# United States Patent [19]

**Vencil**

[11] **3,765,483**

[45] **Oct. 16, 1973**


[54] **METHOD AND APPARATUS FOR PRODUCING DUAL ZONE OIL AND GAS WELLS**


[75] Inventor: **Naylan N. Vencil,** Odessa, Tex.

[73] Assignee: **Dresser Industries Inc.,** Dallas, Tex.



[22] Filed: **Aug. 9, 1971**

[21] Appl. No.: **170,166**

[52] **U.S. Cl.** ..... **166/265,** 166/54.1, 166/313

[51] **Int. Cl.** ..... **E21b 43/00**

[58] **Field of Search** ..... 166/54.1, 265, 313



[56] **References Cited**

UNITED STATES PATENTS

| | | | |
|---|---|---|---|
| 2,910,002 | 10/1959 | Morgan | 166/54.1 |
| 3,283,570 | 11/1966 | Hodges | 166/313 X |
| 2,642,803 | 6/1953 | Morris et al. | 166/313 UX |



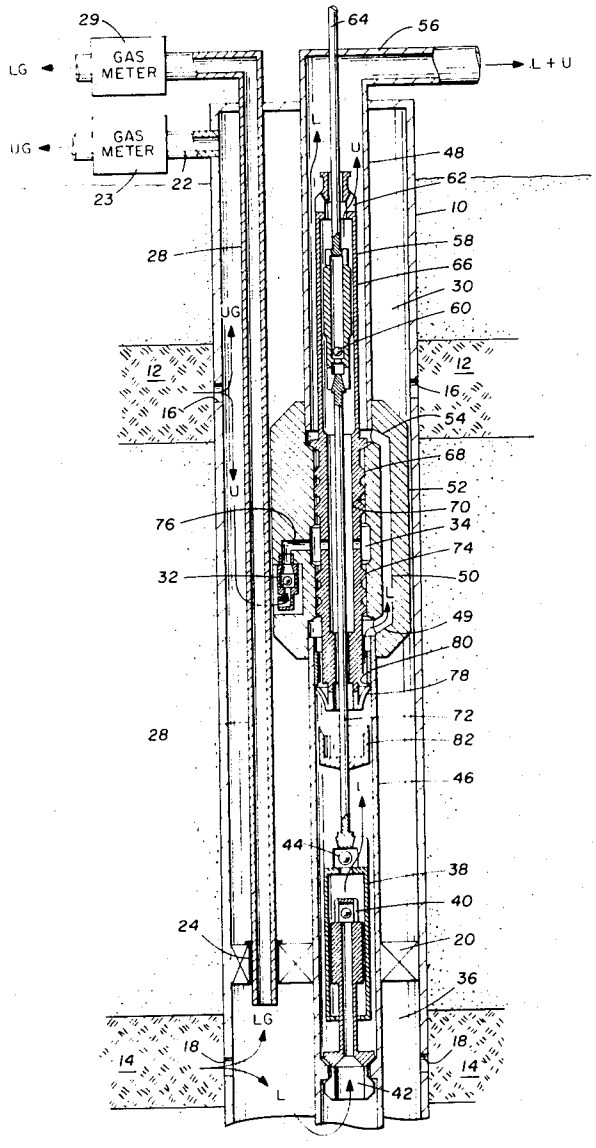
*Primary Examiner*—Marvin A. Champion
*Assistant Examiner*—Jack E. Ebel
*Attorney*—Robert W. Mayer et al.

