W. F. GOULD.

BALANCED VALVE.

APPLICATION FILED MAY 19, 1909.

1,014,591.

Patented Jan. 9, 1912.

3 SHEETS—SHEET 1.

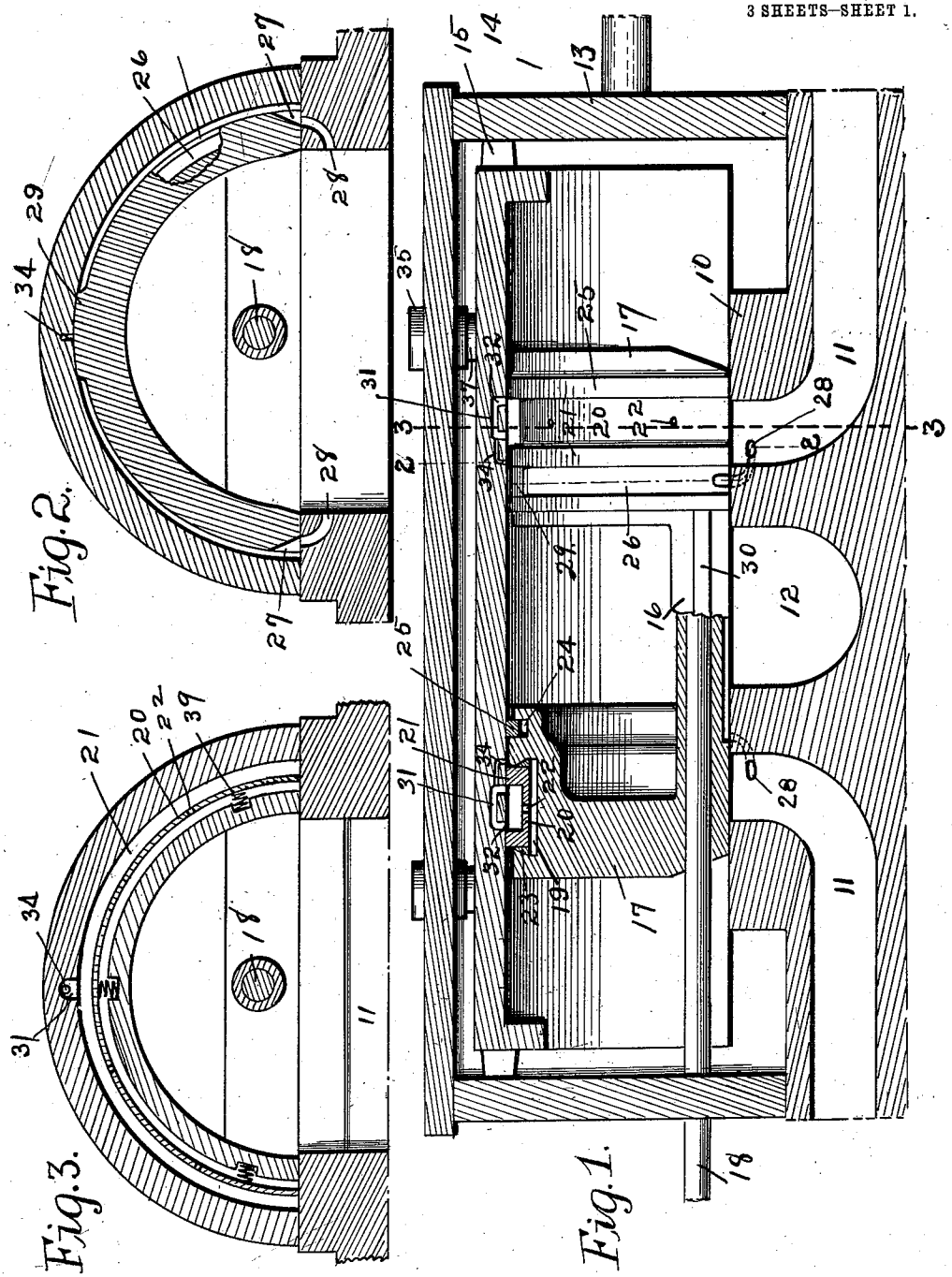

Fig. 2.

Fig. 3.

Fig. 1.

