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WELL TOOLS

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2 Sheets-Sheet 1

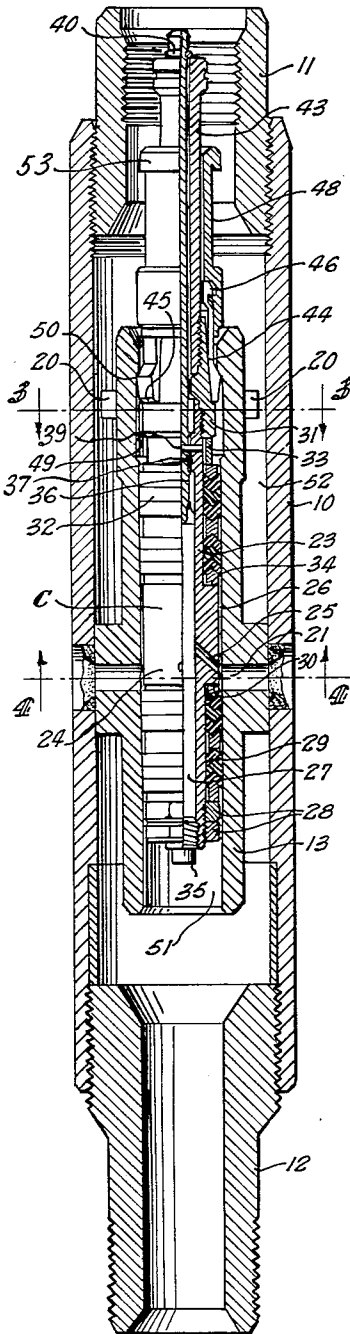


Fig. 1

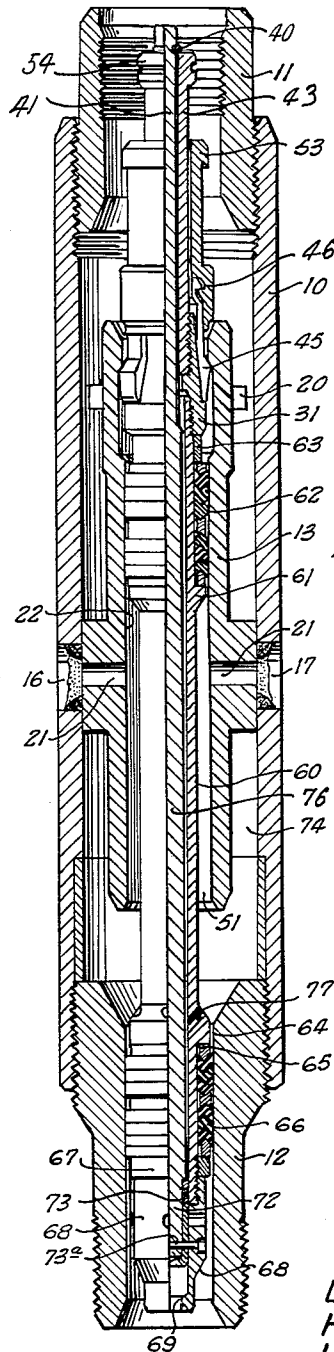


Fig. 5

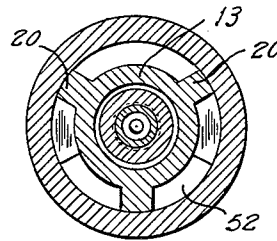


Fig. 3

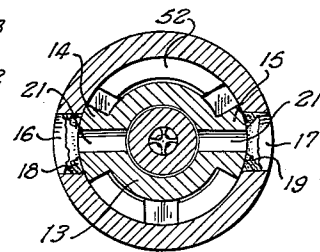


Fig. 4

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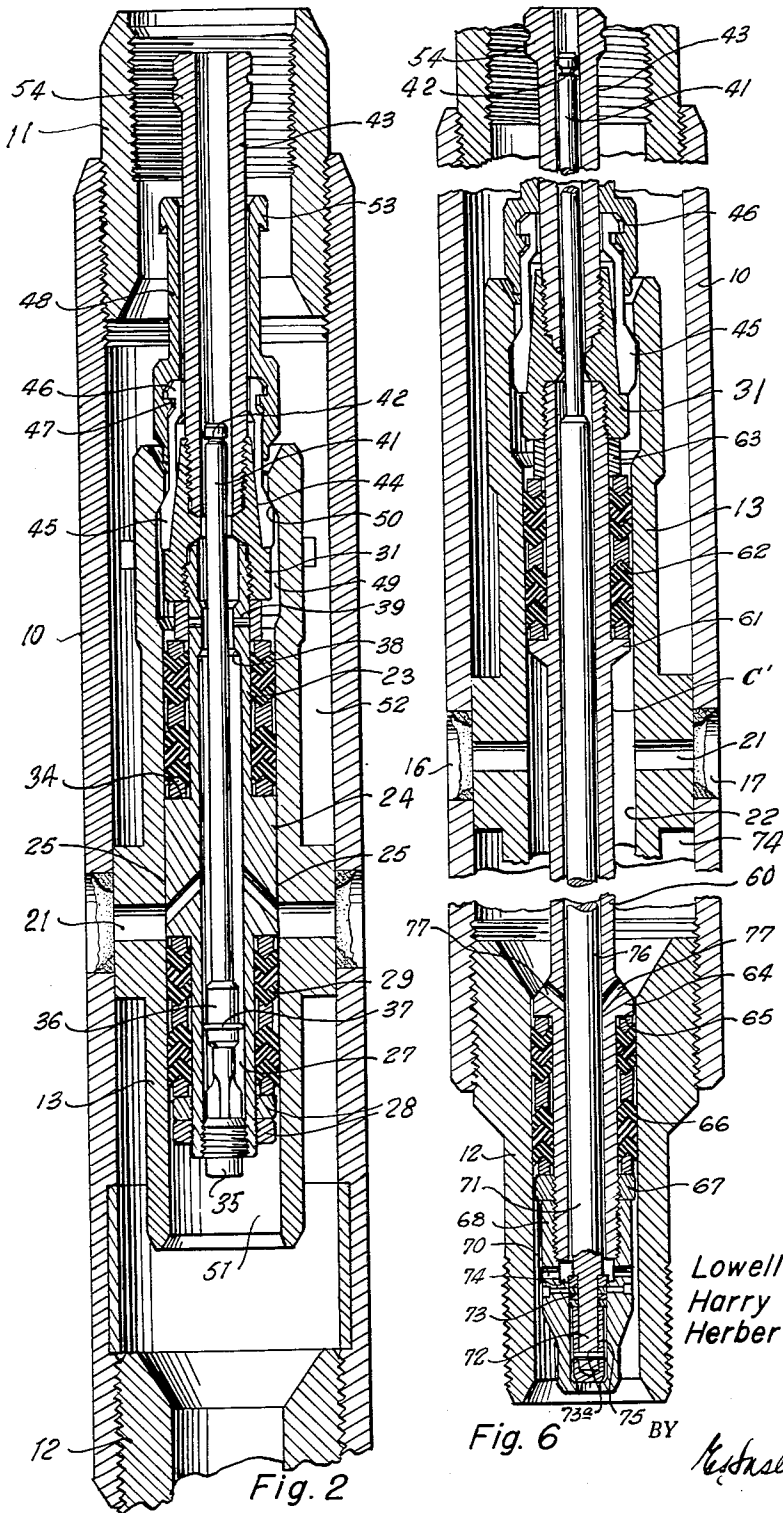
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Fig. 6 732 75 BY

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WELL TOOLS

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16 Claims. (Cl. 166—224)

This invention relates to well tools and more particularly to a by-pass tool having a removable choke therein.

One object of the invention is to provide a by-pass tool for connection in the flow string of wells for selectively permitting the commingling of fluid within the flow string with fluid from without the flow string.

An important object is to provide a housing connectable in a flow string having lateral openings and a bore which are selectively closable by a removable choke, whereby flow of fluids in the flow string may be selectively chosen to be either fluid from exteriorly of the flow string and housing or fluid from within the flow string or both.

A particularly important object of the invention is to provide a by-pass tool of the character described, having a lateral opening from exteriorly to interiorly thereof and a landing nipple for a removable choke controlling said lateral opening, said by-pass tool having an amplified flow passage past said lateral opening for substantially unrestricted flow of fluids therepast, whereby said by-pass tool is adapted for use in formation-fracturing or acidizing treatment of wells, or the like.

