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Bellucci

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[54] **CLOSURE OPERATING STRUCTURE**

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[52] **U.S. Cl.** **49/254,** 49/340, 220/38

[51] **Int. Cl.** **E05d 15/58**

[58] **Field of Search** 49/246, 253, 254, 49/258, 259, 340, 349, 339; 220/34, 38; 105/247

[56] **References Cited**

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[57] **ABSTRACT**

Closure movement assembly providing linear movement of a closure member in a direction transverse to a chamber opening so as to move the closure member into or out of locking position and, also providing in series, rotational movement to swing the closure member away from or toward the chamber; such dual movement of the closure member being provided with a single uninterrupted drive motion.

19 Claims, 8 Drawing Figures

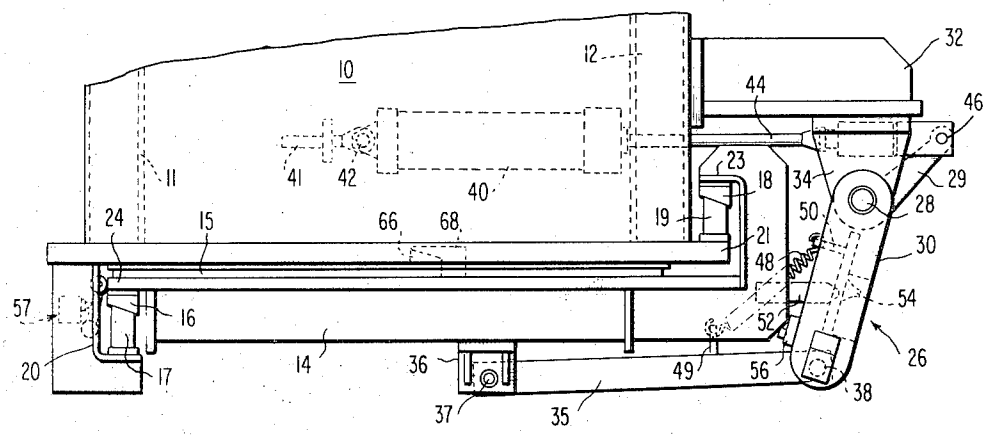


FIG. 1

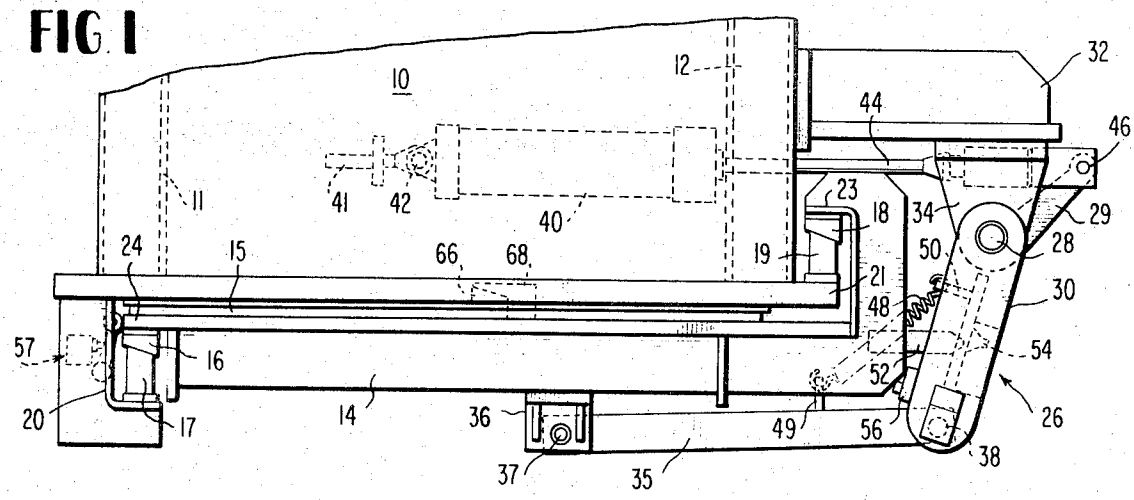


FIG. 2

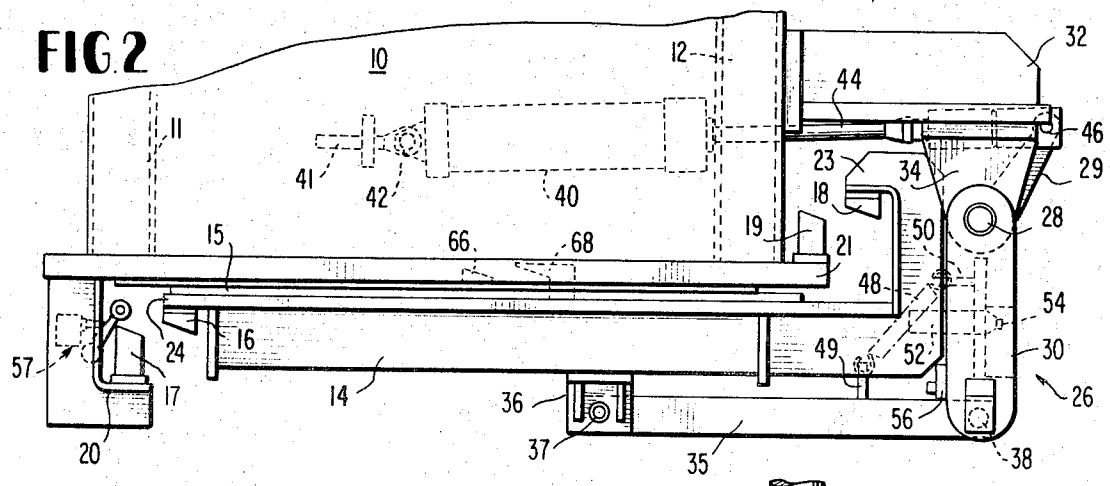


FIG. 4

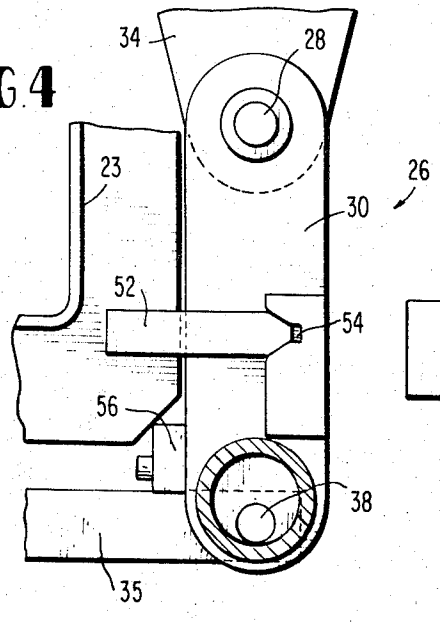
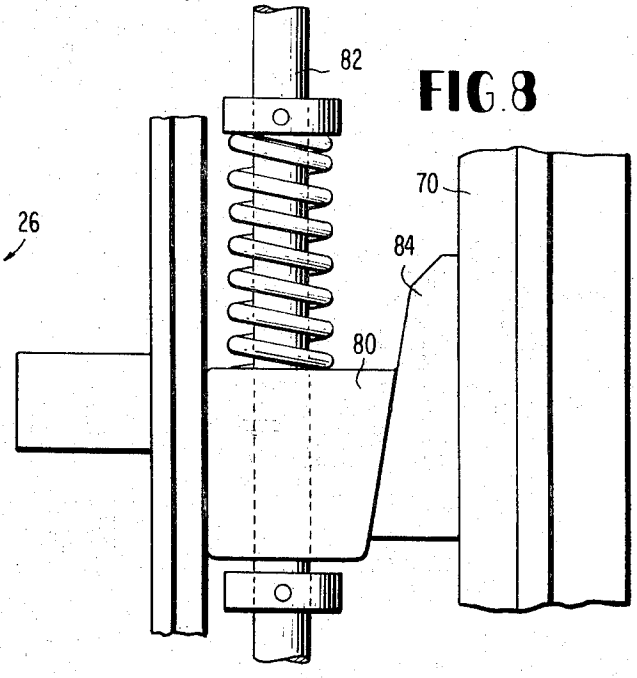


