June 9, 1964 H. L. BIGELOW 3,136,569

PARALLEL TUBING STRING APPARATUS

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FIG. 1.

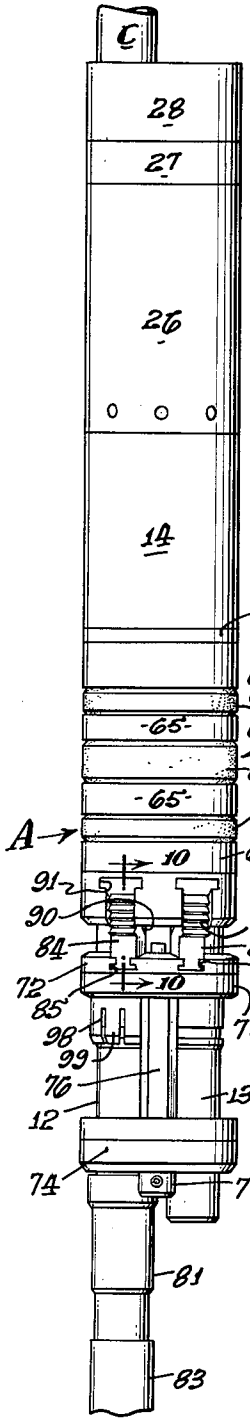


FIG. 2a.

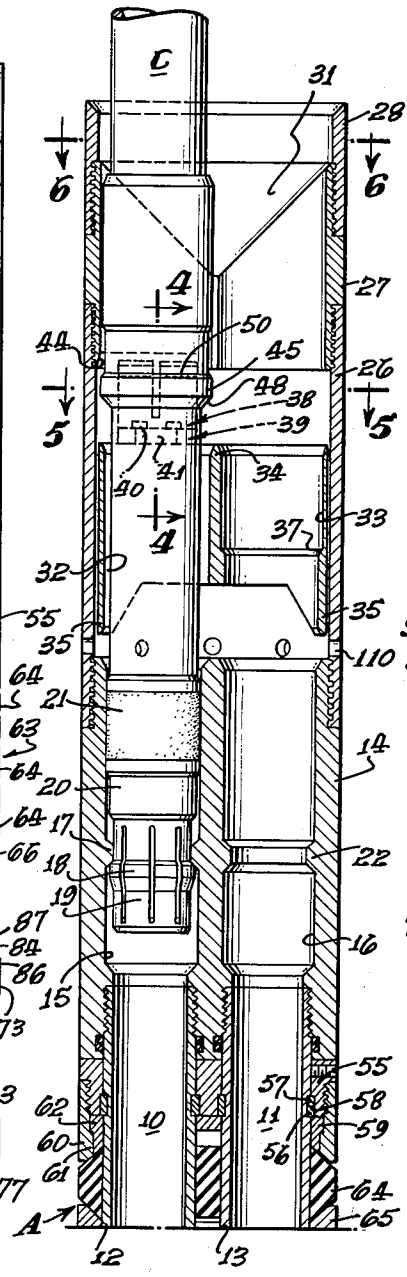
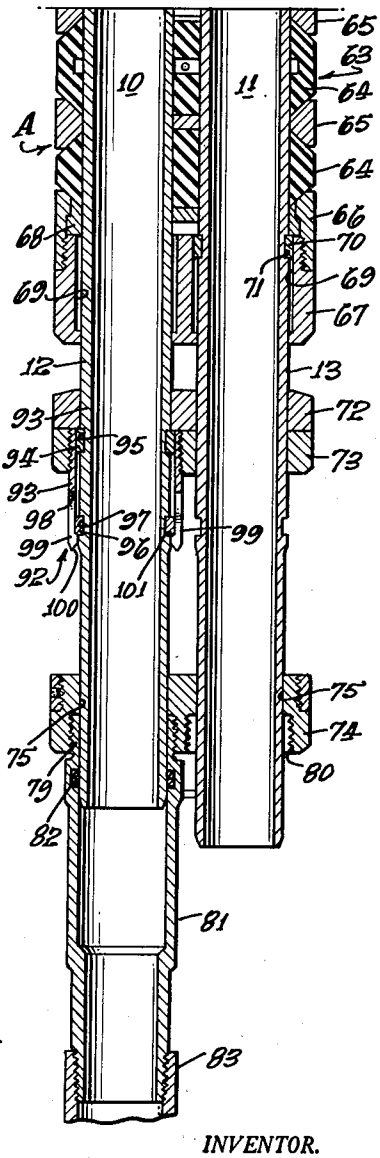


FIG. 2b.



INVENTOR.
HERBERT L. BIGELOW
BY
Mellin and Hanscom
ATTORNEYS.

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FIG. 3a.

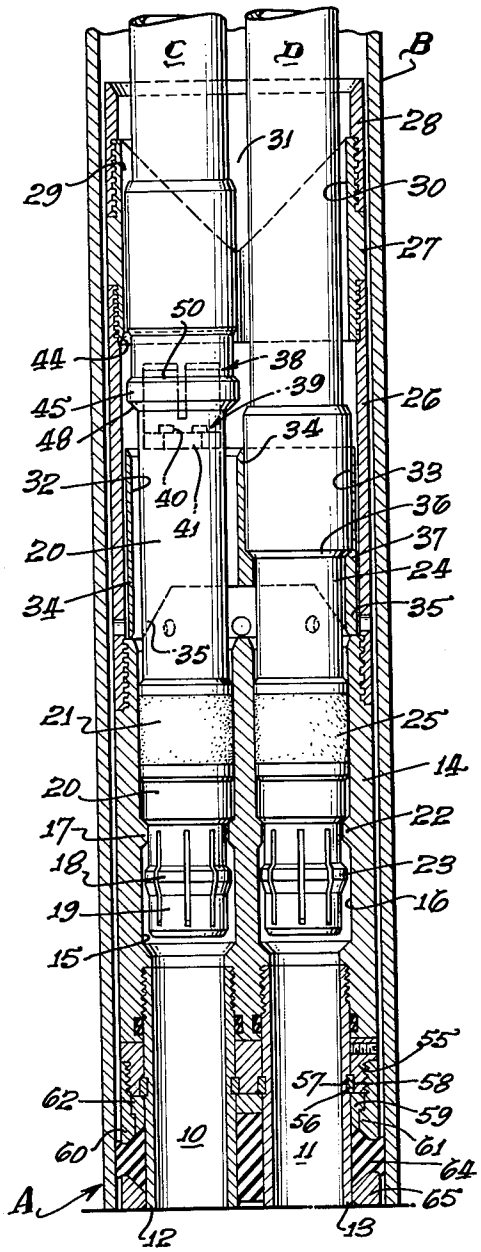
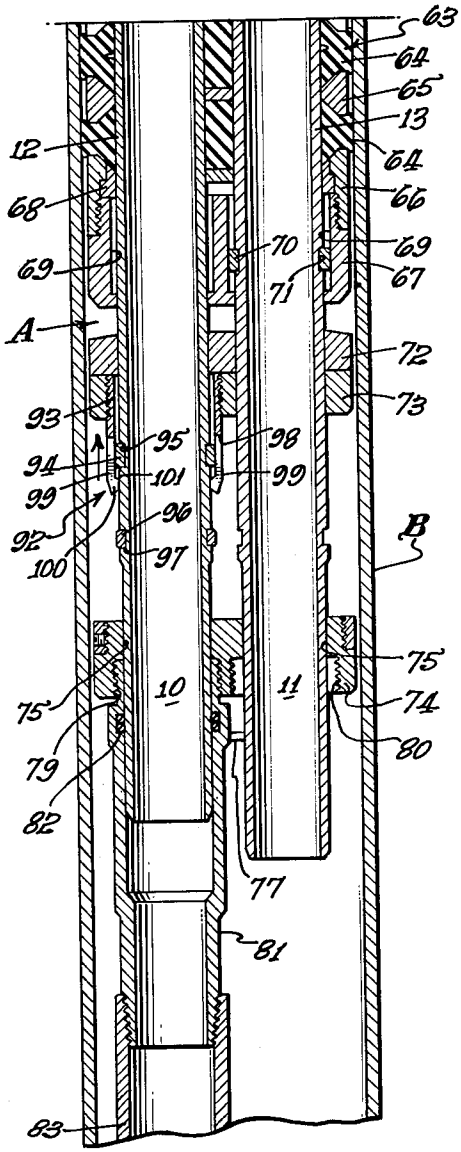


