

**Feb. 23, 1960**

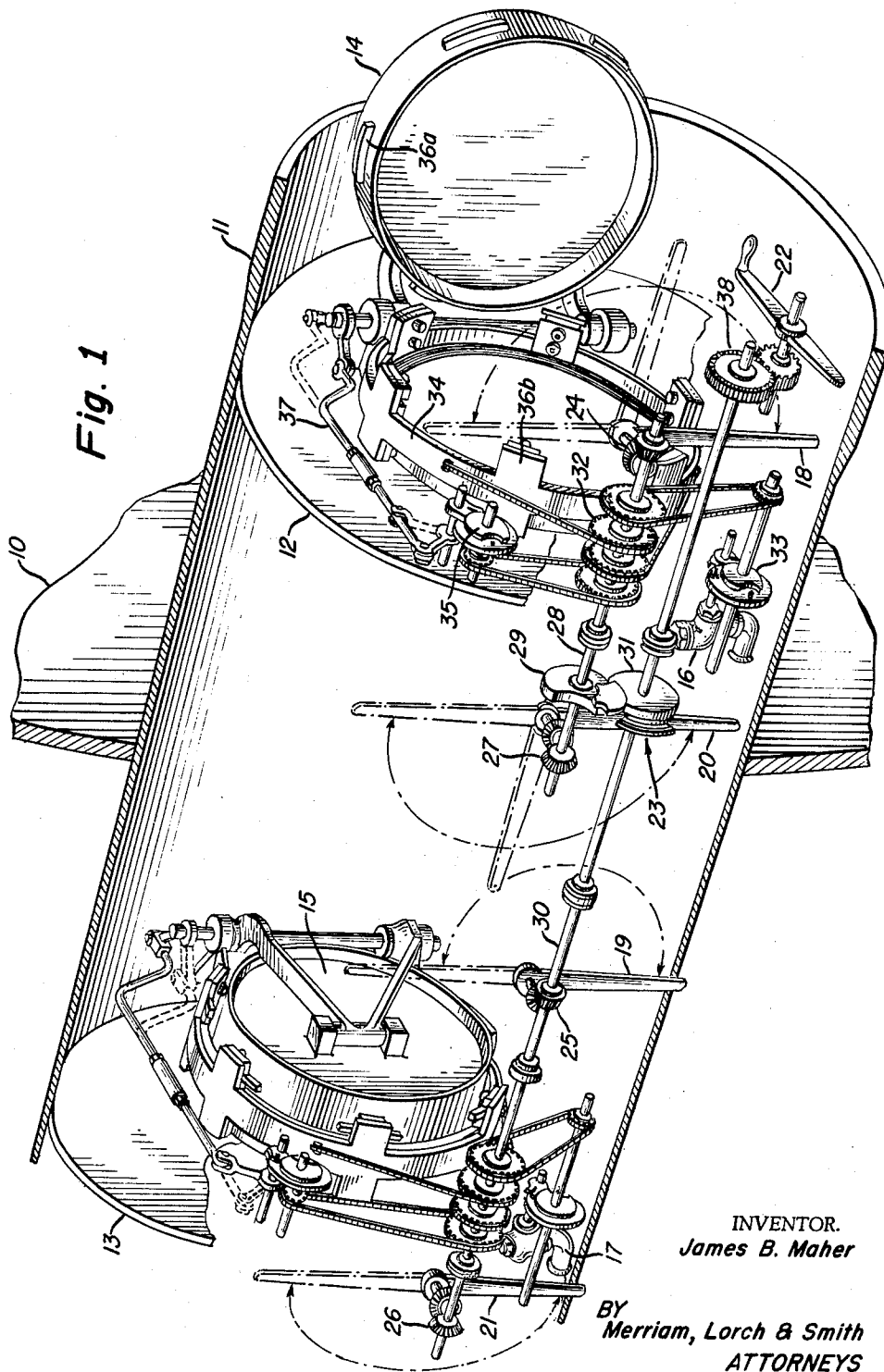
**J. B. MAHER**

**2,926,012**

DOOR INTERLOCK SYSTEM

Filed June 6, 1958

6 Sheets-Sheet 1



Feb. 23, 1960

J. B. MAHER  
DOOR INTERLOCK SYSTEM

2,926,012

Filed June 6, 1958

6 Sheets-Sheet 2

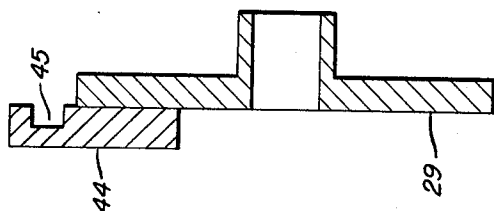


Fig. 3

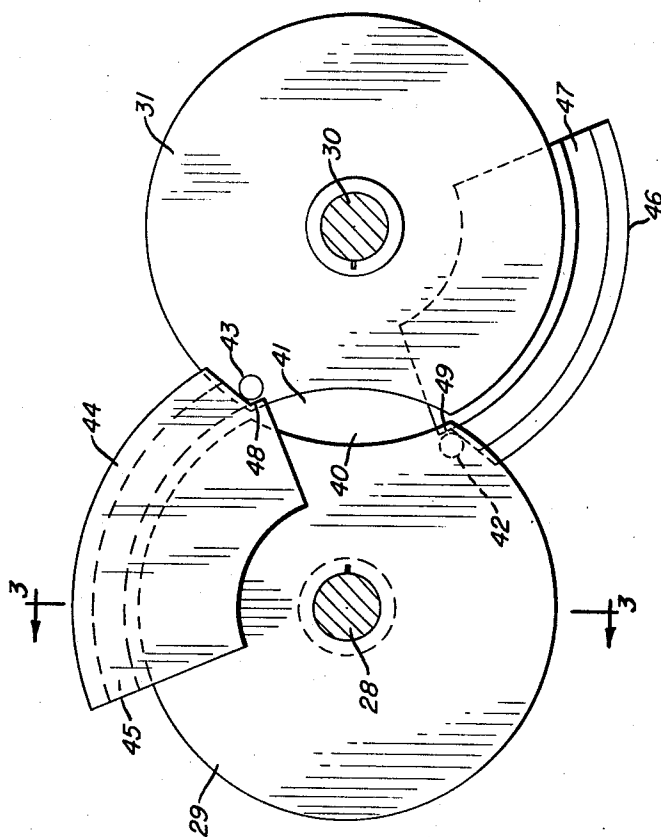


Fig. 2

INVENTOR.  
James B. Maher

BY

Merriam, Lorch & Smith  
ATTORNEYS

Feb. 23, 1960

J. B. MAHER  
DOOR INTERLOCK SYSTEM

2,926,012

Filed June 6, 1958

6 Sheets-Sheet 3

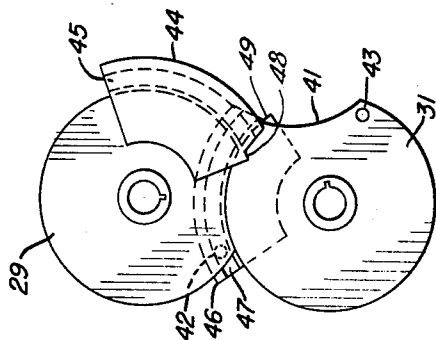


