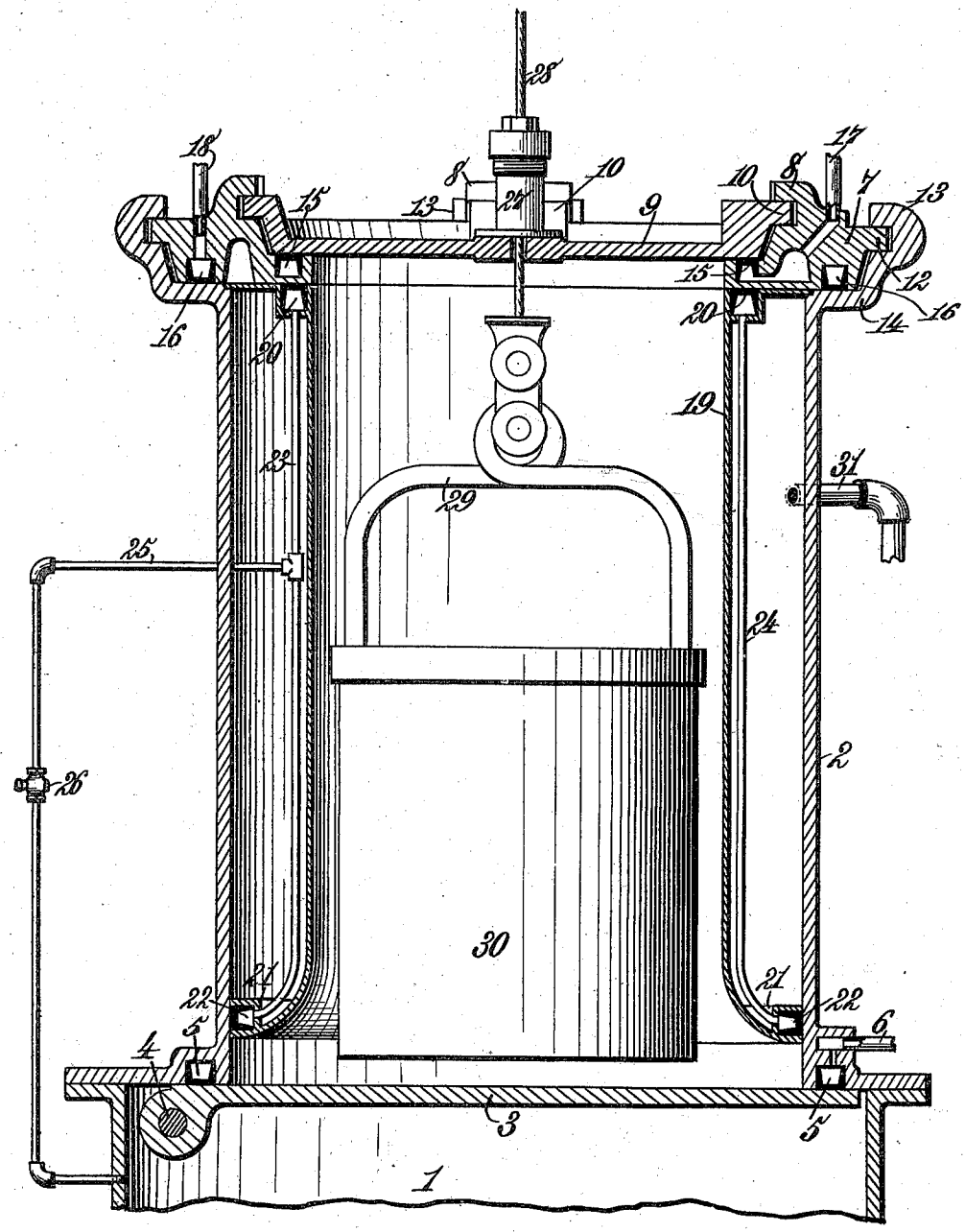
(No Model.) 4 Sheets—Sheet 1.

R. S. GILLESPIE.

AIR LOCK FOR CAISSONS, &c.

No. 576,446. Patented Feb. 2, 1897.

Fig. 1.



Witnesses.
Robert Everett,
Albert H. Norris.

Inventor.
Richard S. Gillespie.
By James L. Norris.
Atty.

