June 24, 1930. A. BOYNTON 1,768,110

STAGE LIFT FLOWING DEVICE

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Fig. 1.

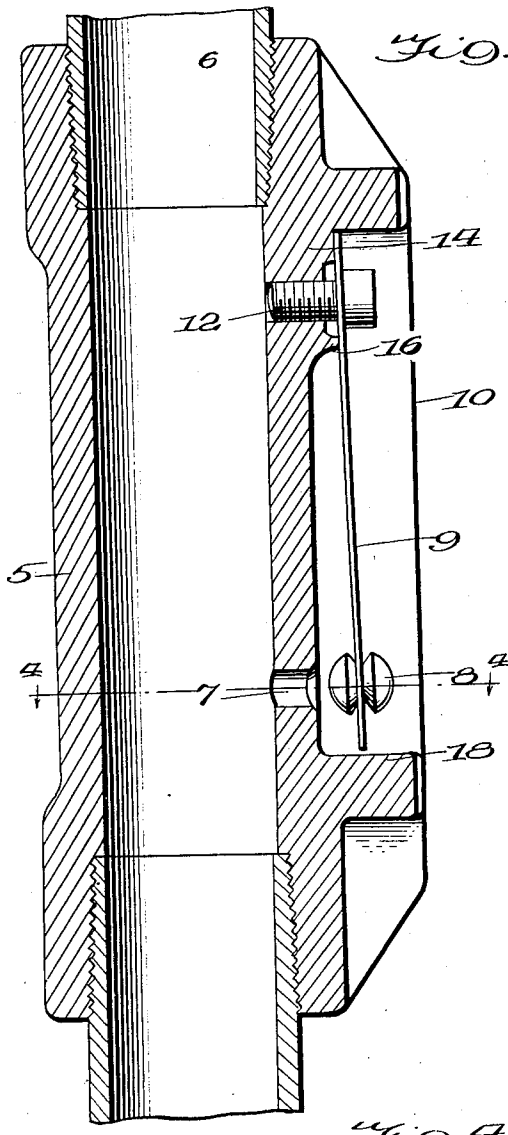


Fig. 2.

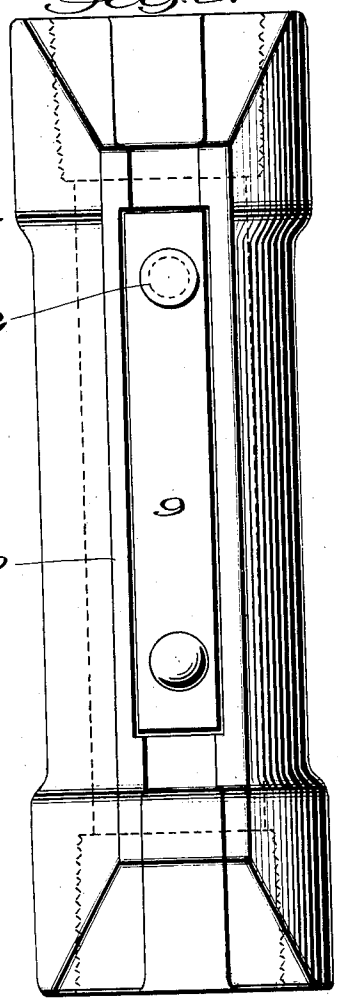


Fig. 3.

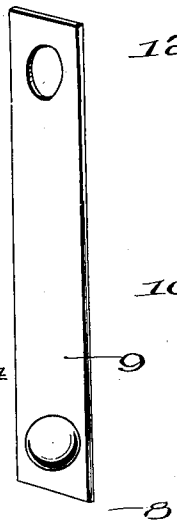


Fig. 4.

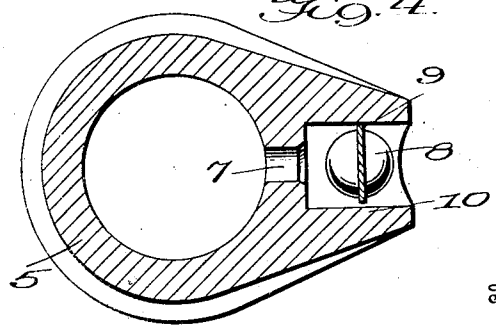
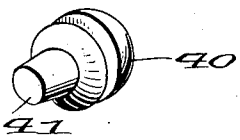


Fig. 5.



