

May 22, 1962

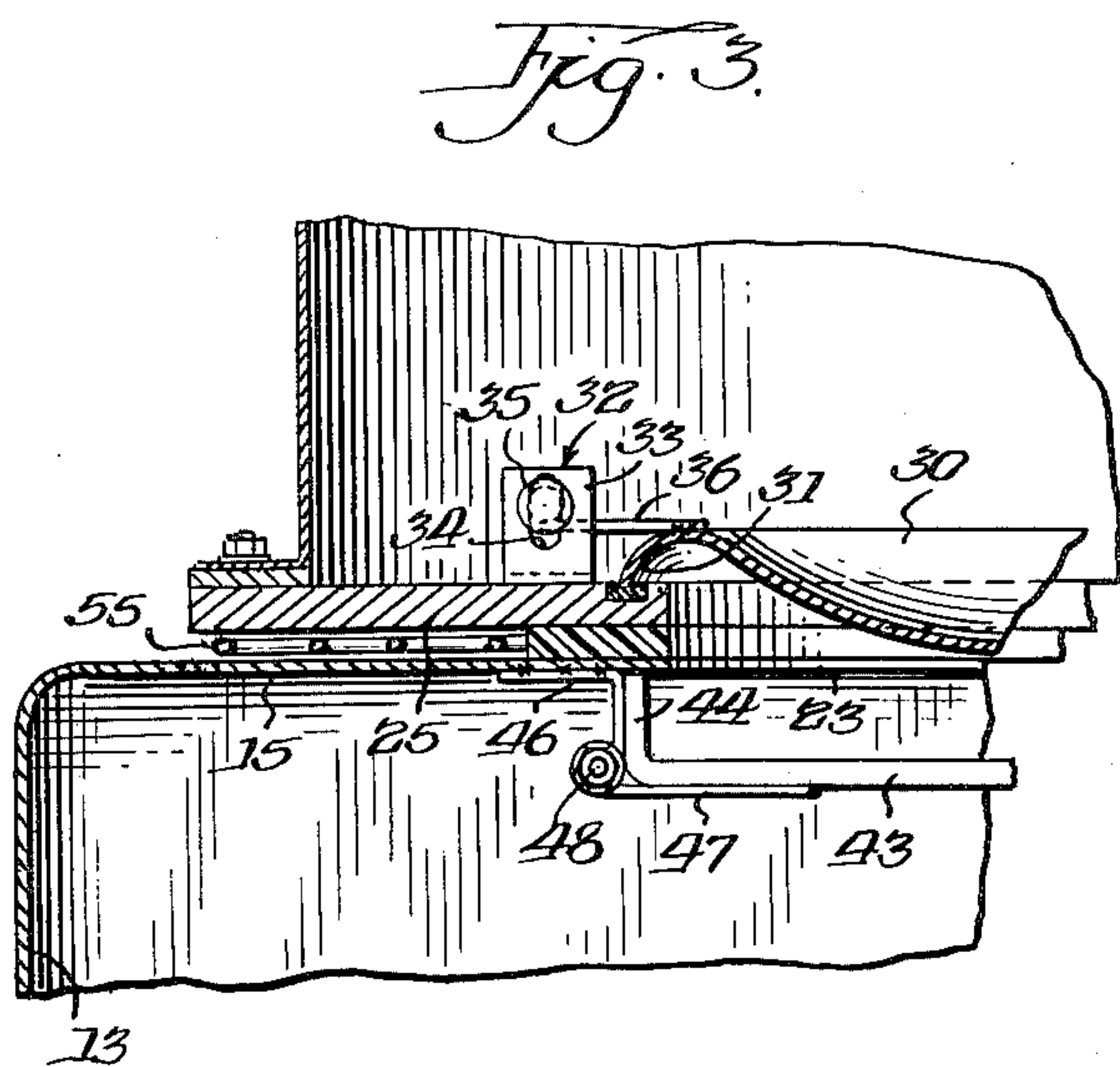
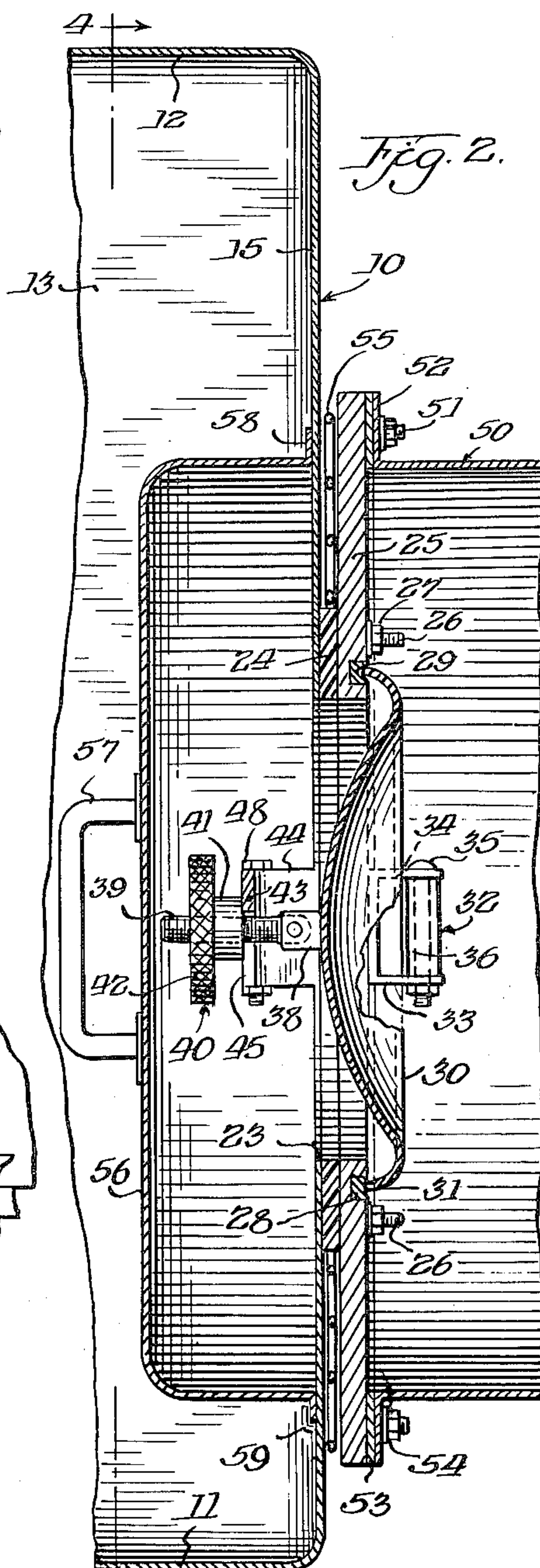
