

Aug. 1, 1944.

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2,355,025

CLOSING AND LOCKING MECHANISM FOR DOORS

Filed March 29, 1941

3 Sheets-Sheet 1

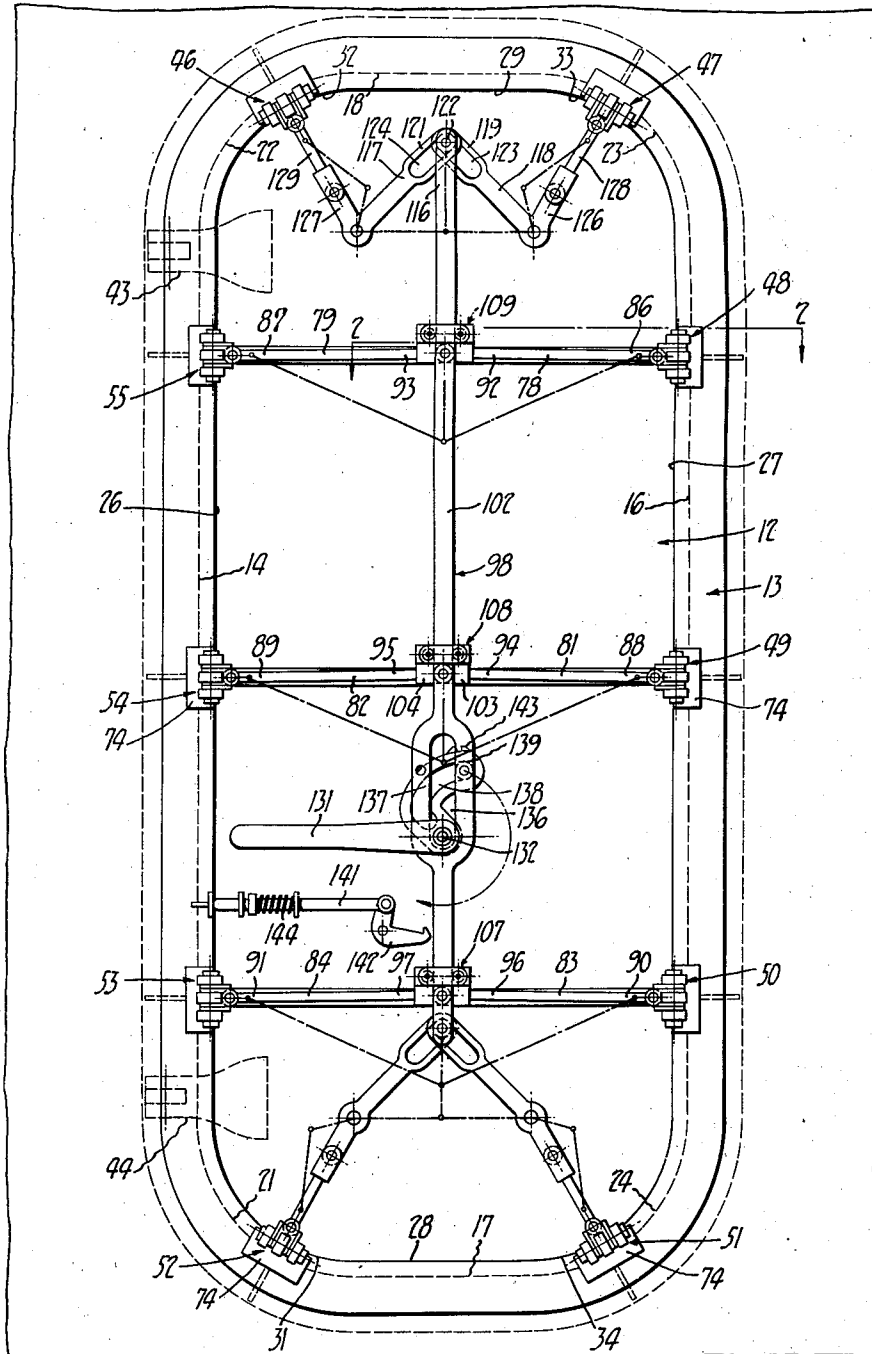