FIG. 8



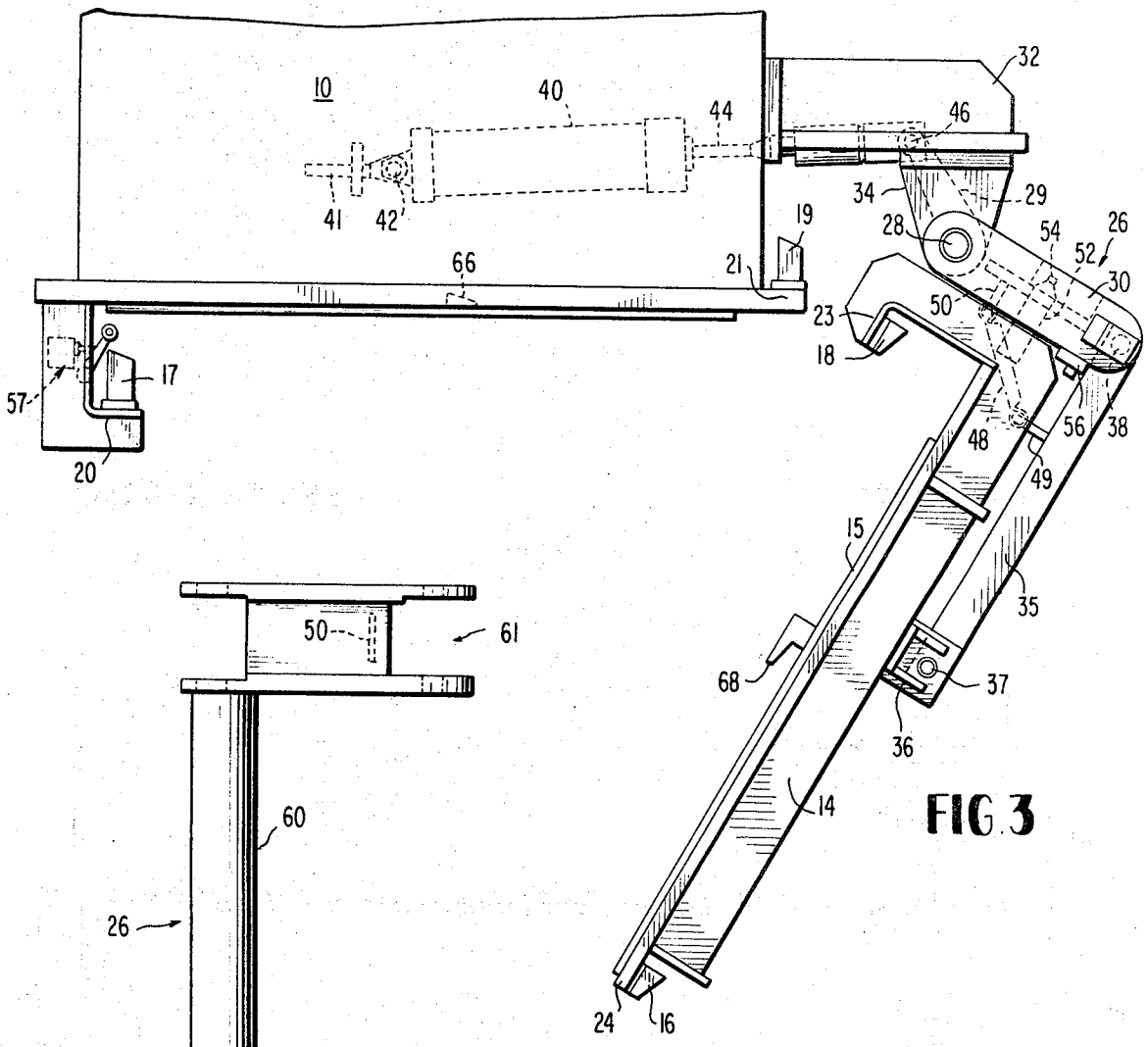


FIG. 3

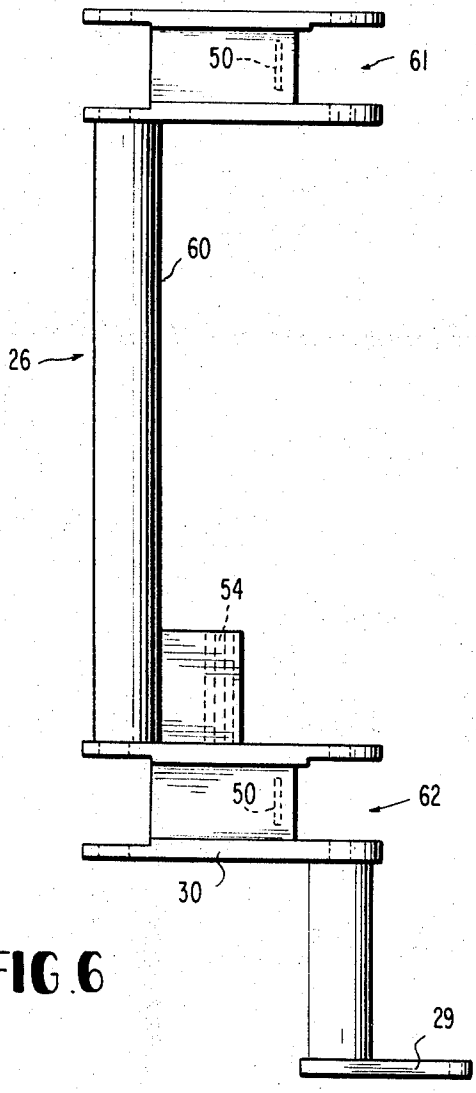


