March 18, 1952 C. J. COBERLY 2,589,672

CLOSED FLUID-OPERATED FREE-PUMP SYSTEM WITH TWO PARALLEL TUBINGS WITHIN A THIRD TUBING

Filed May 16, 1949 2 SHEETS—SHEET 1

Fig. 1

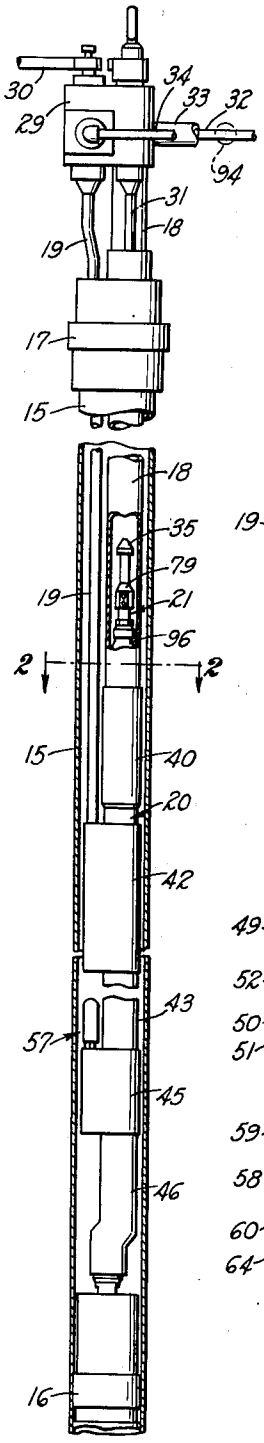


Fig. 3

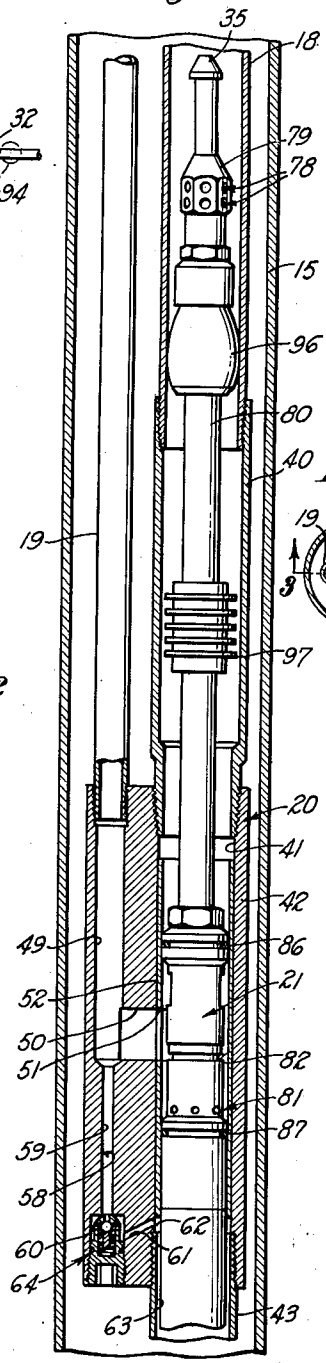


Fig. 2

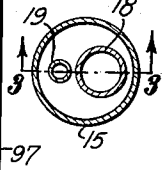
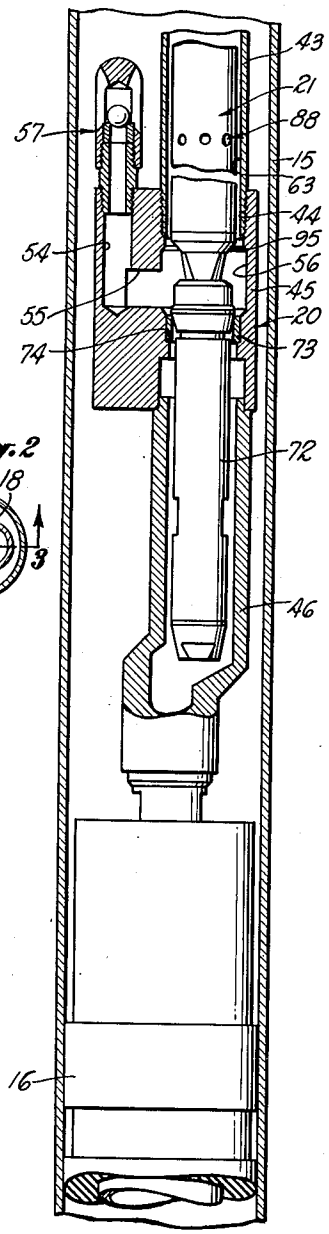