Witnesses
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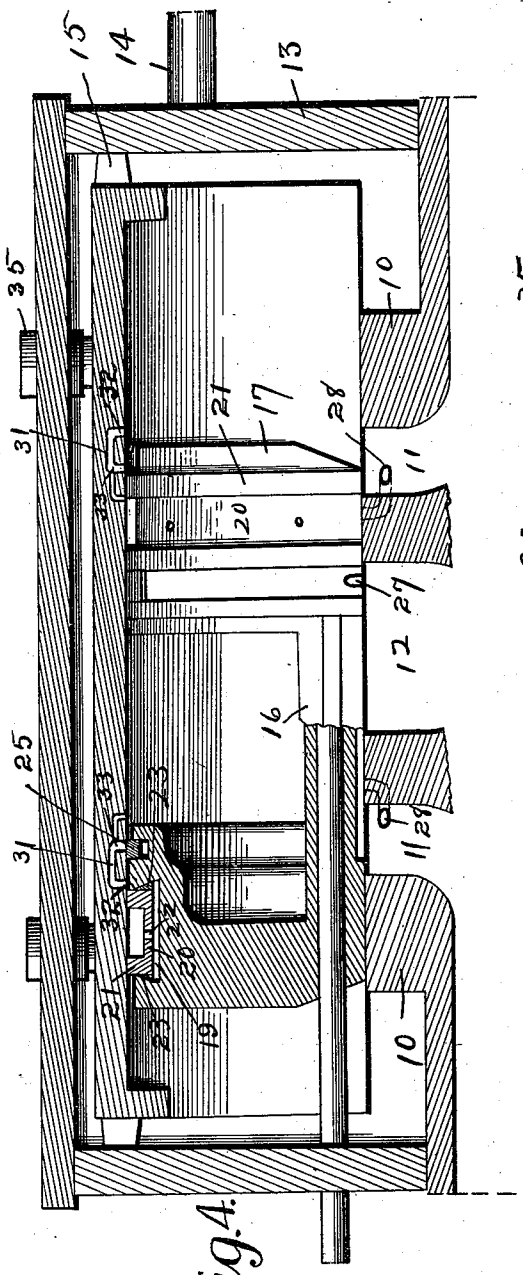

Fig. 4.

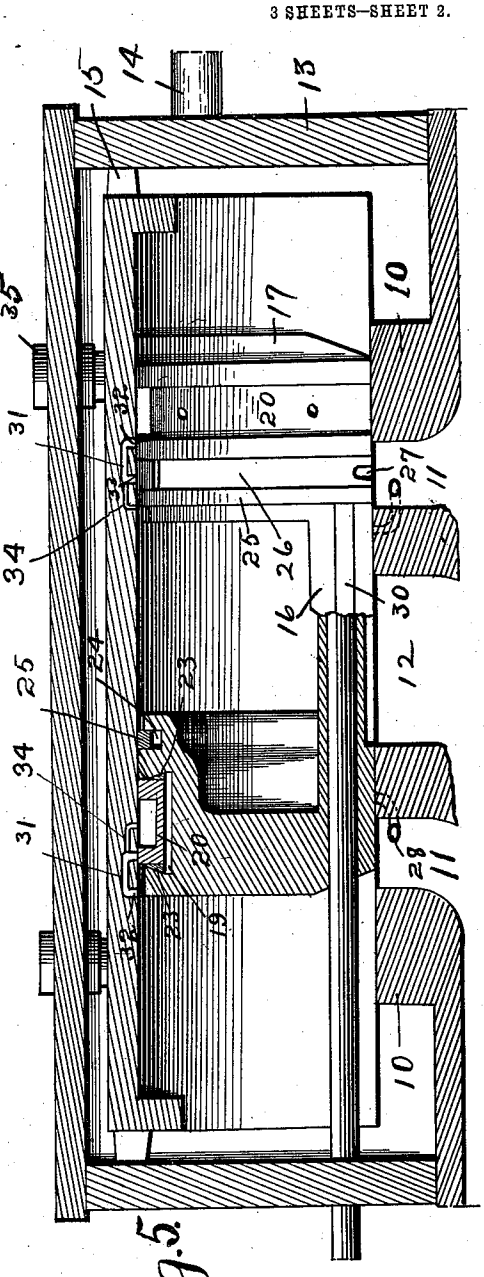

Fig. 5.

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3 SHEETS—SHEET 3.

Fig. 8.

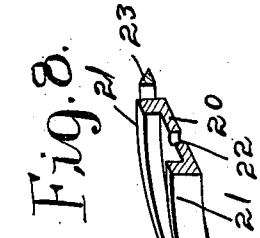


Fig. 9.

