June 4, 1963 B. G. COX 3,092,285

CLOSURE FOR PRESSURIZED VESSELS

Filed Dec. 14, 1959 4 Sheets-Sheet 1

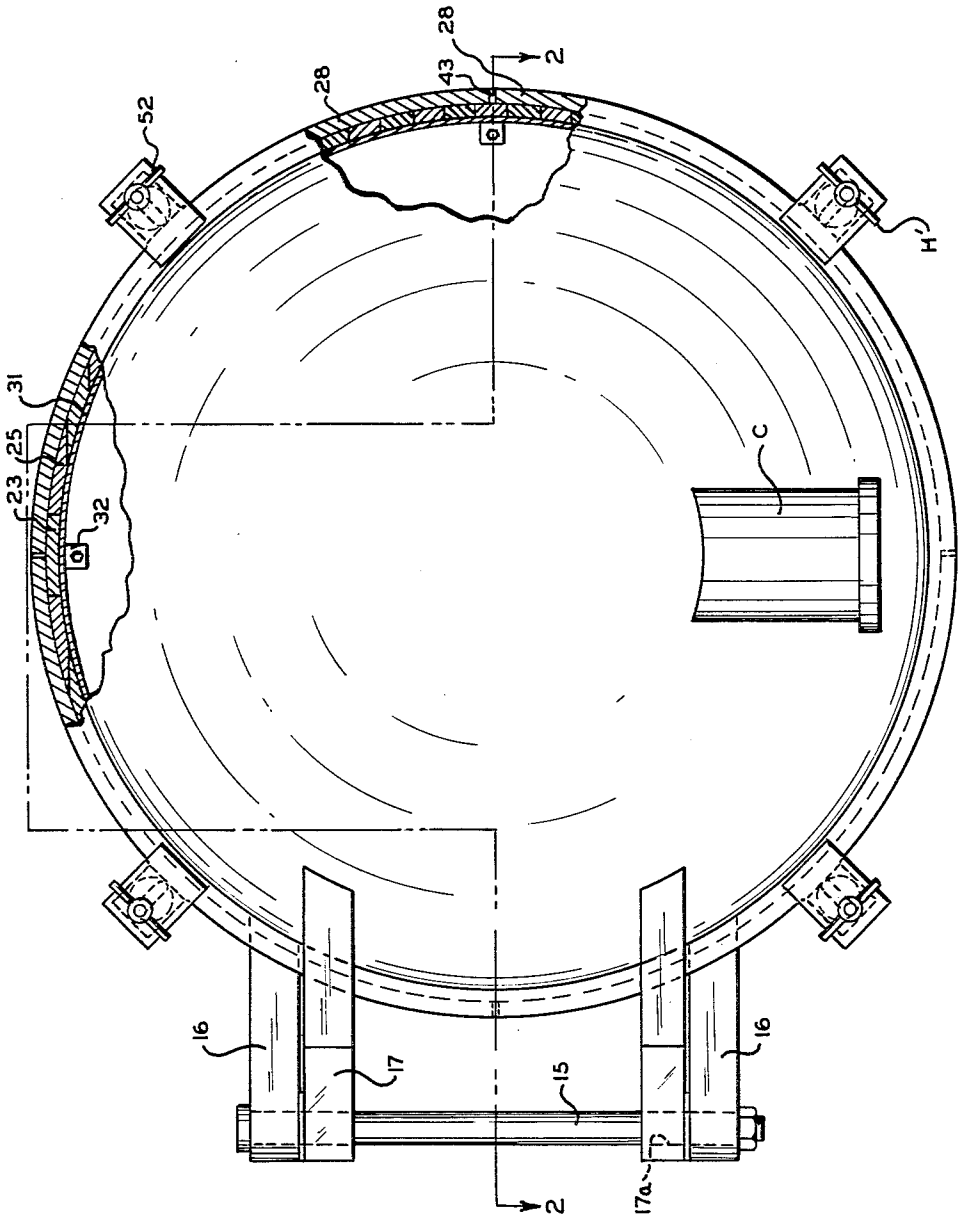


FIG. 1

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CLOSURE FOR PRESSURIZED VESSELS

