

Nov. 24, 1931.

E. GRAY ET AL

1,833,214

FLUID LIFTING DEVICE FOR WELLS

Filed March 3, 1927

2 Sheets-Sheet 1

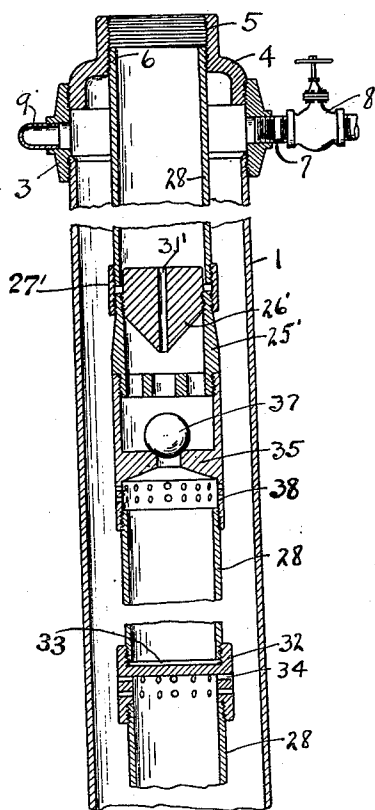


Fig. 1

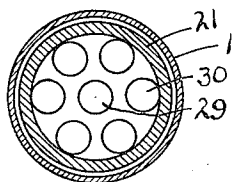


Fig. 3

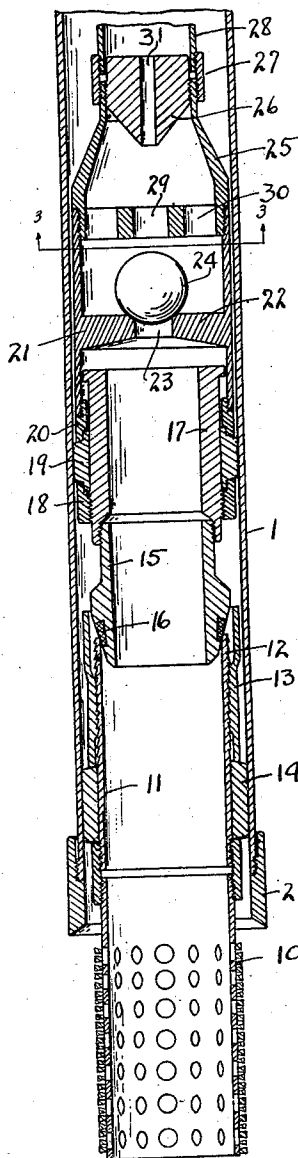


Fig. 2

Ellsworth Gray & Robert A. Mueller
Inventors

By Jesse R. Stone
Attorney

Nov. 24, 1931.

E. GRAY ET AL

1,833,214

FLUID LIFTING DEVICE FOR WELLS

Filed March 3, 1927

2 Sheets-Sheet 2

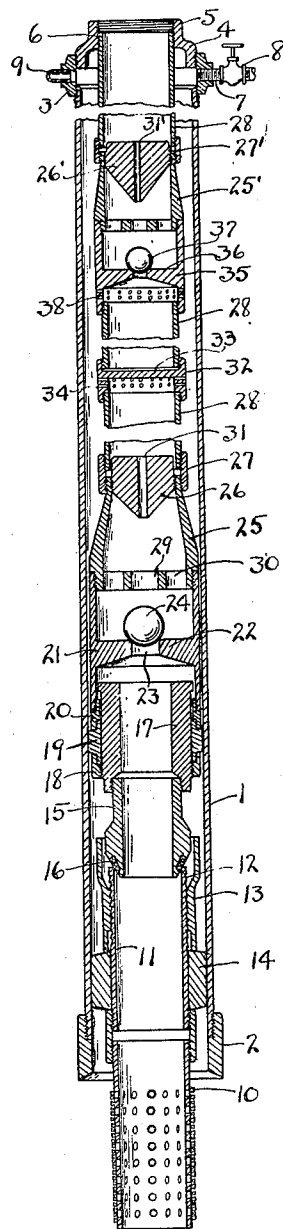


Fig. 4

Ellsworth Gray
Robert A. Mueller

Inventors

By

Jesse R. Stone

Attorney

UNITED STATES PATENT OFFICE

ELLSWORTH GRAY AND ROBERT A. MUELLER, OF HOUSTON, TEXAS

FLUID LIFTING DEVICE FOR WELLS

Application filed March 3, 1927. Serial No. 172,460.

