Oct. 25, 1938. G. A. HUMASON 2,134,045

WELL FLOWING DEVICE

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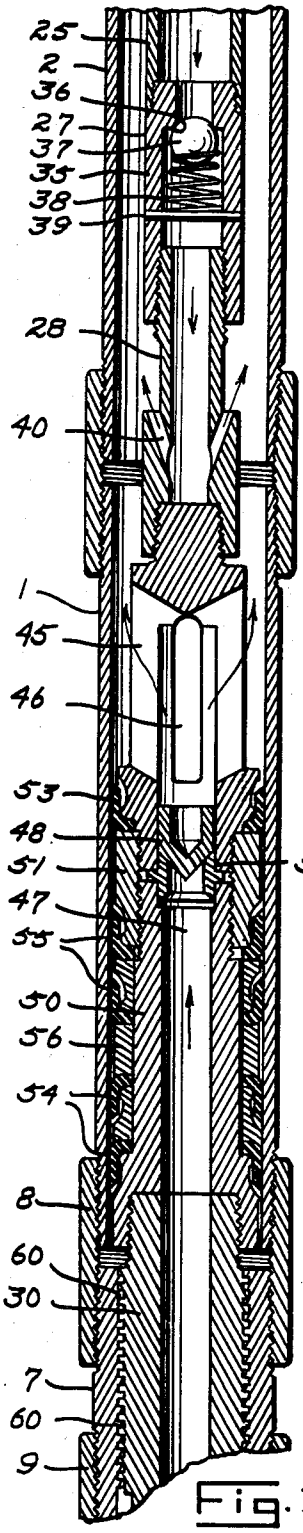


Fig. 1.

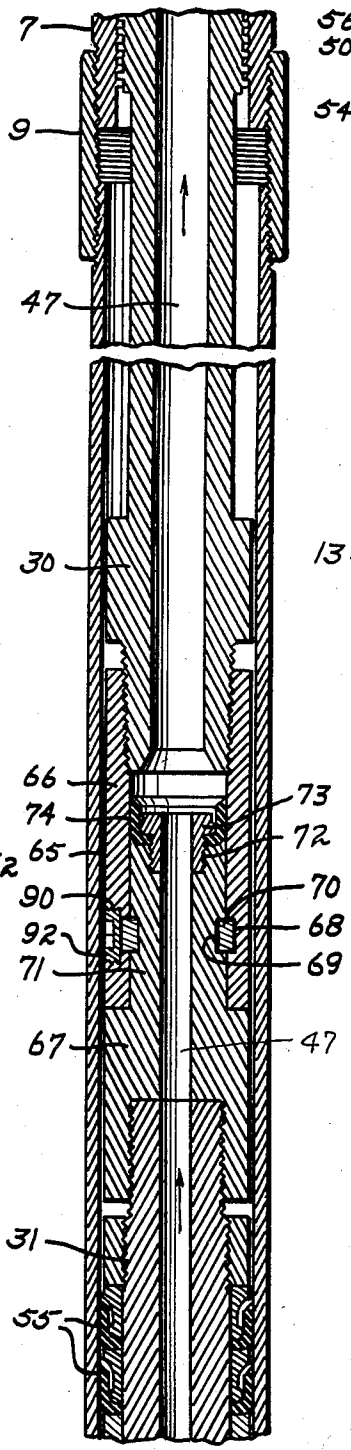


Fig. 2.