FIG. 3b.



INVENTOR.
HERBERT L. BIGELOW
BY
Mellin and Hanscom
ATTORNEYS.

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FIG. 5.

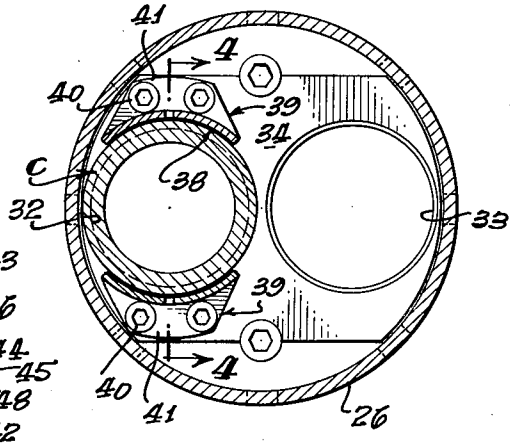


FIG. 4.

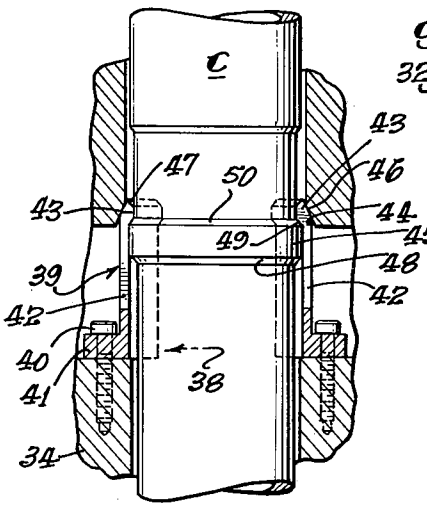


FIG. 6.

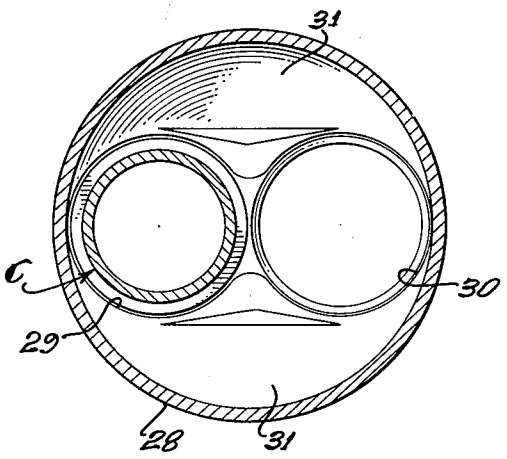


FIG. 7.

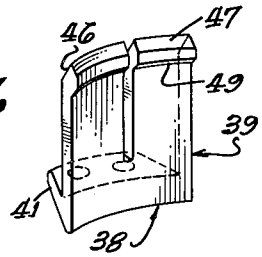
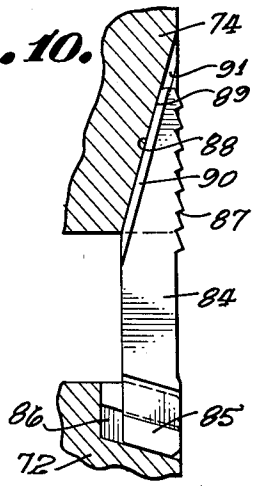


FIG. 10.



INVENTOR.
HERBERT L. BIGELOW
BY
Mellin and Hanscom
ATTORNEYS.

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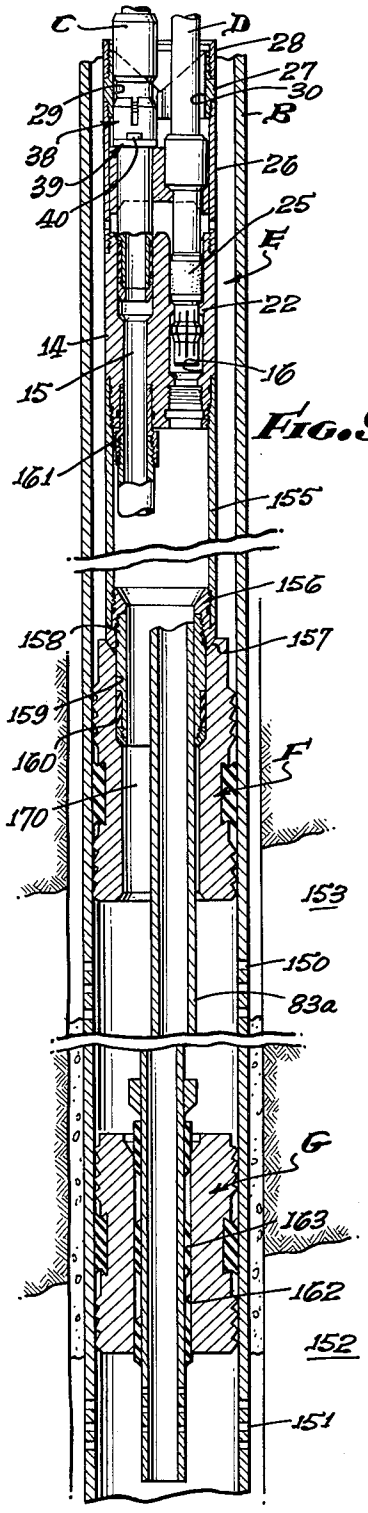


FIG. 9.