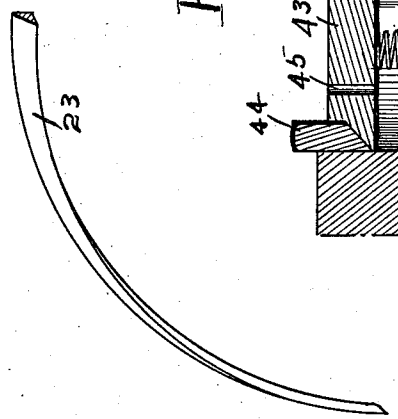
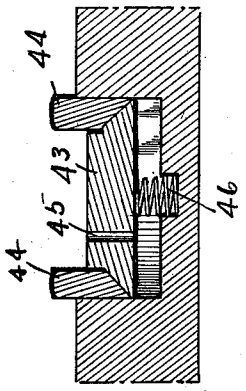


Fig. 10.



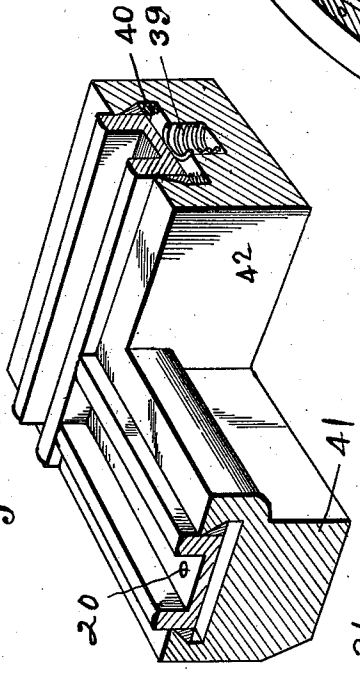


Fig. 6.

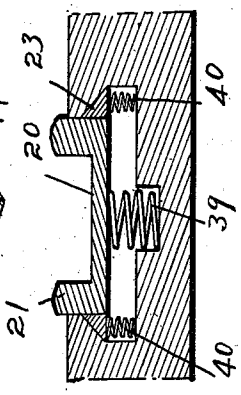


Fig. 7.

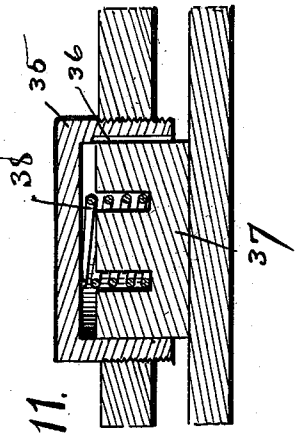


Fig. 11.

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UNITED STATES PATENT OFFICE.

WILLIAM F. GOULD, OF DES MOINES, IOWA.

BALANCED VALVE.

1,014,591. Specification of Letters Patent. Patented Jan. 9, 1912.

Application filed May 19, 1909. Serial No. 496,892.

To all whom it may concern:

Be it known that I, WILLIAM F. GOULD, a citizen of the United States, residing at Des Moines, in the county of Polk and State of Iowa, have invented a certain new and useful Balanced Valve, of which the following is a specification.

My invention relates to that class of balanced valves in which there is a valve seat having two induction ports and an exhaust port between them, a slide valve having two end portions and open at its central portion, a valve cover, and a steam chest. It is well known that in valves of this kind, the valve cover within the steam chest prevents the steam pressure within the chest from pressing the valve toward its seat and, hence, the cover itself would approximately balance the valve except for the pressure outwardly upon the valve through the induction ports.

The object of my invention is to provide means of simple, durable, and inexpensive construction, in a valve of this kind, whereby each end of the valve will have live steam applied to its outer surface from the steam chest for forcing the valve toward its seat, said steam pressure being varied in proportion to the pressure of steam outwardly upon the valve from the adjacent induction port during the time that live steam is being admitted into said induction port.

A further object is to provide means whereby the outward pressure upon the valve caused by the compression of the steam in one end of the cylinder as the valve is approaching said end will produce a pressure of corresponding degree on the outer surface of the valve tending to hold it to its seat during that portion of the valve stroke when said compression pressure it taking place.

A further object is to provide an improved packing device for forming steam chambers on the outer surface of the valve.

A further object is to provide improved means for yieldingly holding the valve cover in engagement with the valve.