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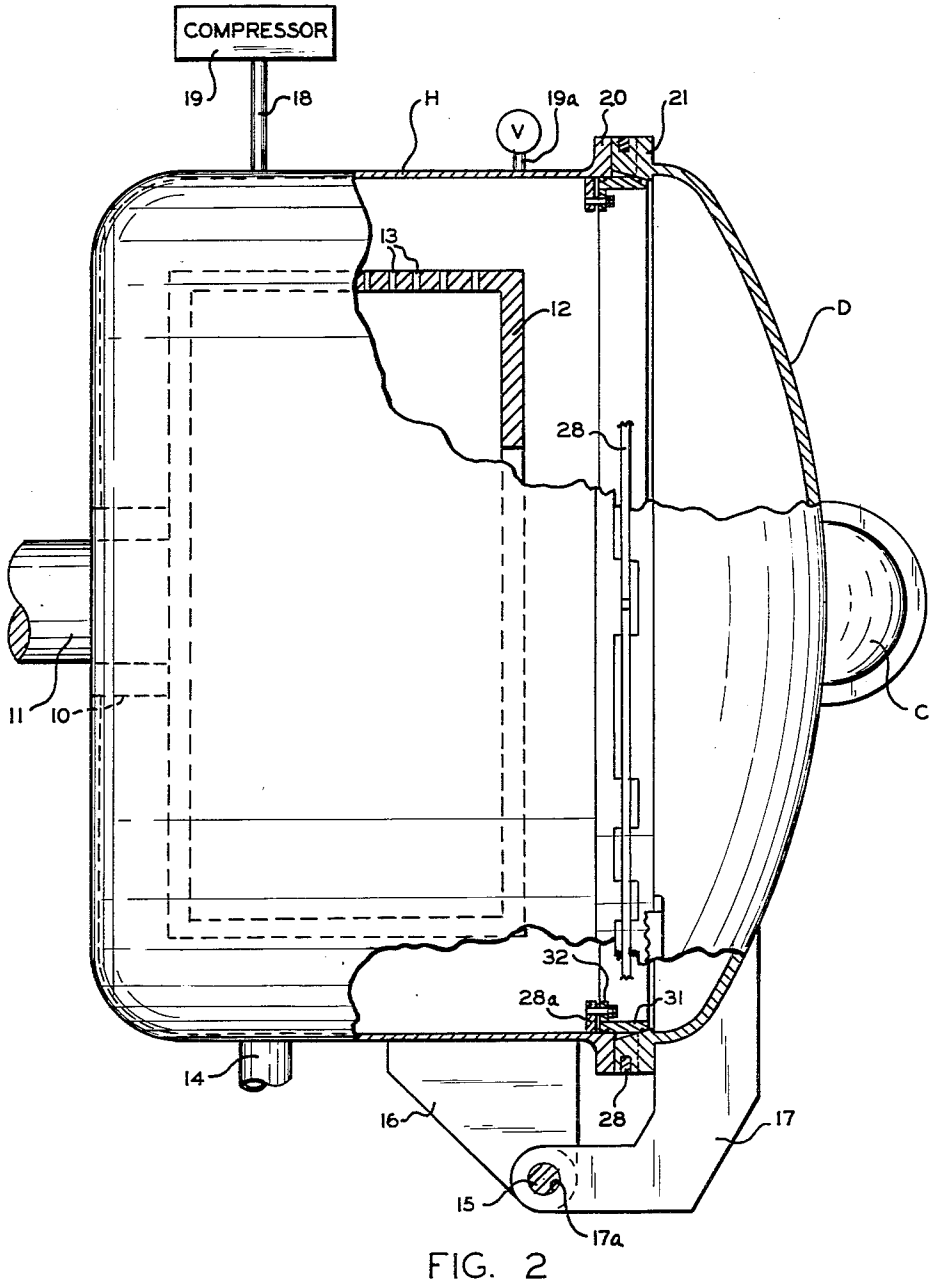


FIG. 2

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CLOSURE FOR PRESSURIZED VESSELS