FIG. 1-

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3 Sheets-Sheet 2

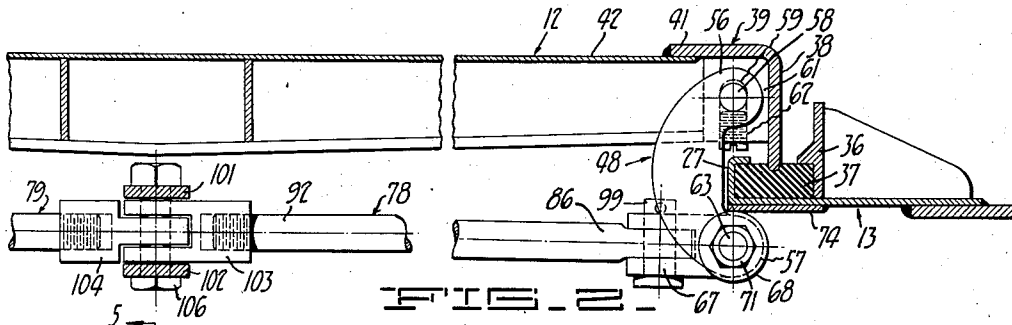
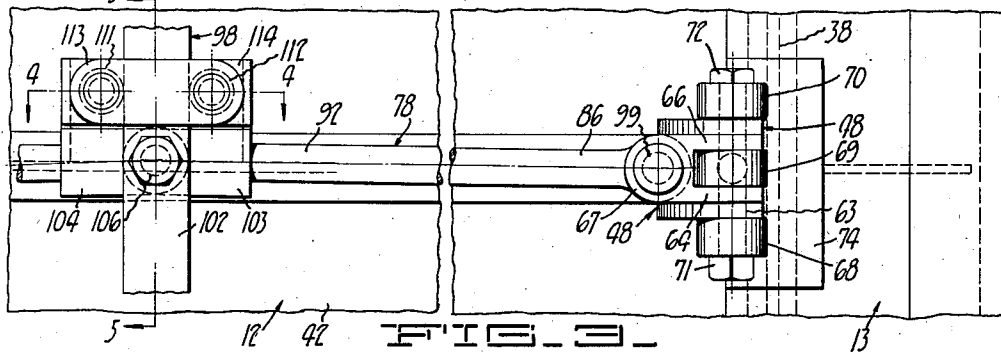
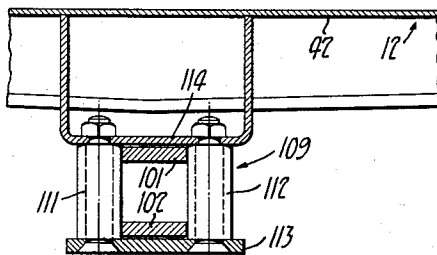