(No Model.)

4 Sheets—Sheet 2.

R. S. GILLESPIE.

AIR LOCK FOR CAISSONS, &c.

No. 576,446. Patented Feb. 2, 1897.

Fig. 2.

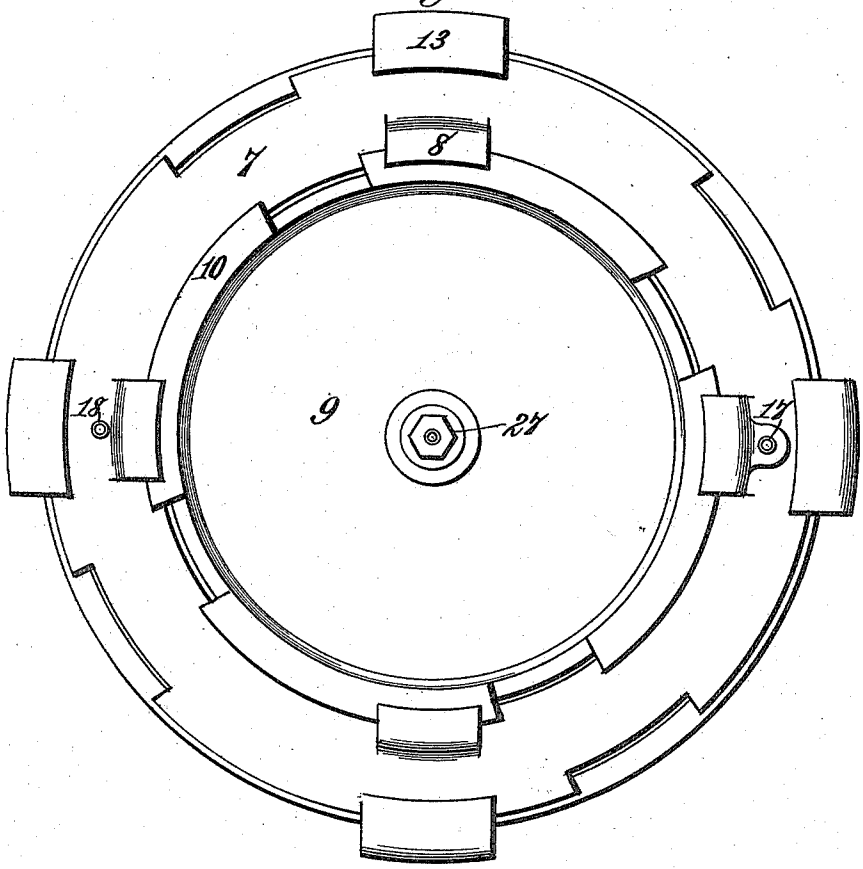
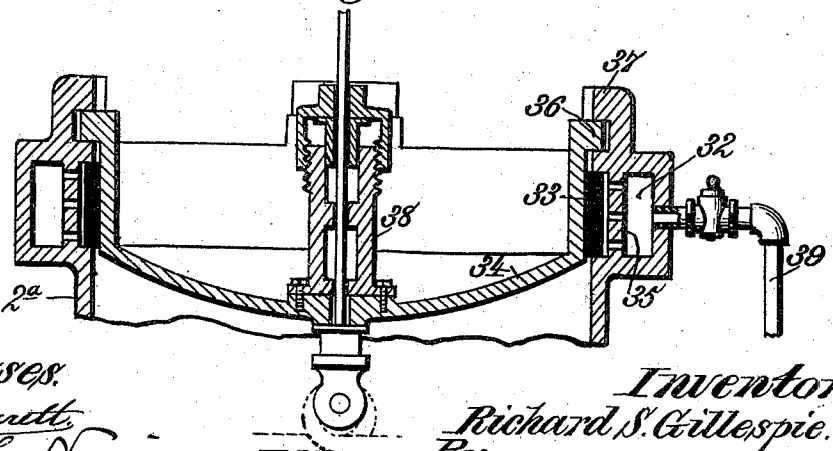


Fig. 3.



Witnesses.
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(No Model.) 4 Sheets—Sheet 3.

R. S. GILLESPIE.

AIR LOCK FOR CAISSONS, &c.

