J. S. FORBES.

BLOW-OFF VALVE.

APPLICATION FILED JUNE 13, 1907.

900,506.

Patented Oct. 6, 1908.

4 SHEETS—SHEET 1.

Fig. 1.

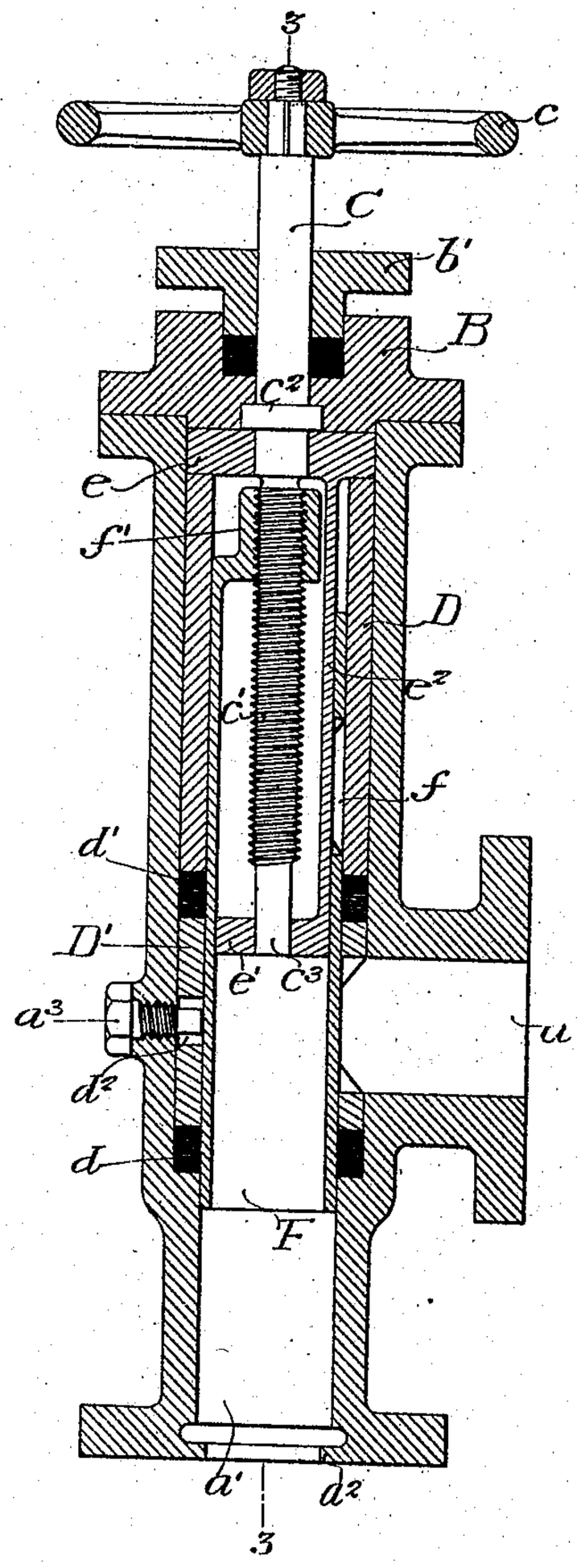
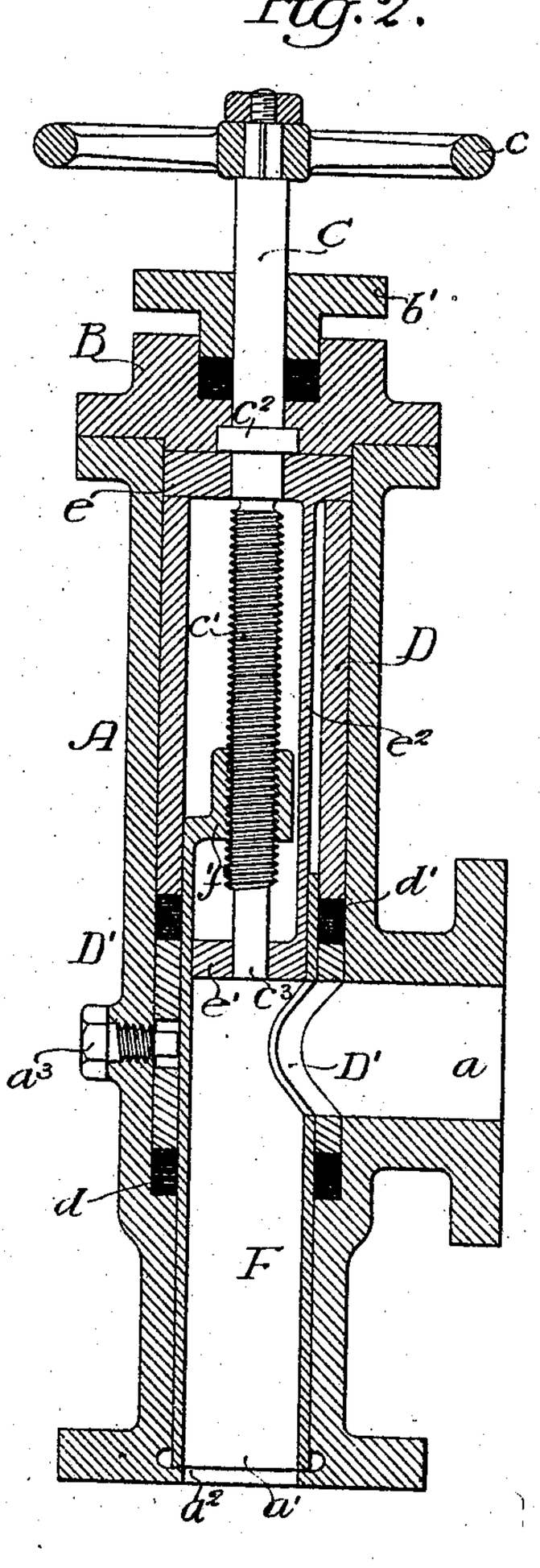


Fig. 2.



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4 SHEETS—SHEET 2.

Fig 4.

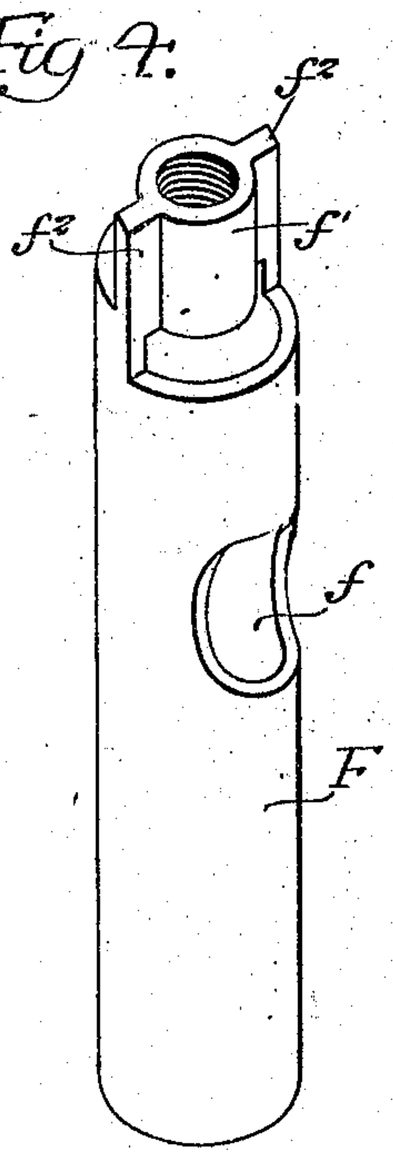


Fig. 5.