Fig. 4



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Fig. 5

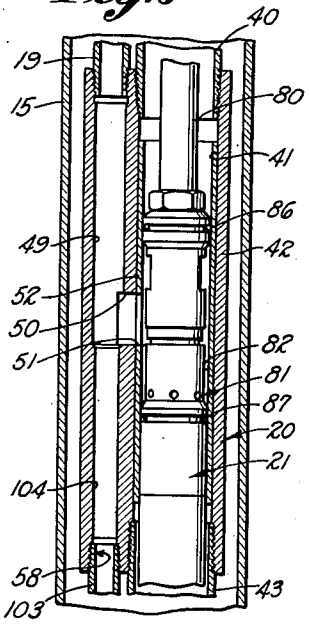


Fig. 8

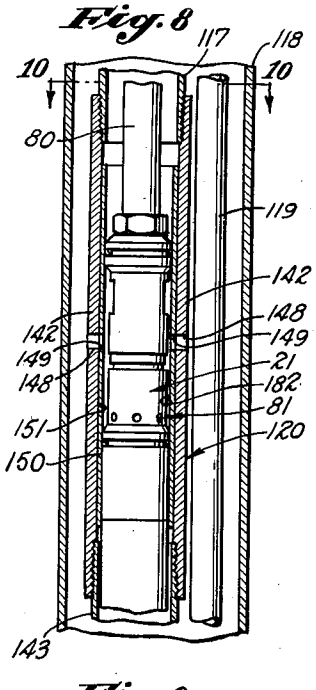


Fig. 10

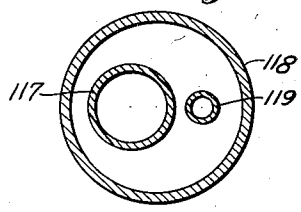


Fig. 12

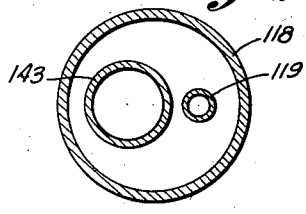


Fig. 11

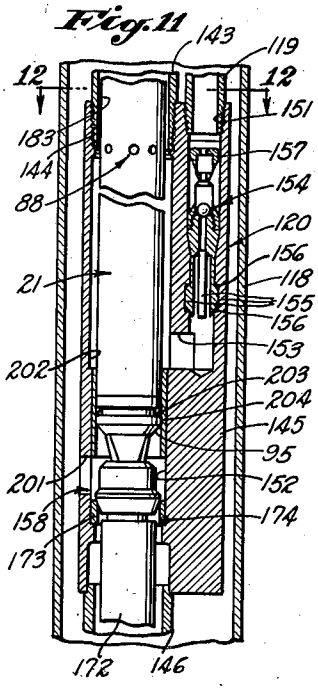


Fig. 6

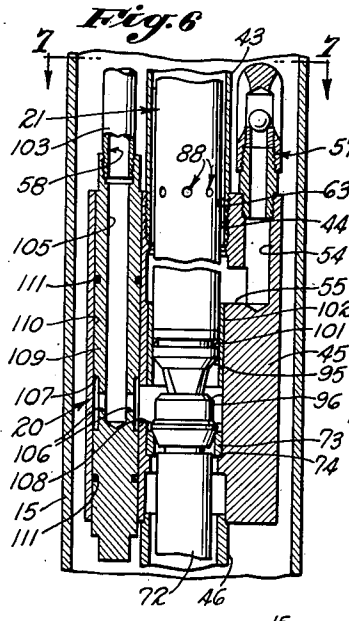


Fig. 9

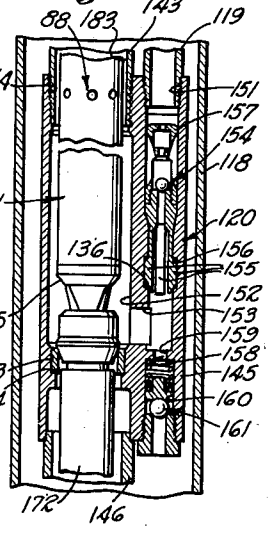
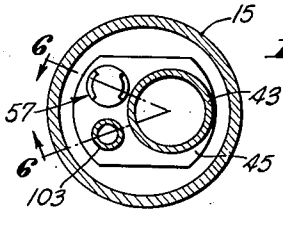


Fig. 7



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UNITED STATES PATENT OFFICE

2,589,672

CLOSED FLUID-OPERATED FREE-PUMP SYSTEM WITH TWO PARALLEL TUBINGS WITHIN A THIRD TUBING

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Application May 16, 1949, Serial No. 93,484

32 Claims. (Cl. 103—46)

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My invention relates in general to tubing systems for fluid-operated well pumps and, more particularly, to a closed tubing system for a fluid-operated well pump of the so-called "free" type.

Reference is hereby made to my co-pending applications Serial No. 93,483, filed May 16, 1949, Serial No. 93,482, filed May 16, 1949, and Serial No. 93,481, filed May 16, 1949.

It is conventional in the oil industry to employ a well pumping apparatus which includes a free fluid-operated pump, such a pump being movable into and out of the well through a tubing set in the well and being adapted to assume an operating position at the lower end of such tubing. Examples of such fluid-operated, free-pump systems are disclosed in my Patents Nos. 2,230,830, granted February 4, 1941, and 2,338,903, granted January 11, 1944.

In conventional fluid-operated, free-pump systems, such as those disclosed in my aforementioned patents, two tubings are employed, one for conveying operating fluid downwardly in the well to the pump and the other for conveying fluid produced by the well upwardly therein from the pump to the surface, the two tubings being referred to hereinafter as the supply and production tubings, respectively. In such conventional systems, the pump is movable into its operating position through the supply tubing. The supply and production tubings are interconnected at their lower ends in fluid communication with each other and with the well so that the pump may receive operating fluid from the supply tubing and well fluid from the well and so that it may discharge well fluid into the production tubing as production fluid.

In installing such a free pump in the well, it is moved downwardly through the supply tubing into its operating position at the lower end thereof either by the action of gravity or by the application of fluid pressure to the upper end of the pump. After the pump has been installed in its operating position, operating fluid, which is usually clean crude oil, is delivered to the motor section of the pump under relatively high pressure through the supply tubing. As is well known in the art, such operating fluid is alternately directed by a suitable valve mechanism in the motor section of the pump to opposite ends of a motor piston which is coupled to a pump piston in the pump section of the device, fluid from the well being admitted to the pump section by a suitable valve mechanism therein. Such alternating application of operating fluid pressure to the ends of the motor piston produces reciprocation of the motor and pump pistons with the result that the pump piston pumps fluid produced by the well into the production tubing, the latter conveying the production fluid upwardly therein to the surface. When removal of the pump from the well is desired for any reason, as for service

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or repair, fluid pressure is applied to the lower end of the pump to move it upwardly out of its operating position and through the supply tubing to the surface. This is accomplished conventionally by reversing the flow through the system so that operating fluid flows downwardly in the production tubing to the lower end of the pump and acts on the pump to move it upwardly through the supply tubing to the surface.

In a conventional free-pump system of the foregoing character, the spent operating fluid discharged by the motor section of the pump is delivered to the production tubing so that the spent operating fluid and the production fluid are intermixed and conveyed upwardly together through the production tubing. Since the operating fluid delivered to the pump through the supply tubing must be clean, in order to prevent abrasion and corrosion of the moving parts of the pump, fresh operating fluid must be supplied to the system continuously. The continuous provision of such fresh operating fluid requires considerable surface equipment, normally in the form of settling tanks or filters, which is expensive to install and operate. Also, in the particular arrangement hereinbefore mentioned wherein the pump is disposed in the supply tubing, the flow reversal necessary to remove the pump from the well may carry any sand or other foreign matter present in the production fluid into the supply tubing with the result that such foreign matter may enter the motor section of the pump upon resumption of operation after reinstallation with the attendant possibility of damage to the pump.

In view of the foregoing, it is a primary object of this invention to provide a closed system for the fluid-operated, free pump which includes a third tubing separate from the supply and production tubings for returning the spent operating fluid to the surface independently of the well fluid, the tubing for returning the spent operating fluid being referred to hereinafter as the return tubing. With such a closed system, the spent operating fluid is separately conveyed back to the surface for storage and re-use to actuate the fluid-operated pump so that there is very little loss of operating fluid from the system and, consequently, the surface equipment necessary to supply fresh operating fluid to the system needs have only a relatively small capacity and can be relatively cheap and economical, both as regards initial cost and operating costs. Also, the reversed flow necessary to move the pump upwardly to the surface during removal of the pump may take place through the return tubing to avoid carrying sand and other foreign matter into that portion of the system reserved for the operating fluid, which is an important feature. As will be pointed out in more detail hereinafter, further objects of the invention reside in certain modifications of the pump and in the tubing ar-

rangements employed to provide such a closed system.

Considering the invention more specifically, an object thereof is to provide a closed system for a fluid-operated, free pump comprising supply, return and production tubings which are set in the well and one of which is adapted to receive the pump and to provide an operating position for the pump at its lower end, the supply, return and production tubings respectively being adapted to convey operating fluid for actuating the pump downwardly into the well to the pump, spent operating fluid discharged by the pump upwardly in the well from the pump to the surface and production fluid discharged by the pump upwardly in the well from the pump to the surface.

An important object of the invention is to provide a closed system wherein the supply, return and production tubings are set in the well with two of the tubings disposed within the third. Another object in this connection is to provide a closed system wherein the two inner tubings are disposed side-by-side within the outer tubing. A further object is to provide a closed system wherein one of the inner tubings is adapted to receive the pump.

Another object is to provide such a closed system wherein the three tubings are interconnected at their lower ends in fluid communication with each other and with the well so that the pump may, when in its operating position, receive operating fluid for its actuation from the supply tubing through an intake, discharge spent operating fluid into the return tubing through an exhaust, receive well fluid from the well through an inlet and discharge well fluid into the production tubing through an outlet.

Another object is to provide a closed system having means whereby a downward flow of fluid through one of the tubings, other than the tubing in which the pump is disposed, may be applied to the lower end of the pump to move it upwardly out of its operating position and through the tubing in which it is disposed to the surface whenever removal of the pump from the well is desired.

Another object is to provide a closed system which includes a tubular pump receiver disposed at the lower end of and in alignment with the tubing through which the pump is movable, the pump receiver being, in effect, an extension of such tubing and providing the aforementioned operating position for the pump. A related object is to provide a pump receiver having a seat at its lower end for the pump, the pump being seated on such seat when it is in its operating position.