My invention consists in the construction, arrangement, and combination of the various parts of the device whereby the objects contemplated are attained, as hereinafter more fully set forth, pointed out in my claims, and illustrated in the accompanying drawings, in which—

Figure 1 shows a central, longitudinal, sectional view of a valve seat with induction and exhaust ports therein, a valve, a valve cover, and a steam chest embodying my invention. Fig. 2 shows a sectional view on the line 2—2 of Fig. 1. Fig. 3 shows a sectional view on the line 3—3 of Fig. 1. Fig. 4 shows a view similar to Fig. 1, with the valve in a different position. Fig. 5 shows a similar view with the valve in another position of its movement. Fig. 6 shows an enlarged, detail, perspective view illustrating a modified form of valve and my preferred form of packing bars therein. Fig. 7 shows an enlarged, detail sectional view illustrating a portion of my improved packing bar and adjacent parts. Fig. 8 shows a detail, perspective view illustrating a portion of a packing bar embodying my invention. Fig. 9 shows a perspective view of one of the packing segments to be used in connection with my improved packing bar. Fig. 10 shows a view similar to Fig. 7, illustrating a modification, and—Fig 11 shows an enlarged, detail sectional view of the device for yieldingly holding the valve cover inwardly toward the valve.

Referring to the accompanying drawings, I have used the reference numeral 10 to indicate the valve seat in which are two induction ports 11 and an exhaust port 12. The steam chest is indicated by the numeral 13 and is provided with a supply pipe 14.

Within the steam chest is a valve cover 15, and between the valve cover and the valve seat is a valve comprising two connecting side pieces 16 and two valve end portions 17, the latter being substantially segmental in cross section. A valve stem 18 is connected to the valve. On the outer surface of each of the valve ends is an annular groove 19 which is widest at its bottom and tapers toward its upper portion. Mounted in this groove is a packing bar, illustrated in Fig. 8, and comprising a central portion 20 and two outwardly extended ribs 21 at its edges, the outer sides of said edges being parallel. In said central portion 20 is a series of openings 22 to permit the passage of steam through the packing bar. In this connection, I have shown, in Fig. 7, a modified form of the packing bar in which the outer surfaces of the ribs 21 are slightly rounded, so that only the central portions of said ribs engage the valve cover. There are two advantages gained by this: first, the friction is reduced, and second, steam enters between the edges of the ribs and the cover to press

the ribs toward the valve and thus partially balance the outward pressure on the under surface of the packing bar.

In order to prevent the escape of steam through between the outer sides of the packing bar and the adjacent sides of the groove in the valve, I have provided two packing strips 23, each substantially triangular in cross section and placed between the packing bar and the adjacent side of the groove as clearly shown in Fig. 1. The construction and arrangement of these parts is such that when steam is admitted into the space between the ribs 21, it will pass under the body portion 20, through the holes 22, and will then cause the packing bar to move outwardly away from the valve and will also cause the strips 23 to move outwardly away from the valve so that said strips will be tightly wedged in position between the packing bar and the sides of the groove, and the packing bar itself will be held outwardly to its limit of movement away from the valve. The steam pressure on the inner surface of the packing bar will be greater than that upon the outer surface on account of the greater area of the inner surface, the steam pressure being equal in all directions.

Formed in each end of the valve, adjacent to the groove 19, is a second annular groove 24 spaced apart from the groove 19 toward the center of the valve and in said groove 24 is a packing bar 25. The space between the packing bar 25 and the adjacent rib 21 forms a steam chamber 26. At each end of the steam chamber 26, I have formed a passage-way 27 to communicate with a steam passage-way 28 which extends through the valve seat and communicates with the adjacent induction port; and in the central portion of the steam chamber 26, I have provided an extension 29 raised above the surface of the valve to come in direct contact with the valve cover. By this arrangement, it is obvious that during certain positions of the valve stroke, such, for instance, as the position shown to the right in Fig. 1, steam may pass through the passage-way 28 and the passage-way 27 into the steam chamber 26 and no steam can pass through the passage-way 28 into the steam chamber between the ribs 21 of the packing bar for the reason that no passage-way similar to the passage-way 27 is provided for the packing bar 20 and 21.

In the connecting side pieces 16 of the valve, I have provided two straight packing bars 30 to engage the valve cover, the ends of said packing bars 30 being in engagement with the packing bars 25, as shown in Fig. 1, to thereby prevent the passage of steam through the ports 28 into the space at the central portion of the valve.