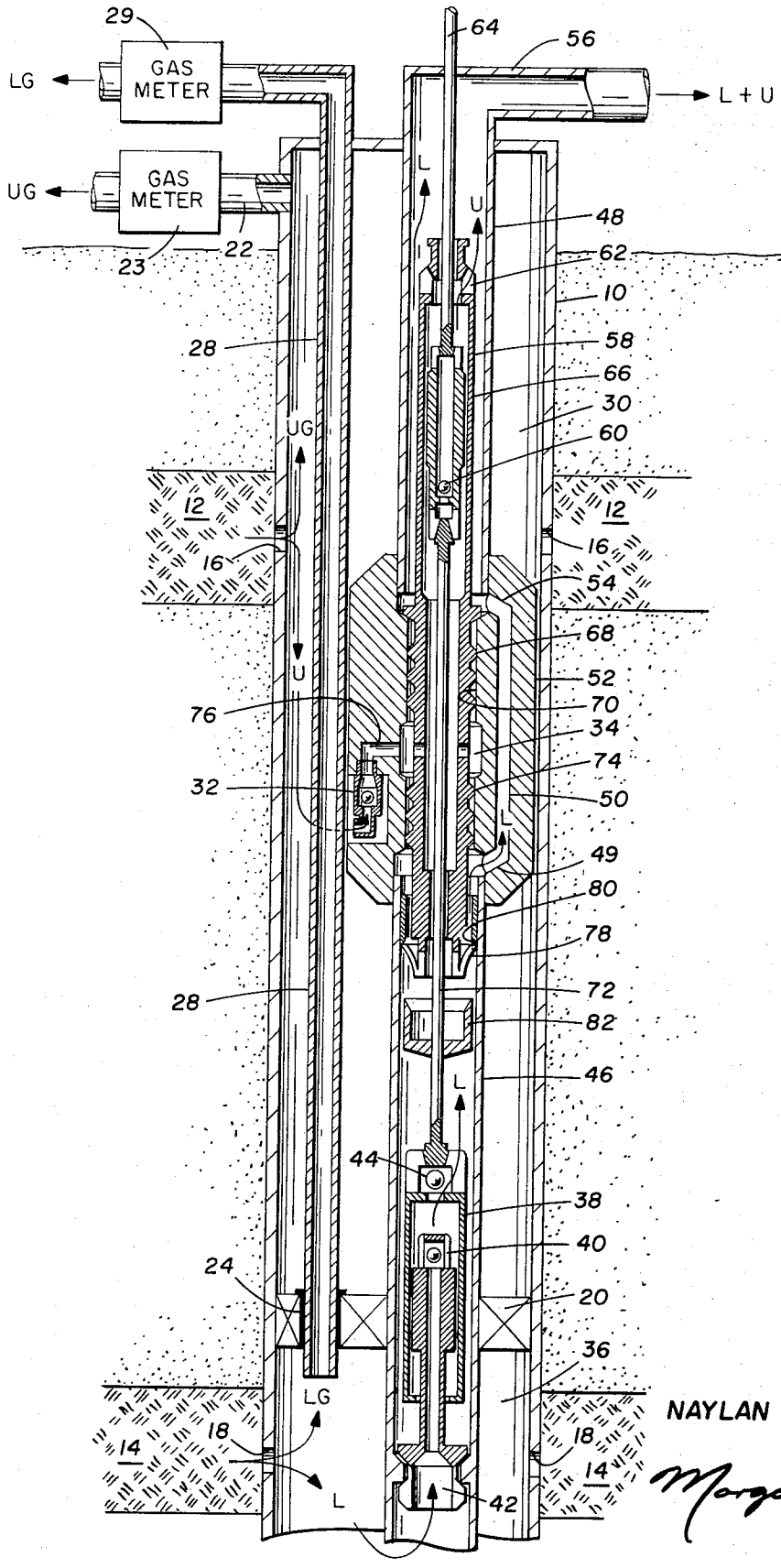


[57] **ABSTRACT**

Two oil and gas zones are produced by allowing production from each zone to drain to separate chambers where production from each zone is pumped by a separate pump; the outputs from the separate pumps are commingled and conducted to the earth's surface. A separate gas vent is provided for each zone to the earth's surface.


**3 Claims, 1 Drawing Figure**






INVENTOR:

NAYLAN N. VENCIL

Morgan L Crow

AGENT

# METHOD AND APPARATUS FOR PRODUCING DUAL ZONE OIL AND GAS WELLS

## CROSS REFERENCES TO RELATED APPLICATIONS

This application is related to my copending application "Method and Apparatus for Producing Multiple Zone Oil and Gas Wells," Ser. No. 163,795 filed July 19, 1972, and copending application "Method and Apparatus for Producing Multiple Zone Oil and Gas Wells," Ser. No. 163,855, filed July 19, 1972 by Nijah Frank Myers.

## BACKGROUND OF THE INVENTION

The field of the invention relates to dual zone wells which require both of the zones to be artificially lifted. This method and apparatus is suitable for wells producing oil, saltwater, fresh water or other liquid with or without natural gas in one or more of the zones.