Another object is to provide a pump receiver having passages which place the interior thereof in fluid communication with the supply, return and production tubings and with the well in such a manner as to provide fluid communication between the intake, exhaust, the inlet and the outlet of the pump and the supply tubing, the return tubing, the well and the production tubing, respectively, when the pump is disposed in the pump receiver and seated on the pump seat.

Another object is to provide sealing means for normally preventing direct flow between the tubings and the well by way of the pump receiver when the pump is in its operating position so that operating fluid may flow only from the supply tubing through the motor section of the pump to the return tubing and so that well fluid may

flow only from the well through the pump section of the pump to the production tubing. More specifically, an object in this connection is to provide a sealing means which, when the pump is in its operating position, places the supply tubing in fluid communication with only the intake of the pump, the return tubing in fluid communication with only the exhaust of the pump, the well in fluid communication with only the inlet of the pump and the production tubing in fluid communication with only the outlet of the pump.

Another object is to provide a system wherein the aforementioned sealing means comprises annular sealing elements which are carried by the pump adjacent various of the ports, such as the intake, exhaust, etc., therein and which are engageable with the inner wall of the pump receiver to prevent direct flow between the tubings.

Another object is to provide passage means communicating at one end with one of the tubings, other than the tubing aligned with the pump receiver, and at its other end with a chamber in the pump receiver between the pump seat and the pump for applying a downward flow of fluid through such tubing to the lower end of the pump to move it upwardly out of the pump receiver and to the surface.

Another object is to provide a sealing device for normally preventing flow of fluid between two of the tubings by way of the aforementioned passage means and the pump receiver when the pump is in its operating position. Other objects in this connection are to provide a system wherein the aforementioned sealing device is a spring-loaded valve in the passage means and a system wherein the sealing device is an annular sealing element adapted to be disposed between the pump and the pump receiver.

Another object is to provide a system wherein the tubing with which the aforementioned passage means communicates is the return tubing so that the pump may be moved upwardly to the surface by a downward flow of clean fluid through the return tubing to prevent introducing sand and other abrasive matter into the pump receiver.

Still another object is to provide a closed system wherein the pump is movable into its operating position in the pump receiver through the supply tubing and wherein the pump is movable upwardly to the surface by a downward flow of clean fluid through the return tubing so as to avoid carrying any of the sand or other abrasive material which may be in the fluid in the production tubing into the pump receiver during the pump-removal operation.

Another object is to provide a closed system in which damage from any corrosive substances in the production fluid is minimized by permitting the production fluid to come in contact with only the production tubing. This is accomplished by locating the supply and return tubings without the production tubing, which is an important feature.

Another object is to minimize the power required to overcome friction between the production fluid moving upwardly through the production tubing and the wall of the production tubing by employing a production tubing having a large internal diameter. This feature is particularly important under well conditions such that a pump having a motor section of small capacity and a pump section of large capacity may be employed.

Another object is to maximize the external

diameter of the pump by making the tubing for receiving the pump of large internal diameter. This permits the employment of a pump having motor and/or pump sections of maximum capacity, which is an important feature.

Another object is to facilitate paraffin control in such a closed system by limiting contact of the production fluid to the production tubing, i. e., by disposing the supply and return tubings without the production tubing.

Another object is to provide a closed system wherein the outer tubing is the casing of the well.

The foregoing objects and advantages of the present invention, together with other objects and advantages thereof which will become apparent, may be attained through the employment of the exemplary embodiments of the invention which are illustrated in the accompanying drawings and which are described in detail hereinafter. Referring to the drawings:

Fig. 1 is a utility view of a closed, fluid-operated, free-pump system which embodies the invention;

Fig. 2 is a horizontal sectional view taken along the broken line 2—2 of Fig. 1;

Fig. 3 is an enlarged, vertical sectional view taken along the broken line 3—3 of Fig. 2;

Fig. 4 is a downward continuation of Fig. 3;

Fig. 5 is a fragmentary, vertical sectional view which is similar to the lower end of Fig. 3 but which discloses another embodiment of the invention;

Fig. 6 is an enlarged downward continuation of Fig. 5 and is taken along the irregular broken line 6—6 of Fig. 7;

Fig. 7 is a horizontal sectional view taken along the broken line 7—7 of Fig. 6;

Fig. 8 is a fragmentary, vertical sectional view which is similar to Fig. 5 but which discloses still another embodiment of the invention;

Fig. 9 is a downward continuation of Fig. 8;

Fig. 10 is a horizontal sectional view taken along the broken line 10—10 of Fig. 8;

Fig. 11 is a fragmentary, vertical sectional view which is similar to Figs. 6 and 9 but which discloses yet another embodiment of the invention; and,

Fig. 12 is a horizontal sectional view taken along the broken line 12—12 of Fig. 11.

Considering the embodiment of the invention which is illustrated in Figs. 1 to 4 of the drawings and referring particularly to Fig. 1 thereof, the numeral 15 designates a well casing which is set in an oil well and which is open below a packer 16 to an oil producing formation adjacent the well as is well known in the art, the casing being provided with a casing head 17 at its upper end. That portion of the well casing 15 which is above the packer 16 serves as a production tubing for conveying fluid produced by the well upwardly therein to the surface and will be referred to hereinafter as the production tubing, rather than the well casing, for convenience. Set side-by-side within the production tubing 15 and connected to the casing head 17 are supply and return tubings 18 and 19, the three tubings 15, 18 and 19 forming a closed system as will be discussed in more detail hereinafter. The supply, return and production tubings are interconnected at their lower ends in fluid communication with each other and with the well below the packer 16 by a tubular pump receiver 20 which is aligned with and which, in effect, forms a downward extension of the supply tubing 18. The pump receiver 20 provides an operating position for a free fluid-operated pump 21 which is movable downwardly through the supply tubing into its operating position in the pump receiver, the internal diameter of the pump receiver being substantially equal to that of the supply tubing. As will be discussed in more detail hereinafter, the supply tubing 18 is adapted to convey operating fluid, such as clean crude oil, under pressure downwardly in the well from the surface to the pump 21 to actuate the pump, the return tubing 19 is adapted to receive spent operating fluid discharged by the pump and to convey the spent operating fluid upwardly in the well to the surface. The pump 21 is adapted to receive well fluid from the well below the packer 16 and to discharge into the production tubing 15 above the packer as production fluid, the production tubing conveying the production fluid upwardly in the well to the surface as previously indicated.

The supply, return and production tubings are connected at their upper ends to a pump head 29 having valve means (not shown) therein which is operable from the surface by a handle 30 to direct flows of fluid through the tubings in the proper manner as will be discussed in more detail hereinafter. The upper end of the production tubing 15 is shown connected to the pump head 29 by a tube 31. Also, connected to the pump head 29 are production, supply and return lines 32, 33 and 34 which, during operation of the pump 21, are adapted to be connected in fluid communication with the production, supply and return tubings 15, 18 and 19, respectively, by the valve means in the pump head. The production line 32 leads to a suitable point of disposal or storage for the production fluid, while the supply line 33 leads to a suitable source (not shown) of operating fluid under pressure, which source may be a conventional triplex pump having its intake connected to a suitable reservoir. The return line 34 leads to the reservoir for the source of operating fluid. As disclosed in my aforementioned Patent No. 2,338,903, the pump head 29 may also include a suitable pump catcher (not shown) for the pump 21, the latter having at its upper end a tapered head 35 which is receivable by the pump catcher during removal of the pump from the well.

