June 19, 1956 R. C. BAKER 2,751,019

APPARATUS FOR DISENGAGING THREADED JOINTS

Filed Feb. 23, 1954

FIG. 1.

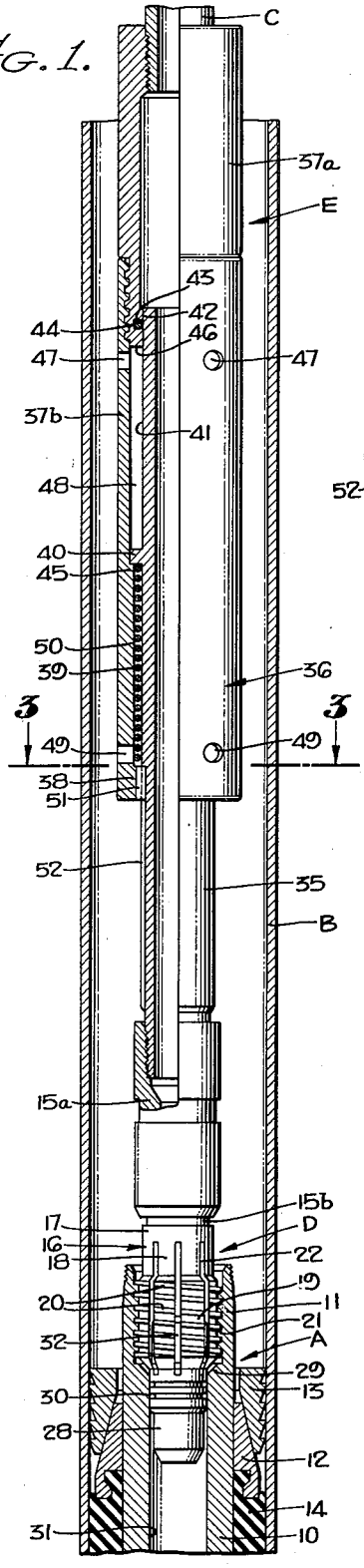


FIG. 2.

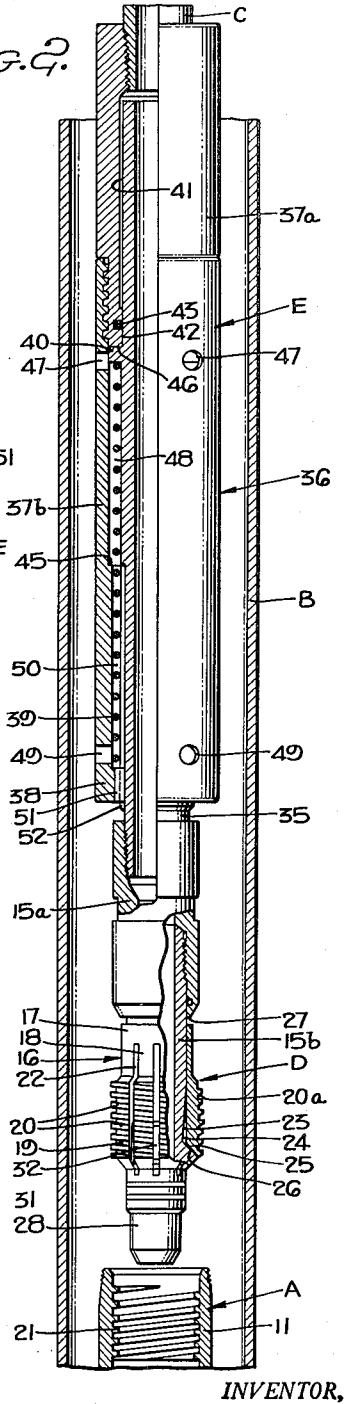
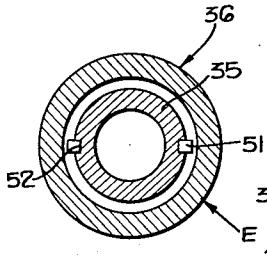


FIG. 3.



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APPARATUS FOR DISENGAGING THREADED JOINTS

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Application February 23, 1954, Serial No. 411,771

6 Claims. (Cl. 166—218)

The present invention relates to subsurface well apparatus, and more particularly to apparatus for facilitating the disconnection of the threaded joints of equipment located in a well bore.

