel 6 in the direction of arrow C power is transmitted to the door operating shaft 4 through the medium of the cam faces 17 of clutch elements 13 and 14 in a direction to effect closure of door 1. When door 1 is moved into closed position under the action of a predetermined force which is determined by the slope of cam faces 17 and by the biasing force of springs 21, driving element 13 slips with respect to driven element 14 and is moved upwardly by said cam faces against the action of said springs. On the other hand, when motor 9 is energized to operate worm wheel 6 in the direction of arrow O power is transmitted from said worm wheel to shaft 4 through the medium of the axially disposed faces 16 on clutch elements 13 and 14 to provide a positive drive for opening of door 1.

As hereinafter set forth, operation of motor M in door closing direction is controlled by a normally closed thrust responsive limit switch 25, and operation thereof in door opening direc-

tion is controlled by a position limit switch 27. Limit switch 26 is operatively connected to thrust plate 23 by a push rod 28 to provide for opening thereof upon upward movement of driving element 13 against the action of springs 21. Limit switch 27 is operated from worm shaft 8 through the medium of spur gears 29 and 30, the latter being fixed to said shaft. Limit switch 27 is arranged to open when door 1 is moved into open position and to close immediately upon movement of said door out of such position.

The motor 9 illustrated in Fig. 1 is of a direct current type to be supplied with current from a direct current supply circuit indicated by lines L^1 — L^2 . The power connections for motor 9 are controlled by a pair of double pole electromagnetically operated reversing switches 32 and 33 and in ship bulkhead installations provision is usually made for controlling these switches from a point adjacent the bulkhead door and also from a control panel located in the wheelhouse of the ship. However, such control means does not enter into the present invention, but in order to set forth the operation of applicant's system a simplified control is shown consisting of a conventional control switch 34 which may be located adjacent the bulkhead door. As shown this switch is movable in opposite directions out of an intermediate off position to selectively engage stationary contacts 34^a and 34^b.

Assuming that door 1 is in open position as shown in the drawing and it is desired to close the same, switch 34 is operated to engage its associated stationary contact 34^b. The operating winding of reversing switch 33 is then connected across lines L^1 — L^2 through the medium of limit switch 26 and upon response of said reversing switch, motor 9 is energized to operate in door closing direction. When said door is moved into closed position under the action of a predetermined force the driving element 13 of clutch 7 is moved upwardly against the action of springs 21 and limit switch 26 is opened to deenergize switch 33 for stopping of motor 9. Assuming that door 1 is in closed position and it is desired to open the same, switch 34 is moved into engagement with its associated stationary contact 34^a. The operating winding of reversing switch 32 is then connected across lines L^1 — L^2 through the medium of limit switch 27 and upon response of said reversing switch motor 9 is energized for operation in door opening direction. When door 1 is moved into full open position limit switch 27 is opened to deenergize reversing switch 32 for stopping of motor 9.

As hereinbefore stated, shaft 8 is provided with a manual operating mechanism 12, and as illustrated in Fig. 1 this mechanism includes a driving spur gear 35 which is fixed to a manual operating shaft 36 and an intermediate spur gear 37 which meshes with the former spur gear and is movable into and out of meshing engagement with the spur gear 30 on worm shaft 8. Shaft 36 has a bell crank 38 rotatably mounted thereon which is provided with arms 39 and 40. Gear 37 is rotatably mounted upon bell crank arm 39 and bell crank arm 40 has an operating toggle associated therewith comprising a pair of levers 41 and 42. Lever 41 has one end pivotally connected to a stationary support 43 and lever 42 has one end pivotally connected to the free end of lever 41 and its opposite end pivotally connected to the free end of bell crank arm 40. The toggle levers 41 and 42 are normally held against

a fixed stop 44 by springs 45, as shown in Fig. 1, and with the toggle levers in this position bell crank arm 39 is held against a fixed stop 46 to maintain gear 37 in meshing engagement with gear 30. Shaft 36 is thus normally coupled to worm shaft 8 through the medium of gears 35, 37 and 30 to provide for manual operation of door 1 in opening or closing direction.

In ship installations provision is usually made for operating the bulkhead door from a point adjacent the door by means of a crank 47, or from a point above the waterline of the ship by means of a crank 48. As illustrated in Fig. 1 these cranks are arranged to operate shaft 36 through the medium of a shaft 49 and a pair of bevel gears 50.

