

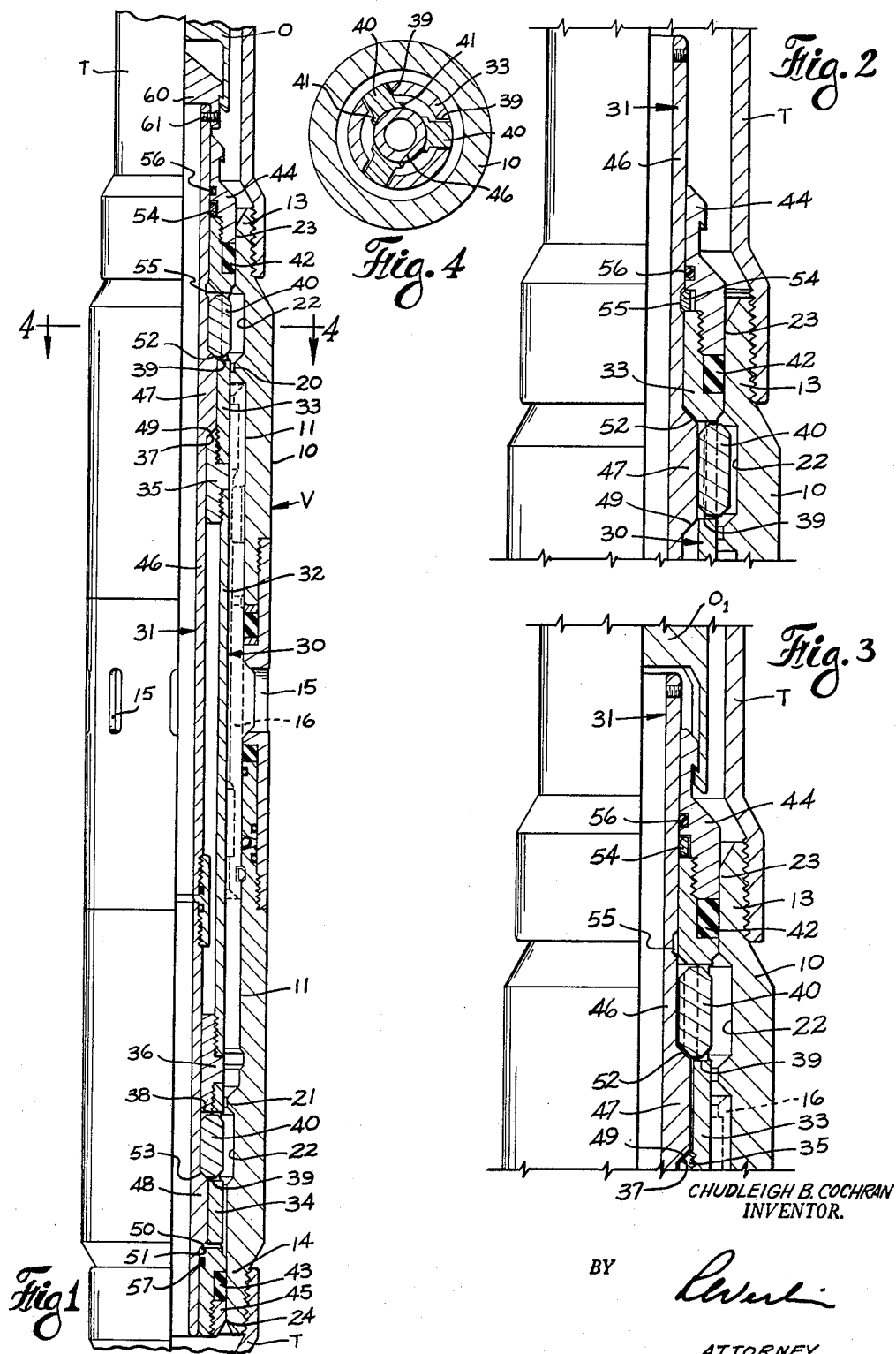
May 14, 1963

C. B. COCHRAN

3,089,546

SLEEVE VALVE FOR WELL PIPE STRINGS WITH BLIND CLOSURE SLEEVE

Filed Dec. 19, 1960



1

3,089,546

SLEEVE VALVE FOR WELL PIPE STRINGS WITH BLIND CLOSURE SLEEVE

Chudleigh B. Cochran, Houston, Tex., assignor to

Cicero C. Brown, Houston, Tex.

