

Jan. 15, 1929.

1,699,227

W. N. CRADDOCK

AUTOMATIC FLOW BEAN

Filed Sept. 27, 1926

2 Sheets-Sheet 1

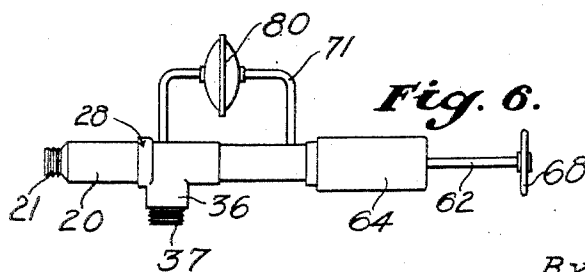
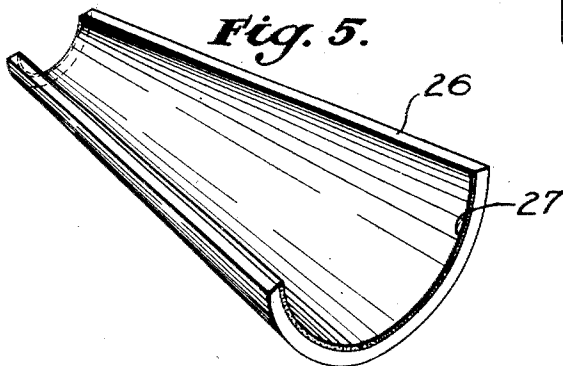
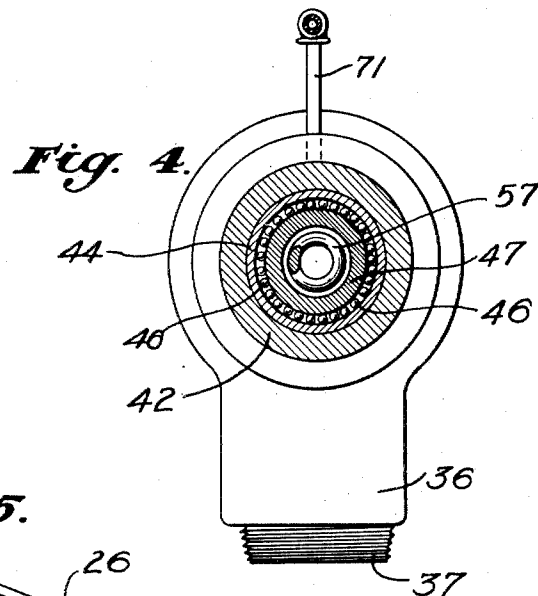
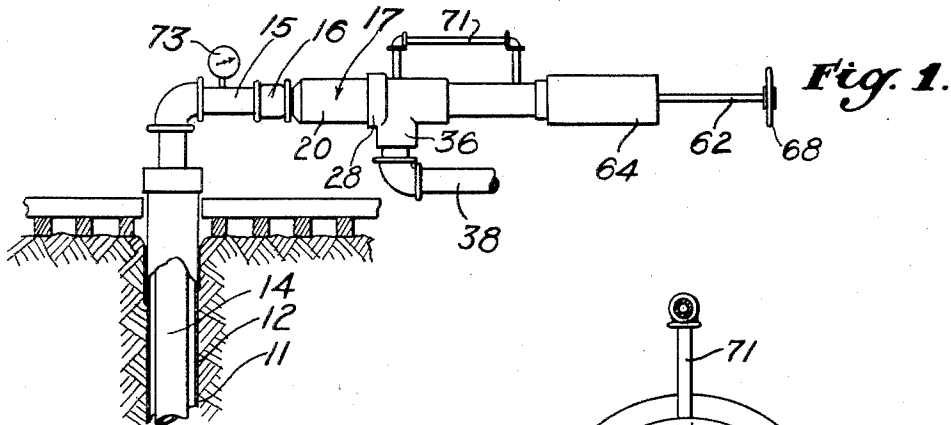


Fig. 6.