FIG. 4

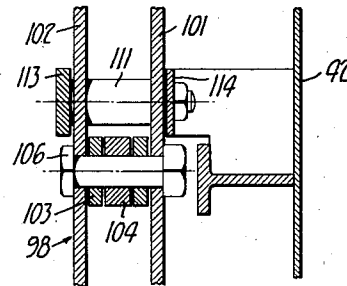


FIG. 5

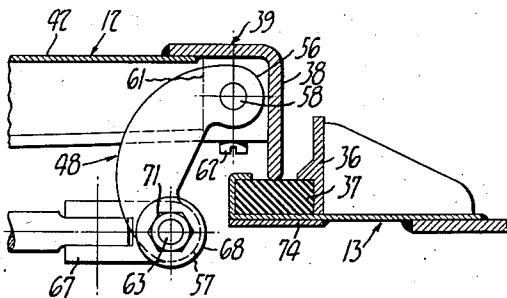


FIG. 6

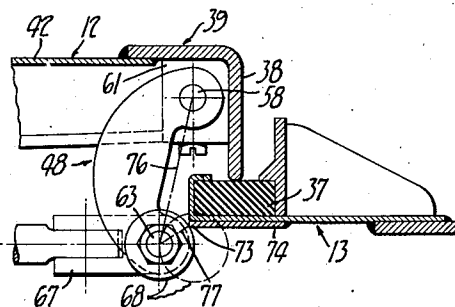


FIG. 7

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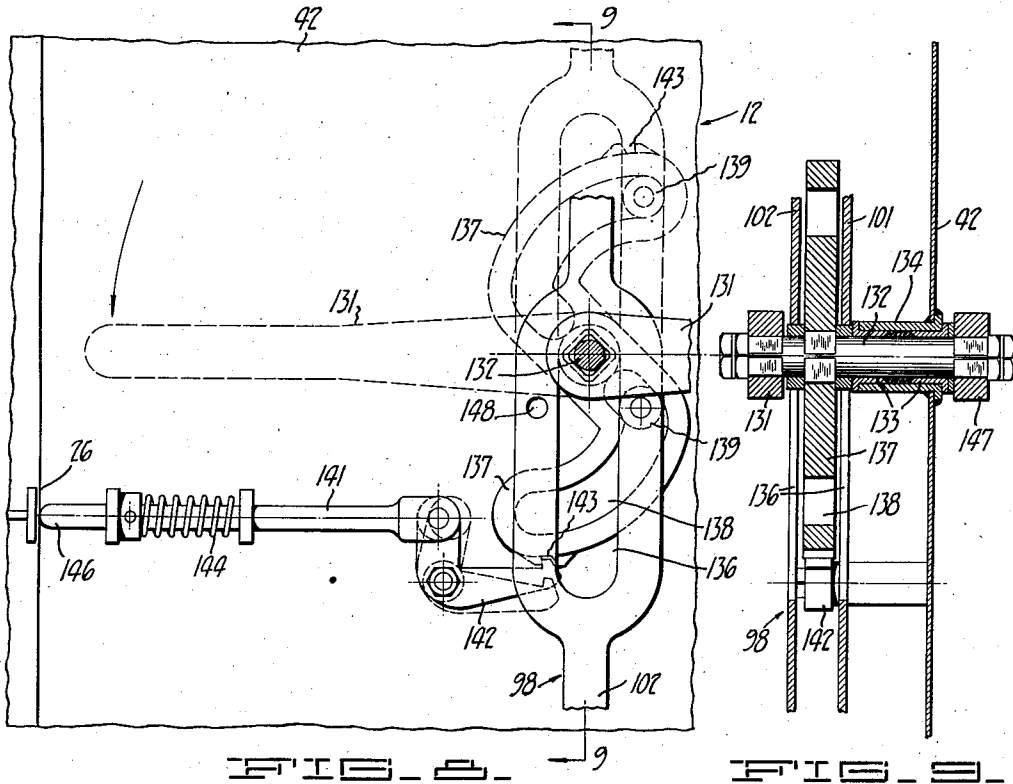
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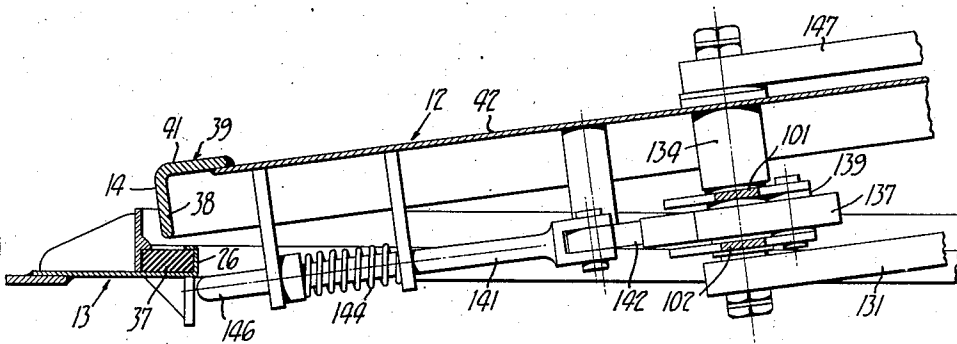
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PAGE 10

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2,355,025

CLOSING AND LOCKING MECHANISM
FOR DOORS

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Application March 29, 1941, Serial No. 385,871

7 Claims. (Cl. 292—45)

The invention relates to a door closing and locking mechanism of the type widely used in the case of ship doors and closures and the like and other constructions where a high degree of sealing is required. Such a door closure mechanism is disclosed and claimed in my copending application Serial No. 262,768, filed March 18, 1939, which has become Patent No. 2,295,324, dated September 8, 1942, of which the present application is a continuation-in-part.

An object of the present invention is to provide a door closure mechanism of the character described which will combine the desirable characteristics of speed and ease of operation, strength and integrity of the seal, and simplicity, dependability and compactness of construction, all to an improved degree over closing and locking mechanisms heretofore available, and as will be more particularly described in connection with the mechanism of the following.

The invention possesses other objects and features of advantage, some of which, with the foregoing, will be set forth in the following description of the preferred form of the invention which is illustrated in the drawings accompanying and forming part of the specification. It is to be understood, however, that variations in the showing made by the said drawings and description may be adopted within the scope of the invention as set forth in the claims.

Referring to said drawings:

Figure 1 is a front elevation of a door closing and locking mechanism constructed in accordance with the present invention.