Filed Dec. 19, 1960, Ser. No. 76,691

10 Claims. (Cl. 166-224)

This invention relates to a sleeve valve for well pipe strings, and particularly to such a valve employing a blind closure sleeve which is adapted to function either as a primary closure for the valve or as a secondary closure shutting-off flow through a sleeve valve in which a primary closure has failed to close-off the flow.

Sleeve valves are conventionally employed in well pipe strings, particularly tubing strings, and generally comprise a tubular body having radial ports through the wall thereof, and a sleeve valve slidably mounted in the bore of the body and provided with radial ports movable longitudinally therein between positions in and out of communication with the body ports. In many cases these ported valve sleeves will leak when in the closed position or may become stuck in the open position, and it becomes necessary to close-off the valve in some manner without having to pull the pipe string.

The present invention has for its primary object the provision of a sleeve-type valve in which the closure sleeve is a blind sleeve which is removably insertable through the pipe string into the bore of the valve body and may function as a primary closure to close the body ports or to form a secondary closure around an existing ported sleeve valve.

An important object is to provide a sleeve valve construction employing a blind closure sleeve slidably insertable in the bore of a valve and concentrically mounted for relative longitudinal movement on a tubular operating mandrel, the closure sleeve being provided with radially projectible latch elements adapted to latch into appropriate latching grooves provided in the bore wall of the body above and below the body ports and fitted with sealing elements for sealing between the closure sleeve and the body at points above and below the body ports, the mandrel carrying annular enlargements operable in response to said relative longitudinal movement between the mandrel and the closure sleeve to project the latching elements into the latching grooves and thereby lock the closure sleeve to the valve body.

Another object is to provide a closure for a sleeve valve in a pipe string which is adapted to be run through the pipe string into the bore of the valve body on a wire line and to be set therein by manipulation of the wire line string of tools.

Still another object is to provide a sleeve valve for well pipe strings having a blind closure sleeve which is releasably insertable into the bore of the body through the pipe string.

A further object is to provide in a well pipe string having a plurality of longitudinally spaced sleeve valves mounted therein, a closure sleeve means constructed and arranged to close-off a selected one of said sleeve valves.

Other and more specific objects and advantages of this invention will become apparent from the following detailed description when read in conjunction with the accompanying drawing which illustrates a useful embodiment in accordance with this invention.

In the drawing:

FIG. 1 is a longitudinal quarter-sectional view of a sleeve valve in accordance with this invention, the closure structure being shown installed in a valve having a primary closure sleeve shown in broken lines, the closure structure being shown in the unset position;

2

FIG. 2 is an enlarged fragmentary view of the upper portion of the closure structure shown in the position at which it is locked to the valve body;

FIG. 3 is a view similar to FIG. 2, showing the latching elements in the released position preparatory to withdrawing the closure sleeve from the valve; and

FIG. 4 is a cross-sectional view taken along line 4-4 of FIG. 1.

Referring to the drawing, there is shown a sleeve valve V, which may be of any generally conventional construction, including a tubular body 10 having a bore 11 provided at its opposite ends with externally threaded tubular fittings 13 and 14 by means of which the body may be co-axially connected into a well pipe string, such as a tubing string T. At an intermediate point between the ends of body 10, a plurality of circumferentially spaced radial ports 15 are provided through the wall of the body to establish communication between the exterior of the valve and the bore thereof. A ported sleeve valve 16, shown in broken lines, is slidably disposed in bore 11 for movement between positions opening and closing communication between the body ports 15 and the interior of the bore of the valve. Sleeve valve 16 may be of any generally conventional design and is shown in broken lines in order to illustrate the employment of the blind closure sleeve in accordance with the present invention as a second closure for body ports 15 in the event of failure of the ported sleeve valve 16 to function properly. It will be understood that details of the ported sleeve valve 16 do not form a part of the present invention. My co-pending application Serial No. 48,146, filed August 8, 1960, illustrates the details of this particular form of sleeve valve 16.