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2 Sheets-Sheet 2

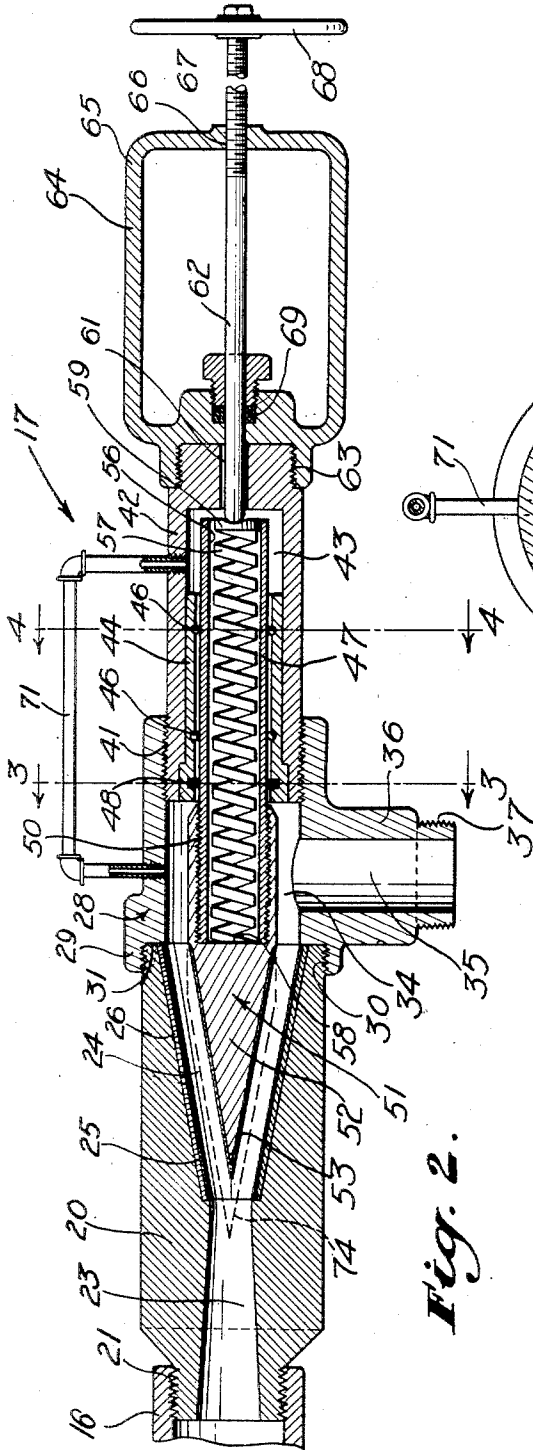


Fig. 2.

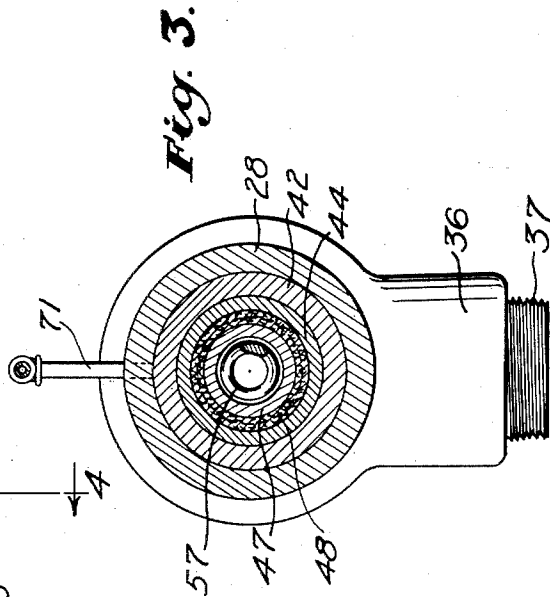


Fig. 3.

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UNITED STATES PATENT OFFICE.

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AUTOMATIC FLOW BEAN.

Application filed September 27, 1926. Serial No. 137,959.

My invention relates to oil wells and particularly to wells which flow naturally under considerable pressure.