Filed Dec. 14, 1959 4 Sheets-Sheet 3

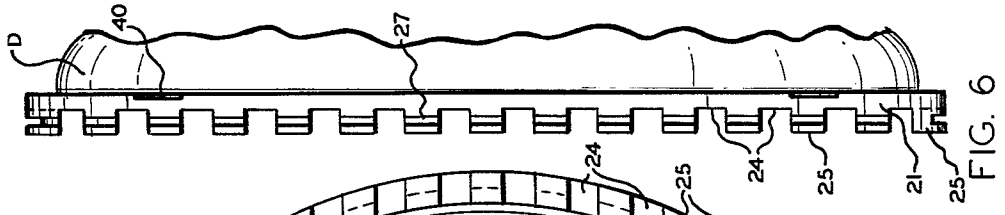


FIG. 6

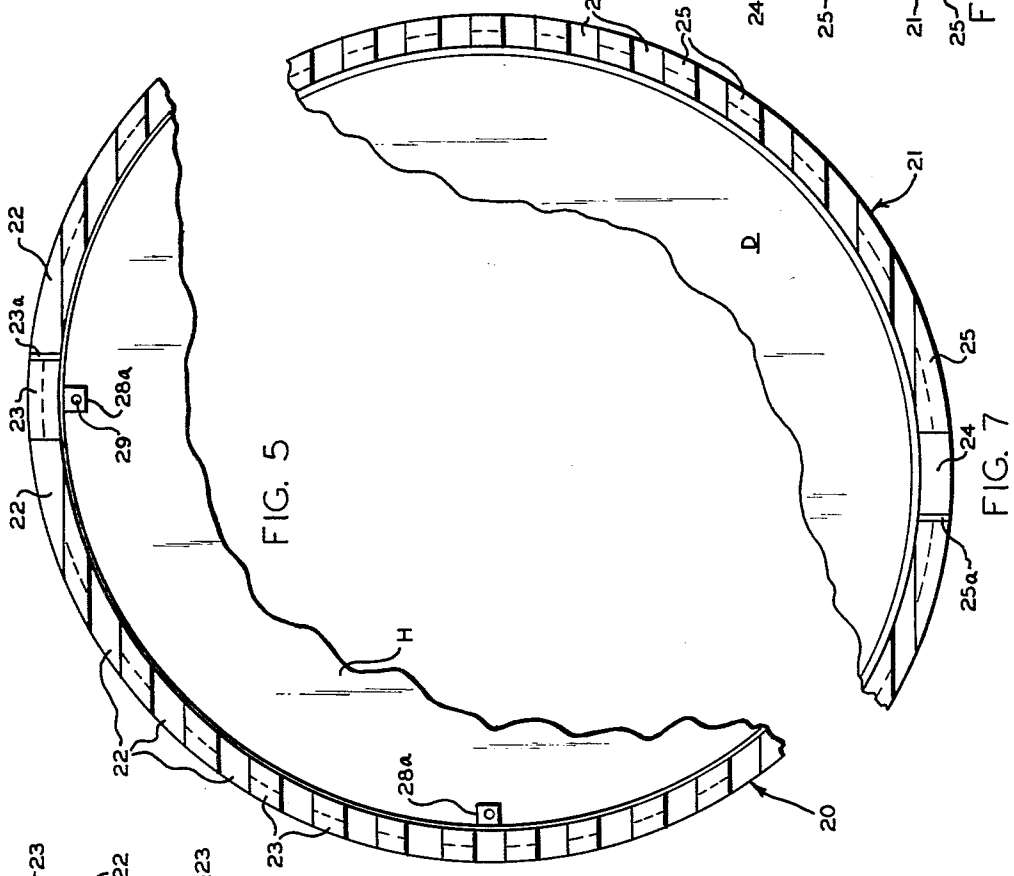


FIG. 5

FIG. 7

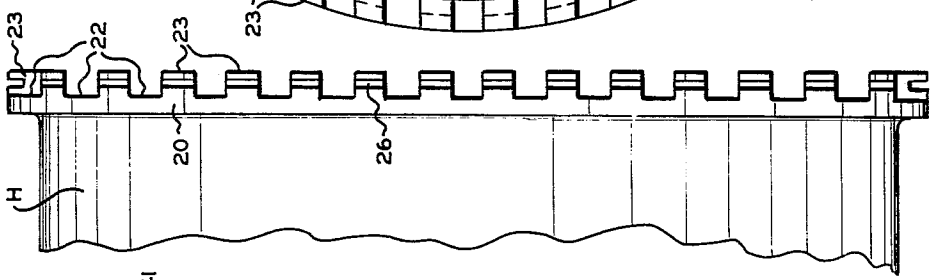


FIG. 4

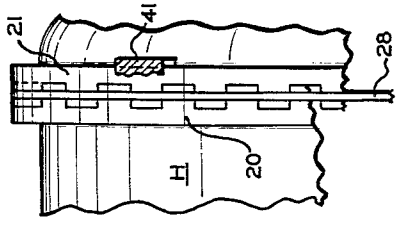


FIG. 3

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CLOSURE FOR PRESSURIZED VESSELS