Figure 2 is a cross sectional view of a part of the door and closing mechanism therefor, on an enlarged scale, taken substantially on the plane of line 2—2 of Figure 1.

Figure 3 is a side elevation of the part of the door and closing mechanism illustrated in Figure 2.

Figure 4 is a cross sectional view of a part of the mechanism taken substantially on the plane of line 4—4 of Figure 3.

Figure 5 is a cross sectional view of the portion illustrated in Figure 4 and taken on a plane at substantially right angles to the plane of Figure 4 as indicated by line 5—5 in Figure 3.

Figure 6 is a cross sectional view similar to Figure 2 but showing only a part of the mechanism illustrated in Figure 2 as the same appears in open position.

Figure 7 is a cross sectional view of the mechanism similar to Figure 6 but showing the parts illustrated moved towards a closed position.

Figure 8 is an enlarged front elevation of the operating handle and attached mechanism illustrated in Figure 1.

Figure 9 is a cross sectional view of the mechanism illustrated in Figure 8 and taken substantially on the plane of line 9—9 of Figure 8.

Figure 10 is a cross sectional view of the mechanism illustrated in Figures 8 and 9 taken at right angles to the plane of Figure 9, and showing the door positioned slightly from closed position.

The closing and locking mechanism of the present invention is illustrated in the accompanying drawings in conjunction with a door 12 and a frame 13, the particular shape and form of the door here illustrated being that commonly used in ship construction wherein the door is of elongated vertical dimension having opposite longitudinal sides 14 and 16, lower and upper ends 17 and 18 and rounded end corners 21, 22, 23, and 24. The door frame is constructed of a shape generally conforming to the outline of the door and including a vertical side 26 adjacent the door side 14, a vertical side 27 adjacent the door side 16 and bottom and top ends 28 and 29 adjacent the corresponding sides of the door, and rounded corners 31, 32, 33 and 34 engaged by the door rounded corners 21—24. As will be best seen from Figures 2, 6 and 7, the frame is provided completely around and facing the door with an annular channel 36 which carries a compressible gasket 37 which may be made of rubber or the like. Surrounding the periphery of the door and projecting therefrom at substantially right angles to the plane of the door and in the direction of the frame channel 36 is an annular flange 38 which engages and penetrates into the body of the gasket 37 in locking the door in closed position to thereby provide a seal between the door and the frame. Preferably, the flange 38 is formed as one side of an angle iron 39 extending around the door as an edge reinforcement therefor, and to the other side 41 of which is secured the main door panel 42. The door is pivotally attached to the frame by means of hinges 43 and 44 mounted at the sides 14 and 26 of the door and frame and these hinges are preferably of a more or less standard construction permitting a limited movement of the door to and from the frame as well as rotatably carrying the door whereby the door may be swung to adjacent its closed position and then moved directly against the frame without rotation in the final closing stage of the movement to thereby permit a direct end-on movement of the flange 38 against

the gasket 37 without producing a rotational distortion of the gasket. The closing and locking mechanism includes as part thereof a plurality of dogs or locking members 46, 47, 48, 49, 50, 51, 52, 53, 54 and 55 which are pivotally supported on the door in circumferentially spaced position around the door periphery, and arranged in pairs as follows: Members 46 and 47 at the upper corners 22 and 23 of the door; horizontally aligned pairs of members 48 and 55, 49 and 54, 50 and 53 along the vertical sides 14 and 16 of the door; and members 51 and 52 at the lower corners 24 and 21 of the door.