In the valve cover adjacent to each end of the valve, I have formed a steam chamber 31 having at one end, a passage-way 32 leading to the under surface of the valve cover, and at the other end, a passage-way 33 leading to the under surface of the valve cover. Communicating with this chamber 31 is a small passage-way 34 extending in a direction toward the center of the valve cover and then inwardly to the inner surface of the valve cover. The said passage-way 34 is made materially smaller than the passage-ways 32 and 33 for purposes hereinafter made clear.

In order to hold the valve cover in engagement with the valve, I have provided, in the top of the steam chest, a screw-cap 35 having a steam passage-way 36 extending from its lower end to a point near its top, as shown in Fig. 11. Slidingly mounted within the screw-cap is a cylindrical block 37 in engagement with the valve cover. A spring 38 is interposed between the block 37 and the top of the screw-cap to yieldingly hold the block against the valve cover. The function of the steam port 36 is as follows: When the parts are in the position shown in Fig. 11, it is obvious that steam from the steam chest may pass through the port 36 into the space between the screw-cap 35 and the block 37 and the steam pressure will co-act with the spring 38 in holding the valve cover toward the valve. Assuming, however, that there is an unusual outward pressure upon the valve, then the block 37 will be forced outwardly toward the top of the cap and the steam between the cap and the block 37 may pass out through the port 36. However, before the block 37 reaches the top of the cover, it will cut off the outer end of the port 36 and thus prevent further escape of steam, whereupon the steam remaining between the cover and the block 37 will act as a cushion to prevent farther outward movement of the valve; that is to say, the steam pressure upon the valve cover tending to hold it toward the valve seat is variable when the valve is against its seat and the steam may freely flow to and from the space between the cap and the block, but when the valve is raised from its seat, the port is closed and a steam cushion is provided that will prevent the block 37 from striking upon the top of the cap.

In Fig. 7 of the drawings, I have shown a spring 39 in engagement with the packing bar 20 and 21 for the purpose of holding it out away from the valve, and I have also shown two springs 40 for holding the packing strips 23 outwardly. These springs will be useful in some instances in holding said parts in position when the steam pressure is insufficient for this purpose.

In the modified form shown in Fig. 6, I have shown a valve in which the valve end 41 is made flat on its outer surface and

the valve sides 42 are also made flat and the packing bars therein are straight. A valve of this kind would have to be used in connection with a flat valve cover. When a valve of this kind is employed, I use the same kind of packing bars as previously described herein, the ones at the sides of the valve being provided with springs 39 and 40 and the ones at the ends of the valve being provided only with the openings 20 for permitting the passage of steam.

In the modified form shown in Fig. 10, I have shown a packing bar consisting of a part 43 flat on its under surface and having inclined edges, said inclined edges being placed in engagement with two ribs 44 which are also provided with mating inclined edges. The part 43 performs the same function as the part 20 before described, and is provided with a steam passage-way 45 for the same purpose as the passage-way 22, and the parts 44 perform the same function as the ribs 21. Obviously, the pressure of the steam on the under surface of the part 43 will tend to hold it outwardly away from the valve and cause a tight joint to be made between the inclined portions of the parts 44 and 43. A spring 46 is also shown in Fig. 10 whereby the part 43 is yieldingly held outwardly when there is no steam pressure within the steam chest.

In connection with the practical operation of the valve, the well known action of an engine piston and the action of the steam pressure within the cylinder and steam chest must be understood. When one end of the valve is in position partly covering the adjacent induction port for the purpose of admitting live steam into the cylinder through the induction port, there will be an outward pressure of the steam upon the part of the valve that extends over the induction port tending to force it away from the valve seat. This pressure is, of course, greatest when the induction port is only slightly open and the pressure gradually diminishes as the valve moves to position uncovering the port. Furthermore, at the time when the piston moves close to one end of the cylinder, it will cause the steam therein to be compressed and forced outwardly through the adjacent induction port, which will also cause an outward pressure upon the valve. This outward pressure on the valve lasts only during the time after the exhaust port has been closed and prior to the time that steam is admitted into the adjacent end of the cylinder, and in order to balance the valve, the pressure inwardly upon the valve toward the valve seat must be proportioned to the pressure upon the valve by means of this compressed steam that is being forced outwardly through the induction port. It is obvious that the action of each end of the valve is exactly the same and for convenience in the following description, I have considered only the right end of the valve and the other operative parts co-acting with the right end of the valve.

