

Oct. 16, 1956

H. C. OTIS

2,766,831

SELECTIVE CROSS-OVER PACKER

Filed March 6, 1950

3 Sheets-Sheet 1

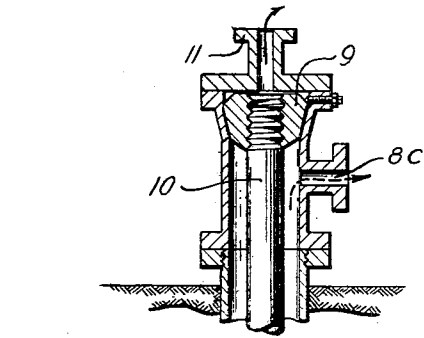


Fig. 1

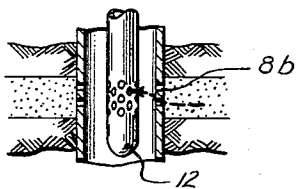
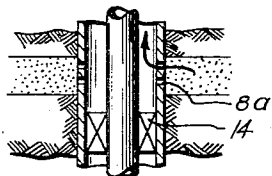
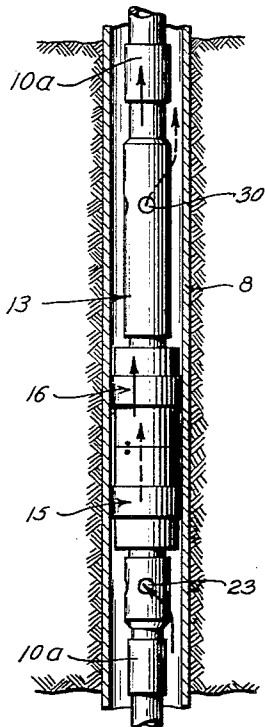
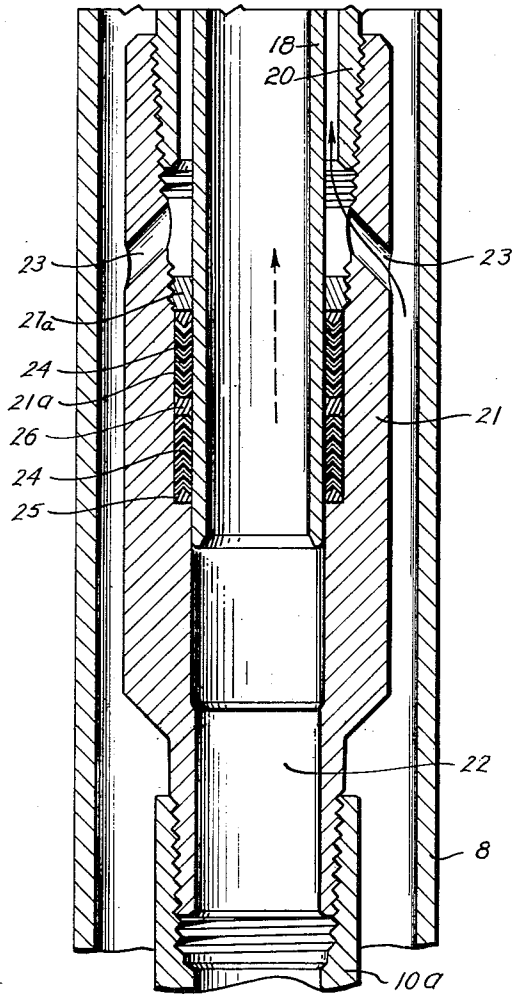


Fig. 4



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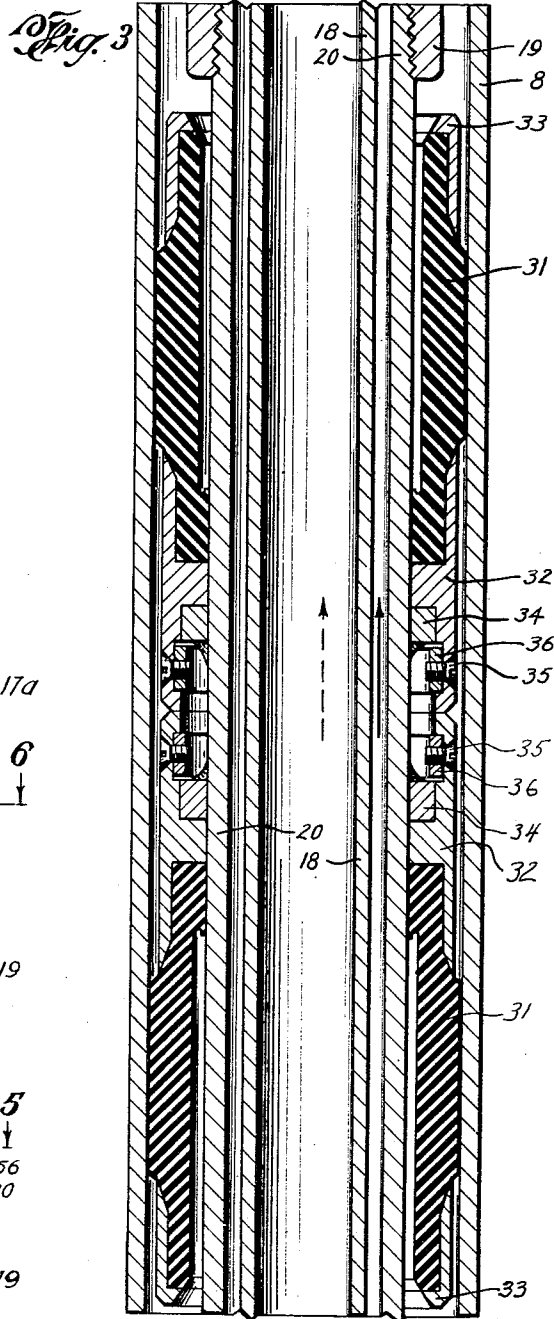
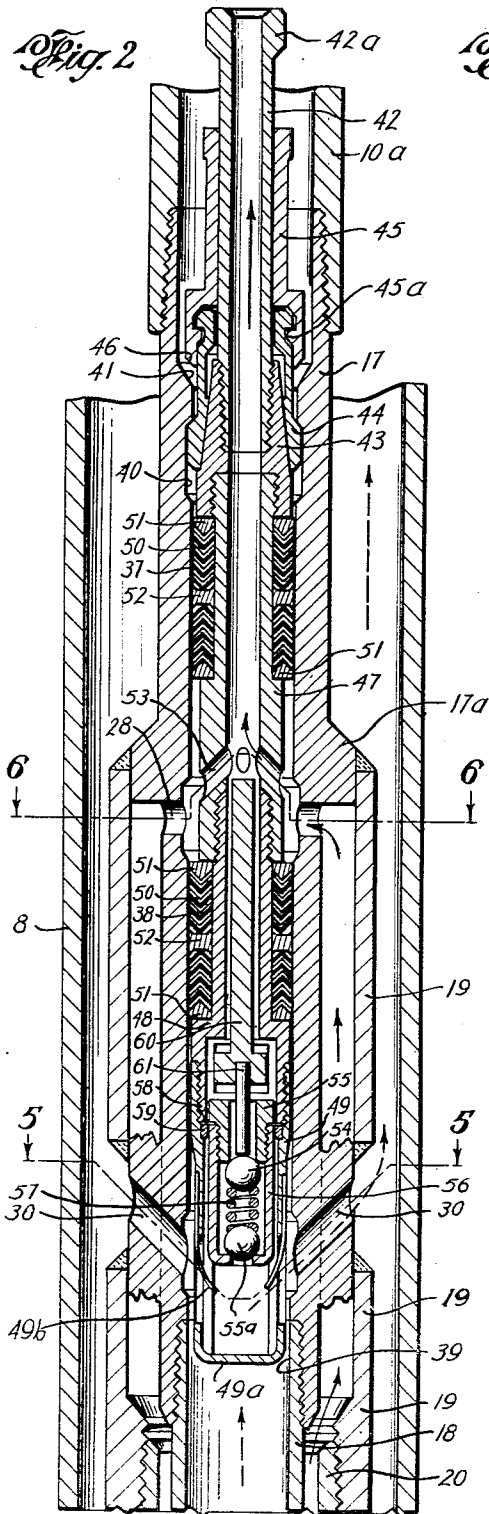
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3 Sheets-Sheet 2