FIG. 6

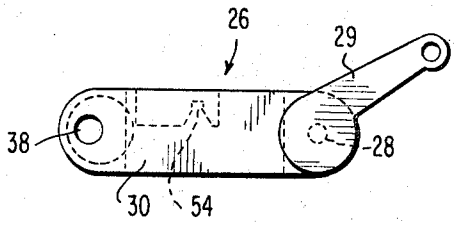
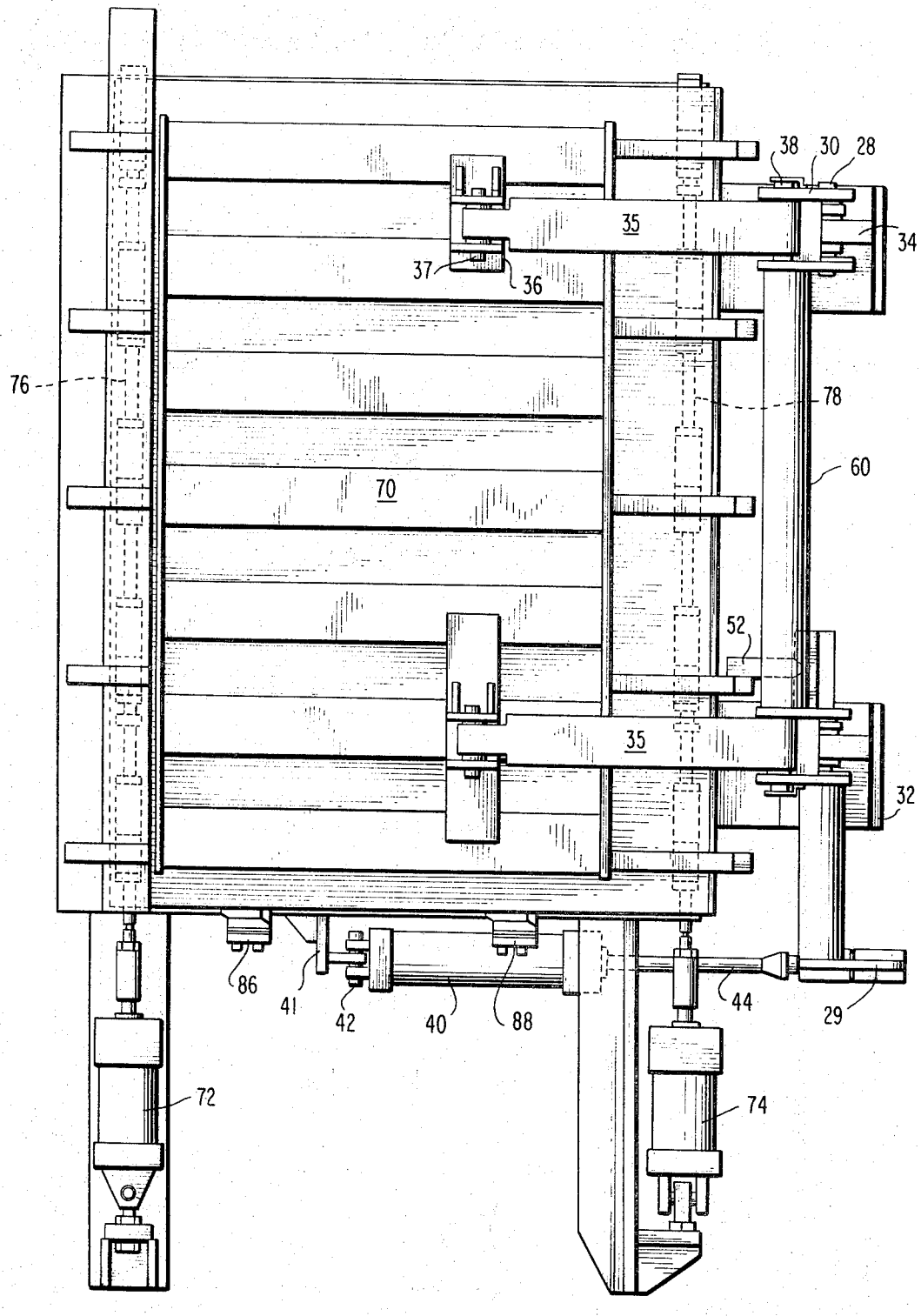