Referring now to Figs. 3 and 4 of the drawings, the pump receiver 20 is, as previously indicated, aligned with and connected to the lower end of the supply tubing 18, the pump receiver having at its upper end a sleeve 40 which is threaded into the lower end of the supply tubing. The lower end of the sleeve 40 is threaded into the upper end of the major bore 41 in an upper fitting 42 which forms part of the pump receiver 20, a sleeve 43 being threaded into the lower end of the major bore 41. The lower end of the sleeve 43 is threaded into the upper end of a major bore 44 in a lower fitting 45 of the pump receiver 20, an inlet sleeve 46 communicating with the lower end of the major bore 44 and being welded or otherwise secured to the lower fitting. The inlet sleeve 46 is provided with an off-set lower end which is connected to the packer 16 and which communicates with the well below the packer so that well fluid from below the packer may enter the pump receiver 20 by way of the inlet sleeve.

The upper fitting 42 of the pump receiver 20 is provided with a minor bore 49 which is spaced from the major bore 41 therein and into which

the lower end of the return tubing 19 is threaded. The minor bore 49 communicates with the major bore 41 in the fitting 42 through a lateral passage 50 in this fitting and through a registering port 51 in a liner 52 which is pressed into the major bore 41. The lower fitting 45 of the pump receiver 20 is provided with a minor bore 54 which is spaced from the major bore 44 therein and which communicates with the major bore 44 through a lateral passage 55, the lower fitting providing an annular chamber 56 which is adjacent the lower end of the pump 21 when the pump is in its operating position and with which the lateral passage 55 communicates. Threaded into the upper end of the minor bore 54 in the lower fitting 45 is a standing valve 57 which permits flow of production fluid discharged by the pump 21 into the production tubing 15 above the packer 16, but which prevents reverse flow. It will be apparent that, with the foregoing construction, the pump receiver 20 interconnects the lower ends of the production, supply and return tubings 15, 18 and 19 in fluid communication with each other and with the well below the packer 16.

The upper fitting 42 of the pump receiver 20 is provided with a passage means 58 for applying a downward flow of fluid through the return tubing 19 to the lower end of the pump 21 to move the pump upwardly out of the pump receiver 20 and through the supply tubing 18 to the surface when removal of the pump is desired for any reason, this passage means comprising a longitudinal passage 59 which communicates at its upper end with the minor bore 49 in the upper fitting 42 and which communicates at its lower end with a chamber 60 in this fitting. The passage means 58 also includes a lateral passage 61 which connects the chamber 60 to an annular groove 62 in the upper fitting 42, this annular groove communicating with an annular space 63 between the pump 21 and the intermediate sleeve 43. The annular space 63 communicates at its lower end with the annular chamber 56 at the lower end of the pump 21. Disposed in the chamber 60 is a spring-loaded valve 64 which prevents flow of fluid from the return tubing 19 into the interior of the pump receiver 20 during operation of the pump 21 and which is adapted to open to permit such flow in response to downward flow of operating fluid through the return tubing 19 during removal of the pump from the well, as will be discussed in more detail hereinafter.

Disposed in the lower end of the major bore 44 in the lower fitting 45 and extending downwardly into the inlet sleeve 46 is an inlet fitting 72 which serves as a seat for the pump 21, the latter being in its operating position when it is disposed in the pump receiver 20 and seated on the pump seat provided by the inlet fitting. The pump 21 is adapted to seat on the inlet fitting 72 automatically when it is moved downwardly through the supply tubing into the pump receiver 20 so that it automatically assumes its operating position. The inlet fitting 72 also serves to convey fluid from the well to an inlet of the pump 21 when the pump is in its operating position, the inlet fitting preferably being provided with a check valve (not shown) therein which permits upward flow of well fluid into the interior of the pump receiver 20, but which prevents downward flow of fluid out of the pump receiver into the well. The inlet fitting 72 is seated on an annular insert 73 which is disposed in the major bore 44 and which is seated on a shoulder 74 therein.

Except for certain modifications required to adapt it to the closed tubing system of the invention, the free fluid-operated pump 21 may be of conventional design and will not be considered in detail. In general, the pump 21 includes a motor section having a pump section therebelow, the motor and pump sections respectively including coupled motor and pump pistons (not shown). The motor section of the pump 21 is actuable by operating fluid under pressure delivered thereto by the supply tubing 18, the operating fluid under pressure being adapted to enter the motor section of the pump through ports which serve as an intake 78 for the pump and which are in fluid communication with the supply tubing when the pump is in its operating position. The ports of the intake 78 are formed in an intake fitting 79 which carries the aforementioned tapered head 35 and which is connected to the upper end of a tubular rod 80 extending upwardly from the motor section of the pump 21, the rod being adapted to convey operating fluid under pressure from the intake to the motor section of the pump.

After the operating fluid admitted to the motor section of the pump 21 through the intake 78 has actuated the pump, it is discharged from the motor section through ports forming an exhaust 81 of the pump. When the pump 21 is in its operating position, the exhaust 81 communicates with an annular space 82 between the pump and the liner 52, the annular space 82 communicating with the return tubing 19 through the port 51 in the liner 52, the lateral passage 50 in the upper fitting 42 and the minor bore 49 in this fitting. Thus, the operating fluid under pressure in the supply tubing 18 flows through the motor section of the pump 21 to actuate it and is discharged into the return tubing 19 as spent operating fluid.

In order to prevent direct flow of operating fluid between the production, supply and return tubings 15, 18 and 19 by way of the pump receiver 20 when the pump 21 is in its operating position, the closed system under consideration is provided with a sealing means comprising annular sealing elements 86 and 87 which are carried by the pump 21 respectively above and below the exhaust 81 and which are adapted to engage the liner 52 respectively above and below the port 51 therein when the pump is in its operating position. Thus, the annular sealing elements 86 and 87 isolate the intake 78 and the exhaust 81 when the pump 21 is in its operating position so that the intake may communicate only with the supply tubing 18 and so that the exhaust may communicate only with the return tubing 19. As previously indicated, flow between the return tubing 19 and the production tubing 15 by way of the passage means 58 during operation of the pump 21 is prevented by the spring-loaded valve 64.

As previously indicated, the pump section of the pump 21 is provided with an inlet at its lower end through which well fluid is adapted to enter the pump section by way of the inlet fitting 72, the pump section inlet not being shown specifically. The pump section of the pump is also provided with ports forming an outlet 88 for the production fluid discharged by the pump section, the outlet communicating with the annular space 63 between the pump 21 and the intermediate sleeve 43 when the pump is in its operating position. Thus, production fluid discharged by the pump section of the pump 21 through the outlet

88 flows downwardly through the annular space 63 into the annular chamber 56 and flows from this chamber into the production tubing 15 above the packer 16 by way of the lateral passage 55 in the lower fitting 45, the minor bore 54 therein and the working valve 57.

It will be noted that the annular sealing element 87 is disposed between the exhaust 81 and the outlet 88 so that it prevents flow between the return and production tubings 19 and 15 when the pump is in its operating position. Also, since the pump 21 is seated on the inlet fitting 72 when in its operating position, the pump seat provided by the inlet fitting serves to prevent direct flow between the well and the production tubing 15.

