

Dec. 21, 1965

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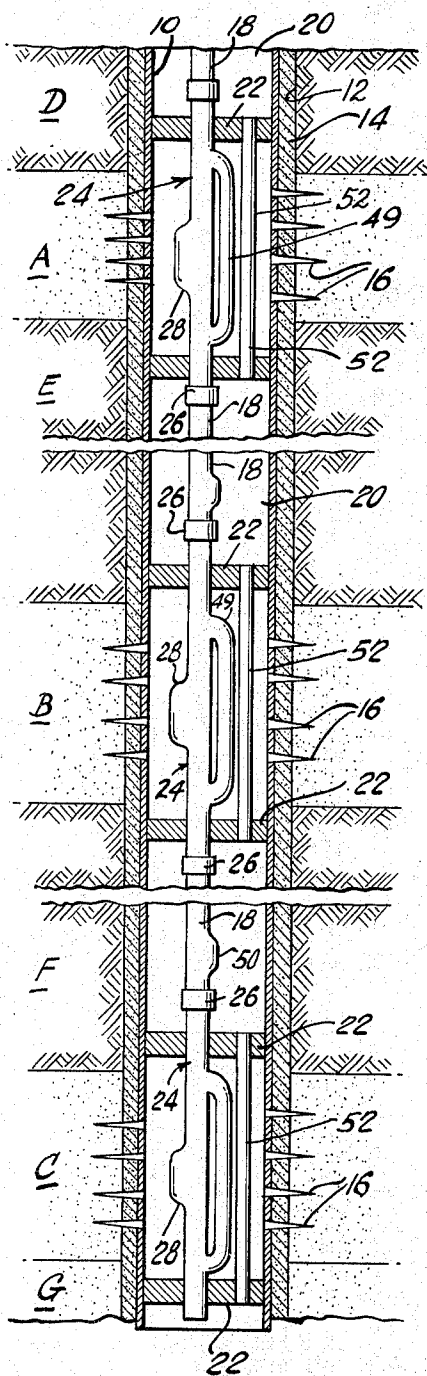
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WELL COMPLETION APPARATUS

