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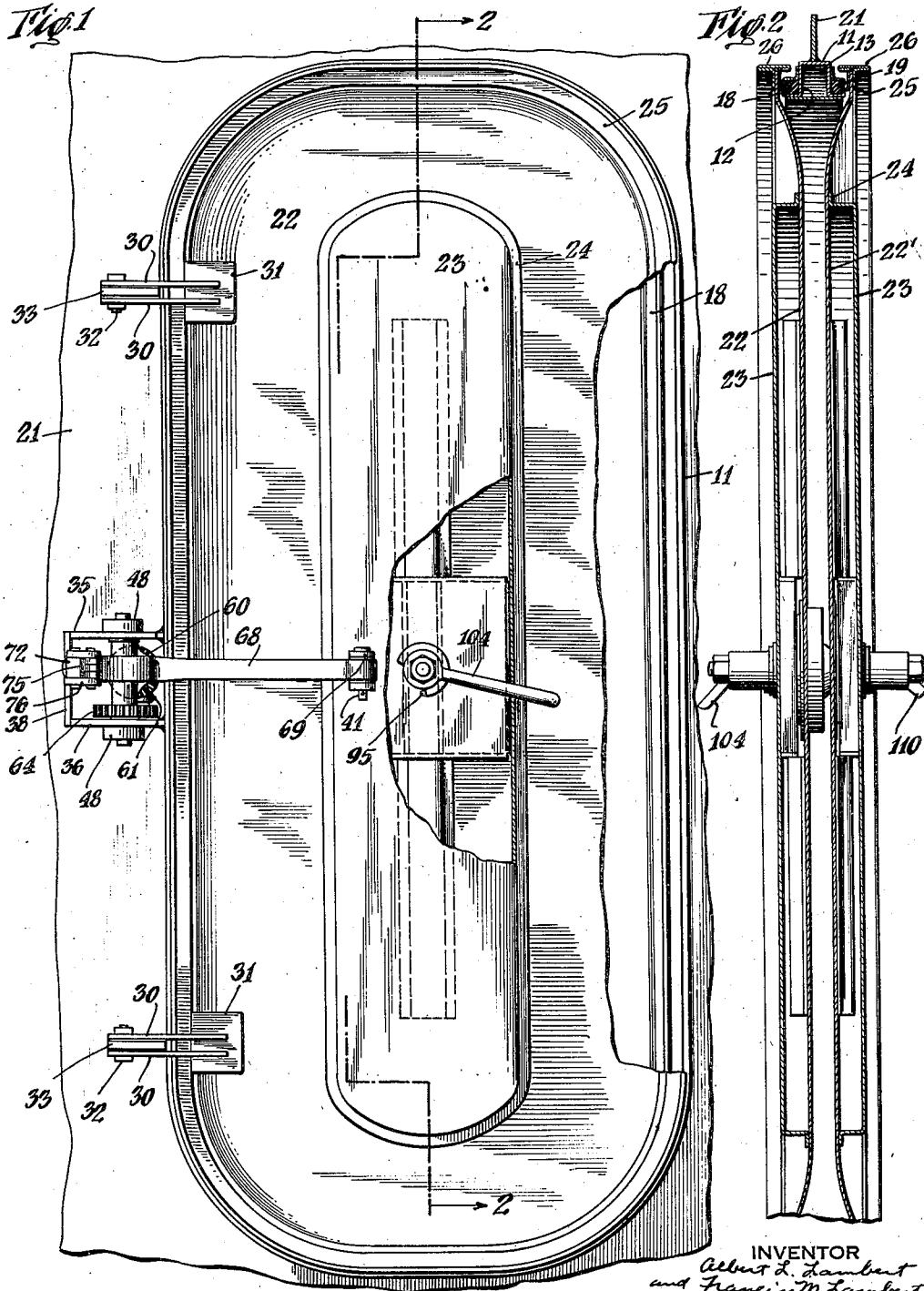
A. L. LAMBERT ET AL

2,103,291

WATERTIGHT DOOR

Filed Aug. 22, 1935

4 Sheets-Sheet 1



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WATERTIGHT DOOR

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4 Sheets-Sheet 2

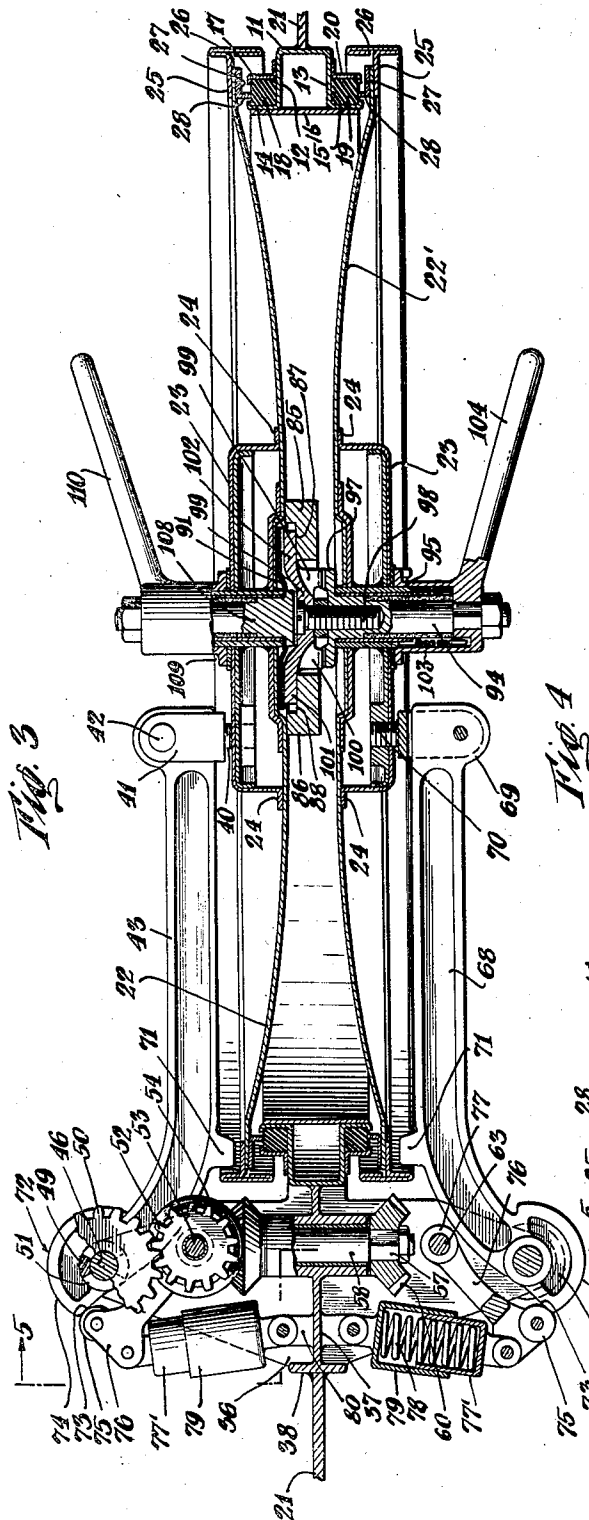
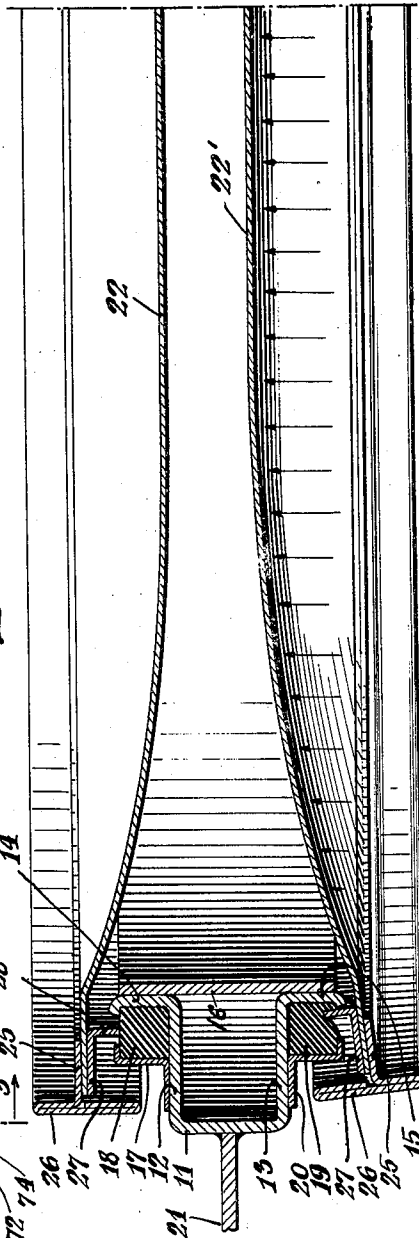