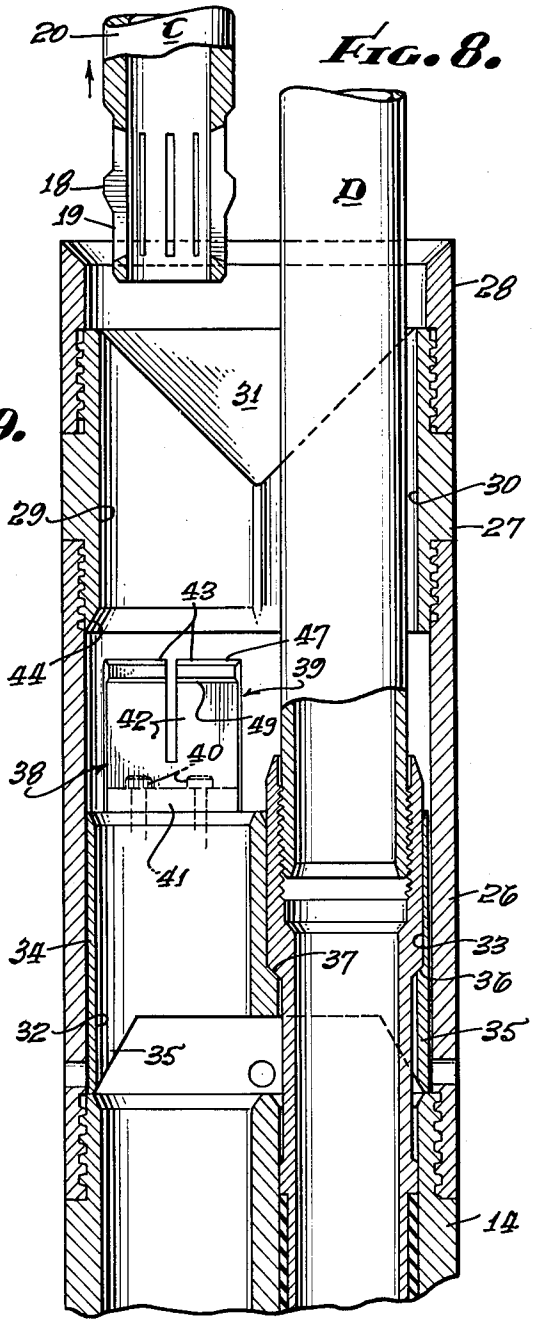


FIG. 8.

INVENTOR.
HERBERT L. BIGELOW
BY
Mellin and Hanscom
ATTORNEYS.

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PARALLEL TUBING STRING APPARATUS

Herbert L. Bigelow, Whittier, Calif., assignor to Baker Oil Tools, Inc., Los Angeles, Calif., a corporation of California

Filed July 21, 1961, Ser. No. 125,783
15 Claims. (Cl. 285—137)

The present invention relates to subsurface well bore apparatus, and more particularly to subsurface apparatus adapted to be operatively associated with a plurality of parallel tubular strings extending to the top of the well bore.

An object of the invention is to provide an apparatus for operative association with parallel tubular strings extending to the top of the well bore, in which the strings may be selectively disassociated from the apparatus and retrieved from the well bore, if desired.

Another object of the invention is to provide an apparatus adapted to be run in a well bore on a first tubular string to a desired location in the well bore, followed by running of a second tubular string in the well bore and operatively connecting it to the apparatus, in which either the first or second tubular string may be released from the apparatus and retrieved from the well bore, the apparatus also being retrievable from the well bore by means of the remaining tubular string.

A further object of the invention is to provide a well packer apparatus for operative association with a plurality of tubular strings extending to the top of the well bore, in which either of the tubular strings can be released from the well packer.

An additional object of the invention is to provide a well packer apparatus for operative association with a plurality of tubular strings extending to the top of the well bore, in which the apparatus can be run in the well bore on one of the tubular strings and set therewithin, followed by running of another tubular string in the well bore and operatively connecting it to the well packer, in which either of the tubular strings may be released from the well packer and retrieved from the well bore, the packer also being retrievable from the well bore by retaining the connection of the other tubular string therewith and elevating such other tubular string.

This invention possesses many other advantages, and has other objects which may be made more clearly apparent from a consideration of several forms in which it may be embodied. Such forms are shown in the drawings accompanying and forming part of the present specification. These forms will now be described in detail for the purpose of illustrating the general principles of the invention; but it is to be understood that such detailed description is not to be taken in a limiting sense, since the scope of the invention is best defined by the appended claims.

Refering to the drawings:

FIGURE 1 is a side elevational view of an apparatus embodying the invention;

FIGS. 2*a* and 2*b* together constitute a longitudinal section through the apparatus disclosed in FIG. 1, with the parts in their retracted position, FIG. 2*b* constituting a lower continuation of FIG. 2*a*;

FIGS. 3*a* and 3*b* are views corresponding to FIGS. 2*a* and 2*b*, respectively, illustrating the well packer anchored in a packed-off condition in the well casing and with a plurality of tubular strings associated therewith, FIG. 3*b* constituting a lower continuation of FIG. 3*a*;

FIG. 4 is an enlarged section taken along the line 4—4 on FIG. 2*a*;

FIG. 5 is an enlarged cross-section taken along the line 5—5 on FIG. 2*a*;

FIG. 6 is an enlarged cross-section taken along the line 6—6 on FIG. 2*a*;

FIG. 7 is an isometric projection of one of the latch devices embodied in the apparatus;

FIG. 8 is an enlarged longitudinal section through the upper portion of the apparatus shown in FIGS. 1 to 7, inclusive, with one of the tubular strings released therefrom;

FIG. 9 is a longitudinal section through another embodiment of the invention disposed in a well bore;

FIG. 10 is an enlarged section taken along the line 10—10 on FIG. 1.

The well packer A disclosed in FIGS. 1 to 8, inclusive, in the drawings is adapted to be lowered in a well casing B on a first tubular string C and may be placed in proper association with a lower well packer (not shown) previously set in the well casing. The well packer has a plurality, such as a pair, of fluid passages 10, 11 therethrough, one of which communicates with the first tubular string C, by means of which the apparatus is lowered in the well casing, and the other of which communicates with a second tubular string D extending to the top of the well bore, and which may be placed in association with the well packer apparatus, usually after it has been anchored in packed-off condition in the well casing. The fluid derived from the well bore below the lower packer (not shown) may be conducted through the first passage 10 and into the first tubular string C, through which it will pass to the top of the well bore. Some other fluid, such as derived from a region in the well bore between the packer A illustrated and the lower packer (not shown), may flow through the other passage 11 and through the other tubular string D to the top of the well bore.

The well packer includes a pair of parallel tubular body members 12, 13 movable as a unit in the well casing, the upper ends of which are threadedly attached to an upper body or receptacle 14 adapted to receive the lower portions of the first and second tubular strings C, D. The receptacle 14 has a first passage 15 communicating with the first body passage 10 and a second passage 16 communicating with the second body passage 11. The body 14 has a latch shoulder 17 projecting inwardly of its passage 15 for cooperation with the fingers or dogs 18 on the flexible arms 19 of the lower portion 20 of the first tubular string C. This first tubular string can move downwardly in the first receptacle passage 15, its flexible fingers or dogs 18 being forced inwardly upon engaging the shoulder 17. When disposed therebelow, the fingers or dogs 18 will deflect or snap in an outward direction for engagement under the shoulder 17. With the dogs or fingers 18 below the shoulder 17, a suitable side seal ring 21 on the lower portion 20 of the first tubular string will seal against the wall of the first passage 15 to prevent leakage between the first tubular string and the receptacle 14.

