June 24, 1930. A. BOYNTON 1,767,202

STAGE LIFT FLOWING DEVICE

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Fig. 1.

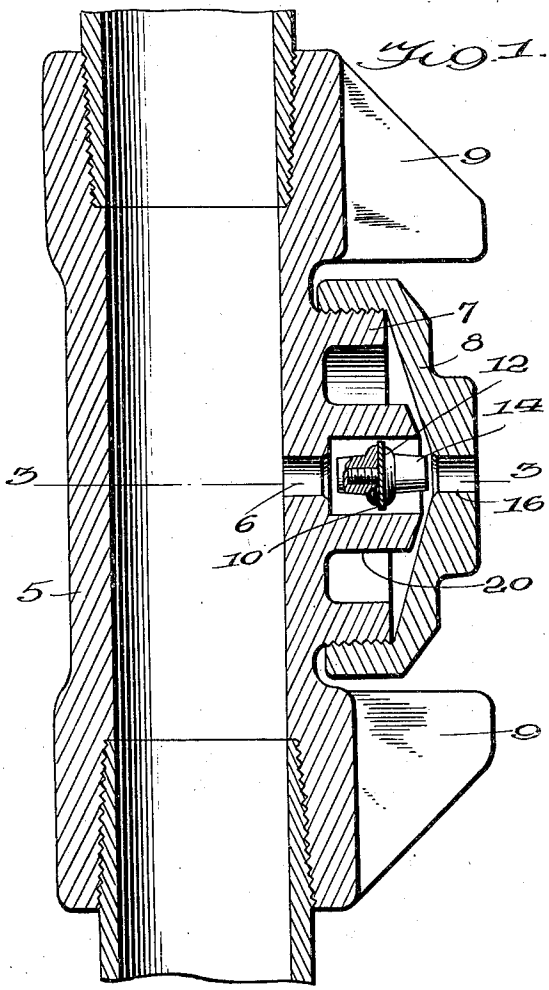


Fig. 2.

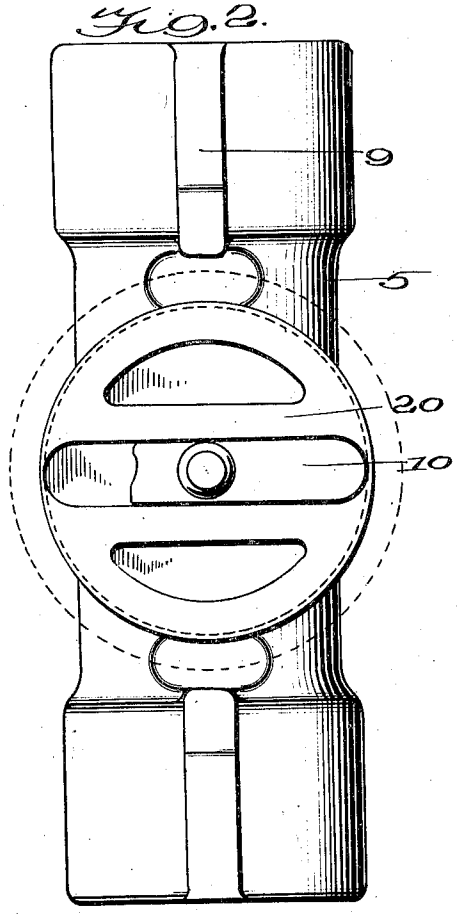


Fig. 3.

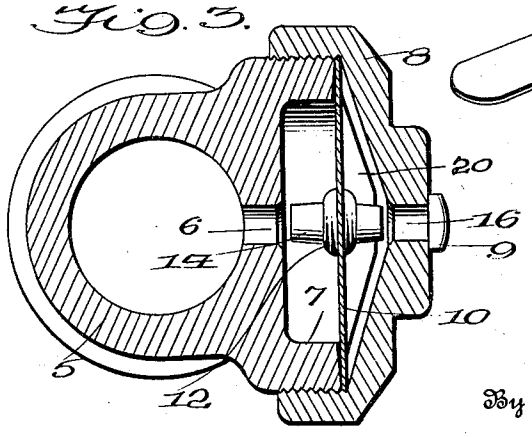
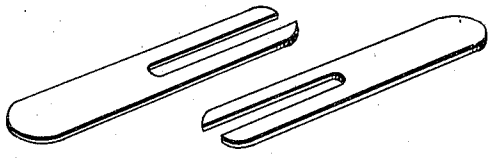


Fig. 4.



