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[54] **TOOL STRING ASSEMBLY FOR USE IN WELLS**
7 Claims, 16 Drawing Figs.

[52] U.S. Cl..... 166/125,
166/128, 166/135

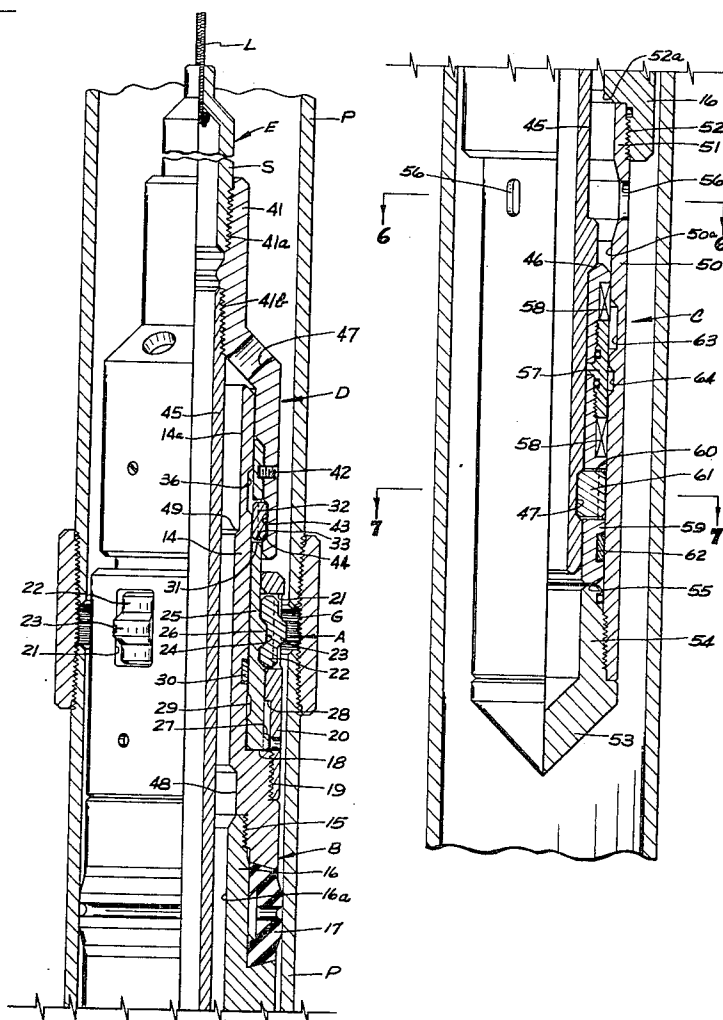
[51] Int. Cl..... E21b
33/12, E21b 23/00

[50] Field of Search..... 166/123,
124, 125, 128, 133, 135, 226

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ABSTRACT: A tool string assembly adapted to be run in a well bore on a wire line and comprising the combination of several subassemblies including an anchor subassembly, a packer subassembly and a bridging plug subassembly, together with a setting tool subassembly releasably connecting the wire line string to the tool string and operable by appropriate manipulation of the wire line running string to releasably anchor the tool string to the well wall and to open and close communication through the bridging plug between sections of the well above and below the packer subassembly.