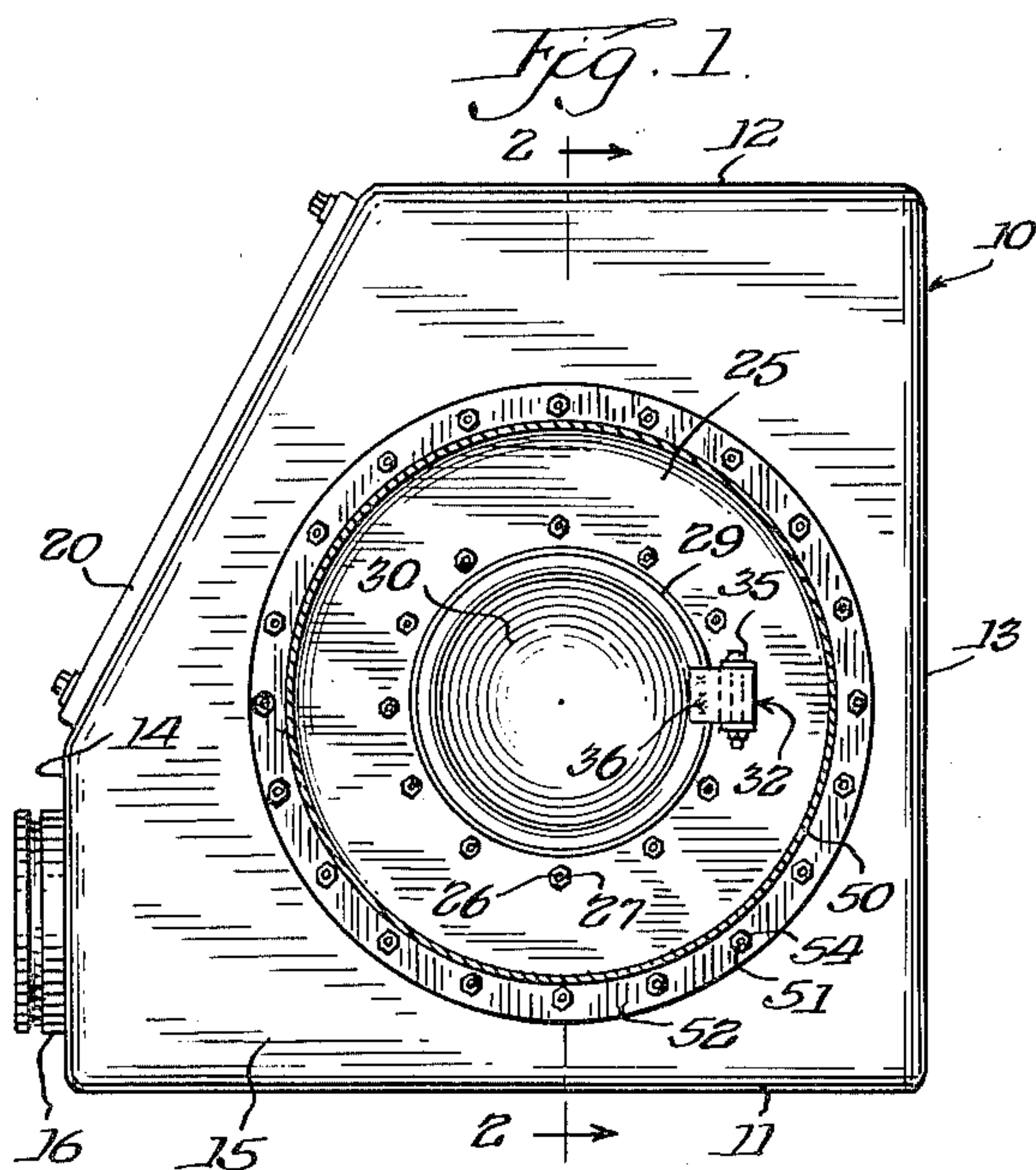
G. T. SAUNDERS

