

Nov. 21, 1950

O. CRANFILL
DUAL FLOWING DEVICE

2,531,258

Filed March 5, 1946

3 Sheets-Sheet 1

Fig. 1

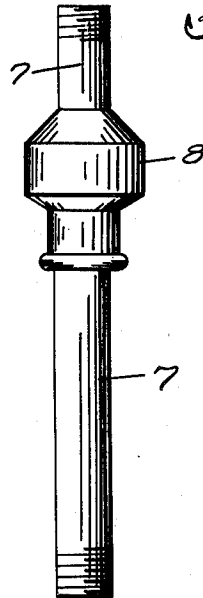
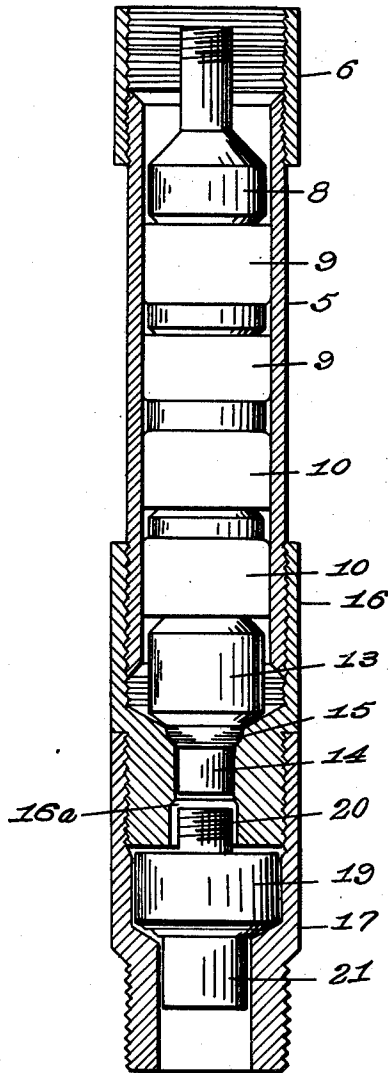