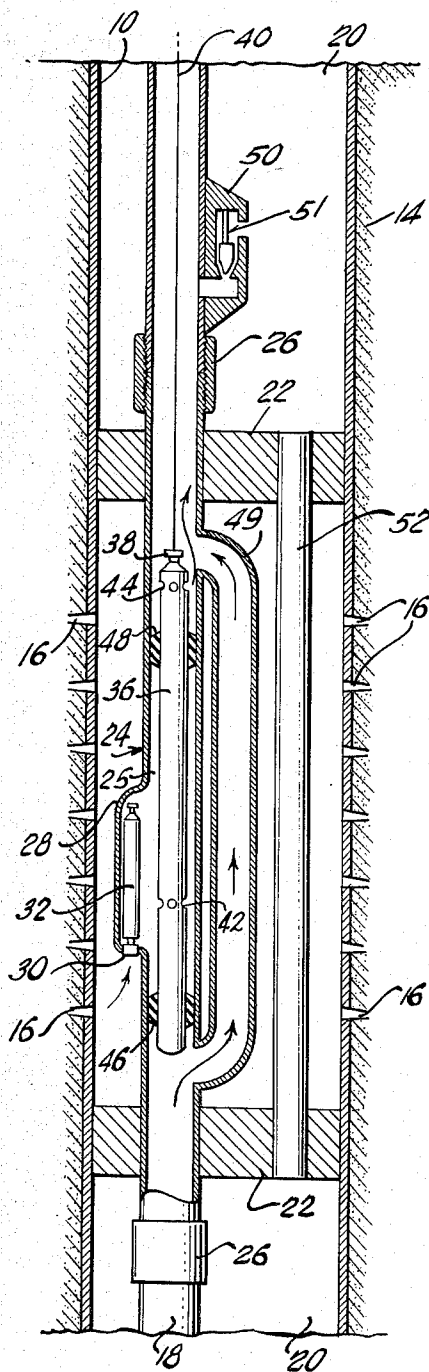
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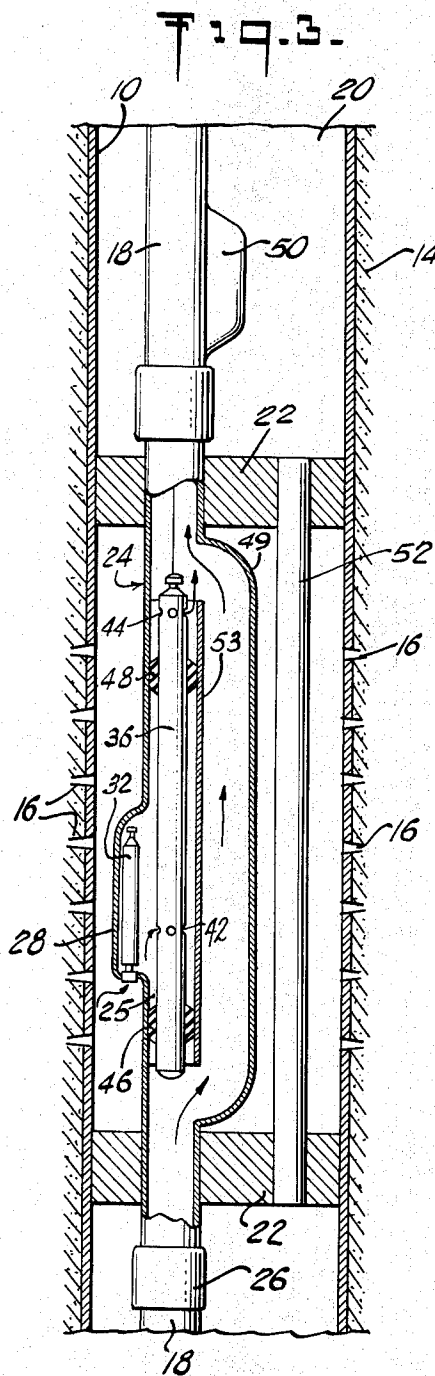
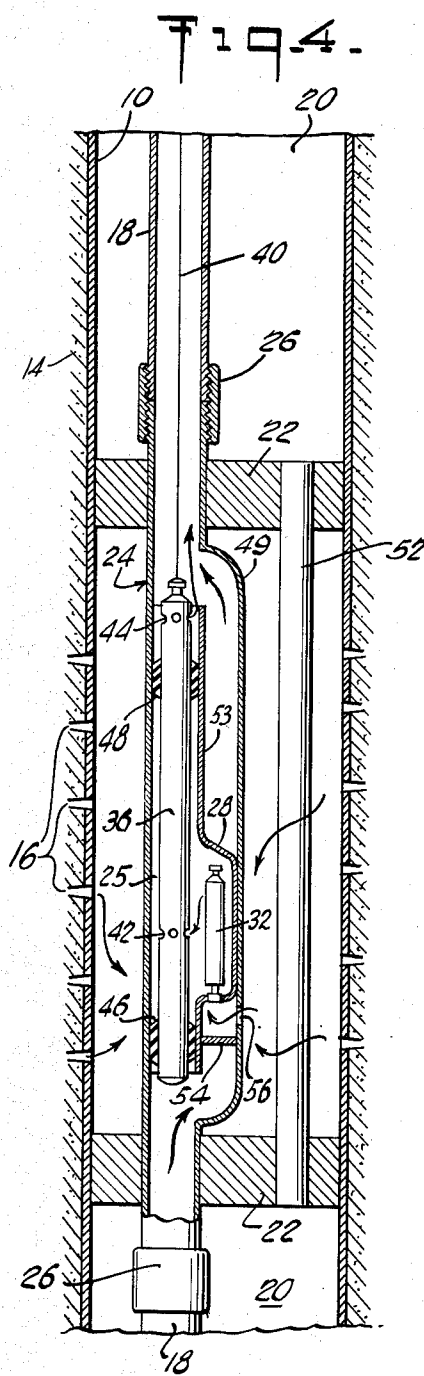
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D. L. HARLAN ETAL
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3,224,267

Filed April 27, 1962

3 Sheets-Sheet 2



Dec. 21, 1965

D. L. HARLAN ETAL
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3,224,267

Filed April 27, 1962

3 Sheets-Sheet 3

Fig. 5.