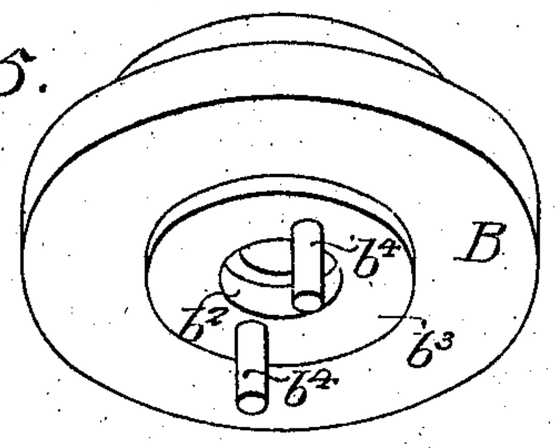


Fig. 6.

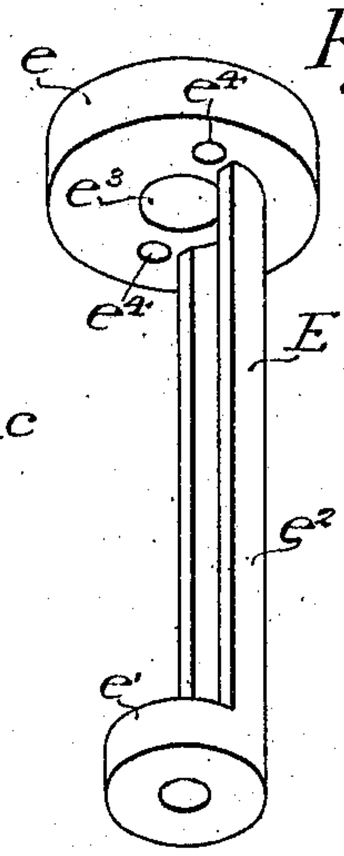
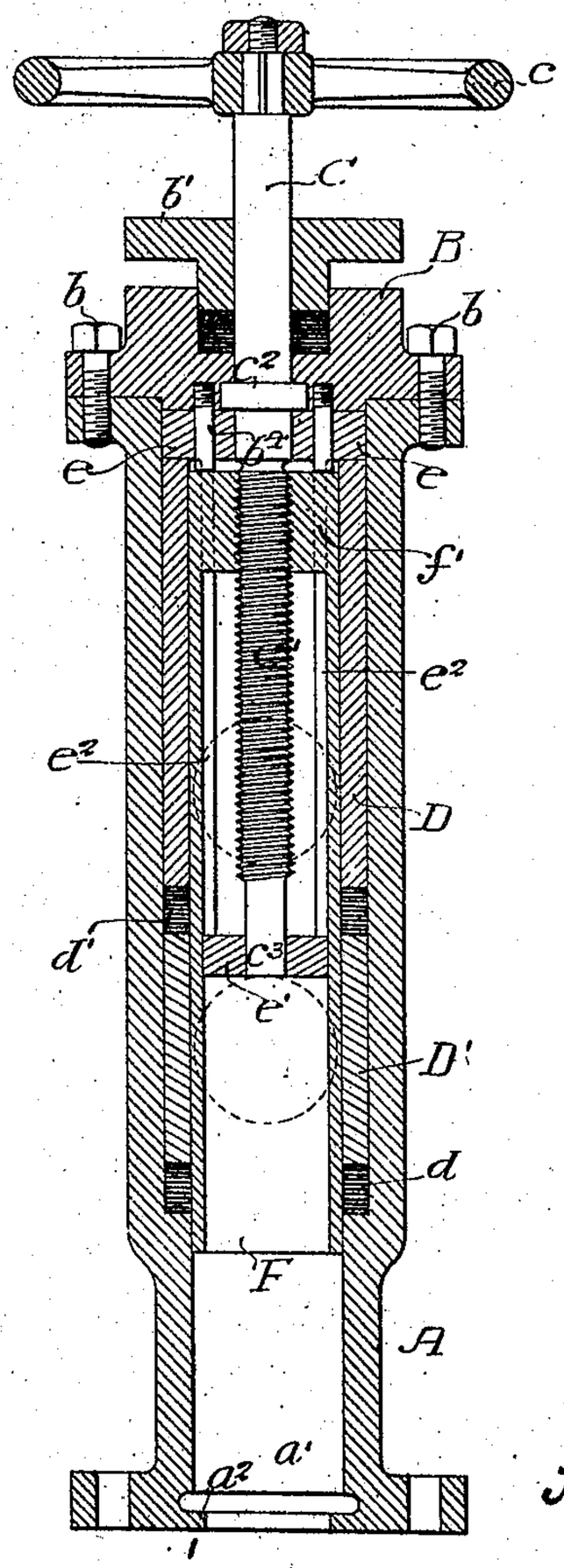


Fig. 3.



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4 SHEETS—SHEET 3.

Fig. 7.