Fig. 4



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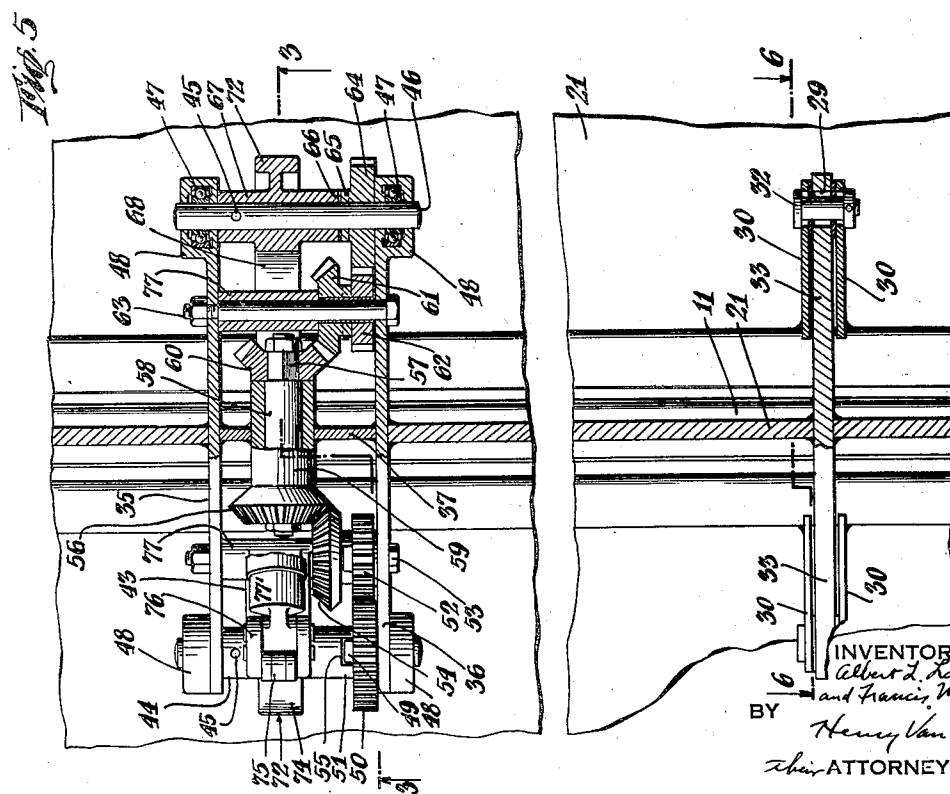
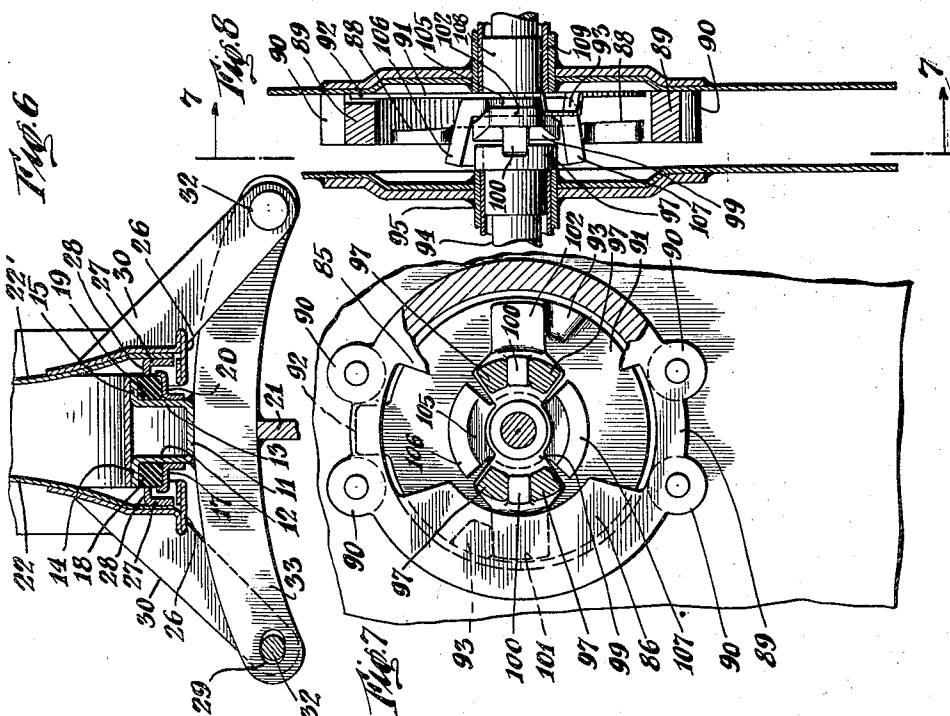
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WATERTIGHT DOOR