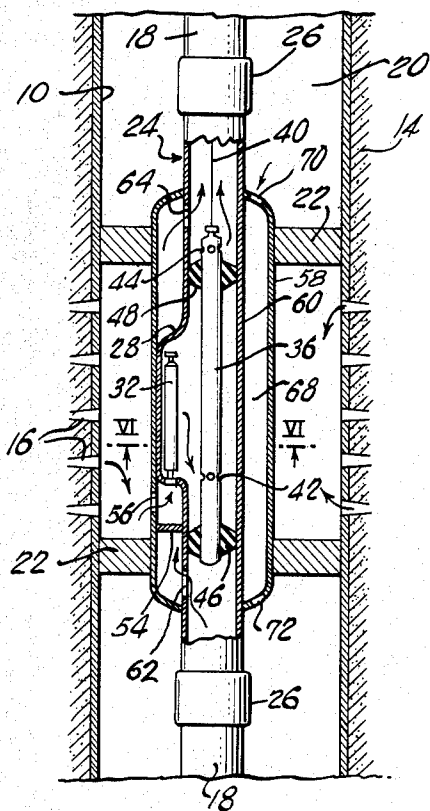
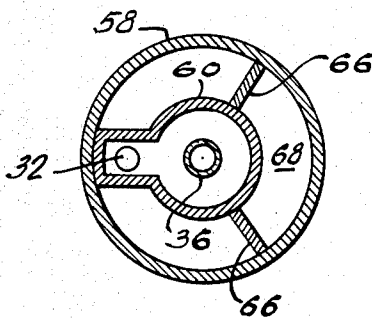


Fig. 6.



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WELL COMPLETION APPARATUS

Don L. Harlan, Houston, and Laurence M. Hubby, Bellaire, Tex., assignors to Texaco Inc., New York, N.Y., a corporation of Delaware

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12 Claims. (Cl. 73-155)

This invention relates to well completion, and more specifically, to apparatus for use in well completion. In its more specific aspects, the invention is directed to apparatus for controlled production of hydrocarbons from a plurality of hydrocarbon productive formations simultaneously through a single tubing string.

In well completion as envisioned by our invention, a single wellbore is drilled through a plurality of vertically spaced hydrocarbon productive formations which are separated by relatively impermeable, non-productive formations. A string of casing extends through the wellbore and is cemented in the hole by conventional methods. A tubing string is arranged in the well casing and extends from the surface and passes through a plurality of hydrocarbon productive formations. Vertically spaced apart packing members are arranged in the casing annulus to seal the wall of the casing and to isolate each hydrocarbon productive formation from the others. A mandrel, having an open tubing bore adapted for fluid communication with the bore of the tubing string upon connection thereto, is interposed in the tubing string and located in the proximity of an isolated hydrocarbon productive formation. The mandrel is provided with a suitable passageway or port for establishing communication between the interior thereof and the annulus of the well casing. In this manner, fluids from the productive formation are allowed to pass through the mandrel and flow to the surface through the tubing string. In the preferred embodiment, the mandrel is provided with a deformation forming a side pocket in the wall, and the passageway for establishing communication between the interior of the mandrel and the casing annulus is located in the side pocket. A flow regulating device is incorporated in the side pocket for regulating the flow of fluids from the productive formation and through the mandrel. A bypass is also provided around that section of the open tubing bore adjacent the pocket for reasons which will be apparent later.

A flowmeter which is adapted to be lowered in the tubing string is retrievably arranged in the mandrel. The flowmeter is provided with an inlet and outlet, and first and second spaced apart packers are located above and below the inlet. By reason of this arrangement of the packers, the annulus between the flowmeter and the mandrel is closed off, and the resulting fluid-tight seal prevents passage of fluids from lower hydrocarbon productive formations through the flowmeter, while directing fluids from the adjacent isolated productive formation through the flowmeter. A suitable bypass means is provided for separably directing the flow of fluids from productive formations below the isolated formation from which fluids are being metered past the flowmeter.

When the mandrel is interposed in the tubing string adjacent a productive formation and a flowmeter is arranged in the mandrel as explained above, fluids from the productive formation enter the mandrel through the flow regulating device and pass through the flowmeter on the way to the surface. Means is provided for receiving and recording the signals transmitted from the flowmeter to the surface. It is important that fluids from lower productive formations are separably directed through the bypass and past the flowmeter such that these fluids do not enter the flowmeter. Where it is desired to meter

another hydrocarbon productive formation, the flowmeter is raised or lowered in the tubing string by such means as a wire line and the flowmeter is positioned in another mandrel located adjacent an isolated hydrocarbon productive formation. Fluids from the formation, upon being lifted to the surface through the tubing string, are metered through the flowmeter.

The present invention will best be understood by referring to the following detailed specification and preferred embodiments thereof, and by reference to the accompanying drawings, in which:

FIGURE 1 shows an arrangement of the apparatus of the present invention in a cased well;

FIGURE 2 is a sectional view showing in greater detail one embodiment of the invention;

FIGURES 3, 4, and 5 are sectional views illustrating modified forms of the apparatus falling within the scope of the invention; and

FIGURE 6 is a transverse view, partly in section, taken on line VI-VI of FIGURE 5.