The second receptacle or body passage 16 has an inwardly directed latch shoulder 22 through which flexible fingers or dogs 23 on the lower portion 24 of the second tubular string can pass, then snapping outwardly for engagement with the lower portion of the shoulder 22 to releasably secure the second tubular string D to the body or receptacle 14. The second tubular string also has a suitable side seal ring 25 thereon adapted to seal against the wall of the body or receptacle 14 above the latch shoulder 22 when the second tubular string is latched to the body, such as shown in FIG. 3*a*.

A sleeve or body 26 is threadedly secured to the upper portion of the receptacle 14 and this sleeve is, in turn, threadedly attached to a guide 27 which is threadedly secured to an upper guide sleeve 28. The guide 27 has a pair of parallel passages 29, 30 extending therethrough

in alignment with the body passages 10, 15 and 11, 16, and through which the first and second tubular strings C, D can move, the first and second tubular strings being directed into their respective passages in the guide by downwardly tapering surfaces 31 which will direct one tubular string into its proper guide passage when the other tubular string is disposed in the other passage. Such tubular strings can also pass through first and second passages 32, 33 in a latch member or support 34 movable longitudinally in the sleeve or body 26, and having downwardly extending legs 35 adapted to engage the upper end of the receptacle 14.

The latch supporting member 34 is urged downwardly by a shoulder 36 on the second tubular string D engaging an upwardly facing shoulder 37 of the latch support within the second passage 33 when the latches 23 of the second tubular member are disposed below the shoulder 22. When the latch sleeve 34 is in such position, a latch device 38 secured to the latch support 34 is retained in an ineffective position. As specifically disclosed, the latch device 38 includes oppositely disposed latch members 39 secured to the upper end of the latch support 34 by screws 40, or the like, passing through a latch flange 41. The latches comprise upwardly extending flexible latch arms 42 terminating in inwardly directed latch fingers 43 adapted to move upwardly into engagement with an upwardly tapered shoulder 44 on the lower end of the latch guide 27 surrounding the first passage 29 therethrough. This shoulder forces and holds the fingers 43 inwardly above a flange or shoulder 45 on the first tubular string C above the latch support 34 when the latch fingers or dogs 18 on the first tubular string are disposed below the latch shoulder 17 in the first receptacle passage 15. The outer portions 46 of the latch fingers 43 are tapered in an upward and inward direction, whereas the upper inner portions 47 of the fingers taper in a downward direction for coaction with a lower downwardly tapering face 48 on the first member flange 45. The fingers 43 also have upwardly tapering surfaces 49 on their lower portions adapted to coact with a companion upwardly facing tapered face 50 on the shoulder flange 45 on the first tubular string C.

The first tubular string C can be moved downwardly through the first passage 29 in the guide 27. When the latch support 34 is in its lower position, the fingers 43 are disposed longitudinally below and in spaced relation to the tapered face 44 on the latch guide 27. The first tubular string C can, therefore, engage the latch fingers 43 and expand them outwardly, whereupon the first tubular string C will pass down through the passage 32 in the latch support 34 and into the first receptacle passage 15, the lower latch fingers 18 snapping past the first passage shoulder 17 to the position illustrated in FIG. 2*a*. At this time, the flange 45 on the first tubular string C will have expanded the latch fingers 43 outwardly and then will be disposed below the latter, whereupon they can inherently shift inwardly, because of the spring-like characteristic of the latch arms 42, to a position above the flange 45.

If the latch support 34 is free to move upwardly in the sleeve or body 26, elevation of the first tubular string C will cause its flange 45 to engage the latch fingers 43 and shift the entire sleeve 34 upwardly until the outer surfaces 46 of the fingers engage the tapered shoulder or face 44 on the guide 27, which will hold the latch fingers 43 in a position above the flange 45, locking or securing the first tubular string C to the guide 27 and to the remainder of the apparatus therebelow. If, however, the second tubular string D is disposed in the apparatus, with its shoulder 36 engaging the companion shoulder 37 on the latch support 34, to hold it in a downward direction in which the latch fingers 43 are spaced below its companion tapered shoulder 44 in the guide 27, then an upward pull taken on the first tubular string C will cause the shoulder 45 to engage the lower tapered surfaces 49 on the latch fingers 43 and expand them outwardly, allowing the shoulder 45 to move through the fingers 43 to a released position. When the lower dogs 18 engage the receptacle shoulder 17 in the first passage 15, they will also cause the lower arms 19 to flex inwardly, allowing the dogs 18 to move through the restricted shoulder 17, at which time the first tubular string C will be released from the apparatus A and can be withdrawn completely from the aligned first passages 29, 32, 15 and elevated in the well casing B, and, for that matter, withdrawn from the well bore entirely, if desired.

In the form of invention disclosed in FIGS. 1 to 8, inclusive, the tubular body members 12, 13 pass through an upper connector 55 abutting the lower end of the receptacle 14. Each tubular body member has a split ring 56 mounted in an external body member groove 57 and received within a counterbore 58 in the connector. The tubular members 12, 13 also pass through an insert member 59 engaging the rings, the insert being held upwardly against the rings and against the upper connector 55 by a coupling or a gauge ring 60 threaded to the connector 55 and having a flange 61 disposed under and engaging an insert flange 62. By virtue of the structure described, the tubular body members 12, 13, receptacle 14, connector 55, insert 59, split rings 57 and gauge ring 60 are movable longitudinally, as a unit, in both directions.

The first and second tubular body members or mandrels 12, 13 extend downwardly from the upper connector 55 through a packing structure 63, which may take any suitable form. As shown, this packing structure includes a plurality of packing elements 64 of pliant, elastic material, such as rubber, the upper end of the uppermost packing element engaging the lower ends of the gauge ring 60 and insert 59. Spacer rings 65, through which the tubular body members 12, 13 extend, are disposed between packing elements 64, the lowermost packing element engaging a lower gauge ring 66 threadedly attached to the upper end of a slip expander 67, the lower packing element also contacting a lower insert 68 clamped against the upper end of the expander by the lower gauge ring 66. The lower insert 68 and expander 67 have parallel bores 69 therethrough through which the tubular body members 12, 13 extend. The expander bore through which one of the tubular body members, such as the second tubular body member 13, extends is larger in diameter than the second tubular body member 13 to enable a retracting ring 70 to slide therewithin, which is mounted within a peripheral groove 71 in the second body member, and which is adapted to engage the lower insert 68 for the purpose of elevating the expander 67 when the second body member 13 is elevated in the well casing B.

Spaced below the expander 67 is a slip ring 72 to which a slip ring connector 73 is suitably attached. Both tubular body members 12, 13 are slidable through the slip ring 72 and the slip ring connector 73. Spaced below the connector 73 is a lower connector 74 having parallel bores 75 therethrough through which the tubular body members 12, 13 are slidable. This lower connector 74 is connected to the slip ring 72 and the upper connector 73 by a pair of longitudinally extending tie rods or bars 76 (FIG. 1). The lower portions of the tie rods extend through the lower connector 74, a nut 77 being threaded on their lower ends and tightened against the connector to firmly secure the tie bars to the latter. The upper end of each tie bar is suitably attached to the upper connector 73 and slip ring 72 so that the slip ring, upper connector and lower connector move together as a rigid unit.