Considering the operation of the embodiment illustrated in Figs. 1 to 4 of the drawings, it will be assumed that the pump 21 is in operation to pump fluid from the well upwardly through the production tubing 15 to the surface. Under such conditions, the pump 21 is in its operating position in the pump receiver 20 wherein it is seated on the inlet fitting 72, and the aforementioned valve means in the pump head 29 respectively connects the supply, return and production tubings 18, 19 and 15 to the supply, return and production lines 33, 34 and 32. Thus, operating fluid under pressure is conveyed downwardly to the pump 21 through the supply tubing 18 and enters the motor section of the pump through the intake 78 to actuate the pump, spent operating fluid being discharged into the return tubing through the exhaust 81 and being conveyed upwardly in the well to the surface by the return tubing. The well fluid entering the pump 21 through its inlet is discharged into the production tubing 15 through the outlet 88 and is conveyed upwardly in the well to the surface as production fluid. It will be apparent that, with this construction, the spent operating fluid is returned to the surface separately from the production fluid so that it may be re-used to actuate the pump 21, which is a primary feature of the invention.

In the event that removal of the pump 21 from the well is necessary in order to service or repair the pump, or for any other reason, it is merely necessary for the operator to set the handle 30 controlling the valve means in the pump head 29 in a position such that the valve means connects the supply line 33 to the return tubing 19 so that the operating fluid under pressure flows downwardly into the well through the return tubing. Preferably, the valve means also connects the supply tubing 18 to the return line 34 under such conditions, and prevents fluid communication between the production tubing 15 and the production line 32. Alternatively, fluid flow through the production tubing 15 and the production line 32 may be prevented by closing a valve 94 in the production line.

Under the conditions outlined in the preceding paragraph, operating fluid under pressure flows downwardly through the return tubing 19 and into the annular chamber 56 at the lower end of the pump 21 by way of the minor bore 49 in the upper fitting 42, the passage means 58 and the annular space 63, the spring-loaded valve 64 being adapted to open in response to the operating fluid pressure thereabove to permit such flow through the passage means 58 to occur. It will be understood that during operation of the pump 21, the pressure above the spring-loaded valve 64, which is the pressure of the spent operating fluid during operation, is insufficient to open this valve. The pressure of the operating fluid entering the annular chamber 56 in the foregoing manner is applied to an annular area 95 at the lower end of the pump 21 so as to unseat the pump from the inlet fitting 72 and is then applied to the entire area of the pump so as to move it upwardly in the pump receiver 20, upward flow of the operating fluid applied to the lower end of the pump in this manner past the pump being prevented by the annular sealing elements 86 and 87. After the pump 21 has moved upwardly in the pump receiver 20 a distance such that the annular sealing elements 86 and 87 disengage the liner 52, upward flow of operating fluid past the pump is prevented by packing devices 96 and 97 which are carried by the rod 89 and which are adapted to engage the inner wall of the supply tubing 18 in a substantially fluid-tight manner, the portions of the pump 21 which carry the annular sealing elements 86 and 87 preferably being of smaller diameter than the internal diameter of the supply tubing so as to prevent damage to the sealing elements during movement of the pump through the supply tubing. After the pump has cleared the port 51 in the liner 52, the downward flow of operating fluid through the return tubing 19 is applied to the lower end of the pump to move it upwardly directly through the lateral passage 50 and the port 51. Thus, the operating fluid under pressure flows through the passage means 58 to unseat the pump 21 and to move it upwardly in the pump receiver 20 a sufficient distance to clear the port 51. Thereafter, the downward flow of operating fluid under pressure through the return tubing 19 enters the pump receiver 20 through the lateral passage 50 and the port 51 to move the pump upwardly out of the pump receiver and through the supply tubing to the surface.

During the foregoing operation of removing the pump, flow of operating fluid out of the pump receiver into the well is prevented by the check valve in the inlet fitting 72 and flow thereof into the production tubing 15 is prevented because flow through the production tubing is prevented, as by closing the aforementioned valve 94, or by means of the valve means in the pump head 29. It will be noted that, since the standing valve 57 prevents downward flow of production fluid out of the production tubing 15 and into the pump receiver, none of the production fluid can enter the pump receiver during the pump-removal operation, which is an important feature since it prevents sand and other foreign matter which may be in the production fluid from entering the pump receiver. This eliminates any possibility of foreign matter of this nature entering the motor section of the pump upon re-installation thereof.

It will be noted that, under the conditions hereinbefore outlined, the operating fluid in the supply tubing 18 above the pump 21 is returned to the reservoir through the return line 34 during the pump-removal operation so that substantially none of the operating fluid is lost from the system.

When re-installation of the pump 21, or of a replacement pump 21, is desired, the pump to be installed is inserted into the upper end of the supply tubing 18 through the pump head 29. The operator then sets the handle 30 controlling the valve means in the pump head in a position such that the supply tubing is placed in fluid communication with the supply line 33 and the return tubing 19 is placed in fluid communication with the return line 34. Thus, the operating fluid under pressure entering the system through the supply line 33 acts on the upper end of the pump

21 to move it downwardly through the supply tubing and into its operating position in the pump receiver wherein it is seated on the inlet fitting 72, the operating fluid previously introduced below the pump during the pump-removal operation being displaced upwardly through the return tubing 19 and into the return line 34 leading to the reservoir. During the operation of installing the pump, the valve 94, or the valve means in the pump head 29, preferably prevents flow through the production tubing 15 and the production line 32 so that all of the fluid employed during the pump-removal operation is returned to the reservoir during re-installation of the pump. However, it will be understood that if the operating fluid in the supply tubing has become contaminated prior to re-installation of the pump 21 for any reason, returning such contaminated operating fluid to the reservoir may be avoided by preventing fluid flow through the return tubing 19 and by permitting fluid flow through the production tubing 15.

As will be apparent, one advantage of the embodiment hereinbefore disclosed is that it is possible to remove and re-install the pump 21 with substantially no loss of operating fluid from the system, the production tubing 15 being isolated from that portion of the system reserved for the operating fluid during the operations of removing and re-installing the pump.

It will also be noted that the embodiment previously disclosed permits the use of a production tubing 15 of relatively large diameter to minimize friction losses between the production fluid stream and the production tubing, which is an important feature, particularly in wells permitting the use of a pump having a pump section of large capacity and a motor section of small capacity, since it permits a high ratio of production to power input.

Another advantage of the embodiment of Figs. 1 to 4 is that the production fluid flowing through the annular chamber 56 constantly washes away any sand deposits tending to form at the junction of the pumps 21 and the inlet fitting 72 to keep the pump seat free.

The embodiment of my invention which is illustrated in Figs. 5 to 7 of the drawings is similar to that illustrated in Figs. 1 to 4 and can best be described by pointing out the difference between it and the embodiment of Figs. 1 to 4, identical reference numerals being employed for corresponding components. One difference between the embodiment presently under consideration and that considered previously is that the lateral passage 55 in the lower fitting 45 for the production fluid communicates directly with the annular space 63 between the pump 21 and the intermediate sleeve 43, instead of with the annular chamber 56 at the lower end of the pump. When the pump 21 is in its operating position, the annular space 63 is separated from the annular chamber 56 by an annular sealing element 101 which is carried by the pump 21 adjacent its lower end and which is adapted to engage a liner 102 pressed into the major bore 44 in the lower fitting. As will be apparent in the light of the next paragraph, the annular sealing element 101 thus prevents fluid communication between the production tubing 15 and the return tubing 19 when the pump 21 is in its operating position.

