

April 2, 1946.

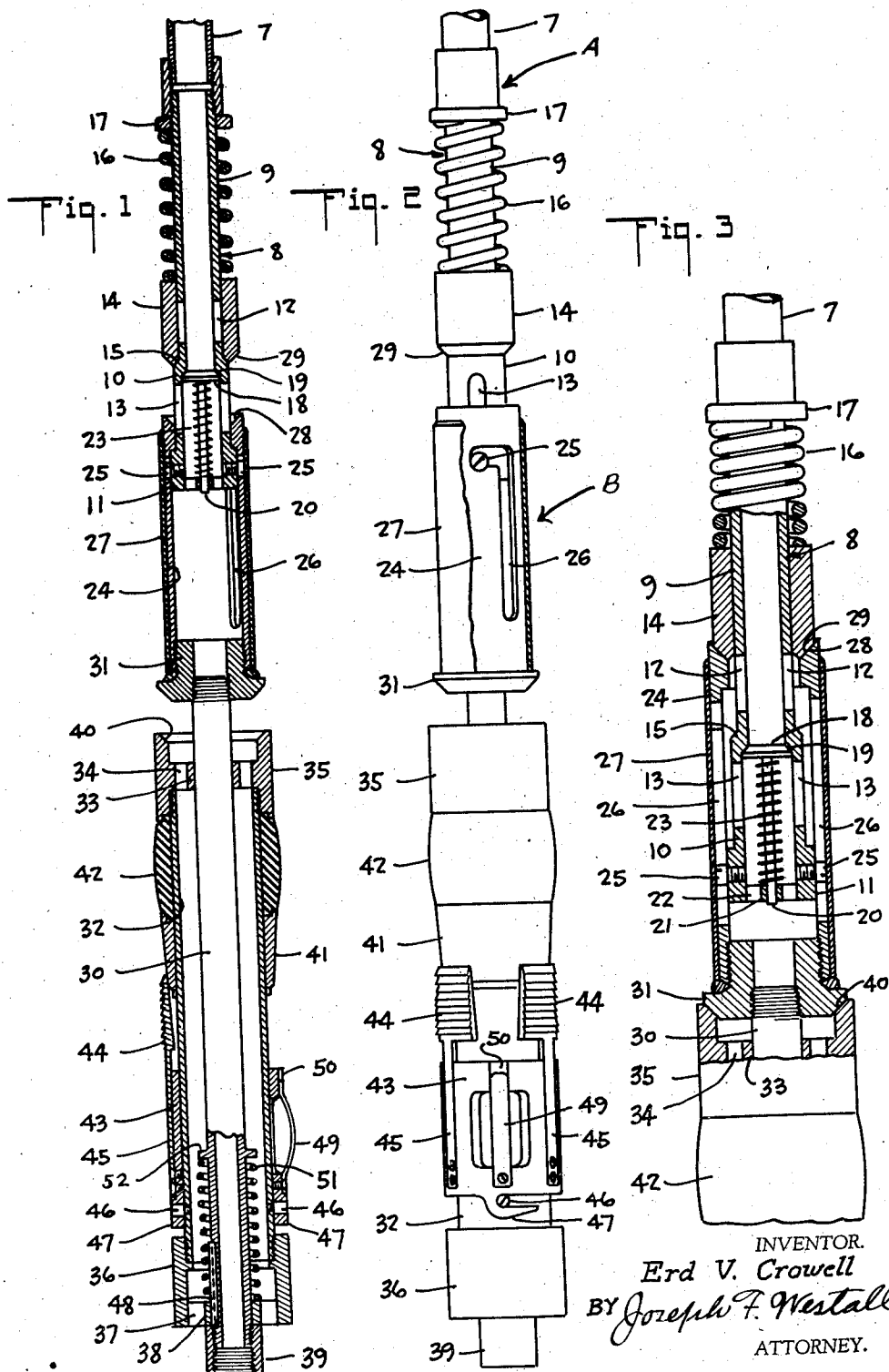
E. V. CROWELL

2,397,472

OIL WELL DEVICE

Filed Dec. 17, 1937

2 Sheets-Sheet 1



April 2, 1946.