Filed Aug. 22, 1935

4 Sheets-Sheet 3



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WATERTIGHT DOOR

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4 Sheets-Sheet 4

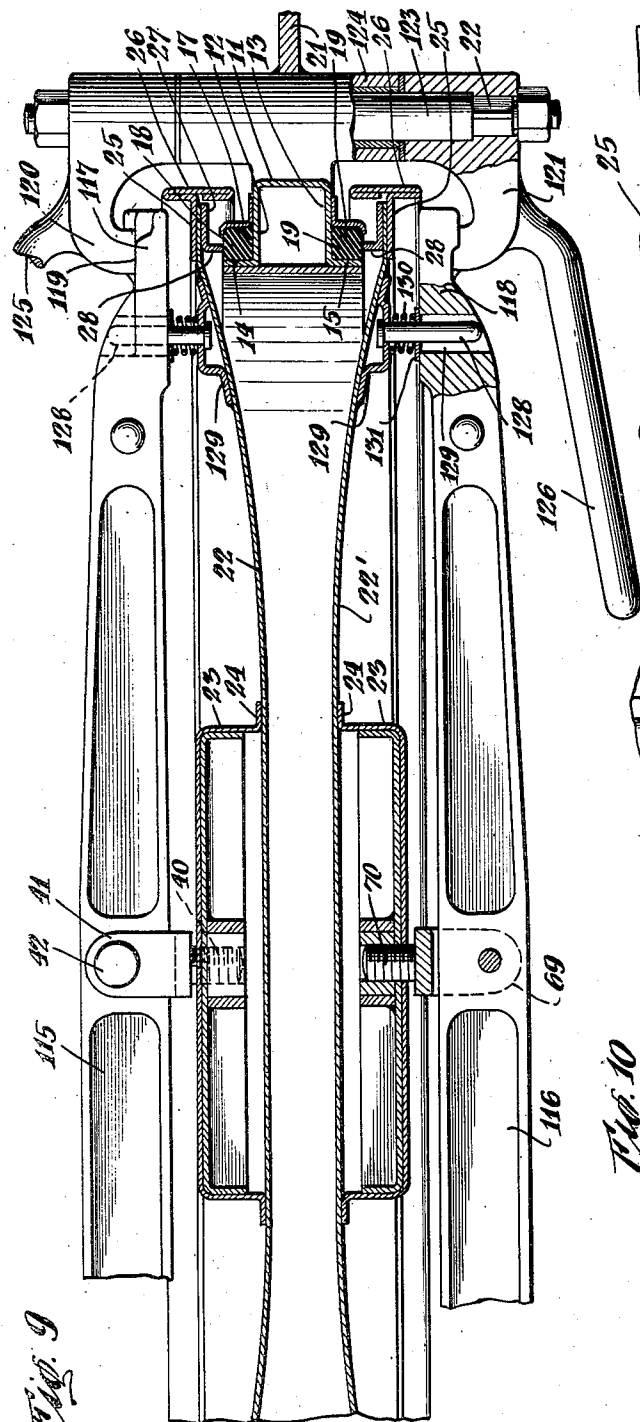


Fig. 9

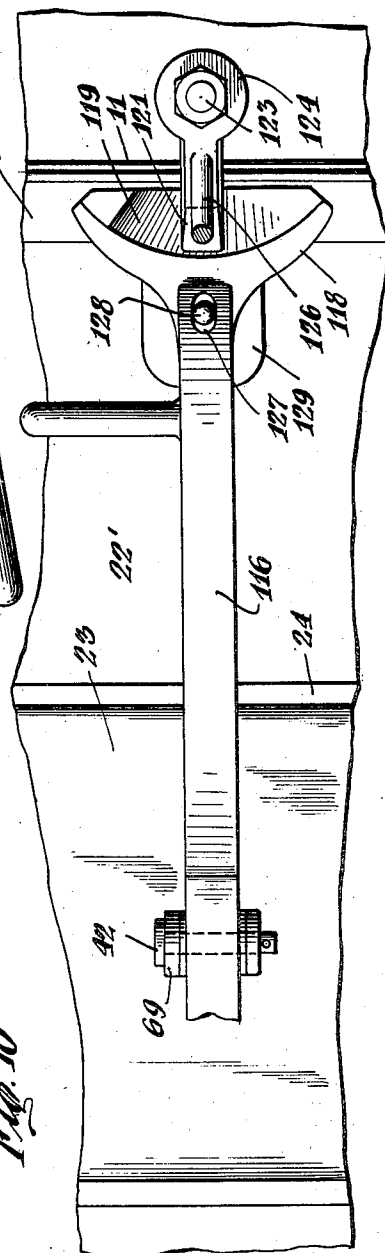


Fig. 10

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UNITED STATES PATENT OFFICE

2,103,291

WATERTIGHT DOOR

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Application August 22, 1935, Serial No. 37,269

33 Claims. (Cl. 114—117)

This invention relates to water-tight doors, and relates to means for mounting and operating the doors as well as to the construction of the doors and of frames and jambs therefor.

One of the principal objects of this invention is to provide a water-tight door so constructed and mounted that an extremely effective water-tight seal is established under pressure applied toward either side of the doorway, and to provide a construction of this character which is light in weight and which is able to withstand great pressures without breaking and without impairing the effectiveness of the seal, and to provide a construction of the character described which is extremely durable and resistant to dislocation and rupture under shocks and jars, even of tremendous severity, including those resulting from explosions or other detonations in the vicinity.

Another object of this invention is to provide a door having the characteristics referred to, and one which is self-seating against its door frame, and one which becomes seated more tightly as the pressure against it increases, and to provide a door which is effectively water-tight irrespective of the height of the water against the door, and is also effectively water-tight under low pressures against the door as well as under high pressures; and another object of this invention is to provide a door structure that is gas-tight as well as watertight.

Another object of this invention is to provide a door of the character referred to and one which can be opened readily, easily, and quickly, with a minimum of operations and comparatively little force, and will not jamb or stick or become hard to open or close.

Another object of this invention is to provide simple and effective means whereby two doors hung on opposite sides of a wall or bulkhead to close an opening therein by swinging in opposite directions may be drawn and held together effectively and securely, and against becoming released, and requiring merely a simple and easy operation which may be carried out quickly and with little effort, from either side of the wall or bulkhead, and at the same time permitting the doors to be released from each other readily, easily and quickly, when desired.

Another object of this invention is to provide means so connecting two doors hung on opposite sides of a partition or bulkhead to close in opposite directions, that the closing or opening of either door will result in a simultaneous and corresponding movement of the other door; and an-

other object of this invention is to provide means of this character whereby the corresponding door movements may be caused to be of different extent.

A further object of this invention is to provide a door jamb or frame which presents a true and even seat for the door, and a frame or jamb member which may be attached to a bulkhead or partition securely and firmly, irrespective of irregularities and unevenness of the edge of the bulkhead or partition receiving the jamb or frame, and without the flatness and alignment of the jamb or frame being dislocated or affected by such irregularities or unevenness of the bulkhead or partition.

A more specific object of this invention includes the provision of a bulkhead door for use in ships, and in this connection it may be pointed out that it is particularly required or desirable that such doors be effectively water-tight under low pressures as well as under high pressures, irrespective of whether the pressure is on either side of the door only or is against both sides, and the seal to be and to remain effective at all levels of water on the door; that the door be self-closing under pressure applied against either side or against both sides simultaneously, and yet may normally be opened and closed quickly and easily; that they effectively withstand shocks and jars of great force without becoming displaced or broken or their effectiveness and operation impaired, and that the doors be light in weight and at the same time extremely strong, shock resistant, and durable, as well as rust and corrosion resistant. Accordingly, the more specific objects of this invention include the provision of a specific door jamb or frame assembly, a specific door panel construction, and means whereby the panel is anchored to the door frame when the door is closed, and particularly when it is closed and under pressure; a special device for drawing and clamping together two doors hung on opposite sides of a bulkhead; specific mechanism connecting such doors together so that they close and open simultaneously as a result of either door being opened or closed, all these features cooperating to provide in a watertight door the features referred to above as being required or desirable.

In addition to these, other objects of this invention will be in part obvious and in part pointed out hereinafter.