In certain types of well bore apparatus, a threaded connection is made between a tool located in a well bore and a tubular string, merely by moving the tubular string downwardly in the tool and without the necessity for rotating the former. A laterally movable type of threaded latch sleeve is used to accomplish this purpose, disconnection between the sleeve and well tool being accomplished by rotating the tubular string.

Specific examples of the foregoing arrangement can be found in my Patent No. 2,644,524, and in my application for "Non-Rotary Threaded Coupling," Serial No. 172,925, filed July 10, 1950. As disclosed therein, it is desired to effect a threaded connection between a string of tubing and a well packer or casing collar disposed in a well bore. The packer or collar has a left-hand threaded portion, which requires the string of tubing to have a mating left-hand threaded portion or element. Since the joints of the tubing string are normally right-hand, it is undesirable to rotate the tubing string in a left-hand direction to effect its threading and attachment to the packer or collar, since the tubing string might become disconnected at one of its joints. Accordingly, a latching type of left-hand threaded connection is employed, which enables the threaded attachment to occur in the manner described above, the disconnection being effected by rotating the tubing string.

At times, after the tubing string has been rotated and disconnected from the well tool, the tubing string, or at least its lower portion, may move inadvertently in a downward direction, shifting its threaded latch member back into threaded and coupled attachment to the well tool. It then becomes necessary to rotate the tubing string once again to unthread it from the well tool.

It is an object of the present invention to prevent the lower portion of the tubular string from inadvertently dropping or moving back into threaded engagement with a well tool disposed in the well bore, after the tubing string has been disconnected from the well tool.

Another object of the invention is to facilitate the unthreading of a tubular string from a well tool disposed in a bore hole.

A further object of the invention is to avoid damage to the threads of a detachable threaded connection while the threads are in meshing engagement, and also after the threaded members have been disengaged from each other.

This invention possesses many other advantages, and has other objects which may be made more clearly apparent from a consideration of a form in which it may be embodied. This form is shown in the drawings accompanying and forming part of the present specification. It 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.

Referring to the drawings:

Figure 1 is a combined longitudinal sectional and elevational view of an apparatus disposed in a well casing, with the upper portion of the apparatus attached to a well packer;

Fig. 2 is a view similar to Fig. 1, disclosing the apparatus detached from the well packer;

Fig. 3 is a cross-section, on an enlarged scale, taken along the line 3—3 of Fig. 1.

As disclosed in the drawings, a well tool A, such as a well packer, which may be of the general type disclosed in the above Patent 2,644,524, is disposed in a well casing B. It is desired to attach the lower portion of a running-in or tubular string C to the tool, as well as to effect a disconnection of the tubular string from the well tool whenever desired.

As specifically shown, the well packer A includes a tubular body **10** having an upper threaded box **11**, which is preferably left-hand. The body of the tool is anchored to the well casing B against movement in both directions. Only a portion of the anchoring device is shown in the drawings, this portion preventing upward movement of the well tool within the casing. To accomplish this purpose, an expander **12** is disposed on the body **10** and is adapted to wedge within a set of upper segmental slips **13** that are digging into the wall of the well casing. A packing sleeve **14** is also disposed around the body **10**, having been compressed into leakproof sealing engagement with both the exterior of the body and the wall of the well casing.

Assuming that the well tool or packer A is anchored in packed-off condition within the well casing, it is desired to secure a string of tubing C thereto, which extends to the top of the well bore. In view of the left-hand threaded box **11** on the body **10** of the well tool, the use of the usual type of left-hand thread on the lower portion of the tubular string would require that the latter be rotated to the left, in order to effect its threaded connection to the tool body. For the reasons pointed out above, it is not desirable to rotate the tubular string to the left. Accordingly, a latching type of coupling D is secured to the lower portion of the tubular string C, it merely being necessary to stab such lower portion into the body **10** of the well tool to effect the threaded connection. It is unnecessary to rotate the tubular string to any degree in either direction.

The general type of latch coupling D disclosed in the drawings is also shown in Patent 2,644,524, whereas the specific type is disclosed in above-identified application Serial No. 172,925. The coupling device D, which actually forms the lower end of the tubing string C, includes a sub **15***a*, **15***b* formed in two parts. An upper sub portion **15***a* is threaded onto the upper end of a lower sub portion **15***b*, around which a threaded latch sleeve **16** is disposed. This latch sleeve has an upper circumferentially continuous portion **17**, from which legs **18** depend, that terminate in externally threaded dogs **19** which collectively have a helical male thread **20** provided on their exterior adapted to mate with the internal female thread **21** at the upper end **11** of the packer body. This male thread **20**, of course, is left-hand and has the same pitch and lead as the companion female thread **21**.