No. 576,446. Patented Feb. 2, 1897.

Fig. 4.

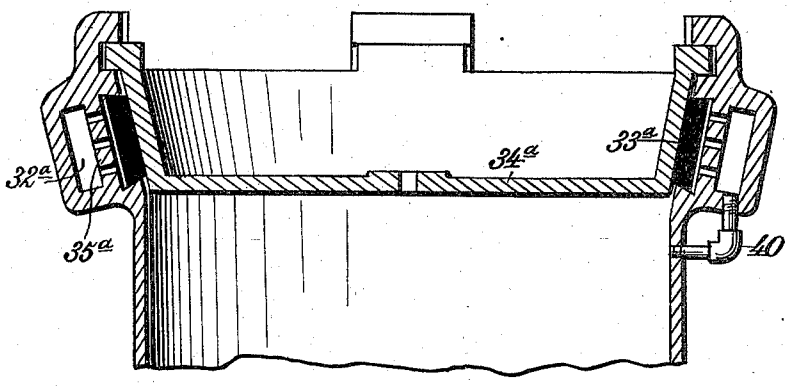


Fig. 5.

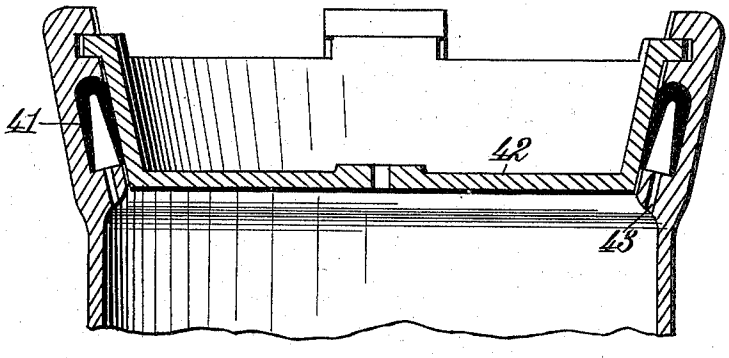
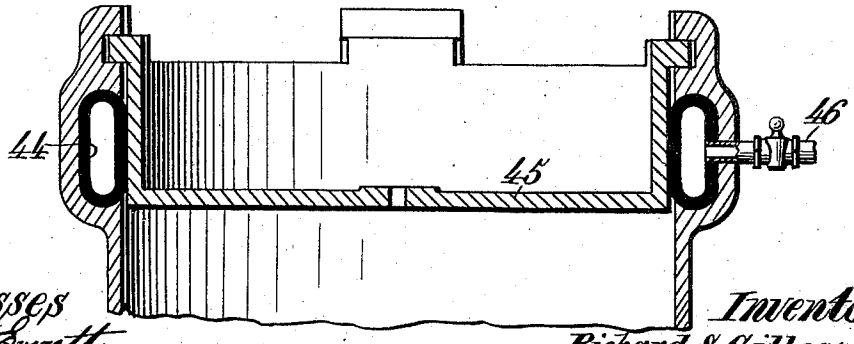


Fig. 6.



Witnesses
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(No Model.) 4 Sheets—Sheet 4.

R. S. GILLESPIE.

AIR LOCK FOR CAISSONS, &c.

No. 576,446. Patented Feb. 2, 1897.

Fig. 7.

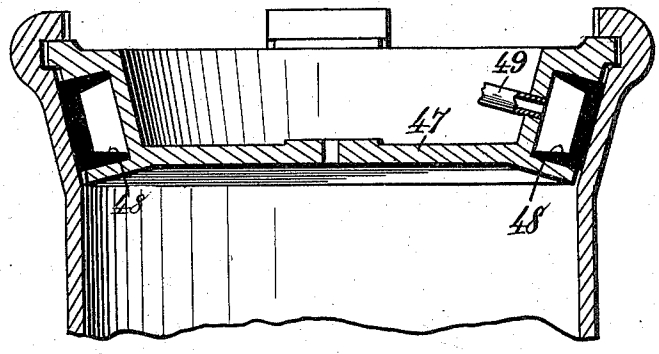


Fig. 8.