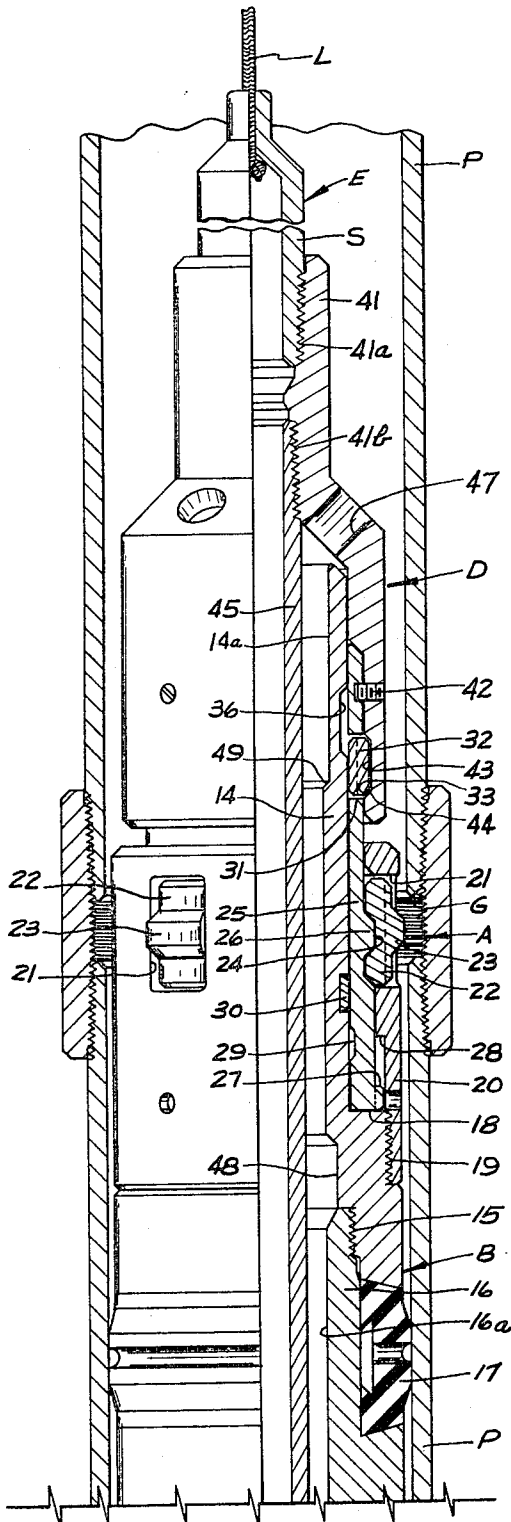


Fig. 1A

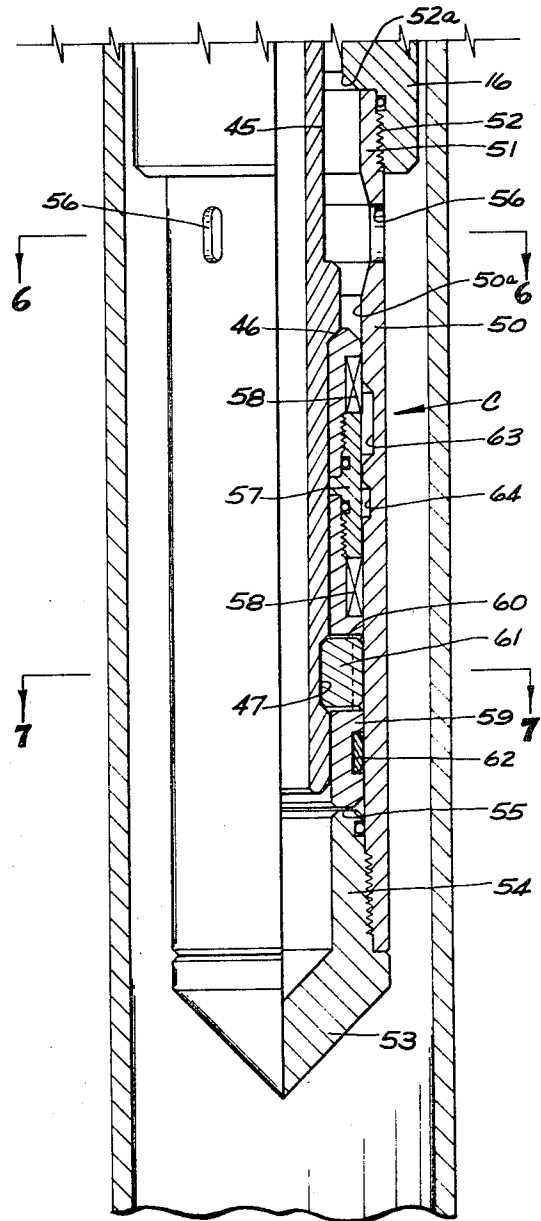
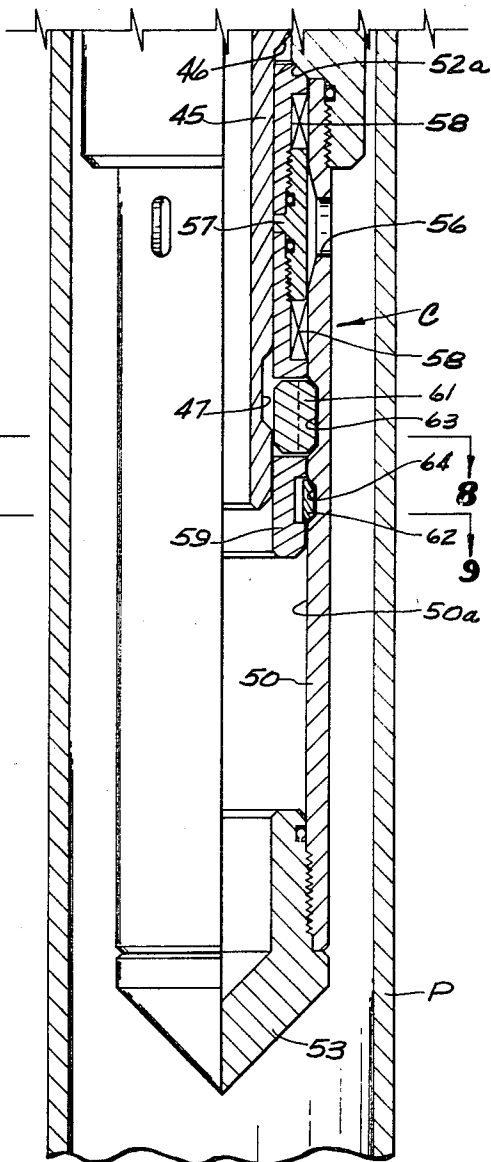
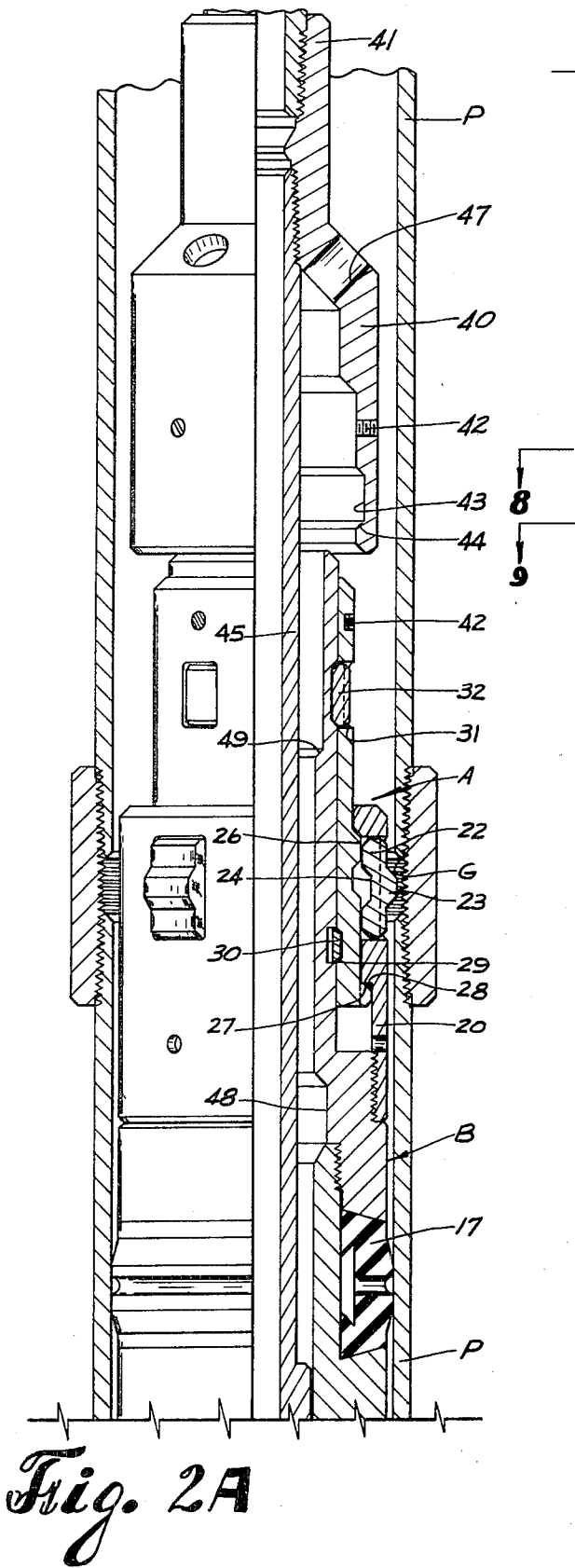