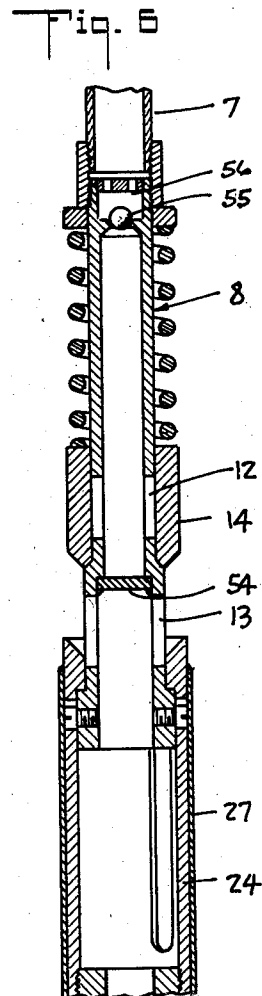
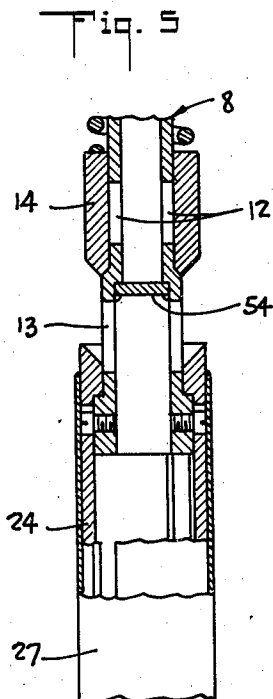
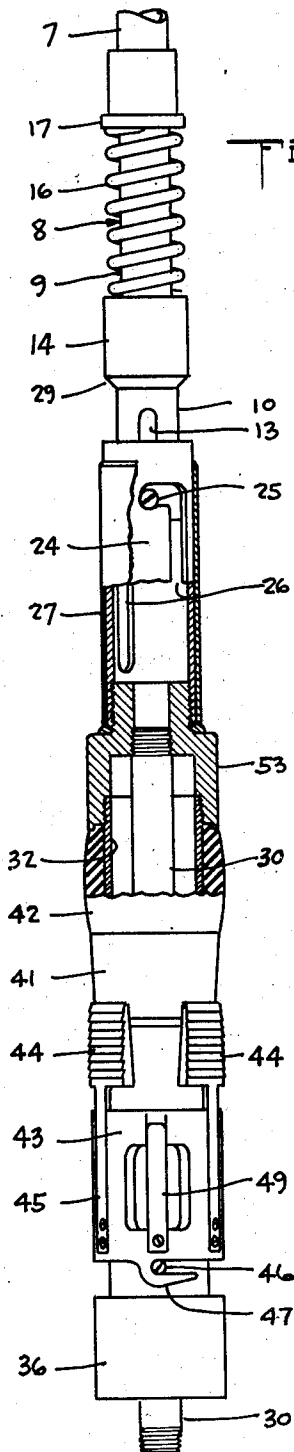
E. V. CROWELL

2,397,472

OIL WELL DEVICE

Filed Dec. 17, 1937

2 Sheets-Sheet 2



INVENTOR.
Erd V. Crowell
BY *Joseph F. Westall*
ATTORNEY.

UNITED STATES PATENT OFFICE

2,397,472

OIL WELL DEVICE

Erd V. Crowell, Huntington Park, Calif.

Application December 17, 1937, Serial No. 180,392

13 Claims. (Cl. 166-12)

This invention relates to oil well devices, and particularly contemplates casing packers for controlling gas pressure in flowing wells and for obtaining samples of fluid occurring below predetermined levels in the well, as well as for numerous other purposes where it is necessary to seal off the bore of a well casing and tap the fluid resources therebelow.

The general object of my Patents No. Re. 16,577, issued March 29, 1927, No. 1,648,377, issued November 8, 1927, and No. 1,608,167, issued November 23, 1926, to provide a device for closing off the bore of the hole to maintain a predetermined pressure in the well therebelow, also comprises an object of the present invention.