The only other difference between the two embodiments disclosed in Figs. 5 to 7 of the drawings resides in the passage means 58, the passage means 58 of the embodiment of Figs. 5 to 7 including a tube 103 which is threaded at its upper end into a bore 104 communicating with the minor bore 49 in the upper fitting 42. The tube 103 is threaded at its lower end into the upper end of a bore 105 which is spaced from the major bore 44 in the lower fitting 45 of the pump receiver 29, the bore 105 communicating with the annular chamber 56 at the lower end of the pump 21 through radial passages 106, an annular groove 107 and a lateral passage 108 in the lower fitting. In practice, instead of forming the bore 105 directly in the lower fitting 45, I prefer to form this bore, the lateral passage 106 and the groove 107 in an insert 109 which is disposed in a minor bore 110 formed in the lower fitting proper, the tube 103 being threadedly connected to this insert and the insert carrying sealing rings 111 above and below the annular groove 107. This construction facilitates assembly of the upper and lower fittings 42 and 45, the intermediate sleeve 43 and the tube 103 since the insert 109 may slide in the bore 110 as the intermediate sleeve is threaded into the upper and lower fittings.

The operation of the embodiment disclosed in Figs. 5 to 7 of the drawings when the pump 21 is in operation is identical to that of the embodiment of Figs. 1 to 4, except that the annular sealing element 101 prevents flow between the production and return tubings 15 and 19, this function being performed by the spring-loaded valve 64 in the previously disclosed embodiment. The operation is also identical during the pump-removal operation except that the flow of operating fluid under pressure from the return tubing 19 to the annular chamber 56 does not take place through any spring-loaded valve. The operation of the embodiment in Figs. 5 to 7 during re-installation of the pump 21 is also identical to that of the embodiment of Figs. 1 to 4.

Turning now to the embodiment of the invention which is illustrated in Figs. 8 to 10 of the drawings, I show a closed tubing system which is set in a well (not shown) and which includes supply, return and production tubings respectively designated by the numerals 117, 118 and 119, the supply and production tubings being set side-by-side within the return tubing 118. As is the case with the production tubing 15, the return tubing 118 may, if desired, be the casing of the well, in which case it is necessary to employ a packer (not shown) such as the packer 16. The supply, return and production tubings 117, 118 and 119 are interconnected at their lower ends in fluid communication with each other and with the well by a tubular pump receiver 120 which is aligned with and which, in effect, forms a downward extension of the supply tubing. The pump receiver 120 provides an operating position for the free fluid-operated pump 21, which is movable downwardly through the supply tubing 117 into its operating position in the pump receiver, the internal diameter of the pump receiver being substantially equal to that of the supply tubing. As in the previously discussed embodiments, the supply tubing 117 is adapted to convey operating fluid under pressure downwardly in the well to the pump 21 to actuate the pump, and the return tubing 118 is adapted to convey spent operating fluid discharged by the pump upwardly in the well to the surface. The pump 21 is adapted to receive well fluid from the well and to discharge it into the production tubing 119 and the production fluid, the production fluid then flowing upwardly through the production tubing to the surface.

As best shown in Figs. 8 and 9 of the drawings,

the lower end of the supply tubing 117 is threaded into a tubular coupling 142 into the lower end of which is threaded a sleeve 143, the lower end of this sleeve being threaded into the upper end of a major bore 144 in a fitting 145 which forms part of the pump receiver 120. Communicating with the lower end of the major bore 114 and suitably secured, as by welding, to the fitting 145 is an inlet sleeve 146, a suitable packer (not shown), such as the packer 16, being connected to the inlet sleeve 146 in the event that the return tubing 118 forms the casing of the well.

The return tubing 118 communicates with the interior of the pump receiver 120 through radial ports 148 in the coupling 142 and through registering ports 149 in a liner 150 pressed into the coupling 142. The fitting 145 is provided with a minor bore 151 therein which is spaced from the major bore 144 and into which the lower end of the production tubing 119 is threaded, the minor bore 151 communicating at its lower end with an annular chamber 152 at the lower end of the pump 21 through a lateral passage 153 in the fitting 145. Disposed in the minor bore 151 is a standing valve 154 having spring fingers 155 which are adapted to engage shoulders 156 to hold it in place, the valve having an inside spear fitting 157 for the reception of a suitable tool lowered through the production tubing 119 to remove the valve, as is well known in the art. The valve 154 is adapted to permit upward flow of production fluid into the production tubing 119, but prevents reverse flow.

The embodiment presently under consideration is provided with a passage means 158 for applying a downward flow of fluid through the return tubing 118 to the lower end of the pump 21 to unseat the pump and move it upwardly out of the pump receiver 120 when removal of the pump is desired for any reason, this passage means including a passage 159 which communicates at one end with a chamber 160 in the fitting 145 and at its other end with the minor bore 151 in this fitting. The chamber 160 contains a spring-loaded valve 161 which prevents flow through the passage means 158 from the return tubing 118 into the annular chamber 152 by way of the minor bore 151 and the lateral passage 153 when the pump 21 is in operation so that the pressure in the return tubing is that of the spent operating fluid. However, the spring-loaded valve 161 is adapted to open in response to a downward flow of operating fluid through the return tubing 118 to permit such operating fluid to enter the annular chamber 152 to act on the lower end of the pump 21.

Disposed in the lower end of the major bore 144 in the fitting 145 and extending downwardly into the inlet sleeve 146 is an inlet fitting 172 for the pump 21, the inlet of the latter being adapted to receive well fluid from the well through the inlet fitting when the pump is in its operating position. As is well known in the art, the inlet fitting 172 is provided with a check valve (not shown) therein which permits upward flow of well fluid into the interior of the pump receiver 120, but which prevents downward flow of fluid out of the pump receiver into the well. The inlet fitting 172 is seated on an annular insert 173 which is disposed in the major bore 144 in the fitting 145 and which is seated on a shoulder 174 therein.

As in the previously discussed embodiments, the inlet fitting 172 also serves as a seat for the pump 21, the latter being in its operating position when it is disposed in the pump receiver 120 and seated on the pump seat provided by the inlet fitting. The pump 21 is adapted to seat on the inlet fitting 172 automatically when it is moved downwardly through the supply tubing 117 into the pump receiver 120 so that it automatically assumes its operating position.

When the pump 21 is in its operating position, the operating fluid under pressure conveyed downwardly through the supply tubing 117 enters the motor section of the pump through the intake 78 and the tubular rod 80 and is discharged from the motor section of the pump through the exhaust 81 as spent operating fluid. It will be noted that the exhaust 81 communicates with an annular space 182 between the pump 121 and the liner 150, this annular space communicating with the return tubing 118 through the ports 148 and 149. Thus, the operating fluid under pressure in the supply tubing 117 flows through the motor section of the pump 21 to actuate it and is discharged into the return tubing 118 as spent operating fluid.

It will be noted that the annular sealing elements 86 and 87 are respectively located above and below the ports 149 in the liner 150 so that they isolate the intake 78 and the exhaust 81 when the pump 21 is in its operating position, the intake communicating only with the supply tubing 117 and the exhaust communicating only with the return tubing 118. As in the preceding embodiments, the inlet of the pump 21 communicates with the well through the inlet fitting 172 and the outlet 88 of the pump communicates with the production tubing 119, the exhaust 88 communicating directly with an annular space 183 between the pump 21 and the sleeve 143. This annular space communicates at its lower end with the annular chamber 152.

The operation of the embodiment presently under consideration during operation of the pump 21 is substantially to that of the embodiment of Figs. 1 to 4 of the drawings and it is thought that a detailed description is unnecessary. During removal of the pump 21 from the well, operating fluid is caused to flow downwardly through the return tubing 118, which causes the spring-loaded valve 161 to open to permit such operating fluid to act on the annular area 95 at the lower end of the pump. This unseats the pump and causes it to move upwardly in the pump receiver 120, the pressure of the operating fluid flowing downwardly through the return tubing being applied to the entire area of the pump once it has unseated. After the pump 21 has cleared the ports 148 and 149, the operating fluid flowing downwardly through the return tubing may enter the pump receiver 120 below the pump through such ports, instead of through the spring-loaded valve 161. As before, a continued downward flow of operating fluid through the return tubing 118 results in upward movement of the pump 21 through the supply tubing 117 to the surface. The pump 21 may be re-installed in substantially the same manner as in the embodiments of Figs. 1 to 4 of the drawings.