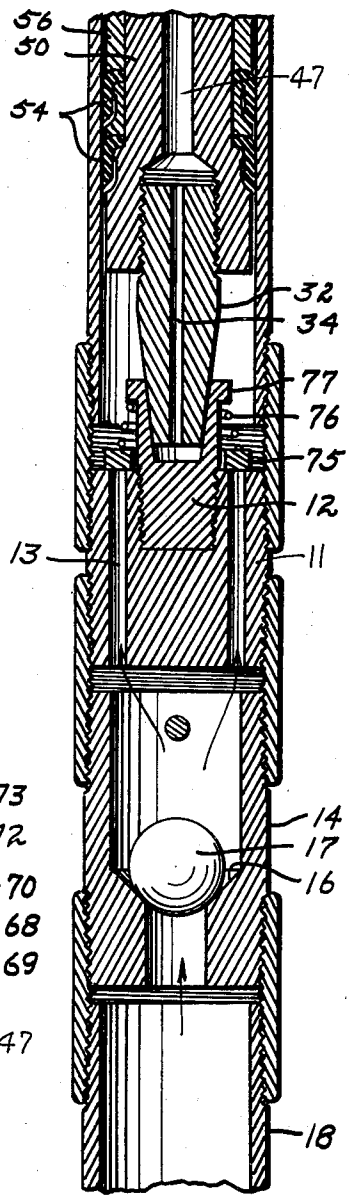


Fig. 3.

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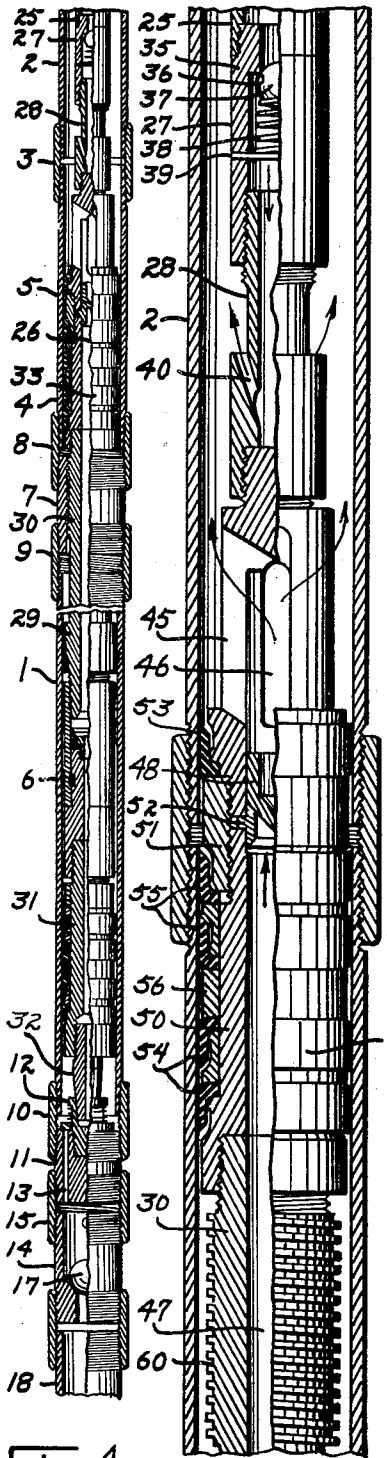


Fig. 4.

Fig. 5

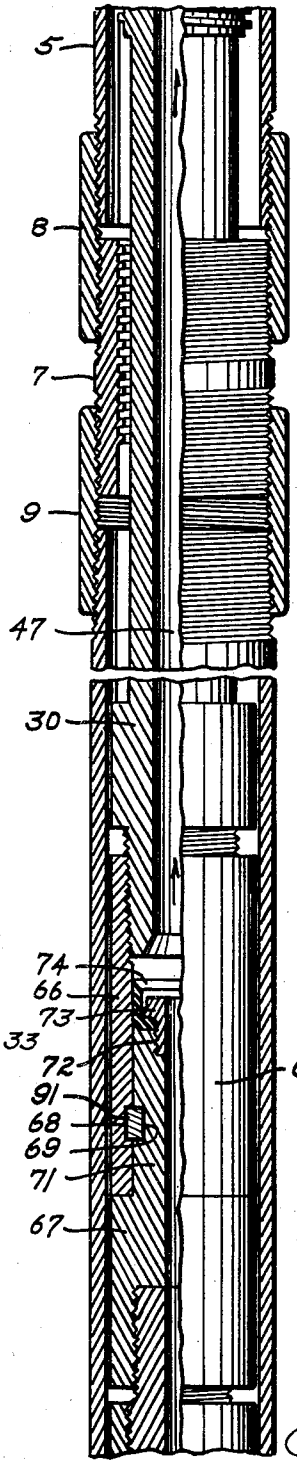


Fig. 6.