3,035,315

DOOR FOR GERM-FREE ENCLOSURES

Filed June 15, 1959

2 Sheets-Sheet 1



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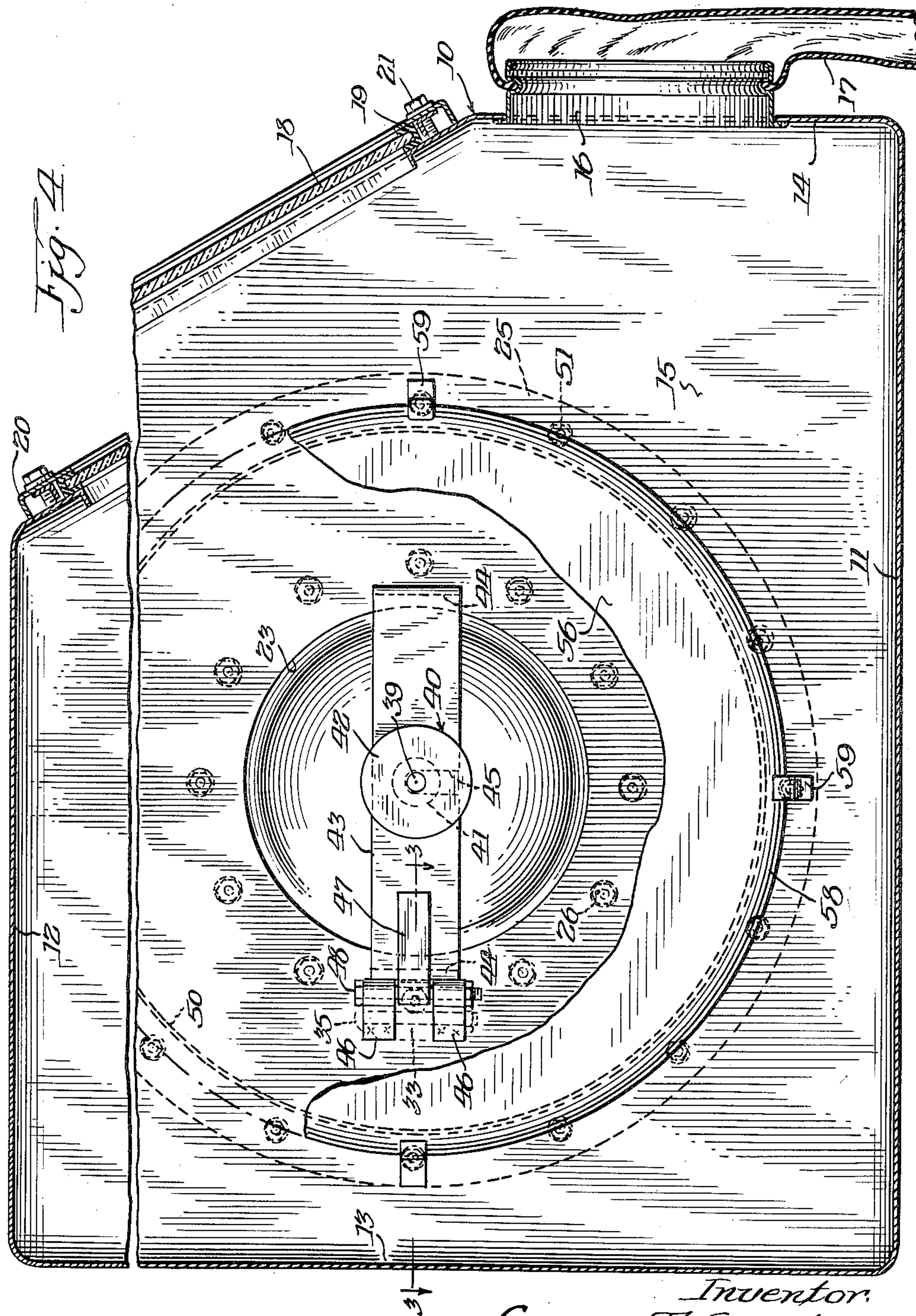
G. T. SAUNDERS