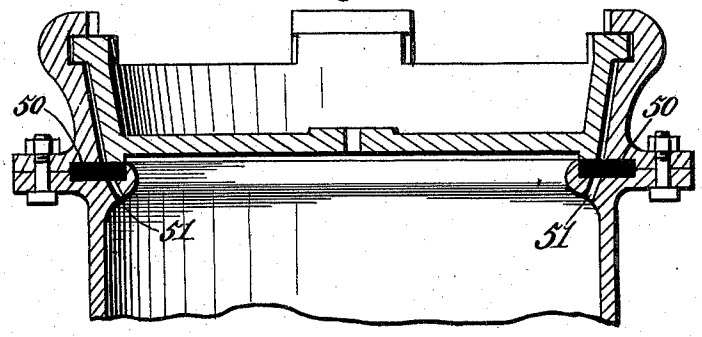
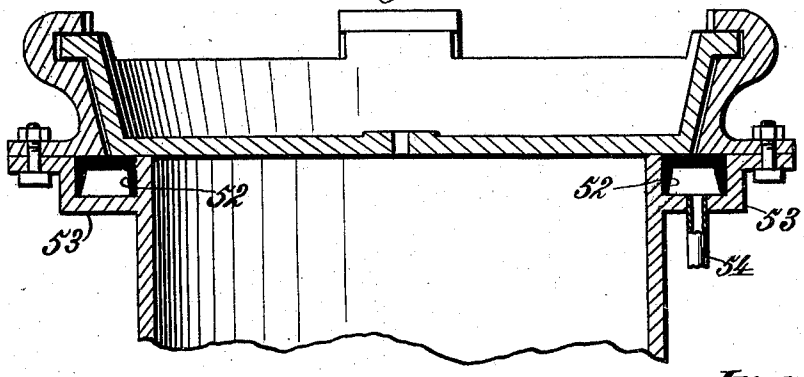


Fig. 9.



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Atty.

UNITED STATES PATENT OFFICE.

RICHARD S. GILLESPIE, OF NEW YORK, N. Y.

AIR-LOCK FOR CAISSONS, &c.

SPECIFICATION forming part of Letters Patent No. 576,446, dated February 2, 1897.

Application filed July 27, 1896. Serial No. 600,696. (No model.)

To all whom it may concern.

Be it known that I, RICHARD S. GILLESPIE, a citizen of the United States, residing at New York, in the county of New York and State of New York, have invented new and useful Improvements in Air-Locks for Caissons, &c., of which the following is a specification.

This invention relates to caissons designed for constructing subaqueous foundations and to apparatus designed for tunneling purposes.

In caissons and apparatus of the character referred to air-locks are employed at the outer or upper ends thereof and the work is executed by the workmen in the presence of compressed air, as is well known. The compression of the air involves considerable expense and therefore it is desirable to avoid the loss or waste of such air as much as possible, for which reason air-tight closures of the air-locks and a diminished bucket-space in the air-lock casing are important.

The chief objects of my present invention are to provide new and improved means whereby the air-lock can be closed perfectly air-tight without the necessity of grinding the contact-surfaces of the air-lock doors or covers and the body of the air-lock casing, and to provide novel, simple, and efficient means whereby the bucket-space within an air-lock or apparatus of comparatively great diameter can be materially diminished to approximately the diameter of the bucket, for the purpose of reducing as much as possible the loss or waste of compressed air from the bucket-space of the air-lock when the top doors or covers of the same are opened to permit the entrance or exit of the bucket.

To accomplish these objects, my invention consists in the several features of construction and in the combination or arrangement of parts hereinafter described and claimed, reference being made to the accompanying drawings, in which—

Figure 1 is a vertical sectional view of an air-lock constructed according to my invention and mounted on the outer or upper end portion of a caisson or tunneling apparatus. Fig. 2 is a top plan view of the same. Fig. 3 is a detail vertical central sectional view of the top portion of the air-lock, showing a modification of the invention; and Figs. 4, 5, 6, 7, 8, and 9 are similar views showing other modifications hereinafter specifically described in detail.