The construction of each of the members 46—55 is the same and accordingly a description of one of these members, 48, as shown in detail in Figures 2, 3, 6 and 7, will suffice. For purposes as will presently appear, I prefer to form these members in the shape of a C clamp and to pivotally attach one end 56 thereof to the edge part of the door, and preferably to the reinforcing angle iron 39 in such a position that the opposite end 57 of the member may be swung out and around the adjacent side of the frame in a position on a line through the pivotal axis at substantially right angles to the plane of the door. In this manner the locking member is brought to a dead-center position in the locked closed position of the door and all stress upon the moving mechanism for the member is eliminated and relieved in the locked position. As will be seen from the drawings, the C clamp 48 may be formed of two flat plates and a pivot pin 58 is secured to and extends transversely through the end 56 and is journaled in a bearing opening 59 in a bearing block 61 fastened in the angle iron corner. Preferably the opening 59 is elongated in the direction of the frame and a set-screw 62 is carried by the block and bears against the pin 58 for adjusting the position of the pin in the opening and thereby controlling the position of the pivotal axis of the members relative to the frame to enable proper adjustment of the mechanism with wear. As will be seen from the drawings, the construction is such as to arrange the pivotal axis of the C clamp member 48 parallel to the plane of the door and to the flange 38 and the adjacent frame side whereby the member 48 will swing about its pivotal axis in a plane perpendicular to the frame side 27. Mounted transversely through the opposite end 57 of the member and parallel to the pin 58 is a pin 63 which projects from the opposite sides of the member and pivotally carries thereat sides 64 and 66 of a yoke 67. Rollers 68 and 69 and 70 are journaled on the pin 63 between and at the outer sides of the yoke arms 64 and 66 and these rollers are held in place by end abutments 71 and 72 on the pin, here in the form of an enlarged head and nut. The provision of a roller at the outer end of the locking member is of considerable importance in obtaining an increase in mechanical advantage as the member moves to a locked position and in reducing friction. As will be best seen from Figure 7, the rollers in moving towards a locked position first engage the leading corner 73 of the frame side and as the member swings to a closed position, the rollers bear forcibly against and roll over the contiguous surface 74 of the frame side until the axis of the rollers reach a dead-center position relative to the axis of rotation of the member, as shown in dotted lines in Figure 7. Preferably the mechanism is adjusted so that when the flange 38 first engages the gasket 37, and the locking member 48 swung towards a closed position, the

rollers will engage the corner 73 of the frame side at a point on the circumference of the rollers within the quadrant of the rollers, as viewed in Figure 7, in advance of the radius of rotation of the member, which radius is indicated by the dash line 76 in Figure 7. In this manner as the member 48, as viewed in Figure 7, is pushed in a counter-clockwise direction, the rollers in rolling across the corner 73 and upon the end surface 74 will draw the frame and door together and cause a penetration of the flange into the gasket. As will be understood in the course of this locking movement of the rollers, the line of force of the rollers against the frame, indicated in Figure 7 by line 77, rotates about the axis of rotation of the rollers until the same coincides with the radius line 76. The force system here operable may thus be indicated by lines 76 and 77 and as will be clear, the mechanical advantage provided by the force system in moving to a locked position increases during such movement and finally reaches a very large magnitude which theoretically is infinity. This gain of mechanical advantage is of great importance in view of the large magnitude of force required to sink the flange into the compressible gasket to a requisite distance, usually in the order of one-eighth of an inch.

The members 46—55 are adapted to swing from a locked position overlying the frame, as described above and as illustrated in Figure 2, to a retracted position, as illustrated in Figure 6, confined entirely within the transverse dimensions of the door, so that upon opening the door, these members will move through the door opening with ample clearance relative to the frame sides and without danger of striking the frame sides. Means for moving the locking members between the two positions aforesaid here include in the case of the horizontally aligned side members 48 and 55, 49 and 54, and 50 and 53, a plurality of toggle link members 78, 79, 81, 82, 83 and 84 which are pivotally connected at their outer ends 86, 87, 88, 89, 90, and 91 to the yoke member 67 above described, and at their inner ends 92, 93, 94, 95, 96, 97 to an elongated actuator bar 98 supported for vertical endwise reciprocation along the longitudinal center of the door in a manner whereby the companion links 78 and 79, 81 and 82, 83 and 84, are moved into and from an aligned position as shown in Figure 1 producing a rocking of the locking members 46—55 to and from their locked position. As will be best seen from Figures 1, 2 and 3, the outer ends 86—91 of the links are pivoted to the yoke members 67, as by means of pins 99, about axes disposed at right angles to the axis of rotation of the locking members and substantially perpendicular to the plane of the door so that the link ends are pivotally attached to the locking members about a set of right angularly disposed axes in a universal manner, whereby the links while moving in a plane parallel to the plane of the door are capable of swinging the locking members in planes at right angles thereto. This feature of construction enables a compact positioning of the toggle links adjacent the face of the door.