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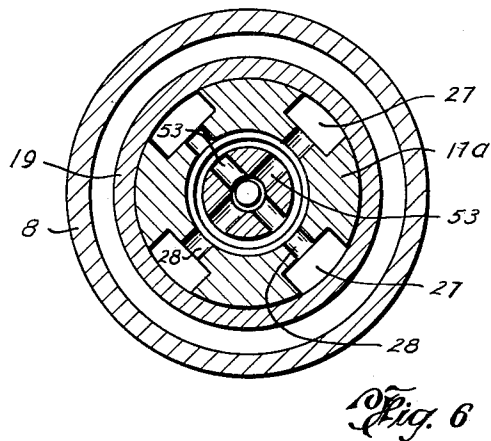
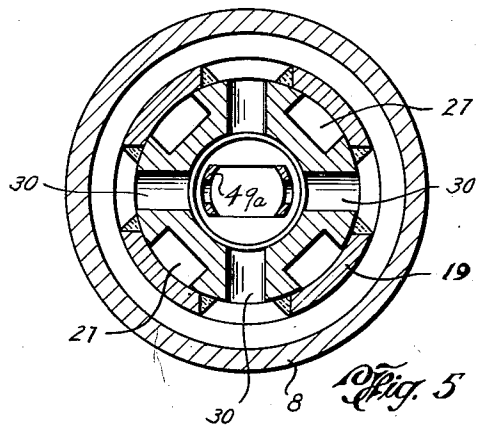
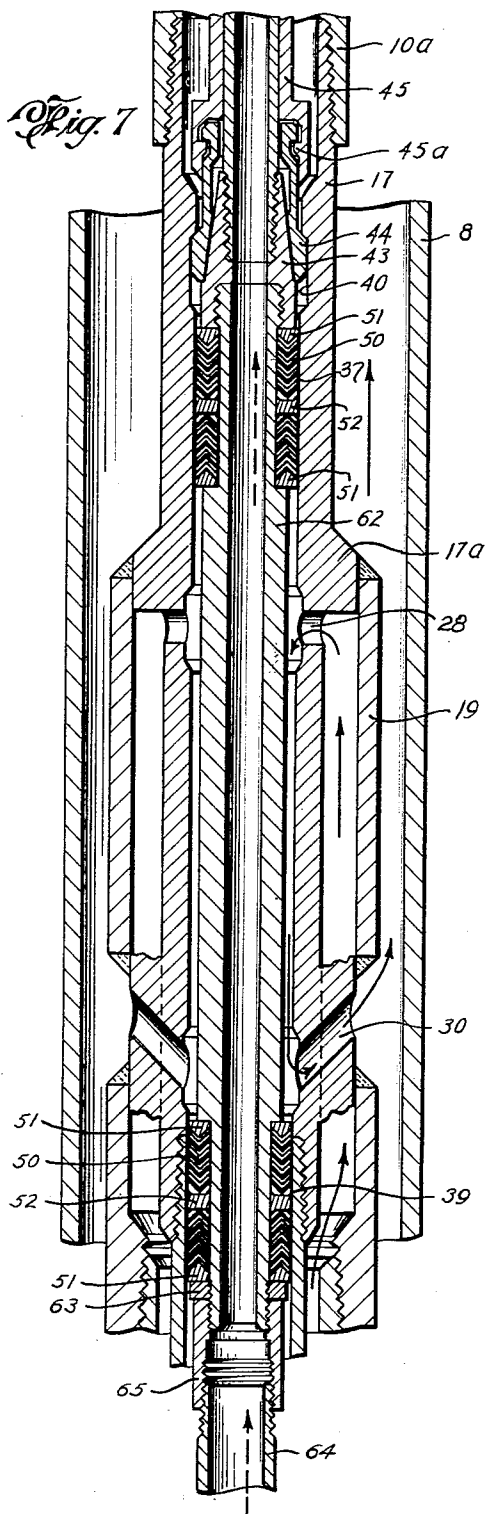
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2,766,831

SELECTIVE CROSS-OVER PACKER

Filed March 6, 1950

3 Sheets-Sheet 3



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2,766,831

SELECTIVE CROSS-OVER PACKER

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Application March 6, 1950, Serial No. 147,785

27 Claims. (Cl. 166—116)

This invention relates to improvements in cross-over packers and refers more particularly to a selective cross-over packer which makes possible the production of a dually-completed well in the conventional or cross-over manner by using one of two types of removable packer tools in a special cross-over landing device which may be made up in a flow string of well pipe.

In recent years a good many wells have been completed for the production of oil and gas which produce from two different formations within the earth. These wells are commonly termed dual completion wells, and it is frequently desirable either for production reasons or because of state conservation laws to produce the fluids from the two producing formations of the earth without co-mingling them. In accomplishing this, the fluid from one of the formations will be produced, at least in part, through the usual annulus between the casing and string of flow tubing of the well. It has been the practice where it is desirable to produce from the upper producing formation through the tubing to use what has been termed by the industry a cross-over packer. These packers provide for production of fluid from the lower formation first through the string of flow tubing and then passing this fluid over to the tubing casing annulus so that the upper portion of the tubing may be employed for producing fluids from the upper formation.