The lower connector 74 has a threaded counterbore 79 surrounding the first tubular body member 12 and another threaded counterbore 80 surrounding the second tubular body member 13. A bottom sub or actuator 81 is adapted to be threadedly attached to the lower connector in either of these counterbores, as, for example, in the first counterbore 79, there being a suitable side seal ring or rings 82 in the bottom sub slidably engaging

the periphery of the first tubular body member 12. A tail pipe 83 is threadedly attached to the bottom sub 81, being of sufficient length to coact with the lower packer (not shown) in the well casing, so as to bear thereagainst and prevent further downward movement of the lower connector 74, upper connector 73 and slip ring 72 in the well casing B, as well as to function as a conductor for fluid from the region below the lower packer into the first body member 12, the fluid then passing through the first tubular string C to the top of the well bore. The other tubular body member 13 terminates below the lower connector 74 and will receive fluid from the region below the well packer A and conduct such fluid through the body member 13 and through the second tubular string D to the top of the well bore.

Displaced from a plane including the axes of the two tubular body members 12, 13, and on opposite sides thereof, are slips 84 carried by the slip ring 72 and adapted to coact with the expander 67. As shown, a pair of slips is disposed on each side of the aforementioned central plane. Each slip 84 is coupled to the slip ring 72 for longitudinal movement therewith, but the slips can move radially of the slip ring from a retracted position into engagement with the well casing B and back to a retracted position. Thus, the lower portions of the slips are formed as T-shaped heads 85, slidably mounted in companion generally T-shape slots 86 in the slip ring. The upper portions of the slips are constituted as anchoring elements having downwardly facing wickers or teeth 87 and inner tapered surfaces 88 inclined in a downward and inward direction, being slidable along companion tapered surfaces 89 in the expander. As the expander 67 moves downwardly relative to the slip ring 72 and the slips 84, the latter are shifted radially outwardly into engagement with the well casing B. Conversely, relative upward movement of the expander 67 with respect to the slip ring 72 and the slips 84 will result in inward movement of the slips from the well casing. This occurs as a result of providing side tongues 90 on each slip parallel to its tapered surface 88 which ride in companion grooves 91 in the expander forming a slidable tongue and groove connection between the expander 67 and each slip 84, and insuring positive retraction of the slips when the expander moves away from the slip ring 72.

Initially the slips 84 and packing structure 63 are in their retracted positions, being retained in such positions during lowering of the packer apparatus in the well casing by a releasable coupling or latch device 92, which is disclosed as specifically interconnecting the first tubular body member 12 with the upper connector 73 secured to the slip ring 72. The latch device is in the form of a control or latch sleeve 93 threadedly secured to the upper connector 73 and disposed around a split ring 94 mounted in a groove 95 in the first tubular body member and also adapted to be disposed around a cam or release ring 96 mounted in a peripheral groove 97 in the tubular body member 12. The control or latch sleeve 93 has a plurality of longitudinal slots 98 extending therethrough to form spring-like latch legs 99 that terminate in inwardly directed latch feet or fingers 100 initially disposed below the lower end of the actuating or cam ring 96. Such ring and the upper surfaces of the latch feet 100 have companion tapered surfaces 101 inclined in an inward and downward direction, such that downward movement of the first tubular body member 12 and ring 96 with sufficient force will cam the latch feet 100 and legs 99 outwardly to free the first body member 12 from the upper connector 73 and slip ring 72. Initially, however, the latch feet 100 are disposed under the actuating ring 96 and couple the first body member 12 to the upper connector 73, slip ring 72 and the slips 84.

In the use of the packer and tubular string apparatus disclosed in FIGS. 1 to 8, inclusive, the slips 84 are disposed initially in a retracted position, which is also true of the packing structure 63, the latch feet 100 being under the actuating cam ring 96. Ordinarily, the second tubular string D is not connected to the apparatus A at this time. However, the first tubular string C is located in the first passage 29, 32, 15 within the guide 27, latch support 34 and body or receptacle 14, with the lower latch dogs 18 disposed below the shoulder 17, the seal 21 engaging the wall of the first passage 15, and with the flange 45 disposed below the upper latch fingers 43, which, at this time, may be engaging the tapered shoulder 44 in the guide 27 so that the entire apparatus is suspended from the first tubular string C by means of which it can be lowered in the well casing B with a suitable length of tail pipe 83 extending from the bottom sub 81. During the lowering movement, the slips 84 remain in their retracted position, since the latch or control mechanism 92 causes the slip ring 72 and slips 84 to move downwardly with the body members 12, 13. The expander 67 also moves downwardly with the body members 12, 13, since the ring 70 prevents it from dropping downwardly therealong.

When the lower end of the tail pipe 83 engages the lower packer (not shown) and becomes suitably related thereto in leakproof relation (in a known manner), further downward movement of the tail pipe 83, bottom sub 81, lower connector 74, upper connector 73 and slip ring 72 cannot occur. Accordingly, the imposition of a sufficient downward force on the first tubular string C will be transmitted through the shoulder 17 to the receptacle 14 and to the first body member 12 and the cam ring 96 on to the latch legs 99, expanding such latch legs outwardly, thereby freeing the tubular body member 12 from the upper connector 73 and slip ring 72. The first tubular body member 12 can now be shifted downwardly, telescoping into the bottom sub 81 and carrying the upper connector 55 and the second body member 13 downwardly with it, since these parts are all secured to one another. This downward movement is accompanied by downward movement of the entire packing structure 63 and the expander 67, the latter shifting down behind the slips 84 and expanding the latter outwardly into anchoring engagement with the wall of the well casing B.

When the slips have been anchored against the well casing, further downward movement of the expander 67 cannot occur. Accordingly, a continuation of the downward movement of the first and second tubular body members 12, 13, as the result of downwardly moving the first tubular string C, moves the upper connector 55, insert 59 and gauge ring 60 (which may collectively be deemed to be an upper abutment) toward the lower gauge ring 66, insert 68 and expander 67 (which may be deemed collectively to be a lower abutment), which cannot move downwardly any further, shortening the packing elements 64 and effecting their outward expansion into sealing engagement with the well casing B, as disclosed in FIGS. 3*a* and 3*b*. The well packer A is now anchored in packed-off condition in the well casing against downward movement therewithin.