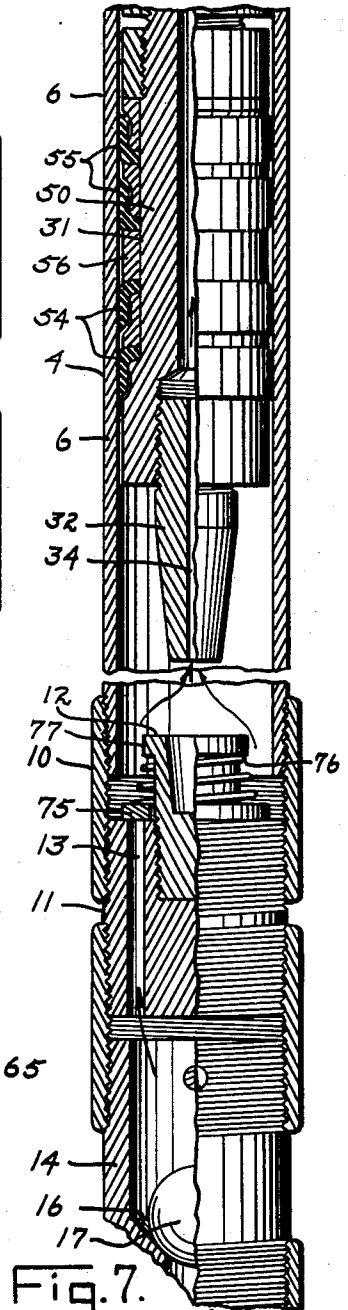


Fig. 7.

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WELL FLOWING DEVICE

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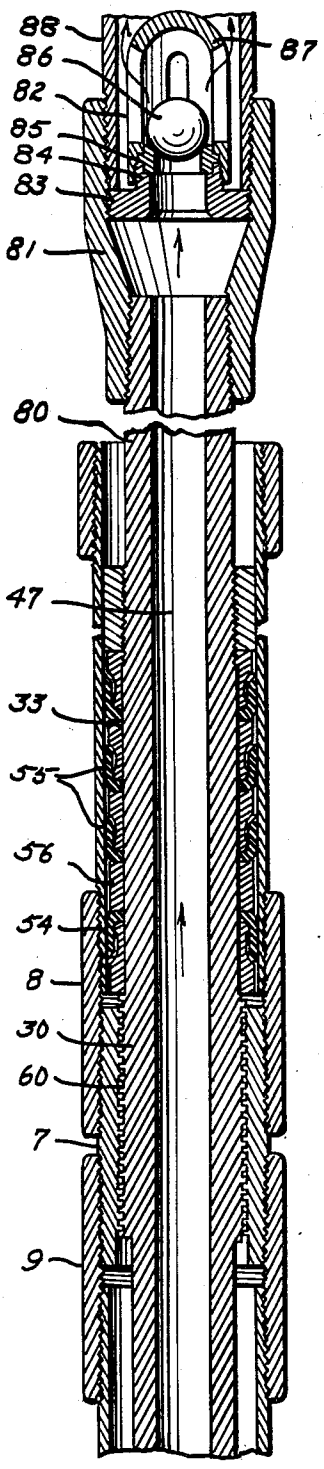


Fig. 8.