The reciprocating center member 98 aforementioned, here consists of a pair of elongated flat strips 101 and 102 of metal, see Figures 2, 4 and 5, which are held in spaced apart position adjacent the front of the door by the pivoting of the inner ends of the link members thereto. As will be seen in Figure 2, the link members are of circular form in cross section and threaded at their

inner ends into fittings 103 and 104 having a clevis and tongue interfit between the strips 101 and 102 and pivotally attached to the strips by means of a pivot pin 106 extending therethrough. In view of the relatively small movement of the outer ends of the link members to and from the plane of the door, the pivotal connection on the center of the door is designed with a sufficient amount of clearance to enable such movement. Preferably and as here shown, the strips 101 and 102 comprising the bar 98 are supported for vertical reciprocation on the face of the door by a series of vertically spaced supporting units 107, 108, 109 which in each instance, see Figures 3, 4 and 5, includes a pair of horizontally set rollers 111 and 112 which engage the opposite longitudinal sides of the strips and which are carried between end plates 113 and 114 in spaced relation to the center part of the door panel 42. Also the units 107, 108, 109 may be positioned as here shown to engage and serve as stops for the pivoted sections 103, 104 of the inside link ends at the end of the upper movement of the bar into a position substantially aligning the pairs of link members afore-described.

By reason of the foregoing toggle construction, the mechanical advantage of force transmission increases as the bar 98 moves upwardly towards a locking position and towards an aligned position of the pairs of link members and reaches a very great magnitude towards the end of the locking stroke when the links move into alignment. This increase in mechanical advantage again amplified by the increase of mechanical advantage by the locking members as above described, produces an over-all gain of mechanical advantage which substantially exactly offsets the increased resistance to compression of the rubber gasket around the door as the door is moved to a locked position, whereby the manually applied force remains substantially constant throughout the locking operation.

In the case of the locking members 46 and 47, and 51 and 52, disposed at the upper and lower corners of the door, a similar toggle operating mechanism is used whereby a similar increase in mechanical advantage is obtained towards the end of the locking movement. As here shown, the upper locking members 46 and 47 are connected to the upper end 116 of the bar 98 by means of a pair of bell cranks 117 and 118 pivotally mounted on the door at equal distances on opposite sides of the bar 98 and having one end 119 and 121 thereof pivotally and slidably connected to the end 116 of the bar. This connection is here effected by means of a pivot pin 122 carried by the bar end and engaging in elongated slots 123 and 124 in the ends 119 and 121 of the bell cranks. The opposite ends 126 and 127 of the bell cranks are pivoted to toggle links 128 and 129 which are in turn pivotally connected to the locking members 46 and 47 in the same manner as the connection of the toggle links and locking members above described. The construction is such that the arms 126 and 127 of the bell cranks move into alignment with the toggle links 128 and 129 in the locked position of the members 46 and 47 whereby in approaching this aligned position, mechanical advantage is gained. It will further be noted that the side thrust on each of the bell cranks is exactly offset and supported by the side thrust of the other bell crank and hence the side thrust is balanced and only a straight longitudinal stress on the bar is involved. The operating connection for the lower corner

members 51 and 52 is the same as that described in connection with the upper corner members 46 and 47. It will thus be seen that the mechanical advantage of force transmission in the chain of movement to the corner locking members increases in the same manner as that described in connection with the side locking members and accordingly the over-all applying force remains substantially constant. This feature is of considerable importance in providing a smooth and easy operation of the door.

Means for reciprocating the bar 98 here consists of a manually operated handle or lever 131 pivoted to the door along the longitudinal center thereof and preferably somewhat below the horizontal center thereof. In accordance with the present construction, the operating lever 131 is operatively connected to the bar 98 in such a manner that the displacement of the bar for each degree of rotation of the lever is substantially constant throughout the full operating movement of these members and the movement of the lever is confined to substantially 180° of rotation to produce a full operating movement of the bar. As will be best seen in Figures 1, 8 and 9, the lever 131 is fastened for rotation with a shaft 132 here journaled in bearing sleeves 133 supported in a tubular part 134 welded or otherwise secured to the door panel 42. The strips 101 and 102 comprising the bar 98 are enlarged widthwise at and adjacent to the lever shaft 132 and are provided with aligned elongated openings 136 which surround the shaft and permit longitudinal reciprocation of the bar relative to the shaft. Secured to and extending from the shaft 132 is a curved arm 137 which is formed with a centrally arranged cam guide slot 138 which slidably receives a roller 139 pinned for rotation to and between the strips 101 and 102, whereby upon rotation of the shaft and swinging of the arm 137, the roller 139 will be displaced in the cam slot 138 to longitudinally displace the bar. As an important feature of the present construction, the cam slot is of such shape that a full operating movement of the bar 98 is effected during rotation of the lever 131 through substantially 180° and the ratio of lever to bar movement remains substantially constant throughout this operating movement.