One manner of forming the sleeve **16** with its continuous upper portion **17** and depending legs **18** and dogs **19** is to first turn the exterior to the proper diameters, and then cut the left-hand thread **20** in its external portion. The external thread conforms to the shape and

diameter of the companion thread 21 on the upper end of the packer body. Thereafter, a plurality of circumferentially spaced, longitudinally extending slots 22 are cut through the sleeve from its lower end to its upper portion 17, which remains uncut. This cutting or severing action effectively splits the sleeve and allows its depending legs 18 and dogs 19 to spring inwardly and outwardly. Normally, the dogs 19 remain in the position that they occupy before the slots are cut, to properly mesh with the body box thread 21. However, the dogs 19 may be retracted sufficiently to allow their longitudinal movement into the body without rotation.

In order to allow the dogs 19 to retract to a sufficient extent, so that their threaded portion 20 clears the thread 21 in the body 10, the exterior of the lower sub portion 15*b* is relieved, as by forming a downwardly and inwardly converging portion 23, allowing a clearance space 24 into which the dogs 19 may retract. This relief portion terminates in a retainer or expander portion 25 having a frustoconical external surface diverging in a downward direction and engaging companion surfaces 26 at the lower ends of the dogs 19. The distance between the tapered expander surface 25 and a lower shoulder 27 on the upper sub portion 15*a* is substantially greater than the length of the sleeve 16 itself, which allows the sleeve to move longitudinally relative to the sub 15*a*, 15*b*, for a reason to be described below.

The tubing string C is lowered in the well casing B, with the coupling device D at its lower portion. When the upper end of the packer body is reached, the forward or pilot portion 28 of the lower sub enters the body 10 until the lowermost thread 20 on the dogs 19 engages the companion thread 21 in the body box 11. Such engagement precludes, for the moment, downward movement of the threaded latch sleeve 16 into the body. However, the lower and upper sub portions 15*a*, 15*b* continue to move downwardly, moving the retainer and expander portion 25 away from the lower ends 26 of the dogs, and bringing the shoulder 27 at the lower end of the upper sub portion 15*a* into engagement with the upper end of the sleeve 16. Such engagement enables the upper sub portion 15*a* to force the sleeve 16 into the body 10.

It is to be noted that the lower surfaces 20*a* of the dog thread 20 are inclined in a downward and inward direction, so as to function as cams urging the dogs 19 inwardly when engaging the upper portions of the body threads 21. The dogs 19 can retract inwardly, in view of the relief 24 provided behind them by the inclining of the lower sub member surface 23, and by the movement of the retainer 25 away from the lower ends 26 of the dogs 19. Such movement of the sub 15*a*, 15*b* and latch sleeve 16 into the body box 11 can occur merely as a result of longitudinal movement of the tubing string C and without its rotation. This downward movement into the packer body will continue until the lower end of the retainer 25 engages a body portion 29 immediately below the thread 21, whereupon the dogs 19 can expand outwardly to their initial position, with their collective external thread 20 in full mesh with the companion internal thread 21 in the body box 11.

An upward strain can now be taken on the tubing string C, which shifts the upper and lower sub portions 15*a*, 15*b* in an upward direction and brings the retainer 25 against the lower tapered ends 26 of the dogs 19. So long as this strain is maintained, the dogs 19 cannot move inwardly, in view of the backing that the retainer 25 provides against them. As a matter of fact, the retainer acts as an expander, urging the dogs in an outward direction, to hold their threaded portion 20 fully meshed with the body box thread 21.

Leakage between the lower sub portion 15*b* and body 10 may be prevented by mounting suitable side seals 30 in the lower portion of the sub, which engage the inner wall 31 of the body.

When it is desired to disconnect the tubing string C from the well tool A, the former need merely be rotated to the right. This rotational effort or torque is transmitted to the dogs 19 of the latch sleeve 16 through a plurality of longitudinally extending keys 32 which are secured to the lower sub member 15*b*. These keys 32 extend laterally outward into the slots 22 between adjacent dogs 19, being engageable with the side surfaces of these dogs. As the sub 15*a*, 15*b* is rotated, the turning effort is transmitted through the keys 32 to the dogs 19, turning them within the body box 11 and unthreading the dogs 19 and the sleeve 16 in an upward direction from the latter. The turning effort on the tubing string C to the right is continued until the sleeve dogs 19 have been completely unscrewed from the body 10, whereupon the tubing string may be withdrawn from the well casing B, or elevated therein to the desired extent.

