Packer Hookups for Triple and Quadruple Completions

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INTRODUCTION

Since the cost of producing oil is continually increasing, oil operators have found themselves in a position of having to determine more economical production methods in order to make a profit. One of the first steps in this direction was the dual completion which enabled the operator to produce two zones, isolated from each other, through the same well bore, at the same time. Although the dual completion is not necessarily new, vast improvements have been made both in technique and equipment and a present day dual completion, producing through parallel strings of tubing is quite commonplace. The dual completion therefore provided the basic principle of multizone completions and was the forerunner of triple and quadruple completions.

Also, since the economic aspect of the dual completion has been proved, it was felt that further development in technique and equipment would enable operators to produce three or four zones, isolated from each other, through the same well bore, at the same time, thus providing additional economic gains. Although triple completions are not an everyday occurrence they are no longer a novelty and several quadruple completions have been made successfully.

It is the purpose of this paper to present several methods by which three or four zones, isolated from each other, may be produced through the same well bore.

BASIC TRIPLE USING TWO PACKERS AND TWO STRINGS OF TUBING

The basic triple consists of a conventional dual completion using parallel strings of tubing, with the bottom two zones being produced individually through each string of tubing and the top zone being produced between the annular area of the tubing strings and casing above the top packer. The selection of packers and downhole equipment may vary as to the preference of the operator but the following packer installation will enable the operator to produce the well in the above mentioned manner. The use of two drillable retainer type packers and flow tube is quite common. (See Fig. 1) A bottom drillable retainer type packer and top retrievable parallel string packer may be used depending upon conditions. (See Fig. 2) Also a retrievable bottom packer and retrievable top parallel string packer may be used if desirable. (See Fig. 3)

If conditions are such that it is not desirable to produce the top zone through the tubing-casing annular area, a third string of tubing may be run in open ended, through which the top zone can be produced. Any of the above mentioned installations will enable the operator to produce three zones at the same time through one well bore. Various landing nipples and sleeve valves may be incorporated with any of the installations to facilitate completion and control of the well.

If it is not desirable to produce the top zone through the tubing-casing annular area, an additional bottom packer can be added to the conventional dual hookup (See Fig.'s 1, 2, and 3); with the use of landing nipples and sleeve valves selective flow of two zones, through one string of tubing, can be accomplished. This will allow production of three zones through one well bore but not all at the same time.