Various types of packing elements have been devised to effect control of flowing wells which rely upon the weight of a tubing string to expand the packer at the point at which the seal is to be effected. As such devices are very often lowered in the well against the flow of oil or gas, a by-pass must be provided for the upwardly moving fluid. It is a common practice with such devices of the prior art to permit the fluid to flow not only upwardly around the tubing but also through the entire length of the tubing string to the well top.

It is therefore an important object of the present invention to provide a device adapted for facile introduction into a well shaft against a heavy expulsion of oil or gas upwardly therethrough comprising a string of tubing having a bore for the passage of pressure fluid downwardly therethrough but not in the opposite direction provided with packing means for closing the annular space between the tubing and the shaft, and having independent vent means to communicate the zone above and below the packing means, not only through packing means exterior of the tubing but also through the tubing to facilitate the lowering of the device through the expelling oil or gas, and carrying means actuated by the tubing for anchoring the device at any desired level in the well shaft and incidentally close the vents and open the bore of the tubing string to the passage of oil or gas upwardly therethrough; thus to divert all the flow of oil or gas from passing upwardly through the well shaft to the tubing string.

Another object is the provision of a tubing string having an expansible packer to close the annular area between the tubing and casing in which the device is adapted to be lowered in use, in combination with a valve to normally maintain the bore of the tubing closed to pressure in the

well and a by-pass around said valve adapted to be made effective after sealing the casing bore.

Another object is to provide a discharge tubing for use in a well shaft comprised of an upper and a lower portion thereof with a single telescopic connection therebetween forming parts, respectively, of said portion of the tubing for permitting relative axial movement thereof but having dependent rotary movement; valve means for maintaining a fluid-tight seal between the portions of the tubing when the telescopic sections thereof are in extended relation; and ports communicating with the well shaft, adapted, upon the telescopic contraction of the parts, to close the ports and open the bore of the tubing string to the passage of pressure fluid therethrough.

Another object is to provide a device of the character described equipped to preserve dry tubing for utilization as a formation tester, but which may be employed in other capacities where-in circulation downwardly through the tubing is desirable.

Another object is to provide a string of tubing with a dual valve controlled inlet whereby the bore of the lower end of the upper portion is adapted to be opened for the entrance of pressure fluid from below, and subsequently automatically closed when the tubing is raised for removal from the well thus entrapping the fluid therein.

Fig. 1 is a sectional view of my invention with the parts as positioned for lowering into the well; Fig. 2 is an elevation of the device as shown in Fig. 1;

Fig. 3 is a broken sectional view of the upper part of the embodiment of Fig. 1 with the parts as positioned during operation;

Fig. 4 is an elevation, partly in section, of a modified form of my device;

Fig. 5 is a broken sectional view of another form of the upper portion of the embodiments of Figs. 1 and 3 and 4;

Fig. 6 is a broken sectional view of the upper part of a modification of either the structure of Fig. 1 or Fig. 4, particularly adapted for use as a formation tester.

The present improvement consists generally of a flow line made up of two sections of tubing string A and B, respectively (see Fig. 2) having a telescopic connection therebetween, incorporating composite valve means for maintaining a fluid tight seal between said tubing sections when in normal extended position, said valve means being adapted to open upon telescopic contraction of the parts of said connection to create a passage

for the flow of pressure fluid therethrough. The lower tubing section B is provided with an expandable packer controlled coincidentally with said valve means. Communication between the tubing sections A and B is maintained while the device is in use and until it is desired to withdraw the tubing from the well, whereupon elevation of the tubing automatically closes the valve means, and, in accordance with specific embodiments hereinafter in detail described, either entraps the fluid in the tubing for subsequent examination, or permits drainage of the fluid from the tubing through a valve provided therefor.