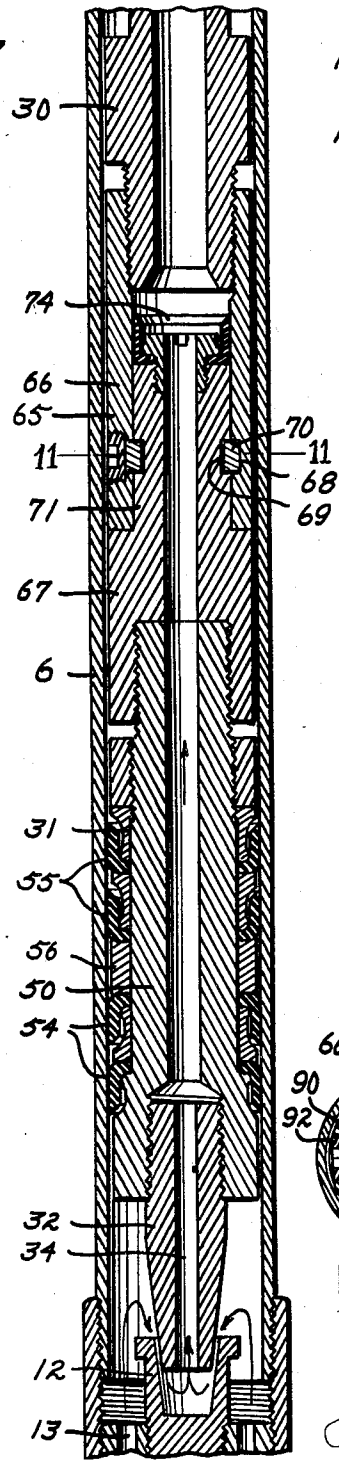


Fig. 9.

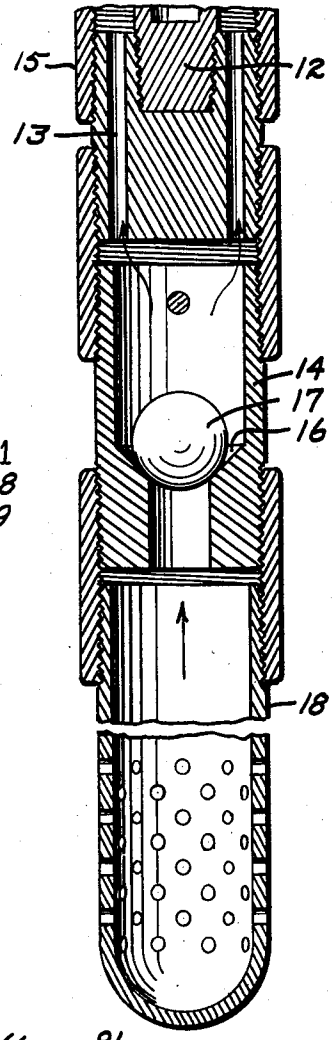


Fig. 10.

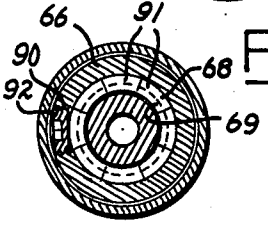


Fig. 11.

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2,134,045

WELL FLOWING DEVICE

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Application July 16, 1937, Serial No. 153,979

8 Claims. (Cl. 103—10)

The invention relates to a well flowing device and more particularly to a device by which a flowing well may be controlled and production thereof continued after the production by natural flow has ceased.

An object of the invention is to provide a device of the class described which will enable an efficient production of fluid from well.

It is an object also to provide a well flowing device that may be utilized as a bottom hole choke.

A further object is to provide a well flowing device in which the elevation of fluid under natural pressure may be supplemented by gas air lift operations.

Still another object is to provide a device of the character described which may be utilized to control the flow of wells under natural pressure and which may thereafter be utilized for production of the well by pumping.

Another object of the invention is to provide a device of the character described in which the moving parts thereof are lubricated by an enclosed oil bath.

Other objects, together with the foregoing, will be apparent from the following description taken in connection with the drawings in which:

Fig. 1 is a longitudinal sectional view showing the upper end of the device comprising the invention.

Fig 2 is a longitudinal sectional view of a central portion of the device and is a continuation of the view shown in Fig. 1.

Fig. 3 is a sectional view showing the lower portion of the device. This view is a continuation of the portion of the device shown in Fig. 2.

Fig. 4 is an elevational view partly in section showing a complete assembly comprising the device of the invention.

Figs. 5, 6 and 7 are sectional views similar to those shown in Figs. 1 to 3 but showing the relative position of parts of the device when operated as a pumping unit.

Figs. 8, 9 and 10 are sectional views similar to Figs. 1, 2 and 3 but showing a modified construction of the device of the invention.

Fig. 11 is a sectional view taken on line 11—11 of Fig. 9.