The second tubular string D can now be lowered in the well casing B alongside the first tubular string C. Its lower end will enter the guide sleeve 28 and engage the tapered guide surface 31 on the upper portion of the guide, which surface will direct it toward and into the second passage 30 through the guide, whereupon it will pass through the passage 33 of the latch member or support 34 and into the second passage 16 of the receptacle 14. Its latch dogs 23 will engage the latch shoulder 22 within the second passage 16, which will deflect the latch elements inwardly, the dogs 23 snapping past the latch shoulder 22 and being disposed therebelow, at which time the seal 25 will engage the wall of the second passage 16 in the receptacle. If a downward force is imposed on the second tubular string D, its shoulder 36 will engage the companion shoulder 37

in the latch support 34 and shift the latter downwardly into engagement with the upper end of the receptacle 14, at which time the latch fingers 43 at the upper end of the latch support 34 will be disposed a substantial distance below the tapered holding shoulder 44 of the guide 27. Downward movement of the latch member 34 is facilitated by providing bleeder holes 110 through the lower portion of the sleeve or body 26 to prevent fluid from being trapped below the latch support 34, or, for that matter, at any point within the sleeve or body 26 and guide 27.

The first passage 10 through the packer structure A is in communication with the tail pipe 83 and the lower packer (not shown) and will direct the fluid from the well bore below the lower packer upwardly into the first tubular string C for conduction to the top of the well bore. The fluid in the well bore below the well packer A will pass upwardly through the second passage 11 in the second body 13 and into the second tubular string D to be conducted thereby to the top of the well bore.

Either of the tubular strings C, D can be selectively released from the well packer and removed therefrom. If the first tubular string C is to be released, a sufficient downweight is imposed on the second tubular string D to hold the latch member 34 in the lower position illustrated in FIG. 3*a*. An upward strain can now be taken on the first tubular string C, its flange 45 engaging the upper fingers 43 and expanding them outwardly until the flange 45 is above such fingers, the lower fingers or dogs 18 also being deflected inwardly in pulling past the shoulder 17 in the first receptacle passage 15. The first tubular string C can now be removed completely from the first receptacle passage 15, the first passage 32 in the latch member 26, and the first passage 29 in the guide 27, and elevated in the well casing B and removed completely therefrom at the top of the well bore, if desired.

At any time, the first tubular string C can be run back in the well casing B alongside the second tubular string D. When its lower end reaches the guide sleeve 28, it will pass thereinto and then be guided by the tapered surface 31 into the first passage 29 through the guide, moving through the first passage 32 in the latch support 34 and into the first passage 15 of the receptacle 14. The lower dogs 18 will snap past the lower shoulder 17 and the flange 45 will snap past the fingers 43, which are disposed below the tapered holding shoulder 44, the parts then occupying the positions illustrated in FIG. 3*a*.

Assuming both tubular strings C, D to be disposed in the well packer apparatus A, the second tubular string D can be removed therefrom by imposing a downward force on the first tubular string C and then pulling upwardly on the second tubular string. The latch dogs 23 on the latter will snap through the latch shoulder 22 in the second passage 16 to release the second tubular string D from the receptacle 14, after which the latter is free to be pulled upwardly out of the apparatus A and removed entirely from the well casing, if desired. After the second tubular string D has been removed, any pull taken on the first tubular string C will cause the shoulder 45 to engage the latch fingers 43 and elevate the latch sleeve 34 until the fingers are wedged in and against the shoulder 44 at the lower end of the guide 27, which will hold the first tubular string C coupled to the guide and prevent release of the first tubular string from the apparatus A in a positive manner.

At any time thereafter, the second tubular string D can again be lowered in the well casing alongside the first tubular string C, its lower end engaging the tapered surface 31 which will steer it into the second passage 30, 33, 16 through the guide, the latch member 34 and the receptacle 14, until the latch dogs 23 again snap downwardly past the latch shoulder 22 in the second passage 16.

In the event it is desired to remove the apparatus from the well casing, an upward pull can be taken on either of the tubular strings C, D that might be connected to the apparatus. Assuming only the first tubular string C to be attached to the apparatus, an upward pull taken on it will cause the flange 45 to engage the latch fingers 43 and wedge them against the guide shoulder 43. For that matter, the lower latch dogs 18 may also engage the shoulder or inwardly directed flange 17 in the first receptacle passage 15. An upward pull now taken on the first tubular string C will move the guide sleeve 28, guide 27, sleeve 26 and receptacle 14 upwardly, pulling the first and second tubular body members 12, 13 upwardly, as well as the upper connector 55, insert 59 and upper gauge ring 60, this latter upper abutment structure being moved away from the lower abutment structure 66, 68, 67, allowing the packing elements 64 to retract inherently from the well casing B back to their initial retracted position, such as disclosed in FIGS. 2*a* and 2*b*. Following retraction of the packing elements, the ring 70 on the second tubular member engages the lower insert 68 to elevate the expander 67 with respect to the slips 84, the tongue and groove interconnection 90, 91 between the expander and slips causing the latter to shift inwardly back to the retracted position. Upward movement of the first and second tubular body members 12, 13 relative to the slip ring 72 and upper connector 73 can occur until the cam ring 96 engages the lower tapered ends 112 of the latch feet 100, expanding them outwardly until the cam 96 is again disposed above the feet, whereupon they will retract under the cam ring to the position disclosed in FIG. 2*b*. The entire apparatus A can now be withdrawn from the well casing B, the flange 45 on the first tubular string C being coupled to the guide 27 through the intermediary of the latch fingers 43. The elevation of the tubular string C will elevate the well packer A and the tail pipe 83 connected therewith in the well casing B until the entire apparatus has been withdrawn from the well bore.

In the event that the first tubular string C has first been removed from the apparatus with the second tubular string D remaining in place, then the lower latches 23 on the second tubular string may have sufficient holding force as to enable the second tubular string to be elevated, its latch dogs being coupled to the shoulder 22 in the second receptacle passage 16 in order to elevate the upper abutment 55, 59, 60 of the well packer from the lower abutment 66, 68, 67, allowing the packing structure 63 to retract, followed by retraction of the slips 84 and the relocation of the cam ring 96 above the latch feet 100, whereupon the entire packer apparatus A can be withdrawn from the well casing B by elevating the second tubular string D.

In the form of apparatus illustrated in FIG. 9, the selective parallel tubing string apparatus E is associated with upper and lower packers F, G that have been previously set in the well bore. Thus, a lower packer G has been anchored in packed-off condition in the well casing B between upper and lower sets of casing perforations 150, 151. An upper packer F has been anchored in packed-off condition in the well casing above the upper set of perforations 150. The lower perforations 151 are disposed opposite a lower formation zone 152 and the upper perforations 150 opposite an upper producing formation zone 153.

The apparatus E from which the first and second tubular strings C, D is selectively releasable is essentially the same as that illustrated in the other form of apparatus; that is to say, it includes the guide sleeve 28, guide 27, sleeve or body 26 threaded onto the latter and the body or receptacle 14 having the pair of passages 15, 16 therethrough. Instead of being associated with a pack-

ing and slip structure, the lower end of the body or receptacle 14 is threadedly attached to a tubular extension sleeve 155, the lower end of which is threaded onto a sub 156 adapted to rest upon an upper shoulder 157 of the upper packer F. Threaded into the sub 156 is a sealing nipple 158 adapted to fit in a counterbore 159 in the packer F, this sealing nipple having a suitable side seal 160 thereon for sealing against the wall of the counterbore.