Fig. 6

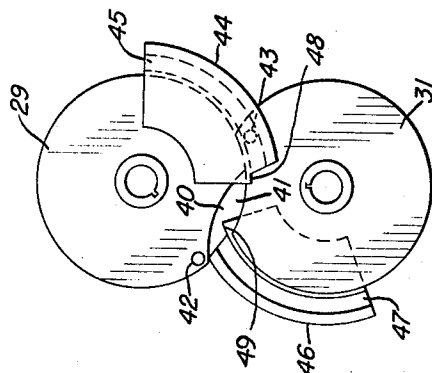


Fig. 5

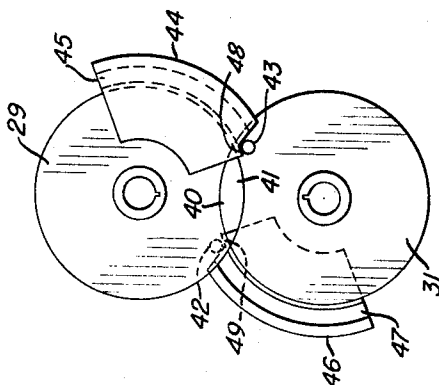


Fig. 4

INVENTOR.  
James B. Maher

BY

Merriam, Lorch & Smith  
ATTORNEYS

Feb. 23, 1960

J. B. MAHER

2,926,012

DOOR INTERLOCK SYSTEM

Filed June 6, 1958

6 Sheets-Sheet 4

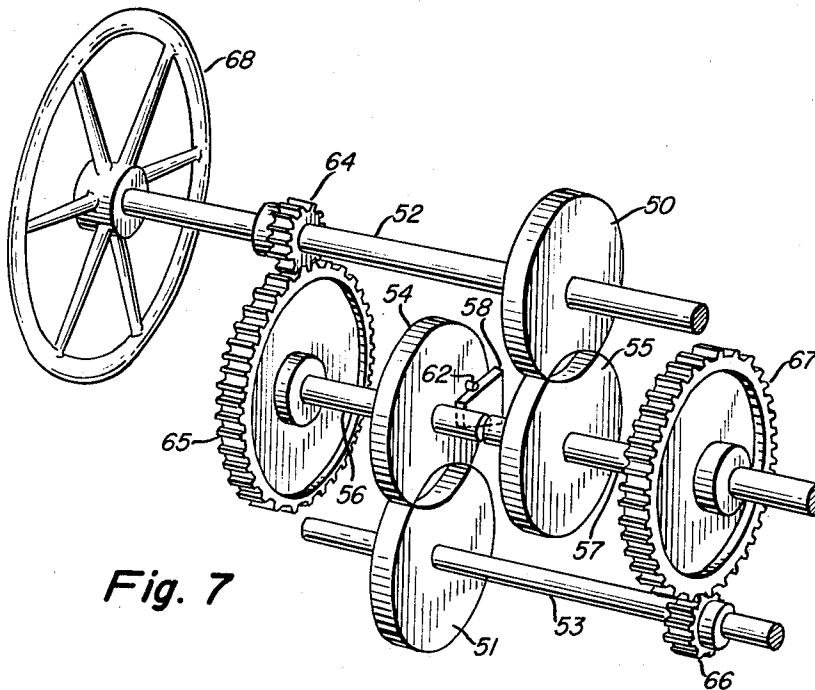


Fig. 7

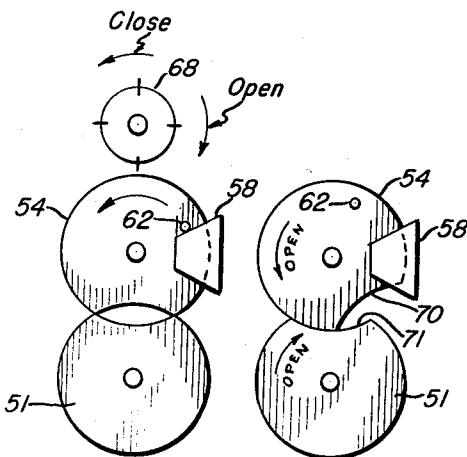


Fig. 10

Fig. 12

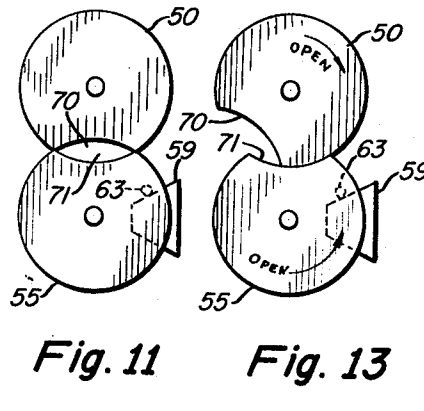


Fig. 11

Fig. 13

INVENTOR.  
James B. Maher

BY

Merriam, Lorch & Smith  
ATTORNEYS

Feb. 23, 1960

J. B. MAHER  
DOOR INTERLOCK SYSTEM