Fig. 1B

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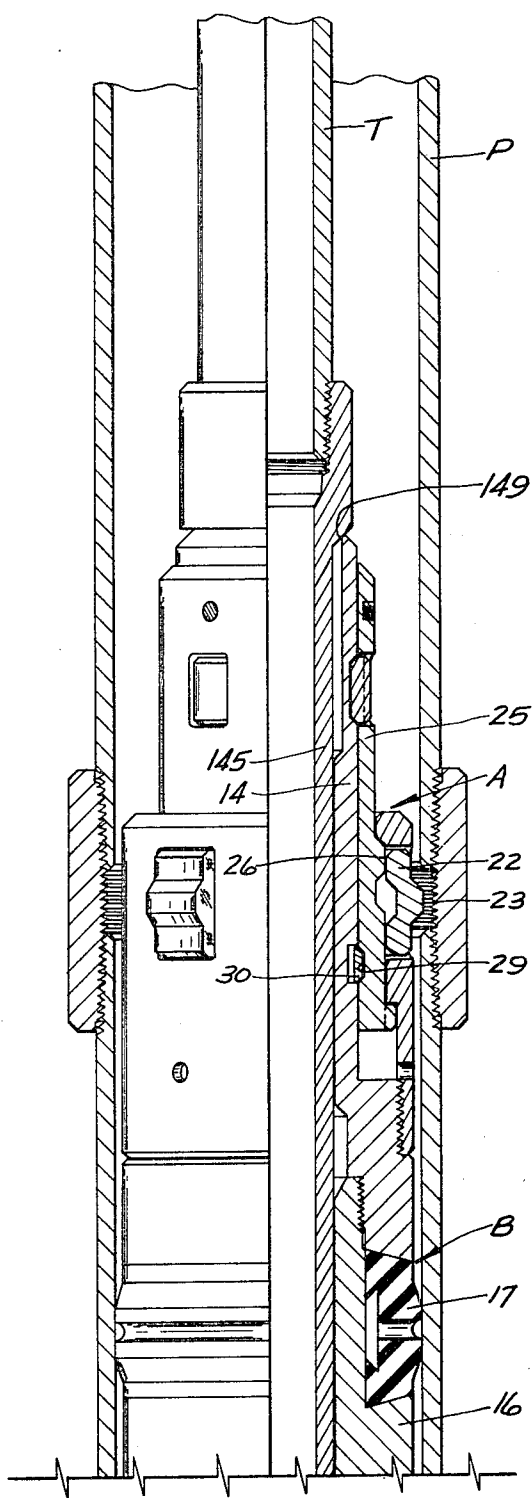


Fig. 3A

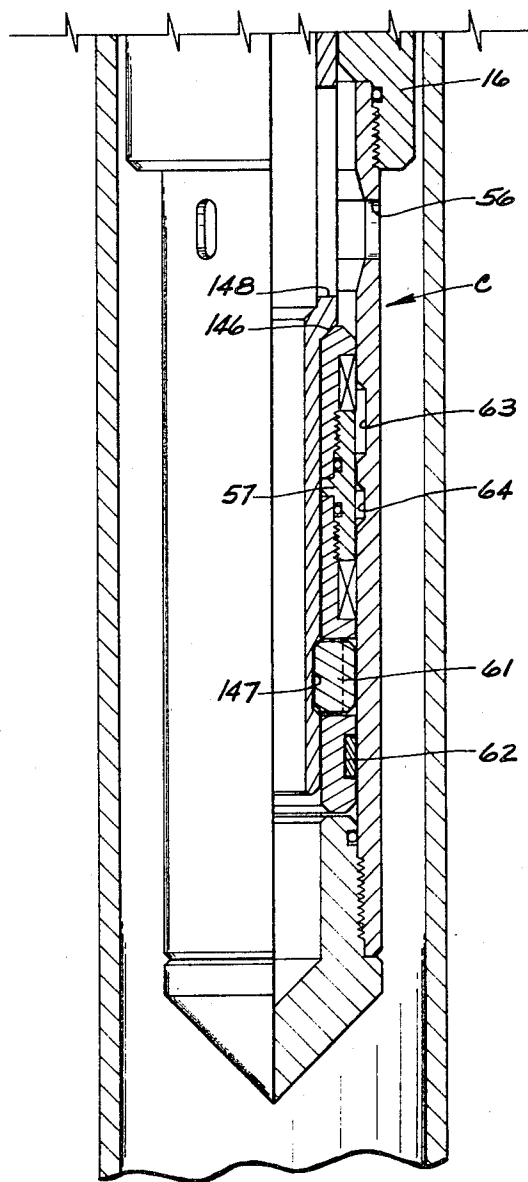


Fig. 3B

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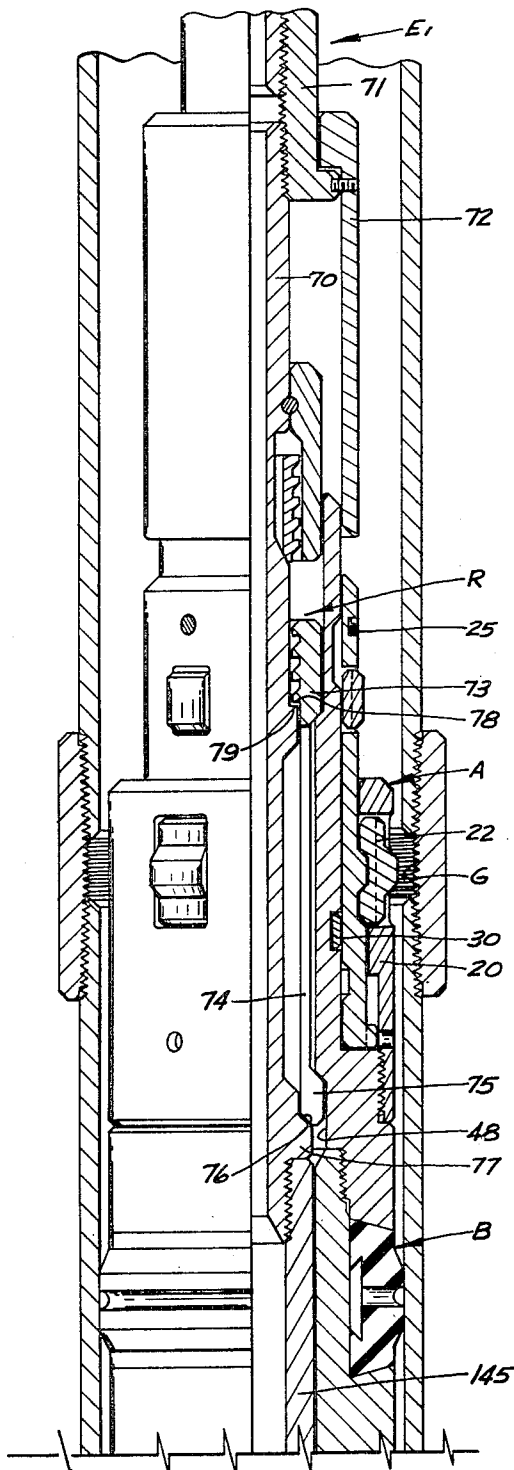