It has been found that if a natural flowing well in fields that produce from soft and unconsolidated oil sands is allowed to flow freely and unrestrained, the oil bearing formations may enter the hole and prevent the oil from flowing. The sanding up occurs because the excessive speed at which the oil and gas mixed therewith enters the well, causes the fluids to carry large quantities of sand and mud into the well. When the well is partly plugged in this manner or the oil bearing formations are sealed to any extent, it is difficult and expensive, as well as hazardous, to conduct work that will cause the well to produce again. Also the presence of sand in flowing oil results in rapid wear of flow tubing, valves, fittings and flow lines, with the result that they must be watched carefully and replaced else oil and gas be wasted or even control of the well lost. It has been demonstrated that if the natural flowing pressure of the well is partially restrained and the oil is not allowed to flow too rapidly because of high pressure in the well, such sanding up can be prevented. For the purpose of choking back the oil so as to maintain a pressure but still allow a flow of oil, it is common practice to locate a "flow nipple" in the oil line at the surface of the ground. The ordinary flow nipple consists of a bar of steel having a small orifice therethrough which holds back the oil and builds up a pressure in the well and allows only a small amount of oil to flow.

Best results are obtained when the well pressure is maintained at some predetermined but substantially uniform level. When the ordinary flow nipple is used, the pressure varies. This is because oil, mixtures of oil and gas and gas alone, all have different viscosities and therefore, coefficients of fluid friction. When oil is flowing through the orifice of the flow nipple, the rate of flow may be comparatively slow. When a mixture of oil and gas flows through the orifice of the flow nipple, the rate of flow will be greater than when oil alone flows through a similar orifice because the viscosity of the mixture is lower than that of oil and therefore the coefficient of fluid

friction is less. When gas by itself is flowing through the orifice of the flow nipple, the rate of flow will be very great because the coefficient of friction is very low. The difference in rate of flow increases or decreases the pressure in the well accordingly, and consequently the pressure is not maintained substantially uniform.

It is an important object of this invention to provide a flow nipple or flow bean of such character that will automatically maintain the pressure in a well substantially uniform.

The flow bean of my invention has a valve which may be adjusted into a certain position. The position of this valve depends upon the coefficient of friction of the fluid passing through the bean and the pressure it is desired to hold in the well. When the fluid passing through the bean has a high coefficient of friction the valve will be forced outward so that the passage will be quite large, and as a fluid having a lower coefficient of friction passes through the bean, the valve will move inward so as to restrict the passage.

It is accordingly one of the objects of this invention to provide a flow bean in which the position of the valve depends on the viscosity and therefore coefficient of fluid friction of the fluids passing there-through.

The flow bean of this invention has a means for resiliently holding the valve in position against the frictional pressure of the fluid passing through the bean. The resilient means and associated parts are located in a chamber adjacent to the fluid passage. Sand which is often carried in the oil in appreciable quantities tends to enter the chamber in which the resilient means and associated mechanism are located and thus to stick the movable parts of the bean, rendering its automatic features inoperative.

It is accordingly an object of this invention to provide a flow bean having an equalizing means for preventing sand from entering the chamber containing the movable parts of the bean.

It is another object of the invention to provide a flow bean in which the parts which are subjected to wear may be readily removed for replacement.

Other objects and advantages of the invention will be made evident hereinafter.

Referring to the drawings in which I illustrate the invention,

Fig. 1 is a diagrammatic view illustrating the utility of the flow bean of my invention.

Fig. 2 is an enlarged fragmentary section taken through the flow bean shown in Fig. 1.

Fig. 3 is a section taken on the line 3—3 of Fig. 2.

Fig. 4 is a section taken on the line 4—4 of Fig. 2.

Fig. 5 is an enlarged perspective view showing a removable liner of the invention.

Fig. 6 is a small elevational view showing an alternative form of the invention.

Referring to Fig. 1, the numeral 11 represents a well into which a casing 12 is extended. An oil flow tube 14 is extended to the lower end of the well 11 through the casing 12. The upper end of the oil flow tube 14 has a horizontal portion 15 which is connected by a coupling 16 to a flow bean 17 embodying the features of this invention.