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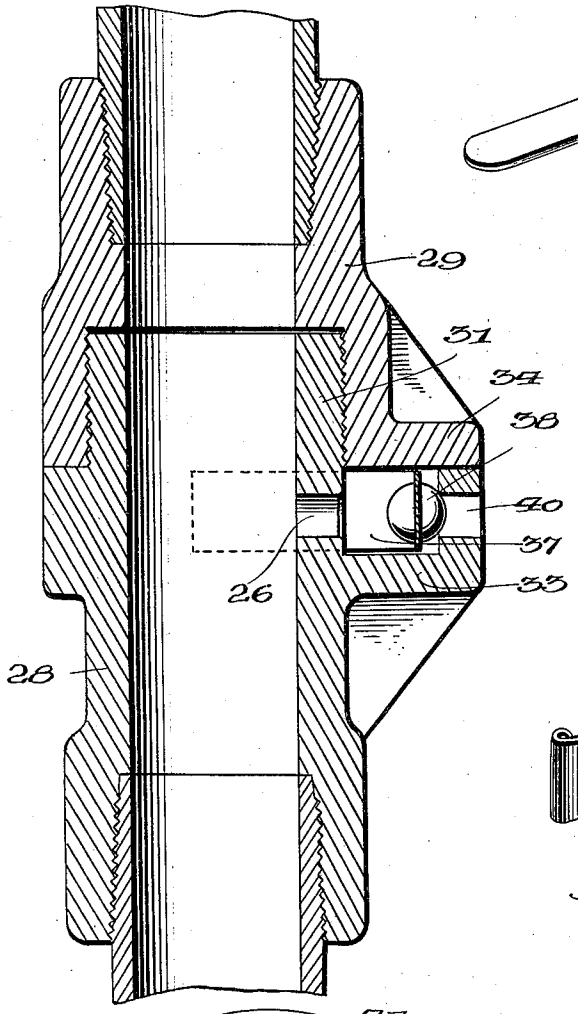


Fig. 6.

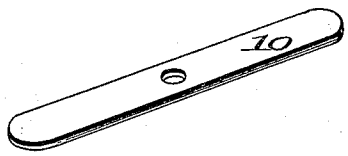


Fig. 5.

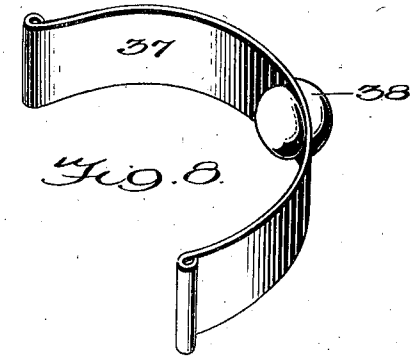


Fig. 8.

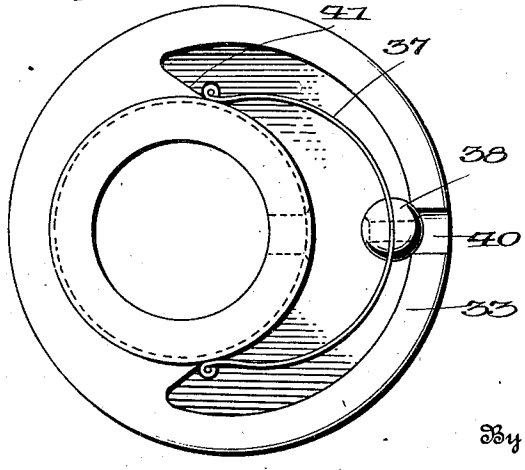


Fig. 7.

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UNITED STATES PATENT OFFICE

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STAGE-LIFT FLOWING DEVICE

Application filed May 6, 1927. Serial No. 189,306.

This invention relates to automatic stage lift flowing devices especially adapted for use in wells and an important object is to provide for the automatic supply of a lifting medium, such as compressed air or gas, to the column of oil or other liquid to be lifted at the periods and in the volume calculated to flow the well in the most economical and expeditious manner.

More specifically an important object is to provide a novel form of induction valve by which the rate of admission of a lifting medium to the column of fluid to be lifted is increased when a low differential obtains between the pressures of the tubing and casing fluids and is diminished or cut off when a high differential obtains between the pressures of the tubing and casing fluids.

Another and equally important object is to provide an induction valve having means by which the well may be flowed either through the tubing or the casing in an efficient manner.

Other objects and advantages will be apparent during the course of the following description.

In the accompanying drawings forming a part of this application and in which like numerals are employed to designate like parts through the same,

Figure 1 is a vertical sectional view through the improved stage lift flowing device applied,

Figure 2 is a side elevation of the same, the housing cap being removed,

Figure 3 is a horizontal sectional view taken on line 3—3 of Figure 1,

Figure 4 is a perspective of a sectional spring embodied in the invention,

Figure 5 is a perspective of a one piece spring which may be employed,

Figure 6 is a vertical sectional view illustrating a modification of the invention,

Figure 7 is an end view illustrating one of the sections shown in Figure 6, the illustrated section being shown with a valve and a pressure responsive spring,

Figure 8 is a perspective of the pressure responsive spring and a valve carried thereby.

In the drawing the numeral 5 designates a body having suitable means at the ends thereof by which the same may be incorporated in a well tubing. The intermediate portion of the body is provided with a two-way port 6 for the passage of a fluid lifting medium such as compressed air or gas. The compressed air or gas may be taken from an outside source if gas is not available in the well being flowed.