In order that a clearer understanding of this invention may be had, attention is hereby directed to the accompanying drawings, forming a part

of this application, and illustrating certain possible embodiments of this invention and in which:—

Fig. 1 is a front elevation of a mounted door embodying this invention, certain parts being broken away to bring out more clearly certain features of the construction;

Fig. 2 is a sectional view thereof and is taken on the line 2—2 of Fig. 1;

Fig. 3 is an enlarged horizontal sectional view through the center of the door, as indicated by the line 3—3 of Fig. 5;

Fig. 4 is an enlarged sectional view of an edge of the construction, showing one of the doors in normal closed position, and showing the other door as seated under emergency pressure;

Fig. 5 is a broken sectional view of the door closing and door connecting mechanism, including a hinge mounting, and is taken on the line 5—5 of Fig. 3;

Fig. 6 is a sectional view of a detail showing a hinge mounting, and is taken on the line 6—6 of Fig. 5;

Fig. 7 is a sectional view of the mechanism for drawing and clamping the two doors together, and is taken on the line 7—7 of Fig. 8;

Fig. 8 is a sectional view thereof taken at a different angle;

Fig. 9 is a sectional view of a portion of a modification, showing fragments of the free edges of the doors, the adjacent portion of the jamb, and the means for drawing and clamping these door edges against the jamb; and

Fig. 10 is a front elevation thereof.

Similar reference characters refer to similar parts throughout the several views of the drawings.

Referring to the drawings, the construction includes a continuous door jamb or frame comprising a channel-shaped sheet metal part having a back wall 11, side walls 12 and 13, with outwardly extending ribs or flanges 14 and 15 along their edges, and a face strip 16 extending across and welded to the ribs 14 and 15, completing a box-like rail formation having outwardly extending flanges along both inner edges. Between the rib 14 and an attachment angle strip 17, secured to channel wall 12, is seated a strip of resilient packing 18, such as rubber, of substantial width and thickness, and a similar rubber packing 19 is seated between rib 15 and a metal attachment strip 20, attached to channel wall 13 as by welding.

Bottom wall 11 of the box frame seats against and is welded to the edge of the bulkhead or partition 21 about the opening therein. The edges of such openings in bulkheads and partitions in ships are frequently wavy or otherwise irregular either longitudinally or transversely or both ways, and because the base of the box frame may be effectively secured to the bulkhead or partition wall by welding, and the welding may be so applied as to effectively seal any apertures or spaces which may appear between the box frame and bulkhead edge, this frame construction and manner of its mounting results in the frame presenting an even, smooth, and properly aligned seating surface for the door at all points, irrespective of the roughness or unevenness of the bulkhead edge at the opening. This door frame or jamb is designed for two doors mounted on opposite sides of the bulkhead or partition 21 to close by swinging in opposite directions so as to face each other.

As shown, each such door comprises an inwardly

dished sheet metal panel 22, 22', reinforced centrally by an inverted box-like sheet metal reinforcement 23, which has a marginal flange 24 resting against and welded to the face of the panel. About the edge of each panel is welded the flange 25 of a reinforcing strip which has a doubled portion 26 extending transversely across the edge of the panel. To the inside face of each panel about its edge is welded an angle strip 27 which has a rib or flange 28 directed inwardly of the door and is adapted to seat on the packing strip 18 or 19 provided therefor on the corresponding face of the door jamb or frame, and to encircle the anchoring rib, 14 or 15, of the door frame on the side away from the center of the doorway of the frame or wall.

In the normal opening and closing of either door the flange 26 of the panel edge reinforcement clears the packing retaining strips 17 or 20, and the sealing and anchoring ribs 28 clear the projecting ribs 14 and 15 at the inner edges of the box frame, without interference. However, when pressure is applied against the outside of either door, its panel tends to bow more inwardly, as illustrated with respect to the panel 22' shown in Fig. 4. This further bowing in of the panel draws its periphery toward the center of the door, and consequently draws the sealing and anchoring rib 28 more deeply into the rubber sealing strip of the door frame, and more tightly against the anchoring ribs 14 or 15 of the box rail, and to increase their interengagement. This interengaging of the panel ribs 28 behind one of the anchoring ribs, 14 or 15, of the door frame prevents the panel edge from moving radially inward and prevents further bowing in of the door panel and places this panel under tension. Because of the dished-in contour of the panel, the strains of the anchoring ribs of the doors and door frame are not nearly so great as would be the case if the panels did not have this contour, and this, in combination with the anchoring of the panel edge against the frame ribs, prevents the panels from being ruptured or becoming distorted under pressures, even when extremely great. Furthermore, the greater the pressure, the deeper and more forcefully will the sealing and anchoring rib 28 enter and press into the rubber sealing strip and interengage with the anchoring ribs, 14 or 15, of the door and thus the strength and the resistance of the seal to penetration by water is increased as the pressure against the panel increases.

Each of the doors may be hung on two or more suitable hinges. As shown, each hinge may include two arms 30, welded at their door ends to a plate (which may be formed integral with flange 25 of strip 26) secured to the door, and pivoted at their rear ends on hinge pins 32, which penetrate an arm or bracket 33 extending through and welded to the bulkhead wall, each hinge bracket thus serving the two doors on opposite sides of the bulkhead. Preferably the hinge pins 32 extend through oversized holes 29 to insure against any jamming or sticking of the doors at these hinges.

The doors may be connected so as to swing simultaneously. As shown, the device for this purpose is in the main carried on a framework comprising upper plate 35 and lower plate 36, connected at their centers by a partition plate 37 welded at its upper and lower edges thereto, there being also a connecting strip 38 engaging and welded to the rear edges of plates 35 and 36 at their center portions and to the rear edge of the

center plate 37. A suitable aperture is cut in a bulkhead adjacent to the center of the door frame at the hinge edge of the doors, and the framework is disposed centrally in this aperture. The front edge of crossplate 37 is welded to the back of the door frame, and the plates 35 and 36 and the cross-strip 33 are welded to the adjacent edges of the bulkhead. This frame or bracket structure carries the mechanism connecting the doors as well as the mechanism for pressure closing both doors.

The mechanism for each door is substantially the same (see Figs. 3 and 5). The door having the panel 22 is engaged by the threaded shank 40 of a clevis 41, which is pivotally mounted, as by pin 42, on the end of an arm 43 which has an outwardly curved opposite end provided with a sleeve portion 44, pinned, as at 45, to a shaft 46, which is journaled in roller bearings 47, carried in housings 48 formed on the plates 35 and 36, pin 46 thus being the pivot pin on which the arm 43 swings. One end of sleeve 44 has clutch teeth 51 complementary to and interlocking with hub teeth 49 of a gear 50, loosely mounted on shaft 46. Gear 50 is in mesh with a pinion 52, rotatably mounted on a pin 53, which is rotatably supported by the plates 35 and 36. Connected to pinion 52 for rotation therewith, as by intermeshing clutch teeth, is a bevel gear 54 which is in mesh with a bevel gear 55, mounted on the square end 57 of a shaft 58, rotatably supported in a journal bearing 59, extending through a suitable aperture therefor in the cross-plate 37, and welded at its center to the plate 37 peripherally. The opposite end of shaft 58 is squared, and carries a bevel gear 60 which meshes with a bevel gear 61 connected, as by clutch teeth, to pinion 62, gear 61 and pinion 62 being mounted for rotation in unison on a shaft 63 supported by plates 35 and 36. Gear 62 is in mesh with a gear 64, having hub teeth 65 interlocking with teeth 66 on the end of a sleeve portion 67 of the arm 68 which is pivotally connected to the other door (which has the panel 22') by means of clevis 69, which has a threaded shank 70 engaging this door.

