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SINGLE TUBING STRING DUAL INSTALLATION

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FIG. 1.

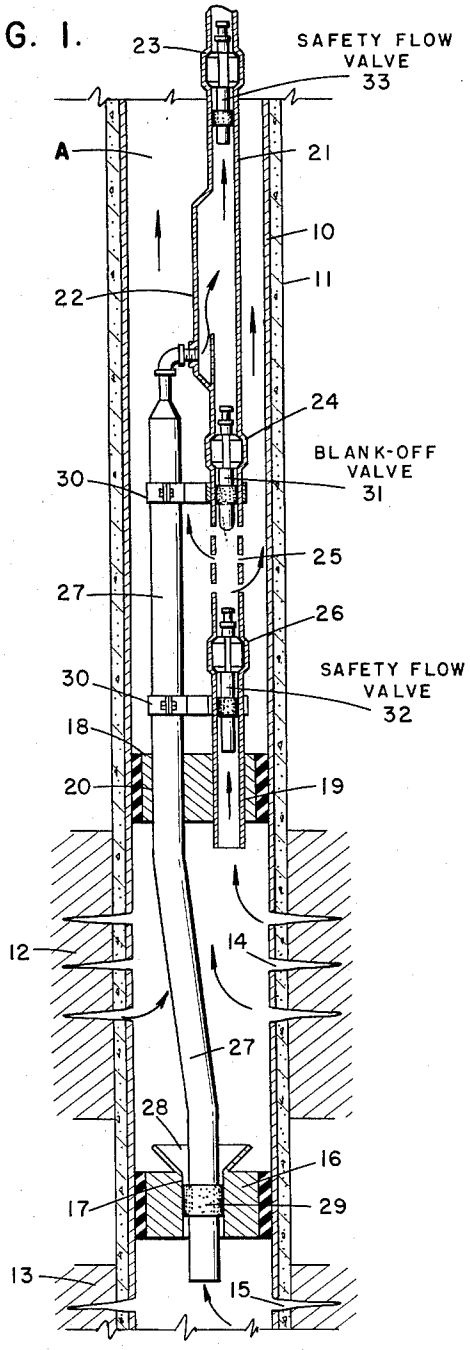
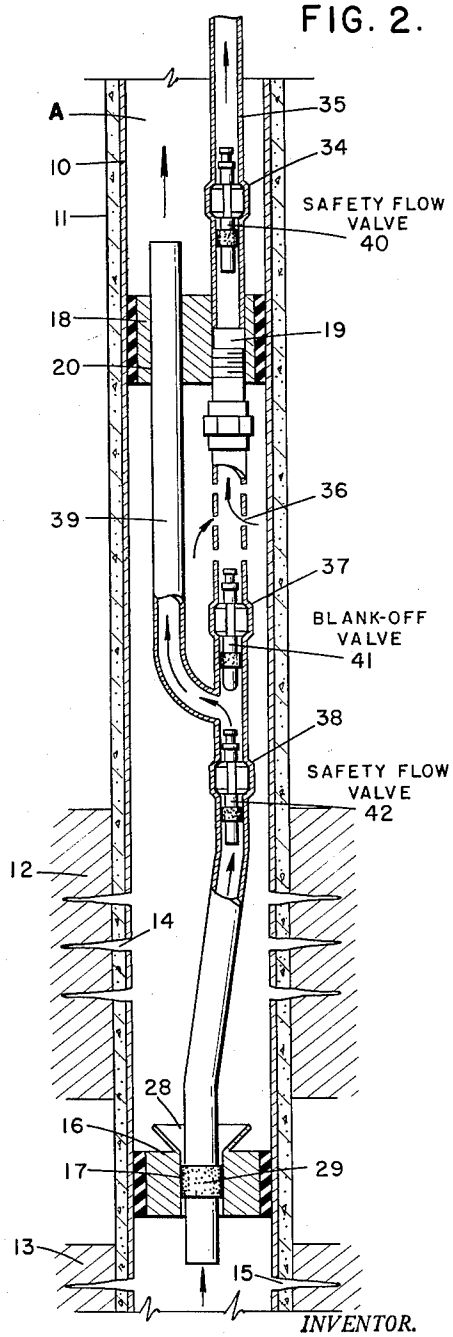



FIG. 2.