Referring to the drawings in detail, the numerals of which indicate similar parts throughout the several views, 7 designates a tubing string extending upwardly to the well surface within a casing (not shown). To the lower end of the tubing is threaded a pipe 8 comprising a hollow stem 9 and a diametrically enlarged lower portion 10 having a peripheral flange 11 on its bottom end. Stem 9 and enlarged portion 10 of the pipe 8 are provided with lateral ports 12 and 13, respectively, for purpose hereinafter described. A sleeve valve 14 slidably encircles stem 9 and normally bears against a shoulder 15 formed on the periphery of pipe 8 by the enlargement comprising the lower portion 10 so as to close ports 12. A spring 16 encircles stem 9 between valve 14 and a peripheral flange 17 adjacent the upper end of the pipe to normally urge the valve toward the closed position just described. The bore of pipe 8 is normally closed to pressure therebelow by a poppet type valve 18 adapted to seat on the internal shoulder 19 formed by the difference in diameter of the bores of stem 9 and portion 10. Valve 18 is secured to the upper end of a valve stem 20, which extends slidably through the hub 21 of a spider 37 secured in the lower end of the bore of pipe 8. A helical spring 23 encircles valve stem 20 to urge valve 18 to closed position.

A barrel 24, forming a part of tubing section B of the flow line which comprises tubing sections A and B, is adapted to telescopically receive the lower end of pipe 8 and has an upper end of smaller diameter than the outer periphery of flange 11, whereby the barrel will be suspended, by engagement with said flange 11, from pipe 8 for lowering in the well; said pipe being movable telescopically into barrel 24 when said barrel is supported in the casing as hereinafter noted.

The barrel 24 is thus adapted to telescopically receive the lower end of pipe 8 but relative rotary movement is limited by pins 25 comprising screws mounted on the opposite sides of the lower end of the pipe 8. Pins 25 extend into slots 26 cut through opposite sides of barrel 24. The bight of the respective slots is disposed in the upper end of the barrel so as to lock the pins in the slots with the barrel in its lowermost position with respect to the pipe. A shell 27 tightly incloses barrel 24 to make the walls of the latter fluid tight. The upper rim of the barrel is bevelled to form a valve seat 28 for a complementary surface 29 on the lower rim of sleeve valve 14 which is adapted to contact seat 28 when the stem of pipe 8 is telescoped into the bore of barrel 24; valve 14 being closed when the pipe and barrel are locked in extended relation.

A lower tubing section 30 is connected to the bottom of barrel 24 to form an extension thereof by means of a hollow valve bushing 31 threaded into the lower end of the barrel. A packer body 32 encircles tubing section 30 and is held con-

centric therewith by a hub 33 of a spider 34 integral with a valve seat member 35 threaded to the upper end of packer body 32 through which the tubing 30 slidably extends. On the lower end of packer body 32, a collar 36 is threaded which carries a spider 37 in its bore having a hub 38 through which the tubing section reciprocably extends.

A coupling 39 is threaded to the tubing section 30 below the spider 37 for support of body 32 while lowering or withdrawing the device from the well. A swinging anchor (not shown) may be threaded into coupling 39, if desired, for obvious purposes. The upper rim of member 35 is bevelled to form a seat 40 on which valve bushing 31 is adapted to bear to effect the closure of the bore of the packer body as later described.

A slip extending element 41 comprising an inverted conical member slidably encircles the packer body 32 below and spaced from the member 35. Between the member and expanding element a packer 42 of the hook wall type, composed of rubber or the like, is disposed, having its upper and lower edges mortised with the member and expanding element, respectively. Conventional slip mechanism is mounted on the packer body comprising a sleeve 43 having a series of slips 44 secured thereto by means of respective shanks 45, said slips 44 being expansible outwardly upon downward movement of the expanding element 41 therebetween. The sleeve 43 and slips 44 are locked in a lower position with respect to the expanding element by the engagement of a pair of gudgeons 46 with suitable hooks 47 integral with the lower end of the sleeve. To enable control of the rotary movement of the body 32 for effecting disengagement of the gudgeons 46 and hooks 47, the hub 38 of the spider 37 is keyed to the tubing 30 as at 48. The bights of the slots 26 and the hooks 47 extend in the same direction to cause upon rotation of the tubing the release of the slips and the unlatching for telescopic movement of the pipe 8 and barrel 24 simultaneously or successively. A plurality of bowed spring members 49 are secured to sleeve 43, their opposite ends being unattached but bearing slidably in individual guiding grooves 50 formed in the sleeve for respective spring members. The springs 49 are thus free to bow outward and frictionally engage the casing to resist rotation of the sleeve when it is desired that the slips be released by rotation of the tubing in a counterclockwise direction.