It will be noted, that, as in the case of the previously described embodiments, the operations of removing and re-installing the pump 21 may be performed with substantially no loss of operating fluid from the system, which is an important feature. Also, since the production fluid in the production tubing 119 cannot return to the pump receiver 120 past the standing valve 154, no sand or other foreign matter in the production fluid

can enter the pump receiver during the operations of removing and re-installing the pump.

Another advantage of the embodiments of Figs. 8 to 10 is that paraffin control is simplified and corrosion damage is restricted to the production tubing 119 because of the fact that the production fluid comes in contact with only the production tubing.

Still another advantage is that the flow of production fluid through the annular chamber 152 prevents sand deposits from covering the pump seat in the inlet fitting 172.

The embodiment of Figs. 11 to 12 is similar to that of Figs. 8 to 10 and identical numerals have been employed to designate corresponding components. The only difference between the embodiment presently under consideration and that illustrated in Figs. 8 to 10 is that the spring-loaded valve 161 is eliminated, the passage means 158 merely being a port 201 formed in the fitting 145 to provide fluid communication between the return tubing 118 and the annular chamber 152 at the lower end of the pump 121. Instead of communicating with the annular chamber 152, the lateral passage 153 in the fitting 145 communicates with an annular space 202 which is located below and communicates with the annular space 183 into which the production fluid is discharged through the outlet 88 of the pump 21. In order to separate the return and production tubings 118 and 119 so that no flow can take place therebetween by way of the passage means 158 when the pump 21 is in its operating position, the pump is provided with an annular sealing element 203 which is adapted to engage a liner 204 pressed into the major bore 144 in the fitting 145.

The operation of the embodiment of Figs. 11 and 12 is substantially identical to that of the embodiment of Figs. 8 to 10 and a detailed description is thought to be unnecessary.

Although I have disclosed several exemplary embodiments of the invention for purposes of illustration, it will be understood that I do not intend to be limited specifically thereto since various changes, modifications and substitutions may be incorporated in such embodiments without departing from the spirit of the invention.

I claim as my invention:

1. In a closed, fluid-operated, free-pump system for a well, the combination of: supply, return, and production tubings set in the well and respectively adapted to convey operating fluid downwardly into the well from the surface, spent operating fluid upwardly in the well to the surface and fluid produced by the well upwardly therein to the surface, two of said tubings being inner tubings disposed within the third; means for interconnecting the lower ends of said tubings in fluid communication with each other and with the well; and a fluid-operated, free pump movable in one of said inner tubings into an operating position at the lower end thereof, said pump having an intake, an exhaust, an inlet and an outlet which communicate with said supply tubing, said return tubing, the well and said production tubing, respectively, when said pump is in said operating position.

2. In a closed, fluid-operated, free-pump system for a well, the combination of: three tubings set in the well and respectively adapted to convey operating fluid downwardly to the well from the surface, spent operating fluid upwardly in the well to the surface and fluid produced by the well upwardly therein to the surface, two of said tubings being inner tubings disposed within the third; means for interconnecting the lower ends of said tubings in fluid communication with each other and with the well; a pump seat at the lower end of and aligned with one of said inner tubings; and a fluid-operated, free pump movable in said one inner tubing into an operating position at the lower end thereof wherein it is seated on said pump seat, said pump having an intake, an exhaust and an outlet which communicate with said tubings, respectively, when said pump is in its operating position, and having an inlet which communicates with the well when said pump is in said operating position.

3. In a closed, fluid-operated, free-pump system for a well, the combination of: supply, return and production tubings set in the well and respectively adapted to convey operating fluid downwardly into the well from the surface, spent operating fluid upwardly in the well to the surface and fluid produced by the well upwardly therein to the surface, two of said tubings being inner tubings disposed within the third; a tubular pump receiver at the lower end of and aligned with one of said inner tubings, said pump receiver being connected to the lower ends of said tubings in fluid communication therewith and being in fluid communication with the well; and a fluid-operated, free pump movable in said one inner tubing and movable into an operating position in said pump receiver, said pump having an intake, an exhaust, an inlet and an outlet which communicate with said supply tubing, said return tubing, the well and said production tubing, respectively, when said pump is in said operating position.

4. A closed system as set forth in claim 3 including sealing devices for normally preventing direct flow of fluid between said tubings and the well when said pump is in said operating position.

5. In a closed, fluid-operated, free-pump system for a well, the combination of: supply, return and production tubings set in the well and respectively adapted to convey operating fluid downwardly into the well from the surface, spent operating fluid upwardly in the well to the surface and fluid produced by the well upwardly therein to the surface, two of said tubings being inner tubings disposed within the third; a tubular pump receiver connected to the lower ends of said tubings in alignment with one of said inner tubings, said pump receiver communicating at its upper end with said one inner tubing and having substantially the same internal diameter as said one inner tubing, and said pump receiver having passages which provide fluid communication between the other of said inner tubings and said pump receiver, between the outer of said tubings and said pump receiver and between the well and said pump receiver; a pump seat carried by said pump receiver at the lower end thereof and in alignment therewith; a fluid-operated, free pump movable in said one inner tubing and movable into an operating position in said pump receiver wherein it is seated on said pump seat, said pump having an intake, an exhaust, an inlet and an outlet which communicate with said supply tubing, said return tubing, the well and said production tubing, respectively, when said pump is in said operating position; and sealing devices for normally preventing direct flow of fluid between said tubings and the well by way of said pump receiver when said pump is in said operating position.

6. In a closed, fluid-operated, free-pump sys-

tem for a well, the combination of: supply, return and production tubings set in the well and respectively adapted to convey operating fluid downwardly into the well from the surface, spent operating fluid upwardly in the well to the surface and fluid produced by the well upwardly therein to the surface, two of said tubings being inner tubings disposed within the third; a tubular pump receiver connected to the lower ends of said tubings in alignment with one of said inner tubings, said pump receiver communicating at its upper end with said one inner tubing and having substantially the same internal diameter as said one inner tubing, and said pump receiver having passages which provide fluid communication between the other of said inner tubings and said pump receiver, between the outer of said tubings and said pump receiver and between the well and said pump receiver; a pump seat carried by said pump receiver at the lower end thereof and in alignment therewith; a fluid-operated, free pump movable in said one inner tubing and movable into an operating position in said pump receiver wherein it is seated on said pump seat, said pump having an intake, an exhaust, an inlet and an outlet which communicate with said supply tubing, said return tubing, the well and said production tubing, respectively, when said pump is in said operating position; sealing devices for normally preventing direct flow of fluid between said tubings and the well by way of said pump receiver when said pump is in said operating position; a chamber in said pump receiver between said pump seat and said pump; and passage means providing fluid communication between said chamber and one of said tubings other than said one inner tubing.