Referring now to Figs. 2 to 4 inclusive, the flow bean 17 has a body 20 which is provided with a threaded extension 21 which is screwed into the coupling 16. Formed through the body 20 is an oil inlet passage 23 having a mouth 24. The mouth 24 is surrounded by an annular conical channel 25. This chamber may or may not be lined with separate liners 26 depending on the character of the well to be controlled. The liners 26, as shown clearly in Fig. 5, are semi-cylindrical in cross section and are tapered. The inner faces of the liners 26 may be coated with a very hard metal as indicated at 27 to resist wear by sand. I prefer to coat the liners 26 with stellite or other extremely hard metal. Stellite, if used, may be applied by means of a welding torch, the coating 27 being rendered smooth by grinding after it has been applied.

Positioned adjacent to the body 20 is a central shell 28 having an annular flange 29 which is internally threaded so that it may be screwed onto the right end of the body 20 as indicated at 30. At the inner end of the flange 29 is a shoulder 31 which engages the ends of the liners 26, clamping them tightly in place. The shell 28 has a chamber 34 which is connected to the mouth 24 and an outlet passage 35 which is connected to the chamber 34. The outlet passage 35 is formed through a cylindrical projection 36 which is threaded at 37 so that a pipe 38 (Fig. 1) may be attached thereto. The right end of the central shell 28 is internally threaded at 41 so that the left end of an end shell 42 may be screwed thereinto. The end shell 42 has a cavity 43 into which a bearing container 44 is pressed.

The bearing container 44 has ball bearings 46 which support a containing member in the form of a tube 47. A packing 48 is sup-

ported at the left end of the bearing container 44 for providing a seal around the tube 47. The left end of the tube 47 is threadedly secured in a cavity 50 provided at the right end of a valve 51. The left end 52 of the valve 51 extends into the mouth 24 of the body 20 and is conical as shown. The left end 52 of the valve 51 is provided with a metallic coat 53 which is formed of stellite which is welded in place, being ground true after it has been applied. Located in a spring chamber 56 provided by the tube 47 is a spring 57, which constitutes a resilient means for holding the valve 51 in proper position. The left end of the spring 57 engages the face 58 of the valve 51 and the right end of the spring 57 engages a plate 59 placed at the right end of the tube 47. Extending through an opening 61 formed in the right end of the end shell 42 is a stem 62 which engages the plate 59. Threadedly attached at 63 to the right end of the end shell 42 is a stem support frame 64. The stem support frame 64 has a yoke 65 which extends out from the end shell 42 and provides a threaded opening 66 through which a threaded portion of the valve stem 62 extends. A hand wheel 68 is attached to the outer end of the stem 62 for operating it. A tight seal is formed around the stem 62 where it extends from the cavity 43 by means of a stuffing box 69.

An equalizing tube 71 is connected to the central shell 28 in communication with the chamber 34 and is connected to the end shell 42 in communication with the right end of the cavity 43.

The operation of the form of my invention just described is substantially as follows. The valve 51 is adjusted to the right or to the left so as to obtain the desired pressure in the well, this pressure being ascertained by any suitable pressure indicating device such as a pressure gauge 73 shown in Fig. 1. It should be noted that the valve 51 is resiliently held in all positions by the spring 57. When oil without any gas present therein is flowing through the flow bean, the valve 51 will be retained in the position shown in full lines in Fig. 2. The valve 51 is held in this position against the action of the spring 57 by the frictional pressure applied to the conical face of the valve by the fluid. If a surge of gas flows through the oil flow tube 14 and into the flow bean 17, the valve 51 will automatically move from the position shown in full lines in Fig. 2 into the position indicated by dotted lines 74. This is because of the fact that the coefficient of friction of gas is much lower than the coefficient of friction of oil; consequently, the frictional pressure on the valve 51 is much lower and the compressive force against the spring 57 is also lower. For these reasons, the valve 51 will move

leftward from full line position into the dotted line position. When a mixture of oil and gas is flowing from the flow bean 17 the valve 51 will occupy a position somewhere between those positions indicated in Fig. 2.