It will be noted that due to the frictional contact of the spring members with the casing, the barrel may not freely gravitate with the tubing string, but may require that the bushing 31 be lowered against its seat 40 and the barrel pushed through the casing to the desired location in the well. To counteract this tendency and insure minimum restriction of the bore of the casing by the device while being lowered to position, a helical spring 51 is provided to encircle the tubing section 30 between an annular flange 52 integral therewith and the hub 38 of spider 37, whereby its expansive force will resist the lowering of the tubing with respect to the barrel.

The operation of this embodiment of my invention is briefly described as follows: This device is lowered into the casing with the parts as shown in Fig. 1, i. e., with sleeve valve 14 closing ports 12 in response to the pressure of spring 16, poppet valve 18 closing the bore of the tubing to pressure therebelow, ports 13 open, and valve bushing 31 displaced from its seat by the pressure of spring

51. Circulation may be established, if desired, by the introduction of fluid into the tubing at the well surface, which is then pumped through the tubing and valve 18 for emission from the ports 13 and thence upwardly in the casing. When the desired location in the well is reached, the tubing string is raised slightly and turned counterclockwise so as to bring the pins 25 into the vertical portions of their respective slots 26; continued rotation being operable to move the gudgeons 46 from hooks 47. Sleeve 43 is held stationary by engagement of spring members 49 with the casing. Continued downward movement of the tubing string urges the slips 44 into engagement with the casing, preventing further downward movement of the expanding element 41. The support afforded the expanding element will also sustain the weight of the packer body 32. The valve bushing 31 is accordingly moved downward with the tubing until it contacts seat 40, whereupon the barrel 24 will be held in the casing while the tubing 7 and pipe 8 continue to move downward, pipe 8 telescoping within the barrel 24. The lower rim of the sleeve valve 14 will contact seat 28, thus closing off the passage of the gas and oil into the casing from the flow line. Continued downward movement of the tubing string will compress the spring 16 to insure a fluid tight seal at seats 40 and 28, thus conveying the weight of the tubing string to the barrel and causing the expansion of packer 42 so as to confine all flow of the oil and gas through the tubing string. It will be observed that the order of operations comprising the expansion of the packer, and the closure of valve 31 and port 13, respectively, relative to each other, depend upon the strength of springs 16 and 51 with respect to each other, and with the force required to effect the expansion of packer 42, which may be varied in specific embodiments, as desired. The telescopic movement of the pipe 8 into the barrel 24 communicates ports 12 and ports 13 around valve 18 and restricts all the flow from the well to the tubing. It will be noted that the proportion of the weight of the tubing string permitted to rest on spring 16 will determine the extension of pipe 8 into the barrel 24 and accordingly, the size of the by-pass around the valve.

Referring to the modification of my invention shown in Fig. 4, valve bushing 31 is omitted and a hollow head 53 is substituted. Head 53 forms an adapter and is threaded into the bore of barrel 24 and directly to the upper end of packer body 32, being mortised to the tubing hook wall packer 42. The lower tubing section 30 is threaded into the bore of head 53. While lowering the device of this embodiment into the well for operation, the upward flow of oil or gas is confined to the tubing section 30 from which the oil or gas passes through ports 13 of pipe 8 into the casing. The seating of packer 42 incident to the actuation of slips 44 as above described with reference to the embodiments of Figs. 1-3, permits pipe 8 to be telescoped into barrel 24 for closing ports 13 and open the bore of the tubing while sustaining the weight of the tubing string.