This type cross-over arrangement has been satisfactory where this is a desirable procedure as long as the well conditions or laws are such that it remains desirable to produce in this fashion. However, if for any reason, as for example, change in the conditions existing within the well and producing formations, it becomes desirable to change this method of flow so as to produce the fluid in what is known to the industry as the conventional manner passing the fluid from the lower formation entirely through the string of tubing and that from the upper formation through the casing tubing annulus, then it is necessary to kill the well, pull the string of flow tubing, remove the cross-over packer device and re-run the string of flow tubing with a more or less conventional packer in the casing tubing annulus between the two producing formations. This operation consumes considerable time during which the well is not in production from either producing formation, is very costly and there is always the possibility of damaging or completely losing one or both producing formations with the mud used in killing the well.

An object of this invention is to provide a cross-over packer such that the production from the producing formations may be selectively switched to produce either conventionally or in the cross-over manner.

Another object is to produce a cross-over packer in which the flow passages conducting fluid from dual completion wells may be switched by wire line operation without the necessity of killing the well.

A further object is to provide an oil tool which makes it possible to produce a dually completed well in the con-

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ventional or in the crossed over manner by using one of two types of special cross-over packer tools or chokes which may be lowered into and removed from a well by a wire line operation under pressure.

Still another object is to provide a dually completed well which may be produced either conventionally or in the cross-over manner without co-mingling the production from the two zones and in such a fashion that the manner of producing the well may be changed at any time during the life of the well without the necessity of killing the well.

A still further object is to provide a cross-over landing device which may be made up in a string of well pipe and is adapted to have landed and anchored therein a cross-over packer tool of either of two types which will determine whether the dually completed well is to be produced in the conventional or the cross-over manner.

Other and further objects of the invention will appear as the description proceeds.

In the accompanying drawings forming a part of the instant specification, and wherein like reference numerals are used to indicate like parts in the various views:

Fig. 1 is a schematic view partially in section illustrating a well which has been dually completed for operation in accordance with this invention;

Figs. 2, 3 and 4 are complementary views upon an enlarged scale and in vertical section, illustrating a cross-over tool in accordance with this invention, with Fig. 2 showing the upper portion of the tool, Fig. 3 an intermediate portion, and Fig. 4 the lower portion;

Fig. 5 is a sectional view taken along the line 5—5 in Fig. 2 in the direction of the arrows;

Fig. 6 is a sectional view taken along the line 6—6 in Fig. 2 in the direction of the arrows; and

Fig. 7 is a vertical sectional view of a portion of the device shown in Figs. 2, 3 and 4, and corresponding more nearly to Fig. 2, but illustrates a selective choke or cross-over packer tool which will cause production of a dually completed well in the conventional manner.

This invention as included in the embodiment shown in the drawings, in general comprises a cross-over landing device or housing and a cross-over packer tool or choke adapted to be lowered into the device, releasably secured therein in such fashion that it may be removed by a wire line or the like without the necessity of killing the well. The device is adapted to be connected in the usual flow string of tubing of a dually completed well and has an inner passage or conduit extending through and an outer passage or conduit communicating between the inner passage and the exterior of the device. This outer passage extends over a considerable length so that a packer may be set between the device and the well casing at a position above the communication of the outer passage with the exterior of the device. The inner passage has communication with the exterior of the device through an opening or conduit beneath the juncture of the two passages, the opening having a cross-over relationship with the outer passage. The device has landing parts for releasably anchoring a selective cross-over choke, packer or flow directing tool therein and has three surfaces adapted to be sealingly engaged by packing elements carried by the cross-over tool. The upper of these surfaces is located above the junction of the inner and outer passages and regardless of the type of flow desired, will have packing elements engaging it when the cross-over packer tool is landed in the device. Another of these surfaces is intermediate the junction between the two passages and the cross-over opening of the device. The third surface is located beneath this latter opening.

The cross-over packer choke, in addition to the packing elements which will engage the upper surface of the

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device, has an additional element spaced longitudinally thereof which will engage one of the other surfaces. If the well is to be produced in conventional manner, the lower surface will be engaged as shown in Fig. 7, but if the well is to be produced in a cross-over fashion, the intermediate surface will be engaged by this second set of packing elements as shown in Fig. 2.

Referring to the drawings in detail, it will be seen in Fig. 1 that the well bore is equipped with a well string of casing 8 perforated at 8a to communicate with an upper producing formation, and at 8b to communicate with a lower producing formation. At the upper end of the casing there is a lateral port 8c for connecting with a flow line or the like. A suitable hanger 9 at the upper end of the casing supports a string of flow tubing 10 which communicates with a fitting 11 at the well head. This fitting is adapted to be connected to a suitable flow line. The string of tubing 10 extends to the bottom of the well and may be equipped with a screen 12 to provide for communication with the lower pay zone of the well. The string of tubing has secured therein, forming a part of the flow passage, the cross-over landing device of this invention shown generally at 13. The well is equipped with the usual annular packer 14 to provide a seal between the inner wall of the casing and the periphery of the flow tubing. Spaced above this packer and above the producing formation communicating with perforations 8a are packing elements shown at 15 and 16. Packer element 15 is adapted to seal against a high pressure therebelow and packer element 16 is adapted to seal against a high pressure thereabove.

Referring to Fig. 2, this landing device itself may comprise a coupling 17 adapted to be secured to the lower end of one section of the tubing 10 by a collar 10a. This coupling 17 extends to the upper end of a section of pipe 18 threaded to an internal bore in the lower end of the coupling. The coupling has an enlarged diameter section 17a to the lower end of which is secured, as by welding or the like, a cylindrical sleeve 19 which secures the packing mandrel 20 thereto. This mandrel substantially concentrically surrounds tubing section 18 and is secured at its lower end to a shoe 21.

Coupling 17 and sleeve 19, together with tubing section 18, mandrel 20, and shoe 21, provides inner and outer passages in the landing device. The inner passage 22 is provided by the tubular character of coupling 17, tubing joint 18, and shoe 21 and extends entirely through the device. The lower end of tubing section 18 has a sealed connection with shoe 21 to seal off this passage from the outer passage at this point. This seal may include the counterbore 21a in shoe 21, through which the lower end of section 18 of the tubing extends. Packing means are retained in the annular space provided, such as V-type packing rings 24 with a suitable expander 25 and spacer 26. A gland nut 27a is threaded in the upper end of bore 21a to compress the packing. By providing part of the packing 24 opening one way and the other part opening the other way, a seal is provided in both directions.