Our invention relates to means for raising fluid from deep wells and has particular application to wells in which a certain amount of gas pressure is present in the producing formation.

In the production of oil from deep wells, it is usual to find the producing oil stratum also permeated by a certain amount of gas under pressure which accumulates in the bottom of the well and acts as a lifting means to raise the oil to the surface, causing the well to flow. The general experience is that the well will flow through the casing for a certain period until the gas pressure is reduced or until the pressure at the bottom of the well is equal to or less than the head of the oil standing in the well, after which the well will not flow of its own accord until further gas pressure has accumulated, and if it does not accumulate rapidly, causing the flow by heads, it will then be necessary to put a pump in the well to raise the fluid to the surface.

It is an object of our invention to provide a structure which may be placed in the well and adapted to employ fluid pressure of the gas in the well or similar pressure artificially produced to raise the oil from the well after it has ceased to flow of its own accord.

It is an object to provide an apparatus which can be economically constructed and installed in the well and which will utilize the fluid pressure in the well for raising the liquid therein to the surface in a most economical manner and without the use of the ordinary reciprocating pump.

Our invention resides in the particular construction and arrangement of the parts making up the device and this will be more clearly understood from the description which follows.

Referring to the drawings herewith, Fig. 1 is a central vertical section through the upper end of the well casing showing our improvement installed therein. Fig. 2 is a similar section showing the lower portion of the well and our apparatus set therein. Fig. 3 is a transverse section on the line 3—3 of Fig. 2; and Fig. 4 is an assembly view, shown somewhat reduced, of the complete device illustrated in Figs. 1 and 2. Like numerals

of reference are employed to designate like parts in all the views.

In putting our invention into use, it is to be understood that the well in which the device is to be employed is equipped with the usual casing, indicated at 1, said casing having a shoe 2 on the lower end, the upper end of the casing being equipped with the casing head 3 having a threaded connection with the upper end thereof. Said casing head is equipped with a swedge nipple 4 in which the diameter thereof is reduced, said nipple being internally threaded at 5 for attachment to the well tubing 6, said tubing being shown as of comparatively large diameter, although it is to be understood that it may be of any preferred diameter. The casing head has lateral openings therein threaded to receive pipe connections, and we have shown a pipe 7 secured in one of these openings, said pipe having a hand-operated valve 8 therein. In the opposite side of the casing head, the opening may be closed by the bull plug 9 or a pipe may be connected therein, as desired.

It is further to be understood that the well may be equipped with a strainer 10 of any desired construction, and above the strainer is connected a packer to close the space between the upper end of the strainer and the casing. We have shown the packer employing an inner mandrel or pipe 11 secured by a coupling to the strainer and having its upper portion formed with a downwardly inclined ratchet thread 12 thereon to engage with a setting sleeve 13, said sleeve being threaded on its interior to co-operate with the ratchet thread upon the mandrel 11. Between the lower end of the setting sleeve and the strainer is placed a compressible packing material 14, which may be of canvas or rubber composition or any desired material, and it is understood that this packing may be compressed when the strainer is set by exerting a downward pressure upon the setting sleeve 13 to force the packing into longitudinally compressed position, thus expanding it laterally to fill the space between the mandrel 11 and the casing. The ratchet thread between the mandrel and setting sleeve prevents the up-

ward movement of the setting sleeve thereafter.

When the well is thus equipped, our invention may be employed at any time thereafter. It is to be understood that the well may flow of its own accord as long as it will but when the pressure within the producing formation has decreased until it will no longer flow of its own accord, our invention is introduced therein.

It is the general object of our invention to provide means whereby the pressure of the gaseous fluid in the well may accumulate so as to exert sufficient pressure to raise the liquid in the well. Our device includes a lower shoe 15 which comprises a tubular member, the lower end of which is tapered and formed with a ring of soft metal or composition 16 which is of the proper diameter to rest upon the upper end of the packer mandrel 11 and to form therewith a seal, preventing the passage of fluid between the packer and the said shoe 15.