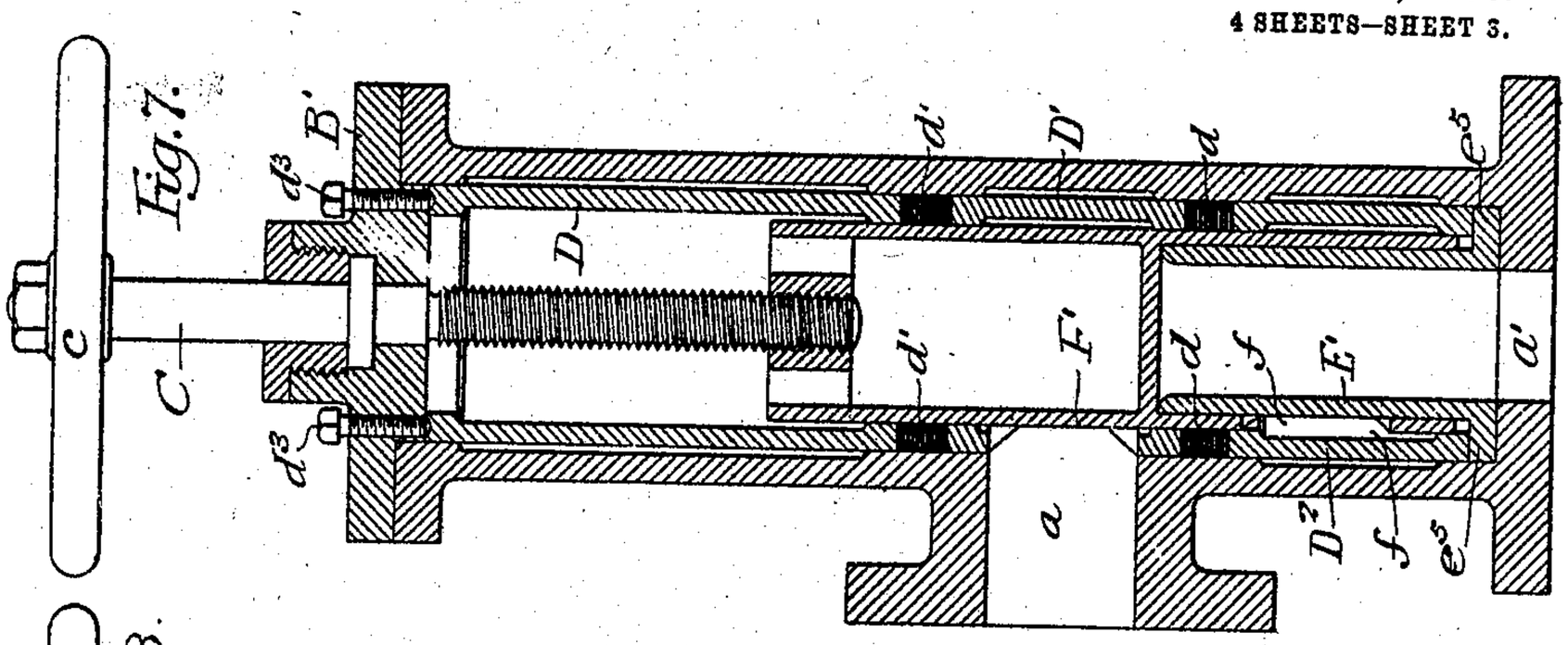


Fig. 8.

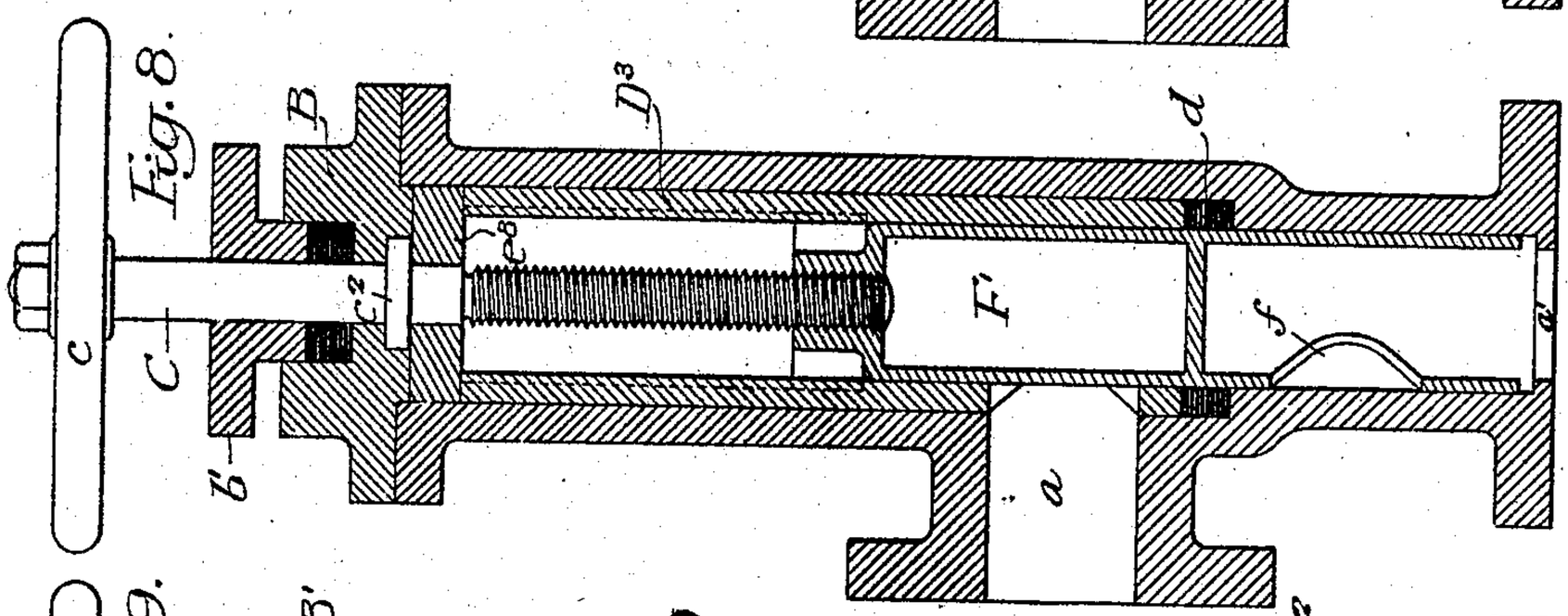


Fig. 9.