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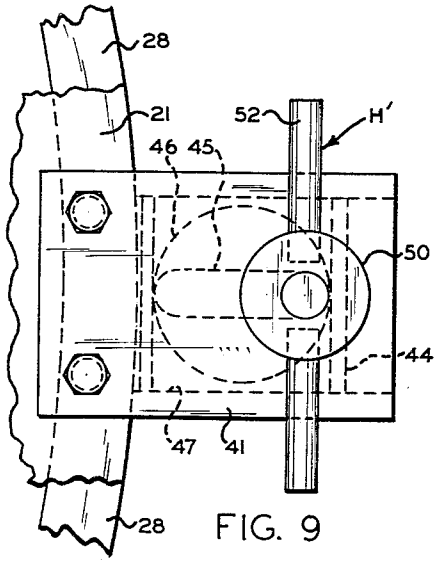


FIG. 9

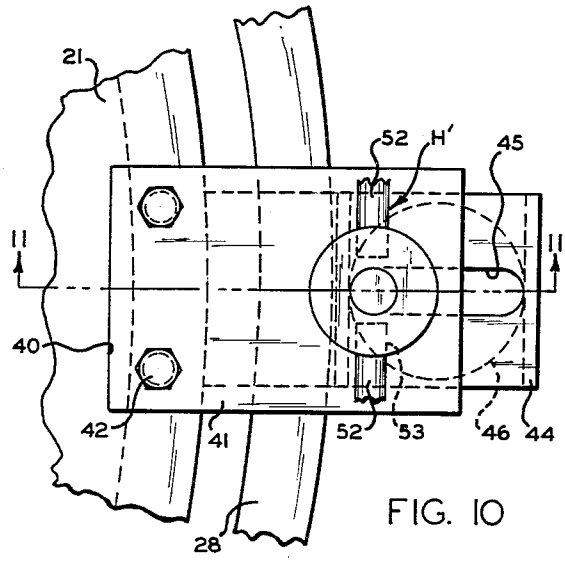


FIG. 10

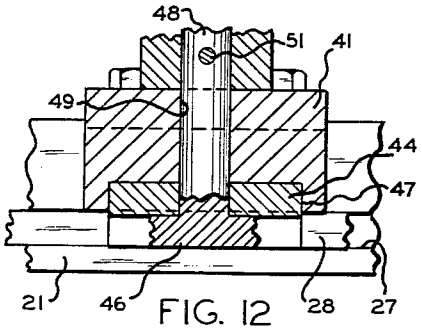


FIG. 12

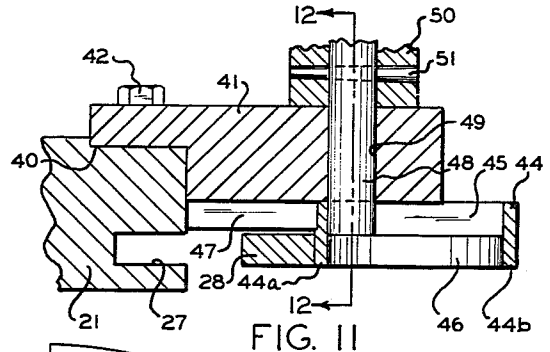


FIG. 11

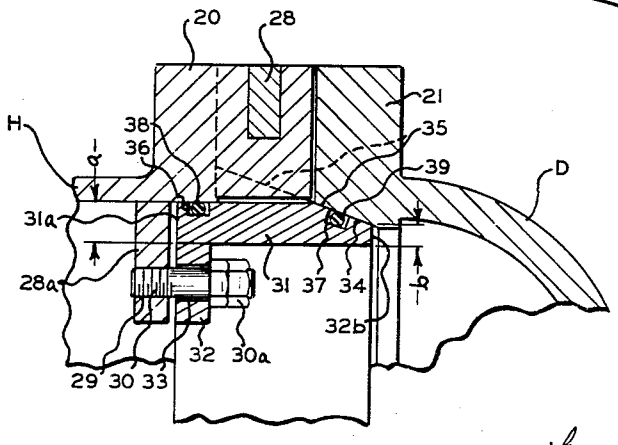


FIG. 8

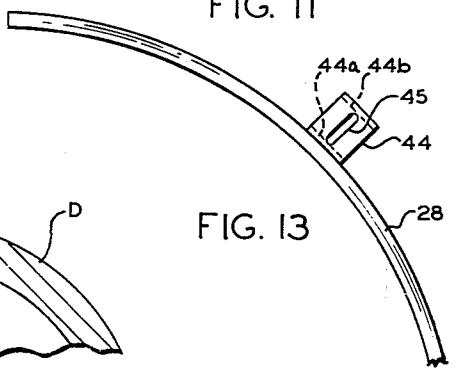


FIG. 13

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United States Patent Office 3,092,285 Patented June 4, 1963

3,092,285

CLOSURE FOR PRESSURIZED VESSELS

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Filed Dec. 14, 1959, Ser. No. 859,432
5 Claims. (Cl. 220—46)

This invention relates to closures and more particularly to closures or doors for centrifugal machines and other vessels which are internally pressurized.

Since the door or closure for the centrifugal chamber of a batch type centrifuge of the type used for segregating liquids and solids normally carries a peeler knife and chute assembly of considerable size, and it is desirable to move this assembly out of the centrifugal drum when the door is opened, it has been found expedient to hingedly mount the door and, to permit the knife box and chute assembly to clear the chamber, to hingedly mount the door at a point which is somewhat removed from and inset relative to mating surfaces on the door and drum.

It is an important object of the present invention to provide a door of this general character which can be readily opened and closed and which, when closed, provides an adequate seal to prevent the escape of the fluid or gases under high pressure or vacuum which are within the centrifugal chamber.

It is a further object of the invention to design a door or cover which need not be bolted in sealing relation and, rather, can be locked by other means which can be simply and readily manipulated to permit a relatively rapid opening and closing of the door.

Another object of the invention is to provide a swing door of the character described, for high pressure vessels, which provides the necessary clearances for the swinging surfaces and yet functions to achieve a close mating of sealing surfaces so that an effective seal which will withstand high pressures is provided.