2,926,012

Filed June 6, 1958

6 Sheets-Sheet 5

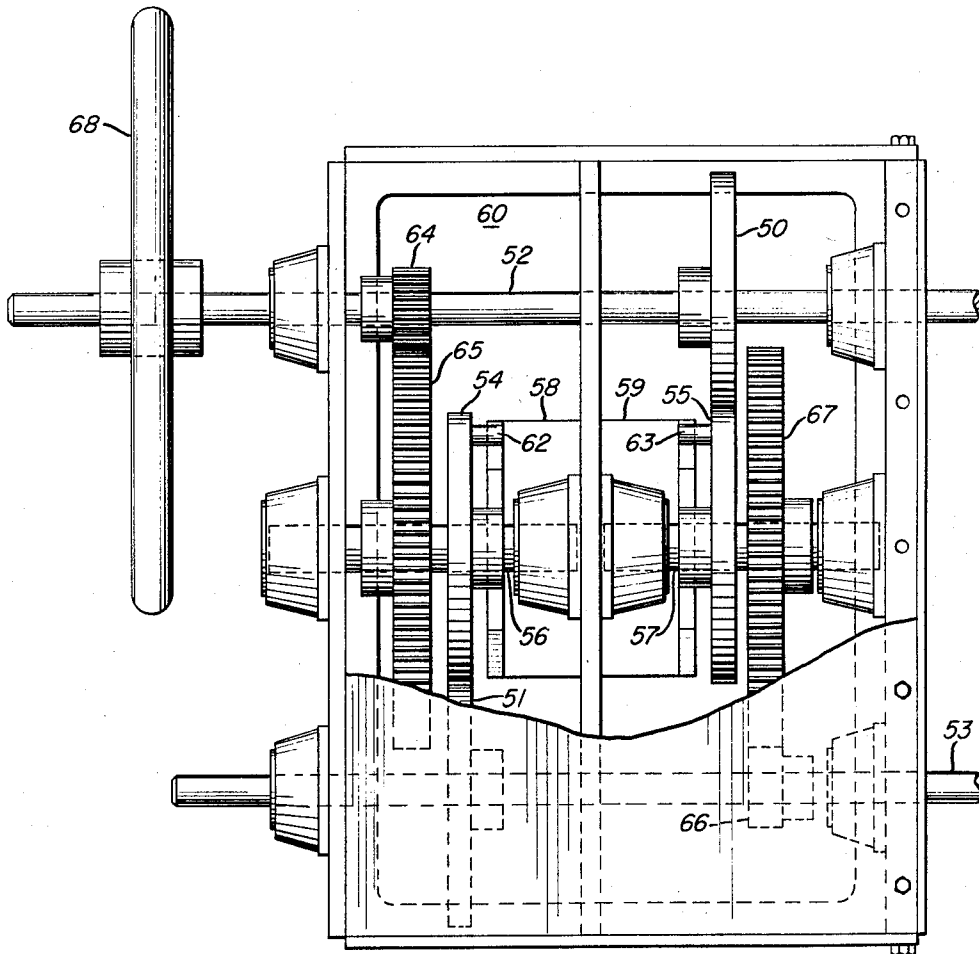


*Fig. 8*

INVENTOR.  
*James B. Maher*

BY

*Merriam, Lorch & Smith*  
ATTORNEYS

Feb. 23, 1960

J. B. MAHER  
DOOR INTERLOCK SYSTEM

2,926,012

Filed June 6, 1958

6 Sheets-Sheet 6

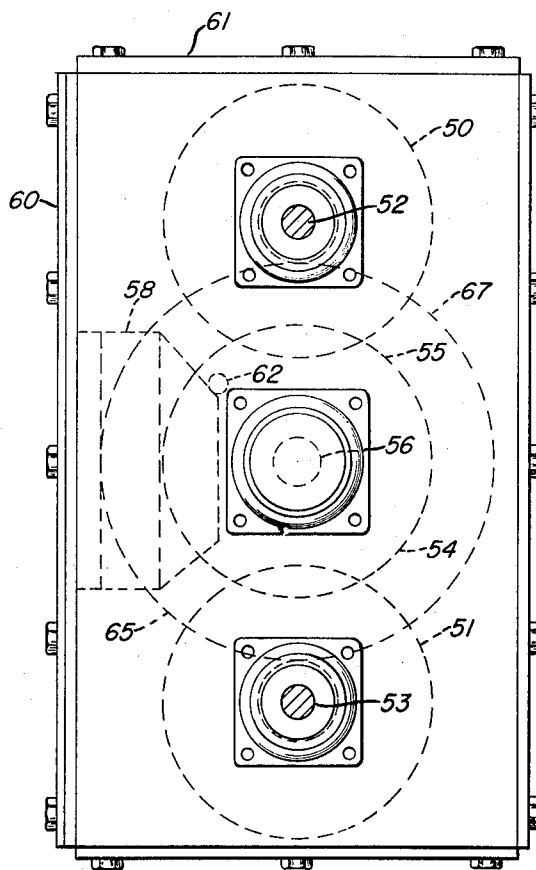


*Fig. 9*

INVENTOR.  
*James B. Maher*

BY

*Merriam, Lorch & Smith*  
ATTORNEYS

1

2,926,012

## DOOR INTERLOCK SYSTEM

James B. Maher, Chicago, Ill., assignor to Chicago Bridge and Iron Company, Chicago, Ill., a corporation of Illinois