The above described manual operating mechanism is provided with automatic control means for disconnecting the same from worm shaft 8 immediately upon energization of motor 9 and for reconnecting the same thereto upon stopping of said motor. This control means comprises an operating solenoid having a stationary winding 51 and a movable plunger 52 which is operatively connected to the toggle levers 41 and 42. Winding 51 is shunted by a condenser 53 and it is connected as shown in Fig. 1 to provide for energization thereof from lines L^1 — L^2 upon closure of either of the reversing switches 32 and 33 by auxiliary contacts *a* associated with said switches.

Winding 51 is thus energized immediately upon energization of motor 9 to move toggle levers 41 and 42 from the position shown in Fig. 1 into the position shown in Fig. 2. Upon movement of the toggle levers 41 and 42 into the position shown in Fig. 2 bell crank 38 is operated to move gear 37 out of mesh with gear 30 to thereby disconnect the manual operating mechanism from worm shaft 8. Upon deenergization of motor 9 solenoid winding 51 is disconnected from lines L^1 — L^2 and is then maintained energized for a temporary period by a discharge current from condenser 53. Condenser 53 is designed so that the discharge current thereof maintains solenoid plunger 52 in its attracted position until motor 9 is brought substantially to rest, and upon release of said plunger toggle levers 41 and 42 are returned to the position shown in Fig. 1 under the action of springs 45 to move gear 37 into mesh with gear 30 for reestablishment of the driving connection between shaft 36 and worm shaft 8.

As shown in Figs. 3 and 4 the above described mechanism is housed within a rectangular enclosing casing 55 to provide a self-contained unit. Motor 9 is secured to one side of casing 55 and as shown in Fig. 4 said casing is provided with an interior wall 56 which provides a chamber 57 for receiving worm wheel 6 and its associated worm 5, and a second chamber 58 for receiving limit switch 26 and the gearing associated with the manual operating mechanism 12. Also as shown in Fig. 3, casing 55 has a skirt 59 formed on the underside thereof which provides a chamber 60 for receiving clutch 7 and its associated springs 21.

As shown in Fig. 3, the top wall 61 of casing 55 has a bearing 62 formed on the underside thereof and the bottom wall 63 of said casing has a bearing 64 secured within an opening therein by screws 65. Worm wheel 5 is held against axial movement between the opposing faces of bearings 62 and 64, and these bearings are bored to receive the sleeve extension 19 on clutch element 13. Clutch element 14 has a circular coupling flange 66 formed on the underside thereof and the shaft

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extension 18 of said clutch element extends upwardly beyond top wall 61 of the enclosing casing and has a circular coupling flange 67 fixed to the upper end thereof. The thrust plate 23 associated with clutch element 13 is supported upon the shoulder 24 of said element by a ball thrust bearing 68 and the springs 21 are held under compression between said plate and bottom wall 63 of the enclosing casing. Clutch element 14 is held against downward axial movement under the action of springs 21 by a ball thrust bearing 69 which is interposed between coupling flange 67 and top wall 61 of the enclosing casing.

Enclosing casing 55 has a mounting plate 70 secured to its top wall 61 which is bored to receive coupling flange 67 and said casing also has a mounting plate 71 secured to the lower end of skirt 59 which is bored to receive coupling flange 66. These mounting plates permit mounting of the unit for operation of the bulkhead door from either of the coupling flanges 66 or 67.

As shown in Fig. 4, the right hand end of worm shaft 8 is supported within chamber 57 by a ball bearing 72, and the left hand end thereof extends through an opening in wall 56 of the enclosing casing and is supported therein by a combined radial and thrust ball bearing 73. Gear 30 is fixed to the left hand end of worm shaft 8 and the manual operating mechanism 12 associated with said gear is carried by a cover 74 which is removably secured to casing 55.

As shown in Fig. 4, cover 74 is formed to provide a bearing 75 for receiving shaft 36 of the manual operating mechanism, and said cover is also formed to provide a recess 76 for receiving solenoid winding 51. The inner end of shaft 36 is supported within an opening in a projection 77 on casing wall 56 and bell crank 38 is provided with spaced hub portions 78 and 79 which are located on opposite sides of gear 35 and are supported between projection 77 and bearing 75. Solenoid winding 51 and its associated plunger 52 are carried by a frame 80 which is mounted within the recess 76, and as shown in Fig. 5 the toggle levers 41 and 42 are operable by said plunger in a plane parallel to the axis of shaft 36. The springs 45 associated with toggle levers 41 and 42 are held under compression between said levers and the solenoid frame 80 and the stationary support 43 for toggle lever 41 comprises an inwardly extending projection 81 on said frame. The stop 44 for toggle levers 41 and 42 comprises a plate 82 which is secured to projection 81 and the stop 46 for bell crank arm 39 comprises a projection formed on the inner face of cover 74.