Thus it will be seen that by means of this gear train connection between the doors, when either door is opened or closed there will be a simultaneous and corresponding movement of the other door. In the illustration shown, both doors will move to the same extent; however, movement of one door to a relatively greater or less extent than the corresponding movement of the other door may easily be arranged for by adjusting the ratios between the gear 50 and pinion 52, or between gear 64 and pinion 62. For instance, by transposing the gear 50 and pinion 52 the movement of the door including panel 22 will be of greater extent than the corresponding movement of the door having the panel 22'. A suggestion is that the gear ratios be such that when the gear 50 and pinion 52 are transposed, or when the gear 64 and pinion 62 are transposed, the corresponding door will open to half the extent of the corresponding movement of the other door, thus permitting an arrangement whereby when one door is swung in an arc of 180 degrees the other door will only swing in an arc of 90 degrees. If desired each arm 43 and 68 may be formed with a heel or lug, such as 71, positioned to seat in front of the reinforcing edge flange 26 of each panel when the doors are closed, and each serving as an abutment for the edge flanges when the panel of the door is bowed in under pressure, and also serving to prevent the edge of the door

from being jarred out of place by shocks and vibrations, or by sudden and violent expansion of the air enclosed between the doors, as may follow an explosion.

To insure against jamming or binding of the mechanism connecting the doors for simultaneous movement, it is suggested that either the clutch connection between the gear 50 and sleeve 44, or the clutch connection between gear 64 and the sleeve 67 be made to have slight play or lost motion. For instance, a loose fitting of the interconnecting clutch teeth providing a slight clearance, such as $\frac{1}{64}$ of an inch between them may be provided, as shown at 55.

The doors are also provided with means for seating them closed under pressure, while at the same time permitting them to be swung open without building up resisting pressure during the entire extent of opening movement. For instance, the inner end of each arm 43 and 68 may be formed as or provided with a cam member 72 having a cam surface 73 inclining sharply toward the pivot 46 and joining at its outer end with a surface 74, which is concentric with the pivot 46, or approximately so. Cam rollers 75 riding on cam 72 are carried on the outer end of an arm 76, which has a hub 77 at its other end, rotatably mounted on pin 53 or 63. The upper end of a cup-shaped plunger 77' is also pivotally mounted on the outer end of arm 76, and embraces the outer end of a compression spring 78 which has its opposite end confined in a cup-shaped plunger 79 which is in telescopic relation to the plunger 77'. Plunger 79 is pivotally mounted on a bracket 80 affixed to the partition 37. The arrangement is such that when the door is nearly fully closed the cam rollers 75 roll off the surface 74 and on to the cam surface 73, whereupon the spring 78 will cause the rollers to press against the surface 73 and will close and hold the door closed under the pressure of the spring. When the door is opened, however, a slight opening movement of the door will ride the cam surface 74 into engagement with the rollers 75, and since surface 74 is concentric with pivot 46 the spring pressure will not be increased as the door is opened further. Thus it will be apparent that the door is closed and held closed under spring pressure, and yet at the same time the door can be opened and closed readily and easily and without great effort. The pressure under which either door is seated may be regulated by detaching the clevis (41 or 69) of that door from its operating arm, giving the clevis one or more half turns on the door, and then reattaching the clevis to the arm.

Means are also provided whereby, by a manual operation, the doors may be drawn tightly into the jamb and so secured. One means of this character may comprise a device whereby the doors may be drawn together. Such means may comprise a pair of arcuate cam members 85 and 86, mounted on the inner side of the panel 22 of one of the doors, and each having an undercut cam surface 87 and 88 bowing toward the panel 22 centrally from both ends, the cam surfaces facing the door and being spaced therefrom. These cam members 85 and 86 may comprise integral portions of a circular member 89, having apertured lugs 90 whereby the plate may be secured to the door. An annular spring plate 91 is disposed within member 89 and spaced from the door panel and held against rotation by means of an ear 92 formed on the plate 91 and engaging between two of the attachment lugs 90. Plate 91 is formed with two diametrically

opposite stamped-in portions or humps 93, which normally rest on the cam surfaces just to one side of the peaks thereof. A spindle 94 is rotatably mounted in a suitable journal assembly 95 carried on the other door, suitable packing being provided to render the connection and bearing water-tight. The inner end of spindle 94 is formed with teeth 97 exposed on the rear of the door, and has a threaded screw hole to receive a screw 98, which penetrates a clamping member 99 which has teeth 100 interlocking with teeth 97, and whereby the clamping member is firmly attached to the spindle and the teeth 100 and 97 held interlocked, thus insuring against relative rotation between the clamping member and the spindle. Clamping member 99 has two oppositely directed clamping arms 101 and 102, adapted, when the doors are closed, to move into a space provided in the wedge ring 89 between the cam portions 85 and 86, so that the clamping arms may be turned to engage and ride on the undercut cam surfaces to draw and to clamp the doors together. As the clamping arms are moved to the peaks of the inclines, or at any suitable points in their clamping movement, the clamping arms engage and depress the detent portions 93 of the spring plate 91 so as to pass under the detents, and as soon as the clamping arms have moved past these detents, the detents snap behind the clamping arms and thus yieldingly restrain return movement of the clamping arms out of the wedging and clamping engagement with the cam surfaces.

A suitable handle 104 is secured to the end of shaft 94 whereby the wedge member 99 may be rotated to engage the cam surfaces 85 and 86 to draw the doors together, and to be engaged by the detents 93. When the doors are disconnected from each other the spring 103 normally holds shaft 94 in such position of rotation that the clamping arms 101 and 102 of the clamp 99 will be in proper position to enter between the cam portions 85 and 86, and into alignment with the spaces which the cam surfaces face, thus eliminating any necessity on the part of a person desiring to couple and draw the doors together to move the handle 104 or to adjust the parts to insure proper entry of the clamping fingers into the cam member for coupling engagement therewith. If the clamping fingers were not normally held in proper position to enter between the cam portions into alignment with the spaces along the cam surfaces, a person might be obliged to manipulate the handle 104 to align the clamping fingers so that they would enter the cam member, and this would be likely to cause difficulty, delay and annoyance.

In order that the wedge fingers 101 and 102 may be rotated into clamping engagement with the cam surfaces 87 and 88 by a person operating from the outside of the opposite door, to draw the doors together, a member 105 having outwardly projecting prongs 106 and 107 is secured to the inner end of a spindle 108 rotatably carried in a journal assembly 109 mounted on that door, and having a suitable handle 110 whereby the shaft 108 and the prong member 105 may be rotated. Prongs 106 and 107 are diametrically opposite each other, and each normally extends through the open center of annular spring plate 91 and into the hollow of the cam plate 89 intermediate the ends of each cam portion, being normally moved to and held in this position by means of a suitable spring (not shown) enclosed in the journal assembly 109 and affixed at one

end to this journal assembly and at its other end to the shaft 108. These prongs thus normally seat between the two clamping arms 101 and 102 of the clamping member, one on one side and one on the other, so that when the handle 110 is turned the engagement of the prongs 106 and 107 against the sides of the clamping arms 101 and 102 will cause their rotation into clamping engagement with the cam surfaces 87 and 88, and such movement may be to the full clamping extent, including the displacement of the detents 93 and the locking of the clamping arms in final clamping position. Since the clamping member 99 and the prong member 105 are thus connected to move in unison, the doors may be coupled and drawn together and may be uncoupled from each other by operating either handle 104 or 110.