The upper end of the shoe is threaded for engagement within the lower end of a packer body 17. Said packer has an outer collar 18 at its lower end, the outer portion of which extends upwardly to include the lower end of a packing sleeve 19. This packing sleeve may be compressed against the collar 18 by means of a ring 20 at the upper end of the packing sleeve, said ring being secured to the lower end of a pressure accumulator 21, which is slidable over the outer face of the packer body 17. The weight of the pipe and other apparatus above the accumulator is sufficient to compress the packing to make a tight seal with the interior of the casing.

The accumulator 21 comprises a short pipe section having a central partition 22 extending across the same, closing the passage therethrough except for a somewhat limited opening 23, the upper end of which is formed to receive a ball valve 24.

The upper end of the accumulator pipe is connected with a cup-shaped member 25, which is tapered upwardly and threaded on its interior to receive a choker plug 26. Its upper end is threaded on the exterior for connection by means of a coupling 27 with a length of tubing 28. The bottom of the cup-shaped member 25 is provided with central opening 29 of smaller diameter than the ball valve 24 and adapted to receive and prevent the upward movement of the valve beyond this limit. Around the central opening 29 are a series of similar openings 30 to allow the passage of fluid therethrough.

The choker plug 26 is cylindrical, except at its lower end where it is tapered downwardly; it has a central passage 31 therethrough for fluid, materially smaller than the valve opening 23.

The pipe section 28 may be of any desired length and at a suitable distance above the

choker the said pipe will be connected with a coupling 32, which has a diaphragm or partition 33 extending across the upper end of the pipe 28 and tending to close the same. Below the partition are a series of radial openings 34 which allow the fluid to pass outwardly from within the pipe 28. The upper end of the coupling 32 is connected with the tubing 28 which is threaded at its upper end for attachment to the lower end of a valve chamber 35. This member comprises a short section of pipe having a central diaphragm or partition 36 therein with a central passage therethrough adapted to be closed by the ball valve 37. Below the partition 36 the valve member has a series of openings 38 therein to allow the entrance of fluid to the tubing below the valve. A cup-shaped member 25' is threaded within the upper end of the valve chamber similar in all particulars to the section 25 and answering the same purpose. The only point of difference being that the size is smaller in the upper section. The upper end of the member 25' is connected with the tubing 28 above by means of a coupling 27' and a choker plug 26' is threaded within the upper end of a member 25', the passage 31' through said choker being smaller in diameter than the passage 31 in the stage below.

In the operation of this device, the gas within the formation will enter the strainer at the lower end thereof along with the oil or other liquid entering the same. The gas and liquid will be held in the lower end of the well by the valve closed passage 23 until the pressure accumulates below the diaphragm 22 sufficient to force the valve 24 from its seat and to cause a stream of liquid and gas to pass through the opening 23 into the chamber above. It will there accumulate sufficiently to force the liquid and gas through the choker passage 31 and upwardly into the tubing. When the pressure below the valve 24 has been exhausted to the extent that it will no longer cause the flow of liquid and gas through the passage 23, the valve 24 will drop back, closing the same until the pressure further accumulates.

The gaseous pressure within the chamber 25 will be sufficient to cause a flow through the constricted passage 31 of the choker until the gas pressure within the chamber has been nearly exhausted. When this pressure has dissipated sufficiently, the flow of liquid through the choker passage will discontinue. This operation may be somewhat intermittent but at each time the gas below the valve 24 has accumulated sufficiently to overcome the pressure above, more oil and gas will be forced past the valve, causing a lift through the constricted passage 31 into the tubing above. It is to be understood that the use of the choker in the fluid passage allows the accumulation of gas in the cham-

ber below to occur to such an extent that the flow through the choker will continue where it would otherwise be quickly dissipated, due to the larger passage for the gas to bubble through were the plug not present.

The gas and liquid within the tubing 28 above the choker 26 will be discharged into the space between the tubing and the casing until the space above the packer 19 has been filled to the level of the openings. The gas and liquid will then issue from these openings 34 against the head of such liquid as accumulates in the space within the casing. This discharge of fluid into the casing will be intermittent until it has been filled to the level of the openings 38 when it will flow into the tubing above the partition 33 and fill the same to the level of the openings 38. Pressure will then accumulate in the casing until the valve 37 has been raised, causing the pressure of the gas to be exerted upon the liquid and cause it to flow upwardly into the chamber 25' and from thence through the choker opening 31'. This will continue until the pressure below the choker 31' has been so far exhausted as to equal the head of the liquid above. The valve 37 will then close and no further flow will occur until the pressure has again accumulated in the manner described. When further flow occurs, the liquid and gas may issue from the upper end of the tubing 28 above the casing head and may be from thence conducted to any tank for storage or use.