In order to enable those skilled in the art to make and use my invention, I will now describe the same in detail, referring to the drawings, wherein—

The numeral 1 indicates a cylinder or structure which may be a caisson designed for building or erecting subaqueous foundations or may be part of a tunneling apparatus wherein the work is effected in the presence of compressed air in the usual manner. The upper end of the cylinder or structure 1 is surmounted by an air-lock casing 2, which, according to my present invention, may be of greater or less diameter. The lower end of the casing is provided with a door or valve 3, which, as here shown, is mounted on a rock-shaft 4, designed to be operated by any suitable means, so that the door or valve may be opened and closed. This door or valve closes against a continuous hollow or tubular packing-ring 5, inserted into an annular groove formed in the lower end of the air-lock casing and into which ring a fluid under pressure can be introduced through the medium of a supply-pipe 6 for the purpose of expanding the ring and causing it to make an air-tight connection with the door or valve 3 when the latter is closed, as in Fig. 1.

The upper end of the air-lock casing is provided with an opening and closing door or cover, which, in the construction illustrated by Figs. 1 and 2, is composed of a ring-frame 7, having overhanging lugs 8 and a dished disk-shaped cover-plate 9, having lateral or outwardly-projecting lugs 10, which can be made to engage under the lugs 8 for the purpose of holding the cover-plate in engagement with the ring-shaped frame. The ring-shaped frame is also provided with outwardly-extending lugs 12, which can be made to engage under overhanging lugs 13, formed on a flanged portion 14, forming a part of or attached to the upper end of the air-lock casing 2. The arrangement of the several lugs is clearly represented in Fig. 2, and it will be obvious that the ring-shaped frame 7 can be inserted into position and then be turned to cause its lugs 12 to engage under the lugs 13 and that the disk-shaped cover-plate 9 can be inserted into the ring-shaped frame and be

turned to cause its lugs 10 to engage under the lugs 8. The cover-plate and also the ring-shaped frame, if desired, can be disengaged whenever necessary by simply turning the same to disengage the interlocking lugs, as will be obvious without further explanation. The ring-shaped frame is provided with two annular grooves in its upper and lower side portions, into which are inserted hollow or tubular expansible packing-rings 15 and 16. The ring 15 is adapted to bear against the under side of the cover-plate 9 at or near the periphery thereof, and the ring 16 seats against a horizontal part of the flanged portion 14, formed on or attached to the air-lock casing. The packing-rings 15 and 16 are adapted to be expanded by the introduction of a fluid under pressure thereinto, so that when the upper end of the air-lock is closed it is possible to effect perfect air-tight joints without the necessity of grinding the cover and air-lock casing to secure a tight closure. The fluid under pressure is introduced into the expansible packing-rings 15 and 16 through the medium of fluid-conveying channels or conduits comprising, as shown in Fig. 1, two pipes 17 and 18. These pipes may be supplied with compressed air or any other fluid under pressure by a separate apparatus or device, but I prefer to carry them down and connect them with the interior of the caisson or tunneling apparatus, so that the air compressed therein may be utilized for expanding the packing-rings 15 and 16.

The air-lock casing may be, according to my present invention, made of comparatively great diameter, but the bucket-space within this casing is diminished to the minimum through the medium of a lining 19, composed of metal or any other material suitable for the purpose and made substantially in the form of a cylinder, although it may be of any proper form or shape in cross-section. The cylindrical lining is provided at its upper end with an annular groove containing a hollow or tubular expansible packing-ring 20, and at the lower end the lining is curved or turned outwardly to form a lateral flange-like portion or rim 21, containing a hollow or tubular expansible packing-ring 22. The packing-ring 20 seats against the under side of a part of the door or cover, and the ring 22 seats against the internal surface of the air-lock casing in juxtaposition to the lower end thereof in such manner that the entrance of compressed air from the cylinder or structure 1 into the space between the lining and the air-lock casing is effectually prevented.

The packing-rings 20 and 22 are adapted to be expanded through the medium of a fluid under pressure, which is preferably introduced by a fluid-conveying channel or conduit composed of a pipe 23, communicating at its upper and lower ends with the interiors of the packing-rings at one side of the lining, as clearly seen in Fig. 1. A similar pipe 24 communicates with the interiors of the packing-rings 20 and 22 at the opposite side of the lining. The pipe 23 is supplied with the fluid under pressure by a supply-pipe 25, which is preferably extended down to and placed in communication with the interior of the cylinder or structure 1, so that the air therein compressed may be utilized for expanding the packing-rings 20 and 22. The fluid under pressure delivered to the packing-rings 20 and 22 by the pipe 23 will circulate through these packing-rings and pass from one to the other through the pipe 24, thereby equalizing the fluid-pressure on the packing-rings at all points of the same, so that an air-tight connection of the lining with the cover and the air-lock casing is secured. The supply-pipe 25 is provided with a suitable valve 26. As before stated, this supply-pipe may communicate with the interior of the cylinder or structure for supplying the pipe 23 with compressed air to expand the packing-rings 20 and 22, but it is obvious that an independent apparatus or device may be employed for delivering a fluid under pressure to the pipe 25 or to the packing-rings.