Still a further object of the invention is to design a door or cover which employs the pressure of the gases within the drum to tightly seal the door so that the necessary operating clearance can be provided for intermeshing surfaces on the vessel and door, and for the locking members which retain the door in closed position without affecting the tight seal which is achieved.

Another object of the invention is to provide intermeshing members on the drum and door which extend normally to the axis of the hinge connection so that the matter of swinging clearances and bending of a shear bar or shear bars is not a problem, and the bore of the housing and the door tend to be located in precise alignment.

Still a further object of the invention is to provide a drum or vessel having a sealing ring which is movable as necessary to achieve a mated engagement over its entire sealing surface with a mating surface on the door for the drum.

Other objects of the invention are to provide a door or closure construction having readily accessible elements which are of simple and relatively inexpensive construction and will stand up under conditions of severe and constant use without requiring undue replacement or repair.

Still other objects and advantages of the invention will be pointed out specifically or will become apparent from the following description when it is considered in conjunction with the appended claims and the accompanying drawings, in which:

FIGURE 1 is a front elevational view of the centrifuge with the door in closed position and shown partly in section, to illustrate interlocking members on the door and drum;

FIGURE 2 is a partly sectional, top plan view taken on the line 2—2 of FIGURE 1;

FIGURE 3 is a fragmentary, side elevational view showing the door in closed position and indicating the manner in which one of the locking sectors is received by the chamber wall and door;

FIGURE 4 is a fragmentary, side elevational view of the open end of the drum only, illustrating the construction of the locking lug members thereon;

FIGURE 5 is a fragmentary, end elevational view thereof;

FIGURE 6 is a fragmentary, side elevational view of the one end of the door only, showing the projecting lug members thereon;

FIGURE 7 is a fragmentary, end elevational view thereof;