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2 Sheets-Sheet 2



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DOOR FOR GERMFREE ENCLOSURES

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11 Claims. (Cl. 20-16)

The present invention relates to germfree enclosures or the like, and more particularly to an access door construction therefor.

Within the past few years there has developed a new branch of science based upon the maintenance of germfree experimental animals in an initially germfree environment so that selected bacterial, viral or other organic factors may be introduced or applied to the animals. The effects of such selected factors obviously can be determined much more precisely and certainly than would be possible if they were affected and complicated due to the presence of other factors. The maintenance of the germfree, or more accurately, the gnotobiotic environment presents great problems, because contamination may result from a great variety of causes or sources, and contamination, of course, results in a research project losing value of validity, either completely or partially. To guard against such a loss, a plurality of duplicating series may be conducted, so that if contamination occurs in one case at least one other uncontaminated series may be continued. Obviously, the research cost is multiplied by such duplication, and it is therefore highly desirable to provide for the reduction of the chances of contamination. The frequency of contamination is the basic factor in determining the number of duplicate series which are required to reduce to an acceptable point the chances of complete loss. The present invention is directed to the substantial reduction of the possibility of contamination in enclosures for gnotobiotic research, or similar enclosures. To this end, the invention provides access means for germfree enclosures and the like, greatly reducing the chances of contamination and accomplishing other advantageous results.

An important object of the invention is the provision of an access door construction for germfree enclosures or the like which is lockable and releasable only from the interior of the enclosure.

Another object is the provision of a door construction for germfree enclosures and similar isolators which affects inward movement of the closure directly axially of the access opening to clamp sealingly against the exterior of the enclosure.

Another object is the provision of a door construction for germfree enclosures and the like, particularly adapted to the connection of an auxiliary chamber in sealed relation exteriorly of the enclosure, whereby the door construction provides communication therebetween.

A further object of the invention is the provision of an access door construction for germfree enclosures or the like which allows ready connection to the enclosure about the access opening of a lock chamber or the like and for heat sterilization of such chamber without affecting the environment with the enclosure.

It is an object to provide a door construction for germfree enclosures and the like which greatly reduces the possibility of contamination of the interior of the enclosure.

It is also an object to provide an access door construction for germfree enclosures and the like with a closure member readily securable and releasable from within the enclosure by the use of only one hand.

It is another object to provide an enclosure structure having a plurality of adjacent enclosures with a door con-

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struction controlling an opening therebetween, and cooling means allowing heat sterilization of one of the enclosures without appreciably affecting the interior of the other.

Other and further objects, advantages and features of the invention will be apparent to those skilled in the art from the following detailed description, taken in conjunction with the accompanying drawings, in which:

FIG. 1 is an end elevational view of a germfree enclosure or the like, showing the door construction;

FIG. 2 is an enlarged vertical sectional view taken substantially as indicated by the line 2-2 of FIG. 1;

FIG. 3 is a fragmentary horizontal sectional view taken substantially as indicated by the line 3-3 of FIG. 4; and

FIG. 4 is a vertical sectional view, with parts broken away, taken substantially as indicated by the line 4-4 in FIG. 2.

Referring to the drawings, there is shown a germfree enclosure or isolator generally designated 10, having a bottom wall 11, a top wall 12, rear wall 13, and front wall 14, together with a pair of end walls 15, only one of which is shown. The front wall 14 has a vertical lower portion with a pair of apertures therein through which the hands and arms of an operator may be extended into the enclosure, each of the apertures being defined by a flange-like cuff 16 extending outwardly and adapted to have secured thereto the open end of a rubber or like, glove 17 (FIG. 4). Only one of the arm apertures and cuffs is shown in the drawings. The front wall 14 has an upper portion which is inclined and formed with a view opening closed by a transparent panel 18, the edges of which are received in a sealing member 19 of the channel section and clamped against the inclined wall surface about the viewing aperture by any suitable means, such as the rim structure 20 secured by bolts 21.