FIG. 5

FIG 7



CLOSURE OPERATING STRUCTURE

This invention is concerned with closure operating structure and, in its more specific aspects, with a hinge assembly means providing both linear movement and rotational movement of a closure from a single drive source.

Chambers requiring frequent access, and pressure operated i.e. at a vacuum or above atmospheric pressure, generally require sturdy construction interconnecting the chamber means and the closure means with interlocking means about at least a portion of the periphery of the closure in order to withstand the pressures involved and provide for proper locking and sealing. The locking can require some relative movement between the closure member and the chamber when the closure member is contiguous with the chamber opening for purposes of engaging or positioning for engagement flanges, edge slots, or other locking means.

It has been found that autoclave structures requiring swinging door access and linear movement for interlocking purposes lead to complexity in support and guide structures, multiple step opening procedures, and/or require multiple drives to effect proper movement or sealing.

The invention circumvents such difficulties in providing a sturdy, simplified, hinging structure providing both linear movement for interlocking purposes and swinging movement for access purposes from a single drive source. The result is a simplified, durable, easy-operating structure providing rapid actuation for both swinging and interlocking purposes.

Other advantages will be brought out in describing specific embodiments of the inventive concepts of the present invention as illustrated in the accompanying drawings.

In these drawings:

FIG. 1 is a plan view, partially in section, embodying the invention showing a chamber with its closure member in interlocking relationship with a chamber,

FIG. 2 is a similar plan view of the structure of FIG. 1 with the closure member shown out of interlocking position ready for rotational movement to swing the closure to an open position,

FIG. 3 is a similar plan view of the structure of FIGS. 1 and 2 with the closure member in partially swung open position,

FIG. 4 is an enlarged view of a portion of the structure of FIGS. 1, 2 and 3 showing releasably interconnectable structure operable between the closure member and the hinge assembly,

FIG. 5 is a plan view of a bell crank structure forming part of the present invention,

FIG. 6 is an elevational view of the structure of FIG. 5,

FIG. 7 is a front elevational view of closure structure of the general type shown in FIG. 1 with auxiliary locking means, and

FIG. 8 is an enlarged view of wedge locking means as used in the structure of FIG. 7.