Still another object of the invention is to provide a housing connectable in a flow string and having a landing nipple with a lateral flow port and closable by a removable choke for selectively flowing fluid upwardly through said flow string so that either fluid within the flow string or fluid from without the flow string may be separately flowed up said flow string, the choke being provided with a locking means for holding it in place in the landing nipple and with a valve for equalizing the pressures acting on the choke whereby the choke can be easily removed from the landing nipple.

A particular object of the invention is to provide a by-pass tool in the form of a housing having an enlarged longitudinal bore and a lateral port and a landing nipple in said housing and spaced from the wall thereof to provide an annular flow passage therebetween, the nipple having a lateral port communicating with the lateral port of the housing by means of a conductor closed off from the annular flow passage between said housing and nipple.

Another object of the invention is to provide a by-pass tool in the form of a housing having an enlarged longitudinal bore with a landing nipple therein spaced from the wall of said bore to provide a flow passage therebetween and a lateral conductor from exteriorly of the housing to the interior of the nipple, and having a removable choke releasably locked in said nipple with a bore in said choke communicating with the lateral conductor whereby the full bore of the choke may be used to control fluid flow through said lateral conductor.

A further object of the invention is to provide a by-pass tool for connection in a flow string having a removable choke for preventing flow of fluid between upper and lower sections of the string and simultaneously permitting flow of fluid between upper sections of the flow string and the exterior of the housing.

A still further object of the invention is to provide a

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by-pass tool having a housing connectable in a flow string closable by a removable choke which prevents the flow of fluid between upper and lower sections of the housing and permits the flow of fluid between the interior and exterior of the housing, the choke being provided with a locking means for holding it in place and with a valve for equalizing the pressures acting on the choke whereby the choke is easily removable.

Additional objects and advantages of the invention will be readily apparent from the reading of the following description of a device constructed in accordance with the invention, and reference to the accompanying drawings thereof, wherein:

Figure 1 is a vertical, partly sectional view of a preferred embodiment of the by-pass tool showing a choke in position in the landing nipple and with its pressure equalizing valve in closed position,

Figure 2 is a vertical sectional view of the tool shown in Figure 1, showing the pressure equalizing valve of the choke in open position,

Figure 3 is a horizontal sectional view taken on the line 3—3 of Figure 1,

Figure 4 is a sectional view taken on the line 4—4 of Figure 1,

Figure 5 is a vertical, partly sectional view of the by-pass tool having a choke for preventing flow of fluid between upper and lower sections of the flow string, the pressure equalizing valve of the choke being shown in closed position, and

Figure 6 is a vertical sectional view of the tool shown in Figure 5, showing the pressure equalizing valve of the choke in open position.

Referring now particularly to Figures 1 to 4 of the drawings, the numeral 10 designates a housing shown to be internally threaded at its upper and lower ends, with subs 11 and 12, respectively, which permit the connection of the housing in a flow string of a well. A smaller landing nipple 13 has wings 14 and 15 which abut the housing adjacent the opposed lateral apertures or ports 16 and 17 in the housing. Welds 18 and 19 rigidly secure the wings 14 and 15 to the housing. The landing nipple is also provided with a plurality of spacer lugs 20 which abut the internal wall of the landing nipple and assist in holding the landing nipple in concentric alignment in the housing. An annular by-pass passage 52 is thus formed between the exterior of the landing nipple and the interior of the housing, whereby fluids may flow there-through upwardly past the landing nipple. The bores of the lower sub 12 and the landing nipple 13 are preferably smaller than the bore of the flow string (not shown) in which the device is connected. The bore of the upper sub 11 is larger than the bore of the landing nipple and lower sub.

The wings 14 and 15 of the landing nipple are provided with lateral bores 21 which communicate with the longitudinal bore 22 of the landing nipple and the lateral ports 16 and 17 of the housing whereby fluids may flow from the exterior of the housing into the bore of the nipple. A removable choke C is employed to control or prevent such flow of fluids. The choke C includes a mandrel 23 having an annular enlargement or flange 24 intermediate its ends provided with a plurality of inlet ports 25 which communicate with the annular space 26 between the flange 24 and the internal wall of the nipple and also with the central bore 27 of the choke mandrel.