In the end wall 15 shown in the drawings, there is provided an access opening 23 which in this case is circular, although it might be of any desired shape. On the exterior of the wall is an annular gasket 24 of any suitable material which extends about the opening 23. Overlying the gasket 24 is an annular connecting member 25, the aperture of which corresponds to the opening 23 and the aperture of the gasket 24, the outer dimensions of this member being considerably greater than that of the gasket. The gasket and connecting member may be secured on the enclosure 10 in any suitable manner, such as by means of studs 26 welded or otherwise secured on the end wall 15 and extending through the gasket and connecting member and receiving nuts 27 thereon which may be drawn up to clamp these parts on the end wall. It will be apparent that the annular gasket 24 serves not only to seal between the end closure and connecting member 25, but to space the connecting member from the end wall 15. The connecting member 25 is formed with an annular groove 28 surrounding the aperture thereof, and receiving a sealing member 29 of any suitable material therein.

A door or closure 30 is provided for closing the opening 23, having bulged or dished central portion substantially as shown and a marginal portion which is reversely curved relative to the central dished portion so as to have the edge 31 extend in the direction of the convex side of the door or closure. The closure 30 is larger than the opening 23, and dimensioned and arranged to have the edge 31 thereof engage the seal 29 in its closed position. The closure is hingedly mounted on the exterior of the connecting member 25 by means of a hinge 32 comprising a U-shaped hinge bracket 33 welded or otherwise suitably secured to the connecting member 25, having corresponding elongated slots 34 in the horizontally extending upper and lower legs thereof to receive a bolt 35 or the like which serves as a hinge pin. A hinge leaf or strap 36 has one end formed into a cylinder or eye

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to receive the hinge bolt 35 and the other end secured to the door or closure 30 in any suitable manner, as by welding. It will be apparent that the closure 30 may be swung by means of the hinge to and from a position closing the access opening and engaging the seal 29, and that the elongated slots 34, extending parallel to the axis of the access opening, provide for limited movement of the closure 30 directly axially of said axis. To the inner or convex face of the closure 30 is secured a pivot bracket 38 pivotally mounting a stud 39 on which is threaded a nut 40 having a bearing portion 41 and a relatively large manipulating flange 42 which may have its edge knurled or otherwise formed to provide for secure gripping thereof. On the interior of the end wall 15 there is hingedly mounted a generally U-shaped retaining or locking bar 43, the legs 44 of which are directed toward the end wall and adapted to engage thereagainst when the bar is swung into its operative position, in which it extends across or bridges the access opening 23. A slot 45 is formed in one edge of the locking bar 43 to receive the stud 39 therethrough, the location and size of the slot being such that the stud 39 extends axially of the opening 23 when engaged in the slot 45.

In the present case, the locking bar 43 is shown as mounted to swing horizontally and in its bridging position to be intersected substantially centrally by the axis of the opening 23, and the slot 45 extends from the lower edge of the bar at the center thereof. The hinge for the locking bar 43 may be of any desired construction, although it is here shown as comprising a pair of angular brackets 46 each having one leg welded or otherwise secured to the interior of the end wall 15 and the other leg formed into an eye at its end, with a hinge leaf 47 also having one end formed into an eye and the other end welded or otherwise secured to the bar 43. A bolt 48 extends through the aligned eyes of the brackets 46 and leaf 47 to serve as a hinge pin. In closing and locking the door or closure 30, it is swung to position closing the opening and engaging the annular gasket 29 as already described, the locking bar is brought to its position bridging the access opening 23, and the pivoted stud 39 is swung into engagement in the slot 45, with the bearing portion 41 of the nut 40 engaging the inwardly directed face of the bar 43. The nut 40 is then rotated to draw the stud 39, and thereby the closure 30, inwardly relative to the enclosure 10, so that the closure is brought into tight clamping relation with the exterior of the enclosure, specifically with the annular gasket or seal 29.

The closure may be of any suitable material, but preferably is of a somewhat yieldable or resilient nature so that a certain degree of tension is provided which tends to maintain the enclosure in the tightly clamped and sealed relation. To release the closure 30, it is only necessary to rotate the nut 40 so that it will move toward the free end of the stud, whereupon the stud may be swung or dropped out of the slot 45. The closure 30 tends to open by reason of its resilience and that of the gasket 29, moving first in a direction directly axial of the opening 23. Similarly in closing, the closure is drawn substantially axially of the access opening by means of the nut 40 on the stud 39 to its final secured position. It will be clear that the locking mechanism is easily operated by one hand.