The outer passage of the landing device terminates at its lower end in the openings 23 in shoe 21, establishing communication with the exterior of the device. The passage then extends upwardly through the annular space between tubing section 18 and packing mandrel 20. To complete the outer passage a plurality of grooves 27 are provided extending longitudinally of the periphery of the enlarged part 17a of couplings 17. These grooves are perhaps best illustrated in Figs. 5 and 6. At their upper ends these grooves communicate with openings or bores 28 which communicate with the interior of coupling 17 to form a junction between the inner and outer passages of the landing device. Cylindrical sleeve 19 encircles the enlarged section 17a of the coupling and is welded thereto at the top to seal

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off the passages formed by grooves 27. The enlarged portion 17a of the coupling has a plurality of openings 30, which may be termed cross-over openings. These openings communicate between the exterior of the device and the inner passage. Sleeve 19 has perforations which register with openings 30 and are welded thereabout to complete this communication between the inner passage of the device and its exterior.

The packing mandrel carries exterior packing elements 15 and 16 to seal off the annulus between the exterior of the device and the inner wall of casing 8. These packing elements may be of any suitable type but preferably are of the sleeve type wherein the pressure to be sealed forces the seal elements into engagement with the casing. The preferred embodiment of these elements include sleeves 31 of rubber or other flexible sealing material having one end anchored in a collar 32 and preferably bonded thereto. The other end of the sleeve may be bonded to a stiffener ring 33. The internal bore through the sleeve is of greater diameter than the periphery of the mandrel 20. The packing assembly may be secured to the mandrel by welding a ring 34 to the periphery of the mandrel, against which the turned flange of collar 32 abuts. A plurality of set screws 35 secure a lock washer 36 within a counterbore formed at the end of collar 32 to secure the collar against sliding movement on the mandrel. Preferably, packing elements 15 and 16 are of the same construction but are secured to the mandrel in back to back relation as shown in Fig. 3 to seal against pressure differentials in either direction.

The interior of the landing device is provided with three different seal forming surfaces 37, 38, and 39. The surface 37 is located above ports 28, the surface 38 intermediate ports 27 and 30 and the lower surface 39 is located beneath the ports 30. These surfaces are adapted to cooperate with sealing elements carried by the removable cross-over choke or packer tool as will hereinafter more fully appear.

The inner passage through the landing device also has parts to facilitate anchoring of the cross-over choke or packer in the passage. The preferred embodiment of this anchoring means includes an internal annular groove 40 formed in the inner passage. This groove cooperates with locking parts carried by the tool to be anchored as will more fully hereinafter appear.

The anchoring means shown in this application is of the type shown in the patent to H. C. Otis, No. 2,144,850, which serves admirably for this purpose where the cross-over packer tool is to be run into the landing device upon a wire line.

The upturned tapered shoulder 41, formed within the passage, provides a stop to be engaged by a part on the packer tool to provide for selective anchoring of the packer tool at the proper position in the device, all as will be hereinafter more fully explained. However, it will be pointed out that the diameter of this shoulder is less than the diameter to be encountered in the string of well pipe thereabove. The surfaces 37, 38 and 39 are of a comparable diameter to the smallest diameter of the shoulder 41. This makes it possible to engage these surfaces with suitable sealing elements which are of sufficiently small diameter to permit lowering of the packoff tool through pipe 10 into place within the landing device.

Considering the details of the cross-over packer tool, it may be considered generally as comprising an elongate member having an upper passage communicating with the inner passage of the device at its upper end, and having means cooperating with the landing device for establishing communicating between this passage and either the inner or the outer passage at a position below the seal between the member and the landing device provided in part by the surface 37. Also the member carries means for landing and securing it within the landing device.

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Two different types of cross-over packing chokes or tools are provided, one for completion of the well to produce in a conventional dual completion manner, and the other which makes it possible to produce the well in the cross-over manner. Considering the latter of these devices, the member is made up of a lowering head 42 which is tubular and has a head 42a at its upper end to facilitate connection with the wire line in order to permit lowering of the tool into the well. The head 42 connects with a coupling 43 having a frusto-conical or tapered outer periphery pointed upwardly, which serves to expand the locking dogs 44. These locking dogs have portions at the lower end adapted to engage the groove 40 in the landing device to anchor the cross-over packer in place. The fingers of the dogs have a pivotal connection interiorly of collar 45 by resting on the inturned flange 45a. The collar has a slide fit on head 42. The lower peripheral edge of collar 45 has a tapered shoulder 46, whose diameter is too great to pass through the constricted opening provided by shoulder 41. Thus engagement of shoulders 46 and 41 will locate the packer tool as it is lowered within the landing device. Then upward movement of the elongate head 42, relative to the collar 45, will cause the tapered surface of coupling 43 to expand the dogs 44 into the groove or anchoring part 40. Inasmuch as this device or means for anchoring a well tool within a string of well pipe is explained fully in the aforesaid Patent 2,144,850, its further detailed description in this instrument will be dispensed with.

The elongate member of the packoff tool includes a tubular packing carrier 47 threaded to the lower end of coupling 43. This packing carrier in turn is threaded at its lower end to a packing support 48. The packing support 48 carries a shoe 49 at its lower end which houses a valve arrangement to be hereinafter described.

Referring back to the packing carrier 47, it has a peripheral portion of reduced diameter around which V-type packing rings 50 are mounted with suitable expander rings 51 at its upper end and a divider ring 52 adjacent its center. The packing rings 50 on either side of the divider ring 52 are oppositely turned so as to seal against high pressure occurring on either side of the packing element. The outer diameter of the rings 50 are such as to engage the surface 37 to provide a seal between the cross-over packing tool and the landing device. The packing support 48 carries a similar packing arrangement with V-rings 50, expander rings 51, and a divider ring 52 surrounding a reduced diameter peripheral portion of the support with the upper expander ring 51 abutting the lower end of carrier 47. The packing elements are adapted to sealingly engage surface 38 to seal between the landing device and packoff tool.

The tubular character of head 42 and carrier 47 are such as to provide a passage through the upper end of the tool communicating with the inner passage above the packing surface 37. This passage communicates with the annular space between the landing device and the cross-over tool at the junction between the inner and outer passages of the landing device. This communication is provided by openings 53 in the carrier 47 and the packing means, including surfaces 37 and 38, seal off the space or annulus which completes the communication between the openings 28 and 53.

In order to complete the sealing off of the cross-over passage which includes the outer passage through the landing device, and the passage through the upper portion of the cross-over tool, it is necessary to seal off the lower end of the elongate member. On the other hand, if this member were permanently plugged, then it would be very difficult or impossible to move the cross-over tool into the landing device or to release it and remove it therefrom. It is then necessary to establish flow through or past the elongate member when it is being lowered into place or removed from place within the landing device to balance the pressure above and below the tool. This

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may be accomplished by providing a valve arrangement housed within shoe 49 in the lower enlarged diameter portion of packing carrier 48. It will be apparent that this valve arrangement includes check valves 54 and 55a which prevent flow through the packer tool in both directions.