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# SINGLE TUBING STRING DUAL INSTALLATION

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This invention is directed primarily to an installation for producing upper and lower hydrocarbon productive intervals. More particularly, the invention is concerned with single tubing string dual completions wherein safety valves may be required for controlling both the upper and lower interval production fluids.

It is known to equip wells with subsurface safety valves to stop the flow of production fluids when for some reason the wells' production cannot be controlled. Valves of this type have been especially useful in offshore wells to prevent blowouts when excessive flow from the well resulting from damage to the well head or other surface equipment caused by storms, floating objects, or other happenings necessitate halting of production.

These valves may be flow velocity operated; that is, they may be designed to close off production flow when the velocity of the fluids flowing through the valve reaches a predetermined value. However, other type valves may be employed. The type completion to which the invention refers and of which two embodiments are illustrated is that wherein two spaced-apart productive intervals are completed utilizing a single tubing string extending to the earth's surface. Separate flow paths are provided for the upper and lower intervals, one of the flow paths being through the tubing-casing annulus and the other flow path being through the single tubing string.

Either of the installations shown may be equipped with permanent type completion apparatus for working over the lower or the upper interval as the case may be.

A full discussion of permanent well completion operations may be found in "Permanent Type Completions and Wire Line Workovers," The Petroleum Engineer, September 1956.

In one embodiment of the invention, the upper zone or interval is produced through a perforated nipple and the single tubing string and the lower zone is produced through a pipe section and the tubing casing annulus. In another embodiment, the upper zone is produced through a perforated nipple and the tubing casing annulus and the lower zone is produced through a pipe section and the tubing string. Thus, the producing flow paths are reversed in each of the embodiments. Safety valves are provided for each flow path.

An object of this invention is to provide improved apparatus for producing a plurality of hydrocarbon productive intervals of a dually completed well while providing the separate flow paths with safety valves.

This and other objects of the invention will be apparent from the following description thereof taken in conjunction with the drawings wherein:

FIG. 1 is a cross-sectional view of a well bore having therein dual completion apparatus arranged according to one embodiment of the invention; and

FIG. 2 is a view similar to that of FIG. 1 showing the dual completion apparatus arranged in the well bore according to another embodiment of the invention.

Referring more particularly to the drawings wherein identical numerals designate identical parts:

A casing **10** is shown in FIGS. 1 and 2 arranged in a borehole **11**. Cased borehole **11** penetrates spaced-apart hydrocarbon productive zones or intervals **12** and **13**. Casing **10** and intervals **12** and **13** are perforated as at **14** and **15**, respectively.



A lower casing production packer **16** provided with a bore **17** therethrough is positioned between upper and lower zones **12** and **13**, respectively.

An upper casing production packer **18** provided with dual bores **19** and **20** is positioned above upper zone **12**.

In FIG. 1, a tubing string **21**, which may be provided with a gas-lift mandrel **22**, extends from the earth's surface, not shown, through bore **19** of packer **18**. Tubing string **21** below mandrel **22** is provided with an upper landing nipple **24**, a perforated section **25**, and a lower landing nipple **26**. Above mandrel **22**, tubing string **21** is provided with a landing nipple **23**. An open-ended pipe string **27** is connected to pipe string **21** adjacent mandrel **22** at its upper end and extends through bore **20** of packer **18** and through bore **17** of packer **16**.

In a desired mode of operation, packer **16** is initially run on a wire line and set between zones **12** and **13**. Pipe strings **21** and **27** are connected together, and packer **18** is arranged thereon. The two pipe strings are then run together until pipe string **27** stabs through bore **17** of packer **16**. A guide member **28** may be provided on packer **16** to facilitate stabbing of pipe string **27** through bore **17**. Also, pipe string **27** is provided with a pack-off **29** to seal off the space between the wall of bore **17** and pipe string **27**. Straps **30** may be employed to strap pipe strings **21** and **27** together to aid in the running-in operation. A suitable plug choke or blank-off **31**, a safety flow valve **33** and a safety flow valve **32** are run on wire lines and arranged respectively in landing nipples **24**, **23** and **26**. Safety valve **33** could be located in mandrel **22** instead of in landing nipple **23** if desired.