FIGURE 8 is an enlarged, fragmentary, sectional, side elevational view with the door locked in sealed position, illustrating particularly the sealing surfaces on the drum housing and door;

FIGURE 9 is an enlarged, fragmentary, front elevational view illustrating particularly the construction of cam mechanism for moving one of the shear ring sectors to locking position and showing the sector in locked position;

FIGURE 10 is a similar view with the shear ring sector moved outwardly to permit the door to be opened;

FIGURE 11 is a sectional, inverse plan view taken on the line 11—11 of FIGURE 10;

FIGURE 12 is a sectional, side elevational view taken on the line 12—12 of FIGURE 11; and

FIGURE 13 is a fragmentary, front elevational view of one of the shear ring segments, showing the cam and support plate thereon.

Referring now more particularly to the accompanying drawings in which I have shown a preferred embodiment of the invention, the centrifuge housing or drum H is provided with the usual bearing **10** for supporting the drive shaft **11**, as shown in FIGURE 2. The perforate, separating basket **12**, which is fixed on the end of shaft **11**, employs the usual expressing ports **13** which permit the liquids to be expressed by centrifugal force from the interior of basket **12** to the housing H and drain **14**, while the solids collect on the interior peripheral wall of the basket. Mounted on the opposite end of shaft **11** is a pulley (not shown) as in Davis et al. Patent No. 2,658,620, hereby incorporated by reference, which shows a similar centrifugal construction.

In the interests of clarity, the knife box and discharge chute assembly for removing the segregated solids, which is supported by the dished door D, are not shown except at C in FIGURES 1 and 2. However, it is to be understood that when the door D swings outwardly about its hinge point **15**, the knife box and discharge chute assembly, which are of the same type as shown in the aforementioned Davis et al. patent, move out of the basket **12** and housing H to permit free access to the interior thereof. Provided on the housing H are hinge pin supports **16** and it will be seen that hinge members **17**, having openings **17***a* to receive the pins **15**, are provided for the door D.

The interior of housing H is pressurized in any convenient manner and in the instant case pipe **18** communicating with the interior of the housing H is shown as leading to a compressor **19** of any commercially available type for delivering air or other suitable gases to the interior of the housing H at pressures which may be 150 p.s.i. or greater. When it is desired to depressurize the drum or housing H, the valve V in line **19***a* which also communicates with the interior of the housing H is simply opened. The pressure within housing H is utilized

to achieve the desired sealed relation between the door D and housing H when the door is in closed position, in a manner which will presently be described.

It will be seen that the housing H has an annular, peripheral front flange **20** and the dished door D has a similar flange **21** of the same diameter. As shown in FIGURES 4 and 5, the drum housing flange **20** is provided with horizontally extending grooves **22** perpendicular to the vertical axis of hinge pin **15**, which define lugs or fingers **23** projecting axially of the drum housing H. The topmost and lowermost grooves **22** are interrupted to provide topmost and lowermost lugs **23** as shown centered on the vertical axis with the one surface of each of these lugs being relieved on the same side as at **23***a*.

Similarly provided in the flange **21** of door D are horizontally extending grooves **24** alternately arranged with respect to the grooves **22** and sized to receive the axially projecting lugs or fingers **23** in the manner shown in FIGURE 3. The grooves **24** define lugs or fingers **25** projecting axially of the drum housing H when the door is in closed position, and these are sized to be received in the grooves **22** of flange **20**. The topmost and lowermost lug members **25** are interrupted by recesses **24** and lug members **25** are relieved on the same side of the vertical centerline as at **25***a*. Because the projections **23** and **25** extend horizontally, the fact that the arc of swing of the projections **25** furthest from hinge pin **15** is quite different from the arc of swing of the projections **25** nearest the hinge pin **15** does not require undue door operating clearances, as would be required if the lugs **23** and **25** were radially or vertically extending. Provided in the projecting locking lugs **23** and **25** are grooves **26** and **27**, respectively, extending generally normally to the lugs and situated in a common vertical plane normal to the horizontal axis of the drum housing H when the door is in closed position and the lugs **23** and **25** are in interlocked relationship to provide a continuous groove which can receive shear ring sector members **28**. The manner in which the shear ring sectors **28** are moved radially into the continuous groove formed by grooves **26** and **27** from position outward thereof to lock the door D in closed position will be later described in detail.