Body 10 is provided with longitudinally spaced internal shoulders 20 and 21, respectively, which serve to limit the longitudinal travel of sleeve valve 16. At points between the shoulders 20 and 21 and the adjacent end fittings 13 and 14, the bore of body 10 is provided with annular latching grooves 22, 22, for purposes to be described hereinafter. The portions of fittings 13 and 14 outside the grooves 22 have co-axial polish bores 23, 24, respectively.

The closure structure, in accordance with the present invention, comprises a tubular sleeve, designated generally by the numeral 30, and a tubular mandrel, designated generally by the numeral 31, which extends through the bore of sleeve 30. Mandrel 31 and sleeve 30 are slidable into and out of the bore of body 10, as a unit, and are longitudinally slidable relative to each other, as will be more fully described hereinafter. Sleeve 30 includes a tubular body 32 threadably connected at its opposite ends to upper and lower slip cages 33 and 34, respectively. The connections between the opposite ends of body 32 and the slip cages are provided by externally threaded upper and lower bushings 35 and 36, respectively, one end of each bushing being received in the bore at one end of the body and the other end in the bore of the adjacent slip cage. Upper bushing 35 thus defines an internal upwardly facing tapered shoulder 37 in the bore of body 32, while bushing 36 defines an internal downwardly facing tapered shoulder 38 in the bore of body 32. Each of the cages is provided with a plurality of angularly spaced, generally rectangular windows 39 in which are mounted latching dogs or slips 40 of generally rectangular configuration having chamfered edges. Each of the slips 40 is provided on its inner end with laterally extending longitudinal edge flanges 41 (FIG. 4) which will engage the inner side edges of windows 39 to limit outward movement of the slips, the inward movement of the slips being limited by engagement with the exterior of mandrel 31. The radial thickness of slips 40 is made

such that when they are projected radially outwardly of windows 39 to the limit permitted by flanges 41, the outer ends of the slips will project into latching grooves 22 when the slips are positioned opposite these grooves, as will appear subsequently. Upper cage 33 has mounted in the exterior thereof an annular seal packing 42 which is adapted to form a slidable seal with bore 23 of upper fitting 13. Lower slip cage 34 is provided with a similar seal packing 43 which is adapted to form a slidable seal with the wall of bore 24 of fitting 14. A tubular fishing neck 44 is screwed over the upper end of upper cage 33 and serves, when screwed down on the cage, to compress packing 42. A gland ring 45 is threaded about the lower end of lower cage 34 to compress packing 43.

Mandrel 31 comprises the tubular body 46, somewhat smaller in diameter than the internal diameter of sleeve 32, the external diameter of mandrel 46 being such as to be snugly slidable in the bores of bushings 35 and 36. Body 46 of the mandrel is provided at longitudinally spaced points with the upper and lower annular enlargements 47 and 48, respectively, these being so positioned along the mandrel that when the latter is fully inserted in sleeve 30, the lower end of upper enlargement 47, which defines a tapered downwardly facing shoulder 49, will abut shoulder 37 of upper bushing 35, while the lower end of enlargement 48, which defines a downwardly facing shoulder 50, will be in abutment with an internal shoulder 51 formed in the lower end of lower cage 34. In the fully inserted position of the mandrel, the upper ends of the respective enlargements defining the respective upwardly facing shoulders 52 and 53, will be substantially flush with the bottom walls of the respective windows 39. With this arrangement, it will be seen that when the mandrel is fully inserted in sleeve 30, the smaller external diameter of the portions of body 46, above the respective enlargements 47 and 48, will be opposite the inner ends of the slips 40, thereby allowing the latter to retract inwardly sufficiently to move the outer ends of the slips out of engagement with latching grooves 22. The upper and lower edges of the slips being chamfered, as are the respective shoulders 52 and 53, upward movement of the mandrel relative to sleeve 30, will be operable to produce a camming action between shoulders 52 and 53 and the slips to urge the latter outwardly of windows 39 into latching grooves 22 (FIG. 2). A snap ring 54 is mounted in the bore of fishing neck 44 and mandrel 46 is provided with a snap ring groove 55 which, in the fully inserted position of the mandrel (FIGS. 1 and 3), will be below and out of registration with snap ring 54. The distance between snap ring 54 and groove 55 in these relative positions will be such that when the mandrel is pulled upwardly to the position at which the enlargements 47 and 48 are opposite slips 40 (FIG. 2), snap ring groove 55 will be opposite snap ring 54, allowing the latter to enter the groove and latch the mandrel to the sleeve in this position (FIG. 2). An annular seal packing 56 is positioned in the bore of fishing neck 44 to provide a fluid-tight slidable seal between the fishing neck and body 46 at a point above snap ring 54. Another annular seal packing 57 is provided in the bore of the lower end of lower cage 34 below shoulder 51 to provide an additional fluid-tight slidable seal between the lower end of the mandrel and the lower end of cage 34. It will be seen that seals 42 and 43 thus provide fluid-tight seals between sleeve 30 and body 10 at points outside the respective latching grooves, while seal packings 56 and 57 provide internal seals between the opposite ends of sleeve 30 and mandrel 31, so that when sleeve 30 is fully inserted in body 10, escape of fluid through ports 15 into the interior of the tubing string will be completely cut off.