Fig. 4A

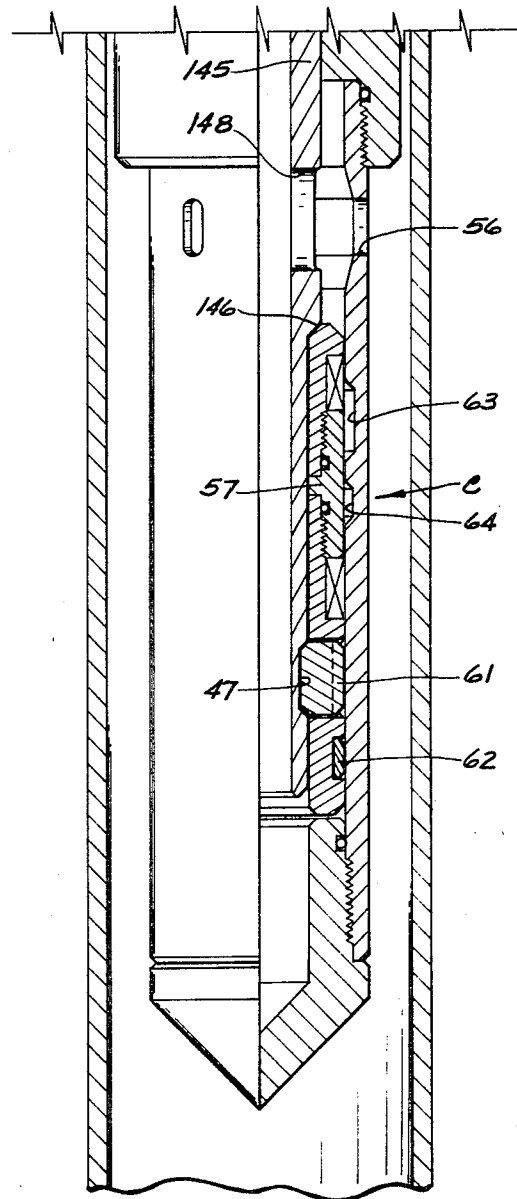


Fig. 4B

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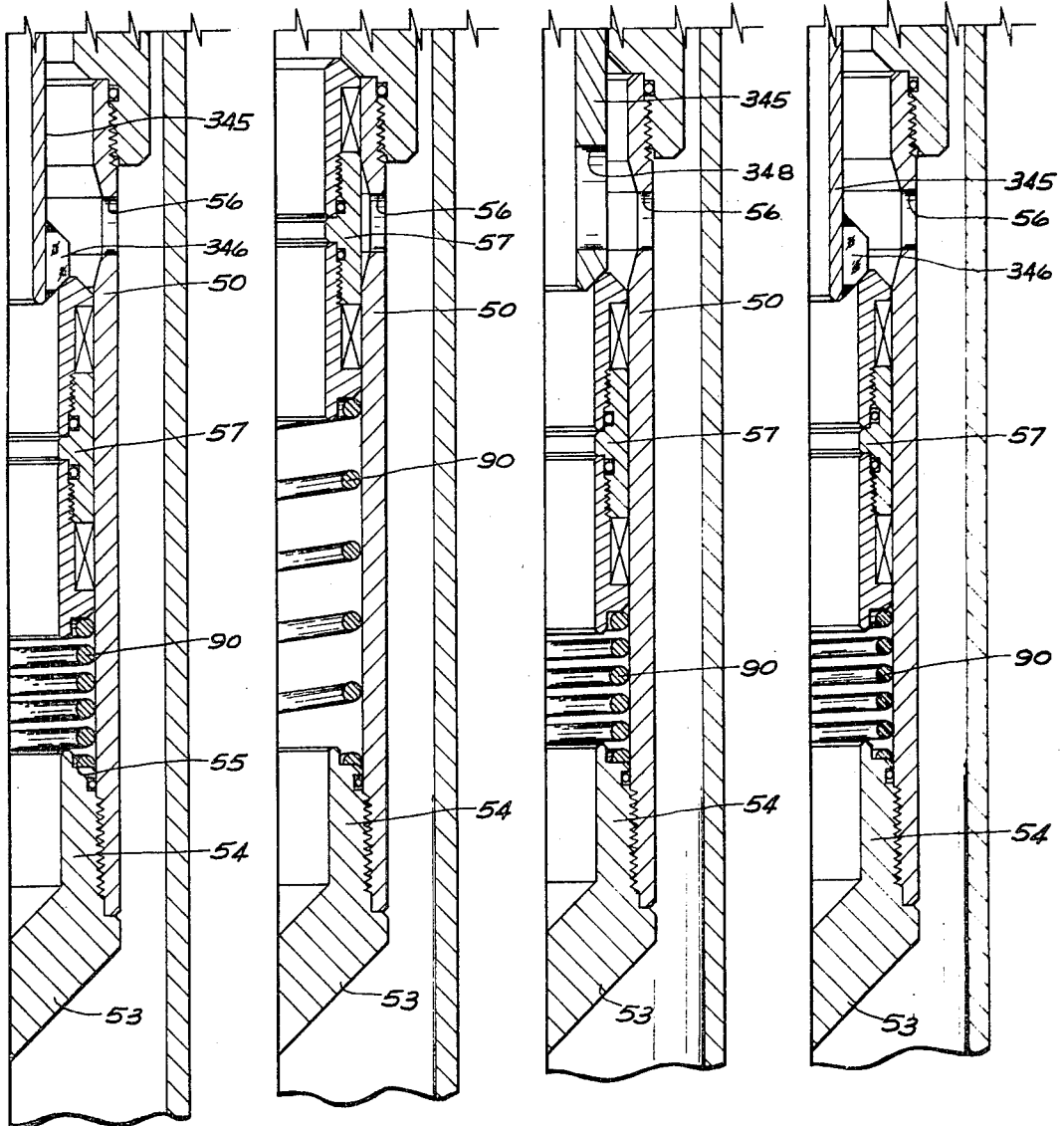


Fig. 5A

Fig. 5B

Fig. 5C

Fig. 5D

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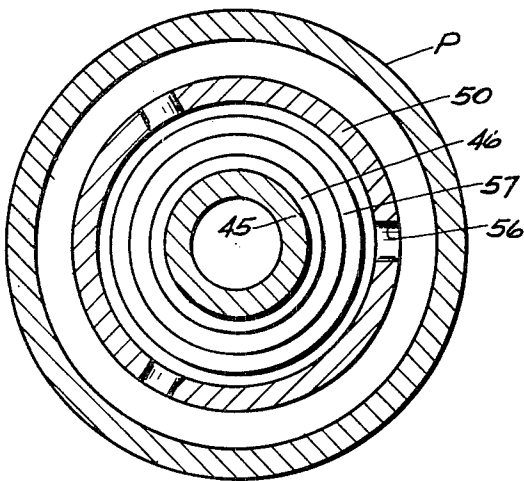