Application June 6, 1958, Serial No. 740,277

10 Claims. (Cl. 268—16)

This invention relates to an airlock suitable for use in pressure or vacuum vessels such as nuclear reactor containment vessels, pressure tunnel entrances, high altitude test chambers, submarines, astronautical vessels and other vessels where it is necessary to provide convenient access for personnel and equipment without disturbing the fluid-tight integrity of the vessel. It is more specifically concerned with an interlock system for controlling the operation of the access doors enclosing the ends of the airlock compartment.

Airlocks of conventional design comprise an intermediate fluid-tight compartment interconnecting the interior of an enclosed vessel with the exterior of the vessel. Access to the airlock compartment is provided by doors at either end of the compartment which are hinged to the end bulkheads. To facilitate the use of the airlock, doors of the "quick opening" type are generally used. In order to preserve the fluid tight integrity of the enclosed vessel penetrated by the airlock the door system should be equipped with an interlock system which prevents both doors from being opened at the same time.

During normal operations when the airlock is not in use, the access door of the airlock should be closed. If, however, the airlock is to be used as an emergency exit from the vessel, the interior door of the escape lock can be left open. The exterior door of the airlock should always remain closed, but provisions should be made for operating the exterior door and the interior door from within the interior of the enclosed vessel.

While it should be understood that the interlock system of this invention can be utilized in a variety of different types of pressure or vacuum vessels, to facilitate its description its use in conjunction with an entrance or escape lock in a nuclear reactor containment vessel will herein be considered.

The purpose of an emergency escape lock in a nuclear reactor containment vessel is to provide a means for the escape of personnel who may happen to be inside the containment vessels when an emergency "scram" signals the happening of a nuclear accident or incident within the reactor. At such a time, the safety of the operating personnel who are within the containment vessel depends upon their ability to get out of the vessel in a minimum length of time and the safety of the public depends upon maintaining the integrity of the vessel for containing radioactive substances which may be released on account of the nuclear accident. As an example, such operating personnel may have only from 15 to 20 seconds in which to make good their escape. During that period of time the pressure within the containment vessel may be rising from atmospheric pressure to as high as 35 to 40 lb. per sq. in. above atmospheric or even higher, with coincident increases in temperature. At the time of a "scram" there may be a complete failure of electric and auxiliary power supplies, and the escape airlock must therefore be capable of being operated manually. Because it is imperative, from the standpoint of the safety

2

of the local population, that no appreciable quantities of radio-active substances escape from the containment vessel, it is considered necessary to provide an interlock system which makes it impossible for escaping personnel, no matter how frantically rushed, to unlock one door of the airlock unless the other is locked.

Even where an airlock is to be used only for normal access for equipment and personnel, and is not designed as an escape airlock, it has been recognized by most designers of nuclear containment vessels that a mechanical interlocking system should be used so as to make it impossible for operating and maintenance personnel to violate the airlock except at times when the nuclear reactor is shut down and the danger of a nuclear incident or accident does not exist.

In an emergency escape airlock, the design must take into consideration power failures and the operation of the mechanical interlock system by a person of modest proportions and strength within the space of a very short period of time, of the order of 2 seconds for the complete sequence of unlocking and opening either door of the airlock.

The interlock must be designed in such a way that the inner door may be opened or closed from inside the containment vessel or from inside the airlock, and the outer door opened or closed from inside the containment vessel, inside the airlock, or outside the vessel. In addition, it is usually desirable that the inner door of the airlock be operable as well from outside the containment vessel.

The subject airlock interlock system provides a fast, positive acting and foolproof locking and interlocking system of a construction sufficiently simple and light that it may be operated manually with a minimum of effort and without excessive gearing down. For example, an airlock like that described in this application, complete with interlock system has been successfully built to go through its complete sequence of interlocking the outside door, equalizing pressure on both faces of the inside door, unlocking the inside door and opening the inside door by a quarter revolution of a hand lever powered by a person of modest proportions and strength in a period of approximately 2 seconds. The same time and effort is required to close and lock the inside door, close the equalizing valve, and unlock the outer door interlock; and similar time and effort is required to go through the same procedure with respect to the outside door. Other similar but larger airlocks have been built and have successfully operated on the bases of lever rotations of 120 degrees and 180 degrees, and still others have been built utilizing a hand wheel which can be turned with a minimum of effort and at only slightly greater lengths of time. The degree of lever movement or of hand wheel rotation depends upon such factors as the mass of each door, the resiliency of the seal gasket, the size of the equalizing valve, the number of moving parts of the interlock system and the amount of friction in those parts.

Figure 1 is a perspective cutaway view of an airlock employing one embodiment of the door interlock of this invention;

Figure 2 is a front elevation view of the interlock disks employed in the airlock shown in Figure 1;

Figure 3 is a cross sectional side view through line 3—3 of Figure 2 of one of the interlock disks employed showing the peripheral groove in the plate attached thereto;

Figures 4—6 illustrate the progressive action of the interlock disks used in the airlock of Figure 1 during use;

Figure 7 is a perspective view of another embodiment of the airlock of this invention illustrating an arrangement employed when more than one complete turn of

the operating handle is necessary to open or close the access doors;

Figure 8 is a front elevation view of the embodiment shown in Figure 7;

Figure 9 is a side view of the embodiment shown in Figure 7;

Figures 10-13 illustrate the progressive action of the interlock system shown in Figure 7 during use as viewed from the interior of the airlock.