Operation of the device is as follows: Assuming that for one reason or another it is necessary to close-off ports 15, the closure structure will be inserted through the tubing string into the bore of body 10. For this purpose the upper end of mandrel 31, which normally projects

above the upper end of fishing neck 44, will, itself, be provided with a fishing neck 60 which is secured to the end of the mandrel by means of a frangible connection, such as a shear pin 61. The closure structure will thus be run through the tubing into the bore of valve body 10 on a wire line carrying a conventional string of wire line tools, including a conventional overshot O. The closure structure will be moved through the bore of body 10 until slips 40 will be at points opposite grooves 22. The downward movement of the structure will necessarily maintain mandrel 31 in its inward or "down" position with respect to sleeve 30, due to the frictional engagement of seals 42 and 43 with the walls of bores 23 and 24, until the structure has been moved fully into the bore of body 10. In these relative positions of the parts, it will be seen that shoulder 49 of the upper enlargement will be seated against shoulder 37 of the upper bushing, while shoulder 50 on the lower enlargement will be seated on shoulder 51 in the lower slip cage, thus preventing further downward movement of mandrel 31 relative to sleeve 30, and also positioning enlargements 47 and 48 below the respective sets of slips 40, allowing the latter to move inwardly and out of latching engagement in latching grooves 22.

When the closure structure has thus been lowered through body 10, an upward pull will be applied through a wire line (not shown) to the overshot O and thence to the mandrel which will cause the mandrel 31 to be pulled upwardly, sleeve 30 being held stationary by the friction between seals 42 and 43 and the bore walls of fittings 13 and 14. This relative upward movement of the mandrel will carry enlargements 47 and 48 upwardly and the chamfered shoulders 52 and 53 will then engage the adjacent chamfered edge of slips 40 and urge slips 40 outwardly into latching engagement in grooves 22. When the enlargements have moved upwardly to a point where they are directly opposite slips 40 (FIG. 2), snap ring groove 55 will have moved opposite snap ring 54 and the latter will constrict and enter groove 55, thus securely latching mandrel 31 to the sleeve 30 in the position which will be effective, through entrance of slips 40 into grooves 22, to latch the sleeve to valve body 10 (FIG. 2). In this position ports 15 will thus be effectively closed off from communication with the tubing by virtue of seals 42, 43 and 56, 57. It will be seen that the closure structure will be effective for this purpose whether or not a sleeve valve, such as sleeve valve 16, is present or absent.

When snap ring 54 is engaged in snap ring groove 55 and the slips are latched into grooves 22, an upward jerk through the lowering line may be applied to overshot O to break shear pin 61 and permit fishing neck 60 and the string of wire line tools to be removed from the tubing string.

Should it become desirable to remove the closure structure from the valve, a wire line tool string can be run back into the bore of the tubing, carrying an overshot O₁ (FIG. 3) adapted to pass over the upper end of mandrel 31 and engage fishing neck 44. In effecting this engagement, a downward blow may be applied through the overshot on the upper end of mandrel 31 to drive the same downwardly relative to sleeve 30, thereby moving snap ring groove 55 out of latching engagement with snap ring 54 and moving enlargements 47 and 48 downwardly out of registration with slips 40 (FIG. 3). Thus the slips are freed to retract inwardly of windows 39. An upward pull applied through overshot O₁ to fishing neck 44 will serve to pull the entire closure structure upwardly out of the bore of body 40.