Fig. 6

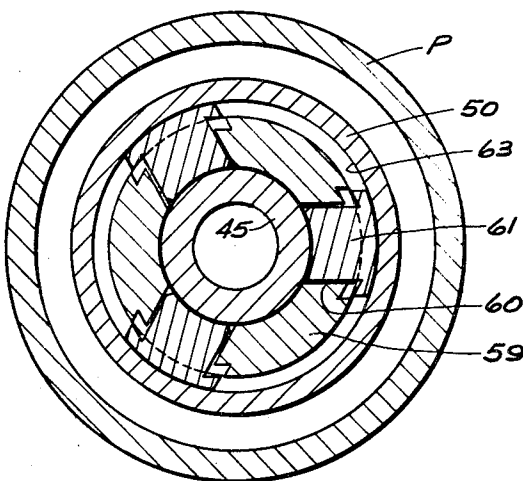


Fig. 8

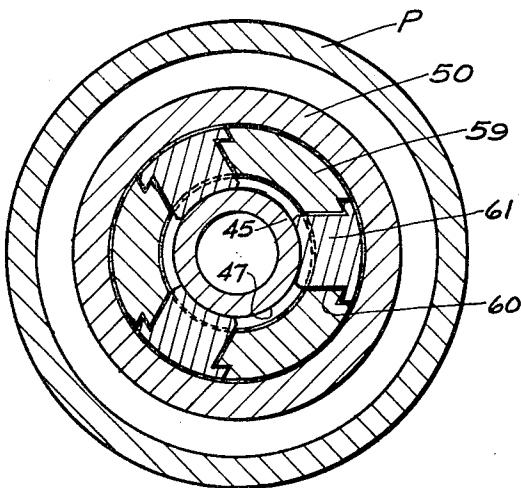


Fig. 7

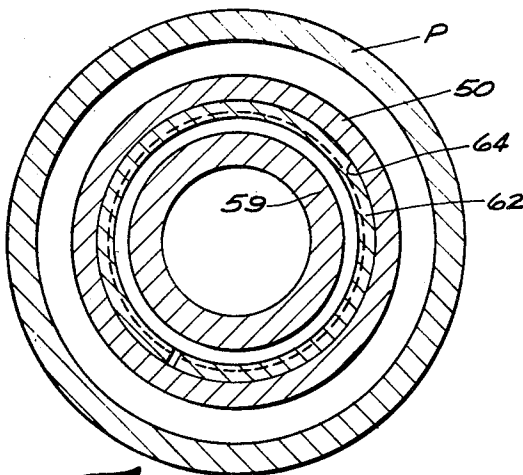


Fig. 9

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TOOL STRING ASSEMBLY FOR USE IN WELLS

RELATED APPLICATIONS

This application is related to our copending application, Ser. No. 857,047 filed Sept. 11, 1969.

In our aforementioned application, we disclosed an improved form of anchor assembly designed to be run on a wire line for anchoring well tools such as packers and the like in a well pipe. In the illustrative embodiment, the anchor assembly was shown combined with a comparatively simple form of packer as the tool to be anchored in the well pipe. The illustrative embodiment included a setting tool subassembly by which the anchor assembly could be actuated and released and included a safety latch to the anchor subassembly which was operable to prevent premature actuation of the anchor subassembly during running of the tools into the well pipe.

The present invention adds to the principal elements of the combination disclosed in our earlier application a bridging plug subassembly of improved form which can be run on the tool string below the packer and opened and closed to fluid flow from the well bore by the manipulations or positioning of the setting tool in holding the anchoring means in inactive position during running of the tools and in actuating the anchor means.

In general, the tool string assembly in accordance with this invention is designed to be run on a wire line and comprises a series of subassemblies which include an anchor subassembly for anchoring the tool string to the wall of a well pipe; a packer subassembly mounted to the anchor subassembly for sealing off the bore of the well pipe; a bridging plug subassembly secured to the lower end of the packer subassembly and incorporating valve means operable to open and close fluid communication between points in the well bore above and below the packer; and a setting tool subassembly connectable to a running string and operable both to actuate the anchor subassembly and the valve means in the bridging plug.

The anchor subassembly, and packer subassembly, for purposes of convenience in this description, are shown in the illustrative embodiment to be identical to the corresponding elements disclosed in the aforementioned application. However, as will be evident to those skilled in this art, other known forms of packers and anchor means may be substituted with appropriate modifications of the setting tool subassembly to obtain the advantages of this invention as will appear hereinafter.

The bridging plug subassembly comprises a tubular body adapted to be mounted to the lower end of the packer subassembly and has an axial bore, closed at its lower end, communicating with the bores of the packer and anchor subassemblies. The plug body is provided with valve means for controlling fluid communication between the exterior and interior thereof, the valve means comprising radial ports through the wall of the body and a sleeve valve means slidably disposed in the bore of the plug body between positions opening and closing the ports. The sleeve valve carries a plurality of angularly spaced latching dogs which are mounted in openings in the wall of the sleeve valve for radial movement into latching engagement with a latching groove provided in the wall of the plug body when the sleeve valve has been moved to the port-closing position. A resilient lock ring is also mounted about the exterior of the sleeve valve below the latching dogs to be projected into a locking groove in the wall of the plug body when the sleeve valve has moved to the port-closing position to lock the sleeve valve in that position.

The setting tool subassembly includes a mandrel which is extendible through the bores in the anchor and packer subassemblies into the bore of the plug body and carries shoulder means operable to engage and hold the sleeve valve downwardly in the port-opening position when the tool string is being run and is also provided with a relief groove cooperating with the latching dogs carried by the sleeve valve to permit the dogs to remain in a retracted position when the tool string is being run but which provides a connection between the

mandrel and the sleeve valve which enables positive movement of the sleeve valve to the upper port-closing position by upward movement of the mandrel. The setting tool connections to the anchor subassembly are such that the positioning of the sleeve valve by the mandrel correspond to the position and movements of the mandrel in running and setting the anchor subassembly.

One object of this invention is to provide a bridging plug which can be run below a packer in a tool string and which can be opened and closed positively by operation of the setting tool mandrel and valve means in the bridging plug.

Another object is to provide a bridging plug including a sliding sleeve valve which is held in open position by positive action dogs and snap-type lock ring engaging the plug body.

Further objects and advantages of this invention will become more readily apparent from the following detailed description in conjunction with the accompanying drawings which illustrate useful embodiments in accordance with this invention.