A prior art device is shown in U.S. Pat. No. 2,618,339. This prior art device discloses apparatus for commingling multiple zone well production, the apparatus being arranged in the well so that the upper zone production travels down the casing and allows gas entrained in the liquid to break out and pass to the surface. No provision is made, however, for separate handling of the lower zone gas. The device does not provide a check valve to prevent high pressure in the lower zone from passing through the tool and into the upper zone where such liquid may not be recoverable. Also, the pump intake is positioned above the packer which is not necessarily a desirable position in the case of a low pressure, low production, lower zone. A further prior art device, shown in U.S. Pat. No. Re 26,319, discloses a flow control device for producing multiple zone wells which have sufficient drive in the producing zones to cause the fluid to flow into the well bore where it is metered through predetermined orifices and commingled at a point whereby gas from a higher pressure zone can assist in lifting production from a lower pressure zone. An additional prior art device, shown in U.S. Pat. No. 3,509,941, discloses a confluent producton apparatus wherein one zone or the other or both zones can be produced. Check valves are provided in the passages from each zone so that flow is prevented between the zones but no provision is made for separate handling of gas from the lower zone nor is the position of the pump intake desirable because the pump intake is above the packer between zones and is, therefore, above the lower zone. An additional prior art device, shown in U.S. Pat. No. 3,559,740, discloses method and apparatus for use with hydraulic pump and multiple completion well bores. This patent discloses a separate vent for the lower zone gas. It also discloses various selector heads which provide production from either one or both of the zones and provides for chokes to meter production from the zones. However, none of the prior art devices show or disclose apparatus which adequately drains production from zones in a multiple zone well, wherein one or more zones have such low pressure that production is reduced in total or in part by reason of hydrostatic pressure from another zone, or in a column of the liquid in the well bore being lifted from the zone to a pump intake.

It is a primary object of this invention to provide a dual zone producing arrangement which provides for individual pumping of a high pressure and a low pressure zone, and then for the commingling of the pumped liquids.



It is a further object of this invention to provide a dual zone producing arrangement which provides for individual lifting of each zone.

It is a further object of this invention to provide a dual zone production apparatus which provides separate venting of the gas from each zone.

It is a further object of this invention to provide a dual zone production apparatus which provides for separate measurement of the gas from each zone.

It is a further object of this invention to provide a multiple zone production apparatus which conserves hydrocarbons and prevents loss of fluid or gas from a high pressure zone into a lower pressure zone in the same well bore.

## SUMMARY OF THE INVENTION

These and other objects of this invention are fulfilled, broadly, with a dual zone producing apparatus and method which provides a separate pump for each zone and which then provides for the commingling of the fluids from the production zones at the discharge of the pumps.

## BRIEF DESCRIPTION OF THE DRAWING

The sole FIGURE is a view partially in elevation and partially in section of a well bore with well casing and apparatus according to this invention which may be used to produce a dual zone well.

## DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to the drawing of the preferred embodiment, casing **10** is shown in a well bore through two producing horizons **12** and **14.** Perforations **16** and **18** in the upper and lower producing zones, respectively, allow production from these zones to flow into the casing **10.** A packet **20** is sealingly engaged with the casing **10** between the perforations **16** and **18** to isolate the producing zones from each other. Gas from the upper zone **12** flows into the casing **10** through perforation **16** and is designated UG. Gas may be dissolved and/or entrained in the upper zone liquid production designated U. Some of the upper zone gas UG can break out of the liquid U and flow upward through the casing **10** to be gathered from outlet **22** in the casing at the top of the well bore. The volume of UG gas passing through this outlet is measured with gas meter **23** and then used for gas lift purposes, sold into a pipeline, or used for other purposes. Production gas LG from lower zone **14** flowing into casing **10** through perforations **18** may flow upward into a seal nipple **24** sealingly engaged to packer **20** and tubing string **28** which extends to the top of the well bore where it may be measured by gas meter **29** and disposed of in one of the ways mentioned for the UG gas. Liquid production U from the upper zone can gravitate or flow downward through annulus **30** to check valve **32** which is incorporated in the flow path for liquid U permitting flow into chamber **34** from the upper zone but preventing back flow from chamber **34** to annulus **30.** Lower zone liquid production L flows into casing **10** through perforations **18** and flows through annulus **36** through intake port **42** into pump **38.** Check valve **40** in pump **38** prevents back flow into liquid to lower zone **14.**