In the operation of the embodiment of FIG. 1, the flow path for production fluids from zone **13** is up pipe string **27** into pipe string **21** above the plug **31** and thence upwardly through tubing string **21** and through safety valve **33**. Flow of production fluids from upper zone **12** is upwardly through the lower end of tubing string **21**, through safety valve **32**, through the openings or perforations in the perforated section **25** and thence upwardly to the surface of the earth through the tubing-casing annulus A. Thus, although one flow path is through the tubing-casing annulus, both flow paths are provided with safety valves.

In FIG. 2, the flow paths are reversed. A tubing string **35** extends from the earth's surface through bore **19** of packer **18** and through bore **17** of packer **16**. Again, a pack-off **29** is employed to close off the space between tubing string **35** and the wall of bore **17** and guide means **28** may be provided to facilitate stabbing pipe string **35** through bore **17**. Tubing string **35** is also provided with a landing nipple **34** above packer **18**, a perforated nipple **36** below packer **18**, another landing nipple **37** below perforated nipple **36**, and a third landing nipple **38** positioned below landing nipple **37**. A pipe string **39** connects to pipe string **35** between landing nipples **37** and **38** and extends upwardly through bore **20** of packer **18**. A safety valve **40**, a plug choke or blanking plug **41** and another safety flow valve **42** are run on wire lines and arranged, respectively, in landing nipples **34**, **37** and **38**.

Production fluids from the lower zone in this embodiment flow through perforations **15** upwardly through the lower portion of tubing string **35**, through safety flow valve **42**, through pipe string **39**, and upwardly through annulus A between tubing string **35** and casing **10**. Flow of production fluids from the upper zone **12** is through perforations **14**, through perforations in the perforated nipple **36** upwardly through safety valve **40** and through the upper portion of the tubing string **35** to the earth's surface. Thus, in this embodiment, also both flow paths are provided with safety valves although one of the flow

paths is substantially through the tubing-casing annulus.

The equipment described in this application is well-known in the art as, for example, the safety valves, blanking plugs, and dual bore and single bore packers; therefore, neither a detailed description of this equipment nor specific reference to any particular equipment has been made.

Having fully described the nature, objects, and apparatus of my invention, I claim:

Apparatus for producing hydrocarbons from upper and lower spaced-apart subsurface hydrocarbon productive intervals penetrated by a well bore to the earth's surface through isolated flow paths comprising one pipe string arranged in said borehole and extending from the earth's surface to above and adjacent said upper productive interval; another pipe string connected to said one pipe string along the length thereof, offset therefrom, and extending to below said upper productive interval; an upper dual-bore packer arranged on said pipe strings above said upper productive interval closing off the space between said pipe strings and the well bore wall; a lower single-bore packer arranged on said other pipe string between said upper and lower productive intervals closing off the space between said other pipe string and the well bore wall; said one pipe string having perforations below the interconnection between said pipe strings fluidly communicating the interior of said one pipe string and the space surrounding said pipe strings;



a plug arranged in said one pipe string above said perforations in said one pipe string but below the connection between said pipe strings for preventing fluid flow upwardly therepast and to direct fluid flow through the pipe strings to establish isolated flow paths for hydrocarbon fluids flowing from each of said productive intervals to the earth's surface; one safety flow valve arranged in said one pipe string below the perforations in said one pipe string for controlling fluid flow upwardly through said one safety valve; and another safety flow valve arranged in said one pipe string above the interconnection between said pipe strings for controlling fluid flow upwardly through said other safety valve such that fluids from said upper productive interval flow through said one safety valve and said perforations and the space between said one pipe string and the borehole wall to the earth's surface and fluids from said lower production interval flow upwardly through said other pipe string, said other safety valve, and said one pipe string to the earth's surface.

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