In Fig. 4 is shown a flow tubing 1 with the parts in relative positions when the device is lowered into a well bore. The part of the flow tubing 1, which extends to the surface and conducts liquid of the well to the surface, is indicated at 2 and is shown as threadably connected to coupling 3. Below coupling 3 and attached thereto is a working barrel generally designated as 4 and which comprises an upper section 5 and a lower section 6, which sections are interconnected by a special nipple 7 through couplings 8 and 9. Attached to the lower end of the working barrel through a coupling 10 is a body 11 which carries a valve seat 12 and has longitudinal openings 13 through which liquid may pass upwardly into the working barrel 4. A valved nipple 14 is threadably secured to the body 11 through coupling 15. Within the nipple 14 is a valve seat 16 upon which a gravity actuated valve member 17 is positioned to permit upward movement of fluid into the device. The tubing string continues downwardly at 18 for any suitable distance into the well bore. It appears obvious that the device may be used for any desired level within the well bore.

If, however, the device is to serve as a bottom hole choke it is obvious that it will be located a material distance below the mouth of the well bore. An operating rod 25 extends downwardly into the operating string 2 and is connected to a composite inner assembly generally designated as 26. This inner assembly 26 comprises a check valve 27, a gas lift connector 28 and a plunger assembly 29 comprising an upper plunger 33 and an interlock body 30 whereby the inner assembly 26 may be secured in fixed position within the working barrel 4 by a threaded engagement with the nipple 7. Continuing below the interlock body 30 are the lower plunger assembly 31 and a valve member 32 which is adapted to seat within the seat 12 in the body member 11 when the inner assembly 26 is screwed downwardly by means of operating rod 25.

Referring now to Figs. 1 to 6 for a more detailed description, it will be noted that the check valve 27 connected to the operating rod 25 comprises valve housing 35 having a downwardly facing valve seat 36 against which ball valve 37 is urged by means of compression spring 38 which is held in position by means of a transverse pin 39 which extends through the walls of the valve housing 35. This construction permits the flow of fluid downwardly under pressure through the operating rod 25. Such fluid passes downwardly into the connector body 28, whence it passes through diagonally upward openings 40 in the connector body into the annular space between the operating rod 25 and the tubing string 2. With this construction fluid lift may be utilized for lifting liquid upwardly from the level of the connector body 28.

A valve body 45 is attached to the connector

body 28 and has radial openings 46 which lead outwardly from the central bore 47 of the plunger assembly 29. Within the valve body 45 is a plunger like valve 48, which is slidable so that liquid rising within the bore 47 will displace the valve upwardly whereby liquid may be discharged through the openings 46. A mandrel 50 is threadably attached to the lower end of the valve body 45 through a collar 51. A flanged ring 52 is clamped between the valve body 45 and the mandrel 50 to provide a seat for the cup-shaped valve 48. At the same time, an upwardly facing valve cup 53 is clamped between the valve body 45 and coupling member 51. In the assembly of the mandrel 50 with the collar 51, two downwardly facing valve cups 54 and two upwardly facing valve cups 55 are placed thereon with intervening clamping rings 56. When the mandrel and the collar are then threadably joined there is formed a composite piston or upper plunger assembly generally designated as 33 which is so constructed as to prevent passage of liquid thereby in either direction. The central bore 47 through the mandrel 50 continues through the interlock body 30, which is provided with coarse peripheral threads 60 to cooperate with complementary internal threads in the nipple 7. When these threads are in engagement it is obvious that the inner assembly 26 is fixed relative to the working barrel 4 except that the inner assembly may be moved upwardly or downwardly by rotating the operating rod 25. While square threads are shown on the interlock body 30 of the nipple 7, it is obvious that other types of threads may be provided. For example, a mutilated thread may be used whereby the inner assembly 26 may be raised or lowered by rotating the operating rod in a fixed direction.

The lower plunger assembly 31 is connected to the interlock body 30 through a swivel connection generally referred to as 65. This swivel connection comprises connector members 66 and 67 which are provided with complementary inner and outer grooves 68 and 69 which receive ring segments 70 in a manner that will be described when referring to Fig. 11. The reduced upper end 71 of the connector 67 is provided with an enlarged bore 72 threaded internally to receive a flange plug 73 which secures packing cup 74 thereon to seal the joint between the connectors 66 and 67 to prevent flow of fluid from within the central bore 47 through the joint in the swivel 65. The opposite ends of the swivel assembly are threadably connected to the bore 30 and lower plunger assembly 31.

The lower plunger assembly 31 is similar to upper plunger assembly 33, and it is believed unnecessary to further describe the assembly to which similar reference characters have been applied.