The lower end of the choke mandrel is threaded to receive a pair of packing nuts 28 which serve to hold in place a lower packing assembly 29, preferably of opposed sets of chevron type sealing rings, disposed about the choke mandrel below the flange 24, the lower annular shoulder 30 of the flange cooperating with the packing nuts to hold the packing assembly on said choke mandrel.

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The lower packing assembly 29 prevents flow of fluid between the choked mandrel and the landing nipple below the ports 21 of the latter.

The upper end of the choke mandrel is also threaded to engage in the lower end of the bore of a locking expander mandrel 31. An upper packing assembly 32, also preferably consisting of opposed sets of chevron type sealing rings, is disposed about the upper portion of the choke mandrel and is held in place between a spacer ring 33 and the upper annular shoulder 34 of the flange 24 of the mandrel. The packing assembly 32 prevents flow of fluid between the choke mandrel and the landing nipple above the ports 21 of the latter. Fluids from the ports are thus directed through the inlet ports 25 into the bore of the choke mandrel.

A plug 35 threaded in the lower end of the choke mandrel closes the lower end of the central bore 27 thereof, while a valve plunger 36 having a seal ring 37 in an external annular groove in said valve plunger closes the upper end of the central bore of said mandrel by contact with a reduced internal annular flange 38 in the upper portion of the bore of the choke mandrel. The valve plunger is held in closed position by a shear pin 39 which extends through the plunger and through the mandrel, and also by an O-ring 40 on the upper end of the valve stem 41. The O-ring is disposed in an annular groove 42 at the upper end of the valve stem and rests on the upper annular surface of a tubular neck member 43 whose lower end is threaded in the locking expander mandrel 31 for the purpose of preventing detritus entering the bore of the neck member.

The locking expander mandrel 31 is provided with an inclined expanding surface 44 which is engaged by a plurality of dogs 45 hung by hooks 46 at their upper ends on an internal annular flange 47 formed in the bore of a dog carrier 48 which is slidably disposed on the tubular neck member 43. The dogs 45 are moved to expanded positions to project into an internal annular locking recess groove 49 formed in the upper portion of the landing nipple when the locking mandrel is moved upwardly relative to the dog carrier. The dogs, when in expanded position, engage beneath a downwardly facing beveled shoulder 50 at the upper end of the annular locking recess in the landing nipple and thus prevent upward displacement of the choke C from said nipple.

In use, the housing 10 is connected in the flow string of a well by means of the upper and lower subs 11 and 12. The choke may or may not be initially in place. Assuming that it is not, fluids may flow through the longitudinal bore 51 of the landing nipple and also through the annular by-pass passage 52 between the landing nipple and the housing. Fluids may flow in either direction through the ports 21 of the wings and the ports 16 and 17 of the housing, whereby the fluid in the flow string and the fluid on the exterior thereof may commingle.

If it is now desired to prevent flow of fluid through the ports 16 and 17, the choke C is lowered in the flow string into the housing and the landing nipple by the use of any suitable running tool which may engage either the flange 53 at the upper end of the dog carrier or the flange 54 at the upper end of the neck member 43 to hold the choke thereby. If the running tool is connected to the dog carrier, the dogs will be in retracted position, since the neck member 43 will be in its lowermost position relative to the dog carrier with its flange 54 abutting the upper end of the flange 53 of the dog carrier. If the running tool is connected to the neck member, the dog carrier and dogs are suspended in their lowermost expanded position, but are freely slidable upwardly therefrom to retracted position upon engaging the upper end of the landing nipple whereby the dogs may enter the bore of the nipple.

The choke is lowered until the dogs 45 are positioned in the landing nipple adjacent the locking recess or groove 49, and the line on which the running tool is suspended

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is operated to cause upward movement of the locking mandrel 31 relative to the dogs whereby the latter are moved outwardly by the inclined surface 44 to project into the locking recess. The various elements of the choke are then in the positions shown in Figure 1. Fluid may now flow upwardly only through the annular flow passage 52 between the landing nipple and the housing, which is obviously substantially longer than any bore which could be provided through the choke. The flow of fluid into the longitudinal bore 51 of the landing nipple from the flow string is now prevented by the choke, the plug 35 and the valve 36 sealing the upper and lower ends of the central bore 27 of the choke mandrel, and the packing assemblies 29 and 32 sealing between the landing nipple and the choke mandrel above and below the flange 24 of the mandrel. The flow of fluid from the exterior of the housing is also stopped by the same sealing means.