Referring to the drawings wherein similar numerals are employed to designate similar parts, numeral 10 designates a well casing which has been arranged in a wellbore 12 drilled from the earth's surface. As shown in FIGURE 1, the well casing penetrates a plurality of vertically spaced apart hydrocarbon productive formations as designated by the letters A, B, and C, which are separated by non-productive formations designated by the letters D, E, F, and G. The casing 10 is cemented in place with cement 14 by conventional methods, and the casing and cement are perforated at 16, i.e. gun perforated, at the level of the formations to be produced and to penetrate the hydrocarbon productive formations. Tubing string 18 is arranged in casing 10 and extends vertically from the well head (not shown). Casing annulus 20 is sealed by vertically spaced apart packing members 22 which are arranged in the casing to isolate a hydrocarbon productive formation. In general, the packing members are so arranged that the productive formation lies between a pair of spaced apart packing members such that the perforations 16 open to the annulus between the pair of packing members thereby isolating each hydrocarbon productive formation from the others.

For each productive formation, a mandrel, indicated generally at 24, is interposed in tubing string 18 in the proximity of the formation. Mandrel 24 is provided with a full open tubing bore 25 which is substantially coaxial with the bore of tubing string 18 and is adapted for fluid communication therewith. The connecting ends of mandrels 24 and tubing string 18 are externally threaded and joined by internally threaded couplings 26. Alternately, the mandrels and tubing string may be internally threaded at their respective ends and connected by means of an externally threaded nipple (not shown). Also, where desired, mandrel 24 may be coupled to tubing string 18 at junctures between a pair of packing members 22. Each mandrel is interposed in the tubing string adjacent an isolated hydrocarbon productive formation. Outwardly extending deformation forming a side pocket 28 in the wall of mandrel 24 is provided with at least one passageway or port 30 for establishing communication between that portion of the casing annulus isolated by a pair of packing members and the tubing bore 25 of the mandrel. Side pocket 28 extends for a length less than the entire length of the mandrel, and the longitudinal axis of the side pocket is eccentrically disposed with relation to the longitudinal axis of the tubing bore 25 of the mandrel. It should be understood, however, that the cross-section of the pocket may be substantially elliptical or circular. Retrievable choke 32, which desirably is adjustable, is arranged in side pocket 28 for regulating the flow of fluids

3

from the adjacent productive formation and for allowing communication between the casing annulus isolated by a pair of packing members and the tubing bore 25 of mandrel 24.

A sub-surface flowmeter 36 having a closed lower i.e., normally upstream end and an upper i.e. normally upstream end adapted to engage a fishing head or spear 38 is positioned in the tubing string and bore 25 of mandrel 24 by means of an electrically conductive wire line 40 connected to the fishing head. The flowmeter is retrievably arranged in mandrel 24 in the proximity of side pocket 28. The flowmeter is provided with at least one inlet port 42 and at least one outlet port 44, and more preferably with a plurality of said inlet and said outlet ports, to allow fluid communication between the mandrel in which the flowmeter is arranged and the interior of the flowmeter. First and second vertically spaced apart packers 46 and 48 are mounted on the flowmeter 36 and preferably are of the inflatable-deflatable type. The first packer 46 is mounted on the flowmeter below the inlet port 42 and the second packer 48 is mounted intermediate the inlet port 42 and the outlet port 44. Mandrel 24 is provided with a bypass comprising conduit 49 which is open to bore 25 at opposite sides of packers 48 and 46 for separably directing fluids from lower productive formations past the flowmeter.

Tubing string 18 is provided with a plurality of gas-lift mandrels 50 at vertically spaced apart intervals and desirably adjacent non-productive formations. The gas-lift mandrels are of conventional construction and are provided with a suitable valve, indicated generally at 51 of FIGURE 2, that admits gas to the interior of the tubing string from the casing annulus 20. Bypass members 52 having an open tubular bore extend vertically between a pair of packing members 22 and are open to casing annulus 20. When the well casing is pressured with gas to place the well on artificial lift, the gas bypasses each productive formation by means of bypass members 52. Thus, when the pressure in the productive formation is no longer sufficient to cause the fluids to flow to the surface and the well ceases to flow, compressed gas is forced into casing annulus 20 at the surface. The gas is admitted to the tubing string via valve 51 to allow artificial lifting of the fluids from the productive formation.