When the right end of the valve is in the position shown in Fig. 1 of the drawings and assuming that the valve is moving toward the left, then the piston is in position just approaching the right end of the cylinder and moving toward the right, thus causing the steam therein to be compressed and to be forced outwardly through the adjacent induction port. When in this position, the steam passing outwardly through said induction port will pass through the passage-ways 28 and 27 into the chamber 26, thus causing a pressure upon the outer surface of the valve tending to hold it toward its seat and this pressure will be proportioned to the outward pressure through the induction port; that is to say, if the pressure outwardly in said induction port is, for instance, two hundred pounds to the square inch, the same pressure of two hundred pounds to the square inch will be applied to the outer surface of the valve in the steam chamber 26, and therefore it is only necessary to make the steam chamber 26 of sufficient area to obtain the desired amount of pressure on the valve tending to hold it to its seat. In practice, in connection with this valve, I have found that the area of this steam chamber 26 should be slightly less than the area of the induction port. The only other time during the stroke of the valve that there is any communication between the chamber 26 and the induction port 11 is when the valve is in the position shown in Fig. 1 and moving toward the right, but when in this position, there is no steam being admitted to the cylinder but there is a certain amount of outward pressure on the valve caused by the expansion of steam within the cylinder. This pressure is variable in proportion to the amount of expansion that is taking place and therefore this expansion pressure outwardly upon the valve is counter-balanced by a steam pressure in the chamber 26. In other words, there are two positions of the valve in which there is a steam pressure outwardly upon the valve that is variable, one of them being the pressure that is caused by the steam being compressed in the end of the cylinder by the piston and the other by the expansion of the steam after the flow of live steam into the cylinder has been stopped, and in both of these positions of the valve where there is a variable steam pressure, the valve is balanced by a corresponding variable steam pressure upon the outer surface of the valve. In addition to this variable pressure outwardly upon the valve, there is, during certain parts of the stroke, an outward steam pressure upon the valve.

This occurs from the time that the valve begins to move to position uncovering the induction port to admit steam to the cylinder until said uncovering movement is completed and the valve returns to position for cutting off the supply of live steam and it is obvious that during this time there is an outward pressure upon the valve which is substantially the same per square inch as the pressure within the steam chest, and therefore, the best medium for balancing against this live steam pressure is the live steam pressure within the steam chest. For this purpose, I have provided the chamber 19 on the outer surface of the valve, the area of which is substantially the same as the area of the induction port, and the passageways 32, 33, and 34 are so arranged as to admit steam from the steam chest to the chamber 19 during that portion of the stroke in which there is a live steam pressure outwardly upon the valve. In this connection it is also to be considered that the position of the valve relative to the induction port varies constantly, and hence there is sometimes more and sometimes less of the under surface of the valve exposed to the outward pressure of steam. In order, therefore, that the steam chest pressure on the outside of the valve may be made to vary in proportion to the area of that part of the valve that projects over the port, I have provided the small passageway 34 connected with the steam chamber 31. In practical operation, with this part of the device, and assuming that the valve is in the position shown to the left in Fig. 5 and the valve is moving toward the right, the valve obviously is in position where the induction port is partially open. In said view, the passageway 33 is covered by the rib 21, but it is obvious that just prior to the time the valve assumed the position there shown, the passageways 32 and 33 were both open to admit a full flow of steam from the steam chest into the steam chamber of the packing bar 20, and, therefore, just at the time that steam began to enter the induction port, that is to say, the time when the outward pressure upon the valve is greatest, then the full steam pressure of the steam chest was applied to the outer surface of the packing bar. When the valve has moved as far as the position shown to the left in Fig. 5, the amount of the under surface of the valve exposed to the outward pressure from the induction port begins to diminish and, hence, by closing the passage-way 33 and permitting only a small quantity of steam to enter the steam chamber through the passageway 34, the pressure upon the valve in a direction toward the seat diminishes as the valve moves over the induction port. As soon as the valve has moved to position where the outer one of the ribs 21 closes the passage-way 34, then all live steam pressure from the steam chest is cut off and the pressure upon the packing bar is only that of the confined, expanding steam, so that when the valve is in position almost wholly uncovering the induction port, and only a slight portion of its surface is exposed to the outward steam pressure from the induction port, then the pressure on the outer surface of the valve is only that of the expansion of the steam within the steam chamber. When the valve is in the position shown at the right in Fig. 5, then the steam confined within the steam chamber of the packing bar 20 may be discharged into the exhaust opening of the valve. By having the part 29, as shown in Fig. 3, extended outwardly to the valve cover, I prevent the steam from the steam chamber of the packing bar 20 from entering the steam chamber 26. By the arrangement of the large and small passage-ways 32, 33 and 34, I provide for applying a variable steam pressure on the outer surface of the valve which will substantially counter-balance the variable steam pressure upon the under surface of the valve caused by the live steam when it is entering the cylinder.