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Fig. 6.

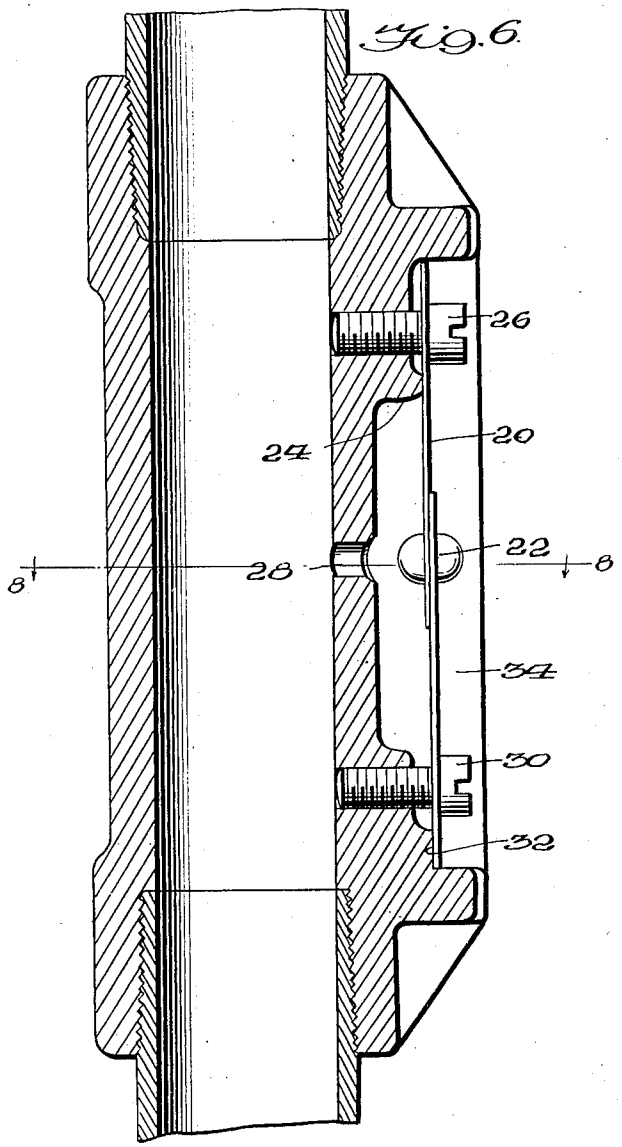


Fig. 7.

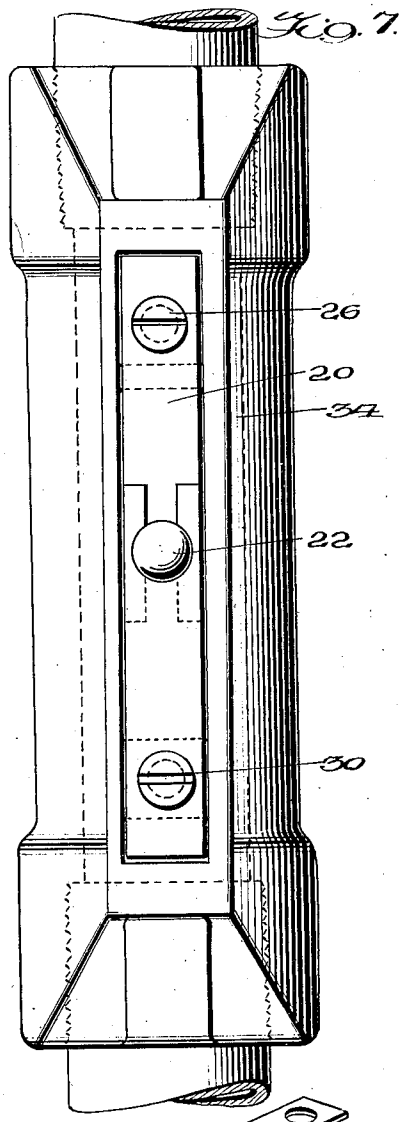


Fig. 8.