In operation, the sub-surface flowmeter 36 is lowered in the tubing string and arranged in the mandrel 24 adjacent the side pocket 28. The packers 46 and 48 mounted on the flowmeter are inflated to form a fluid-tight seal thereby preventing passage of fluids from lower hydrocarbon productive formations through the flowmeter. Fluids from the productive formation are admitted to the mandrel via choke 32 arranged in the side pocket. The fluids enter the flowmeter through the inlet ports 42 and pass upwardly and then out of the flowmetering device through outlet ports 44. The arrows in FIGURE 2 indicate the direction of flow. Although the embodiment illustrates upward flow of fluids through the flowmeter, it should be understood that the direction of the flow is dependent upon the type of flowmeter employed and therefore this direction may be downward. Upon passage of the fluids through the flowmeter, signals from the flowmeter are transmitted to the surface via line 40 where they are recorded. The data recorded depends upon the type of flowmeter employed, but the fluids from the productive formation may be metered, for example, for rate of flow, gas to oil ratio, basic sediment and water, volume, gravity and temperature.

There are illustrated in FIGURES 3 and 4 further modifications of our invention in which bypass 49 has a diameter substantially greater than the diameter of tubing bore 25 of mandrel 24 and is eccentrically disposed with relation to the longitudinal axis of the tubing bore 25 of the mandrel. As illustrated, cylindrical member 53, longitudinally disposed with relation to mandrel 24 and in fluid communication therewith, extends for a length less

4

than the length of bypass 49, and preferably abuts the wall of mandrel 24 along a longitudinal axis and is substantially co-terminous therewith. In the preferred embodiment, the bore 25 of cylindrical member 53 is substantially coaxial with the bore of tubing string 18. In this manner, bypass 49 houses cylindrical member 53.

By reason of the modification shown in FIGURE 4, pocket 28, protruding outwardly from the wall of cylindrical member 53, is oppositely disposed to the abutment of the wall of cylindrical member 53 and the wall of mandrel 24, and terminates along its vertical surface in abutment with the wall of bypass 49. Compartment 54 extends downwardly from pocket 28 and has a passageway 56 for establishing communication between the casing annulus and the interior of the pocket. Fluids from the adjacent isolated productive formation are directed through passageway 56 and choke 32 in pocket 28, and from there enter the flowmeter 36 arranged in cylindrical member 53 for metering. On the other hand, fluids from lower productive formations are directed upward through bypass 49 and, by reason of compartment 54, circumvent the side pocket 28. The arrows in FIGURE 4 indicate the direction of flow.

In another embodiment of our invention, there is shown in FIGURES 5 and 6 a mandrel indicated generally at 24 and comprising a shell 58 and a cylindrical member 60 concentrically arranged with relation to the longitudinal axis of the shell and extending longitudinally through the shell. The bore of cylindrical member 60 is substantially coaxial with the bore of tubing string 18 and is adapted for fluid communication therewith upon connection as by means of couplings 26. Pocket 28, protruding outwardly from the wall of cylindrical member 60, terminates along its vertical surface in abutment with the wall of shell 58. Where deemed desirable, packing members 22 may be arranged in the casing between the wall of casing 10 and the wall of shell 58, as shown in FIGURE 5. In addition, cylindrical member 60 is provided with lower and upper ports 62 and 64, respectively, for separably directing fluids from lower productive formations past the flowmeter 36. Shell 58 is further provided with a pair of spaced longitudinal wall members 66, FIG. 6, defining longitudinal passageway or channel 68, having upper and lower ports 70 and 72, FIG. 5, respectively, whereby the said passageway 68 is open to casing annulus 20.

In operation of the modification shown in FIGURE 5, fluids from the adjacent isolated productive formation are directed through passageway 56 of compartment 54 and choke 32, and from there enter flowmeter 36 arranged in cylindrical member 60 for metering. Fluids from lower productive formations are bypassed through the annulus of shell 58 and past the flowmeter, as with the other embodiments of the invention. When the well is placed on artificial lift, the gas used in pressuring the well casing bypasses each productive formation by means of passageway 68. The arrows in FIGURE 5 indicate the direction of flow.

It will be observed that our apparatus for use in well completion involves a number of advantages. The cased wellbore passes through a plurality of hydrocarbon productive formations, and consequently any number of the productive formations can be produced through a single tubing string. This facilitates drilling operations, and eliminates additional equipment and materials thereby rendering the operation more economical. Flow of fluids from each productive formation can be regulated or controlled individually, or completely shut-in, by adjusting or changing the choke arranged in the side pocket of the mandrel. Fluids from each formation can be metered individually and separately by means of the sub-surface, in-line flowmeter. In addition, each productive formation can be separately acidized, fractured, or the like, and the tubing string can be kept free of paraffin deposits by use of conventional mechanical

5

scrapping tools. The hydrocarbon fluids from productive formation can be initially flowed by pressure in the formation and subsequently artificially gas-lifted to the surface as required. State regulatory bodies usually require that the packing members be tested for leakage, and this may be readily accomplished by bleeding off the pressure from the annulus. In this manner, any leakage in the packing members may be detected.