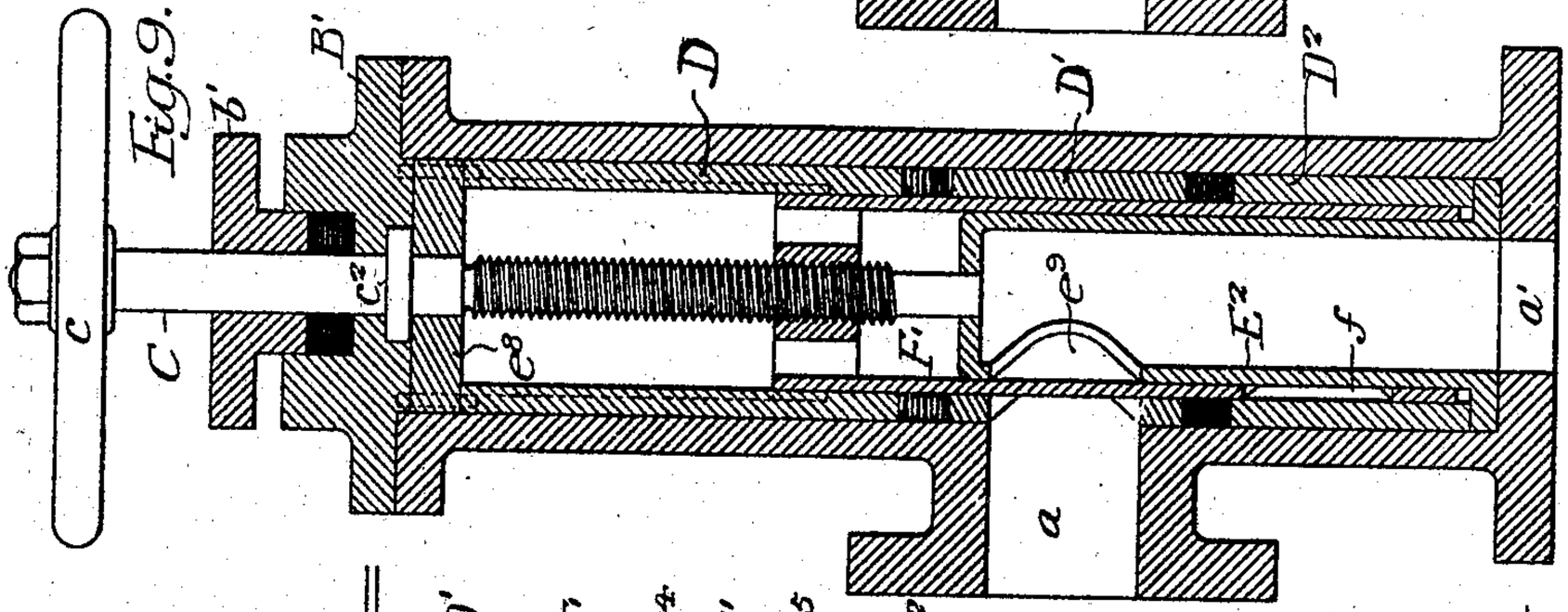
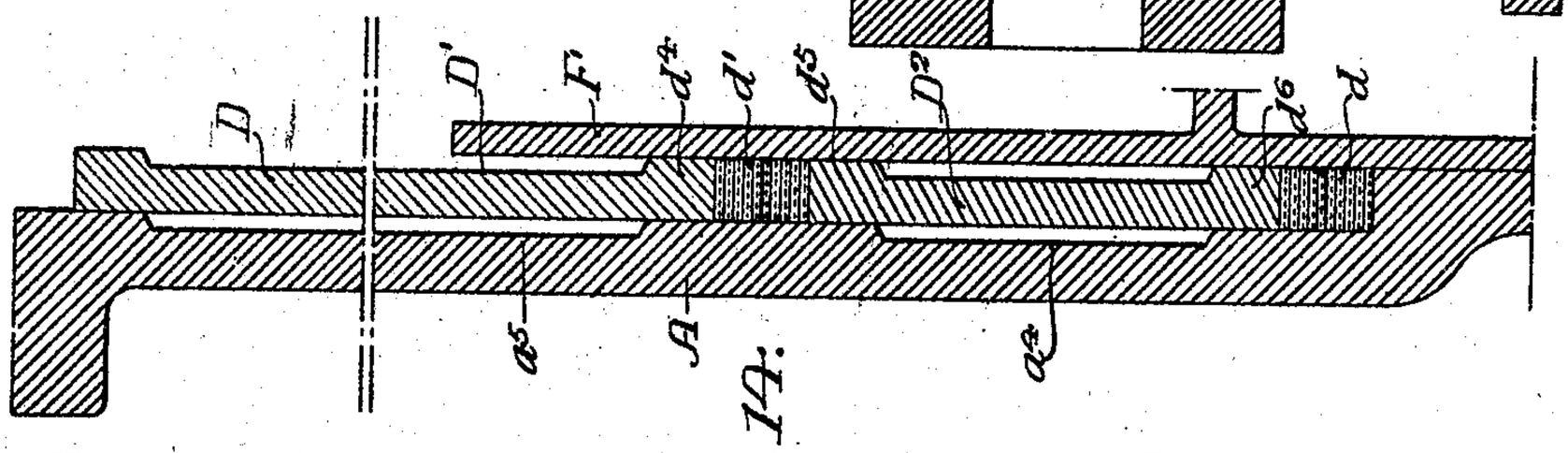


Fig. 14.



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4 SHEETS—SHEET 4.

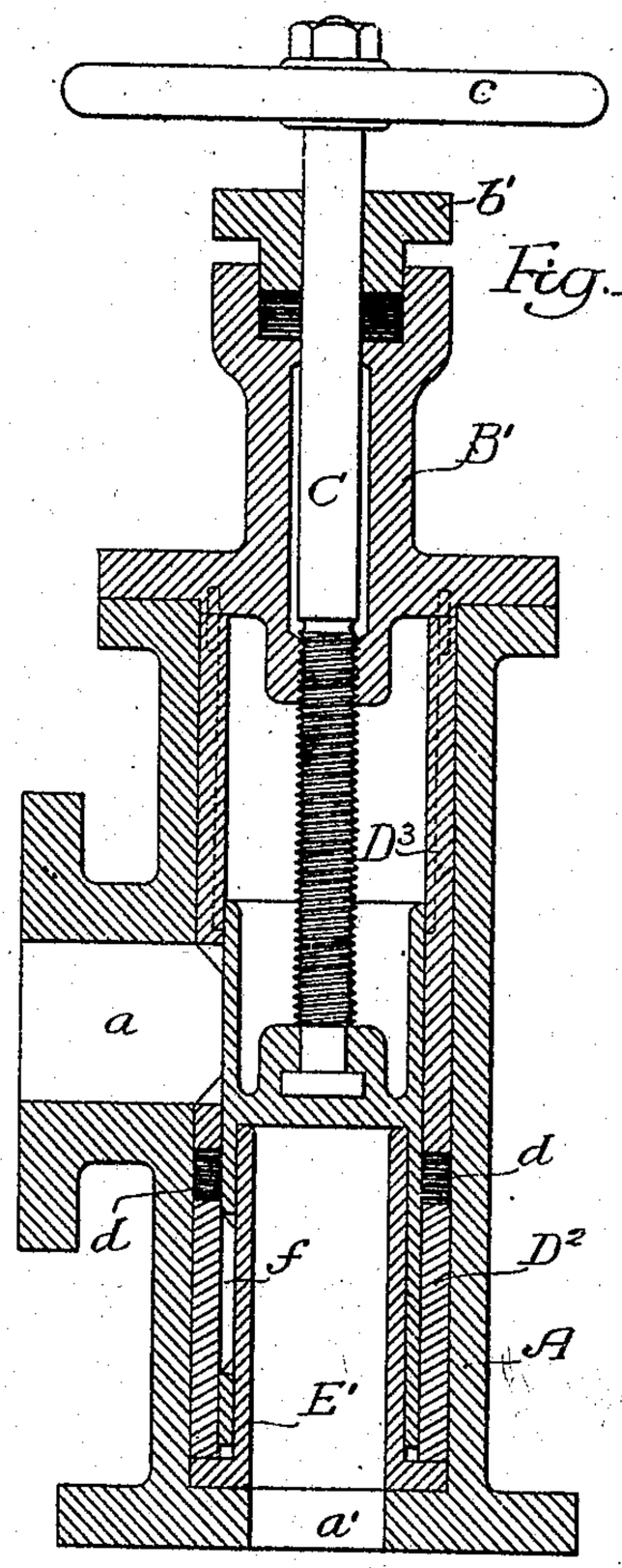


Fig. 10.