Fig. 2

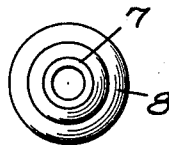


Fig. 3

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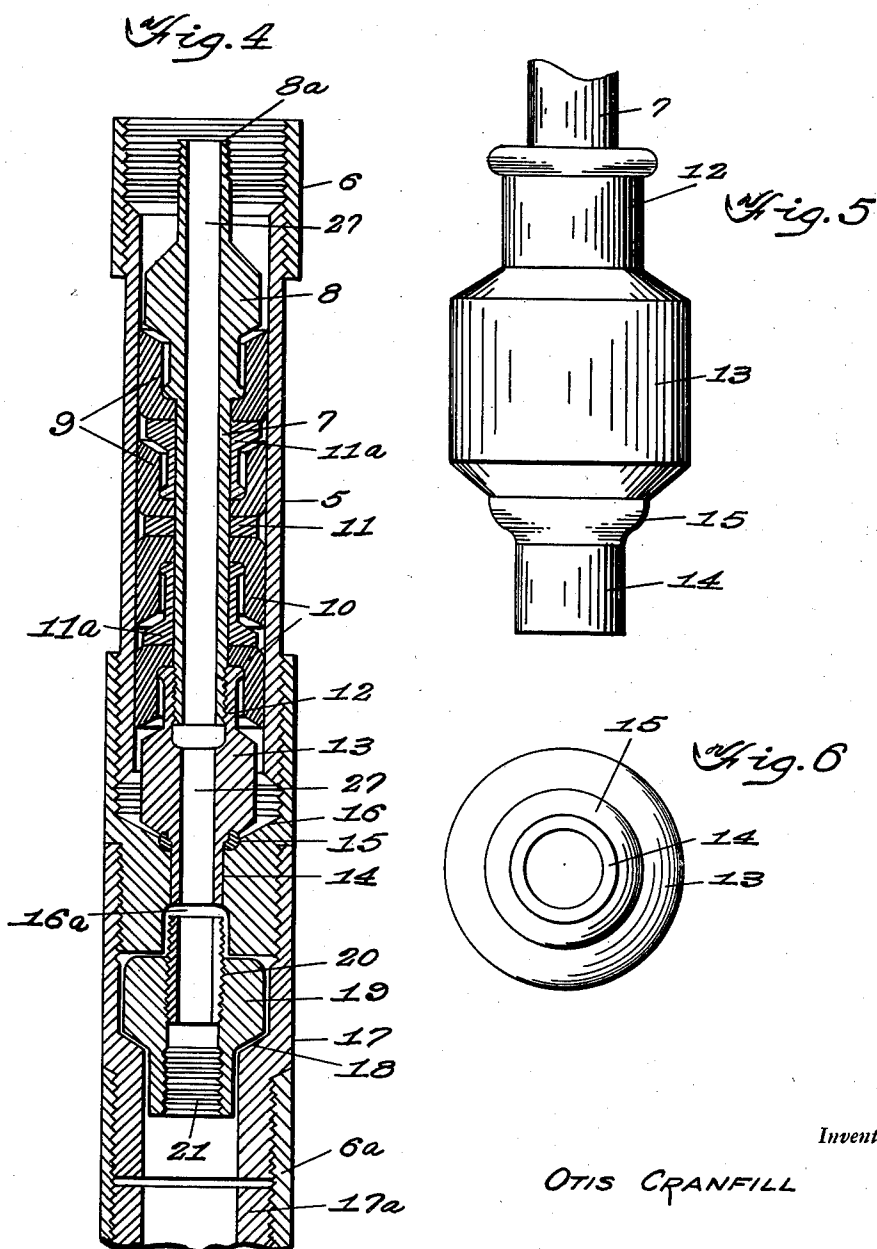
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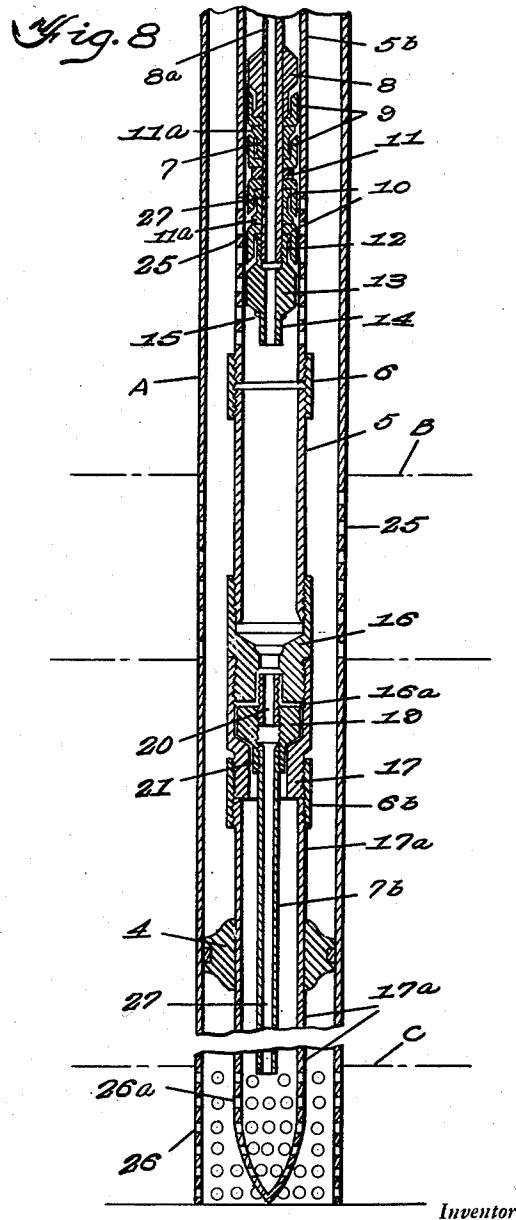
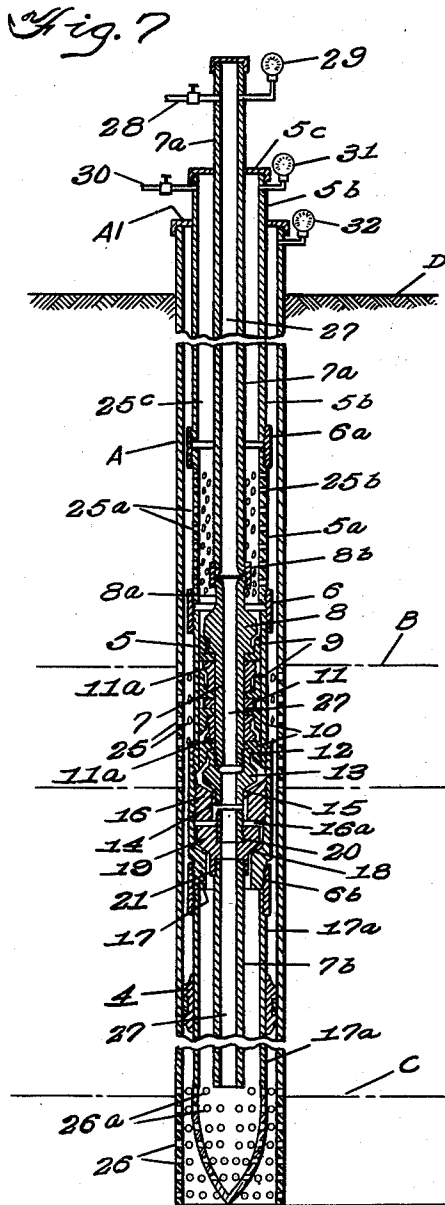
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UNITED STATES PATENT OFFICE