It is quite evident that the tubing string C can be coupled to the body 10 of the well tool merely by moving the former downwardly without rotation within the latter, and that uncoupling can occur as a result of rotating the tubing string to the right. However, under some circumstances, after the sleeve dogs 19 have been completely unscrewed from the body of the tool, the tubing string C, or at least its lower portion, may be inadvertently moved downwardly again, which will have the effect of stabbing the latch sleeve 16 back into the body 10 and recoupling the tubing string to the body. It then becomes necessary to rotate the tubing string to the right once again, to effect its uncoupling from the tool A.

The present invention seeks to overcome the foregoing possibility by providing an apparatus E in the tubular string C which will automatically elevate the sub 15*a*, 15*b* and latch device 16 away from the threaded body box 11 when the threaded disconnection has taken place. As disclosed in the drawings, the upper sub 15*a* is threadedly connected to an inner tubular member or mandrel 35 telescopically arranged within an outer tubular member or barrel 36 whose upper portion 37*a* is threaded onto the lower end of a section of the tubing string C, which extends to the top of the well bore. The inner and outer tubular members 35, 36 are elongated, to enable a substantial amount of relative longitudinal movement between these parts to occur.

The outer tubular member 36 is composed of an upper section 37*a* threaded into the upper end of a lower section 37*b*, this lower section terminating in a lower inturned flange or spring seat 38 against which the lower end of a helical compression spring 39 bears, this spring encompassing the inner tubular member or mandrel 35. The upper end of the spring bears upon a spring seat or flange 40 formed on the inner tubular member 35, the latter having a cylindrical peripheral portion 41 extending above the flange 40 which is slidable along the lower inner wall 42 of the upper section 37*a* of the outer tubular member 36. Leakage from the interior of the tubing string C and upper tubular section 37*a* and downwardly along the cylindrical periphery 41 of the inner mandrel is prevented, as by providing a suitable rubber seal ring 43, in the form of an O ring, in an internal groove 44 in the upper section adapted to slidably seal against the cylindrical periphery 41 of the inner mandrel member 35.

The outer tubular member 36 may occupy an upper extended position with respect to the inner mandrel 35, determined by engagement of an intermediate internal stop shoulder 45 on the outer tubular member with the lower end of the mandrel flange 40. When the parts are in this position, the compressed spring 39 is exerting a substantial force on the inner and outer tubular members 35, 36 tending to elevate the inner member. The outer tubular member 36 may occupy a lower, or collapsed position, relative to the inner tubular member 35, which is determined by engagement of the mandrel flange 40 with a stop shoulder 46 provided by the lower end of the upper section 37*a* of the outer barrel 36.

When the parts are in this last-mentioned position, the spring **39** has expanded to a substantial extent, but it is still capable of exerting a force on the inner and outer members **35, 36** tending to hold them in their collapsed or contracted position, such as shown in Fig. 2.

The movement of the inner and outer members **35, 36** with respect to each other is facilitated by minimizing the effect of resistance by fluids that might be disposed between the inner and outer members. Thus, one or more bleeder ports **47** is provided in the outer tubular member **36** immediately below the stop shoulder **46**, so as to enable fluids in the annulus **48** between the inner and outer members above the mandrel flange **40** to pass to the exterior of the apparatus upon upward movement of the flange **40** toward the stop shoulder **46**. Similarly, one or more bleeder ports **49** is provided in the outer tubular member **36** immediately above the lower spring seat **38**, to allow fluid in the annulus **50** between the inner and outer members below the mandrel flange **40** to move to the exterior of the apparatus, upon relative downward movement of the flange **40** toward the lower spring seat **38**.

For the purpose of enabling the rotation of the tubular string C to be imparted to the latch sleeve **16**, when the latter is to be unthreaded from the female body thread **21**, a slidable spline connection is provided between the inner and outer tubular members **35, 36**. Thus, the lower flange **38** of the outer tubular member **36** may have one or more keys **51** secured thereto slidable in elongate slots or keyways **52** in the exterior of the inner member **35**. It is evident that rotation of the tubing string C is transferred to the outer tubular member **36**, and through the key and keyway connection **51, 52** to the inner tubular member **35**, such rotation then being imparted to the sub **15*a*, 15*b*** and through the keys **32** to the dogs **19**, for the purpose of unthreading the latter in an upward direction from the body **10** of the tool A.