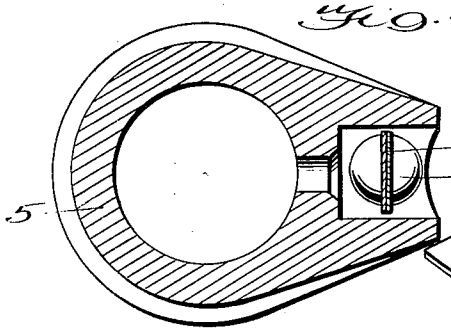
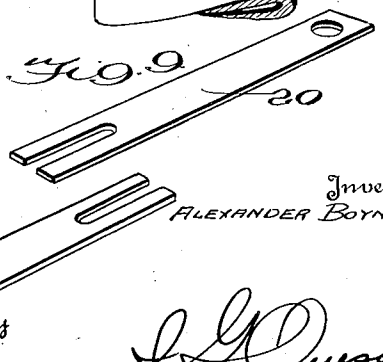


Fig. 9.



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UNITED STATES PATENT OFFICE

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STAGE-LIFT FLOWING DEVICE

Application filed May 6, 1927. Serial No. 189,304.

This invention relates to stage lift flowing devices especially adapted for use in wells and contemplates the utilization of the varying differentials obtaining between the pressures of the tubing and casing fluids to bring about the introduction of a lifting medium, such as compressed air or gas, into the column of oil or other product of the well at the most advantageous periods.

An important object is to provide a stage lift flowing device having simple means to admit an increased volume of lifting medium to the tubing when a low pressure differential obtains between the fluids interiorly and exteriorly of the tubing and to reduce and possibly cut off the admission of lifting medium to the tubing as a result of a drop in the pressure of the tubing fluid with respect to the pressure exteriorly of the tubing, this latter condition prevailing as a result of the movement of the oil or other product of the well.

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

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

Figure 1 is a vertical sectional view through the improved induction valve incorporated in a tubing,

Figure 2 is a side elevation of the same, the view being taken at right angles to Figure 1,

Figure 3 is a perspective of a spring and valve embodied in the invention,

Figure 4 is a horizontal sectional view taken on line 4—4 of Figure 1,

Figure 5 is a detail sectional view illustrating a different form of valve,

Figure 6 is a vertical sectional view through a modification of the invention, a portion of the tubing being illustrated,

Figure 7 is a side elevation of the induction valve illustrated in Figure 6,

Figure 8 is a horizontal sectional view taken on line 8—8 of Figure 6,

Figure 9 is a group perspective of a sectional spring embodied in the invention.

In the drawing the numeral 5 designates the body of the improved induction valve and the ends of the body are provided with suitable means such as internal screw threads by which the device may be incorporated in a tubing. Since it is well known that stage lift flowing devices are incorporated in the tubing at spaced points no illustration of this appears.

In carrying out the invention the body 5 is provided in one side thereof with an inlet passage 7 for the admission of a lifting fluid from the casing. This lifting fluid may be in the nature of gas from the well being flowed or compressed air or gas from an outside source.

The inlet passage 7 has the outer end thereof provided with a seat adapted to be engaged by a valve 8 on the free end portion of a leaf spring 9. Figures 2 and 4 clearly illustrate that the leaf spring 9 is confined between a pair of spaced parallel longitudinally extending ribs 10 by which the leaf spring is guided and is held within the zone of influence of the varying pressures interiorly and exteriorly of the tubing. However, there is sufficient space between the edges of the leaf spring 9 and the opposed walls of the ribs 10 to permit of the admission of a lifting medium by way of the passage 7 when a low differential obtains between the pressures of the tubing and casing fluids.

The upper portion of the leaf spring 9 is apertured for the reception of the shank of an attaching and tensioning screw 12. The tensioning screw 12 is clearly shown in Figure 1 to be connected to the body 5 and holds the spring in engagement with a transverse shoulder 14 and a heel 16. Tightening of the screw will move the major portion of the spring 9 and the valve carried thereby outwardly so a greater pressure differential is required to move the valve in the direction of or into engagement with the seat thereof. On the other hand, loosening of the screw will render the leaf spring and the valve carried thereby more responsive. Figure 1 illustrates that the lower end of the groove defined by the parallel ribs 10 is closed by a transverse rib 18 so that the major movement of the

lifting medium is about the edges of the leaf spring.