It will be obvious that our construction allows the accumulation of gas in the separate stages of the apparatus so as to cause a flow of the gas and oil through the constricted passages in the choker above the valve as long as the pressure is strong enough, but when the pressure is relieved, the valves take up the load of the head of liquid in the apparatus until sufficient gas pressure has accumulated to force further liquid past the valves and through the choker openings.

In case the gas pressure becomes reduced to such an extent that the flow is not in such volume as to make it profitable to operate the well, the flow of liquid can be accelerated by the introduction of air or gas under pressure through the pipe 8. Any source of air under pressure may be connected with said pipe and when the valve 8 has been opened the air or gas under pressure may be introduced into the casing so as to exert a pressure upon the liquid above the openings 38 in the upper stage and force the same downwardly with sufficient pressure to force the liquid past the valve 37 and upwardly to the surface. When the liquid above the openings 38 has been thus exhausted, the gaseous fluid will then pass the valve and the flow of liquid will stop, thus making it necessary to discontinue the pressure through the line 7 un-

til the gas pressure in the well has raised the liquid above the level of the openings 38, after which the process may be again repeated.

The use of this structure will allow the well to be operated for long periods after it would otherwise have necessitated the use of pumps. The device will be cheaper in operation than would the usual pumps and it will not be subject to wear in the manner of the ordinary reciprocating pump employed in wells of this nature. It will, therefore, be economical to operate and capable of use for long periods of time without repair. The advantages of this sort of structure will be obvious to those skilled in the art.

Having thus described our invention, what we claim as new and desire to protect by Letters Patent is:

1. In a device of the character described, a well casing, a tubing string in said casing, a packing member on said tubing string adapted to make a fluid tight seal with said casing, a partition across said tubing having an upwardly opening valve passage therein, a valve therein, a pressure accumulator chamber above said valve and a choker plug in said chamber having a constricted passage upwardly therethrough materially smaller than the passage through said string.

2. In a device of the character described, a well casing, a tubing string in said casing, a packing member on said tubing string adapted to make a fluid tight seal with said casing, a partition across said tubing having an upwardly opening valve passage therein, a valve therein, a chamber above said valve and a choker plug in said chamber having a constricted passage upwardly therethrough, and means in said tubing above said choker to divert the fluid from said tubing to the interior of said casing, and a valve controlled outlet through said string above said means.

3. In a device of the character described, a well casing, a tubing string therein, a seal between said tubing string and casing adjacent the lower end thereof, pressure chambers arranged in stages in said tubing, valves controlling the entrance of fluid thereto, and a choker plug having a constricted passage therethrough above each said chamber in the manner described.

4. In a device of the character described, a well casing, a tubing string therein, a seal between said tubing string and casing adjacent the lower end thereof, pressure chambers arranged in stages in said tubing, valves controlling the entrance of fluid thereto, a choker plug having a constricted passage therethrough above each said chamber in the manner described, and means to force fluid under pressure from the surface into said string below one of said valves.

5. In a device of the character described, a

well casing, a tubing string therein, a seal between said tubing string and casing adjacent the lower end thereof, pressure chambers arranged in stages in said tubing valves controlling the entrance of fluid thereto, and
5 a choker plug above each of said valves, said plugs being tapered downwardly and having a constricted axial opening therethrough of smaller diameter than said valves, for the
10 purpose described.

6. In a device of the character described, a casing, a tubing string therein, means to prevent upward passage of fluid outside said string at the lower end thereof, a pressure
15 accumulator in said string including a transverse partition having an upwardly opening valve therein, a pressure chamber above said valve, and a downwardly tapered choker plug at the upper end of said chamber, said
20 plug having a fluid passage of small diameter therethrough.

In testimony whereof we hereunto affix our signatures this 24th day of February, A. D. 1927.

25

ELLSWORTH GRAY.
ROBERT A. MUELLER.

30

35

40

45

50

55

60

65