I claim as my invention.

1. The combination of a valve, a valve cover, a packing bar between the valve and cover, means whereby pressure is applied to the packing bar to hold it toward one of said parts, the side of the packing bar opposite to the side to which said pressure is applied having a raised, longitudinal, central portion, for the purposes stated.

2. The combination of a valve seat having an induction port therein, a steam chest, a valve cover, a slide valve between the cover and valve seat, a steam chamber formed in the outer surface of the valve, a chamber formed within the valve cover, two comparatively large passageways formed in the valve cover communicating with said steam chamber in the cover and with the under surface of the valve cover, and a comparatively small passage-way formed in the valve cover communicating with said steam chamber and with the under surface of the valve for the purposes stated.

3. The combination of a valve seat having an induction port therein, a steam chest, a valve cover, a slide valve between the cover and valve seat, said valve being formed with a steam chamber on its outer surface, a steam chamber formed in the valve cover, and a number of passage-ways in the valve cover communicating between the steam chamber therein and the under surface of the valve cover and so arranged as to admit steam from the steam chest into the steam chamber on the outer surface of the valve in large quantities during certain portions of the valve stroke, and in smaller

quantities during certain other portions of the valve stroke.

4. The combination of a valve seat having an induction port therein, a steam chest, a valve cover, a slide valve between the cover and valve seat, said valve being formed with a steam chamber on its outer surface leading to the valve seat, said valve seat being formed with passage-ways at its sides communicating between the induction port and said steam chamber in the valve when the valve is in a certain position relative to the induction port.

5. The combination of a valve seat having an induction port therein, a steam chest, a valve cover, a slide valve between the cover and valve seat, said valve being segmental on its outer surface, packing bars mounted in the valve and spaced apart from each other to form a steam chamber, said valve being provided on its under surface with passage-ways extending into the steam chamber, and said valve seat being provided with passage-ways leading from the sides of the induction port to the valve seat to discharge into the passage-ways of the valve leading to said steam chamber on the valve.

6. The combination of a valve, a valve cover, a groove formed in the valve, and a packing bar mounted in said groove comprising a body portion having ribs at its sides, said body portion being provided with steam passage-ways extending through it.

7. In a device of the class described, a valve, a valve cover, a groove formed in the outer surface of the valve narrowest at the part adjacent to the valve cover, a packing bar therein comprising a body portion and ribs at the sides of the body portion, and packing strips inserted between the sides of the packing bar and the adjacent sides of the groove, and means for holding the packing bar and the packing strips outwardly away from the valve.

8. In a device of the class described, a valve, a valve cover, a groove formed in the outer surface of the valve narrowest at the part adjacent to the valve cover, a packing bar therein comprising a body portion and ribs at the sides of the body portion, and packing strips inserted between the sides of the packing bar and the adjacent sides of the groove, and springs for holding the packing bar and the packing strips outwardly away from the valve.

9. In a device of the class described, a valve, a valve cover, a groove formed in the outer surface of the valve narrowest at the part adjacent to the valve cover, a packing bar therein comprising a body portion and ribs at the sides of the body portion, and packing strips inserted between the sides of the packing bar and the adjacent sides of the groove, and means for holding the packing bar and the packing strips outwardly away from the valve, said means comprising steam passageways formed in said body portion to admit steam under the packing bar and the packing strips.

10. In a device of the class described, the combination of a steam chest, a slide valve, a valve cover, and a spring actuated device for forcing the valve cover toward the valve.

11. In a device of the class described, the combination of a valve and a valve cover, said valve being provided with a groove, a packing device in said groove comprising a body portion and ribs, said ribs being designed to engage the valve cover, and said parts being so arranged that an outward movement of said body portion relative to the valve will seal the space between the packing device and the sides of the groove.

Des Moines, Iowa, April 19, 1909.

WILLIAM F. GOULD.

Witnesses:
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M. B. GOLDIZEN.