In the drawings:

FIG. 1A and 1B, together, comprise a longitudinal quarter-sectional view of the tool string. The parts being shown in running-in position with the bridging plug ports open;

FIGS. 2A and 2B, together, comprise a view similar to FIGS. 1A and 1B showing the anchor subassembly set, the bridging plug ports closed and the setting tool subassembly in process of being withdrawn from the well;

FIGS. 3A and 3B, together, comprise a view similar to FIGS. 1A and 1B, but with the setting tool mandrel replaced by a mandrel connected to a production pipe string, and disposed to reopen the ports in the bridging plug;

FIGS. 4A and 4B, together, show the tool assembly in process of being released from the well pipe, the setting tool mandrel being replaced by a retrieving tool operative to release the anchor subassembly and reopen the bridging plug ports;

FIGS. 5A, 5B, 5C and 5D are fragmentary sectional views illustrating a modification of the bridging plug subassembly in several stages of its operation;

FIGS. 6 and 7 are cross-sectional views taken respectively along lines 6-6 and 7-7 of FIG. 1B; and

FIGS. 8 and 9 are cross-sectional views taken respectively along lines 8-8 and 9-9 of FIG. 2B.

The tool string as shown in FIGS. 1A and 1B, comprise an anchor subassembly, designated generally by the letter A; to the lower end of which is attached a packer subassembly, designated generally by the letter B; a bridging plug subassembly, designated generally by the letter C, secured to the lower end of the packer subassembly; and a setting tool subassembly, designated generally by the letter D, having operative connection to the other subassemblies as will be described subsequently, and connectable to a wire line running string, designated generally by the letter E.

Referring now to FIG. 1, anchor subassembly A comprises a tubular body 14, having an axial bore 14a and having at its lower end an internally threaded box or socket 15 for attachment of the packer subassembly B. The latter includes a tubular body 16 having an axial bore 16a in coaxial communication with bore 14a. A deformable seal element 17 is mounted about body 16 and is adapted to seal with the wall of pipe P and to provide frictional engagement with the latter to enable operation of the anchoring assembly as will be subsequently described. Packer subassembly B may be of any well-known and suitable form adapted to provide the necessary seal as well as the frictional engagement referred to. The exterior of body 14 of the anchor assembly is reduced substantially in diameter above box 15 to form the upwardly facing shoulder 18 and a portion of the exterior of body 14 below shoulder 18 is externally threaded at 19 to receive a tubular cage 20 concentrically surrounding body 14 and spaced therefrom. Cage 20 includes a plurality of angularly spaced generally rectangularly shaped windows 21 in which are mounted a corresponding number of rectangular anchor dogs

22 of a well-known form including a central outward projection 23 and an internal recess 24 opposite projection 23 and disposed between the opposite ends of the dog for purposes to be described subsequently.

Slidably mounted between body 14 and cage 20 is a tubular setting sleeve 25 provided about its exterior at a point spaced from its lower end with a section matching the shape of the inner faces of dogs 22 including a radial projection 26 adapted to be received in recess 24 of anchor dog 22 to allow the latter to retract inwardly a sufficient distance to clear the wall of pipe P in running the tools as will be described subsequently. The lower end of setting sleeve 25 is provided with an external shoulder 27 engageable with an inwardly projecting shoulder 28 formed in the bore of the cage 20 to limit upward movement of the setting sleeve relative to the cage. The inner wall of setting sleeve 25 near its lower end is provided with a latching slot or groove 29 adapted to receive a split latch ring 30 mounted in the exterior of body 14 at a point adapted to register with recess 29 when setting sleeve 25 has been moved upwardly a distance sufficient to dispose recess 29 opposite latch ring 30.

Near its upper end setting sleeve 25 is provided with a plurality of radial windows 31 in which are mounted latching dogs 32 which are arcuate in transverse cross section to fit snugly against the exterior of body 14. Latch dogs 32 are made to somewhat greater thickness than the wall of the upper end of setting sleeve 25 so that in the lower position of setting sleeve 25 seen in FIG. 1 the inner face of the latch dogs will bear against the exterior of body 14 and will thereby be forced to project outwardly of the windows so as to form downwardly facing shoulders 33. The exterior wall of body 14 is provided with an annular groove 36 adapted to receive latch dogs 32 when in registration with the latter in the course of operation of setting tool as will appear subsequently.

Bridging plug subassembly C comprises a tubular casing 50 having an externally threaded upper end 51 adapted to be received in a threaded socket 52 provided in the lower end of packer body 16 and defining a downwardly facing shoulder 52a adjacent upper end 51. Casing 50 has an axial bore 50a which is in coaxial communication with bores 16a and 14a and is closed at its lower end by cap 53 having a threaded shank 54 which is screwed into the lower end of bore 50a to form an upwardly facing shoulder 55 therein. Near its upper end, casing 50 is provided with a plurality of angularly spaced radial ports 56 providing fluid communication between the exterior and the interior of the casing.

A sleeve valve 57 is slidably mounted in bore 50a for axial movement between a lower position uncovering ports 56 (FIG. 1B) and an upper position covering ports 56 (FIG. 2B). The exterior of sleeve valve 57 is fitted with spaced-apart packings 58, 58 to seal between the valve and the wall of bore 50a at points above and below ports 56 when the valve is in the upper port-closing position. The lower end portion of the sleeve valve forms a cage 59 having a plurality of rectangular windows or openings 60 in which latching dogs 61 of corresponding shape are mounted for radial movement. The thickness of dogs 61 is made somewhat greater than that of the wall of cage 59 so that the dogs will project to one side or the other of the cage to provide a latching shoulders either inside or outside cage 59 during operation and for purposes to be described hereinafter. Mounted about the exterior of cage 59 below openings 60 is an expansible split latch ring 62. The wall of bore 50a is provided with an annular latching recess 63 having bevelled upper and lower end walls adapted to receive dogs 61 when the latter are moved into registration with recess 63 and projected outwardly of cage 59 when the sleeve valve has been moved to the upper port-closing position (FIG. 2B). A latching groove 64 is also provided in the wall of bore 50a to receive split ring 62 when the latter is in registration therewith. The spacing between recess 63 and groove 64 is made the same as that between dogs 61 and split ring 62 so that when dogs 61 have been lodged in recess 63 in the port-closing position of the valve, split latch ring 62 will latch into

groove 64 and thereby lock the sleeve valve in the port-closing position.

A running collar 40 is provided for connecting setting sleeve 25 to wire line tool string E. The latter may be of any conventional form including the wire line L and connector S. Weight bars and jarring tools such as are conventionally incorporated in a wire line running string but are not shown here since they are well known to those skilled in the art. Running collar 40 is provided with a reduced diameter tubular shank 41 having an internally threaded socket 41a at its upper end for attachment to connector S and is dimensioned to concentrically surround the upper end of body 14 and setting sleeve 25. Collar 40 is connected to the upper end portion of setting sleeve 25 at a point above windows 31 by one or more shear pins 42 which are adapted to be broken in the operation of the tool as will be described hereinafter. The lower end of collar 40 is provided with an internal annular recess 43 into which latch dogs 32 project and which provide a lower abutment or shoulder 44 for engagement by shoulder 33 formed by the outward projection of the latch dogs. Thus, in the position shown in FIG. 1, with the latch dogs 32 projected into recess 43 the thickness of the latches will be such that the latches will be closely held between the exterior surface of body 14 and the interior wall of recess 43 and with shoulders 33 and 44 engaged, collar 40 cannot be pulled off of the setting sleeve particularly while the latter is in the downward position as seen in FIG. 1.