Referring to Figure 1, the shell of the reactor containment vessel is generally shown at 10. A cylindrical sleeve 11 penetrates this shell, terminating at the interior end with a bulkhead 12 and at the exterior end with a bulkhead 13. Doors 14 and 15 are hinged to bulkheads 12 and 13 respectively. Equalizing valves 16 and 17 are provided in the bulkheads 12 and 13 respectively. A lever 18 is mounted inside the containment vessel for the purpose of effecting the operating sequence necessary to open and close door 14 from within the containment vessel. Lever 19 is located inside the airlock for the purpose of operating the exterior door 15 from inside the airlock. Lever 20 is also located inside the airlock for the purpose of operating interior door 14 from inside the airlock. Lever 21 is located outside the airlock and outside the containment vessel for the purpose of operating exterior door 15 from outside the vessel. Lever 22 is mounted inside the containment vessel external of the airlock for the purpose of operating the exterior door 15 remotely from inside the vessel. The interlock mechanism 23 is located inside the airlock and is so arranged that neither door may be operated unless the other door is closed and locked. Gear boxes 24, 25, 26, and 27 are provided for the purpose of transforming the angular movement of the various levers described above into rotational movement of the shaft hereinafter described. Shaft 28 interconnects gear box 24 and gear box 27 for the operation of interior door 14 by lever 18. Keyed to shaft 28 is interior door interlock disk 29. Shaft 30 which controls the opening and closing of exterior door 15, extends from gear box 26, operated by lever 21, through gear box 25, operated by lever 19, to interconnect with gear box 38, operated by lever 22. On shaft 30, coplanar with interior door interlock disk 29, is mounted exterior door interlock disk 31. In other words, shaft 28 connects the interlock with all the levers used to operate the interior door 14, while shaft 30 connects the interlock with all the levers used to operate the exterior door 15.

The illustrative door opening and closing mechanism is shown generally and consists of a chain and sprocket drive 32 which (1) controls the timing mechanism which controls the opening and closing of pressure equalizing valve 16; (2) effects the rotation of locking ring 34 which by means of a cam system 36a and 36b controls the locking and sealing of the door; and (3) controls the Geneva timing mechanism 35 which operates the door swinging mechanism 37.

In Figures 2 and 3 inclusive, the illustrative embodiment of the interlock mechanism of this invention employed in the airlock shown in Figure 1 is presented. This mechanism which prevents the operation of one door when the other door is not locked, consists, as its essentials, of two door interlock disks 29 and 31 of equal diameter mounted in the same plane on axes which are spaced apart a distance less than the diameter of the disks. A portion 40 and 41 of each disk is cut out, the shape of the cutout being (within permitted machine tolerances) the shape of the portion of the other disk which otherwise would overlap it. The axes of these disks are, respectively, the shafts 28 and 30.

Stops 42 and 43 are also provided so as to limit the amount of rotation of the shafts and the disks and to provide a positive stop when the door has reached its locked position. A stop operating in co-operation with the door serves to prevent the door from opening any

farther than is desired. The interlock stops are necessary to assure that the interlock will be in proper position for the desired operation at all times, although they conceivably could be installed elsewhere. It is a matter of convenience to locate the stops so as to be a part of the interlock mechanism.

Figures 2-3 in conjunction with Figures 4-6 show the detail and operation of the interlock mechanism used in connection with the structure of Figure 1. Disk 29 is axially mounted on shaft 28. Attached to one face of door interlock disk 29 is a plate 44 having a curved slot 45 spaced concentrically from the circumferential surface of disk 29. Mounted on the opposite face of disk 29 is pin 42. Similarly, disk 31 is attached axially to shaft 30 and has a plate 46 containing a curved slot 47. Plate 46 is mounted on the opposite face of disk 31 from that of plate 44. Pin 43 extending outwardly from the other face of disk 31 is positioned to engage slot 45 of plate 44 and pin 42 on disk 29 is positioned to engage slot 47 of plate 46. Both disks have cut away portions 40 and 41, respectively, so that, even though disks 29 and 31 are located in the same plane, under certain conditions either disk can be rotated without coming into contact with the other, but both cannot be operated concurrently. When the position of disks 29 and 31 is as shown in Figure 2 with cut away portions 40 and 41 vis-a-vis, the interlock is in a neutral position and either shaft 28 or shaft 30 is free to be moved by the operation of any appropriate lever shown in Figure 1. It will be seen, however, that pin 42 and pin 43 act as effective stops against rotation of the disks in one direction, because they bear respectively against shoulders 48 and 49 of plates 44 and 46. As a consequence, it is obvious that disk 29 and disk 31 can be rotated only in a clockwise direction commencing from the open position shown in Figure 4.

Referring to Figures 4-6, it will be seen that in order to prevent non-operating disk 31 from rotating, during the brief period while the cut-out portions 40 and 41 of disks 29 and 31 are still exposed to each other, curved slot 45, which is provided in plate 44 attached to operating disk 29, engages pin 43 in non-operating disk 31 and prevents non-operating disk 31 from intruding into exposed cut-out portion 40 of operating disk 29. When the movement of the operating disk 29 with respect to the non-operating disk 31 closes cut-out portion 40 of the operating disk 29, pin 43 can be disengaged if desired by providing a plate of proper design.