Lower production L then flows into lower pump **38** which lifts lower production L and discharges the liquid

through check valve **44** which acts as a discharge port from pump **38.** Liquid L then flows up through the lower portion **46** of tubing string **48,** and then through a side port **49** into a passageway **50** in body **52.** Lower production L then continues upward and passes through port **54** into the upper portion of tubing string **48** through which it is conducted to the top of the well bore and is produced into a flow line connection **56.** The upper zone pump **58** receives upper zone production through check valve **32** and chamber **34.** The liquid then flows up into pump **58** where it is lifted and discharged through check valve **60.** Upper zone production U flows upward and out discharge port **62** inside tubing string **48** where upper zone production U and lower zone production L are commingled and conducted to the surface to be carried away in flowline connection **56.** The upper zone pump **58** and lower zone pump **38** are operated by a conventional sucker rod string **64** which is reciprocated by a pumping jack (not shown) or other apparatus well known to those of ordinary skill in the art.

Plunger pumps may be of the traveling plunger variety with a stationary barrel or may be of a traveling barrel variety with a stationary plunger according to the needs of a particular installation. In the instant invention, the sole FIGURE illustrates the upper pump of the stationary barrel and traveling plunger variety. Upper pump **58** has a stationary barrel **66** which is anchored to a conventional seating nipple **68** which is well known to those of ordinary skill in the art. The seating nipple **68** anchors the stationary portion of the upper pump and forms a seal with body **52** in the main passageway **70,** a portion of which forms chamber **34.** A polish rod **72** connects the movable portions of the upper and lower pumps and provides for reciprocating the movable portion of lower pump **38** along with the reciprocation of the movable portion of upper pump **58.** A lower seal means **74** is provided in the passage **70** in body **52.** The seal means **74** sealingly engages the lower portion of passage **70** below the side port **76** which connects check valve **32** to chamber **34** and provides a moving seal with polish rod **72** to isolate passage **70** between side port **76** and lower port **49.** Upper seating nipple **68** seals side port **76** from upper port **54** to provide a seal between intake side of the upper pump **58** from the discharge port **62** of the upper pump **58.** collet **78** is connected to lower seal means **74** and mechanically engages shoulder **80** to provide a mechanical lock to hold lower seal means **74** in position while polish rod **72** reciprocates therein. A tubular release mechanism **82** is attached to lower end of polish rod **72** to collapse collet **78** to a diameter smaller than the diameter of shoulder **80** when the dual zone pump assembly is lifted by sucker rod string **64** for withdrawal from the tubing string, providing for complete recovery of the dual zone pump assembly for service simply by withdrawing the assembly on the sucker rods when service is required. A lower landing nipple is provided in the tubular string **46** below the body **52** to seal the stationary portion of the lower pump **38** to the tubular string **46.**

A dual zone producing apparatus according to this invention which provides a dual zone pump with separate pump elements for each zone is adaptable for a well which has differing producing zone pressures. Referring to my copending application, Ser. No. 163,795, filed July 19, 1972, entitled Method and Apparatus for Producing Multiple Zone Oil and Gas Wells, a chamber is disclosed for receiving production which drains from the multiple zones. A single pump then lifts the fluid from this chamber in which production from the various zones is commingled. In a well apparatus such as this, if one zone has a significantly higher pressure than the other zone, it would be possible for the higher pressure zone to maintain such a large pressure in the chamber where the production is commingled such that the lower pressure zone would not have adequate pressure to cause flow into the common chamber thereby preventing or reducing production from the lower pressure zone. Apparatus according to the instant invention, however, provides for a separate pump for each zone so that zones of different pressures may be pumped, each zone with its own pump, providing commingling of the pumped fluids so that the higher pressure in one zone will not affect the drainage and production from the lower pressure zone.

Commingling the produced liquids provides a completion which can be installed at much lower cost than a completion which provides for separate production of each zone to the surface.