The lower end portion of shank 41 is internally threaded at 41b to receive the threaded upper end of a tubular mandrel 45 smaller in diameter than the several connecting bores 24a, 16a and 50a and having a length to extend through the several bores to a point just above shank 54 when running collar 40 is secured to setting sleeve 25. The lower portion of mandrel 45 which extends into bore 50a is externally dimensioned to have a close sliding fit in the bore of sleeve valve 57 and carries an external shoulder 46 which is adapted to abut the upper end of the sleeve valve to urge the latter downwardly to the lower port-opening position (FIG. 1B) when the mandrel is fully inserted and running collar 40 is secured to setting sleeve 25. Mandrel 45 is provided with an annular relief recess 47 having bevelled end walls spaced below shoulder 46 a distance to be in registration with dogs 61 when shoulder 46 is in abutting engagement with the upper end of sleeve valve 57. When in this relation, dogs 61 are free to retract into recess 47 sufficiently to free sleeve valve 57 for downward movement to the port-opening position and upwardly from the latter to the port-closing position.

The lower end of body 14 is provided internally with an annular recess 48 at a point just above socket 15 for the reception of other tools to be described hereinafter. Likewise, the bore of body 14 from a point extending from its upper end for some distance downwardly is increased in diameter to form the upwardly facing shoulder 49 also for reception of other tools employed in connection with the device. Running collar 40 is provided with a plurality of ports 47 through which fluid may freely circulate during running of the tools.

In operation, the tool string including anchor subassembly A, packer subassembly B and bridging plug subassembly C, connected as described to setting tool subassembly D, secured to the wire line string E will be run inside the pipe P, the parts being in the inactive positions illustrated in FIGS. 1A and 1B wherein the anchor dogs 22 are retracted or are free to move in inwardly to their retracted position while the tool string is run into the well and latch dogs 32 are in the position securing running collar 40 to setting sleeve 25. Sleeve valve 57 is in the port-opening position, thereby permitting free fluid circulation through ports 47 and 56 as the tool string is run. To set the anchor assembly, upward pull will be applied to the tool string whereby the resulting friction between seal 17 and the wall of pipe P will hold body 14 stationary allowing collar 40 to apply an upward pull through shear screws 42 and the engagement of shoulders 33 and 44 to setting sleeve 25. However, the latter cannot move upwardly until anchor dogs 22 are projected since they will drag the inner surface of the pipe

until the dogs come into registration with a collar gap G. At that point the anchor dogs are freed to move outwardly into the collar gap, whereupon the upward pull being applied through running collar 40 will pull setting sleeve 25 upwardly to the position shown in FIGS. 2A and 2B at which the enlargements on the setting sleeve will engage the inner ends of the anchor dogs 22 forcing them outwardly and moving projections 23 into collar gap G thereby anchoring cage 20 and the anchor assembly as a whole to pipe P.

When the pull on running collar 40 through the wire line string has raised setting sleeves 25 to the position projecting the anchor dogs into collar gap G, latch dogs 32 will be raised at the same time to a position registering with latch recess 36 as seen in FIG. 2A. Thereupon, continued tension or jarring as may be required on the wire line string will break shear pins 42 and allow the running collar and the wire line string to be released from the anchor assembly and withdrawn from the well leaving the anchor assembly anchored in collar gap G. The upward movement of the setting sleeve in anchoring the assembly, as described, will also bring latch recess 29 into registration with latch ring 30 thereby locking the setting sleeve in the anchor position projecting the anchor dogs into collar gap G and thereby preventing their release until such time as other tools may be run as will be subsequently described for purposes of removing the anchor assembly and its attached well tools from the well pipe. The upward movement of setting sleeve 25 to the dog-projecting position is also limited by engagement of shoulder 27 with shoulder 28 to assure both the holding of the anchor dogs in their anchored position in gap G as well as registration of the latch ring 30 in the locking position as is seen in FIG. 2A.

The upward movement of the setting tool subassembly following the breaking of shear pins 42 will also pull mandrel 45 upwardly, the upward pull being transmitted to sleeve valve 57 through the engagement of dogs 61 in recess 47, thereby providing positive upward pull on the sleeve valve which will thus be moved upwardly in casing 50 until the sleeve valve is in the port-closing position (FIG. 2B), the upward movement being limited by the abutment of the upper end of the sleeve valve with shoulder 52a. At this point dogs 61 will be placed in registration with recess 63 permitting outward movement of dogs 61 sufficient to free mandrel 45 so it can be withdrawn from the well with the running collar. At the same time that dogs 61 come into registration with recess 63, split latch ring 62 will be put in registration with groove 64 into which it will snap, locking the sleeve valve into the upper port-closing position.

With the tool string in place, if it is now desired to produce fluid, such as oil or gas, from the well below the packer, a tubing string T (FIGS. 3A and 3B) is run into the well carrying on its lower end a stinger or mandrel 145 substantially identical in all respects to mandrel 45, except for the provision of production slots 148 located above shoulder 146. The mandrel is run through bores 14a, 16a and 50a and when shoulder 146 contacts the upper end of sleeve valve 57, relief groove 147 will be opposite dogs 61, whereupon downward force applied through tubing string T will push sleeve valve 57 downwardly, forcing latch ring 62 out of groove 64, thereby allowing the sleeve valve to be pushed down to the port-opening position. The upper end portion of the mandrel may be provided with an external enlargement 149 adapted to engage a seal off with the upper end of anchor body 14 so that fluid entering port 56 will flow through slots 148 into the bore of tubing T and thence to the surface.

When it becomes necessary or desirable to remove the tool string from the well, tubing string T will be lifted, applying an upward pull to mandrel 145, which will be transmitted through the engagement between dogs 61 and the walls of relief recess of 147 to sleeve valve 57 to thereby pull the sleeve valve upwardly to the port-closing position. This will permit dogs 61 to be projected into recess 63, releasing the mandrel from the dogs. Snap ring 62 will be latched into groove 64. The tool string parts will thus be returned to the positions

shown in FIGS. 2A and 2B, shutting off flow of well fluids, and tubing string T and mandrel 145 may be withdrawn from the well.

After the tubing string is out of the well, a retrieving tool R (FIGS. 4A and 4B) is run into the well, carrying on its lower end tubular mandrel 145. Retrieving tool R may be any suitable type of fishing tool adapted to release and retrieve the tool assembly from the well. In the illustrative embodiment the retrieving tool is of the form disclosed in the aforementioned U.S. application Ser. No. 857,047, filed Sept. 11, 1969, by the present inventors.