If it is desired to remove the choke, the upward pressure exerted on the choke by the fluid on the interior and exterior of the housing and landing nipple must be relieved or substantially equalized, since such pressure tends to hold the locking mandrel in its uppermost position. Otherwise, even severe blows on the top of the tubular member 43 might not succeed in driving the locking mandrel down to free the dogs for movement into retracted position; and if the dogs were freed, the choke might be blown up the flow string and become hung up therein or damage the flow string or well surface connections.

It will be seen that the upper end of the valve stem 41 projects above the upper end of the neck member, so that when a suitable pulling tool is lowered through the flow string it will first strike the upper end of the valve stem, forcing it down; the O-ring 40 being expanded and moved out of its groove and the pin 39 being sheared by this blow. The valve plunger 36 will then drop down to the position shown in Figure 2, the guide fins below the valve plunger preventing the valve plunger from becoming lodged improperly or jammed in the central bore 27 of the choke mandrel. Fluid may now flow through the ports 16 and 17 of the annular space 26, through the ports 25 upwardly into the central bore 27 and then upwardly through the central bore since the valve 36 no longer seals the upper end of the central bore. With the surface controls (not shown) closed, the pressures below and above the locking mandrel and choke are more or less equalized after the valve plunger is unseated, so that a sharp blow on the upper end of the neck member 43 will cause the locking mandrel 31 to move downwardly relative to the dogs until the flange 54 on the upper end of the neck member engages the upper end of the dog carrier. When the pulling tool now engages the flange 53 of the dog carrier and pulls the dog carrier upwardly, the dogs 45 are free in their retracted positions and the choke can be lifted upwardly.

It will now be seen that a by-pass tool has been provided which includes a housing 10 connectable in a flow string and having a landing nipple concentrically disposed therein and a longitudinal annular by-pass flow passage 52 between said nipple and housing; the housing and nipple having connected ports whereby fluid may pass between the longitudinal bore 51 of the landing nipple and the exterior of the housing. Furthermore, it will be seen that an easily removable choke C has been provided which has a locking means for holding it in position in the landing nipple and means for closing the passage through the bore of the landing nipple so that fluids flow upwardly through the annular by-pass passage of the housing.

In Figures 5 and 6, the structure of the choke C' differs from that of the choke C, being designed to prevent flow upwardly through the flow string below the by-pass tool and to permit flow from exteriorly of the housing into the by-pass tool and upwardly through the flow string above the by-pass tool. The housing 10, the landing nip-

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ple 13, and the locking mandrel 31, and their associated parts are identical in structure to the corresponding elements of the tool illustrated in Figures 1 to 4, and are therefore identified by the same reference numerals.

The modified form of the choke has an elongate mandrel 60 threaded at its upper end into the locking mandrel 31 and provided with an upper annular flange 61 on which rests a chevron packing assembly 62 held in place by the spacer ring 63. The packing assembly 62 seals between the choke mandrel and the landing nipple above the ports 21 to prevent flow of fluids therebetween in either direction.

A lower annular flange 64 on the lower portion of the choke mandrel provides an annular downwardly facing shoulder 65, and a second chevron packing assembly 66 is disposed on the lower end of the choke mandrel between the shoulder 65 and a packing nut 67 threaded on the lower end of the mandrel. The chevron packing assembly 66 seals between the choke mandrel and the sub 12 to prevent flow of fluid therebetween either upwardly or downwardly through the sub.

A cap 68 is also threaded on the lower end of the choke mandrel and is provided with a seat 69 and a plurality of lateral ports 70 positioned above the seat and below the lower end of the choke mandrel. An elongate valve stem 71 is slidable in the bore of the choke mandrel and has a reduced lower end portion 72 on which is disposed a ring seal 73 between the downwardly facing annular shoulder 74 at the upper end of the reduced portion of the valve stem and a cap sleeve 75 fitted on the lower end of the reduced end portion 72 of the stem. A shear pin 73a extends through registering apertures in the cap 68, the cap sleeve 73 and in the reduced end portion 72 of the valve stem to hold the stem in the position shown in Figure 5. It will be apparent that the ring seal 73 prevents passage of fluid downwardly to or upwardly from the lateral ports between the valve stem and the choke mandrel.