Some state regulatory authorities have previously required separate production and measuring of liquids from each zone before the liquids are mixed. Current testing methods which determine the production rate from the various zones are now being recognized and permitted by these regulatory authorities whereby commingled production from a well can be allocated to the various zones based on individual production testing from each zone.

Provision of the parallel tubing string **28** with the second passage through packer **20** is an optional feature which may be incorporated if there is sufficient gas produced from a lower zone to require a separate vent for the lower zone gas LG.

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

**1.** In multiple zone well production and commingling apparatus comprising:

a well casing passing through upper and lower producing zones in a well bore, said casing having upper and lower openings through which production from said upper and lower zones can flow, respectively, into the well casing;

barrier means in said casing between said upper and lower openings, said barrier means having a longitudinal passage;

a tubular string having upper and lower sections, said tubular string extending from the top of the well bore to said barrier means and communicating with and secured to said longitudinal passage;

body means interposed between said upper and lower sections of said tubular string and located above said barrier means, said body means having a first longitudinal passageway and a side port extending from said first longitudinal passageway to the exterior of said body, said body means further having a second longitudinal passageway, said second longitudinal passageway having an upper port communicating with the upper section of said tubular string, said second passageway having a lower port communicating with the lower section of said tubular string which communicates with said second longitudinal passage and said lower zone;

an upper plunger pump in said tubular string and having a movable portion and a stationary portion;

a lower plunger pump located in said tubular string below said upper pump and having a movable portion and a stationary portion;

upper seal means for sealing the stationary portion of said upper plunger pump to said body between said side port and said upper port;

a polish rod connecting the movable portion of said upper pump to the movable portion of said lower pump;

lower seal means for sealing said polish rod to the lower end of said first longitudinal passageway between said side port and said lower port; and

lower landing nipple means in said tubular string located below said body for sealing the stationary portion of said lower pump to said tubular string.

**2.** Apparatus according to claim **1** further comprising:

a second passage in said barrier means; and

a second tubular string communicating with said second passage in said barrier means and extending to the top of the well bore for conducting gas from the lower zone to the top of the well bore.

**3.** In dual zone pumping and commingling apparatus adapted to be operated in a tubular string having upper and lower sections located in a well bore having casing passing through two producing zones and having a packer in the casing between the producing zones, the packer being connected to the tubular string, the improvement comprising:

a body having at least two longitudinal passages, said first passage aligned and connected to said tubular string, said body interposed between said upper and lower sections of the tubular string intermediate the packer and the top of the well bore, said body having a side port connecting said first passage to the exterior of said body, said second longitudinal passage having an upper port communicating with said upper section of said tubing string, said second passage having a lower port communicating with the lower section of said tubular string and the zone beneath said packer;

a check valve controlling flow in said side port, allowing upper zone production to flow into said first passage and preventing reverse flow;

an upper plunger pump in said tubular string, having a stationary portion, a movable portion, an intake port and a discharge port;

a lower plunger pump in said tubular string, having a stationary portion, a movable portion, an intake port and a discharge port;

a polish rod connecting the movable portion of said upper plunger pump to the movable portion of said lower plunger pump;

upper seating nipple means sealing and connecting the stationary portion of said upper plunger pump to said body between said side port and said upper port;

said upper plunger pump having said intake port communicating with said first passage above said upper seating nipple means and having said discharge port communicating with the tubular string above said upper seating nipple means;

seal means for sealing said polish rod to the lower rod of said first longitudinal passage

between said side port and said upper port;

lower seating nipple means sealing and connecting the stationary portion of said lower plunger pump to the tubular string; and

said lower plunger pump having said intake port communicating with the tubular string below said lower seating nipple means, and having said discharge port communicating with the tubular string above said lower seating nipple means and below said body.

* * * * *

PO-1050
(5/69)

# UNITED STATES PATENT OFFICE
# CERTIFICATE OF CORRECTION

Patent No. 3,765,483 Dated October 16, 1973

Inventor(s) Naylan N. Vencil

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

In claim 3 at column 6, line 26, delete "rod" at its second occurrence, and insert therfore -- end --.

Signed and sealed this 9th day of April 1974.

(SEAL)
Attest:

EDWARD M.FLETCHER,JR.
Attesting Officer

C. MARSHALL DANN
Commissioner of Patents