The converse sequence is also shown in Figure 6 wherein disk 31 becomes the operating disk and groove 47 in plate 46 engages pin 42 of the non-operating disk 29. With the disks in the illustrated position the non-operating disk 29 is prevented from turning because a peripheral area of disk 31 completely closes cut-out portion 40 in disk 29.

When it is desired to open door 14 shown in Figure 1, either lever 18 or lever 20 will be moved. As soon as either lever is moved an appreciable distance, shaft 28 and disk 29 rotate clockwise and pin 43 engages slot 45 in plate 44 which, of course, has rotated with disk 29. From this point on in the operating sequence, the engagement of pin 43 in slot 45 prevents the rotation of disk 31 and thereby prevents the rotation of shaft 30 and the movement of any of the operating levers 19, 21 and 22. In addition the presence of a portion of disk 29 in the cut-out portion 41 of disk 31 also prevents disk 31 from being rotated. Further movement of lever 18 or lever 20 provides further rotation of disk 29 and plate 44, but disk 31 continues to be locked. It can be seen that plate 44 is selected to provide locking during a 90 degree rotation of disk 29. In general a plate is provided which is large enough to engage the corresponding pin while any portions of the disk cut outs coregister. Accordingly if the operating sequence of a door requires shaft rotation of more than 90 degrees, then plate 44 should,

in order to assure a smoothly functioning interlock, be made to accommodate whatever rotation is required.

After the door has been opened, it is closed by operating the lever 18 or the lever 20 in the opposite direction, which causes disk 29 and plate 44 to rotate counterclockwise until they return to their original positions, at which point pin 42 bears against shoulder 49, providing an effective stop and positioning the interlock in the open position. At this time any one of levers 19, 21 or 22 may be operated, which in turn rotate shaft 30, disk 31 and plate 46 in a clockwise direction, thus engaging pin 42 in slot 46. This engagement effectively locks disk 29 and shaft 28 so that thereafter, during the remainder of the cycle of opening and closing door 15, door 14 is prevented from being unlocked.

In the airlock illustrated in Figure 1, the operation of the gear train by levers 19—22 controls equalizing pressure, the several phases in the door opening and closing sequence including unlocking the door and swinging the door open in sequence, and going through the same steps in the reverse sequence. For example, the levers shown in Figure 1 are designed for shaft rotation of approximately 90 degrees with a lever operating through an arc of 180 degrees. In other designs of door opening systems angular displacements of the lever of 90 degrees to 180 degrees are used.

The interlock details shown in Figures 2 and 3 are unsuitable where it is necessary for shafts 28 and 30 to be rotated 360 degrees or more, because pins 42 and 43 and shoulders 49 and 48 prevent rotation of disks 29 and 31 for more than a major fraction of a complete revolution. Where the doors of an airlock are of large size, thereby necessitating the use of heavier doors and operating mechanisms, and where great pressures are used, requiring the use of more rigid gasketing materials and larger equalizing valves, it no longer is possible to achieve manual operation of the doors without increasing the mechanical advantage and thereby increasing the amount of rotation of shafts 28 and 30. Thus the type of interlock used in the airlock construction, requiring elements of this nature, is shown in Figures 7, 8 and 9. The principle of operation, however, is the same, and only the means for providing effective stops is different.

The interlock associated with the structure shown in these figures is another embodiment of this invention which is utilized when the door operation mechanism drive shafts rotate more than 360 degrees. This result obtains in airlock installations where the personnel and equipment access doors are larger and heavier, thus requiring considerable gearing down of the operating mechanism to enable a person of slight proportions to operate them manually. This gearing down results in a rotation of shafts 52 and 53 amounting to several revolutions in going through the entire operating sequence. It is therefore necessary to gear down the interlock disks in the interlock mechanism. Accordingly door interlock disks are therefore mounted on axes separate from the axes of the door operating shafts as is shown clearly in Figure 7. It is to be noted that a different type of stop is used with this interlock to prevent the rotation of the non-operating disk during the rotation of its operating counterpart.

In an airlock of this type, there are two sets of door interlocking disks instead of only one as in the interlock shown in Figure 1. Door interlock disks 50 and 51 are each keyed to interior door and exterior door operating mechanism drive shafts 52 and 53, and co-operate, respectively, with disks 54 and 55 fixed to neutral axles 56 and 57. Fixed stops 58 and 59 which are mounted on sidewall 60 of housing 61 are positioned to provide positive stops for stop pins 62 and 63 and are separately attached to disks 54 and 55. Pinion gear 64 is keyed to drive shaft 52 and meshes with spur gear 65 keyed to axle 56, the gear ratio being such as to reduce the required number of rotations of shaft 52 to less than 1

rotation of axle 56. Similarly spur gear 66 is keyed to drive shaft 53 and meshes with another spur gear 67 keyed to neutral axle 57, the gear ratio being the same as stated above.

In operation, anyone desiring to open the door of the airlock controlled by handwheel 68 will turn handwheel 68 in a clockwise direction as shown in Figures 10—13. The turning of handwheel 68 effects the same door opening sequence as hereinbefore described. As handwheel 68 is turned, drive shaft 52 is rotated. Door interlock disk 50 and pinion gear 64, which are fixed to shaft 52, turn at the same rate of rotation. The turning of disk 50 immediately locks disk 55 by moving cut-out portions 70 and 71 thereof out of alignment as shown in Figure 13. The turning of gear 64 causes gear 65 and axle 56 to rotate but at a slower rate of rotation. Upon completion of the opening cycle for the door, shaft 52 has rotated several times but axle 56 has rotated less than one full turn, and pin 62 on disk 54 has stopped against a shoulder of stop 58. Rotation of any handwheel on shaft 52 (only one shown) in the other direction effects the closing of the door and, as soon as the door has been closed and locked, and the equalizing valve closed, all parts of the interlock assembly have returned to their initial, or open, position shown in Figure 7, at which time either operating shaft is again free to be moved. As soon as any one of the handwheels (not shown) which control the movement of the exterior door of the airlock is rotated, shaft 53 also rotates, causing disk 51 to rotate and thereby immediately to lock disk 54 against rotation. This locking prevents axle 56, gear 65, gear 64, and shaft 52 from being rotated, and shaft 52 cannot be rotated until shaft 53 has been rotated so as to place disk 51 in its initial, or open, position at which time the interlock is once more open and either of the operating shafts handwheels are free to be moved.