It is advantageous in providing for the introduction of material into the enclosure 10 to employ a second or auxiliary enclosure, which may be in the nature of a lock chamber, generally designated 50. The chamber 50 may be of smaller cross section than the enclosure 10, and is secured to the connecting member 25 by means of studs 51 projecting from the connecting member 25 and through suitable apertures in a flange 52 of the chamber 50 about its open end. A suitable gasket 53 or other sealing member is disposed between the connecting member and the chamber flange, the parts being clamped tightly together by nuts 54 drawn up on the studs 51. The chamber 50

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when secured to the connecting member 25, and thus in effect to the enclosure wall 15, may be heat sterilized, together with the outer surfaces of the access door construction and the connecting member 25, while the enclosure 10 is maintained tightly sealed. The closure thereafter may be opened from within the enclosure 10 without danger of contamination. To avoid any deleterious effects to any experimental animals within the enclosure, cooling means in the form of suitable cooling coils 55 are disposed in the space between the end wall 15 and the connecting member 25. The cooling means are operated in any suitable manner and by any appropriate means, the latter not forming a part of this invention. To further prevent undue heating of the interior of the enclosure 10, a heat-barring cover member 56 having a depth sufficient to receive the locking bar 43 and stud 39 therein when engaged against the interior of the end wall 15 is provided within the enclosure 10. A suitable handle 57 is provided by which the cover member 56 may be readily manipulated by one hand, and an outturned flange 58 is formed on the periphery of the cover member. A plurality of Z-shaped clips 59 secured on the interior of the end wall 15 serve to receive the flange 58 and hold the cover member in position over the locking mechanism and in close contact with the end wall. The cover member 56 preferably corresponds in size and shape to the end of the chamber 50, to which it is opposed when in its operative position on the end wall 15, so as to provide a barrier between the chamber and the interior of the enclosure.

It will be evident that with the access door construction disclosed hereinabove, very easy and convenient one hand operation in locking or releasing the access door or closure from the interior of the enclosure 10 is provided. The fact that only one hand need be employed is obviously very advantageous in that the other hand is left free to perform other functions or operations simultaneously with the opening or closing of the door construction. The fact that the closure may be opened and closed only from the interior of the enclosure 10 makes it almost certain that the procedure necessary to assure maintenance of the sterile barrier is followed. This is particularly true when the enclosure is to be opened, since it is impossible for the closure 30 to be opened from the exterior of the enclosure, and to be opened unintentionally from the interior. The provision of means for preventing the heating of the enclosure when an adjacent and connected chamber is being sterilized is of importance in preventing harm befalling the experimental animals or the like in the enclosure 10 from this source, and thus eliminates a factor which might deleteriously affect the outcome of the experimental procedure.

Having thus described my invention, it is obvious that various immaterial modifications may be made in the same without departing from the spirit of my invention; hence, I do not wish to be understood as limiting myself to the exact form, construction, arrangement and combination of parts herein shown and described, or uses mentioned.

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

1. In an entrance structure for germfree enclosures and the like, the combination of an enclosure wall having an access opening therein, an annular member secured to the outer face of said wall and encircling said opening, a second annular member of greater outer diameter than the first and secured thereto to form a laterally extending flange, said second member having a groove in its outer face encircling said opening, a gasket member positioned in said groove, a semi-flexible dish-shaped closure member having peripheral portions cooperable with said gasket member, hinge means operatively connecting said closure member and said second member, said hinge means being constructed to permit limited movement of said door in a direction normal to the plane of said gasket member, a

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U-shaped retaining member positioned adjacent the inner face of said wall with the leg portions of said member extending toward and engageable with the latter and disposed at opposite sides of said opening and the intermediate portion extending thereacross, hinge means operatively connecting one leg of said U-shaped member with said wall structure, said U-shaped member having a slot therein extending from an edge thereof inwardly with respect to the axis of said opening, said door having a stud pivotally connected to the inner face of said closure member, the pivotal axis thereof extending transversely with respect to said slot whereby said stud is pivotally movable in said slot, and a nut on said stud adapted to engage said member whereby said door may be drawn down on said gasket member or released by loosening said nut and disengaging said stud from said member.

2. In an entrance structure for germfree enclosures and the like, the combination of an enclosure wall having an access opening therein, means on the exterior of said wall defining a groove about said access opening, a gasket in said groove, a stiffly yieldable closure member for the access opening including a dished central portion extending in the direction inwardly of the access opening and a peripheral marginal flange portion extending in said direction sealingly engageable with said gasket, said dished central portion operatively positioned within said access opening, hinge means mounting the closure member on the exterior of the wall including means allowing limited closure member movement normally of the plane of the gasket, a U-shaped retaining member positioned adjacent the inner face of said enclosure wall with the leg portions of said U-shaped retaining member extending toward and engageable with said enclosure wall and disposed at opposite sides of said access opening and the intermediate portion extending thereacross, hinge means operatively connecting one leg of said U-shaped retaining member with said enclosure wall, a slot extending from one edge of said U-shaped retaining member at the intermediate portion thereof, a stud pivotally secured to the central portion of the closure member and swingable to engage in said slot, and a nut on said stud engageable with the U-shaped retaining member to shift the stud inwardly of the enclosure for clamping the closure member on the gasket and outwardly for releasing the closure member.