Assuming that the well packer A, or other well tool, has been previously disposed in the well casing B, the telescopic apparatus E with the latching device D mounted on its lower end, is secured to a tubing string section C and the tubing string then lowered in the well casing. In view of the compressive force of the spring **39**, the latter will hold the mandrel **35** in an upper position with respect to the outer tubular member **36**, limited by the engagement of the flange **40** with the upper stop shoulder **46** on the outer barrel **36**, this position being disclosed in Fig. 2. The tubing string C and its connecting apparatus E, D forming the lower part thereof are lowered in the well casing B until the latching sleeve **16** is stabbed or shifted downwardly within the body box **11**, a threaded connection being secured between the threaded dogs **19** and the box, in the manner described above. If an upward strain is now taken on the tubing string C, assurance is had that the dogs **19** will be retained in threaded engagement with the box thread **21**. The taking of a sufficient upward strain on the tubular string C will effect a shifting of the outer barrel **36** upwardly with respect to the inner barrel **35** to the extent determined by engagement of the intermediate stop shoulder **45** with the mandrel flange **40** (Fig. 1). With the parts in this position, the spring **39** has been compressed to a substantial extent.

It is to be noted that with the telescopic parts occupying their collapsed position shown in Fig. 2, or their extended position disclosed in Fig. 1, the seal ring **43** is continuously in contact with the cylindrical periphery **41** of the mandrel **35**, to prevent fluid from leaking out of the apparatus through the telescopic joint. Fluids may now pass in either an upward or a downward direction through the tubular string C and the packer device A without fear of its leaking from the apparatus.

If it is desired to disconnect the tubular string C from the well tool A, the tubular string is rotated to the right, the tubular string first preferably being elevated, so as to effect a compression of the spring **39**. The rotation of the tubular string is transmitted to the outer barrel **36**, through the key and keyway connection **51, 52** to the inner mandrel **35**, and from the latter through the sub **15*a*, 15*b*** to the keys **32** and the dogs **19**, rotating the dogs and unscrewing the latter from the body box **11**. As the unthreading action occurs, the latching sleeve **16** and the mandrel sub **15*a*, 15*b***, as well as the mandrel **35** itself, move in an upward direction, this action being assisted by the expansion of the compression spring **39**. Finally, the dog threads **20** will be completely disengaged from the box thread **21**. When this occurs, the spring can expand promptly to its fullest extent, lifting the latching sleeve **16** completely out of the threaded body portion **11** and a substantial distance above the latter (Fig. 2). The spring **39** maintains the mandrel **35**, sub **15*a*, 15*b***, and threaded latch sleeve **16** in such an upward position, and precludes inadvertent dropping of the sub **15*a*, 15*b*** and latch sleeve **16** back into threaded engagement with the female thread **21** of the box **11**.

The tubing string C, with the inner and outer tubular members **35, 36**, sub **15*a*, 15*b*** and latch sleeve **16** connected thereto, may now be elevated in the casing B and withdrawn from the well bore, if desired. On the other hand, they can be moved down in the casing to recouple the threaded dogs **19** to the body thread **21**, if this is desired.

With the arrangement disclosed, the unthreading of the dogs **19** from the body **10** of the well tool is facilitated, since the spring is constantly urging the inner mandrel **35** and the lower parts attached thereto in an upward direction, which is the direction in which the parts are being moved by the latch sleeve **16** when being unscrewed from the body box **11**. In addition, damage to the threads is avoided, since the detachment of the latch sleeve from the uppermost thread of the box immediately allows the spring **39** to expand and elevate the latch sleeve well **16** above the box thread **21**, and prevents any possibility of the continued rotation of the tubing string to cause the lowermost latch sleeve thread **20** to rotate along and bounce upon the uppermost body thread **21**. Undue strain on the threads **20, 21** is avoided, since the rotation of the tubing string causes a substantially immediate elevation of the mandrel flange **40** above the intermediate stop shoulder **45**, the only force exerted between the threads being that due to the compression spring **39**, which force actually decreases as unthreading proceeds. In the absence of the device, it is difficult to gauge the upward strain that must be taken on the tubing string C to effect unthreading of the latch sleeve **16** from the box thread **21**. The tendency is to take too great a strain on the tubing string, which may produce thread damage in and of itself.