An inner tubing string 83*a* has its upper end threaded into an adapter 161 threadedly attached to the lower portion of the receptacle 14 in communication with the first passage 15 therethrough. This inner tubing string is much smaller in diameter than the extension sleeve 155 and the sub 158, and extends completely therethrough and through the central passage 162 in the lower packer G, there being one or more seals 163 on the tubing sealing against the wall of the lower packer passage. The apparatus just described is lowered in the well casing B toward the upper and lower packers F, G (which have previously been set therewithin) on the first tubular string C, which, as illustrated, does not have the lower latch dogs 18 and arms 19, but which does possess the shoulder 45 located, at this time, below the latch fingers 43, the latch fingers wedging upwardly against the tapered shoulder 44 on the guide 27. The lower end of the first tubular string C has the side seal 21 sealingly engaging the wall of the first receptacle passage 15. The apparatus is lowered until the inner tubing string 83*a* extends through both packers F, G and with the lower end of the adapter sub 156 engaging the upper end 157 of the upper packer F. The second tubular string D is now lowered in the well casing B alongside the first tubular string C, engaging the tapered guide surface 31 on the guide 27, which will direct it into the second guide passage 30 and through the second passage 33 of the latch member 34 into the second passage 16 of the receptacle 14. The latch dogs 23 on the second tubular string will snap past the latch shoulder 22 in the second passage, the shoulder 36 on the string engaging the companion upwardly facing shoulder 37 in the second passage 33 of the latch member 34.

Production from the lower zone 152 will now pass through the lower casing perforations 151 and into the inner tubing string 83*a*, flowing upwardly through the latter into the first passage 15 through the receptacle and into the first tubing string C to the top of the well bore. Production from the upper zone 153 will pass through the casing perforations 150 between the upper and lower packers F, G, and through the passage in the upper packer F and the space 170 around the inner tubular string 83*a*, flowing upwardly into the extension 155 and the second receptacle passage 16 into the second tubular string D, to be conducted thereby to the top of the well bore.

In the event the first tubular string C is to be released from the apparatus, a downweight is imposed on the second tubular string D, which will hold the latch support 34 in its lower position with the latch fingers 43 spaced below the tapered shoulder 44 on the guide 27. An upward pull can now be taken on the first tubular string C, with a downward force maintained on the second tubular string D, the shoulder 45 expanding the fingers 43 and snapping past them, which will then allow the shoulder 45 to move upwardly through the first passage 29 in the guide followed by the entire length of the first tubular string therebelow. The first tubular string C can now be removed from the well casing.

At any time, the first tubular string C can again be lowered in the well casing B alongside the second tubular string D. Its lower end will engage the tapered guide surface 31 on the guide 27, which will direct it into the first guide passage 29, the lower portion of the first tubular string moving through the first passage 32 in the latch support 34 and into the first receptacle passage 15, the shoulder 45 on the first tubular string expanding the fingers 43 outwardly and snapping past the fingers to be disposed therebelow. If desired, the second tubular string D can be released from the apparatus and be removed from the well casing by taking an upward strain thereon to snap its latch dogs 23 past the latch shoulder 22, thereby freeing the second tubular string from the receptacle 14. It can now be moved upwardly completely through the second passages 33, 30 in the latch support and guide and be elevated in the well casing B to the top of the well bore.

At any time, the second tubular string D can be relowered in the well casing alongside the first tubular string and reinserted in the second passages 33, 30, 16 in the guide 27, latch support 34 and receptacle 14, and latched in place with its seal 25 engaging the wall of the second passage 16.

With either of the tubular strings C, D connected to the apparatus E, it can be elevated in the well casing B and removed from the upper and lower well packers F, G. If the first tubular string C is in the well casing and latched to the apparatus E with its shoulder 45 disposed below the latch fingers 43, it can be elevated, the latch fingers 43 coupling it to the guide 27. Its upward movement will pull the entire apparatus E upwardly, removing the seal sub 158 and the seal 160 from the upper packer F, followed by an elevation of the inner tubular string 83*a* through the passages 170, 162 in the upper and lower packers F, G. The entire apparatus E can readily be withdrawn from the well casing, by virtue of continued elevation of the first tubular string C in the well casing.

If the second tubular string D is connected to the apparatus with its latch dogs 23 disposed below the latch shoulder 22, then elevation of the second tubular string will elevate the entire apparatus E with respect to the well packers F, G therebelow and within the well casing B to the top of the hole, in the same manner as the first tubular string C.

It is, accordingly, apparent that parallel tubular string apparatus has been provided, which is capable of being run in the well casing on one of the tubular strings, after which another tubular string can be operatively connected thereto. At any time, either of the tubular strings can be selectively released and removed from the apparatus. The apparatus itself can be released and removed by use of one of the tubular strings. It is also possible to run the packer apparatus illustrated in FIGS. 1 to 8, inclusive, or the apparatus illustrated in FIG. 9, in well casing on both tubular strings and remove the apparatus from the well casing by simultaneously elevating both tubular strings, if they remain connected to the apparatus. However, it is usually more convenient and expedient to run an apparatus A or E in the well casing on one tubular string and elevate it in the well casing on one tubular string.

I claim:

1. In subsurface well production apparatus adapted for use with a plurality of tubular strings extending to the top of a well bore: body means adapted to be disposed in the well bore and having passage means therein adapted to receive the plurality of tubular strings which extend to the top of the well bore; releasable means in said body means adapted to releasably couple one of the tubular strings to the body means; and means in said body means connected to the releasable means and engageable and movable by another of the tubular strings to prevent said releasable means from coupling said one tubular string to the body means.

2. In subsurface well production apparatus adapted for use with a plurality of tubular strings extending to the top of a a well bore: body means adapted to be disposed in the well bore and having passage means therein adapted to receive the plurality of tubular strings which extend to the top of the well bore; releasable means movable in said body means in one direction into engagement with said body means to couple one of the tubular

strings to the body means; and support means in said body means connected to said releasable means and embodying means adapted to be engaged by an actuating member to move said support means and releasable means in the opposite direction to prevent engagement of said releasable means with said body means, whereby said one tubular string can be uncoupled from the body means and withdrawn therefrom.

3. In subsurface well production apparatus adapted for use with a plurality of tubular strings extending to the top of a well bore: body means adapted to be disposed in the well bore and having passage means therein adapted to receive the plurality of tubular strings which extend to the top of the well bore; laterally movable latch means in said body means engageable with said body means and one of the tubular strings to couple the one tubular string to the body means; and means in said body means connected to said latch means and engageable by another of the tubular strings to prevent engagement of the latch means with said body means and allow the one tubular string to be released from said body means.

4. In subsurface well production apparatus adapted for use with a plurality of tubular strings extending to the top of a well bore: body means adapted to be disposed in the well bore and having passage means therein adapted to receive the plurality of tubular strings which extend to the top of the well bore; laterally movable latch means in said body means movable in one direction into engagement with said body means to couple one of the tubular strings to the body means; and means in said body means connected to said latch means and movable by another of the tubular strings in the opposite direction to hold said latch means disengaged from said body means and allow the one tubular string to be released from said body means.