The plan view of FIG. 1 shows a closure member in locking position with respect to a chamber opening. Chamber **10**, only a portion of which is illustrated, includes side walls **11** and **12**. Door **14** closes an opening in the frontal portion of chamber **10**. Gasket structure **15** establishes contact between the closure member and the chamber opening.

The door **14** is held in locking position by wedge members such as **16, 17** and **18, 19** on side flanges of the door and chamber. Chamber flange support takes the form of an angled member **20** at the left forward edge of the chamber shown and, at the opposite side of the chamber opening, a rearwardly projecting flange member **21** supports wedge member **19**. Wedge member **18** is supported by door flange support arm **23** and, at the opposite side of the door, wedge **16** is supported on door edge flange **24**. Interaction of such flange members, or other locking means, will be considered in more detail in later description.

Door **14** is supported through a hinge crank means comprising bell crank **26**. The bell crank includes a fixed position fulcrum **28**, input arm **29**, and output arm **30**. The fixed position of fulcrum **28** is established by rigid support structure **32** attached to the chamber side wall **12** but this support can be obtained from other rigid structure having a fixed positional relationship to the chamber opening. Fulcrum **28** is pivotally mounted on rigid structure arm **34**.

Hinge arm **35** interconnects closure member **14** with crank output arm **30**. Bracket **36** on door **14** is mounted centrally to provide sturdy support for the door; preferably it is mounted contiguous to the center of gravity of the door. Pin **37** at bracket **36** provides for at least limited pivotal movement of the hinge arm **35** with respect to the panel of door **14**. At the opposite end of the hinge arm **35**, the bell crank output arm **30** and the hinge arm **35** are pivotally connected at pin **38**.

Power for movement of the door originates or, at least is transmitted, from a single source. In a simplified embodiment, a mechanical drive such as a fluid-operated cylinder **40** (shown in broken lines) is utilized. Outer crank input means, such as a gear drive connected to the shaft of crank **26** could be substituted for cylinder **40**. Drive cylinder **40** is mounted on chamber **10**, or chamber framing, by bracket **41**. The mounting includes a pivotal connection **42** for limited angular movement of the cylinder. Cylinder **40** has a straight power stroke but limited angular movement for the cylinder is provided because of the angular movement of bell crank input arm **29** about the fixed fulcrum **28**. The working end of piston rod **44** is pivotally connected to the bell crank input arm **29** at pin **46**.

In FIG. 1 piston rod **44** is in its extended position which through bell crank output arm **30** and hinge arm **35** has moved door **14** linearly across the closure opening (to the left as shown) into locking position.

For purposes of opening door **14**, piston rod **44** is withdrawn into cylinder **40**. In the plan view shown, bell crank input arm **29** moves to the left about fulcrum **28** and bell crank output arm **30** moves to the right. This action, through hinge arm **35**, moves the door **14** linearly across the chamber opening to the position shown in FIG. **2**. Such linear movement of the door is provided when the door is in contiguous relationship to the chamber opening.

Retention means are provided to hold the door **14** in contiguous relationship to the chamber opening prior to opening and after swinging movement of the door to a close position. Such retention is provided by spring **48** which is connected at post **49** to hinge arm **35** and at post **50** to bell crank output arm **30**. Spring **48** exerts a moment of force tending to hold door **14** to bell crank output arm **30** in releasable interlocking relationship.

Additional means for releasably interlocking the door **14** and bell crank **26** for swinging movement is provided through prong **52** which is mounted on door **14.** This pring fits into bell crank recess **54** upon linear movement of door **14** into position for swinging open so that both the crank arm and door swing together. This releasable interlocking structure is shown in greater detail in FIG. **4.**

Such interlocking for swinging movement can also be carried out by limiting the pivotal movement at pin **37** where hinge arm **35** connects to the door **14.** If the pivotal movement at this point is limited to the slight angular relative movement at pin **37** as required to allow for and provide the linear movement of door **14** through hinge arm **35,** swinging movement will take place when the door has moved to its unlocked position. A stop or other means located at bracket **36** can lock the door and hinge arm for swinging movement. Stop block **56** on output arm **30** stops arm **35** from being swung further in a clockwise direction, by spring **48,** when the door **14** has been moved to the right and interlocked for swinging movement. Stop block **56** is adjustably mounted on output arm **30.**