This valve arrangement includes a seat member 55 threaded to a cage 56 having a seated aperture at its lower end with a spring 57 urging valve members 54 and 55a against the respective seats. The seat and cage have a frangible seal connection with the elongate member of the tool, including a frangible or shear washer 58 having its inner portion clamped tightly between seat member 55 and the cage. The outer portion of the frangible washer is tightly clamped between the lower end of packing support carrier 48 and a bushing 59 seated against an upturned shoulder 54.

This frangible connection is provided in order that the valve arrangement may be released when it is desired to withdraw the cross-over packer tool from the landing device. Shoe 49 carries a receptacle 49a at its lower end for retrieving the valve arrangement when it is broken loose. This receptacle 49a may be an integral portion of the shoe, but is connected by wall sections to the upper portion thereof. The openings between sections provide ample passage for well fluids from the lower portion of the inner passage through the landing device, into the shoe. Spring fingers 49b are adapted to engage the outer periphery of cage 56 when it is released from its connection with the shoe. These fingers hold the cage in position within the receptacle 49a.

To lower the tool, a push rod 60 with a pin 61 at its lower end for unseating ball valve 54 is positioned in support 48. The push rod 60 is adapted to be depressed by a pin which is carried by the lowering tool employed to install the packer. Thus, when the lowering tool is released from the head 42 and withdrawn from the well, the spring 57 will return the ball valve 54 to its seated position to seal off the lower end of the tool against upward flow. Downward flow is sealed against by check valve 55a.

In Fig. 7, the cross-over packer tool which is employed to provide conventional flow from a dual completion well is illustrated. This tool at its upper end may employ the same landing means as in the other type choke, the parts being the same from and including coupling 43, to the upper end of the tool. However, this tool is different from the part 43 down.

The packing elements carried by this tool for engagement with surfaces 37 and 39 of the landing device may be mounted upon a single elongate carrier 62. This carrier is threaded to the underside of coupling 43 and is sufficiently long so that when landed in its Fig. 7 position it extends below the openings 30. The upper seal is substantially identical as that supported by carrier 47 and includes the seal elements 50, the expanders 51, and divider 52. The assembly is held between the end of coupling 43 and an upturned shoulder formed on the periphery of carrier 62. This upper assembly is adapted to engage the surface 37 to seal between the landing device and the packer tool.

The lower packing assembly also includes the seal elements 50, the expander rings 51, and the divider ring 52. This assembly is secured between a downturned shoulder formed exteriorly on the carrier 62 and a gland nut 63 threaded to the end of carrier 62. Any suitable conduit, tool or the like, shown schematically at 64, may be secured to carrier 62 by a coupling collar 65, or this may be dispensed with and suitable lock nuts secured to the end of the carrier to hold the gland nut 63 in place. This lower packing assembly sealingly engages surface 39 in the inner passage of the landing device.

It is to be noted that the periphery of carrier 62 between the upper and lower packers is of lesser diameter than the internal diameter of the inner passage at the

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position between openings 28 and 30, so as to provide an annulus communicating between these two openings. By this means the outer passage establishes communication with the exterior of the landing device through the openings 28 and 30 and this annulus.

To assemble the oil tool of this invention, the landing device is made up as an integral part of the string of well pipe through which well fluids are to be conducted and usually called the flow string of tubing. Referring to Fig. 1, the device will be located somewhat above the upper producing formation of a dual completion well, and packing elements 15 and 16 provide a seal between the device and the interior of the well casing. This seal is located above the upper producing formation and another seal 14 is provided between the tubing string and the wall of the casing intermediate the producing formations.

If the well is to be produced in a cross-over manner, the packer tool detailed in Fig. 2 is lowered into the string of flow tubing until engagement between shoulders 41 carried by the landing device and 46 carried by the slidable collar of the packer tool arrests its movement. Usually a wire line or the like is used for this lowering purpose. At this point, the dogs 44 will reside in the lower reaches of groove 40. Sharp upward movement of the elongate member causes the head 42 to move along its longitudinal axis upwardly, but collar 45 tends to remain stationary due to inertia and gravity. Thus, the frusto-conical expander coupling 43 will force the dogs 44 outwardly and raise them to abut the tapered shoulder at the upper edge of groove 40. The wire line is then released from the tool in a conventional manner by shearing the shear element which secures the tool to the wire line.

In landed position, the outer passage of the landing device establishes communication between the annulus between the device and the well casing and the upper portion of the inner passage through the device. By reference to Fig. 2, it will be seen that the openings 28 are in communication with the openings 53 carried by the cross-over tool. The passage in the cross-over tool then completes the means for establishing communication with the upper end of the inner passage.

Flow from the lower producing formation, as shown by the dashed line arrows, will rise through the flow tubing and the inner passage of the landing device until it reaches the lower end of the cross-over packer tool. The valve member 54 prevents passage of fluid into the interior of this tool, but communication is established between the exterior of the landing device and the lower portion of the inner passage thereof. Thus, the fluid from the lower producing formation will pass through openings 30 and into the annulus between the landing device and the well casing. This fluid is then conducted to the ground surface through this annulus and passes from the well head through fitting 8c. Fluid from the upper zone, as shown by the solid line arrows, enters the casing tubing annulus, at 8a, thence flows through openings 23 into the outer passage of the landing device. It then flows upwardly through the grooves 27 and thence through openings 28 and 53 into the interior of the packoff choke and thence upwardly through conduit 10 to the ground surface.

If at any time during operation of the well it becomes desirable for any reason to produce the well in the conventional manner instead of the cross-over manner, this may be quickly and economically accomplished in accordance with this invention without killing the well. To do this, a wire line having a head adapted to engage the underside of the annular enlargement upon collar 45 at its upper end, which tools are well known to those skilled in the art, is run into the well and attached to the packer tool. The anchoring means are released and the tool withdrawn from the well. However, it is usually desirable to equalize the pressure across the tool prior to releasing the detent means, and thus may be accomplished by driving downwardly with a suitable pin to engage the

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upper end of punch 60. This is conventional practice and will be well understood by those skilled in the art. A sufficiently hard blow is struck to shear the washer 58 and drive the valve cage 56 into the receptacle 49a. The flexible fingers 49b hold this valve cage and seat arrangement in position within the receptacle and, of course, this permits equalization of pressure across the tool to facilitate its safe removal.

After the cross-over packer tool of the Fig. 2 disclosure has been removed, the choke shown in Fig. 7 is then secured within the landing device. This establishes continuous communication between the lower and upper portions of the inner passage through the landing device so that the production from the lower producing formation is conducted through the string of flow tubing to the surface of the well and is produced through fitting 11.