It will be obvious that the lining 19 reduces the bucket-space of the air-lock casing to approximately the diameter of the bucket or to any diameter that may be found suitable for the purpose in hand, by which means the quantity of compressed air received into the bucket-space when the lower door or valve 3 is opened is largely diminished, and consequently the loss or waste of compressed air from the bucket-space when the air-lock is opened is greatly reduced, which is very important and valuable in that the compression of air in a caisson or tunneling apparatus is very expensive and it is desirable to avoid the loss or waste of this compressed air as much as possible.

The cover-plate 9, which detachably engages the ring-shaped frame 7, is provided at its center with a stuffing-box 27, through which passes the bucket-hoisting cable 28. This cable is ordinarily composed of a wire rope, but of course it may be of any suitable material. The lower end of the cable is connected with a bail 29, attached to the bucket 30. Although I have illustrated a single bucket-hoisting cable, I wish it understood that I may employ two separate or distinct cables passing through independent stuffing-boxes mounted on the cover-plate 9, the lower ends of the cables being attached to the bucket 30, as will be obvious without further explanation.

The air-lock casing is in practice connected with the caisson or tunneling apparatus through the medium of a pressure-equalizing pipe 31 in the usual manner.

If the bucket 30 is in the caisson or tunneling apparatus and it is desired to raise it into or remove it from the air-lock, the lower door or valve 3 is opened, the bucket is elevated into the interior of the cylinder which constitutes the lining 19, the door or valve 3 is

closed, the cover-plate 9 is disengaged from the ring-shaped frame 7, and the bucket hoisted out of the lining, carrying with it the cover-plate 9. The bucket may be lowered into the air-lock while the lower door or valve 3 is closed, and then, after properly connecting the cover-plate 9 with the ring-shaped frame 7, the lower door or valve may be opened and the bucket may be lowered into the caisson or tunneling apparatus, as will be obvious.

As regards the air-tight closure of the upper end of the air-lock casing the essential feature of my invention resides in a packing interposed between a part of the door or cover and a part of the casing and a fluid-conveying channel or conduit leading to the packing, so that a fluid under pressure may be introduced and caused to press against the packing to secure an air-tight closure of the door or cover. This part of my invention may be carried into effect by the construction and arrangement of parts described with reference to Figs. 1 and 2, but I will now describe in detail certain modifications. In Fig. 3 the upper end of the air-lock casing 2^a is provided with an annular chamber 32 and an annular flexible or yielding packing-ring 33, which bears against the periphery of a deeply-dished circular cover-plate 34. The chamber 32 is separated from the packing-ring 33 by an annular perforated wall 35 in such manner that if a fluid under pressure be introduced into the chamber 32 it will flow through the perforations in the wall 35 and press the flexible or yielding packing-ring 33 tightly against the periphery of the circular cover-plate 34, thereby securing a perfect air-tight closure of the upper end of the air-lock casing. The cover-plate 34 is provided with lateral lugs 36 to engage under overhanging lugs 37 on the upper side of the chamber 32, so that the cover-plate can be readily attached and detached in substantially the manner described with reference to Figs. 1 and 2. The cover-plate 34 carries at its center a stuffing-box 38, through which the bucket-hoisting cable extends to connect with the bucket, as before explained. The chamber 32 is supplied with the fluid under pressure through the medium of a pipe 39, which may be extended down and placed in communication with the interior of the caisson or tunneling apparatus, so that the compressed air therein may be utilized to act upon the packing-ring 33, but if desired the pipe 39 may be connected with a source of supply independent of the caisson or tunneling apparatus. In Fig. 3 the packing-ring 33 is arranged perpendicular, and consequently the flanged or rim portion of the cover-plate 34 is also perpendicular, but, as shown in Fig. 4, the fluid-chamber 32^a, perforated wall 35^a, and flexible or yielding annular packing-ring 33^a are arranged at angles of inclination to a perpendicular plane and the flanged or rim portion of the dished disk-shaped cover-plate 34^a is correspondingly inclined. In this example the chamber 32^a is placed in communication with the interior of the air-lock casing by an elbow-shaped pipe connection 40, so that compressed air can be introduced from the interior of the lining hereinbefore described for the purpose of pressing the packing-ring 33^a tightly against the periphery of the cover-plate.