When it is desired to remove the device of either of these embodiments from the well, the upper section of the tubing string 7 is raised to open the ports 13 whereupon the fluid in the tubing thereabove will drain therefrom to find a common level in the well shaft, or circulation downwardly through the upper section 7 past valve 18 to said ports 13 and thence upwardly through the shaft, may be established to wash the packer free of sediment accumulations thereabove. Continued

elevation of the tubing string disengages the slips 44 facilitating removal of the device from the well.

Poppet valve 18 may be omitted from either of the embodiments of Figs. 1-3 or Fig. 4, and the bore of pipe 8 between ports 12 and 13 closed by a disc 54 (Fig. 5), welded or otherwise secured in the pipe. It will be obvious that in such embodiments the fluid in the well tubing cannot freely drain out as the device is raised from the well due to the closure of the ports 12 by sleeve valve 14 when the weight of the tubing on spring 16 is relieved. Where it is desired to drain the tubing to expedite removal of the assembly from the hole, the tubing may be raised in a series of operations, each time resetting the slips and exerting downward pressure on spring 16 to bring ports 12 and 13 into communication.

An embodiment hereof provided with disc closure means 54 may be used with equal efficacy as a formation tester, in which case fluid admitted into the upper tubing section is retained for subsequent examination at the well surface by the closure of ports 12 simultaneously with the alleviation of the pressure on the packer and spring 16.

For purposes of formation testing, however, the device may be modified (Fig. 6) by the provision of a ball valve 55 and a cage 56 secured or integrally formed in the bore of pipe 8 above ports 12. Valve 55 is adapted to open to pressure from below so as to admit into the tubing string the fluid under pressure to be subsequently tested but to close the bore to a balance of pressure in the tubing string thereabove.

It will thus be seen that I have provided a device capable of numerous embodiments and adapted for use primarily in securing maximum utilization of gas pressure in flowing wells which embodies a pair of valves for most effectively diverting the flow of oil and gas fluid, selectively, into the well casing around the tubing string or into the tubing string with a variable rate of flow; and further, that such device is equally adaptable for use in obtaining samples of fluid in the well hole.

When in the following claims I refer to "anchoring means" or "means for anchoring," I mean mechanism for securing and holding a portion of the flow line at some desired point within the well.

While I have described but a few of the embodiments of my invention, it will be apparent to those of skill in the art that numerous changes in size, design, proportion and number of the various parts may be made, and that various other well known expedients may be utilized with and/or substituted for the elements of the above specific disclosure—all without departing from the spirit of my invention as defined by the appended claims.

What I claim and desire to secure by Letters Patent is:

1. A circulating valve assembly adapted for use with pipe in an oil well or the like consisting essentially of two conduit members telescoped and secured together for limited relative movement longitudinally, said members having means for conducting fluid from end to end thereof when telescoped together, means for preventing flow of fluid from end to end thereof when extended, means for conducting fluid from the interior to the exterior thereof or vice versa when extended, and means operable in response to relative rotation between said members for controlling relative movement between said members longitudinally.

2. A circulation valve assembly adapted for use with pipe in an oil well or the like consisting essentially of two conduit members telescoped and secured together for limited relative movement longitudinally, said members having means for conducting fluid from end to end thereof when telescoped together, means for preventing flow of fluid from end to end thereof when extended, means for conducting fluid from the interior to the exterior thereof when extended, and means operable in response to relative rotation between said members for controlling relative movement between said members longitudinally.

3. In a device for use in a well shaft, a flow line having a packer associated therewith carrying anchoring means controlled by the flow line and having a passage therethrough communicating the zone of the well shaft at opposite ends of the packer, valve means to close said passage, said flow line having a port therein opening into the well shaft, means to close the bore of said line, means to close the port in said line and communicate the zone of the bore of said line at opposite sides of said last-named means, and resilient means to resist actuation of said last-named means.

4. In a device of the character described, adapted for use in a well, a flow line comprising relatively telescopic upper and lower portions carrying anchoring means controlled thereby, said upper portion having a bore, means to close said bore to the passage of pressure fluid therethrough in either direction, said upper portion having ports communicating with the well shaft below said closure means, and means to close the ports and open the bore of said flow line to the passage of pressure fluid therethrough actuated by telescoping said upper and lower portions.