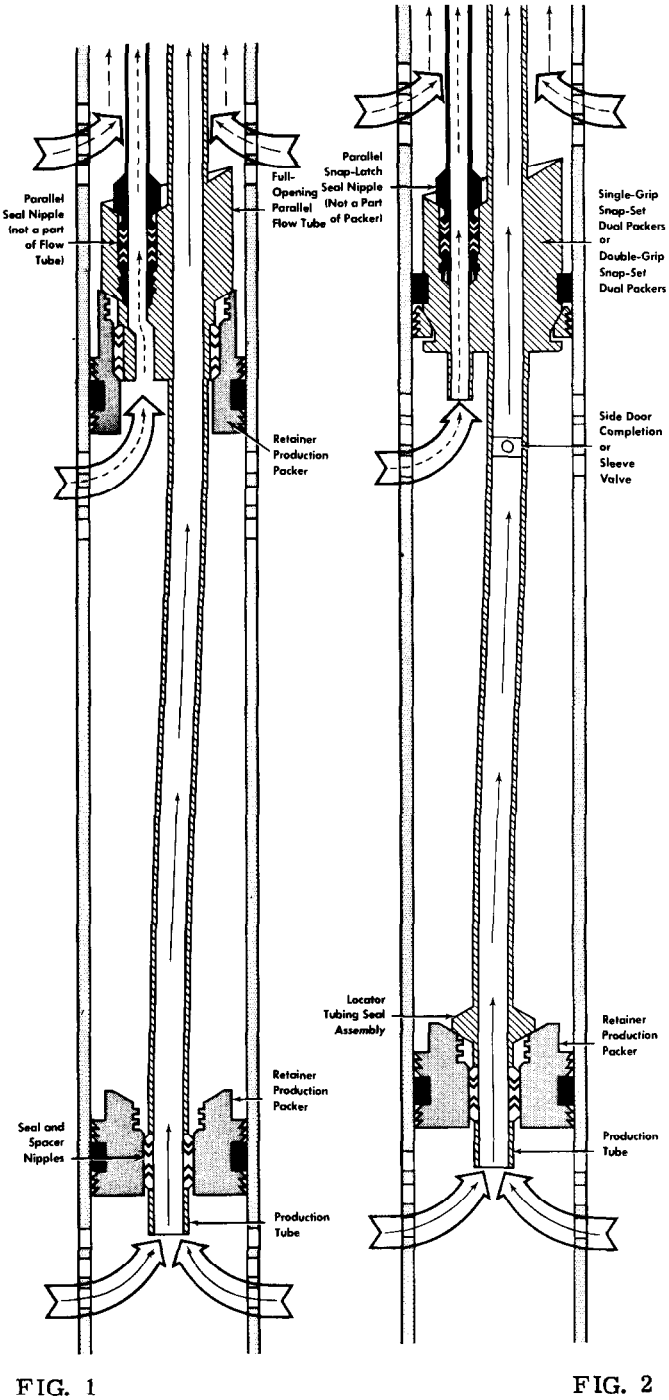


FIG. 1

FIG. 2

TRIPLE USING THREE PACKERS AND THREE STRINGS OF TUBING

The ultimate triple enables the operator to produce three zones, isolated from each other, through three different strings of tubing, all zones being produced at the same time. (See Fig. 4)

Three retainer type production packers can be used on this type installation; the top packer is the same type used as the top packer for the parallel string completion. It has a bore of two ID's; the middle packer has the same ID bore as the smalled ID bore of the top packer; and the bottom packer has a smaller ID bore than that of the middle packer. The flow tube, which is run on the primary string and lands in the top bore of the top packer, has an outer tube extending from the top of the flow tube to the middle packer, and an inner tube to the bottom packer. Both tubes have seals on the end to seal off the respective packers.

All three packers are set at predetermined depths, and the primary string with flow tube is run and seated in the top packer; this automatically positions the seals for the middle and bottom packer in place. Seal nipples of different OD's are made up on the remaining two strings of tubing. They are run selectively and seated in their appropriate bores in the top of the flow tube, the middle zone producing through the intermediate short string, and the top zone through the short string.