Another arrangement for clamping the doors against the door jambs is illustrated in Figs. 9 and 10. In this modification the operating arms 115 and 116, which at their hinge edges are similar to and mounted the same way as the arms 43 and 68, extend beyond their clevises 41 and 69 to the free edges of the doors, and at these ends each is provided with an arcuate formation 117 and 118, presenting a cam surface, such as 119, for engagement by a dog, such as 120 and 121, mounted on the square ends, such as 122, of a shaft 123, which is journaled in a suitable bracket 124 penetrating and welded to the bulkhead. The dogs are thus connected together to move in unison. The dogs have operating handles 125 and 126 whereby both dogs may be engaged with the cam surfaces of both arms 115 and 116 and both doors forced into the jambs and so held. It will be noted that the pressures applied by the dogs are exerted against the doors through the clevises 41 and 69, thereby distributing the clamping effect about the entire peripheries of the doors.

If desired each of the arms 115 and 116 may be apertured, as at 127, somewhat inwardly of the cam surfaces 119, to receive a pin 128 mounted on a bracket 129, secured to each door, each pin carrying a spring 130 confined between the bracket 129 and a washer 131 mounted on the pin for limited movement toward and from the bracket and so arranged that when the dogs 120 and 121 are engaged with the cam surfaces 119, springs 130 press against the door and against the arms 115 and 116. The function of these springs is to establish a certain resiliency which permits the edges of the doors to yield sufficiently and momentarily under extremely severe and sudden expansion of air in the space between the doors to permit sufficient air to escape to avoid any breaking or distortion of any of the parts or connections which otherwise might occur. Such expansion of the air between the doors may be occasioned by an explosion or detonation in the vicinity. With this construction each door may have a suitable handle (not shown) to facilitate opening and closing of the doors.

The operation of opening and closing the doors is simple and requires little effort and may be done quickly. To open the doors all that is necessary is to go to either door and either turn the center handle to uncouple the center lock, or, if the doors have the edge dogs instead of the center lock, to disengage the dogs, and then pull that door open. The operation of closing the doors is also very simple and requires little effort and may be done quickly. If the doors are open to a substantial extent it is only necessary to go to one of the doors and move it, or cause it to swing to

nearly closed position. At the end of the closing movement the springs 78 will act on the cam surfaces 73 to fully close the doors and to press and hold the doors against the rubber sealing strips.

To draw the doors together and to seat them more firmly and with a tighter seal it is only necessary to turn either center handle of the center locking device, or to engage the dogs 121 with the cam surfaces 119 of the levers 115 and 116.

It will be apparent from the above that the doors when closed establish a water-tight seal effective under low pressures as well as under high pressures, and at all points about the peripheries of the doors, and for all heights of water from their sills to their tops. It will also be noted that the seals are tight against penetration by gases, and are also highly resistant to penetration by heat, due to the completeness of the air space between the doors and in the jamb and the few and small areas of metal which bridge the two doors. The doors are resistant not only to pressures applied inwardly, but also are resistant to outward pressures from the intermediate air space and which are apt to follow gunfire or other explosions taking place outside of the doors.

The advantages and improvements contemplated by the objects of this invention, as well as other advantages and improvements, will be readily apparent from the above description and the accompanying drawings. Variation in and modification of the construction and the parts thereof are possible, and as many changes may be made in the above construction and as many apparently widely different embodiments of this invention may be had without departing from the scope thereof, it is understood that all matter contained in the above description or shown in the accompanying drawings be interpreted as illustrative and not in a limiting sense.

What we claim is:

1. A door frame of the character described, comprising a channel iron having a bottom wall adapted to be disposed longitudinally along and to be welded to metallic partition members providing an opening for the frame, flanges extending outwardly from the edges of the channel side walls and substantially at right angles thereto, and a tie piece bridging and secured to said flanges to form with the channel iron a frame member box-like in cross section.

2. A door frame of the character described, comprising a channel iron having a bottom wall adapted to be disposed longitudinally along and to be welded to metallic partition members providing an opening for the frame, flanges extending outwardly from the edges of the channel side walls and substantially at right angles thereto, and a tie piece bridging and secured to said flanges to form with the channel iron a frame member box-like in cross section, a retaining flange secured to the outer face of each channel side wall and spaced from said flanges and forming with said flanges and the intermediate portions of said side walls retaining channels for packing strips, and packing strips seated in said retaining channels.

3. In combination with a swinging door and a door frame providing a jamb for the door, of an arm attached to the door, means pivotally mounting the arm adjacent the door to swing therewith, a cam attached to the arm to rotate therewith about the arm pivot, and a pressure device having a pressure member engaging and pressing against said cam when the door is closed, to urge the arm to rotate on its pivot in door closing direction and

to press the door into the jamb, said cam having an arcuate cam surface approximately concentric with the pivot axis of the arm engaging said pressure member in certain open positions of the door, and having a cam surface extending sharply inwardly of said concentric cam surface engaging said pressure member when the door is moved to a certain closing position to fully close and press the door into the jamb.

4. In combination with a swinging door and a door frame providing a jamb for the door, of an arm attached to the door, means pivotally mounting the arm adjacent the door to swing therewith, a cam attached to the arm to rotate therewith about the arm pivot, and a pressure device having a pressure member engaging and pressing against said cam when the door is closed, to urge the arm to rotate on its pivot in door closing direction and to press the door into the jamb, and a clevis attaching the arm to the door, said clevis being carried on the arm and in adjustable threaded engagement with the door, the relative closing positions of the door and arm being variable in accordance with variations in the threaded engagement of the clevis with the door to vary the closing conditions of the door.

5. In combination with a swinging door and a door frame providing a jamb therefor, of an arm attached to the door, means pivotally mounting the arm adjacent the door to swing therewith, a cam attached to the arm to rotate therewith about the arm pivot and having a cam surface inclining toward said pivot, a pressure member engaging said cam surface, and means, including a spring plunger engaging and pressing the pressure member against said cam surface to urge said operating arm to rotate in door closing direction to press the door into the jamb, said cam surface moving out of contact with the pressure member when the door is opened to a predetermined position, and said cam having an arcuate cam surface approximately concentric with the pivot axis of the arm positioned to move into engagement with said pressure member when the door is opened to said predetermined position and to engage the door in further open positions.

6. In door structure of the character described, including a door frame, a swinging door to close against said frame, complementary ribs on the frame and door margin interengaging when the door is closed to restrain radially inward movement of the door edge, the rib on the door being laterally outward of the frame rib, an arm attached to the door, means pivotally mounting the arm adjacent the door to swing therewith, and abutment means on the arm to swing therewith into position opposite the outer surface of the door adjacent said rib to engage the door edge and to confine the door rib against movement out of interengagement with the frame rib when the door is subjected to shocks and explosion pressures tending to throw the door edge outwardly of the frame and to disengage the door rib from the frame rib.