In the form of invention illustrated in Figures 6 to 9 inclusive the leaf spring consists of a pair of sections 20 having overlapping terminals longitudinally bifurcated to define pairs of branches received in the annular groove in a more or less spherical valve 22.

The upper section of the leaf spring is extended across a heel 24 and is engaged by a tensioning screw 26 through the medium of which the upper section may be caused to urge the valve 22 outwardly to unseated position. Clearly, when the tensioning screw 26 is tightened the lower portion of the sectional spring will be urged outwardly so that a high pressure differential is required to engage the valve with the seat at the outer end of an inlet port 28.

The lower section of the leaf spring is engaged by a tensioning screw 30 and by a transverse shoulder or base portion 32. Since the tensioning screw 30 is located between the valve 22 and the transverse shoulder 32 tightening of the tensioning screw will urge the valve in the direction of its seat so that the same is rendered more responsive to the pressures interiorly and exteriorly of the tubing. In preparing the improved induction valve for use the screws 26 and 30 are adjusted to cause the valve 22 to operate at the proper pressure differentials.

The sections of the leaf spring operate between spaced parallel longitudinally extending reenforcing ribs 34 so that the sections of the spring are constantly within the zone of influence of the tubing and casing pressures. Sufficient space is allowed between the edges of the spring and the opposed side walls of the ribs 34 to allow of the admission of a lifting medium in sufficient volume to flow the well.

Figure 5 illustrates that the valve which in this figure is designated by the numeral 40 may be provided with a tapered stem or plunger 41 adapted to enter the inlet port or passage 7 to diminish the volume of lifting fluid, such as compressed air or gas, when the pressure within the tubing drops below a predetermined point with respect to the pressure obtaining in the casing as a result of the flow of the oil or the like in the tubing.

In practice the springs carrying the valves will hold the valves in unseated position when a low differential obtains between the tubing and casing fluids. When the valve is thus positioned, compressed air or gas, may enter the tubing from the casing to bring about the ascent of the oil or other product of the well. When the oil is thus caused to flow the pressure within the tubing will drop with respect to the pressure within the casing and the valve will be moved in the direction of its seat to curtail and possibly cut off the supply of compressed air or gas to the tubing.

The reduction and possible cessation of the supply of lifting fluid to the tubing will allow a pressure to be again built up within the tubing. The return of the pressure within the tubing will bring about a low pressure differential between the tubing and casing fluids so that the spring may return the valve to unseated position and the supply of lifting fluid is resumed.

With reference to the foregoing description taken in connection with the accompanying drawing it will be seen that the lifting fluid, such as compressed air or gas, is supplied to the tubing during the periods when it may be most advantageously employed and in the volume calculated to allow the oil or other fluid to flow so far as is possible without air from an outside source whereby the supply of compressed air or gas is conserved.

The improved induction valve and especially the one illustrated in Figures 6 to 8 inclusive may be placed either end up in the tubing whereby the installation of the invention is greatly simplified.

Having thus described the invention, what is claimed is:

1. An induction valve comprising a body having a port for the admission of a lifting medium, a spring consisting of a pair of separate sections having overlapping portions, a valve carried by said overlapping portions, separate tensioning devices for said sections, said body being provided with a recess receiving said spring and having walls spaced from said spring and cooperating therewith in the formation of a passage for a fluid lifting medium.

2. An induction valve comprising a body having a port for the passage of a fluid lifting medium, a valve controlling said passage, a leaf spring having sections connected to said valve, and tensioning devices for tensioning said sections in opposite directions.

3. An induction valve comprising a body having a port for the passage of a fluid lifting medium, a valve controlling said port, a leaf spring having separate sections connected to said valve, tensioning devices for tensioning said sections in opposite directions, said body being provided with longitudinal ribs and end members defining a recess receiving said spring and said valve to protect the same.

4. An induction valve comprising a body having a port, a valve for controlling said port and having a groove, a leaf spring having separate straight sections provided with overlapping bifurcated terminal portions defining branches received in said groove, and attaching devices for said sections.

In testimony whereof I affix my signature.

ALEXANDER BOYNTON.