By appropriate spacing of the latching grooves 22 and correspondingly spacing slips 40 on the closure structure, the closure structure can be adapted to selectively close-off one of a series of such sleeve valves. Thus, if a series of valves is run in a pipe string and the spacing of grooves 22 for each of the valves is made different, any one of the valves may be selectively closed-off by providing a closure

5

structure in which the slips are spaced to conform to the spacing between the latching grooves of the selected valves.

In another arrangement, the spacing between the pairs of the grooves 22 may be uniform and the same as the spacing between the slips on the sleeve. In such an arrangement the sleeve may be run downwardly to below the lowest set of grooves and upon picking up the tool string carrying the sleeve, the slips will automatically be set in the lowest pair of the grooves.

From the foregoing, it will be seen that the closure structure of the present invention may be employed, as previously noted, as a primary closure for a sleeve valve having a ported body of the general form illustrated, or it may be employed as a repair or patching tool to form a secondary closure to close-off the ports around an existing ported sleeve valve. Thus, in its broader aspect, the present invention may comprise a sleeve valve structure comprising the body 10, the closure sleeve 30, and the mandrel 31. Or the closure structure, including sleeve 30 and mandrel 31, may be considered as a sub-combination defining a secondary closure for a sleeve valve which includes a body and a primary closure sleeve.

It will be evident that the closure structure comprising sleeve 30 and mandrel 31 may be employed as a latching tool for releasably anchoring various types of well tools other than the closure sleeve, heretofore described, in a well tubing. Such other tools may be removable plugs, tail pipe or tubing hangers, removable chokes, collet packers, safety valves, etc. By providing a grooved latching collar for cooperation with the latching tool at an appropriate location in the tubing string, the well tool may be anchored by means of the latching tool in the same manner as heretofore described.

It may be noted that a latching tool of the type described possesses several advantages over more conventional latching devices. The absence of outward pressure on the slips when being run into the tubing, by reason of the freedom of radially retractive movement permitted for the slips when the enlargements are below the slips, obviates a scraping action of the slips on the pipe wall. This is important in cases, now becoming quite common, where the interior wall of the tubing is coated with plastic for corrosion protection. The loosely mounted slips and their chamfered edges as herein illustrated will minimize the danger of cutting or marring such plastic coatings. Moreover, since the latching is effected by the provision of grooves in the wall of the latching collar or tubing, rather than inwardly projecting landing shoulders, the tubing string will have a full open bore for the reception of well tools.

It will be understood that various changes and modifications may be made in the details of the illustrative embodiment within the scope of the appended claims, but without departing from the spirit of this invention.

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

1. A sleeve valve for well pipe strings, comprising, a tubular body coaxially connectible in a well pipe string to form a part thereof, radial ports through the wall of the body communicating with the bore thereof, annular grooves in the bore wall of the body above and below said ports, and closure means for said ports, said closure means comprising a tubular sleeve slidably insertable in said bore, radially movable latch elements mounted in the wall of the sleeve at longitudinally spaced points to register with said grooves, a tubular mandrel slidable in the bore of said sleeve, a pair of annular enlargements on the mandrel longitudinally spaced apart to correspond to the spacing of said latch elements, said enlargements being operable when the mandrel is moved to a first position at which the enlargements are in registration with said latch elements to project the latter into latching engagement with said grooves and when moved to a second position out of registration with the latch elements to release said latch elements for retraction from said grooves,

6

cooperable latch means on the sleeve and mandrel for releasably latching the mandrel to the sleeve in said first position, and seal means sealing between said closure means and said body to close off fluid flow between the pipe string and said ports.

2. A sleeve valve according to claim 1, wherein said cooperable latch means comprises a snap-ring mounted in the bore of said sleeve, and a snap ring groove in the periphery of said mandrel.

3. A sleeve valve according to claim 1, wherein said seal means comprises a first pair of annular seal elements sealing between the sleeve and the body above and below said latch elements and said grooves, and a second pair of annular seal elements between the mandrel and the sleeve at points above and below said latch elements.