The packers carried by the choke seal between the choke and the surfaces 37 and 39 formed in the passage. Thus the junction between the inner passage and outer passage is sealed off but flow from the outer passage, which comes from the upper producing formation, has free access through openings 30 with the annulus between the well casing and landing device and string of flow tubing. Thus, the upper producing formation is withdrawn from the annulus through fitting 8c.

From the foregoing it will be seen that this invention is one well adapted to attain all of the ends and objects hereinabove set forth together with other advantages which are obvious and which are inherent to the structure.

It will be understood that certain features and sub-combinations are of utility and may be employed without reference to other features and sub-combinations. This is contemplated by and is within the scope of the claims.

As many possible embodiments may be made of the invention without departing from the scope thereof, it is to be understood that all matter herein set forth or shown in the accompanying drawings is to be interpreted as illustrative and not in a limiting sense.

The invention having been described, what is claimed is:

1. A selective cross-over flow device for wells communicating with two zones comprising an elongate tubular housing; port means in the housing providing three separate conduits communicating between the interior and exterior of the housing at three different levels, the first conduit communicating through the lower end of the housing with the exterior of the housing, the second conduit communicating with the exterior of the housing adjacent but below the upper end of the housing and the third conduit communicating with the exterior of the housing at a level intermediate said other two levels, the third conduit communicating interiorly of the housing at a level above the second conduit's intersection with the interior of the housing, means having a tubular part positionable within the interior of the tubular housing, and sealing means between the housing and the exterior of said tubular part to effect two separate passageways, one communicating between the upper end of the interior of the tubular housing and the exterior of the housing through one of said first and third mentioned conduits and said second separate flow passageway including the second mentioned conduit and the other of said first and third conduits.

2. As a subcombination, an elongate flow conducting device adapted to be secured in a string of well pipe and to receive a packer tool therein, said device having a first passageway therethrough and a second passageway extending along an intermediate part of the device, the second passageway communicating between the exterior of the device and the first passageway; said device having a cross-over opening communicating between the first passageway, at a position below the junction of the first and second passageways, and the exterior of the device at a position spaced above the junction of the second passageway with the exterior of the device; and sealing surfaces on the inner wall of the first passageway adapted to be

sealingly engaged by packing elements, said sealing surfaces being located one above the junction of the first and second passageways, one between the junctions of the first passageway with the second passageway and the cross-over opening, and one below the junction of the cross-over opening with the inner passageway.

3. A selective cross-over flow device for wells communicating with two zones comprising an elongate housing with an opening extending through the length of the housing, said housing having a cross-over conduit communicating between said housing opening and the exterior of the housing, a by-pass conduit in the housing communicating with said housing opening at a position above the communication of the cross-over conduit with said housing opening and with the exterior of the housing at a position spaced below the cross-over conduit's junction with the exterior of the housing, a packing tool, and means removably anchoring the packing tool in said housing opening, said packing tool carrying seals which, when said packing tool is anchored, seals off said opening through the housing between the junctions therewith of the cross-over and the by-pass conduits, the by-pass conduit communicating with said housing opening above the packing tool and the cross-over conduit communicating with said housing opening below the packing tool and being sealed off from the by-pass conduit and the portion of said housing opening above said packing tool.

4. A selective cross-over flow device for wells communicating with two zones comprising an elongate housing with an opening extending through the length of the housing, a cross-over conduit in said housing communicating between said housing opening and the exterior of the housing, a by-pass conduit in the housing communicating with said housing opening at a position above the communication of the cross-over conduit with said housing opening and with the exterior of the housing at a position spaced below the cross-over conduit's junction with the exterior of the housing, and a packing tool removably landed in said housing opening and carrying seals for sealing off said opening through the housing both above and below the junctions of both the by-pass and cross-over conduits with said opening through the housing, said packing tool having a passageway therethrough communicating between the portions of said opening above and below the seals between the packing tool and said housing opening, the by-pass and cross-over conduits communicating one with the other intermediate said seals and being sealed off by the packing tool and its seals from the portions of said housing opening above and below said seals.

5. A selective cross-over flow device for wells communicating with two zones comprising an elongate housing with an external packer thereon and an opening extending through the length of the housing, a cross-over conduit in said housing communicating between said housing opening and the exterior of the housing at a position above the packer, a by-pass conduit in the housing communicating between said housing opening at a position above the junction of the cross-over conduit with said housing opening and with the exterior of the housing at a position below the packer, a packing tool, and means removably anchoring the packing tool in a selected position within said housing opening, said packing tool carrying seals which, with said packing tool anchored in said housing opening, seal off said housing opening between the junctions therewith of the cross-over and the by-pass conduits, the by-pass conduit communicating with the portion of said housing opening above the packing tool and the cross-over conduit communicating with the portion of said housing opening below the packing tool and being sealed off from the by-pass conduit and the portion of said housing opening above said packing tool.

6. A selective cross-over flow device for wells communicating with two zones comprising an elongate housing with an external packer thereon and an opening ex-

tending through the length of the housing, said housing having a cross-over conduit communicating between said housing opening and the exterior of the housing at a position above the packer, a by-pass conduit in the housing communicating between said housing opening at a position above the junction of the cross-over conduit with said housing opening and with the exterior of the housing at a position below the packer, and a packing tool removably landed in said housing opening and carrying seals for sealing between said housing opening and the packing tool above and below the junctions of both the by-pass and cross-over conduits with said opening through the housing, said packing tool having a passageway therethrough communicating between the portions of said housing opening above and below the seals between the packing tool and said housing opening, the by-pass and cross-over conduits communicating one with the other intermediate said seals and being sealed off by the packing tool and its seals from the portions of said housing opening above and below said seals.

7. In a cased well a well tool for selectively controlling flow relative to two zones comprising upper and lower tubing sections extending within the well casing, means connecting the tubing sections, said means including a cross-over fitting with an elongate conduit extending between the tubing sections and having a cross-over passageway and a by-pass passageway communicating between the exterior of the cross-over fitting and the interior of the elongate conduit, a well packer sealing between the casing and the exterior of the cross-over fitting and between the junctions of the cross-over and by-pass passageways with the exterior of said cross-over fitting, a removable packing tool releasably anchored within the cross-over fitting conduit, said packing tool having packing means sealing between the packing tool and the inner wall of the crossover fitting conduit effecting two separate flow ways through the connecting means, one of said flow ways communicating between the upper tubing section and one of said by-pass passageway and the lower tubing section and the other of said two separate flow ways communicating through the cross-over passageway between the annular space between the casing and the upper tubing section above the connecting means and the other one of said by-pass passageway and the lower tubing section.