In accordance with the present construction, sufficient mechanical advantage is obtained in the force and movement transmission connecting the lever and the locking members so as to make possible the locking of the door through a relatively short movement of the operating lever, here as aforementioned in the order of 180°. This feature makes possible an extremely rapid and easy opening and closing of the door which is of great importance in ship door construction, where in many instances and in case of emergency the speed and ease of opening and closing the door is a matter of life or death. In opening the door, the release of compression of the rubber gasket materially assists in the swinging of the dogs away from a locked position and starting the initial opening movement of the door. So rapid is the opening operation of the present mechanism that a user of the same may approach and open the door and walk through the door opening without changing his pace.

As to the strength of the door equipped with the present mechanism and the integrity of the seal obtained, it may be pointed out that the locking members by reason of their mounting upon the reinforcing angle iron around the door and

by reason of their movement to a self-locking position, completely relieves the center of the door and the connecting mechanism for the dogs of all stress in the locked position of the door.

When the door is in open position, it is important that the locking members remain contracted to within the confines of the door so as to prevent a jamming of these members against the door frame upon closing of the door. As will be understood, this is particularly important in the case of the dogs mounted at the hinged side of the door. In the present construction it will be noted that the locking members are moved to a retracted position in the normal gravitated position of the bar 98 and consequently, when the mechanism is moved to open position, the weight of the several parts tends to hold the parts in open position and in this manner the tendency of the parts to vibrate or jar into a closed position is completely eliminated. In order, however, to in addition prevent manual operation of the mechanism to swing the locking members from the edge of the door in the open position of the door, I provide a locking means for the control mechanism which is operative in the open position of the door to positively prevent the lever 131 from being rotated from its open position when the door is open. This means here consists of a slide member 141 reciprocally mounted on the door for movement at right angles to the frame side 26 and connected to a bell crank detent 142 which engages in a slot 143 in the operating arm 137 attached to the lever shaft. The member 141 is normally resiliently urged, by means of a helical spring 144 mounted thereon to position the detent to engage in the slot 143 in the open position of the lever, as illustrated in Figure 8, to thereby hold the lever against movement. The opposite end 146 of the slide member 141 is normally pressed by spring 144 to overhang the edge 14 of the door whereby the end 146 is engaged with and displaced by the adjacent side 26 of the frame, as illustrated in Figures 8 and 9, in closing the door. Displacement of the member 141 rotates the detent 142 out of its engaged position with the arm 137, as shown in dotted lines in Figure 8, so as to thereby release the operating mechanism for manual operation.

Preferably, the lever shaft 132 is extended completely through the door panel 42, see Figures 9 and 10, for connection of an operating lever 147 to the shaft at the opposite side of the door.

One of the features of the present centrally arranged operating mechanism is its adaptability for use with either left or right hand opening doors. In the construction shown in the drawings, the mechanism is adapted for a door hinged along its left side. In order to change the mechanism to a right hand opening door, it is only necessary to invert the lever arm 137 and to change the position of the roller 139 to the opposite side of the opening 136 and onto a bearing pin opening 148 positioned thereat. With this change, the operating lever will move through the same length of movement as here indicated for a right hand opening door. In this connection it will be noted that I have arranged the lever so that it is in a horizontally left hand position, as illustrated in Figure 1, when the mechanism is in closed position and in a horizontally right hand position when the mechanism is in locked position. This arrangement is preferable in order to enable the application of considerable and most convenient body leverage to the handle when operating the same either in the locking or unlocking operation.

I claim:

1. A closing and locking mechanism for a door and a frame therefor wherein opposite peripheral portions of the door overlie and engage opposite sides of said frame in the closed position of the door, comprising, a plurality of members pivoted adjacent one end thereof to said door at opposite sides thereof along parallel axes parallel to the plane of the door and movable in arcs in a common plane perpendicular to the plane of said door and perpendicular to said frame sides so as to swing the opposite outer ends of said members to and from said frame sides, rollers carried by said outer ends of said members for engagement with said frame sides, the spacing between said rollers and the pivotal axes of said members and the location of said axes relative to said frame sides being such as to cause said rollers to roll over and to bear forcibly against said frame sides in the closed position of the door to draw said door and portions and frame sides together upon movement of said rollers to positions on lines through said pivotal axes perpendicular to the plane of the door whereby said members will be self-locking in said positions, and manually operative means for swinging said members to and from their last named positions.