The choke C' may be used for acidizing or similar operations where it is desirable to cause fluid to flow downwardly through the flow string to the annular space exteriorly of the flow string, particularly to such annular space between packers sealing off between the flow string and well bore above and below a producing formation. The acidizing fluids would flow through the annular passage 74 between the landing nipple and the housing, up through the bore 51 of the nipple, through the ports 21 and 16 and 17 to the exterior of the housing. The fluid is prevented from flowing downwardly through the sub 12 by the chevron packing assembly 66 and the ring seal 73. At the same time fluid may not flow up from lower sections of the flow string through the sub 12.

The choke C' may also be used where it is desired to allow only fluid from the exterior of the housing 10 to flow through the ports 16 and 17 in the housing and the ports 21 in the landing nipple into the bore of the housing, and thence upwardly through the annular passage 74 into the upper sections of the flow string. The chevron packing 66 and the ring seal 73 will prevent any fluid from the lower sections of the flow string from flowing into the housing.

If it is desired to permit commingling of the fluids on the exterior of the housing and flowing upwardly through the sub 12, the choke C' may be removed in the same manner as the choke C. A downward blow on the upper end of the valve stem 7 will cause the O-ring 40 to spring out of its groove and will shear the pin 73a at the lower end of the stem. The valve stem 71 will then move downwardly until its downward movement is stopped by the seat 69 in the cap on the lower end of the choke mandrel. Fluid from lower sections of the flow string may now flow through the lateral ports 70 in the cap 68 into the annular space 76 between the valve stem 71 and the choke mandrel, and thence upwardly through ports 77 in the mandrel above the lower flanges 64 into the annular pas-

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sage 74 between the landing nipple and the housing. The pressures acting on the choke C' will thus be substantially equalized, and the locking mandrel may be moved downwardly by a blow on the upper end of the tubular neck member to free the dogs 45 for movement into retracted position. The choke C' can then be lifted out by a suitable pulling tool which engages the flange 53 of the dog carrier. Fluid from both the exterior of the housing and that flowing upwardly through the sub 12 will now commingle and flow upwardly through the flow string.

It will be seen that the choke C and the choke C' act with the by-pass tool as separation tools since they close off the side ports 21 or the sub 12 to separate fluids exteriorly of the flow string from those interiorly of the flow string below the by-pass tool. The term "choke" as used herein includes the anchoring means and packing or sealing means and may include the valve means initially closed and openable to permit flow therepast.

The foregoing description of the invention is explanatory only, and changes in the details of the construction illustrated may be made by those skilled in the art, within the scope of the appended claims, without departing from the spirit of the invention.

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

1. A well tool including, an outer tubular member; an inner tubular member within said outer tubular member and spaced therefrom to form a flow passage therebetween; said inner and outer members each having a lateral port formed therein; means connecting said ports of said inner and outer members to establish a flow passage from the port of the outer member through the port of the inner member to the interior of said inner member; said inner member having its upper and lower ends communicating with the interior of said outer member; said outer member being connectable in the flow string of a well; said inner member having a cylindrical sealing surface in its bore above and below said lateral opening in said inner member; said outer tubular member having its bore reduced to form a sealing surface therein spaced longitudinally from the inner member.

2. A well tool including, a housing having a longitudinal flow passage therethrough and means providing a choke landing bore, said longitudinal flow passage being disposed exteriorly of the choke landing means, the upper and lower ends of said choke landing means communicating with the flow passage of the housing, a lateral conductor in the housing establishing communication between the exterior of said housing and the base of said choke landing means, said means providing the choke landing bore having cylindrical sealing surfaces therein above and below the lateral conductor, and said housing having its base reduced to provide a cylindrical sealing surface therein below the lower end of the choke landing means.

3. A well tool of the character set forth in claim 2 and including: a removable choke having a bore therein and disposed in said choke landing bore and having sealing means engaging at least one of said sealing surfaces in said landing bore and housing to control flow of fluids through said housing and said lateral conductor, said choke also having means controlling flow of fluids through its bore.

4. A well tool comprising: an elongate tubular housing connectable in the flow string of a well, said housing having a lateral port intermediate its ends, and an elongate tubular landing nipple disposed concentrically in said housing and having one of its ends disposed between one of the ends of said housing and said port, said landing nipple being of substantially smaller diameter than said housing whereby an annular passage is formed therebetween, said nipple having an integral lateral wing extending to and abutting said housing, said wing being provided with a lateral bore communicating with said port and with the interior of said landing nipple, said housing

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having a portion of its bore spaced longitudinally from said landing nipple reduced to a diameter not greater than the bore of the landing nipple and axially aligned therewith.