As pointed out in the first part of this specification, the important object of the invention is to provide a flow bean in which the pressure in the well is maintained substantially uniform. It has been demonstrated in actual practice that there is danger in choking back as well as there is danger in allowing it to flow too freely. It is necessary for the oil to flow at all times so that any sand carried in suspension will not have time to settle in the well of flow tubing. My invention is proof against either a detrimental stopping of the flow of oil or allowing too great a flow of oil. When using the ordinary flow bean, the rate of flow of oil may be very greatly reduced at times so that there is danger of sand settling in the flow tubing; but in my invention the action is different. When a comparatively viscous fluid for example, is flowing through the flow bean at a reduced rate, the frictional pressure on the valve 51 is so great that the valve 51 is forced outward against the action of the spring 57 so that there will be a substantial flow of oil. The maintaining of a uniform flow of oil from the well encourages the oil to flow and increases the flowing life of the well considerably.

The bearing arrangement for supporting the tube 47 is an important part of the invention since it greatly reduces any friction and gives a free action of the valve 51. The means for preventing sand from entering the cavity 43 is also important to the invention. This means includes the packing 48 and also the equalizing pipe 71. The equalizing pipe 71 transfers the pressure in the chamber 34 to the cavity 43. When there is a surge of gas there is a tendency for the pressure in the chamber 34 to increase momentarily. This increase in pressure is immediately transferred to the cavity 43. If the equalizing pipe 71 were not provided any sand present in the chamber 34 could be forced through the packing 48 into the bearings 46. It is obvious that this would be detrimental to a perfect operation of the valve 51 since it would be encumbered by a faulty operation of the bearings 46.

In Fig. 6, I show a form of my invention which includes a diaphragm box 80 in the equalizing tube 71. With this arrangement the cavity 43 is filled with a heavy smooth oil. When the pressure in the chamber 34 increases, the diaphragm box 80 is operated so that the pressure of the oil in the cavity 43 is increased to the same pressure as is present in the chamber 34. With the ar-

range shown in Fig. 6 there is no possibility of any sand passing through the equalizing tube 71.

The invention is adapted for use on wells which discharge only gas, and in such use will operate substantially as described.

The spring 57 is only one means which may be used for governing the position of the valve 51. A lever arrangement or hydraulic means may also be used.

I claim as my invention:

1. In a flow bean the combination of: walls forming a mouth through which fluid under pressure passes; removable liners surrounding said mouth; a valve in said mouth adapted to restrict the passage of fluid therethrough; a containing member extending from said valve; a spring enclosed by said containing member for urging said valve into said mouth against the frictional pressure of said fluid; and means for regulating the force applied on said valve by said spring.

2. In a flow bean the combination of: walls forming a mouth through which fluid under pressure passes; removable liners surrounding said mouth; a valve in said mouth adapted to restrict the passage of fluid therethrough; a containing member extending from said valve; walls forming a cavity connected to said mouth and an outlet, said containing member being located in said cavity; bearings for supporting said containing member; a spring enclosed by said containing member for urging said valve into said mouth against the frictional pressure of said fluid; and means for regulating the force applied on said valve by said spring.

3. In a flow bean the combination of: walls forming a mouth through which fluid under pressure passes; a valve in said mouth adapted to restrict the passage of fluid therethrough; a containing member extending from said valve; walls forming a cavity connected to said mouth and an outlet, said containing member being located in said cavity; bearings for supporting said containing member; packing providing a seal at the inner end of said containing member; an equalizing tube connecting said mouth and the remote part of said cavity; a spring enclosed by said containing member for urging said valve into said mouth against the frictional pressure of said fluid; and means for regulating the force applied on said valve by said spring.

4. In a flow bean the combination of: walls forming a mouth through which fluid under pressure passes; removable liners surrounding said mouth; a valve in said mouth adapted to restrict the passage of fluid therethrough; a containing member extending from said valve; walls forming a cavity connected to said mouth and an outlet, said containing member being located in said cavity;

bearings for supporting said containing member; packing providing a seal at the inner end of said containing member; an equalizing tube connecting said mouth and the remote part of said cavity; a spring enclosed by said containing member for urging said valve into said mouth against the frictional pressure of said fluid; and means for regulating the force applied on said valve by said spring. 10

In testimony whereof, I have hereunto set my hand at Ventura, California, this 18th day of September, 1926.

WARREN N. CRADDOCK.