In carrying out the invention the body is provided with a valve housing consisting principally of an annular boss 7 and a cap 8, the cap being threaded in place and protected by triangular projections 9 by which the device is prevented from hanging on the joints of the casing. The terminals of the projections extend beyond the plane of the outer surface of the cap so that the cap is constantly spaced from contact with the casing.

Figure 3 illustrates that the opposed surfaces of the boss 7 and the cap 8 are beveled to allow of the flexing of a leaf spring 10, the extremities of which are clamped between the boss and the cap. The intermediate portion of the spring 10 is provided with a double acting double headed valve element 12 having stems or plungers 14 adapted to control the movement of a lifting fluid, such as compressed air or gas, through the port 6 and a port 16 in the cap. The stems 14 are shown to be tapered slightly toward the outer ends thereof and adapted to enter the ports with which the same are associated to regulate the effective cross sectional areas of the same. When the heads of the valve elements 12 are engaged with the inner ends of the ports the flow of lifting fluid is entirely cut off.

The leaf spring 10 is confined between a pair of parallel ribs 20, the ends of which join the boss 7 so that the lifting fluid, be it compressed air or gas, must pass between the edges of the leaf spring and the opposed walls of the ribs 20 in order to be discharged through one of the ports. Thus it is that the spring 20 is within the zone of influence of the tubing and casing pressures

and it will be observed that the ribs extend sufficiently beyond the normal position of the spring to at all times cooperate with the edges of the spring in defining passages for the conduct of the lifting fluid from one port to the other.

The double acting valve element may be made in two sections, one of which is provided with a threaded extension extending through the leaf spring and secured in the other section as suggested in Figure 1.

As shown in Figure 4 a number of leaves may be employed to make up the spring which carries the valve element and in that case the leaves are oppositely slotted to straddle the intermediate portion of the valve element.

In the form of invention illustrated in Figures 6 to 8 inclusive the body of the device is made in two separate sections 28 and 29, the section 28 being provided with a threaded extension 31 secured in a counter bore in the section 29.

Figures 6 and 7 illustrates that the meeting portions of the sections 28 and 29 are provided with arcuate flanges 33 and 34 and that the flange 33 is provided with an arcuate or crescent shaped chamber for the reception of an arcuate spring 37 upon which a more or less spherical valve element 38 is secured.

Particular attention is directed to Figure 7 which illustrates that the valve element 38 is disposed between and is in line with the port 26 and a second port 40 so that the valve element may assume an operative position with respect to either of these ports. In this connection it is pointed out that when the well is to be flowed through the tubing the spring 7 is manually bent so that the rolled ends of the same will be engaged with the tangentially extending cam surfaces 41 of the valve chamber. With the spring 37 thus adjusted the ball 38 is normally away from the port 26 to allow of the admission of a lifting fluid, such as compressed air or gas, to the tubing. When a low pressure differential obtains between the tubing and casing fluids the compressed air may enter the crescent shaped valve chamber from the casing by way of the port 40 and discharge into the tubing by way of the port 26. When the pressure of the fluid in the tubing drops as a result of the ascent of oil or other liquid being flowed the valve element 38 will be drawn in the direction of the port 26 to partly or completely close the same.

It is important to note that the compressed air or gas previous to entering the tubing must pass about the edges of the bowed spring 37. Thus it is that the spring is at all times within the zone of influence of the varying tubing and casing fluids.

If the well is to be flowed through the casing the spring 37 is bent outwardly so that the rolled ends of the same are engaged with the curved outer wall of the crescent shaped valve chamber. When the spring is thus bent the valve 38 is normally spaced from the port 40 and is engaged therewith only as the result of a predetermined drop in the pressure of the casing fluid. When a low pressure differential obtains the valve 38 will be spaced from the port 40 to allow of the discharge of a fluid lifting medium into the casing from the tubing. It is believed to be obvious that when the well is being flowed through the casing the spring 37 will be within the zone of influence of the varying pressure differentials in exactly the same manner as when the well is being flowed through the tubing.

Having thus described the invention, what is claimed is:

1. A valve comprising a body having a housing provided with separate two-way ports and a valve chamber, a leaf spring within said valve chamber and having the intermediate portion thereof provided with a double acting valve element adapted to control said separate two-way ports, said chamber being provided with spaced internal ribs adjacent the edges of said spring and cooperating therewith in the formation of passages establishing communication between said ports.

2. A valve comprising a body having a housing consisting of an annular boss and a cap having opposed beveled portions, a leaf spring confined between said opposed beveled portions and having a valve element, said body being provided with a port controlled by said valve element, said housing being provided with spaced internal ribs adjacent the edges of said spring and cooperating therewith in the formation of a fluid passage.

3. A valve comprising a body having a port and a housing, a leaf spring secured within said housing and consisting of oppositely slotted leaves, and a valve element extending through the slotted portions of said leaves and adapted to control said port.

In testimony whereof I affix my signature.

ALEXANDER BOYNTON.