As regards the delivery of the fluid under pressure to the chamber 32^a, I wish it understood, however, that this may be accomplished in any suitable manner, and therefore the pipe connection 40 is only typical of many devices that may be employed to convey fluid under pressure to the packing-ring.

In both Figs. 3 and 4 the continuous flexible or yielding packing-ring is represented in the form of a flattened strip suitably shaped into a circle to fit the disk-shaped cover-plate, but in the modified construction Fig. 5 the flexible or elastic packing-ring 41 is hollow or tubular, or approximately U-shaped, so that one limb or side portion bears against the top portion of the air-lock casing, while the other limb or side portion bears against the periphery of the disk-shaped cover-plate 42. The interior of the hollow or tubular packing-ring 41 is placed in communication with the interior of the air-lock casing through the medium of a fluid-conveying channel or conduit 43. This channel or conduit may be extended to communicate with the interior of the lining 19, Fig. 1, but in either event the compressed air contained in the air-lock is utilized for expanding the packing-ring and causing it to make an air-tight connection with the cover-plate for the purpose of perfectly closing the upper end of the air-lock. The packing-ring 41, Fig. 5, is seated in an annular groove formed in the top portion of the air-lock casing, but, obviously, it could be seated in the cover-plate itself.

In the modification Fig. 6 the continuous flexible or yielding packing-ring is in the form of a tube 44, seated in an annular groove in the top portion of the air-lock casing, so that it will bear against the periphery of the dished disk-shaped cover-plate 45. The tube 44 may normally or originally be circular in cross-section and when pressed into its seat be flattened and made oblong or oval-shaped in cross-section. The fluid under pressure is introduced into the interior of the tube 44 through the medium of a pipe 46, connected with any source of supply, so that compressed air or any other fluid under pressure may be introduced into the tube for expanding the latter and causing it to press tightly against the periphery of the cover-plate and thus secure a perfect air-tight closure of the air-lock. The pipe 46 may be connected with a separate or independent apparatus, or it may be connected with the interior of the air-lock casing or with the interior of the caisson or tunneling apparatus.

In the modification shown in Fig. 7 the dished disk-shaped cover 47 is formed with

an annular groove in its periphery, in which the trough-shaped or tubular packing-ring 48 is arranged, so that it will press against the inclined inner surface of the upper end of the air-lock casing. The packing-ring 48 is expanded by fluid introduced through the medium of a pipe 49.

In the modification shown in Fig. 8 the packing-ring 50 is in the form of a flat circular strip of flexible material seated in a groove formed in the upper end of the air-lock casing, and the latter is provided at points under the packing-ring with channels or conduits 51 for the passage of compressed air from the interior of the air-lock for the purpose of forcibly pressing the packing-ring against the under side of the disk-shaped cover.

In the modification shown in Fig. 9 the trough-shaped or tubular ring 52 is arranged in a groove formed in the upper side of a lateral ring-shaped extension 53, provided with a pipe 54, by which a fluid can be introduced into the packing-ring for expanding the same and causing it to press against the disk-shaped cover.

In all the constructions shown and described the expansible packing is made as a continuous or endless piece to form a ring which is seated in a grooved seat of a shape corresponding to the shape of the ring. This grooved seat holds the ring in place in such manner that when the lid or cover is in position the pressure of the fluid on the ring may be raised to any degree without danger of disturbing the position of the ring or bursting the same when made hollow or tubular. The lid or cover is not forced into contact with the ring by screws or levers, but the lid or cover is merely adjusted into position and subsequently the ring is subjected to the action of the fluid-pressure to obtain the air-tight joint. If the tubular ring were not arranged in a seat so that substantially all parts of the ring pressed against parts of the cover and air-lock casing, excessive internal pressure in the ring might burst the same, and, moreover, the ring would be very liable to be displaced by the air-pressure in the caisson.