The thrust limit switch 26 is located within chamber 58 and is mounted upon an insulating panel 83 which is secured to projections 84 on casing wall 56. As shown in Fig. 3 the operating push rod 28 for this switch extends upwardly from thrust plate 23 and is slidably supported within an opening in the bottom casing wall 63. The position limit switch 27 is mounted upon cover 74 and is provided with an operating shaft shown in dotted lines (Fig. 4) which is driven as shown in Fig. 5 from worm shaft 8 through the medium of gears 29 and 30. The specific construction of limit switches 26 and 27 need not be considered since the present invention is not concerned therewith.

What I claim as new and desire to secure by Letters Patent is:

1. The combination with a power transmission mechanism and a driving motor therefor,

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of a manual drive for an element of said mechanism comprising a manually rotatable operating member and a gear drive between said member and said element including a pair of cooperating gears movable into and out of meshing relation to connect and disconnect said operating member from said element, a toggle mechanism for normally locking said gears in meshing relation and electromagnetic operating means associated with said toggle mechanism for moving said gears out of meshing relation upon energization of said motor and for permitting return thereof to meshing relation upon deenergization of said motor.

2. The combination with a power transmission mechanism and a driving motor therefor, of a manual drive for an element of said mechanism comprising a manually rotatable operating member and a gear drive between said member and said element including a pair of cooperating gears movable into and out of meshing relation to connect and disconnect said manual operating member from said element, a toggle mechanism for normally maintaining said gears in meshing relation, electromagnetic operating means associated with said toggle mechanism for moving said gears out of meshing relation upon energization of said motor and for permitting return thereof to meshing relation upon deenergization of said motor, and means associated with said electromagnetic operating mechanism for preventing return of said gears into meshing relation for a predetermined interval upon deenergization of said motor.

3. In an operating mechanism for driving apparatus such as bulkhead doors, in combination, an enclosing casing, a reversible driving motor mounted upon said casing, a rotatable drive shaft mounted within said casing and having exposed coupling parts located at opposite ends of said casing, a driving mechanism between said motor and said shaft located within said casing and including a clutch having cooperating spring engaged parts of the spiral jaw type which operate to provide a positive drive between said motor and said shaft upon operation of said motor in one direction and which slip with respect to each other when said shaft is subjected to a predetermined load during operation of said motor in an opposite direction, and means carried by said casing and associated with an element of said driving mechanism to afford hand operation of said shaft, said casing and all of said parts carried thereby constituting a self-contained unit which is capable of being mounted in a fixed position upon the apparatus to be driven and coupled to drive such apparatus through the medium of either of said coupling parts.

4. In an operating mechanism for apparatus such as bulkhead doors, in combination, an enclosing casing, a reversible driving motor mounted upon said casing, a rotatable drive shaft mounted within said casing and having exposed coupling parts located at opposite ends of said casing, a driving mechanism between said motor and said shaft located within said casing and including a clutch having cooperating spring engaged parts of the spiral jaw type which operate to provide a positive drive between said motor and said shaft upon operation of said motor in one direction and which slip with respect to each other when said shaft is subjected to a predetermined load during operation of said motor in an opposite direction and a manual operating

mechanism carried by said casing and including a manually rotatable operating member which is normally coupled to said driving mechanism and is automatically disconnected therefrom immediately upon energization of said driving motor, said casing and all of the parts carried thereby constituting a self-contained unit which is capable of being mounted in a fixed position upon the apparatus to be driven thereby and coupled to drive such apparatus through the medium of either of said coupling parts.

CLARENCE W. KUHN.

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Certificate of Correction

Patent No. 2,525,915

October 17, 1950

CLARENCE W. KUHN

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows:

Column 4, line 36, for the word "in" second occurrence, read *is*; column 8, list of references cited, after "Dec. 25, 1945" insert the following:

FOREIGN PATENTS

Number

Country

Date

131,788

Germany

June 18, 1902

and that the said Letters Patent should be read as corrected above, so that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 20th day of February, A. D. 1951.

[SEAL]

THOMAS F. MURPHY,
Assistant Commissioner of Patents.

Certificate of Correction

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