At the end of the lower plunger assembly 31 is valve member 32 which has a central bore 34 which is coaxial with the bore 47 in the plunger assemblies 31 and 33. The outer surface of this valve member 32 is tapered to engage the inner tapered walls of the valve seat member 12 in the upper end of the body 11. Surrounding the valve seat member 12 is a ring valve 75 normally held in seating position to close the passages 13 by means of compression spring 76, which is retained in position by the flange 77 on the valve seat 32.

Figs. 5, 6 and 7 show the relative positions of the parts of the device just described when the inner assembly has been rotated to release the interlock body 30 from the nipple 7. When the parts are in this position it seems obvious that this inner assembly 26 may be reciprocated through the reciprocation of rod 25 so that the device will operate as a reciprocating pump, the flow of liquid taking the path indicated by the arrows.

In the modification shown in Figs. 8 to 10 the interlock member 30 is provided with an upward extension 80 which serves as a mandrel for the upper plunger assembly 33. A reducing coupling 81 is attached to the upper end of extension 80 and has a cage valve, generally designated as 82, threadably fixed therein. Cage valve 82 comprises a plug portion 83 having an external threaded boss 84 upon which a flange valve seat ring 85 is positioned. A ball valve 86 moves downwardly and engages the seat on ring 85 and permits movement of fluid upwardly through the bore 47 of the plunger assembly 29. Seating ring 85 is secured in place by a cap member 87 which serves as a valve cage. Surrounding the cage valve 82 and secured to the threads within the coupling 81 is the tubing string 88, which serves as a pumping rod and flow line, as will more clearly appear.

The remainder of the modified form of the invention illustrated in Figs. 8 to 10 is identical to that above described when referring to Figs. 1 to 7 and the parts are designated by similar reference characters.

In Fig. 11 is shown a cross-sectional detail of the swivel connection afforded by the connector 65. In this construction a threaded radial opening 90 is provided in the tubular connector member 66 to admit individual ring segments 91 which are successively inserted until a complete ring is formed. The segments are then retained in place within the complementary grooves 68 and 69 by means of a screw cap 92. With this construction it is apparent that there is an effective swiveling of the lower plunger assembly 31 and the valve member 12 with the remainder of the inner assembly 26. This feature is of importance in that it minimizes friction which tends to prevent the rotation of the upper portion of the inner assembly when it is desired to alter the threaded connection between the inner assembly 26 and the nipple 7.

Furthermore, the connection obviates the transmission of any rotational movement from the interlock member to the valve member 32 as the valve is moved relative to its seat 12 and is approaching closed position or is receding therefrom.

When the described device is being assembled a good grade of oil is poured into the working barrel to fill the entire space between the upper and lower plunger assemblies 33 and 31 and hence interlock member 30 and swivel connection 65 are completely surrounded by oil at all times. The downwardly and upwardly facing valve cups of these plungers, respectively, prevent any leakage of this oil from within the device and hence the working parts of the device are protected and long life and ease in operation of the device are assured.

The operation of the device is as follows:

Referring first to Figs. 1 to 7, it will be assumed that the device and its parts in the respective positions shown in Figs. 1 to 3 is lowered and fixed in position in the well adapted to flow under pressure in the producing strata. To start the well flowing, operating rod 25 is rotated to

lift valve member 32 from its seat 12 whereby fluid under pressure will lift ring valve 75 and will flow upward through the inner assembly 26, thence through passages 46 in valve cage 45 into the flow string 2, and fluid will thus be conducted from the well through the flow tubing. In event it is desired to alter the choking action of the valve member 32 and its complementary seat 12, it is merely necessary to rotate the operating string 25 sufficiently to obtain desired amounts of choking. If the pressure in the well falls below a point at which the natural flow of the well ceases, further flow may be induced by introduction of fluid under pressure through the operating string 25 whereby the bottom well pressure is supplemented by a gas air lift and production of the well continues.

In this manner, production from the well may be inefficient or may become inefficient as the life of the well increases. In such event the operating string 25 may be rotated sufficiently that interlock body 30 is released from its connection with nipple 7, whereupon the inner assembly 26 may be reciprocated by means of operating string 25 and the device functions as a plunger pump. Such operation may be used alone or it may be supplemented with the gas air lift feature described above.