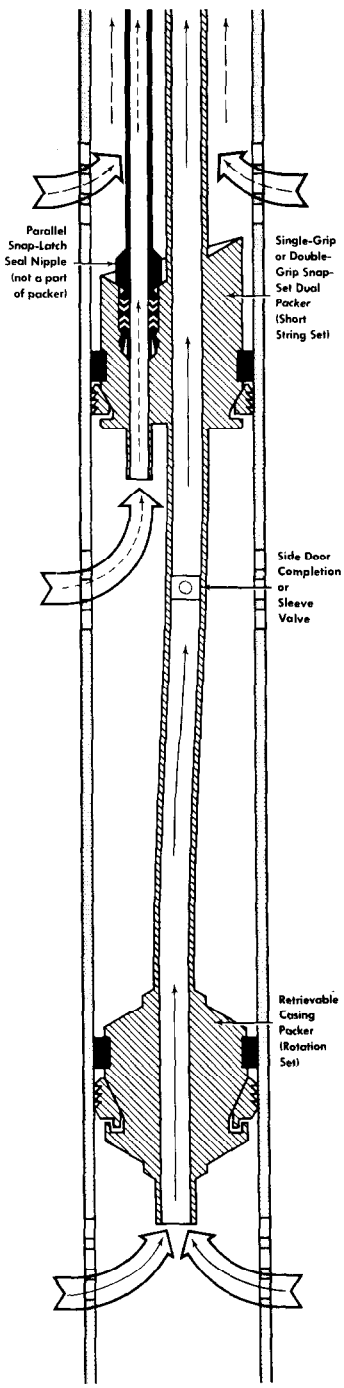


FIG. 3

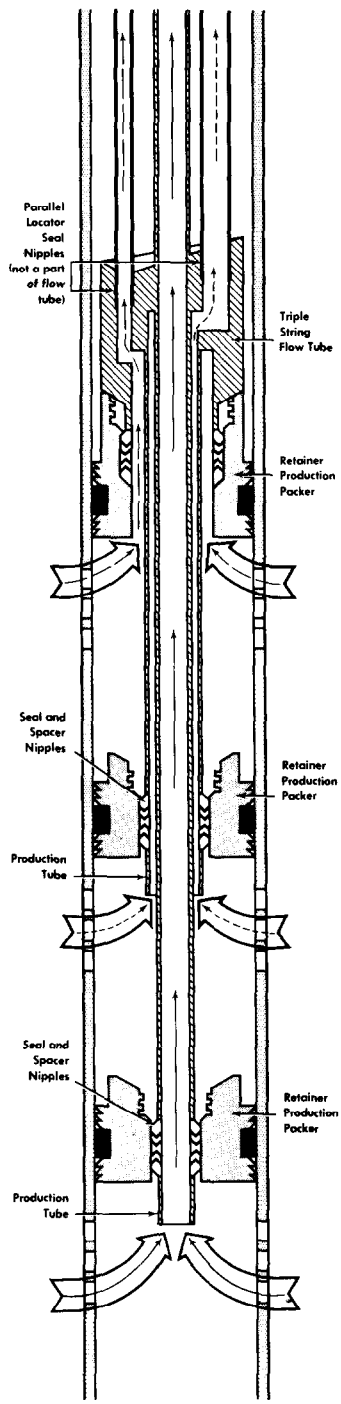


FIG. 4

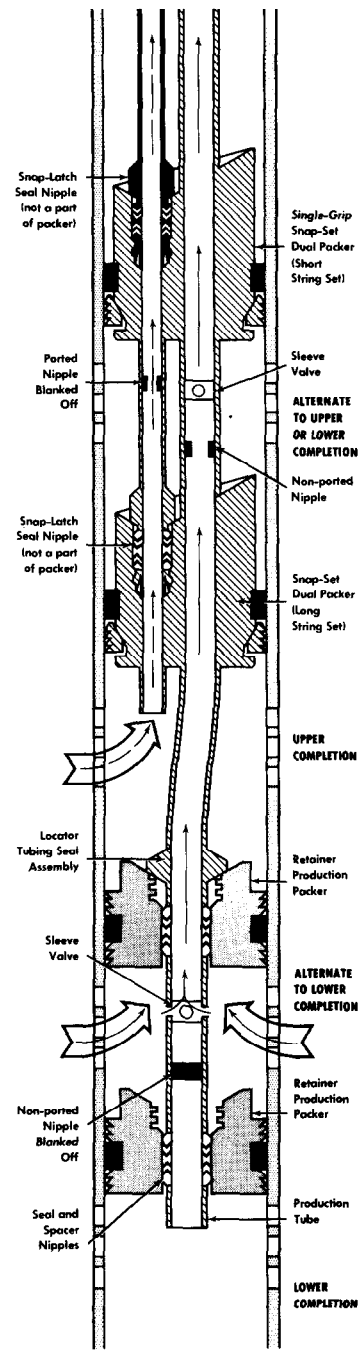


FIG. 5

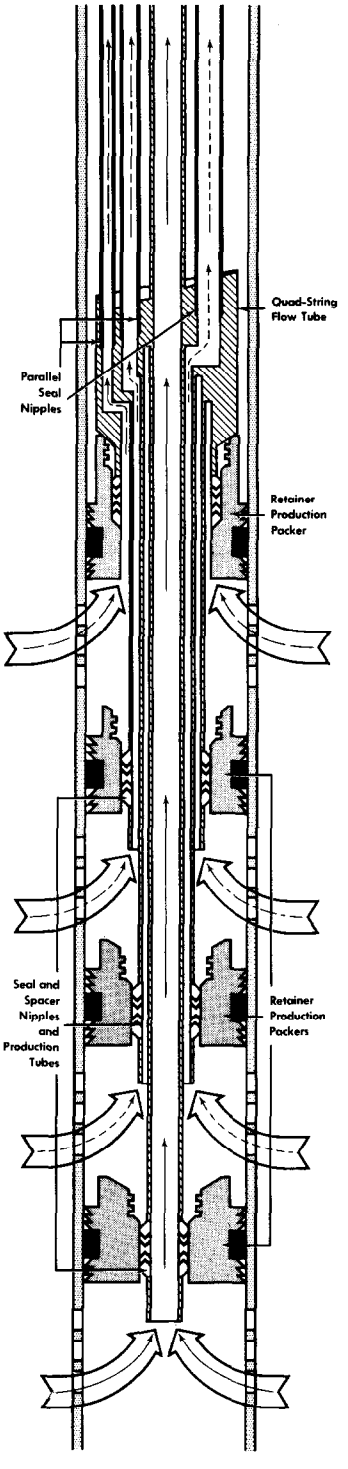


FIG. 6

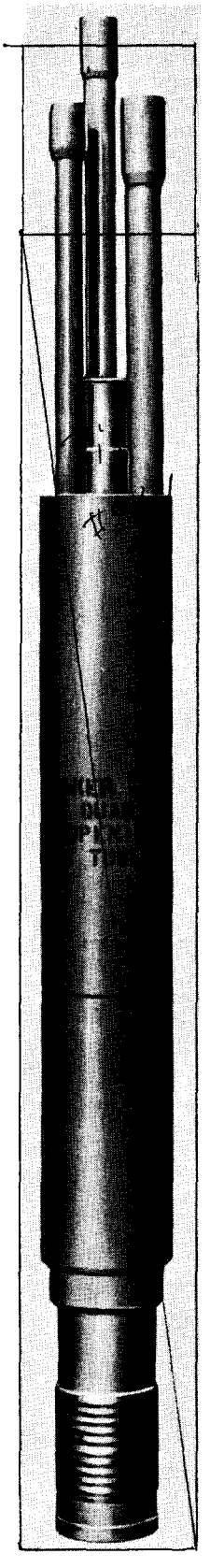
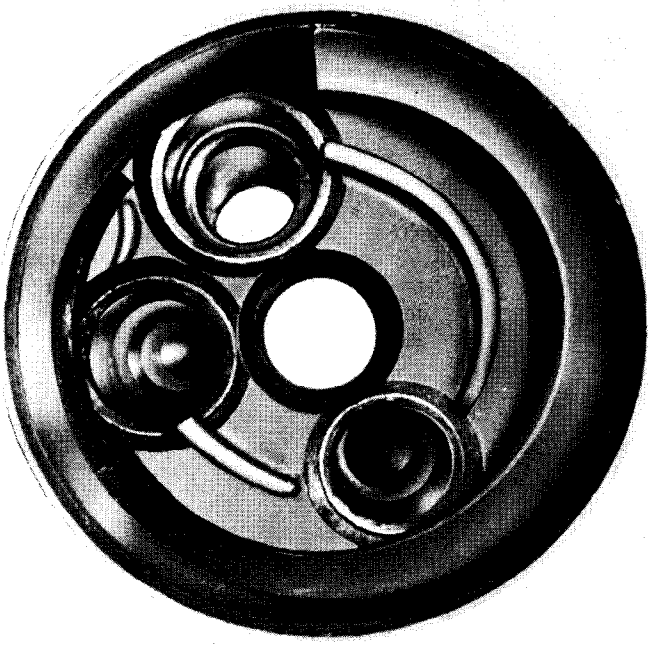


FIG. 7



and the top zone through the short string.

Landing nipples and sleeve valves may be incorporated in this installation to facilitate completion and control of the well.

Retrievable packers also may be used in this installation.

BASIC QUADRUPLE USING THREE PACKERS AND THREE STRINGS OF TUBING

The basic quadruple would consist of an ultimate triple installation as shown in Fig. 4, with the fourth zone perforated above the top packer and this zone producing through the tubing-casing annular area. This type of installation would permit four zones to be produced at the same time, isolated from each other, through one well bore. If it is not desirable to produce one zone through the tubing-casing annular area an additional bottom packer can be added. By use of landing nipples and sleeve valves, two zones can be produced selectively through the primary string which will allow production of four zones but not all at the same time.