2,531,258

DUAL FLOWING DEVICE

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Application March 5, 1946, Serial No. 652,048

4 Claims. (Cl. 166—2)

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This invention relates to new and useful improvements in oil well equipment and more particularly to a dual flowing device for oil and gas wells having a plurality of productive zones, strata or productive pay areas in one well. In certain localities, there is often found two or more productive pay areas at different depths in one well and the present invention is designed to facilitate and control the flow from said areas simultaneously or independently, and to facilitate the running and pulling or removal of the piping, especially in very deep wells, and where the distance between the respective productive pay areas is considerable and the length and weight of tubing becomes a problem, especially in sealing off the productive areas from each other for independent flow control or in elevating the upper inner tubing to permit simultaneous flow of both areas through the same outlets.

The principal object of the present invention is to provide a novel and efficient device whereby two pay areas or strata can be produced simultaneously or separately, if desired, or to permit the areas or zones to be successively and independently swabbed in or made to flow through the tubing, and wherein when the flow is established, the pressure of the gases in the different areas or zones may be used to facilitate and provide the necessary pressure for insuring the flow and production from either or both areas.

Another important object of the invention is to provide a dual flowing device of the character as stated, which can be inserted into an oil well casing which houses the oil well tubing having the usual casing head, Christmas tree and rigging, for the purpose of permitting either one of the two pay areas to produce and flow separately, or to permit both areas to produce or flow simultaneously.

A still further object of the invention is to facilitate the running of the piping or tubing and pulling or removal thereof, especially in very deep wells, where the distance between the areas is considerable, and to produce and facilitate a combination dual installation in wells of extreme depth due to the extreme weight of the tubing, and make the same much less hazardous and much less likely of parting when running the tubing and for sealing off or establishing communication between the respective independent production or pay areas without allowing the lower section of the tubing to drop and necessitating a fishing job.

A still further object of the invention is to facilitate the running of the tubing or pulling of

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the upper section thereof with respect to the inside tubing, for the flow of oil and gas from the deepest oil bearing formation or stratum constituting a productive pay area, by having the inside tubing divided into two parts so that the same may be connected with facility or separated so that the pressure from either or both productive pay areas may be used to provide the necessary pressure for causing the flow or discharge of the gas or oil from either area and to conserve the pressure for a longer time duration, as well as to permit the use of plain tubing instead of upset tubing for the inside tube in order to maintain an ample annular space for the top pay to produce through to the surface, and to guide and keep the sections of the tubing in alignment at all times to facilitate the running and pulling thereof, without necessitating a fishing job.

This application is a continuation in part of my prior application Serial No. 473,759, filed January 27, 1943, now abandoned.

Other objects and advantages reside in the details of construction and operation as more fully hereinafter described and claimed, reference being had to the accompanying drawings forming part hereof, wherein like numerals refer to like parts throughout, and in which:

Figure 1 is a vertical sectional view of the barrel or cylinder of the dual flowing device constituting the invention.

Figure 2 is a side view in elevation of the upper core of the sealing device.

Figure 3 is a bottom end view of the core shown in Figure 2.

Figure 4 is a longitudinal sectional view of the structure shown in Figure 1, taken substantially on the line 4—4 thereof and showing the connection for the lower outer tubing section.

Figure 5 is a side view in elevation of the sealing head of the device.

Figure 6 is a bottom view of the structure shown in Figure 5.