The embodiment shown in Figs. 8 to 10 operates in a manner similar to that just described with the exception that fluid moving upwardly in the inner assembly 26 is not discharged outwardly therefrom into the tubing string. Instead the well liquid flows upwardly to the cage valve 32 and thence upwardly through the operating string 88 which thus serves as a flow line.

The above description of the preferred embodiment and a modification of the invention, together with a disclosure of the mode of operation thereof, makes apparent the advantages of the invention and construction whereby the objects of the invention are realized.

What is claimed is:

1. In a device of the class described the combination of a flow tubing, a working barrel connected to said flow tubing, said working barrel having an internally threaded portion intermediate its ends, a body connected to said working barrel and having openings communicating with the interior of the barrel, a valve seat in said body, a plunger assembly in the barrel, said plunger assembly having an axial bore therein and means for engaging the threaded portion of the barrel, a valve member on the plunger assembly for engagement with said valve seat, and an operating string connected to said plunger assembly and extending upwardly within said flow tubing.

2. In a well flowing device the combination of a flow tubing, a plunger assembly within said tubing, said assembly comprising an upper plunger, and a lower plunger, an interlock member between said plungers for releasable engagement of the assembly with the flow tubing, cooperating means on said flow tubing to inter-engage therewith, a valve on the lower end of the plunger assembly, a valve seat in said tubing below the valve, and an operating string connected to said assembly, and extending upwardly within the flow tubing whereby the valve may be opened to admit fluid to the flow tubing.

3. In a well flowing device the combination of a flow tubing having a valve seat at the lower end thereof, a plunger assembly slidable within said tubing and having an axial bore whereby fluid may pass axially upward through said assembly and tubing, means for moving said assembly axially of said tubing, a valve on said assembly adapted to engage said valve seat to control the rate of flow through the tubing when the plunger assembly is moved to lift the valve from its seat and releasable means to lock said plunger with said valve in its seat.

4. In a well flowing device, a flow tubing having a valve seat therein, a plunger assembly slidable within said tubing and having an axial bore, whereby fluid may flow through the valve seat and plunger assembly into the tubing, said plunger assembly comprising spaced plungers swivelly interconnected through an interlocking member adapted to engage internal threads in the tubing, a valve member on the lower end of the plunger assembly and an operating string connected to the assembly to rotate the assembly and advance the valve member into seating engagement with the valve seat.

5. In a well flowing device a flow tubing having a valve seat therein, a plunger assembly slidable within said tubing and having an axial bore, said plunger assembly comprising spaced plungers having sealing rings thereon to confine an oil bath within the tubing and between the plungers, an interlocking member between said plungers and having peripheral threads for engagement with an internally threaded section of the tubing, a valve member on the lower end of the assembly to engage said seat, and an operating string connected to the assembly whereby the assembly may be rotated to move the valve from the seat.

6. In a well flowing device a flow tubing having a valve seat therein, a plunger assembly slidable within said tubing and having an axial bore, a valve member on said assembly adapted to cooperate with said seat to close the same, a threaded connection between said assembly and the tubing, an operating string extending downwardly in said tubing and connected to the plunger assembly, whereby said connection may be unthreaded and the plunger assembly reciprocated by the operating string.

7. In a well flowing device, a flow tubing having a valve seat therein, a plunger assembly slidable within said tubing above said seat, said assembly having an axial bore therein, a valve member on the lower end of the plunger assembly adapted to engage said seat to close the axial bore through the assembly, a threaded connection between said asembly and the flow tubing, means for rotating the plunger assembly to separate the valve from its seat whereby liquid may flow through said assembly, and means for introducing a gaseous fluid under pressure to the liquid above the assembly to lift the liquid in the tubing.

8. In a well flowing device, a string of tubing within the well and having a valve seat therein, an operating string extending downwardly into the well and having a check valve therein, a plunger assembly slidable within said tubing and connected to said operating string, said assembly comprising spaced plungers having a passage therethrough, a threaded connection between said assembly and the tubing, and a valve member on the assembly for engagement with said valve seat when the assembly is moved downwardly by rotation of the operating string.

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