Another installation that may be considered a basic quadruple is shown in Fig. 5. This installation incorporates two retainer type single string packers and two retrievable type parallel string packers. By using landing nipples and sleeve valves at appropriate points four zones can be produced selectively but only two zones can be produced at one time.

QUADRUPLE USING FOUR PACKERS AND FOUR STRINGS OF TUBING

The ultimate quadruple enables the operator to produce four zones, isolated from each other, through four individual strings of tubing, all zones being produced at the same time. (See Fig. 6) Fig.'s 7, 8, and 9 show additional views.

The quadruple installation is similar in design to the ultimate triple installation (See Fig. 4) in that it incorporates one additional packer and one additional concentric string below the flow tube. The flow tube and all accessory equipment below it except the packers are run in and landed on the primary string. The second, third,

and fourth strings with sealing nipples of different OD's are run in selectively and seated in their appropriate positions in the flow tube, which completes isolation of the four zones and allows the four zones to be produced as shown in Fig. 6.

SUMMARY

It has not been the purpose of this paper to cover all possible multizone installations. The installations covered are the most basic type but with a working knowledge of the basic types, variations can be incorporated to meet the more specialized installations.

FIG. 8

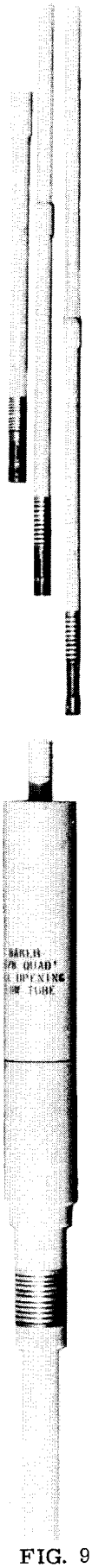


FIG. 9