7. In door structure of the character described, including a door frame and a swinging door to close against the frame, an arm extending across the door and attached to the center thereof, means pivotally mounting the arm at one end adjacent one edge of the door to swing with the door, the opposite end of the arm having a cam surface, said arm being spaced outwardly of the outer face of the door, resilient means pressing outwardly on said arm and inwardly on the surface of the door, a dog, means mounting the dog

adjacent the corresponding edge of the door to swing into and out of dogging engagement with said cam surface when the door is closed to clamp the door edge resiliently against said frame.

8. In door structure of the character described, including a door frame, two doors, means mounting said doors to swing in opposite directions against opposite faces of the frame, said frame holding said doors spaced apart when closed, an arm extending across the outer face of each door and attached centrally thereto, means pivotally mounting one end of each arm to swing with its door, the opposite end of each arm having a cam surface, each arm being spaced outwardly of the outer face of its door, resilient means pressing outwardly on each arm and inwardly on each door, a dog for each arm, and means mounting the dogs adjacent the corresponding door edges to swing into and out of clamping engagement with the cam surfaces of the corresponding arms when the doors are closed to clamp the door edges resiliently against said frame and to establish a water-tight and gas-tight joint between each door and the frame, permitting resilient movement of the door edges from the frame and the escape of gas through said joint under relatively great sudden pressures acting in the space between the doors.

9. In a door structure of the character described, including a door frame, two doors fitted thereto, each including a flexible central panel, means mounting said doors to swing in opposite directions against opposite faces of the frame, an arm extending across the outer face of each door and attached centrally to the flexible panel portion thereof, means pivotally mounting one end of each arm to swing with its door, the opposite end of each arm having a cam surface, a dog for each arm, and means mounting both dogs adjacent the corresponding door edges to swing simultaneously into and out of clamping engagement with the cam surfaces of the corresponding arms when the doors are closed to flex the flexible panels toward each other and to clamp the doors simultaneously to and to unclamp the doors simultaneously from the frame.

10. In door structure of the character described, two doors facing each other when closed, coupling means including members on the opposing faces of the doors interfitting and one member movable into coupling engagement with the other member when the doors are closed to couple the doors together, and detent means mounted on one of said doors and engaging said movable member when in coupling engagement with the other member to retain said movable member in said engagement.

11. In door structure of the character described, two doors facing each other when closed, coupling means including members on the opposing faces of the doors interfitting and one member movable into coupling engagement with the other member when the doors are closed to couple the doors together, and a spring detent mounted on one of said doors to engage and retain said movable member in said coupling engagement when the movable member is moved into said engagement.

12. The combination with two doors facing each other, of mechanism for coupling and drawing the doors together, said mechanism including complementary coupling members on the opposing faces of said doors, one of said members having wedge surfaces spaced from and facing the door on which it is mounted and the other of said members having fingers to engage said wedge

surfaces, one of said coupling members being movable relatively to the other to interengage said wedge surfaces and fingers to couple and to draw the doors together.

13. The combination with two doors facing each other, of mechanism for coupling and drawing the doors together, said mechanism including complementary coupling members on the opposing faces of said doors, one of said members having wedge surfaces spaced from and facing the door on which it is mounted and the other of said members having fingers to engage said wedge surfaces, one of said coupling members being movable relatively to the other to interengage said wedge surfaces and fingers to couple and to draw the doors together, and operating means on both doors engaging and operable to move said movable coupling member into coupling engagement with the other coupling member, said operating means being operable from the outside of either door.

14. The combination with two doors facing each other, of mechanism for coupling and drawing the doors together, said mechanism including a pair of spaced wedge members on the inner face of one of the doors, each having a cam surface spaced from and facing said door, a cam member movably mounted on the other door and having cam fingers to fit into the space between said wedge members and into alignment with the spaces faced by the cam surfaces and means for moving said cam member to ride said fingers upon said cam surfaces to draw and to clamp the two doors together.

15. The combination with two doors facing each other, of mechanism for coupling and drawing the doors together, said mechanism including a pair of spaced wedge members on the inner face of one of the doors, each having a cam surface spaced from and facing said door, a cam member movably mounted on the other door and having cam fingers to fit into the space between said wedge members and into alignment with the spaces faced by the cam surfaces and means for moving said cam member to ride said fingers upon said cam surfaces to draw and to clamp the two doors together, and a spring detent member mounted on the door having the wedge members and having detent portions disposed in the spaces faced by the wedge surfaces and engaging said cam fingers when each is moved to predetermined clamping position on the wedge surfaces to resist movement of said fingers out of said clamping position.

16. The combination with two doors facing each other, of mechanism for coupling and drawing the doors together, said mechanism including a pair of spaced wedge members on the inner face of one of the doors, each having a cam surface spaced from and facing said door, a cam member movably mounted on the other door and having cam fingers to fit into the space between said wedge members and into alignment with the spaces faced by the cam surfaces and means for moving said cam member to ride said fingers upon said cam surfaces to draw and to clamp the two doors together, said means including a rotatable member mounted on the door having the wedge members and engaging the cam member to move in unison therewith, a handle on said door connected to said rotatable member and movably to move said rotatable member and said cam member, and a handle on the other door connected to said cam member and movable to move said cam member.

17. The combination with two doors facing each other, of mechanism for coupling and drawing the doors together, said mechanism including a pair of spaced wedge members on the inner face of one of the doors, each having a cam surface spaced from and facing said door, a cam member movably mounted on the other door and having cam fingers to fit into the space between said wedge members and into alignment with the spaces faced by the cam surfaces and means for moving said cam member to ride said fingers upon said cam surfaces to draw and to clamp the two doors together, said means including a rotatable member mounted on the door having the wedge members and engaging the cam member to move in unison therewith, a handle on said door connected to said rotatable member and movably to move said rotatable member and said cam member, and a handle on the other door connected to said cam member and movable to move said cam member, and spring means connected to each door and to each handle thereon normally setting and maintaining the said cam fingers in position to enter and to fit between the wedge surfaces and in alignment with the spaces along the wedge surfaces and set for movement into engagement therewith.

18. The combination with two doors facing each other, of mechanism for coupling and drawing the doors together, said mechanism including on one of the doors a pair of spaced cam members, each having a cam surface facing and spaced from the door, a rotatable shaft having an operating handle on the outer face of the door and a pair of prongs fixed to the shaft and projecting between said cam members centrally, and including on the other door a rotatable shaft having an operating handle on the outer face of the door and a pair of divergent fingers fixed to the shaft to fit between and laterally engage said prongs to rotate simultaneously therewith and to fit between said cam members and into alignment with the spaces therealong and to rotate into engagement with said cam surfaces to draw and to clamp the doors together, the rotation of either door handle moving said fingers relatively to said wedge surfaces.

19. In door structure of the character described, including a door frame, two doors, means mounting said doors to swing in opposite directions against opposite faces of the frame, means including interengaging members on the opposite faces of the doors and inwardly of their edges to couple the doors together and to draw them against said frame, and motion transmitting mechanism connected to both doors connecting the doors to move simultaneously.