3. In an entrance structure for germfree enclosures and the like, the combination of an enclosure wall having an access opening therein, a gasket secured on the wall exterior surrounding said access opening, a stiffly resilient closure for the access opening having an edge portion sealingly engageable with said gasket, hinge means for mounting the closure on said wall exterior and including means for allowing said closure edge portion to seat squarely on said gasket prior to clamping thereagainst, a U-shaped retaining member operatively mounted on the interior of said wall to swing to position spanning the access opening, said U-shaped retaining member including leg portions extending toward and engageable with said enclosure wall and disposed at opposite sides of said access opening and the intermediate portion extending thereacross, hinge means for said U-shaped retaining member operatively mounted on the interior of said closure and including a hinge leaf operatively affixed to one leg of said U-shaped retaining member, means defining a recess in the intermediate portion of said U-shaped retaining member, a stud swingably mounted on the closure and engageable in said recess, and a nut on said stud engageable with the U-shaped retaining member and manipulable to effect clamping of the closure against said gasket.

4. In an entrance structure for a germfree enclosure or the like, the combination of an enclosure wall having an access opening therein, a closure for said opening including a dished portion and extending within said opening and a peripheral flanged portion extending in the direction of said dished portion and larger than the access

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opening, hinge means mounting said closure exteriorly of said wall for swinging to and from a position closing the access opening, a U-shaped retaining member mounted interiorly of said enclosure wall and movable into position spanning the access opening, said U-shaped retaining member including leg portions extending toward and engageable with said enclosure wall and disposed at opposite sides of said access opening and the intermediate portion extending thereacross, hinge means operatively connecting one leg of said U-shaped retaining member with said enclosure wall, said U-shaped retaining member having a slot therein extending from one edge thereof inwardly with respect to the axis of the access opening, complementally formed securing means on the closure engageable with said recess of said U-shaped retaining member in said spanning position thereof and cooperable therewith for clamping the closure against the wall exterior in said closing position, and means sealing between the closure and wall completely about the access opening in said closing position.

5. A germfree enclosure construction comprising a first enclosure having a wall with an access opening therein, an annular sealing member on the exterior of said wall about said opening, an annular attaching member of greater overall dimensions than said sealing member secured to the wall exterior and spaced therefrom by the sealing member, cooling means in the space between said wall and attaching member, a second enclosure having an open end securable on said attaching member in sealedly closed relation, a gasket member carried by the attaching member extending completely about said opening, a closure member for the opening extending exteriorly of said first enclosure and having a peripheral flange engageable in sealing relation with said gasket member, hinge means mounting the closure member on the wall exterior including means permitting limited movement of the closure member normally relative to the plane of the gasket member, a stud pivotally mounted on the inner face of the closure member centrally thereof, a nut on said stud, a retaining member hingedly mounted on the interior of said wall for swinging to and from a position spanning the access opening, a slot in said retaining member for receiving said stud in said spanning position of the retaining member with the nut engageable against the inwardly directed face thereof to draw the closure into tightly clamped relation with the gasket member, and a heat-barring cover member removably disposable on the wall interior over said access opening and in opposed relation to said open end of the second enclosure and substantially corresponding to said open end in shape and dimensions, said cooling means and cover member reducing the transfer of heat from the second enclosure to the first upon subjection of the second enclosure, attaching member, and closure member to heat sterilization upon securement of the second enclosure to the attaching member.

6. A germfree enclosure or like construction comprising an enclosure having a wall with an access opening therein, an annular sealing member on the exterior of said wall about said opening, an annular connecting member of greater overall dimensions than said sealing member secured to the wall exterior and spaced therefrom by the sealing member, co-planar cooling coil means in the space between said annular connecting member and wall, a hollow member having an open end, means for securing said open end to the annular connecting member about the access opening in selected relation, a closure for the access opening of a size to extend outwardly beyond the edge of the opening, hinge means mounting said closure exteriorly in said wall to swing to and from position closing the opening, a U-shaped retaining member positioned adjacent the inner face of said wall with the leg portions engageable with the wall and disposed at opposite sides of said access opening and movable to a position bridging the access opening, hinge means operatively connecting

one leg of said U-shaped retaining member with said wall, complementally formed securing means on the closure engageable with said U-shaped retaining member in said bridging position thereof and cooperable therewith for drawing the closure into clamping relation with the wall exterior in said closing position, means for sealing between the closure and wall completely about the access opening in said clamped relation, and a detachable heat barring cover member within which is positioned said U-shaped retaining member and means on the closure member engageable with said U-shaped retaining member, and upon detachment of said heat barring cover member, said U-shaped retaining member and means on the closure member engageable with said U-shaped retaining member may be actuated.