Having thus described our invention generally and in terms of specific embodiments, we claim:

1. In a production well penetrating a plurality of vertically spaced, hydrocarbon bearing productive formations separated from each other by relatively impermeable, non-productive formations and having casing set in the bore thereof and with a single tubing string spaced within said casing to define an annulus therebetween, apparatus for multiple zone completion therein, comprising, in combination with said casing and said single tubing string,

a first means connected into said tubing string for controlling the individual hydrocarbon production fluid from each of said plurality of spaced hydrocarbon bearing productive formations, including a production fluid by-pass; and

a second means for interconnecting said non-productive formations bypassing said hydrocarbon bearing productive formations, comprising a bypass member;

said first means including spaced apart sealing means in said bore between said casing and said tubing string for isolating the hydrocarbon productive and non-productive formations from each other, and flow control means intermediate said sealing means and adjacent and in fluid communication with an isolated hydrocarbon bearing productive formation including devices for regulating and measuring hydrocarbon production fluid flow into said tubing string individually from each isolated hydrocarbon bearing productive formation;

each device for regulating production fluid flow of said flow control means comprising an adjustable choke having communication with said isolated hydrocarbon bearing productive formation, and each device for measuring production fluid flow of said flow control means comprising a flowmeter having inlet communication with respect to said choke and outlet communication with respect to said tubing string and isolated from inlet flow of production fluid therein;

said choke being housed in a side pocket in said tubing string intermediate said sealing means;

said flowmeter being housed within said tubing string adjacent said choke; and

a concentric shell around said tubing string enclosing said flowmeter and choke;

said sealing means isolating a hydrocarbon bearing productive formation from adjacent non-productive formations being positioned between said shell and said casing thereby defining separated annuli in said well;

said shell having a passageway permitting petroleum fluid flow between said hydrocarbon bearing productive formations and said choke, and passageways for bypassing production fluid in said tubing string around said choke and flowmeter and for interconnecting separated annuli exposed to nonproductive formations in said well.

2. Well completion apparatus for use in multiple zone completion using a single tubing string spaced in a casing in a well bore penetrating a plurality of vertically spaced hydrocarbon bearing productive formations separated by relatively impermeable non-productive formations comprising,

a first means for isolating said formations from each other,

6

a second means for providing sequential communication between each of the hydrocarbon bearing productive formations with each other and communication between each of the non-productive formations with each other, including an annulus by-pass, said second means supporting said first means, and

a third means for controlling the individual flow of production fluid into said tubing string from each hydrocarbon bearing productive formation and supported by said second means,

said first means comprising sealing means between said tubing string and said casing in said well bore,

said second means comprising a divided chamber-like structure surrounding said tubing string between two of said sealing means with one chamber therein having open communication with non-productive formations separated by a hydrocarbon bearing productive formation isolated by said two of said sealing means, and a second chamber therein for bypassing production fluid in said tubing string around said third means,

said third means comprising an adjustable choke having inlet communication with the isolated hydrocarbon bearing formation and a flowmeter having spaced packing means thereon positioned in said tubing string to provide inlet communications with respect to said choke and outlet communication with respect to said tubing string and to prevent inlet flow of production fluid in said tubing string into said flowmeter.

3. Apparatus for use in well completion which comprises, in combination,

a single tubing string in a wellbore spaced from the well casing thereof and passing through a plurality of vertically spaced hydrocarbon productive formations separated by relatively impermeable, non-productive formations;

packing members vertically spaced apart in said wellbore providing a sealed off section in the annulus between said well casing and said tubing string to isolate at least one of said hydrocarbon productive formations from others of said formations;

a mandrel connected into said tubing string in sequential fluid communication therewith located between said packing members and exposed to the isolated hydrocarbon productive formation;

said mandrel being provided with an inlet between two of said packing means for receiving production fluid from said isolated hydrocarbon productive formation;

means positioned in the mandrel inlet to control the flow of production fluid therethrough from said isolated hydrocarbon production formation;

a flowmeter adapted to be lowered into said tubing string and positioned in said mandrel, and provided with an inlet in communication with the aforesaid means to control the flow of production fluid and an outlet; and

a first packer located upstream said mandrel inlet and said inlet of said flowmeter to prevent passage of production fluid from lower hydrocarbon productive formations through said flowmeter, and a second packer located downstream said mandrel inlet and said inlet of said flowmeter providing a fluid-tight upstream seal to insure communication between said mandrel inlet and the flowmeter inlet and a fluid-tight downstream seal to prevent production fluid from said isolated hydrocarbon productive formation from bypassing said flowmeter;

said mandrel including bypass means for separately directing the flow of production fluid past said flowmeter from a hydrocarbon productive formation below said isolated formation from which production fluid is being metered.