5 A well tool comprising: an elongate tubular housing connectable in the flow string of a well, said housing having a lateral port, and an elongate tubular landing nipple disposed in said housing and having its lower end disposed between the lower end of said housing and said port, said nipple being of substantially smaller diameter than said housing whereby a flow passage is formed therebetween, said nipple having an extension projecting laterally therefrom to said housing and having a bore communicating with said port and the interior of said landing nipple, said housing having a bore providing a cylindrical sealing surface therein below the lower end of the landing nipple.

6. A well tool comprising: an elongate tubular housing connectable in the flow string of a well, said housing having a lateral port, and an elongate tubular landing nipple disposed in said housing and having its lower end disposed between the lower end of said housing and said port, said nipple being of substantially smaller diameter than said housing whereby a flow passage is formed therebetween, said nipple having an extension projecting laterally therefrom to said housing and having a bore communicating with said port and the interior of said landing nipple, said landing nipple being provided with an annular internal groove adjacent the upper end thereof for cooperation with locking members of a choke insertable in said landing nipple, said housing having a bore providing a cylindrical sealing surface therein below the lower end of the landing nipple.

7. A well tool comprising: an elongate hollow housing connectable in the flow string of a well, said housing having a lateral port, and an elongate hollow landing nipple disposed in said housing and having its lower end disposed between the lower end of said housing and said port, said nipple being of substantially smaller diameter than the interior of said housing whereby a flow passage is formed therebetween, said nipple having an extension projecting laterally therefrom to said housing and having a lateral flow passage therein communicating with said lateral port of the housing and with the interior of said landing nipple, said housing having a sub secured to the lower end thereof, said sub having a bore of a diameter not greater than the diameter of the bore of said landing nipple.

8. A well tool comprising: an elongate tubular housing connectable in the flow string of a well, said housing having a lateral port, an elongate tubular landing nipple disposed in said housing and having its lower end communicating with the lower end of said housing, said nipple being of substantially smaller diameter than said housing whereby a flow passage is formed therebetween, said nipple having an extension projecting laterally therefrom to said housing and having a bore therein communicating with the lateral port of the housing and with the interior of said landing nipple, and a removable choke disposed in said landing nipple, said choke including sealing means disposed above and below said extension bore and sealing between said choke and said landing nipple, and retractable locking means on its upper end engageable with the landing nipple above the seal to hold the choke in place therein, said housing having a bore providing a cylindrical sealing surface therein below the lower end of the landing nipple.

9. A well tool comprising: an elongate tubular housing connectable in the flow string of a well, said housing having a lateral port, and an elongate tubular landing nipple disposed concentrically in said housing and having its lower end communicating with the lower end of said housing, said nipple being of substantially smaller diameter than said housing whereby an annular flow passage is formed therebetween, said nipple having an extension

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projecting laterally therefrom to said housing and having a bore communicating with said lateral port of the housing and with the interior of said landing nipple, a removable choke disposed in said landing nipple, said choke comprising a mandrel having a longitudinal bore open at its upper end and closed at its lower end and having a lateral opening intermediate its ends communicating with the exterior of said mandrel and with the longitudinal bore of said mandrel, a valve member in said longitudinal bore disposed above said lateral opening for sealing said bore to prevent flow of fluid from below the valve upwardly through the longitudinal bore of the choke, said valve having a stem projecting upwardly above the upper end of the choke whereby said valve may be opened by moving said valve stem downwardly, and fluid excluding sealing means between said choke and said nipple disposed above and beneath said lateral bore of said landing nipple extension, said lateral opening of the mandrel communicating with said lateral bore of the nipple extension whereby fluid may pass from the exterior of said housing into the longitudinal bore of the mandrel and out of said longitudinal bore of said mandrel when said valve is moved to open position whereby fluid pressures above and below said choke may be equalized to facilitate removal of said choke.