In the instant case, the effectiveness of the seal does not depend on the fit of the locking lugs **23** and **25** in the grooves **24** and **22**, respectively, and it is to be understood that these members are provided with adequate operating clearances, as are the grooves **26** and **27**. The seal achieved is, rather, a function of other surfaces, which will now be described.

Mounted on the flange **20** of the housing H are inwardly extending plates **28***a* having threaded openings **29** (see FIGURE 8) for receiving the threaded ends of stud members **30**. The stud members **30**, which have nuts **30***a*, mount an annular housing seal ring **31** having flange plates **32** with openings **33** aligned with the openings **29** and providing a sliding clearance for the seal ring **31** so that it is shiftable axially of the housing H. Provided on the forwardly projecting and outward portion of the ring **31** is an axially tapering, annular surface **34** which mates with an identically tapered, annular and inner surface **35** on the door flange **21**. Grooves **36** and **37** on the seal ring **31** accommodate annular, rubber, O-ring seals **38** and **39**, as shown, which respectively seal the interlocking lugs **23** and **25** from both sides. It is important to observe that the width or depth "*a*" of the inner radial surface **31***a* of the continuous seal ring **31** is considerably greater than the width "*b*" of the outer radial surface **32***b* of the seal ring **31**. Since the interiors of the housing H and door D are pressurized, the pressure against the surface **31***a*, which is of greater area, will hold the surfaces **34** and **35** in tightly sealed relation and the pressure is in this way effectively utilized with surfaces of different area to provide an adequate and effective seal. The seal ring **31** can move axially of the housing H and also tilt very, very slightly, so that undue care does not have to be exercised in the machining of the grooves **22** and **24** and the seal ring **31** adjusts to permit the surfaces **34** and **35** to achieve tightly sealed facial engagement over the length and width of surface **34**.

Mounted on the door housing flange **21**, which is shouldered as at **40** (see FIGURE 11), are cam support blocks **41** secured to the flange **21** by bolts **42**. Four such blocks **41** are shown in FIGURE 1, since four locking sectors or shear bars **28**, slightly spaced one from the other as at **43**, are employed. However, it is to be understood that more or less locking sectors **28** could be provided as desired. Each sector **28** has a radially, outwardly projecting plate **44** thereon provided with a radial slot **45** and projecting inner and outer wall portions **44***a* and **44***b* which receive a cylindrical cam **46** between them, as shown. Each plate **44** is received for sliding movement in a groove **47** provided in the block **41** (see FIGURE 12) and each cam **46** is eccentrically mounted at one side on a shaft **48** which extends through the slot **45** in the sector plate member **44** and a bore **49** provided in the block **41**.

A handle H' comprising a sleeve **50** pinned to the shaft **48** as at **51**, and provided with oppositely extending handle arms **52** fixed in openings **53** provided in the hub **50** is conveniently provided for each rotating shaft **48**. Accordingly, cam **46** can be readily moved about the axis of shaft **48** to force a locking ring sector **28** from the outward position in which it is shown in FIGURE 11 to an interlocked position in the continuous groove formed by grooves **26** and **27**, as shown in FIGURE 9. Since there are no side walls for the plates **44** corresponding to the walls **44***a* and **44***b*, the cams **46** are free to revolve about the axes of their shafts **48** and the locking ring sectors **28** are moved smoothly in a radial path into the notches **26** and **27**. Because of the seal effected at surfaces **34**, **35**, operating clearances can be provided for the locking ring sectors **28** and not attempt is made to wedge the sectors **28** into position or to clamp the locking lugs **23** and **25** in locked relation. The sectors **28** serve simply as shear bars to maintain the door in closed position.

The operation of centrifuges of this type is well understood and will not be described herein. A pressurized condition is provided by the compressor **19** but a conventional vacuum pump may be employed in place of the compressor to create a depressurized condition in some centrifugal operations. When for inspection or the like it is desired to open door D, housing H is depressurized by opening the valve V and the four locking handles H' are simply turned 180° from the position in which they are shown in FIGURE 1 so that cams **46** operate to force the walls **44***b* outwardly. In this manner the locking sectors **28** are smoothly withdrawn radially from the grooves **26** and **27**.