Note in FIG. **2** that the flange means have been moved out of locking position so that the door is free for rotational movement, i.e. to be swung open. With the interlocking of door **14** and bell crank **26,** continued rotation of crank **26** by withdrawal of piston rod **44** into cylinder **40** causes door **14** to swing open about fixed fulcrum **28** to a position such as that shown in FIG. **3.** Reversing the action of cylinder **40,** i.e. extending piston rod **44** reverses the action. The door **14** is swung into closing position(as in FIG. **2**) contiguous to the chamber opening. Continued rotation of crank **26** by extension of piston rod **44** causes the door **14** to move linearly into locking position (FIG. **1**). Linear movement is stopped by limit switch **57** which stops drive from cylinder **40.** Other means, including mechanical stop means can be used in place of or in conjunction with limit switch **57.**

Note that the in-series dual motion of the closure member is brought about by the continued rotation of the crank means in the same direction without need of interruption of motion nor direction of such motion during the separate movements of the door.

Details of the specific embodiment of the crank means, bell crank **26,** are shown in FIGS. **5** and **6.** The length of bell crank shaft **60** and the number of hinge arm sockets, such as **61, 62,** can be varied to suit the weight and dimensions of the closure member.

The dual movement hinge assembly structure provides unusual advantages in sturdier construction and in the adaptability to a single, unidirectional-drive means. The coordinated rotational and linear movements provided are especially advantageous in facilitating locking and sealing of pressure vessels. After the closure member has swung into place the linear movement can move the door into locking position and/or such linear movement can itself complete locking. As an example of the latter, by having the interacting wedge surface positioned as shown in FIG. **2,** their interaction upon linear movement causes the door to be moved into sealing relationship, that is, toward the chamber opening. This type of wedge interaction activated by linear movement is especially suited for vacuum seal applications, lighter weight structures, and embodiments using inflatable sealing gaskets.

The rotational and linear movement in series permits clearance for top and bottom edge interlocking means during swinging of the door. For example, flange projections can be moved into alignment upon linear movement of the door and flange mounted wedge surfaces can act to hold the closure member to the chamber along the top and bottom edges. An example of this arrangement for top and bottom edge sealing support is shown schematically in dotted lines in FIGS. **1** and **2.** In FIG. **1** the chamber wedge surface **66** is shown contacting a wedge surface on door flange **68,** thus moving and holding the door to the chamber opening. Whereas, in FIG. **2** the interacting wedge surfaces are separated by the linear movement of door **14,** such separation allowing for swinging movement of the door.

For heavy-duty high-pressure type chambers, where it is desired to interlock the closure member and the chamber and mechanically effect sealing, the coordinated linear movement of the closure member moves and holds the closure member in position for locking. For example, the apparatus of FIG. **7** uses vertically spaced flange wedges on the sides of the door and opening. After door **70** is moved into position for locking, auxiliary locking means, with power drives **72** and **74,** move the locking wedges carried on locking shaft means **76, 78** (shown in dotted lines) at the sides of the closure structure.

A mechanical type of locking and sealing action is described in detail in the patent referred to above U.S. Pat. No. 3,490,641. However, for purposes of understanding the present invention, as shown in the enlarged view of cooperating wedge surfaces in FIG. **8,** wedge **80** moved downwardly by shaft **82** acts against wedge **84** carried by door **70.** This action causes door **70** to move toward the chamber with intermediate gasket means sealing the closure. The coordinated rotational and linear movements enables such wedge surfaces to be moved out of and into interacting relationship for unlocking and for locking and sealing purposes.

As shown in FIG. **7,** brackets **86** and **88** along the bottom edge of the opening support the door during the downward movement of the auxiliary locking shaft means on each side of the closure structure and thus help avoid strain being placed on the hinge assembly. The drive means **72** and **74** can be conventional fluid-operated cylinders.