The inventor claims:

1. In subsurface apparatus: a well tool having a thread; an upper member attachable to a running-in string; a lower member telescopically related to said upper member; expansible and retractable latch means carried by and movable laterally of said lower member, said latch means having a thread companion to said well tool thread and engageable therewith, said latch means being movable laterally in one direction on said lower member into threaded engagement with said well tool thread and laterally in the other direction on said lower member to an extent sufficient to position said threads out of engagement with each other to enable said latch means to be moved longitudinally and without rotation past said well tool thread; means providing a connection between said lower member and latch means for transmitting rotary motion therebetween; means providing a connection between said upper and lower members for transmitting rotary motion therebetween; and means urging said lower member and latch means in an upward direction relative to said upper member.

2. In subsurface apparatus: a well tool having a thread;

an upper member attachable to a running-in string; a lower member telescopically related to said upper member; expansible and retractable latch means carried by and movable laterally of said lower member, said latch means having a thread companion to said well tool thread and engageable therewith, said latch means being movable laterally in one direction on said lower member into threaded engagement with said well tool thread and laterally in the other direction on said lower member to an extent sufficient to position said threads out of engagement with each other to enable said latch means to be moved longitudinally and without rotation past said well tool thread; means providing a connection between said lower member and latch means for transmitting rotary motion therebetween; means providing a connection between said upper and lower members for transmitting rotary motion therebetween; and spring means acting between said members for urging said lower member and latch means in an upward direction relative to said upper member.

3. In subsurface apparatus: a well tool having a thread; an upper member attachable to a running-in string, a lower member telescopically related to said upper member; expansible and retractable latch means carried by and movable laterally of said lower member, said latch means having a thread companion to said well tool thread and engageable therewith, said latch means being movable laterally in one direction on said lower member into threaded engagement with said well tool thread and laterally in the other direction on said lower member to an extent sufficient to position said threads out of engagement with each other to enable said latch means to be moved longitudinally and without rotation past said well tool thread; means providing a connection between said lower member and latch means for transmitting a rotary motion therebetween; means providing a connection between said upper and lower members for transmitting rotary motion therebetween; and a compression spring engaging said members to urge said lower member and latch means in an upward direction relative to said upper member.

4. In subsurface apparatus: a well tool having a female thread; an upper member attachable to a running-in string; a lower member telescopically related to said upper member; expansible and retractable latch means carried by and movable laterally of said lower member, said latch means having a male thread engageable with said female thread, said latch means being retractable on said lower member to the extent in which the effective outer diameter of said male thread is less than the inner diameter of said female thread; means providing a connection between said lower member and latch means for transmitting rotary motion therebetween; means providing a connection between said upper and lower member for transmitting rotary motion therebetween; and means urging said lower member and latch means in an upward direction relative to said upper member.

5. In subsurface apparatus: a well tool having a female thread; an upper member attachable to a running-in string; a lower member telescopically related to said upper member; expansible and retractable latch means carried by and movable laterally of said lower member, said latch means having a male thread engageable with said female thread, said latch means being retractable on said lower member to the extent in which the effective outer diameter of said male thread is less than the inner diameter of said female thread; means providing a connection between said lower member and latch means for transmitting rotary motion therebetween; means providing a connection between said upper and lower members for transmitting rotary motion therebetween; and a compression spring engaging said members to urge said lower member and latch means in an upward direction relative to said upper member.

6. In subsurface apparatus: a well tool having a female thread; an upper member attachable to a running-in string; a lower member telescopically related to said upper member; expansible and retractable latch means carried by and movable laterally of said lower member, said latch means having a male thread engageable with said female thread, said latch means being retractable on said lower member to the extent in which the effective outer diameter of said male thread is less than the inner diameter of said female thread; means providing a connection between said lower member and latch means for transmitting rotary motion therebetween; means providing a connection between said upper and lower members for transmitting rotary motion therebetween; a compression spring engaging said members to urge said lower member and latch means in an upward direction relative to said upper member; and seal means between said upper and lower members to prevent fluid from passing from the interior of said members to the exterior of said members both when said members are in fully contracted and fully extended positions with respect to each other.

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