20. In combination with a wall having a door opening, of two doors, means mounting said doors to swing in opposite directions face to face to close the door opening, each door having a marginal rib projecting from the doorway side at an angle to the plane of the door, a door frame for both doors, fitting the door opening marginally and having ribs projecting toward each door and resilient packing adjacent the wall sides of said ribs, the door ribs seating against said packing and interlocking with the frame ribs when the doors are closed to restrain radially inward movement of the door edges when the bodies of the doors are subjected to pressure in closing direction, and means including interengaging members on the opposing faces of the doors to couple the doors together and to draw the ribs on the

doors into said packing and into increased inter-engagement with the frame ribs.

21. In a door of the character described, a dished, flexible, sheet metal face panel having the concavity extending from all points around its edge to a common central area of the panel, of a door frame, a member supported adjacent the door frame and connected to said panel adjacent said central area and means for urging said member toward said panel when the door is closed, the concave face of said panel being on the outward side thereof.

22. In a door of the character described, a dished, flexible, sheet metal face panel having the concavity extending from all points around its edge to a common central area of the panel, a metal stiffening edge frame having an attachment flange seating against and secured to the edge portion of the panel, and having a stiffening flange extending across the edge of the attachment flange at an angle thereto, and a metal angle secured to the panel portion and having a sealing flange extending from the inner face of the panel edge portion and at an angle thereto.

23. The combination with a door provided with a dished, flexible, sheet metal face panel having the concavity extending from all points around its edge to a common central area of the panel, of a box-like metal reinforcement secured to the panel at the center of the concavity, a door frame, a member supported adjacent said frame and connected to said reinforcement and means for urging said member toward said reinforcement when the door is closed.

24. The combination with a door frame and a door fitting the frame and having an inwardly flexible sheet metal panel, of means, including members on the edge of the panel and on the door frame interengaging when the door is closed on the door frame, to anchor the edge of the panel against movement toward the center of the door when the panel is flexed inwardly, said panel being dished inwardly and the concavity extending from all points around its edge to a common center area of the panel, said panel shape tending to diminish strain on the said interengaging members and on the body of the panel consequential to outside pressure applied to the panel tending to flex the panel inwardly, a member supported adjacent said door frame and connected to said panel adjacent said center area and means for urging said member toward said panel when the door is closed.

25. The combination with a door frame and a door fitting the frame and having an inwardly flexible sheet metal panel, of complementary means on the door and door frame providing interengaging surfaces angularly related to the plane of the door when closed to restrain radially inward movement of the door edge when the door panel is subjected to flexing pressure in closing direction, said panel being dished inwardly and the concavity extending from all points around its edge to a common center area, the said panel shape tending to diminish strain on said interengaging surfaces and on the body of the panel consequential to flexing pressure against the panel in door closing direction, and means connected to said panel adjacent said center area for urging said door against said frame when the door is in closed position.

26. The combination with a door frame and a door fitting the frame and having an inwardly flexible sheet metal panel, of means comprising complementary anchoring ribs on the door and

door frame interengaging when the door is closed to restrain radial inward movement of the door edge when the door panel is subjected to flexing pressure in closing direction, said panel being

5 dished inwardly and the concavity extending from all points around its edge to a common center area of the panel, said panel shape tending to diminish strain on said interengaging ribs and on the body of the panel consequential to inwardly

10 flexing pressure applied against the panel, and means supported adjacent said door frame and connected to said panel adjacent said center area for urging said door against said frame when the door is in closed position.

15 27. The combination with a door frame and a door fitting the frame and having an inwardly flexible sheet metal panel, of means comprising complementary anchoring ribs on the door and door frame interengaging when the door is closed

20 to restrain radial inward movement of the door edge when the door panel is subjected to flexing pressure in closing direction, said panel being dished inwardly and the concavity extending from all points around its edge to a common center

25 area of the panel, said panel shape tending to diminish strain on said interengaging ribs and on the body of the panel consequential to inwardly flexing pressure applied against the panel, and packing on the door frame having water-tight

30 contact with said anchoring ribs of the door when the door is closed.

28. A door structure of the character described, including, a door frame having a doorway and

35 anchoring rib extending about the doorway and a resilient packing strip extending about and disposed against the wall side of the anchoring rib, and a door fitting the frame and having a dished, inwardly flexible sheet metal panel having the

40 concavity extending from all points around its edge to a common central area of the panel and having a peripheral anchoring and sealing rib to seat against said packing and about the door

45 frame rib when the door is closed, said panel flexing inwardly under pressure applied thereagainst in closing direction to press said anchoring and

50 sealing rib more intimately into the packing strip and drawing said rib into tight interengagement with the anchoring rib of the door frame, whereby the door edge is restrained from radial inward

55 movement and the body of the door is placed under tension, the concavity of the panel tending to diminish the strain on said interengaging ribs and on the body of the panel.

29. A door structure of the character described, including, in combination, a door frame

55 having a doorway, a swinging door to close the doorway and having an inwardly flexible sheet metal panel and a metal stiffening edge frame

60 extending about and secured to the panel, complementary anchoring ribs on the panel edge frame and door frame interengaging when the door is closed to restrain the radial inward movement

65 of the door edge when the door is subjected to flexing pressure in closing direction, said panel being dished inwardly, and the concavity extending from all points around its edge to a common

center area of the panel, said panel shape tending to diminish strain on said interengaging ribs and on the body of the panel when the panel is subjected to inwardly flexing pressure.

30. A door structure of the character described, 5 including, in combination, a door frame having a doorway, a swinging door to close the doorway and having an inwardly flexible sheet metal panel and a metal stiffening edge frame extending

10 about and secured to the panel, complementary anchoring ribs on the panel edge frame and door frame interengaging when the door is closed to restrain the radial inward movement of the door

15 edge when the door is subjected to flexing pressure in closing direction, said panel being dished inwardly, and the concavity extending from all points around its edge to a common center area

20 of the panel, said panel shape tending to diminish strain on said interengaging ribs and on the body of the panel when the panel is subjected to inwardly flexing pressure, and packing on the

25 door frame having water-tight contact with the anchoring rib of the panel edge frame when the door is closed.

31. The combination with two doors swinging 25 in opposite directions on opposite sides of a wall to close a doorway therein, each door having a marginal rib projecting from the doorway side at an angle to the plane of the door, of a door frame comprising a channel iron having a bottom wall

30 adapted to be disposed longitudinally along and to be welded to metallic partition members providing an opening for the frame, flanges extending outwardly from the edges of the channel side walls and substantially at right angles thereto,

35 and a tie-piece bridging and secured to said flanges to form with the channel iron a frame member box-like in cross section, the said ribs of said doors interengaging with the flanges

40 extending outwardly from the side walls of the door frame channel when the doors are closed to restrain radial inward movement of the edges of

45 each door when subjected to inwardly flexing pressure.

32. The combination comprising a door frame, 45 two doors mounted to engage opposite sides of said frame, each of said doors having a dished flexible sheet metal panel therein, the dished face of each panel being on the outward side there-

50 of, and means engaging the panels in said doors for urging them toward each other when said doors are closed.

33. The combination comprising a door frame, 55 two doors mounted to engage opposite sides of said frame, each of said doors being provided with a dished flexible sheet metal panel having the concavity extending from all points around its edge to a common central area, the concave

60 face of each panel being on the outward side thereof, and means engaging said panels in the vicinity of said central areas for urging them toward each other when the doors are closed.

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