7. The enclosure construction as defined in claim 6, wherein said heat-barring cover member is removably securable interiorly of the wall over the access opening and in opposed relation to said open end of said hollow member.

8. A germfree enclosure or like construction comprising an enclosure having a wall with an access opening therein, a connecting member surrounding said access opening secured to said wall in spaced and sealed relation thereto, a hollow member having an open end, means for securing said open end to the connecting member about the access opening in sealed relation, a closure for the access opening larger than the access opening including a dished central portion adapted for operatively positioning within said access opening and a peripheral marginal flanged portion larger than said access opening and adapted for clamping in sealing engagement about the access opening, means mounting said closure exteriorly of the wall movable to position closing the opening, a U-shaped retaining member positioned adjacent the inner face of said wall with the leg portions engageable with and disposed at opposed sides of said access opening and movable to a position bridging the access opening, hinge means operably connecting one leg of said U-shaped retaining member with said wall, complementally formed securing means on the closure engageable with said U-shaped retaining member in said bridging position and cooperable therewith for drawing the closure into clamping relation with the wall exterior, and means for sealing between the closure and wall in said clamped relation of said closure.

9. A door for an access opening in a wall of a germfree enclosure or the like and including an annular connecting member and a gasket on the exterior of said annular connecting member and surrounding said access opening, comprising a closure member, means for hinging said closure member on said exterior of said annular connecting member and permitting movement of the closure member normal to the plane of said gasket, said closure member including a dished central portion and extending inwardly relative to the access opening and also including a flange portion directed inwardly for engagement in tight sealing relation with the aforesaid gasket, a U-shaped retaining member for hinging on the interior of said germfree enclosure and swingable to a position spanning said access opening, said U-shaped retaining member including leg portions extending toward and engageable with said wall and disposed at opposite sides of said access opening and the intermediate portion extending thereacross, a slot in said intermediate portion of said U-shaped retaining member, a stud swingably mounted on the dished portion of said closure member for engagement in said slot, and a nut member on said stud adapted to bear on the inward face of said intermediate portion of said U-shaped retaining member for drawing the closure member inwardly into clamping engagement with the gasket.

10. A door structure for an access opening in a wall of a germfree enclosure or the like, comprising a closure member of greater size than said access opening, means for mounting said closure member exteriorly of said wall for movement to and from a position closing the access opening, said means for mounting including means for allowing relative axial movement of said closure member axially of said access opening in the clamping of said closure member, said closure member including a dished central portion and adapted to extend inwardly relative to the access opening and also including a marginal flanged portion and adapted to extend inwardly relative to the access opening, a U-shaped retaining member mounted interiorly of the germfree enclosure and movable to a position bridging the opening, said U-shaped retaining member including leg portions extending toward and engageable with said wall and disposed at opposite sides of said access opening and the intermediate portion extending thereacross, hinge means for operatively connecting one leg of said U-shaped retaining member with said enclosure wall, securing means including a stud swingably mounted on said closure member and operative for engaging a slot formed on the intermediate portion of said U-shaped retaining member cooperable in said bridging position of the closure member to draw the closure member into clamping relation with the wall exterior axially of said access opening, said means on said closure member and U-shaped retaining member including threaded means carried by one of said closure members and U-shaped retaining member and complementally formed means on the other of said members, and means for sealing between the closure member and wall about the access opening.

11. A door structure for an access opening in a wall of a germfree enclosure or the like, comprising a closure of greater size than said access opening, said closure including a dished central portion and adapted to extend inwardly relative to the access opening and also including a marginal flanged portion exteriorly of said access opening, means for mounting said closure exteriorly of said wall for limited movement directly axially of the access opening to close the access opening, a U-shaped retaining member mounted interiorly of the germfree enclosure and movable into position bridging the opening, said U-shaped retaining member including leg portions extending toward and engageable with said wall and disposed at opposite sides of said access opening and the intermediate portion extending thereacross, hinge means for operatively connecting one leg of said U-shaped retaining member with said enclosure wall, means on the closure and U-shaped retaining member cooperable in said bridging position of the U-shaped retaining member and closing position of the closure to move the closure axially of the opening into clamping relation with the exterior of the wall, and said means on said closure member and U-shaped retaining member including threaded means carried by one of said closure members and U-shaped retaining member and complementally formed means on the other of said members.

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