5. In a device of the character described, a ported flow line comprising an upper tubing section and a lower tubing section telescopically connected and carrying means for anchoring the flow line at any desired level in the well, a valve closing the bore of said upper section to pressure therebelow, and a valve structure connected in said flow line and actuated by said sections upon telescopic movement thereof to close the port and open communication between said sections.

6. A well tester comprising a tubular string adapted to be lowered into a well to be tested containing drilling fluid, valve means movable to one position to close the lower end of the string, means for forming a seal between the string and the walls of the well bore to exclude the drilling fluid from the formation to be tested carrying anchoring means controlled by the tubular string, means for actuating the valve means into open position to permit the entrance of a sample from said formation beneath the sealing means, into the string, means for moving the valve means to another position to open the lower end of the string to the well bore, above said sealing means, to permit the entrance of drilling fluid into the string, and means for moving the valve means to original position to again close the lower end of the string to entrap the contents thereof, therein.

7. A well tester comprising a tubular string including an upper tubular member and a lower tubular member telescopically connected and adapted to be lowered into a well to be tested containing drilling fluid, valve means movable to one position to close the lower end of the string, means for forming a seal between the string and the walls of the well bore to exclude the drilling

fluid from the formation to be tested, means for actuating the valve means into open position to permit the entrance of a sample from said formation beneath the sealing means, into the string, means for moving the valve means to another position to open the lower tubular member of the string to the well bore, above said sealing means, to permit the entrance of drilling fluid into said lower member, means for moving the valve means to original position to again close the lower end of the upper tubular member to entrap the contents thereof, therein, and means operable in response to relative rotation of said members for controlling relative movement between said members longitudinally.

8. A circulating valve assembly adapted for use with a pipe in an oil well or the like consisting essentially of two conduit members telescoped together for limited relative movement longitudinally and carrying anchoring means controlled by said pipe, said members having means for conducting fluid from end to end thereof when telescoped together, means for preventing flow of fluid from end to end thereof when extended, and means for controlling relative movement between said members longitudinally.

9. In a device for use in a well shaft, a flow line comprising a pair of telescopic sections, a packer associated with said flow line carrying anchoring means, means to communicate the flow line above the packer with the zone of the well shaft above the packer, and means operable by telescopic movement of said sections to close off said last-named means of communication and open the flow line for communication of the area of the well shaft below said packer with the well surface.

10. In a device of the character described, a string of tubing comprising relatively telescopic upper and lower portions of the string, means for anchoring the lower portion at any desired level in a well bore, means for connecting said portions together for limited relative longitudinal movement, and a single valve associated with said portions to control, selectively, communication of the lowermost of said portions with the well shaft, and with the bore of the upper portion.

11. A circulating valve assembly for use with pipe in an oil well or the like consisting essentially of two conduit members one superposed relative to the other and telescoped together for limited relative movement, said upper and lower members forming, respectively, a valve and seat providing means for conducting fluid from end to end when said members are telescoped together, and means for preventing flow of fluid from end to end when said members are extended, and means for conducting fluid from the interior to the exterior thereof when said members are extended.

12. In a device of the character described disposed in a well shaft, a flow line comprising relatively telescopic upper and lower portions thereof, a valve closing the bore of said upper portion from communication with said lower portion, said lower portion having a packer mounted thereon carrying anchoring means controlled by the flow line, a passageway through said lower portion of the flow line and through the packer exterior of said lower portion to communicate the area of the well shaft above and below said packer, valve means actuated by the relative movement of said portions of the flow line and the movement thereof relative to the packer when

anchored in the well shaft for closing said passageways and opening the bore of the flow line to the passage of pressure fluid upwardly there-through.

13. A circulating valve assembly adapted for use with a pipe in an oil well or the like consisting essentially of two conduit members, one superposed relative to the other, telescoped and se-

cured together for limited relative movement longitudinally and mounted above a packer, a valve closing the bore of the upper member to pressure therebelow, and a valve structure forming a part of said conduit members and actuated thereby upon telescopic movement thereof to open communication between said members.

ERD V. CROWELL.