7. In a closed, fluid-operated, free-pump system for a well, the combination of: supply, return and production tubings set in the well and respectively adapted to convey operating fluid downwardly into the well from the surface, spent operating fluid upwardly in the well to the surface and fluid produced by the well upwardly therein to the surface, two of said tubings being inner tubings disposed within the third; a tubular pump receiver connected to the lower ends of said tubings in alignment with one of said inner tubings, said pump receiver communicating at its upper end with said one inner tubing and having substantially the same internal diameter as said one inner tubing, and said pump receiver having passages which provide fluid communication between the other of said inner tubings and said pump receiver, between the outer of said tubings and said pump receiver and between the well and said pump receiver; a pump seat carried by said pump receiver at the lower end thereof and in alignment therewith; a fluid-operated, free pump movable in said one inner tubing and movable into an operating position in said pump receiver wherein it is seated on said pump seat, said pump having an intake, an exhaust, an inlet and an outlet which communicate with said supply tubing, said return tubing, the well and said production tubing, respectively, when said pump is in said operating position; sealing devices for normally preventing direct flow of fluid between said tubings and the well by way of said pump receiver when said pump is in said operating position; a chamber in said pump receiver between said pump seat and said pump; passage means providing fluid communication between said chamber and one of said tubings other than said one inner tubing; and another sealing device for normally preventing flow of fluid between said passage means and said production tubing.

8. A closed system as set forth in claim 7 wherein said other sealing device comprises a spring-loaded valve in said passage means.

9. A closed system as set forth in claim 7 wherein said other sealing device comprises an annular sealing element positionable between said pump and said pump receiver.

10. In a closed, fluid-operated, free-pump system for a well, the combination of: supply, return and production tubings set in the well and respectively adapted to convey operating fluid downwardly into the well from the surface, spent operating fluid upwardly in the well to the surface and fluid produced by the well upwardly therein to the surface, two of said tubings being inner tubings disposed within the third; means for interconnecting the lower ends of said tubings in fluid communication with each other and with the well; a fluid-operated, free pump movable in one of said inner tubings into an operating position at the lower end thereof, said pump having an intake, an exhaust, an inlet and an outlet which communicate with said supply tubing, said return tubing, the well and said production tubing, respectively, when said pump is in said operating position; means for normally preventing direct flow of fluid between said tubings and the well by way of said inter-connecting means when said pump is in said operating position; and passage means communicating with said one inner tubing and with one of said tubings other than said one inner tubing.

11. A closed system as set forth in claim 10 wherein said inner tubings are disposed within said return tubing.

12. A closed system as set forth in claim 10 wherein said inner tubings are disposed within said production tubing.

13. A closed system as set forth in claim 10 wherein said one inner tubing is said supply tubing.

14. A closed system as set forth in claim 10 wherein said passage means communicates with said one inner tubing and with said return tubing.

15. A closed system as set forth in claim 10 wherein said supply and return tubings are without said production tubing.

16. A closed system as set forth in claim 10 wherein said one inner tubing is of larger diameter than the other inner tubing.

17. A closed system according to claim 10 wherein said production tubing is of larger diameter than at least one of the other two tubings.

18. A closed system as defined in claim 10 wherein said production tubing is of larger diameter than either of the other two tubings.

19. A closed system according to claim 10 wherein said inner tubings are disposed side-by-side within the outer tubing.

20. A closed system as set forth in claim 19 wherein said one inner tubing and the other inner tubing are said supply tubing and said production tubing, respectively.

21. A closed system as set forth in claim 10 wherein said inner tubings are disposed side-by-side within the outer tubing, said one inner tubing and said other inner tubing being said supply tubing and said return tubing, respectively.

22. In a closed, fluid-operated, free-pump system for a well, the combination of: supply, return and production tubings set in the well and

respectively adapted to convey operating fluid downwardly into the well from the surface, spent operating fluid upwardly in the well to the surface and fluid produced by the well upwardly therein to the surface, said supply tubing and one of the others of said tubings being disposed side-by-side within the third tubing; a tubular pump receiver at the lower end of and aligned with said supply tubing, said pump receiver being connected to the lower ends of said tubings and being in fluid communication with said tubings and with the well; a pump seat carried by said pump receiver and disposed at the lower end thereof in alignment therewith; a fluid-operated, free-pump movable in said supply tubing and movable into an operating position in said pump receiver wherein it is seated on said pump seat, said pump having an intake, an exhaust, an inlet and an outlet which communicate with said supply tubing, said return tubing, the well and said production tubing, respectively, when said pump is in said operating position; means for normally preventing direct flow of fluid between said tubing and the well through said pump receiver when said pump is in said operating position; and passage means communicating with one of said tubings other than said supply tubing and with said receiver above said pump seat.

23. A closed system as set forth in claim 22 wherein said passage means communicates with said return tubing and wherein said means for preventing direct flow comprises a sealing device for normally preventing fluid flow from said return tubing to said production tubing when said pump is in said operating position.

24. A closed system as set forth in claim 22 wherein said supply and production tubings are disposed side-by-side within said return tubing.

25. A closed system as set forth in claim 22 wherein said supply and return tubings are disposed side-by-side with said production tubing.

26. A closed system as set forth in claim 22 wherein said supply tubing is of larger diameter than one of the other two tubings.

27. A closed system as set forth in claim 22 wherein said production tubing is of larger diameter than one of the other two tubings.

28. In a closed, fluid-operated, free-pump system for a well, the combination of: supply, return and production tubing set in the well and respectively adapted to convey operating fluid downwardly into the well from the surface, spent operating fluid upwardly in the well to the surface and fluid produced by the well upwardly therein to the surface, said supply tubing and one of the other tubing being disposed side-by-side within the third tubing; a tubular pump receiver at the lower end of and aligned with said supply tubing, said pump receiver being connected to the lower ends of said tubings in fluid communication therewith and being in fluid communication with the well; a fluid-operated, free pump movable in said supply tubing into an operating position in said pump receiver, said pump having an intake, an exhaust below said intake, an outlet below said exhaust and an inlet below said outlet, said intake, said exhaust, said inlet and said outlet respectively communicating with said supply tubing, said return tubing, the well and said production tubing when said pump is in said operating position; an annular sealing element carried by said pump intermediate said intake and said exhaust and engageable with said pump receiver when said pump is in said operating position; another annular sealing element carried by said pump intermediate said exhaust and said outlet and engageable with said pump receiver when said pump is in said position; and sealing means providing a fluid-tight seal between said inlet and said outlet when said pump is in said operating position.

29. A closed system according to claim 28 including a passage communicating at one end with said return tubing and at its other end with said pump receiver at a point which is intermediate said other annular sealing element and said sealing means when said pump is in said operating position, said system including a sealing device for normally preventing flow through said passage from said return tubing to said production tubing when said pump is in said operating position, said sealing device comprising a spring-loaded valve in said passage.

30. A closed system according to claim 22 including a passage communicating at one end with said return tubing and at its other end with said pump receiver at a point which is intermediate said other annular sealing element and said sealing means when said pump is in said operating position, said system including a sealing device for normally preventing flow through said passage from said return tubing to said production tubing when said pump is in said operating position, said sealing device comprising an annular sealing element carried by said pump below said outlet and engageable with said pump receiver.

31. A closed system as set forth in claim 1 wherein said third tubing is the casing of the well.

32. In a closed, fluid-operated, free-pump system, the combination of: a primary tubing and a pair of secondary tubings set in the well with one of said secondary tubings enclosing the other of said secondary tubings and said primary tubing, said primary tubing being of a size to receive a fluid-operated, free pump and providing for movement of the pump between an operating position at the lower end of said primary tubing and the surface; means interconnecting the lower ends of said tubings, said interconnecting means having passage means providing fluid communication between one of said secondary tubings and said primary tubing and having passage means providing fluid communication between the other of said secondary tubings and said primary tubing; and inlet means connected to said primary tubing and having a passage providing fluid communication between the well and said primary tubing, said inlet means having means for preventing flow of fluid from said primary tubing into the well through said passage.

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