In the illustrative embodiment simple pin stops are provided. It may be desirable in certain instances to employ spring loaded dampeners in conjunction with the pin stop in order to cushion the shock of contact between the pin and stop and prevent misalignment of the interlock disks upon closing the airlock doors.

In installations of this nature, an electric motor can be interconnected to the door operating shafts so as to provide power to turn these shafts without interfering with the interlock system. It is advisable, however, for ease of operation when power has failed, to provide clutches which will automatically disengage the motors at times when the motors are not in use.

In each of the illustrative embodiments herein described interlock disks having the same diameter were employed. Depending upon the various installations co-operating interlock disks of different diameter can also be used.

It can be seen from the foregoing detailed description that the interlocking mechanism of this airlock is as simple and as free from numerous heavy moving parts as is consistent with the complexity of the operating requirements. The interlocking system presents a minimum of frictional resistance when properly lubricated, and a minimum of mass whose inertia must be overcome.

Although the instant invention is illustrated by several specifically illustrated embodiments, it is apparent that variations in the herein-described apparatus can be made by those skilled in this art without departing from the spirit and scope of this invention. Accordingly, the foregoing detailed description is made for purposes of clarity only, and no undue limitations of the scope of the appended claims should be implied on account of such detailed description.

What is claimed is:

1. An intermediate airlock between the interior of an enclosed vessel and the exterior thereof which comprises a chamber, the ends of which being enclosed by means of

an interior pressure door assembly and an exterior pressure door assembly, each assembly comprising a bulkhead provided with an entrance way and a pressure door hinged to said bulkhead and co-operating with said entrance way to provide a fluid-tight seal between said bulkhead and said door; door operating means for controlling the opening and closing of the interior and exterior doors including a first operating drive shaft controlling the operation of the interior door and a second drive shaft controlling the operation of the exterior door and separate means for rotating said drive shafts; and a door interlock system co-operating with said door operating means whereby the concurrent operation of said interior and exterior doors is prevented, said interlock system comprising a first door interlock disk keyed to said first operating drive shaft and being provided with an arcuated cut-out portion in the periphery of said disk, a second door interlock disk keyed to said second operating drive shaft and being provided with an arcuated cut-out portion in the periphery of said disk, said operating shafts being spaced apart such that the periphery of each of said door interlock disks coregisters with the arcuated portion of another disk having substantially the same configuration of said door interlock disks, a first stop means for controlling the one way rotation of each of said door interlock disks when the arcuated portions thereof are in an opposite and neutral position, and second stop means for immediately preventing the concurrent operation of one of said operating shafts upon the rotation of the other of said operating shafts.

2. An intermediate airlock between the interior of an enclosed vessel and the exterior thereof which comprises a chamber, the ends of which being enclosed by means of an interior pressure door assembly and an exterior pressure door assembly, each assembly comprising a bulkhead provided with an entrance way and a pressure door hinged to said bulkhead and co-operating with said entrance way to provide a fluid-tight seal between said bulkhead and said door; door operating means for controlling the opening and closing of the interior and exterior doors including a first operating drive shaft controlling the operation of the interior door and a second drive shaft controlling the operation of the exterior door, and separate means for rotating said drive shafts; and a door interlock system whereby the concurrent operation of said interior and exterior doors is prevented, said interlock system comprising a first door interlock disk keyed to said first operating drive shaft and being provided with an arcuated cut-out portion in the periphery of said disk, a second door interlock disk keyed to said second operating drive shaft coplanar with said first disk and being provided with an arcuated cut-out portion in the periphery of said disk, said operating shafts being spaced apart such that the periphery of said disks coregisters with the arcuated cut-out portion of the other disk, a first stop means for controlling the one way rotation of each of said disks when the arcuated portion of said first and second disks are in a face to face position, and second stop means for immediately preventing the concurrent operation of one of said operating shafts upon the rotation of the other of said operating shafts.

3. An intermediate airlock between the interior of an enclosed vessel and the exterior thereof which comprises a chamber, the ends of which being enclosed by means of an interior pressure door assembly and an exterior pressure door assembly, each assembly comprising a bulkhead provided with an entrance way and a pressure door hinged to said bulkhead and co-operating with said entrance way to provide a fluid-tight seal between said bulkhead and said door; door operating means for controlling the opening and closing of the interior and exterior doors including a first operating drive shaft controlling the operation of the interior door and a second drive shaft controlling the operation of the exterior door and separate means for rotating said drive shafts; and a

door interlock system whereby the concurrent operation of said interior and exterior doors is prevented, said interlock system comprising a first pair of door interlock disks consisting of a first door interlock disk keyed to said first operating drive shaft and being provided with an arcuated cut-out portion in the periphery of said disk, and a second co-operating disk keyed to a first intermediate neutral shaft coplanar with said first interlock disk and being provided with an arcuated portion in the periphery of said second disk, said intermediate shaft being driven by the rotation of said first operating drive shaft, said first operating drive shaft and said first intermediate neutral shaft being spaced apart such that the periphery of said disks coregisters with the arcuated cut-out portion of the other disk, a second pair of door interlock disks consisting of a first interlock disk keyed to said second operating shaft and being provided with an arcuated cut-out portion in the periphery of said disk, and a fourth co-operating disk keyed to a second intermediate neutral shaft coplanar with said third interlock disk and being provided with an arcuated cut-out portion in the periphery of said disk, said second intermediate neutral shaft being driven by the rotation of said second operating drive shaft, said shafts being spaced apart such that the periphery of said disks coregisters with the arcuated cut-out portion of the other disk, a first stop means for controlling the one way rotation of each of said disks when the arcuated portion of each pair of disks are in a face to face position, and a second stop means for immediately preventing the concurrent operation of one of said operating shafts upon the rotation of the other of said operating shafts.