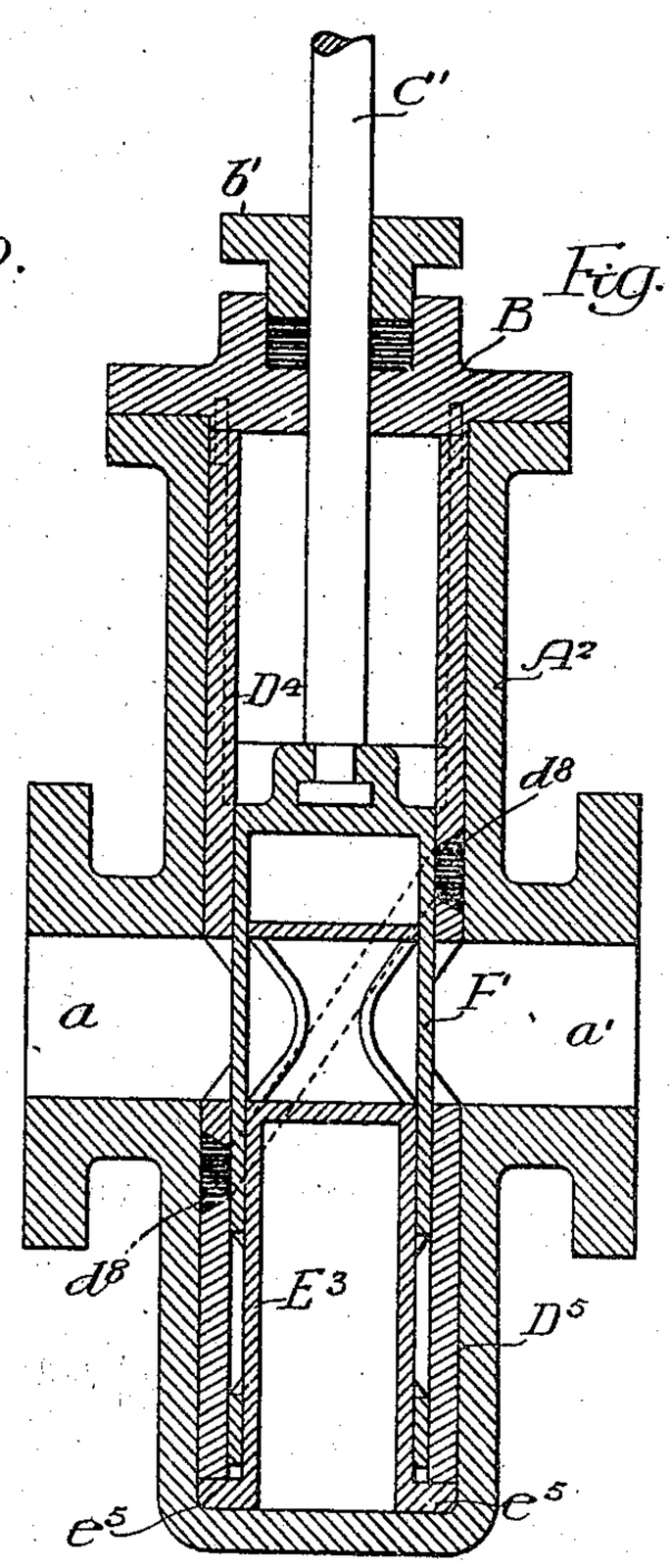


Fig. 11.

Fig. 13.

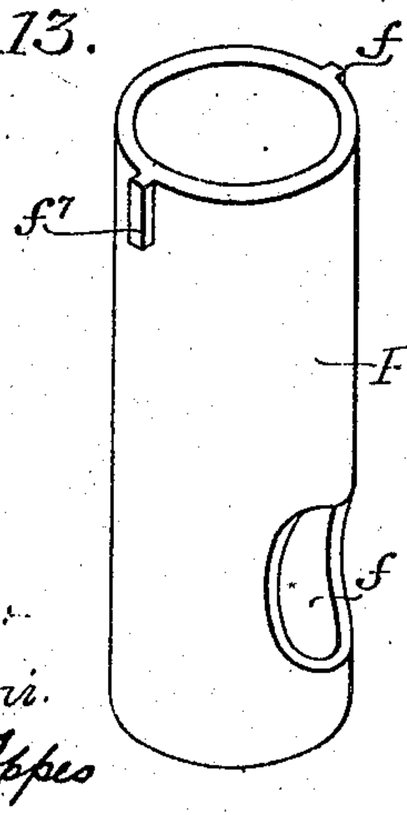
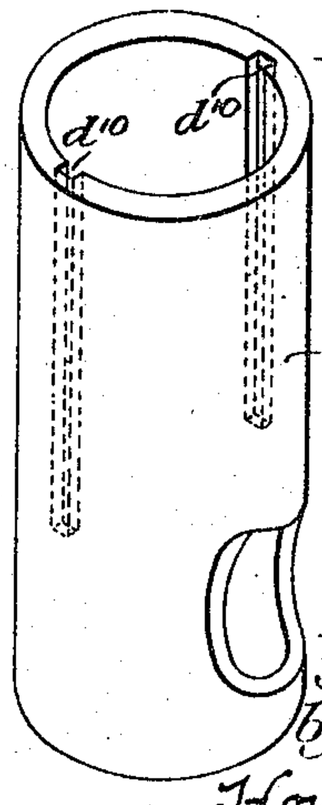


Fig. 12.



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UNITED STATES PATENT OFFICE.

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BLOW-OFF VALVE.

No. 900,506. Specification of Letters Patent. Patented Oct. 6, 1908.

Application filed June 13, 1907. Serial No. 378,759.

To all whom it may concern:

Be it known that I, JOHN S. FORBES, a citizen of the United States, residing in Philadelphia, Pennsylvania, have invented certain Improvements in Blow-Off Valves, of which the following is a specification.

One object of my invention is to provide a valve, which, while of relatively simple construction and inexpensive to manufacture, shall have its parts so arranged that even under the most severe operating conditions said parts shall satisfactorily perform their various functions with a minimum of attention and repairs.

It is further desired to provide a fluid controlling device especially adapted for use as a boiler blow off valve, in which the parts subjected to wear under operating conditions shall in no way affect the tightness or serviceability of the device; there being also provided means whereby the part serving as the movable element of the valve causes a body or bodies of packing to be so acted on as to prevent leakage through the valve after said part has been brought to its closed position.

Another object of the invention is to provide a valve of the blow off type, which in its preferred form shall be balanced and therefore easily manipulated and which shall have its movable element completely protected from the injurious action of any solid bodies passing through the valve when said element is in its open position.

A further object of the invention is to provide a valve in which is overcome the objections inherent in all valves where the closure is effected by means of a disk or gate held against a seat:—wherein the surfaces forming the seat or joint are liable to become scratched or scored by grit or scale passing over them or by so-called "wire drawing" when the valve is "cracked" or only slightly open. This object is accomplished by the use of packing arranged to form a joint between the interior surface of the valve casing or body and a sliding cylindrical shell, and by providing means whereby said packing is always protected from the current of fluid with its possible charge of solid material passing through the valve.