In my invention the expansible packing is permanently seated in the groove or recess, and it cannot be displaced by the air-pressure in the cassion or air-lock.

My invention provides simple, efficient, and economical means for closing an air-lock perfectly air-tight without grinding the contact-surfaces of any of the parts and for greatly diminishing the bucket-space of the air-lock casing, so that the loss or waste of compressed air is materially reduced.

Having described my invention, what I claim is—

1. The combination in an air-lock, of a casing, and an opening and closing door, one of the parts having an annular groove, with a continuous packing-ring arranged in said groove, seated against the opposite walls of the same so that a solid annular part will effect the air-tight closure of the door, and a fluid-conveying channel leading to said continuous packing-ring introducing a fluid which uniformly expands the said solid annular part of the packing-ring to secure an air-tight joint between the casing and the door, substantially as described.

2. The combination in an air-lock, of a casing, and a removable and replaceable door constructed to enter into and fit the upper end of said casing, one of the parts being constructed with an annular groove, with a continuous packing-ring arranged in said groove, seated against the opposite walls of the same so that a solid annular part will effect an air-tight closure of the door, and a fluid-conveying channel for introducing a fluid which uniformly expands the said annular solid part of the packing-ring and secures an air-tight joint between the air-lock casing and the door inserted thereinto, substantially as described.

3. The combination with the door or cover and the casing of an air-lock mounted on a caisson or tunneling apparatus, of a packing interposed between the door or cover and the casing, and a fluid-conveying channel or conduit supplied from the interior of the caisson or tunneling apparatus and leading to the said packing for causing the fluid under pressure to act directly against the packing, substantially as described.

4. The combination with an air-lock casing having upper and lower opening and closing doors, of a lining inserted into the interior of the casing between said upper and lower doors and having its upper and lower ends connected air-tight with top and bottom portions of said casing, for diminishing the bucket-space and reducing the loss or waste of compressed air when the air-lock is opened at its upper end, substantially as described.

5. The combination with an air-lock casing having upper and lower opening and closing doors, of a lining inserted into said casing between said upper and lower doors and having its upper and lower ends provided with packings which make air-tight connections with upper and lower portions of said casing, for diminishing the bucket-space and reducing the loss or waste of compressed air when the air-lock is opened at its upper end, substantially as described.

6. The combination with an air-lock casing having upper and lower opening and closing doors, of a lining inserted into the interior of the casing for diminishing the bucket-space thereof, and having its upper and lower ends connected air-tight with top and bottom portions of said casing, and thereby reducing the loss or waste of compressed air when the air-lock is opened, and packings arranged at the upper and lower ends of said lining to

prevent the passage of compressed air into the space between the lining and the air-lock casing, substantially as described.

7. The combination with the casing of an air-lock, of a lining provided at its upper and lower ends with packings and inserted into said casing to reduce the bucket-space thereof, and means for introducing a fluid under pressure to said packings for pressing the same against parts of the air-lock to prevent the passage of air into the space between the lining and the air-lock casing, substantially as described.

8. The combination with an air-lock casing, of a cylindrical lining arranged therein and provided at its upper and lower ends with expansible packings, whereby the bucket-space of the air-lock is diminished, loss or waste of compressed air is reduced, and the passage of compressed air into the space between the lining and the casing is avoided, substantially as described.

9. The combination with an air-lock casing having upper and lower opening and closing doors, of a lining inserted into the casing to reduce the bucket-space and having air-tight connections with the top door and with the internal surface of the casing, substantially as described.

10. The combination with an air-lock casing, of a ring-shaped frame detachably engaged with the upper end of the casing, a cover-plate detachably engaged with the ring-shaped frame, and expansible packings for securing air-tight connections between the casing and the ring-shaped frame and between said frame and the cover-plate, substantially as described.

In testimony whereof I have hereunto set my hand in presence of two subscribing witnesses.

RICHARD S. GILLESPIE.

Witnesses:
ALBERT H. NORRIS,
THOS. A. GREEN.