When the drum housing H is to be closed once again, the door D is swung closed about its hinge pin **15** to bring the locking lugs **23** and **25** into intermeshing relation and align the peripheral grooves **26** and **27**. The handles H' are then rotated reversely through 180° to cause the cams **46** to bear against the walls **44***a* of the plates **44** and move the locking ring sectors **28** radially from the position shown in FIGURES 10 and 11 to the position shown in FIGURE 9 received within the aligned grooves **26** and **27**. Thence the compressor **17** can be started to provide the chamber H with the desired gases at the desired pressure and the centrifuging cycle can thence be repeated.

It should be apparent that a closure construction of simple and reliable design which is suitable not only for centrifuges but for other pressurized vessels has been perfected and constitutes a substantial improvement over prior art constructions.

It is to be understood that the foregoing descriptive material is to be regarded as illustrative of one form of the invention, rather than limiting, and various equiva-

lent elements may be employed within the scope of the appended claims.

I claim:

1. A housing having an opening bounded by a fixed marginal, annular radially disposed surface, said housing having an axially extending guide means radially inward of said radial surface; axially shiftable annular seal means mounted by said guide means radially inward of said radially disposed surface, said seal comprising a metallic ring with a radially outer, axially tapering, peripheral surface portion of decreasing diameter outwardly leading to its outer edge, and axially spaced inner and outer radial end surfaces; a closure door for said opening hinged to said housing at one side thereof and having a complementary, axially tapering, interior ring surface shaped to engage with the axially tapering surface of said metallic ring; means for pressurizing the interior of the housing; the annular radial surface bounding said opening being located intermediate said axially spaced inner and outer end surfaces of the metallic ring and abutting with an annular radial surface on said closure door when the door is in closed position; and ring means of deformable material in engagement between the metallic ring and door and between the metallic ring and housing near the ends of said metallic ring said axially inner radial end surface being of greater area than said axially outer radial end surface so that the pressure condition within said housing acts to maintain sealed engagement of said tapering surfaces.

2. A vessel having an opening bounded by a fixed marginal, generally radially disposed perimetral surface portion; a hinged door for said opening swingable to open and closed positions and having a generally radially disposed perimetral surface portion fixed thereon for radially abutting said fixed surface portion of the vessel; means for changing the pressure in said vessel from atmospheric; and axially movable seal ring means carried radially inwardly of said abutting surface portions and having axially spaced inner and outer, generally radial surfaces, said seal ring means including a surface portion inclined to the axis of the vessel; one of said vessel and door having a sealing surface portion inclined to the axis of the vessel for abutting engagement with said inclined surface portion on the seal ring means when the door is swung to closed position; the said inner radial surface of the seal ring means having a portion exposed to the atmosphere of the vessel, and the said outer radial surface of the seal ring means also having a portion exposed to the atmosphere of the vessel different in area than the said exposed portion of the inner radial surface, the seal ring means being disposed so that pressure in the vessel urges the seal ring means in an axial direction toward said sealing surface portion.

3. The combination defined in claim 2 in which guide means on the interior of said vessel mounts said seal ring means for limited radial movement as well as axial movement.

4. A vessel having an opening bounded by a fixed marginal, generally radially disposed perimetral abutment surface portion extending in a radial plane from a radially inner edge to a radially outer edge; a door for said opening movable to open and closed positions and having a perimetral abutment surface portion, extending radially from a radially inner edge to a radially outer edge, and abutting radially with said fixed perimetral surface portion of the vessel when the door is moved to closed position; means for changing the pressure in said vessel from atmospheric; seal ring means carried radially inwardly of the said abutting surface portions and having axially spaced inner and outer, generally radial surfaces; and guide means on one of said vessel and door mounting said seal ring means for limited axial movement; one of said vessel and door having a sealing surface portion engaged by said seal ring means when the door is in closed position; the said inner radial surface of the seal ring means having a portion exposed to the atmosphere of the vessel, and the said outer radial surface of the seal ring means also having a portion exposed to the atmosphere of the vessel different in area than the said exposed portion of the inner radial surface, the seal ring means being disposed so that pressure in the vessel urges the seal ring means in an axial direction toward said sealing surface portion.

5. The combination defined in claim 4 in which said guide means is mounted on the inner peripheral wall of said vessel.

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