These objects and other advantageous ends I secure as hereinafter set forth, reference being had to the accompanying drawings, in which:—

Figure 1, is a vertical section of one form of my improved valve, illustrating it in its closed position; Fig. 2, is a section similar to Fig. 1, illustrating the valve in its open position; Fig. 3, is a vertical section taken on the line 3—3, Fig. 1, further illustrating the detail construction of the valve shown in Figs. 1 and 2; Figs. 4, 5 and 6, are perspective views illustrating certain detail elements of the valve shown in Figs. 1 to 3; Figs. 7 to 11 inclusive, are vertical sections illustrating various modifications of my invention; Figs. 12 and 13, are perspective views illustrating the detail construction of certain of the parts found in that form of my invention illustrated in Fig. 10, and Fig. 14, is a vertical section on an enlarged scale illustrating in detail the construction and arrangement of the packing rings and their associated parts as found in Fig. 7.

In Figs. 1 to 6 of the above drawings, A represents the main structure or casing of the valve and this is provided with an inlet a and an outlet a'; the casing being constructed with a cylindrical bore in line with said outlet. The end of said bore opposite the outlet is provided with a cover B secured to the casing in any desired manner, in the present instance by bolts b. Passing through the cover is the valve stem C having an operating wheel or handle c and provided with a threaded portion c'. Between the upper end of said threaded portion and the handle, the spindle passes through a stuffing box in the cover provided with a gland b' and in addition said cover is counterbored, as illustrated at b^2, to receive a collar c^2 formed on the spindle C. The bore of the casing A is lined with two cylindrical sleeves D and D′ whose interior diameter is in the present instance substantially the same as the internal diameter of the outlet a', though it is to be noted that the lower extremity of said outlet is provided with a shoulder formed by an inwardly extending flange a^2 for a purpose hereafter noted.

Between the lower edge of the sleeve D′ and the adjacent edge of the recess formed in the casing A for its reception, is an annular body of packing d and it will be noted that this encircles the bore of the casing below the inlet a. Confined between the upper edge of the sleeve D′ and the lower edge of the sleeve D, so as to encircle the bore of the casing above the level of the inlet a, is a second body of packing d', and the said sleeve D′ is provided with an opening in line with

the inlet *a* so as to permit liquid to flow therefrom into its interior. In order to prevent this sleeve from turning and yet permit it to move for a limited distance longitudinally of the bore I provide it with a slot d^2, placed in the present instance opposite the inlet *a*, for the reception of the end of a bolt a^3, as shown in Figs. 1 and 2.

The cover B of the valve casing has a portion b^3 projecting for a limited distance into the bore of said casing and between this part and the upper edge of the lining sleeve D I confine the disk-shaped head *e* of a structure E, shown in detail in Fig. 6. Said structure includes a second and smaller disk *e'*, connected to the head *e* by a portion e^2, curved to form part of a cylindrical surface. The valve stem C passes through an opening e^3 in the part *e* of the structure E, while its end c^3 is centered and properly supported by a bearing formed in the part *e'* of said structure. In order to prevent revolution of the structure E, I provide in the present instance two pins b^4, which project from the part b^3 of the cover B through openings e^4 in the disk *e;* these pins being, moreover, of such a length that they extend beyond the lower face of said disk. The valve proper or movable member of my device consists of a cylindrical shell F of the construction illustrated in detail in Fig. 4. This is of such an external diameter as to fit within the sleeves D and D', as well as in the lower part of the bore of the valve casing, and is of such a length that when its lower edge is seated on the shoulder or flange a^2, its upper edge will extend above the upper ring of packing *d'*. The upper end of said shell is provided with an opening *f* which, when the structure is in the lower position above mentioned, is in line with the inlet *a* and also with the opening in the side of the sleeve D. At the upper end of this movable member or shell F I provide a lug *f'* threaded for the reception of the threaded part *c'* of the valve spindle and having laterally extending wings or lugs f^2 whose upper ends are so placed as to engage the ends of the pins b^4 when said shell is moved to its uppermost position.

From Figs. 1 to 3 inclusive, it will be seen that the parts *e'* and e^2 of the structure E are designed to fit within the movable shell F and for this purpose I so form the latter as to permit of the introduction of the part *e'* into its interior just below the threaded lug *f'*. The radius of curvature of the part e^2 and of the outer edge of the disk portion *e'* of the structure E is such that when the various parts are assembled, as shown in Figs. 1 to 3, there is left between the said curved part e^2 and the interior of the sleeves D and D' a space just sufficient to receive and permit free movement of the shell member F. The disk part *e'* of the structure E is so placed relatively to the disk *e* that its lower face is at or just above the level of the top of the inlet *a*.

With the various parts arranged in the positions illustrated in Fig. 2, the inlet *a* has in line with it the openings in the sleeve D' and the shell F respectively, so that any material is free to pass from the inlet *a* to the interior of said shell and thence to the outlet *a'*. Under these conditions it will be noted that the movable member of the valve is balanced, for the disk part *e'* so fits said member as to permit the passage of fluid above or into the upper part of the valve structure within the sleeve D. If, now, it be desired to close the valve, the handle *c* is turned in a right handed direction, with the result that the movable member or shell F is moved longitudinally upward within the casing A, thereby gradually cutting off the flow of fluid through the inlet *a* and the opening in the sleeve D' until the opening *f* in said movable member has been drawn entirely above the top of the inlet.

It will be seen that there is little or no opposition to the movement of the shell F, since both of its ends are equally exposed to the pressure of the liquid or fluid in the structure. The continued upward movement of said shell finally causes its wings f^2 to strike the pins b^4, which, as before noted, project beyond the under surface of the disk *e*, and as a result of the consequent downward pressure of the collar c^2 on the valve stem upon this disk *e*, the latter is caused to press downwardly upon the upper edge of the sleeve D. By the time that this downward pressure occurs, it will be understood that the flow through the inlet has been completely blocked or shut off by the lower cylindrical portion of the shell F, so that said pressure is transmitted through the packing *d'* to the sleeve D' and thence to the packing *d*. These two rings or bodies of packing are therefore compressed and caused to form fluid tight joints between the wall of the casing proper and the exterior wall of the shell or movable member F, so that any possible leakage of fluid above or below said rings is absolutely prevented. It is obvious that the said rings may be compressed to any desired degree simply by turning the handle *c* of the valve stem C.

In again opening the valve, the moving of the handle *c* in a left handed direction at once releases the pressure of the pins e^4 on the wings f^2 and hence releases the pressure of the collar c^2 on the disk *e* and on the upper edge of the shell D. The packing rings *d* and *d'* are, therefore, loosened so that the movable member or shell F may be freely lowered in the casing without undue friction or wear on said packing.

With the device described it is to be noted that there is absolutely no possibility of wear or injury to those portions of the movable

member which are depended upon to prevent flow of water through the structure, for when in use these parts are completely covered within the lower part of the casing and are at no time exposed to the action of fluid passing through the valve or to damage from solid particles carried thereby.