5. In subsurface well production apparatus adapted for use with a plurality of tubular strings extendng to the top of a well bore: body means adapted to be disposed in the well bore and having passage means therein adapted to receive the plurality of tubular strings which extend to the top of the well bore; laterally movable latch means movable upwardly in said body means into engagement with said body means to couple one of the tubular strings to the body means; and means in said body means connected to said latch means and movable downwardly in said body means by another of the tubular strings to hold said latch means disengaged from said body means and allow the one tubular string to be released from said body means.

6. In subsurface well production apparatus adapted for use with a plurality of tubular strings extending to the top of a well bore: body means adapted to be disposed in the well bore and having first and second parallel passages therein adapted to receive first and second parallel tubular strings, respectively, which extend to the top of the well bore; releasable means in said body means adapted to releasably couple the first string to said body means when said first string is in the first passage; and means in said body means connected to the releasable means and engageable and movable by the second string when the second string is in the second passage to prevent said releasable means from coupling the first string to the body means.

7. In subsurface well production apparatus adapted for use with a plurality of tubular strings extending to the top of a well bore: body means adapted to be disposed in the well bore and having first and second parallel passages therein adapted to receive first and second parallel tubular strings, respectively, which extend to the top of the well bore; releasable means movable in said body means in one direction into engagement with said body means to couple the first string to said body means when said first string is in the first passage; and means in said body means connected to the releasable means and engageable and movable in the opposite direction by the second string when the second string is in the second passage to prevent engagement of said releasable means with said body means and enable said one tubular string to be uncoupled from said body means.

8. In subsurface well production apparatus adapted for use with a plurality of tubular strings extending to the top of a well bore: body means adapted to be disposed in the well bore and having first and second parallel passages therein adapted to receive first and second parallel tubular strings, respectively, which extend to the top of the well bore; laterally movable latch means in said body means movable in one direction into engagement with said body means to couple the first string to the body means; and means in said body means connected to said latch means and movable by the second string in the opposite direction to hold said latch means disengaged from said body means and allow the first string to be released from said body means.

9. In subsurface well production apparatus adapted for use with a plurality of tubular strings extending to the top of a well bore: body means adapted to be disposed in the well bore and having first and second parallel passages therein adapted to receive first and second parallel tubular strings, respectively, which extend to the top of the well bore; laterally movable latch means movable upwardly in said body means into engagement with said body means to releasably couple the first string to said body means when said first string is in the first passage; and means in said body means connected to said latch means and movable upwardly in said body means by the first string when the first string is in the second passage and movable downwardly by the second string when the second string is in the second passage to hold said latch means disengaged from said body means and allow the first string to be released from the body means.

10. In subsurface well production apparatus adapted for use with a plurality of tubular strings extending to the top of a well bore: body means adapted to be disposed in the well bore and having passage means therein adapted to receive the plurality of tubular strings which extend to the top of the well bore; a sleeve movable in said body means; laterally movable latch means on said sleeve adapted to be coupled to one of the tubular strings and movable in one direction with said sleeve into engagement with said body means to prevent lateral release of said latch means from the one tubular string to maintain the one tubular string coupled to the body means; said sleeve having means thereon engageable by another of the tubular strings to be moved thereby in the opposite direction to prevent engagement of said latch means with said body means to allow said latch means to be moved laterally from coupled relation to the one tubular string and body means, whereby said one tubular string can be released from said body means.

11. In subsurface well production apparatus adapted for use with a plurality of tubular strings extending to the top of a well bore: body means adapted to be disposed in the well bore and having passage means therein adapted to receive the plurality of tubular strings which extend to the top of the well bore; a sleeve movable in said body means; laterally movable latch means on said sleeve adapted to be coupled to one of the tubular strings and movable upwardly with said sleeve into engagement with said body means to prevent lateral release of said latch means from the one tubular string to maintain the one tubular string coupled to the body means; said sleeve having means thereon engageable by another of the tubular strings to be moved downwardly thereby in the body means to prevent engagement of said latch means with said body means to allow said latch means to be moved laterally from coupled relation to the one tubular string and body means.

12. In subsurface well production apparatus adapted for use with a plurality of tubular strings extending to the

top of a well bore: body means adapted to be disposed in the well bore and having first and second parallel passages therein adapted to receive first and second parallel tubular strings, respectively, which extend to the top of the well bore; a sleeve movable in said body means; laterally movable latch means on said sleeve adapted to be coupled to the first tubular string when the first string is in the first passage and movable in one direction with said sleeve into engagement with said body means to prevent lateral release of said latch means from the first string to maintain the first string coupled to the body means; said sleeve having means thereon engageable by the second string to be moved thereby in the opposite direction to prevent engagement of said latch means with said body means to allow said latch means to be moved laterally from coupled relation to the first string, whereby the first tubular string can be released from said body means and removed from said first passage.

13. In subsurface well production apparatus adapted for use with a plurality of tubular strings extending to the top of a well bore: body means adapted to be disposed in the well bore and having first and second parallel passages therein adapted to receive first and second parallel tubular strings, respectively, which extend to the top of the well bore; a sleeve movable longitudinally in said body means; laterally movable latch means on said sleeve adapted to be coupled to the first string and movable with said sleeve upwardly in said body means into engagement with said body means to prevent lateral release of said latch means from the first string to maintain the first string coupled to the body means; said sleeve having means thereon engageable by the second tubular string to be moved thereby downwardly in the body to prevent engagement of said latch means with said body means to allow said latch means to be moved laterally from coupled relation to the first tubular string and body means.

14. In subsurface well production apparatus adapted to be used with a plurality of tubular strings extending to the top of a well bore: body means adapted to be disposed in the well bore and having first and second parallel passages therein adapted to receive first and second parallel tubular strings, respectively, which extend to the top of the well bore; said body means having a downwardly facing shoulder adjacent to its first passage; a sleeve movable longitudinally in said body means; laterally movable latch means on said sleeve movable upwardly therewith in said body means into engagement with said shoulder to be held inwardly in engagement with the first tubular string to couple the first tubular string to the body; said sleeve having means thereon engageable by the second tubular string to be moved downwardly thereby to lower said latch means from said shoulder and prevent its engagement therewith to allow outward expansion of said latch means from coupled relation to the first tubular string, whereby the first tubular string can be released from the body means and removed from the first passage.

15. In subsurface well production apparatus: first and second tubular strings adapted to be disposed in a well bore and extending to the top thereof; body means adapted to be lowered in the well bore and having first and second parallel passages therein adapted to receive the first and second tubular strings, respectively; said body means having a downwardly facing shoulder adjacent to said first passage; said first tubular string having a shoulder disposed below said downwardly facing shoulder when said first tubular string is disposed in said first passage; a sleeve movable in said body means; laterally movable latch means on said sleeve between said shoulders and movable upwardly with said sleeve into coupling engagement with said body means shoulder and first tubular string shoulder to couple said first tubular string to said body means; said sleeve having means thereon engageable by the second tubular string when disposed in said second passage to be moved downwardly thereby to hold said latch means below said body means shoulder and prevent its engagement therewith, whereby upward movement of the first tubular string will expand said latch means from engagement therewith and allow upward movement of said first tubular string through said first passage means and its uncoupling from said body means.

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