Figure 7 is a vertical longitudinal sectional view showing the dual flowing device installed in a well casing of a well having two productive pay areas, and the parts positioned to isolate the fluid flowing from one fluid bearing stratum from that flowing from another fluid bearing stratum, and

Figure 8 is an enlarged fragmentary sectional view of the device showing the parts positioned to permit simultaneous flow of fluid from both strata through the tubular conduit of the device.

Referring to the drawings in detail and par-

ticularly to Figures 7 and 8, a conventional well is shown as passing through a plurality of oil bearing or productive pay areas or strata, indicated as an upper oil bearing formation or stratum B and a lower oil formation or productive stratum C. The ground level is designated at D, above which the casing, and oil flow control devices extend. Conventional well rigging is disposed above the well and is equipped with conventional means for raising or lowering the tubular conduit, tube and the well casing in a manner well known in the art. The well is cased with a conventional well casing A which is provided with spaced groups 25 and 26 of perforations through which the fluid from the respective strata B and C may enter the casing A.

Referring more especially to Figure 4 of the drawings, as well as to Figures 1 and 7, the numeral 5 designates a barrel or cylinder of tubing constituting a portion of the outer tube of the device. This tube may be of any suitable diameter, less than the i. d. of the well casing, such for example as $2\frac{1}{2}$ ", so as to provide an annular space between the tube and the well casing A. This barrel 5, like the other sections of the tube is preferably of the plain tubing type and is externally threaded at its upper end to connect to an internally threaded coupling into which is threaded a perforated sub-barrel or tube section 5a. The upper end of the perforated tubing section 5a is coupled in a conventional manner as by coupling 5a to an upper string or run of tubing 5b which extends above the upper end of the casing A of the well in the usual manner.

As best seen in Figure 7, the tubular well casing A extends from above the top of the ground to the bottom of the well, through an upper pay layer or oil producing stratum B and right down into and through the lower pay or oil producing stratum C, which may be as deep down as 4,000' below the upper oil producing stratum B, which itself may be located several thousand feet below the ground level C. As indicated in Figure 7, the well casing A is provided with a group of perforations 25 to establish communication between the upper stratum B and the interior of the casing and this casing A is also provided with a longitudinally spaced group of perforations 26 which open into the lower stratum C. The upper end of the casing A terminates slightly above the ground level D and is closed by a cap A' of any preferred construction. The cap A' is provided with an axial opening through which passes the end of the string or run of tubing 5b remote from the perforated section 5a.

Numeral 7 indicates a mandrel or piston body which constitutes a section of the inner tubing or tubular conduit and has a central passageway 27 throughout its entire length terminating near its upper end in an enlarged oppositely tapered guide portion or cup protector 8 having a tube portion or extension corresponding to portion 7, at its upper end, where it is externally threaded as at 8a to accommodate and removably attach to an internally threaded collar 8b by means of which the upper end or section 7a of the smaller inside tubing or tubular conduit is attached to form a continuation of the central passageway 27 and extend above the head 5c of the outer tubing and section 5b thereof, through and above said head, where it may be attached to suitable rigging or elevating means so that it may be moved up or down. In this way, the upper section 7a of the inner tubing extends movably

through the head 5c constituting the closed upper end of the barrel constituted by the sections 5, 5a and 5b, and in spaced relation coaxially within said barrel or tubing.

5 Numerals 9, 9, denote a plurality or pair of packing or sealing cups similar to those used on pistons and may be of the standard Darcona type on the hollow lower portion of the mandrel or piston body 7 facing in one direction, while
10 numerals 10, 10, denote another pair or plurality of similar cups on the same lower portion of the mandrel or body 7 facing in the opposite direction to the cups 9, 9. A flat metal spacer ring 11 is placed between the opposite ends of the
15 adjacent cups 9 and 10 and is slightly smaller than the interior diameter or bore of the outer tubing to readily move therein while causing proper spreading of the sealing or packing cups.

Other necked metal spacers 11a fit around the mandrel or piston body 7 with their necks seated within and between the cups of said pairs of cup
20 packings 9 and 10 respectively, as more particularly shown in Figure 4 of the drawings.