Other sealing means and other flange locking means, such as cam-operated structures can be used. Also, other drive means and other configurations of the structural elements described can be resorted to in the light of the concepts and embodiments disclosed and explained. Therefore, the scope of the invention is not to be limited to the specific description but is to be determined by the scope of the appended claims.

It is claimed:

1. Closure operating structure including

chamber means having an opening,

closure means for closing the opening of the chamber means, and

hinge assembly means interconnecting the chamber means and the closure means and operable with an uninterrupted drive movement to cause the closure means to move linearly in a direction transverse to the opening when the closure means is in contiguous relationship to such opening and, in series with such linear movement, to cause the closure means

to move rotatably to swing the closure means toward or away from the chamber, the hinge assembly means including

crank means including an output arm means positioned for angular rotation about a fulcrum means,

support means for establishing a fixed position for the fulcrum means in relation to the chamber means such that the crank output arm means moves rotationally without need for interruption of movement or direction of such movement to produce both the linear and swinging movement of the closure means,

hinge arm means interconnecting the closure means and the crank output arm means for transmitting output force for movement of the closure means in relation to the chamber means,

drive means connected to the crank means for moving the crank output arm means pivotally about the fixed position fulcrum means,

retention means urging the closure means toward the chamber means when the closure means is in contiguous relationship to the opening of the chamber means, and

means releasably interconnecting the closure means and the hinge assembly means.

2. The combination of claim **1** in which the drive means comprises

power transmitting means operating with a single uninterrupted power stroke to move the closure means serially through both linear and rotational movements.

3. The combination of claim **2** including

limit means to limit linear movement of the closure means when in contiguous relationship to the chamber opening.

4. The combination of claim **3** in which the crank means comprises

bell crank means having an input arm means with the input arm means and the output arm means being rigidly connected for coordinated rotation about the fixed position fulcrum means.

5. The combination of claim **4** in which the single stroke drive means comprises

a fluid operated work cylinder having piston rod means pivotally connected to the bell crank input arm means, with

the work cylinder being mounted for limited pivotal movement to allow for curvilinear movement of such piston rod connection with the bell crank input arm means about the fixed position bell crank fulcrum means.

6. The combination of claim **1** in which the hinge arm means comprises

a rigid elongated arm pivotally connected to the crank output arm means and connected to the closure means.

7. The combination of claim **6** in which

the hinge arm means is connected centrally of the closure means for support of the closure means.

8. The combination of claim **8** in which the hinge arm means is connected to the closure means contiguous to a location for center of gravity support of the closure means.

9. The combination of claim **1** including

means for releasably interconnecting the closure means and the crank output arm means upon linear movement of the closure means in a direction toward the fulcrum means, with the retention means exerting a directional moment of force urging the closure means toward the fulcrum means.

10. The combination of claim **9** in which the means for releasably interconnecting the closure means and the crank output arm means is mounted on the closure means and interacts with the crank means.

11. The combination of claim **10** in which the means for releasably interconnecting the closure means and the crank output arm means comprises

an elongated prong means mounted on the closure means and tapered at one longitudinal end to interfit with a tapered recess in the crank output arm means upon linear movement of the closure means in a direction toward the fixed position fulcrum means.

12. The combination of claim **1** in which

the retention means is connected to the hinge arm means.

13. The combination of claim **12** in which the retention means comprises spring means interconnecting the hinge arm means and the crank means.

14. The combination of claim **12** including

stop block means mounted on the crank output arm means and acting to limit angular movement of the hinge arm means in relation to the crank output arm means.

15. The combination of claim **1** including

means carried on the closure means and means positioned about the opening of the chamber means for interlocking the closure means and the chamber means.

16. The combination of claim **16** in which the means carried on the closure means and positioned about the opening of the chamber means comprises cooperating flange means.

17. The combination of claim **16** in which

the linear movement of the closure means imposed by the crank means causes relative movement between the flange means on the closure means and the cooperating flange means on the chamber means establishing alignment of such flange means to permit sealing between the closure means and the chamber means.

18. The combination of claim **16** further including

auxiliary locking means for effecting a pressure-tight seal between the closure member and the chamber opening.

19. The combination of claim **1** in which

the chamber means comprises a pressure-operated sterilizing vessel.

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