10. A well tool comprising: an elongate tubular housing connectable in the flow string of a well, said housing having a lateral port, an elongate tubular landing nipple disposed concentrically in said housing and having its lower end communicating with the lower end of said housing, said nipple being of smaller diameter than said housing whereby an annular flow passage is formed therebetween, said nipple having an extension projecting laterally therefrom to said housing and having a lateral bore therein communicating with said housing port and with the interior of said landing nipple, said housing having a tubular extension secured to the lower end thereof, said housing extension having a bore of a diameter not greater than the diameter of the bore of said landing nipple, and a removable choke extending through said landing nipple and into said tubular housing extension, said choke comprising an elongate mandrel having a longitudinal bore and a lower opening adjacent its lower end communicating with the bore of the housing extension and with the interior of said mandrel in said housing extension, a valve member in said longitudinal mandrel bore disposed above said lower opening for preventing flow of fluid from said lower opening upward through the longitudinal bore of the mandrel, said mandrel also having a lateral aperture above said valve communicating with said longitudinal mandrel bore and with the annular flow passage between the landing nipple and housing, sealing means disposed between said mandrel and said landing nipple above the lateral bore of said lateral extension of said landing nipple, sealing means disposed between said mandrel and said housing extension and on the mandrel between said lateral opening and lower opening in said mandrel, and means for moving said valve member downwardly to permit fluid to flow upwardly from said tubular housing extension through said lower longitudinal bore of said mandrel outwardly through the lateral opening of the mandrel into said annular flow passage to equalize fluid pressures above and below said choke to facilitate removal of said choke.

11. A well tool comprising: an elongate tubular housing connectable in the flow string of a well, said housing having a bore providing a cylindrical sealing surface therein at its lower end; an elongate tubular landing nipple disposed in said housing and having its lower end spaced from the cylindrical sealing surface at the lower end of said housing; said landing nipple being of substantially smaller diameter than said housing whereby a flow passage is formed between said housing and the exterior of said landing nipple; and means providing a lateral passageway

communicating with the exterior of the housing and with the interior of the landing nipple.

12. A well tool of the character set forth in claim 11 and means removably mounted in the housing and closing the bore thereof at said cylindrical sealing surface.

13. A well tool of the character set forth in claim 11 and including: valve means removably positioned in said housing closing the sealing surface portion of the bore of said housing at the lower end of the housing, said valve means being initially closed and openable to permit flow therepast.

14. A well tool including: an elongate housing connectable in a well flow conductor and having a longitudinal bore; an elongate landing nipple having a longitudinal flow passage therein, said nipple being mounted in the housing and positioned to provide a flow passage exteriorly thereof between said housing and said landing nipple; and a lateral flow passageway providing communication at its outer end with the exterior of the housing and at its inner end with the flow passage of said landing nipple, the inner end of said lateral flow passageway being positioned intermediate the ends of the landing nipple, said housing having a portion of its bore wall providing a sealing surface below the lower end of said landing nipple.

15. A well tool of the character set forth in claim 14 and including: means removably positioned in said housing closing the sealing surface portion of the bore of the housing below the lower end of said landing nipple.

16. A well tool comprising: an elongate tubular housing connectable in the flow string of a well, said housing having a lateral port, and an elongate tubular landing nipple disposed concentrically in said housing and having its lower end communicating with the lower end of said housing, said nipple being of substantially smaller di-

ameter than said housing whereby an annular flow passage is formed therebetween, said nipple having an extension projecting laterally therefrom to said housing and having a bore communicating with said lateral port of the housing and with the interior of said landing nipple, a removable choke disposed in said landing nipple, said choke comprising a mandrel having a longitudinal bore open at its upper end and closed at its lower end and having a lateral opening intermediate its ends communicating with the exterior of said mandrel and with the longitudinal bore of said mandrel, a valve member in said longitudinal bore disposed above said lateral opening for sealing said bore to prevent flow of fluid from below the valve upwardly through the longitudinal bore of the choke, a stem projecting upwardly from said valve and exposed at its upper end through the open upper end of the longitudinal bore of the choke whereby it may be opened to permit flow therepast, and fluid excluding sealing means between said choke and said nipple disposed above and beneath said lateral bore of said landing nipple extension, said lateral opening of the mandrel communicating with said lateral bore of the nipple extension whereby fluid may pass from the exterior of said housing into the longitudinal bore of the mandrel and out of said longitudinal bore of said mandrel when said valve is moved to open position.

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