The lower end of the tubular mandrel or piston
25 body 7 is externally threaded to engage the internally threaded neck portion 12 of a cup support guide or head 13 which is also tapered in opposite directions and has a smooth faced tubular downward extension or nipple 14 provided
30 with a lead packing 15 adjacent its lower reduced portion at the juncture of the lower tapered or beveled end thereof, forming a seal for the internal upwardly facing seat 16 of a top sealing collar which has an internally threaded enlarged
35 upper end threaded on the externally threaded lower end of the barrel 5. The guide 13 has the passageway 27 continued therethrough by reason of the hollow bore 27 forming a continuation of said passageway through the mandrel or rod 7.
40 The tubular conduit includes the sealing device or piston, and consists thereof of the following parts, namely: 7, 7a, 8, 8a, 8b, 9, 10, 11, 11a, 12, 13, 14 and 15, and the inner sealing section or tube consists of the parts 5, 5a, 5b, 5c, 6, 6a, and
45 16.

The lower portion of the seat 16 is thickened and smooth internally to receive the portion 14 of the seat body 13 and has a reduced externally threaded portion to accommodate the internally threaded portion at the upper end of a combination hanger sleeve 17 which has an internally threaded axial socket opening into an axial threaded bore which extends downwardly
50 through a reduced externally threaded lower portion. The junction of the socket and bore form a shoulder 18 for supporting a tubular hanger 19 having a reduced internally threaded extension or nipple 21 by which the upper externally threaded end of a lower tubular conduit section
55 7b is connected thereto. The hanger also has an axial internally threaded socket entering its top into which is threaded a short externally threaded nipple 20. This nipple 20 extends up into the recess 16a provided in the lower portion of the seating collar 16. The hanger 19 as before stated, is internally threaded as at 21 to receive the upper threaded end of the lower section 7b of the tubular conduit which corresponds in diameter to the mandrel 7. The lower reduced
60 and externally threaded end of the hanger sleeve or collar 17 has a lower barrel section or tube 17a corresponding in size to the main barrel section 5 connected thereto by means of an internally threaded collar 6b corresponding to the collar 6 at the upper end of the barrel 5 and by which the
65 75

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latter is connected to the perforated tubular section 5a so that the lower tubular barrel section 17a of the outer tubing is connected to the hanger seat 17.

With two oil paying or bearing formations 5 producing productive areas or zones, one a considerable distance below the other in the well, as described, a suitable packer or outer tubing head 4, such as bronze, provided with a packing ring, is placed or fixed on the lower barrel section 10 or tubing 17a between the well casing A and the lower barrel or tubing section 17a so as to seal off the annular space between the casing A in the lower barrel at a point between the strata B and C as shown in Figures 7 and 8, 15 to prevent any upward flow of the oil therebetween. However, above the packer 4, the casing is perforated as at 25 where it passes through the upper oil producing area B so that oil can be produced from the upper area and allowed 20 to flow through other perforations 25a provided higher up in the inner tubing section or barrel 5a and then flow upwardly in the annular space 25c between the inner tubing 7a and the outer tubing or barrel 5b above the sealing device or piston within the outer tubing. The lower oil producing or paying area is drained by passing the oil through the perforations 26 in the bottom end of the casing A and then through the perforations 26a in the tapered lower end or nozzle 30 of the lower outer tubing section or barrel 17a and up through the inner tubing starting with the lower section 7b as shown in Figures 4 and 7, this flow being entirely separate from the flow in the casing A above the packer or outer piston 35 head 4, constituting a seal between the outer tubing at 17a and the well casing A. It will thus be seen that the separable dual flowing device and inner seal is so constructed as to establish a continuous inner tubing passage connecting 40 the sections 7a and 7b, of uniform size and relatively smooth bore, sealed off from the annular passage therearound, between the inner tubing and the outer tubing to allow separate or independent flow of the oil therethrough from the lower oil bearing formation or producing area C through the passage 27. Also, the pressure of the gases from the sand formations in the lower oil bearing area C will be stored or back up in the space between the outer tubing and the well casing below the packer 4 to facilitate the pressure of the gases acting on the oil to discharge the same through the perforated lower end of the casing A and the perforated lower end of the nozzle or outer tubing and then up through 55 the central smaller tubing or passageway 27. In this operation and relation of the parts as shown in Figures 4 and 7, the lead seal 15 supplemented by the sealing rings or cups 9 and 10, effectively seal off the annular space or passage 60 between the inner tubing and the outer tubing in the lower portion of the casing A, and the corresponding space or passage in the upper portion of the casing above the separable dual flow device of the present invention so that the flow is entirely through the inner tubing or passageway 27 independently of the annular passage therearound, with the discharge through the oil delivery pipe 28, while the pressure may be determined by the gauge 29. Obviously, a Christmas tree or any other suitable arrangement may be provided at the top for controlling the flow and for raising and lowering the upper section of the inner tubing and the sealing device, as well as for running or pulling the tubing and for

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turning the same to couple or uncouple the same at the threaded connections with positive alignment insured to facilitate same as above described and prevent dropping of the lower section or unit to avoid the necessity of a fishing job.