For purposes of this description, retrieving tool R includes a tubular body 70 in the upper end of which is connected by a collar 71 to a running string E₁ and its lower end to mandrel 145. Collar 71 is secured to release collar 72 which is dimensioned to slide over the upper end of body 14 of the anchor subassembly to abuttingly engage the upper end of setting sleeve 25. A collet 73 surrounds an intermediate portion of body 70 and is provided with a number of separate elongate flexible fingers 74 depending therefrom and terminating at their lower ends in enlarged heads 75 adapted to be received in recess 48 and clamped therein by a shoulder 76 formed on the exterior of an enlargement 77 on the lower end of body 70. The bore of collet 73 is provided with a downwardly facing shoulder 78 adapted to abut an upwardly facing shoulder 79 formed on the exterior of body 70 limiting relative downward movement of the collet on the body. Shoulder 49 forms a seat for the collet in the bore of body 14 to position heads opposite recess 48.

When the retrieving tool carrying mandrel 145 is run through the bores of anchor subassembly A and packer subassembly B enlargement 146 will engage the upper end of sleeve valve 57 as relief recess 147 is disposed opposite dogs 61. Downward force applied through the running string to the mandrel sufficient to overcome the holding force of latch ring 62 will cause the mandrel to push the sleeve valve to the port-opening position (FIG. 4B). At the same time, the downward movement of the tools will cause releasing sleeve 72 to push downwardly on the upper end of setting sleeve 25, overcoming the latching force of latch ring 30, and causing sleeve 25 to move downwardly sufficiently to release dogs 22 for retraction from collar gap G. Thereupon, upward pull applied to the running string will act through the clamping engagement of heads 75 between shoulder 76 and the upper wall of recess 48 to apply a pulling force to the now-freed tool assembly and permit the withdrawal of the total assembly from the well.

FIGS. 5A to 5D, inclusive, are fragmentary views of a modified form of bridging plug in which the force employed to move the sleeve valve to the port-closing position is a coil spring 90 which is mounted in bore 50a of the plug casing in compression between shoulder 55 and the lower end of sleeve valve 57. In this modification, the force urging the sleeve valve to the port-opening position is applied by a shoulder 346 mounted adjacent the lower end of a mandrel 345.

The positions of the sleeve valve and related mandrel parts shown in FIGS. 5A to 5D, inclusive, correspond to the position of these parts as seen, respectively, in FIGS. 1B, 2B, 3B, and 4B, and further explanation thereof is believed unnecessary, since the related operations will be obvious from the foregoing description.

It will be evident that various alterations and modifications may be made in the details of illustrative embodiments within the spirit of this invention as hereinafter claimed.

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

1. A tool string assembly to be run in a well bore, comprising:
 - a. an anchor subassembly for anchoring the tool string to the well bore and including a tubular body;
 - b. a packer subassembly mounted to the lower end of the anchor subassembly for sealing engagement with the well wall;
 - i. said subassemblies having coaxial communicating bores defining a central passage therethrough;

- c. a bridging plug mounted to the lower end of said packer subassembly and having an axial bore communicating with said central passage;
 - d. a setting tool subassembly including:
 - i. a running collar connectable to a running string and extending concentrically over the upper end portion of said tubular body;
 - ii. latch means connecting the collar to said upper end portion of said body and releasable therefrom in response to nonrotative relative upward movement of the collar; and
 - iii. a tubular mandrel connected to the running collar to extend through said central passage into the bore of the bridging plug;
 - e. valve means in the bridging plug arranged for movement between positions opening and closing fluid communication between the well bore and said central passage; and
 - f. means carried by the mandrel cooperating with said valve means to hold the latter in open position when said collar is secured by said latch means to said anchor subassembly and to effect movement of said valve means to the closed position in response to said relative upward movement of said collar.
2. A tool according to claim 1 wherein said valve means, comprises:
- a. ports through the wall of said bridging plug; and
 - b. a sleeve valve slidably disposed in the bore of said plug for axial movement between an upper position closing said ports and a lower position opening said ports.
3. A tool string according to claim 1 wherein said bridging plug and said valve means, comprises:
- a. a tubular casing leaving a plurality of radial ports communicating with the bore thereof;
 - b. a sleeve valve slidable between an upper position closing said ports and a lower position opening said ports;
 - c. a plurality of radially movable anchor dogs mounted in the wall of said sleeve valve;
 - d. an annular recess in the wall of said casing registrable with said dogs when the sleeve valve is in said upper position; and
 - e. cooperating latch means arranged between said sleeve valve and said casing to lock the sleeve valve to said casing when the sleeve valve attains said upper position.
4. A tool string according to claim 3 wherein said latch means, comprises:
- a. a split latch ring mounted about the exterior of said sleeve valve below said anchor dogs; and
 - b. an annular latch groove in the wall of said casing below said annular recess positioned to receive said latch ring when said anchor dogs are in registration with said recess.
5. A tool string assembly according to claim 3, wherein said

- means carried by the mandrel cooperating with said valve means comprises:
- a. shoulder means abutable with the upper end of said sleeve valve to move the latter downwardly; and
 - b. an annular recess in the exterior of the mandrel positioned to register with said anchor dogs when said shoulder means is in abutting engagement with said upper end of said sleeve valve.
6. A tool string assembly to be run in a well bore, comprising:
- a. a well packer having an axial through bore;
 - b. anchor means for releasably anchoring the packer to the well wall;
 - c. a bridging plug mounted to the lower end of the packer;
 - d. valve means in the bridging plug arranged for opening and closing fluid communication between the well bore and said through bore; and
 - e. a releasable anchor setting tool connectable to a running string comprising:
 - i. a tubular mandrel extendible through said through bore;
 - ii. means carried by the mandrel releasably connected to the anchor means and operable in one position to hold said anchor means out of anchoring engagement with the well wall and in a second position to cause said anchor means to engage the well wall; and
 - iii. means carried by said mandrel cooperating with said valve means to hold the latter in the open position when the mandrel is in said one position and to release the valve means for movement to the closed position when the mandrel is in said second position.
7. A bridging plug for use in a well tool string, comprising:
- a. a tubular casing connectable to a well tool string and having an axial bore closed at its lower end;
 - b. ports through the wall of said casing above said lower end;
 - c. sleeve valve means slidable in the bore of the casing between an upper position closing said ports and a lower position opening said ports;
 - d. an annular anchor recess in the wall of said casing below said ports/
 - e. a plurality of angularly spaced anchor elements mounted in the wall of said valve means for radial movement into and out of anchoring engagement with said recess in accordance with said positions of the sleeve valve means;
 - f. cooperating lock means carried by the casing and said sleeve valve means arranged to lock the sleeve valve means to the casing in said upper position; and
 - g. means extendible into said bore for moving said valve means between said positions.
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