4. A sleeve valve for well pipe strings, comprising, a tubular body coaxially connectible in a well pipe string to form a part thereof, radial ports through the wall of the body communicating with the bore thereof, annular grooves in the bore wall of the body above and below said ports, and closure means for said ports, said closure means comprising a tubular sleeve slidably insertable in said bore, radially movable latch elements mounted in the wall of the sleeve at longitudinally spaced points to register with said grooves, a tubular mandrel slidable in the bore of said sleeve, a pair of annular enlargements on the mandrel longitudinally spaced apart to correspond to the spacing of said latch elements, said enlargements being operable when the mandrel is moved to a first position at which the enlargements are in registration with said latch elements to project the latter into latching engagement with said grooves and when moved to a second position out of registration with the latch elements to release said latch elements for retraction from said grooves, the opposite ends of each of said enlargements defining upwardly and downwardly facing annular shoulders, respectively, internal shoulder means in the bore of said sleeve engageable beneath said downwardly facing shoulders to limit downward movement of the mandrel relative to the sleeve to attainment of said second position, and said upwardly facing shoulders defining cams engageable with the inner ends of said latch elements to project them radially outwardly into said grooves in response to upward movement of the mandrel from said second position to said first position, and seal means sealing between the closure means and said body to close off fluid flow between the pipe string and said ports.

5. In a sleeve valve for well pipe strings including a tubular body coaxially connectible into a well pipe string to form a part thereof, said body having radial ports through the wall thereof communicating with the bore of the body, a blind sleeve closure assembly for said ports removably insertable through the bore of the pipe string into the bore of the body, said assembly, comprising, a tubular sleeve having a length to extend through the bore of the body to points on opposite sides of said ports, means for sealing between the sleeve and the bore wall of said body on opposite sides of said ports, latch means for releasably latching said sleeve to said body at points above and below said ports, said latch means including annular latching grooves in the bore wall of the body, radially movable latch elements mounted in the wall of said sleeve opposite said grooves, a tubular mandrel extending through the bore of said sleeve, means for moving said mandrel longitudinally between first and second positions relative to the sleeve, means on the mandrel operable in response to longitudinal movement of the mandrel to said first position relative to said sleeve to project said latch elements into said latching grooves, said last-mentioned means being operable to release said latch elements upon longitudinal movement of the mandrel to said second position relative to said sleeve, means sealing between the mandrel and the sleeve at points above and below the latching elements, and

7

means carried by said assembly for operably connecting the same to an operating string of tools.

6. A closure assembly according to claim 5, wherein said mandrel and said sleeve carry cooperable auxiliary latch elements engageable at said first position of said mandrel to secure said mandrel to said sleeve in said first position, and releasable upon said movement of said mandrel to said second position.

7. A closure assembly according to claim 5, wherein said means on the mandrel for projecting said latch elements comprises annular enlargements defining cams engageable with adjacent portions of said latch elements.

8. A well tool anchor, comprising in combination, a latching collar connectible in a well pipe string to form a part thereof, longitudinally spaced annular grooves in the bore wall of said collar, a tubular sleeve slidably insertable in said bore, radially movable latch elements mounted in the wall of the sleeve at longitudinally spaced points to register with said grooves, a tubular mandrel slidable in the bore of said sleeve, a pair of annular enlargements on the mandrel longitudinally spaced apart to correspond to the spacing of said latch elements, said enlargements being operable when the mandrel is moved

8

to a first position at which the enlargements are in registration with said latch elements to project the latter into latching engagement with said grooves and when moved to a second position out of registration with the latch elements to release said latch elements for retraction from said grooves, and cooperable latch means on the sleeve and mandrel for releasably latching the mandrel to the sleeve in said first position.

9. A well tool anchor according to claim 8 wherein said cooperable latch means comprises a snap-ring mounted in the bore of the sleeve, and a snap-ring groove in the periphery of said mandrel.

10. A well tool anchor according to claim 8 wherein said latch elements are generally rectangular in shape having chamfered upper and lower end edges and said annular grooves are defined by upper and lower end walls tapered to complement the tapers of said edges.

References Cited in the file of this patent

UNITED STATES PATENTS

2,804,830	Garrett et al. -----	Sept. 3, 1957
2,953,206	Brown -----	Sept. 20, 1957
2,958,336	Yancey -----	Nov. 1, 1960