The oil from the upper oil producing area B is caused to flow under pressure of the gases from the sands therein for discharge separately from the oil from the lower oil producing area C, and takes place through the perforations 25 in the well casing A to the space of annular form between the same and the outer tubing at the cylinder or barrel 5 and then through the perforations 25a of the barrel or tubing section 5a and annular space 25c around the inner tubing section 7a, for discharge through the delivery pipe 30 at the top, where the pressure may be determined by a pressure gauge 31. As distinguished from the bottom oil supply, the top oil supply through the annular passage, will be under pressure of the gases above the packer 4, and at the top of the space between the outer tubing and the well casing at the top, where the pressure may be determined by another pressure gauge 32 in the space 25b, permitting the pressure to be stored or back up therein in order to facilitate the flow from the upper oil bearing formation or area B, and in each instance, to conserve the pressure for a longer time duration.

A very important feature of this invention is the hanger construction. The upper or inner sealing section or piston terminates at the lower end with the tube nipple 14. For very deep wells, a tubular conduit section 7b is needed to reach down into the lower oil deposit at C, and this tubular conduit section 7b is threaded in the hanger 19 and has the same bore as the main tubular mandrel and the nipple 20. The advantage of this arrangement will be readily seen as when assembling or removing the tubular conduit in the oil well, the nipple will serve as a coupling by which the lower tubular section may be attached to suitable hoist mechanism and the weights to be handled may be materially reduced. Supposing, for instance, that the casing A has been installed in the well together with the lower parts 4, 17a of the lower or outer sealing section to the hanger sleeve and seat 17, then it will be possible to lower the hanger 19 with the attached tube section 7b therein, suitable implements being used for gripping the threaded stub-pipe 20 during this procedure. Subsequently the collar seat 16 with barrel 5 is added and then the inner sealing section proper from the support guide head 13 up is lowered into its seat 16.

By this means a two-stage installation is possible; with the inner tubular conduit comprising parts 7, 7a, 7b in perfect alignment and the weight of the lower part 7b and hanger 19 supported on the hanger seat 18. The tubular conduit comprising the parts from the support guide head 13 up are supported by the lead packing 65 15 in the collar or piston seat 16. By thus supporting the tubular conduit at spaced points the running and pulling thereof in deep wells is made less hazardous.

Another advantage is that raising of the oil from the bottom layer takes place through a relatively small conduit, about 1 1/4" diameter, while the raising of the oil from the upper deposit takes place through a larger tube, about 2 1/2" diameter.

Figure 8 of the drawings, the dual flow or seal-

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ing device is shown parted or separated at the lead seal 15 to permit simultaneous or joint flow from both oil producing areas through the upper portion of the annular flow passage or space and the inner tube or passage, as well as facilitating running or pulling of the tubing or piping in deep wells, and permitting the flow from the upper and lower pay or production areas to be swabbed in the customary manner and so that the oil or fluid entering above the swab may be lifted out in the nature of bailing to induce the flow of the oil out of the formation to the surface of the ground through the well for storage. Especially is this true, when it is necessary to swab in the bottom pay area or production formation and in washing out the mud with water and the water with oil. The device also cuts the gas waste down in lifting the fluid due to smaller columns thereby reducing the gas breaking through the fluid and allowing the well to flow longer on its own gas reserves, thereby lengthening the life of the well flush output to some extent. It also completely eliminates the cost of drilling a second well and the material required in connection therewith.

Under certain circumstances and particularly for cleaning in the case of very deep wells, it is necessary to pull up the inner sealing or piston structure including the support guide head 13 where it is seated at 15 as shown in Figures 1, 4 and 7. It might become necessary to switch or change joints at the top in order to equally divide the weight at the seal 15 and the usual Christmas tree hanger at the well surface (not shown). This would likely be necessary on each installation while making the installment, but after the completion of this installment and the device is in position, as shown in Figure 1, it is in this position that it is ready to function and serve its purpose as a means of closing the annular space of the tube 5 and the outside of the smaller tube line below the hanger seat 17.