4. An airlock in accordance with claim 3 wherein said door interlock system and said first and second intermediate neutral shafts are coaxially aligned.

5. An intermediate airlock in accordance with claim 3 where in said door interlock system a first stop means co-operating respectively with said second and fourth co-operating disks is employed for controlling the one way rotation of said first and third door interlock disks when the arcuated portions thereof are in a face to face position.

6. An intermediate airlock in accordance with claim 3 where in said door interlock system disks of substantially the same diameter are employed in said first and second pairs of door interlock disks.

7. An intermediate airlock between the interior of an enclosed vessel and the exterior thereof which comprises a chamber, the ends of which being enclosed by means of an interior pressure door assembly and an exterior pressure door assembly, each assembly comprising a bulkhead provided with an entrance way and a pressure door hinged to said bulkhead and co-operating with said entrance way to provide a fluid-tight seal between said bulkhead and said door; door operating means for controlling the opening and closing of the interior and exterior doors including a first operating drive shaft controlling the operation of the interior door and a second drive shaft controlling the operation of the exterior door and separate means for rotating said drive shafts; and a door interlock system whereby the concurrent operation of said interior and exterior doors is prevented, said interlock system comprising a first door interlock disk keyed to said first operating drive shaft and being provided with an arcuated cut-out portion in the periphery of said disk, a second door interlock disk keyed to said second operating drive shaft coplanar with said first disk and being provided with an arcuated cut-out portion in the periphery of said disk, said operating shafts being spaced apart such that the periphery of said disks coregisters with the arcuated cut-out portion of the other disk, a first stop means comprising a first pin laterally depending from one face of said first interlock disk peripherally adjacent one extremity of the arcuated cut-out portion therein, a first plate means affixed to the

other face of said disk overlapping the periphery thereof and including a shoulder portion radially depending from adjacent the other extremity of said arcuated cut-out portion, a second pin laterally depending from one face of said second interlock disk peripherally adjacent one extremity of the arcuated cut-out portion therein, a second plate affixed to the other face of said disk overlapping the periphery thereof and including a shoulder portion radially depending from adjacent the other extremity of said arcuated cut-out portion, said first pin abutting the shoulder portion of said second plate and said second pin abutting the shoulder portion of said first plate when the arcuated cut-out portions of said interlock disks are in a face to face position, and second stop means for immediately preventing the concurrent operation of one of said operating shafts upon the rotation of the other of said operating shafts.

8. An intermediate airlock in accordance with claim 7 where in the door interlock system said interlock disks have substantially the same diameter.

9. An intermediate airlock between the interior of an enclosed vessel and the exterior thereof which comprises a chamber, the ends of which being enclosed by means of an interior pressure door assembly and an exterior pressure door assembly, each assembly comprising a bulkhead provided with an entrance way and a pressure door hinged to said bulkhead and co-operating with said entrance way to provide a fluid-tight seal between said bulkhead and said door; door operating means for controlling the opening and closing of the interior and exterior doors including a first operating drive shaft controlling the operation of the interior door and a second drive shaft controlling the operation of the exterior door and separate means for rotating said drive shafts; and a door interlock system whereby the concurrent operation of said interior and exterior doors is prevented, said interlock system comprising a first door interlock disk keyed to said first operating drive shaft and being provided with an arcuated cut-out portion in the periphery of said disk, a second door interlock disk keyed to said

second operating drive shaft coplanar with said first disk and being provided with an arcuated cut-out portion in the periphery of said disk, said operating shafts being spaced apart such that the periphery of said disks co-registers with the arcuated cut-out portion of the other disk, a first stop means comprising a first pin laterally depending from one face of said first interlock disk peripherally adjacent one extremity of the arcuated cut-out portion therein, a first plate means affixed to the other face of said disk overlapping the periphery thereof and including a shoulder portion radially depending from adjacent the other extremity of said arcuated cut-out portion, a second pin laterally depending from one face of said second interlock disk peripherally adjacent one extremity of the arcuated cut-out portion therein, a second plate affixed to the other face of said disk overlapping the periphery thereof and including a shoulder portion radially depending from adjacent the other extremity of said arcuated cut-out portion, said first pin abutting the shoulder portion of said second plate and said second pin abutting the shoulder portion of said first plate when the arcuated cut-out portions of said interlock disks are in a face to face position, and second stop means comprising a first groove positioned in said first plate peripherally spaced from said first interlock disk and co-operating with said second pin, and a second groove positioned in said second plate peripherally spaced from said second interlock disk co-operating with said first pin whereby the concurrent operation of said operating shafts upon the rotation of one of said shafts.

10. An intermediate airlock in accordance with claim 9 where in the door interlock system said interlock disks have substantially the same diameter.

#### References Cited in the file of this patent

##### UNITED STATES PATENTS

2,830,838 Drager ----- Apr. 15, 1958

##### FOREIGN PATENTS

568,849 France ----- Apr. 2, 1924