8. As a subcombination, an elongate flow conducting device adapted to be secured in a string of well pipe and to receive a packer tool therein, said device having an inner passageway therethrough and an outer passageway extending along an intermediate part of the device, the outer passageway communicating between the exterior of the device and the inner passageway; said device having a cross-over opening communicating between the inner passageway, at a position below the junction of the inner and outer passageways, and the exterior of the device at a position spaced above the junction of the outer passageway with the exterior of the device; and sealing surfaces on the inner wall of the inner passageway adapted to be sealingly engaged by packing elements, said sealing surfaces being located one above the junction of the inner and outer passageways, one between the junctions of the inner passageway with the outer passageway and the cross-over opening, and one below the junction of the cross-over opening with the inner passageway.

9. As a subcombination, an elongate flow conducting device adapted to be made up in a string of well pipe and to receive a packer tool therein, said device having a first passageway therethrough and a second passageway extending along an intermediate part of the device, the second passageway communicating between the exterior of the device and the first passageway; said device having a cross-over opening communicating between the first passageway, at a position below the junction of the first and second passageways, and the exterior of the device

at a position spaced above the junction of the second passageway with the exterior of the device; sealing surfaces on the inner wall of the first passageway adapted to be sealingly engaged by packing elements; said sealing surfaces being located one above the junction of the first and second passageways, one between the junctions of the first passageway with the second passageway and the cross-over opening, and one below the junction of the cross-over opening with the first passageway; and an anchor part in the inner passage for releasably receiving a flow directing packer tool.

10. As a subcombination, an elongate flow conducting device adapted to be made up in a string of well pipe and to receive a packer tool therein, said device having a first passageway therethrough and a second passageway communicating between the exterior of the device and the first passageway; said device having a cross-over opening communicating between the first passageway, at a position below the junction of the first and second passageways, and the exterior of the device at a position spaced above the junction of the second passageway with the exterior of the device; sealing surfaces on the inner wall of the first passageway adapted to be sealingly engaged by packing elements, said sealing surfaces being located one above the junction of the first and second passageways, one between the junctions of the first passageway with the second passageway and the cross-over opening, and one below the junction of the cross-over opening; and a packer mounted exteriorly of the device between the terminus of the cross-over opening with the exterior of the device and the junction of the second passageway with the exterior of the device.

11. A well tool comprising an elongate flow conducting device having a first passageway therethrough and a second passageway communicating between the exterior of the device and the first passageway; said device having a cross-over opening communicating between the first passageway and the exterior of the device, a flow directing packer tool removably secured in the first passageway, packing means sealing between said removable tool and the inner wall of the first passageway of the device above the junction of the first and second passageways, said removable tool having a central passageway communicating with the portion of the first passageway above said packing means, means carried by said removable tool communicating between said central passageway of said removable tool and one of the second passageway and the portion of the first passageway below said removable tool, and means sealing off this communication from the other of said second passageway and said portion of the first passageway from the central passageway of said removable tool.

12. The device of claim 11 wherein the central passageway of the removable packer tool extends completely therethrough, and packing means seal between the packer tool and the first passageway below both the cross-over opening and the junction of the first and second passageways.

13. The device of claim 12 wherein the space between the inner wall of the first passageway and an intermediate portion of the periphery of the removable packer tool provides a passageway intermediate the two packer means and communicating with both the cross-over opening and the junction of the first and second passageways of said device.

14. The device of claim 11 wherein the removable packer tool carries a packing means sealing between the flow conducting device and packer tool at a location between the junction of the first and second passageways of the device and the cross-over opening, and said packer tool has an opening communicating between the central passageway of the removable packer tool and the exterior of the tool at a location between said two packing means whereby the central passageway of the tool communi-

cates with the second passageway of said flow conducting device.

15. The device of claim 14 wherein the removable packer tool has a releasable valve closure means sealing the central passageway of said packer tool from the portion of the first passageway of said device below the packer tool for the purpose of facilitating removal of the packer tool.

16. A well tool comprising an elongate flow conducting device adapted to be made up in a string of well pipe, said device having an inner passageway therethrough and an outer passageway extending along an intermediate part of the device, the latter passageway communicating between the exterior of the device and the inner passageway, a cross-over opening communicating between the inner passageway and the exterior of the device, sealing surfaces on the inner wall of the inner passageway adapted to be sealingly engaged by packing elements, one above the junction of the inner and outer passageways and one between the junctions of the inner passageway with the outer passageway and with the cross-over opening, and one below the cross-over opening, a flow directing packer tool removably secured in the inner passageway with two packing elements, one packing element engaging the sealing surface above the junction of the two passageways and the other packing element engaging one of the other said sealing surfaces, to seal between the packer tool and inner passageway, and means carried by the packer tool communicating between the part of the inner passageway above the upper of said packing elements and one of the outer passageway and the portion of the inner passageway below said packer tool and sealing off the part of the inner passageway above the upper packing element from the other of said outer passageway and said portion of the inner passageway below the packer tool.

17. As a subcombination a cross-over packer tool adapted to be lowered into and removed from a well tubing by a wire line operation comprising an elongate member with a passageway therethrough, releasable closure means closing off the lower end of this passageway, said closure means being connected to the elongate member by a frangible element so that the entire closure means can be released to permit flow in either direction in said passageway, the member having an opening communicating with the passageway and the exterior of the tool at an intermediate position along its length, packing elements carried on the exterior of the member on both sides of said opening, and means on the exterior of the member including expansible locking parts adapted to anchor said tool upon upward movement of said member relative to said locking parts.

18. As a subcombination a cross-over packer tool adapted to be lowered into and removed from a well tubing by a wire line operation comprising an elongate member with a passageway therethrough, releasable closure means closing off the lower end of this passageway, said closure means being connected to the elongate member by a frangible element so that the entire closure means can be released to permit flow in either direction in said passageway, said member having an opening communicating with the passageway and the exterior of the tool at an intermediate position along its length, packing elements carried on the exterior of the member on both sides of said opening and means on the exterior of the member adapted to releasably anchor the packer tool upon upward movement of said packer tool.

19. The combination of a housing adapted to be connected in a tubing string of an oil well communicating with upper and lower producing formations, said housing having a packer mounted on its exterior for sealing with a well casing and port means leading between the interior of the housing and the exterior thereof at positions above and below the packer, a flow directing means releasably positionable within the housing and having packing means cooperable with the housing and port means thereof to

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effect communication between the lower formation and a tubing string above the housing, and a separate communication through at least a part of the housing between the upper formation and the space exterior of the housing and above the packer whereby the well may be produced in a conventional flow manner, additional flow directing means releasably positionable within the housing and having packing means cooperable with the housing and its port means to effect communication between the lower formation and the space exterior of the housing above the packer and a separate communication through at least a part of the housing between the upper formation and a tubing string above the housing whereby the well may be produced in the cross-over manner, and means for interchangeably positioning the two flow direction tools in their operable positions within the housing whereby the well may be selectively and inter-changeably produced in either of said two manners.