2. A closing and locking mechanism for a door and a frame therefor wherein opposite peripheral portions of the door overlie and engage opposite sides of said frame in the closed position of the door, comprising, a plurality of members pivoted adjacent one end thereof to said door at opposite sides thereof along parallel axes parallel to the plane of the door and movable in arcs in a common plane perpendicular to the plane of said door and perpendicular to said frame sides so as to swing the opposite outer ends of said members to and from said frame sides, rollers carried by said outer ends of said members for engagement with said frame sides, the spacing between said rollers and the pivotal axes of said members and the location of said axes relative to said frame sides being such as to cause said rollers to roll over and to bear forcibly against said frame sides in the closed position of the door to draw said door and portions and frame sides together upon movement of said rollers to positions on lines through said pivotal axes perpendicular to the plane of the door whereby said members will be self-locking in said positions, toggle links pivoted to said members adjacent said rollers and pivoted together adjacent the center of the door forming a toggle knee thereat, and manually operative means for displacing said knee to and from an aligned position of said links to correspondingly displace said members to and from said frame sides, said links and members being attached and supported to position said links in their aligned position at substantially right angles to the aforesaid lines through said rollers and member axes.

3. A closing and locking mechanism for a door and frame therefore wherein opposite peripheral portions of said door overlie opposite sides of said frame in a closed position of said door, comprising, a plurality of C shaped clamping members pivotally attached adjacent one end thereof to said door at the overlying peripheral portions thereof for swinging to and from said frame sides, rollers mounted on the other ends of said members and adapted to roll over and forcibly bear against said frame sides, said members being movable to a self-locking position wherein the clamping force applied by said members is par-

allel to the force of contact between said door portions and frame sides, and manually operative means for moving said members to and from said positions.

4. A door closing and locking mechanism for a door and frame therefor wherein said door is provided with a flange about the periphery thereof at substantially right angles to the plane of the door and engageable with a sealing gasket carried by said frame, a plurality of substantially C shaped clamping members each pivotally secured adjacent one end thereof to said door adjacent to said flange along an axis parallel to the plane of said door and parallel to said flange for swinging of the opposite end of said member into and from engagement with the adjacent frame side, a roller carried on said second named end of said member adapted to roll upon and forcibly bear against said frame side in the closed position of the door to draw said flange against said gasket, the length of said members and the arrangement of the pivotal axes thereof relative to said flange and frame sides being such as to permit movement of said rollers on said frame sides to positions applying a clamping force to said frame sides on lines passing through said member axes perpendicular to the plane of said door and parallel to said flange whereby said members will be self-locking in said positions, and manually operative means for moving said members to and from said positions.

5. A closing and locking mechanism for an elongated door and frame therefor comprising, a plurality of members pivoted to said door adjacent the corners thereof along axes parallel to the plane of the door for movement of said members in planes perpendicular to said door plane to engage and disengage said frame, an elongated member reciprocally mounted along the longitudinal center of said door, a lever for each of said first members pivoted to said door intermediate its ends and pivotally and slidably connected to an end of said second named member, links pivotally connected adjacent one end thereof to the other end of said levers and universally connected adjacent their opposite ends to said first members to produce oscillation of said first members about their axes upon longitudinal

reciprocation of said second member, and a manually operated means carried by said door and operatively connected to said second member for reciprocating the same.

6. In a quick-opening water-tight door closure mechanism, the combination with a hinged door and frame having overlapping peripheral portions contacting an annular compressible sealing gasket carried by one of said portions and arranged to be engaged by the other portion, a mounting point on said door and a bearing surface on said frame positioned on a line parallel to the line force between said overlapping peripheral portions, a locking member pivoted to said other portion at said mounting point along an axis parallel to the plane of the door and said peripheral portions to swing in an arc perpendicular to said plane and portions, and a roller carried by said member for rotation about an axis parallel to said member axis and engageable with said bearing surface and rollable thereover to a position wherein the point of contact of the roller periphery with said surface is on a line substantially intersecting the point of interengagement of said overlapping portions.

7. In a quick-opening water-tight door closure mechanism for a door and frame having overlapping peripheral portions and adapted to be closed and sealed by a force perpendicular to said portions, a gasket carried by said frame at said overlapping portion, a member pivoted at one end to said door portion to swing in a plane perpendicular to the plane of said door and being bowed centrally away from the adjacent overlapping frame portion to permit positioning of the other end of said member in opposed position to the side of said frame opposite to said door and in a dead center position with respect to the pivotal axis of said member, and a roller carried by said second named end of said member for rotation about an axis parallel to said last named axis and adapted to bear forcibly against said frame surface and roll thereacross to said dead center position and with the line intersecting said axes substantially passing through the interengagement points of said overlapping portions.

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