A separate deposit of fluid from the top stratum B, (as is clearly shown in Figure 7) is made in the casing A outside of the large tube 5 through the use of the packer and the dual flowing device, which makes it possible to confine the fluids from different strata to separate lines to storage vessels. The fluid from the bottom deposit C passes through the bore 27 of the tubular conduit 7a to the surface line 23 and corresponding storage vessel, while the fluid from the top stratum B passes through the flow passages 25a in the tube section 5a to the outside of the tubular conduit 7a and hence it will be seen that the fluids from the two strata will be prevented from commingling. When however it is desired to discharge the fluids from both strata, the tubular conduit 7a together with the head 13 and packing rings 9 is moved longitudinally of the tube section 5 until it passes through the tube section 5a having the flow passages 25a and into the tube section 5b. In this position it will be evident that the fluids from both strata B and C will be discharged from the well through the tubular conduit.

While the foregoing specification sets forth the invention in specific terms, it is to be understood that numerous changes in the shape, size and materials may be resorted to without departing from the spirit and scope of the invention as claimed hereinafter.

What I claim is:

1. A dual flowing device for a well hole which passes through two vertically spaced oil producing strata, comprising a casing lining the well

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hole from the bottom thereof to the surface of the ground and having a perforated area at each of said strata, outer flow tubing disposed within and in spaced concentric relation to said casing and extending continuously from the bottom of the well to a point above the top of said casing, a packer on said outer flow tubing engaging the casing between the perforated areas for isolating the strata from each other with respect to the space between the casing and the outer flow tubing, said outer flow tubing having a perforated area above the packer and adjacent the upper perforated area of the casing and being provided with an internal valve seat below said perforated area in the outer flow tubing, an inner flow tubing including a lower section open at its lower end hung in the lower portion of the outer flow tubing below said valve seat and extending downwardly to a position adjacent the lower perforated area in the casing and an upper vertically movable section separate from the lower section extending above the outer flow tubing and having an external valve head on its lower end engageable with said valve seat when said upper section is lowered, said upper section further having packing means on its lower portion sealingly engaging the outer flow tubing and selectively movable to a position above or a position below the perforated area of the outer flow tubing by raising or lowering said upper section, whereby communication may be established between the inner flow tubing and both strata or communication may be established between the inner flow tubing and the lower stratum only while simultaneously establishing communication between the outer flow tubing and the upper stratum only.

2. The construction defined in claim 1, wherein the upper section of the inner flow tubing has a reduced neck on its lower end adapted to enter a restricted passage of the outer flow tubing below said valve seat when said valve head is engaged with the latter.

3. In a dual flowing device for a well hole which passes through two vertically spaced oil producing strata, comprising a casing lining the well hole from the bottom thereof to the surface of the ground and having upper and lower spaced perforated areas therein for communicating with the strata, an outer flow tubing disposed within and in spaced concentric relation to the casing, a packer surrounding the outer flow tubing and in sealing engagement with the casing at a location between the perforated areas in the casing, said outer tubing having a fluid inlet below the packer and having a perforated area therein at a position above the packer, an inner flow tubing open at its lower end disposed within and in spaced concentric relation to the outer flow tubing, a packing member surrounding and fixed to the inner flow tubing that sealingly engages the outer flow tubing, said inner flow tubing being vertically movable in the outer flow tubing to selectively position the packing member above and below the perforated area of the outer flow tubing, whereby communication may be established between the inner flow tubing and both strata or communication may be established between the inner flow tubing and the lower stratum only while simultaneously establishing communication between the outer flow tubing and the upper stratum only.

4. The construction defined in claim 3, wherein heads close the upper ends of the casing and the

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flow tubings, in combination with oil delivery pipes communicating with the upper end portions of the flow tubings.

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REFERENCES CITED

The following references are of record in the file of this patent:

Number	Name	Date
1,871,319	Griswold -----	Aug. 9, 1932
2,274,407	Hammer -----	Feb. 24, 1942
2,277,380	Yancey -----	Mar. 24, 1942
2,403,987	Lewis -----	July 16, 1946
2,428,139	Bridwell et al. -----	Sept. 30, 1947

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UNITED STATES PATENTS