20. A well packer tool usable in completing a well having multiple producing zones whereby two of said zones may be selectively produced through the well tubing and casing in the cross-over and conventional manners, said tool comprising a housing adapted to be operatively connected between upper and lower sections of the well tubing, a packer mounted on the exterior of the housing adapted to seal between the housing and the inner wall of the well casing; two port means formed in the housing one communicating with the exterior of the housing above and the other below the packer; means movably positionable in the housing to provide two separate flow passageways, one passageway connecting between the well tubing above the packer tool and the upper zone through the port means below the packer and the second passageway connecting between the exterior of the housing above the packer and the lower zone through the port means above the packer; and means movably positionable in the housing to provide two additional separate flow passageways, one passageway connecting between the lower zone and the well tubing above the packer tool through the lower end of the housing, and the other of the additional passageways communicating between the upper zone and the well casing above the packer through the port means both below and above the packer; all of the various passageways, in part, passing through at least a portion of the housing and means to move the two movable means to alternately position them operably within the housing to establish their said respective passageways.

21. A well packer tool usable in completing a well having upper and lower producing zones, said tool comprising a housing adapted to be mounted on a lower section of the well tubing and to be operatively connected to an upper section of well tubing, a packer mounted on the exterior of the housing for sealing off the space between a well tubing and casing above the upper producing zone, means for establishing communication between the upper producing zone and the well casing above the packer, additional means for establishing communication between the upper zone and the well tubing above the tool, means for establishing communication between the lower zone and the well casing above the packer, additional means for establishing communication between the lower zone and the well tubing, said various communication establishing means including tubular parts positionable differently within the housing and seal elements operable between the tubular parts and housing whereby flow may be conducted simultaneously from the two zones in the cross-over manner and flow may be conducted simultaneously from the two zones in the conventional manner, dependent upon the relative positions of the tubular parts within the housing.

22. The combination of a housing adapted to be connected to a tubing string of an oil well communicating with upper and lower producing formations, said housing having a packer mounted on its exterior for sealing

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with a well casing, port means in the housing communicating with the exterior thereof at a position above the packer and a port means in the housing communicating with the exterior thereof at a position below the packer; a flow directing means releasably positionable within the housing and having packing means, said flow directing means cooperable with the housing to provide two separate, mutually exclusive conduits, one conduit connecting between the lower end of the housing and a tubing string above the housing, and a second conduit connecting between the port means communicating below the packer and the port means communicating above the packer whereby the well may be produced in a conventional flow manner through the said two conduits; additional flow directing means releasably positionable within the housing and having packing means; said flow directing means cooperable with the housing to provide two additional separate, mutually exclusive conduits, one of the additional conduits connecting between the lower portion of the housing and the port means communicating above the packer and a second conduit connecting between the port means communicating below the packer and a tubing string above the housing whereby the well may be produced in a cross-over manner through said two additional conduits; and means for alternately positioning the two flow directing means in their operable positions within the housing whereby the well may be selectively and alternately produced in either the conventional or cross-over flow manners.

23. A well tool adapted for use in multiple zone wells comprising a housing adapted to be connected to a tubing string of an oil well communicating with upper and lower producing formations, said housing having a packer mounted on its exterior for sealing with a well casing, first port means in the housing communicating with the exterior thereof at a position above the packer and a second port means in the housing communicating with the exterior thereof at a position below the packer; a flow directing means releasably positionable within the housing, means carried in part by the housing and in part by said flow directing means providing two separate mutually exclusive conduits when the flow directing means is positioned within the housing, one conduit connecting between the lower end of the housing and a tubing string above the housing, and a second conduit connecting between the second port means and the ports means communicating above the packer whereby the well may be produced in a conventional flow manner through said two conduits; and means for releasably anchoring the flow directing means in operable position within the housing relative to the two port means, said releasable anchoring means including a part carried by the housing for indexing the flow directing means relative to the two port means of the housing to establish said two separate mutually exclusive conduits.

24. A well tool adapted for use in multiple zone wells comprising a housing adapted to be connected to a tubing string of an oil well communicating with upper and lower producing formations, said housing having a packer mounted on its exterior for sealing with a well casing, first port means in the housing communicating with the exterior thereof at a position above the packer and a second port means in the housing communicating with the exterior thereof at a position below the packer; a flow directing means releasably positionable within the housing, means carried in part by the housing and in part by said flow directing means providing two separate mutually exclusive conduits when the flow directing means is positioned within the housing, one conduit connecting between the lower portion of the housing and the first port means and the second conduit connecting between the second port means and a tubing string above the housing whereby the well may be produced in a cross-over manner through said two additional conduits; and means for releasably anchoring the flow directing

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means in operable position within the housing relative to the two port means, said releasable anchoring means including a part carried by the housing for indexing the flow directing means relative to the two port means of the housing to establish said two separate mutually exclusive conduits.

25. An oil tool adapted for use in multiple zone wells comprising a housing adapted to be connected to a tubing string of an oil well communicating with upper and lower producing formations, said housing having a packer mounted on its exterior for sealing with a well casing, first port means in the housing communicating with the exterior thereof at a position above the packer and a second port means in the housing communicating with the exterior thereof at a position below the packer; a flow directing means releasably positionable within the housing, means carried in part by the housing and in part by the flow directing tool to provide two separate mutually exclusive conduits when the flow directing means is positioned within the housing, one conduit connecting between the lower end of the housing and one of a tubing string above the housing and the first port means, the second conduit connecting between the second port means and the other of the tubing string and first port means; and means for releasably anchoring the flow directing means in operable position within the housing relative to the two port means, said releasable anchoring means including a part carried by the housing for indexing the flow directing means relative to the two port means of the housing to establish said two separate mutually exclusive conduits.

26. In a selective cross-over flow device for multiple zone completion wells, a housing adapted to be made up in a string of well tubing as a part thereof and having an opening therethrough, a conduit in the housing communicating exteriorly thereof and with the opening for conducting well fluids from an upper well zone, a second conduit in the housing communicating between

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the exterior of the housing at an upper level relative to the exterior terminus of the first conduit and the interior opening of the housing at a position spaced from the interior terminus of the first conduit with said opening, and a flow directing tool releasably securable in the housing and having packing means to seal between the housing and tool at a position intermediate the interior termini of the first and second conduits, said tool and seal when secured in the housing cooperating with the housing to provide a continuous communication between the first conduit and the portion of the housing opening above the tool and a continuous communication between the second conduit and the portion of the housing opening below the tool, this latter communication being sealed off from the first conduit.

27. The arrangement of claim 26 in which the housing opening has additional seal surfaces one above and one below the termini of the first and second conduits with the housing opening.

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