4. Apparatus according to claim 3 wherein said means

to control production fluid flow comprises a choke disposed in said mandrel inlet to control fluid flow there-through to said flowmeter.

5. Apparatus according to claim 3 having

a plurality of gas-lift mandrels at vertically spaced apart intervals supported on said single tubing string and in communication with non-productive formations, said gas-lift mandrels having a valve for admitting gas under pressure to the interior of said tubing string, and

a second bypass means for establishing communication between the annuli on either side of said isolated hydrocarbon productive formation.

6. Apparatus for use in well completion which comprises, in combination,

a tubing string positioned in a well casing and passing through a plurality of vertically spaced, hydrocarbon productive formations separated by relatively impermeable, non-productive formations;

packing members vertically spaced apart on said tubing for sealing off the annulus between said tubing string and said casing and for isolating at least one of said hydrocarbon productive formations;

a mandrel connected sequentially into said tubing string between two of said packing members exposed to an isolated hydrocarbon productive formation and having a full open tubing bore substantially co-axial with the longitudinal axis of said tubing string for fluid communication with said tubing string on connection thereto;

an outwardly extending deformation in the wall of said mandrel defining a pocket and having an inlet intermediate said packing members for establishing communication with said annulus at said isolated hydrocarbon producing formation said pocket extending for a length less than the entire length of said mandrel;

a flowmeter adapted to be lowered in said tubing string and arranged in said mandrel, said flowmeter having a closed upstream end and being provided with an inlet and outlet;

a first packer mounted on said flowmeter upstream said inlet to prevent passage of production fluid from lower hydrocarbon productive formations through said flowmeter, and a second packer mounted on said flowmeter between said inlet thereof and said outlet thereof providing a fluid-tight seal to insure communication between said inlet thereof and said inlet of said pocket thereby to prevent production fluid from said isolated hydrocarbon productive formation from bypassing said flowmeter; and

a choke disposed in said pocket to control production fluid flow through said inlet of said pocket to said flowmeter;

said mandrel including bypass means for separately directing past said flowmeter the flow of production fluid from a hydrocarbon productive formation below said isolated hydrocarbon productive formation from which fluid is being metered.

7. Apparatus for use in well completion which comprises, in combination,

a single tubing string arranged in a well casing positioned in a production wellbore passing through a plurality of vertically spaced, hydrocarbon productive formations, separated by relatively impermeable, non-productive formations;

packing members vertically spaced apart on said tubing string for sealing off the annulus between said tubing string and said casing and for isolating at least one of said hydrocarbon productive formations;

a mandrel located between said packing members exposed to the isolated hydrocarbon productive formation and connected sequentially into said tubing string in fluid communication therewith;

said mandrel including a longitudinally disposed, cylin-

drical member having a full open bore, and a bypass means formed integrally with said cylindrical member and having a diameter greater than said cylindrical member whereby said bypass means houses at least a portion of said cylindrical member;

said cylindrical member having an inlet located intermediate said packing members for establishing communication between the annulus at said isolated hydrocarbon productive formation and the interior of said cylindrical member;

a flowmeter having an inlet and outlet adapted to be lowered in said tubing string and positioned in said cylindrical member;

a first packer mounted on said flowmeter upstream said inlet thereof to prevent passage of production fluid from lower hydrocarbon productive formations through said flowmeter, and a second packer mounted on said flowmeter downstream said inlet thereof providing a fluid-tight seal to prevent fluid from said isolated hydrocarbon productive formation from bypassing said flowmeter, said inlet of said flowmeter being in fluid communication with said inlet of said cylindrical member;

and a flow regulating means positioned in said inlet of said cylindrical member to control fluid flow there-through;

said bypass means being of sufficient length for separably directing past said flowmeter the flow of production fluid from a hydrocarbon productive formation below said formation from which production fluid is being metered.

8. Apparatus according to claim 7 wherein said cylindrical member is substantially coaxial with the longitudinal axis of said tubing string bore and said bypass means is eccentrically disposed with relation to the longitudinal axis of said cylindrical member.