In the event of any solid body becoming caught in the inlet so as to project through the opening *f* of the movable member F, it will be seen that the edge of said opening will act, when the valve is closing, as a shear blade to cut such a body, inasmuch as it passes between the two relatively sharp edges formed by the upper part of the opening through the sleeve D′ and the lower face of the disk portion *e* of the structure E. Moreover, it is obvious that the various parts of the valve may be removed with the greatest ease for purposes of inspection or the replacing of the packing rings *d* and *d′*, though under conditions of use neither of these operations is apt to be required except at long intervals because of the protection afforded to both packing, sleeves, shell and casing by virtue of their construction and arrangement. It will further be noted that when the valve is closed there is no possibility of sediment or other solid material so accumulating as to interfere with the immediate opening of the valve, for from Fig. 1, it will be seen that under these conditions the opening through the shell or movable member F is completely inclosed between the curved part e^2 of the structure E and the interior surface of the shell D. Moreover, there are no recesses or hollows to become filled with sediment, since the inlet is closed by the curved lower portion of the shell F.

In Fig. 7, I have illustrated a form of my invention in which the bodies of packing *d* and *d′* are tightened by means of bolts d^3 extending through the cover B′ of the valve casing into engagement with the adjacent edge of the sleeve D. In this case the movable member or shell has the form indicated at F′ and in order to close the valve it is moved toward the outlet *a′* thereof. With such a construction I provide a cylindrical sleeve E′ having at one end a flange e^5 and mount this so that its interior forms a continuation of the outlet *a* of the valve casing. The flange a^5 is engaged by a sleeve D^2 and the internal diameter of the parts is such that an annular space is left between the sleeves E′ and D^2 for the reception of the end of the cylindrical shell F′. In this instance, the packing *d* is confined between the sleeves D′ and D^2, while, as before, the packing *d′* is confined between the sleeves D′ and D. When, therefore, the valve is in its closed position, the space *f* is fully protected from an accumulation of solid material, while when the valve is open, the opening in the shell is in line with the inlet *a*. Fluid passing through the valve, therefore, flows from said inlet through the opening of the sleeve D′ and into the sleeve E′, from whence it passes to the outlet.

In the form of my valve illustrated in Fig. 7, I have shown a construction of sleeves, shell and casing which may be employed in any form of my invention, and this involves casting the casing A so that certain limited portions only of its interior require finishing. In other words, while the exterior surface of the sleeve D, D′ and D^2 is accurately finished, the inside surface of the casing A is accurately finished only at those points where it is adjacent to packing *d* and *d′*. The intermediate portions of the interior of the casing, such as those indicated at a^4 and a^5, are rough and unfinished; being formed of a larger diameter, so that there is a space left between them and the adjacent portions of the surface of the sleeves D, D′ and D^2. Similarly, these sleeves themselves are formed so as to have the greater portion of their interior surface of a larger diameter than the external diameter of the cylindrical shell F′ so as to engage the same at their end portions d^4, d^5, etc. As a consequence, while the packing acts against finished surfaces, the relatively extensive areas otherwise requiring finishing may be left in a comparatively rough condition, thereby materially reducing the cost of the valve, as well as diminishing the amount of surface frictionally engaging the cylindrical shell.

In Fig. 8, I have illustrated a form of my valve in which the cylindrical shell F′ is unbalanced, and is used with but a single body of packing *d* placed around it between the inlet *a* and the outlet *a′*. In this case, I provide a single long sleeve D^3 extending between a disk e^8 placed immediately adjacent to the cover B, and a body of packing *d*; this sleeve being provided with an opening to permit flow of fluid into its interior from the inlet *a*.

In Fig. 9, the sleeve E^2 has a flange mounted in a manner similar to the sleeve E′ shown in Fig. 7, but extending upwardly within the cylindrical shell F′ and having its upper end closed; there being similarly an opening in the side, as indicated at e^9, placed so as to be in line with the inlet *a* of the casing. There are two bodies of packing confined between the sleeves D, D′ and D^2, and the cylindrical shell operates in a space between these latter sleeves and the sleeve E^2. In this instance also said shell is moved toward the outlet in order to close the valve. The valve stem C has its end guided in the end section of the sleeve E^2 and, as before described, engages a threaded lug in the upper portion of the shell.

In Fig. 10, is shown a form of valve in which the valve stem, while threaded as be-

fore, passes through a threaded portion of the cover B′, so that in opening the valve, said stem will move longitudinally. Otherwise, as is noted, this form of valve is similar to that illustrated in Fig. 7, except that it is provided with but a single body of packing *d* placed between its inlet and outlet.

In Fig. 11, I have illustrated my invention as applied to a through valve or one having its outlet placed 180° distant from its inlet, instead of at right angles thereto as in the other valve illustrated. In this case, the sleeve E^3 is provided with a straight passage through its upper end in line with the inlet and outlet *a* and *a′*. Said sleeve fits within the cylindrical shell F, which is connected to the valve stem C′ whereby it may be moved longitudinally.

Lining the valve casing A^2 are two sleeves D^4 and D^5, the latter of which bears upon the flange e^5 of the sleeve e^3 and has its upper end cut off so that its end lies in a plane of about 30° to its axis. Similarly, the sleeve D^4 has its upper end cut away so as to lie in a plane at a similar angle to its axis, while the upper portion of the sleeve D^5, as well as the lower portion of the sleeve D^4, have openings respectively coming in line with the inlet and outlet of the valve casing. A body of packing d^8 is confined between the adjacent edges of these two sleeves D^4 and D^5 and will be seen to extend in the form of a ring around the sleeve F′, and, as before, between the inlet and outlet of the casing. By virtue of the position of said ring, it extends around the cylindrical passage through the valve and also around the cylindrical shell which intersects said passage, so that though being but a single ring, it very effectually prevents the leakage around said shell.

In order to tighten up the packing rings in such cases as have been illustrated in Figs. 8, 9, 10 and 11, I form on the shell F′ a pair of projecting lugs f^7 and provide on the inside of the sleeve D or D^6, as the case may be, vertically extending grooves d^{10} for the reception of said lugs. As a result, not only is the shell F′ prevented from turning, but after it has been moved to its closed position, the lugs f^7 strike the bottoms of the grooves d^{10} and thereafter any further revolution of the valve stem causes said shell F′ to force downwardly the sleeve D^6, with the result that the packing rings are forced out or tightened as before.

It is obvious that the upward movement of the shell F′, which occurs in opening the valve, releases the packing from its compressed condition so that said shell is thereafter free to slide without undue friction.

I claim:

1. The combination in a valve, of a casing having openings in its side and at its ends, a cylindrical shell movable within the casing and having an opening capable of being brought opposite the side opening thereof, means for moving the shell, and a structure extending within the casing so as to form with the interior thereof a recess for the reception of that part of the shell having the side opening, substantially as described.

2. The combination with a casing having a cylindrical bore provided with side and end openings, a disk-shaped structure mounted in the casing and to one side of the side opening thereof, a shell longitudinally movable in the casing and fitting outside of said disk structure, with means for moving said shell to open or close the valve, substantially as described.

3. The combination in a valve, of a casing having inlet and outlet openings, a shell in the casing, means for moving the shell so as to close the valve, packing surrounding the shell to prevent leakage between the inlet and the outlet, means for moving the shell, and a device for tightening the packing said device being placed to be actuated by the continued operation of the shell moving means after the shell has been moved to its closed position, substantially as described.

4. The combination in a valve, of a casing having inlet and outlet openings, a shell longitudinally movable in the casing, bodies of packing surrounding the shell on both sides of the said opening, and means for moving the shell to close the valve, with a device actuated by said means for tightening the packing, substantially as described.

5. The combination in a valve, of a casing having an inlet and an outlet opening, a sleeve in the casing, a body of packing confined between one end of said sleeve and the casing and placed between the inlet and the outlet opening thereof, a shell in the casing, means for moving the shell to close the valve, and means for causing said shell moving means to exert pressure on the sleeve to cause the packing to prevent leakage around the shell, substantially as described.

6. The combination in a valve, of a casing having an inlet and an outlet opening, a shell movable in the casing to cut off the flow of fluid through the valve, sleeves in the casing outside of the shell, a body of packing between said sleeves, and a second body of packing between one of the sleeves and the casing, with means for moving the shell, said means being operative on the sleeves to tighten the packing after the valve is closed substantially as described.

7. The combination in a valve, of a casing having an inlet and an outlet opening, a shell movable in the casing to cut off the flow of fluid through the valve, two sleeves in the casing outside of the shell, a body of packing between said sleeves, a second body of packing between one of the sleeves and the casing, means for moving the shell, and a

device actuated by said means for pressing upon one of said sleeves to force the two bodies of packing into intimate engagement with their adjacent structures to prevent leakage, substantially as described.

8. The combination in a valve, of a casing having an inlet and an outlet, a cover for one end of the casing, a valve stem passing through the cover and having a threaded portion, a longitudinally movable shell in the casing having a threaded lug engaging the threaded part of the valve stem, there being an opening in the end of said shell and another opening in the side thereof so placed that the valve is closed when the shell is moved toward the cover, substantially as described.

9. The combination in a valve, of a casing having an inlet and an outlet opening, a shell movable within the casing to open and close the valve, packing surrounding the shell between the inlet and the outlet, a rotatable valve stem having a limited longitudinal movement and operatively connected to the shell for operating the same, and means acted on by the valve stem for tightening the packing after the shell has been moved to close the valve, substantially as described.

10. The combination in a valve, of a casing having a cover at one end and inlet and outlet openings, a shell movable within the casing for closing the valve, a valve stem passing through the cover and operatively engaging the shell, a collar on the valve stem, a pin or pins on the cover placed to engage the shell structure when the valve is closed, packing for preventing leakage past the shell between the two openings, and a sleeve acted on by said collar after the pins have engaged the shell structure to compress said packing and prevent leakage, substantially as described.

11. The combination in a valve, of a casing having inlet and outlet openings, of which one is formed in its side, a valve stem supported at one end of the casing, a shell operatively connected to the valve stem and movable thereby within the casing to cut off the flow of fluid between the inlet and outlet openings, a disk-like structure fitting within the said shell on that side of the side opening distant from the other opening of the casing, and a supporting structure for said disk structure forming with the interior of the casing a recess for the reception of the shell, substantially as described.

12. The combination in a valve, of a casing having an inlet and an outlet, a cylindrical shell movable within the casing, two disk-like structures having a section of a sleeve connecting them and mounted in one end of the casing, a cover for said end of the casing, a valve rod operatively engaging the shell and guided by said disk-like structures, the sleeve forming with the interior of the casing a recess for the reception of the shell, substantially as described.

13. The combination in a valve, of a casing having an inlet and an outlet, a cover for the casing provided with a projecting pin or pins, lining sleeves within the casing, a body of packing between the adjacent ends of said sleeves, and a second body of packing between one of the sleeves and the casing, a disk-like structure confined between the cover and one of the sleeves and having openings for the passage of the pin or pins, a shell movable within the sleeves provided with an opening placed to be brought in line with one of the openings of the casing, a valve stem passing through the cover and the disk-like structure and provided with a threaded portion in engagement with a correspondingly threaded part of the shell, there being a collar on said stem engaging the disk-like structure, and a projecting wing or wings on the shell placed to engage the pin or pins of the cover under predetermined conditions, substantially as described.

14. The combination in a valve, of a casing having an inlet and an outlet opening, a sleeve in the casing, means for preventing turning of the sleeve, a body of packing engaged by one end of the sleeve, a movable shell within said sleeve, means for longitudinally moving the shell, and a device actuated from said means through said shell for exerting pressure on the sleeve to compress the packing when the valve is in its closed position, substantially as described.

15. The combination in a valve, of a casing having an opening in its side, and another in its end, a cylindrical shell within the casing, means including a rod for moving the shell to bring a portion of its surface opposite the side opening of the casing to close the same, with means within the shell constructed to serve as a guide for the end of the shell operating rod for preventing passage of solid material into that part thereof distant from the end opening of the casing, substantially as described.

16. The combination in a valve, of a casing having an opening in its side and another in its end, a cylindrical shell within the casing, means for moving the shell to bring a portion of its surface opposite the side opening of the casing to close the same, with a disk mounted in the shell on that side of said opening of the casing distant from the end opening thereof, substantially as described.

17. The combination in a valve, of a casing having an inlet and an outlet, a cylindrical shell within the casing, a valve rod for moving the shell to open or close the valve, and a structure placed within but independent of the shell to receive the inner end of the valve rod and confine material to

that part of said shell between the inlet and outlet of the casing, substantially as described.

18. The combination in a valve, of a casing having an inlet and an outlet, a lining sleeve or sleeves for the casing, a cylindrical shell operative in said sleeve or sleeves for controlling the passage of fluid from the inlet to the outlet, and means for moving the shell, the interior surface of said lining sleeve or sleeves having both finished and unfinished portions, of which the former are of limited extent and are placed to be engaged by the shell, while the unfinished portions are distant from the shell and provide empty spaces separate from the passage for the flow of fluid, substantially as described.

19. The combination in a valve, of a casing having an inlet and an outlet, a longitudinally movable shell for controlling the passage of fluid from the inlet to the outlet, means for moving the shell, and packing set in the casing for preventing leakage around the shell from the inlet to the outlet, the interior surface of the casing having finished portions of limited extent placed to engage the shell only in the immediate vicinity of the packing and at its ends and having empty recesses between said finished portions.

In testimony whereof, I have signed my name to this specification, in the presence of two subscribing witnesses.

JOHN S. FORBES.

Witnesses:
WM. E. SHUPE,
JOS. H. KLEIN.