9. Apparatus for use in well completion which comprises, in combination,

a single tubing string arranged in a well casing in a production wellbore passing through a plurality of vertically spaced, hydrocarbon productive formations, separated by relatively impermeable, non-productive formations;

packing members vertically spaced apart on said tubing string for sealing off the annulus between said tubing string and said casing and for isolating at least one of said hydrocarbon productive formations;

a mandrel connected into fluid communication with said tubing string between said packing members and in fluid communication with an isolated hydrocarbon productive formation;

said mandrel including a bypass means formed integrally therewith and eccentrically disposed with relation to the longitudinal axis of said mandrel; and

a cylindrical member having a full open bore longitudinally disposed therewithin and abutting the wall of said mandrel; said cylindrical member having a diameter less than the diameter of said bypass means and extending for a length less than the length of said bypass means whereby said bypass means houses said cylindrical member;

a pocket having an inlet and protruding outwardly from the wall of said cylindrical member disposed opposite the abutment between said cylindrical member with said mandrel and terminating along its vertical surface in abutment with the wall of said bypass means,

a choke disposed in said pocket to control fluid flow through said inlet of said pocket;

a flowmeter adapted to be lowered in said tubing string and positioned in said cylindrical member, said flowmeter having a closed lower end and provided with an inlet and outlet;

a first packer mounted on said flowmeter upstream said inlet thereof to prevent passage of fluid from lower

9

hydrocarbon productive formations through said flowmeter and a second packer mounted on said flowmeter between said inlet thereof and said outlet thereof providing a fluid-tight seal to ensure fluid communication between the inlets of said pocket and said flowmeter and to prevent fluid from said isolated hydrocarbon productive formation from bypassing said flowmeter;

said mandrel having a passageway providing for fluid flow from said isolated hydrocarbon productive formation to said choke disposed in said inlet of said pocket;

said bypass means being of sufficient length for directing separably past said flowmeter the flow of fluid from a hydrocarbon productive formation below said formation from which fluid is being metered.

10. Apparatus according to claim 9 having

a plurality of gas-lift mandrels at vertically spaced apart intervals on said tubing string and in communication with non-productive formations, said gas-lift mandrels having a valve for admitting gas under pressure to the interior of said tubing string, and

a second bypass means establishing communication between the annuli on either side of said one isolated hydrocarbon productive formation.

11. Apparatus for use in well completion which comprises, in combination,

a single tubing string arranged in a well casing in a production wellbore passing through a plurality of vertically spaced, hydrocarbon productive formations separated by relatively impermeable, non-productive formations;

packing members vertically spaced apart on said tubing string for sealing off sections of the annulus between said tubing string and said casing for isolating at least one of said hydrocarbon productive formations;

a mandrel connected into fluid communication with said tubing string between said packing members isolating the aforementioned one of said hydrocarbon productive formations;

said mandrel including a shell, and a cylindrical member concentrically arranged with relation to the longitudinal axis of said shell and extending longitudinally through said shell substantially coaxial with the longitudinal axis of said tubing string upon connection thereinto;

a pocket extending outwardly from the wall of said

10

cylindrical member and terminating along its vertical surface in abutment with the wall of said shell, and having a port;

said shell having a passageway leading to said port of said pocket for establishing fluid flow communication between the annulus at the isolated aforementioned one of said hydrocarbon productive formations and the interior of said cylindrical member; a choke disposed in said pocket adapted to control fluid flow through said port of said pocket;

a flowmeter adapted to be lowered into said tubing string and positioning in said cylindrical member; said flowmeter having a closed lower end and provided with an inlet and outlet;

a first packer mounted on said flowmeter upstream said inlet thereof to prevent passage of fluid from lower hydrocarbon productive formations through said flowmeter and a second packer mounted on said flowmeter between said inlet thereof and said outlet thereof providing a fluid-tight seal to insure fluid communication between the pocket port and the flowmeter inlet and to prevent fluid from said isolated aforementioned one of said hydrocarbon productive formations from bypassing said flowmeter; and

a bypass means extending longitudinally through said shell of sufficient length for separately directing past said flowmeter the flow of fluid from a hydrocarbon productive formation below said formation from which fluid is being metered.

12. Apparatus according to claim 11 having

a plurality of gas-lift mandrels at vertically spaced apart intervals on said tubing string and adjacent non-productive formations, said gas-lift mandrels having a valve for admitting gas under pressure to the interior of said tubing string, and

a second bypass means extending longitudinally through said shell establishing communication between the annuli on either side of said isolated one of said hydrocarbon productive formations.

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RICHARD C. QUEISSER, *Primary Examiner*.

DAVID SCHONBERG, *Examiner*.