

[54] **SELECTIVELY-ANCHORED WELL TOOLS**

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[21] Appl. No.: **113,527**

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Related U.S. Application Data

[63] Continuation-in-part of Ser. No. 885,155, Dec. 15, 1969, abandoned.

[52] U.S. Cl. 166/129, 166/139, 166/216

[51] Int. Cl. E21b 23/06, E21b 33/129

[58] Field of Search.....166/120, 118, 129, 131, 139, 166/133, 134, 206, 216, 217, 243

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[57] **ABSTRACT**

In each of the representative embodiments of the present invention disclosed herein, a retrievable well tooth is arranged to include a body member, slip means operated by a downwardly movable expander for anchoring the body member against movement in a well conduit, and mechanical means responsive to upwardly-acting forces on said body member for imposing downwardly-acting forces on the expander to retain the slips in anchoring engagement with the well conduit.

27 Claims, 9 Drawing Figures

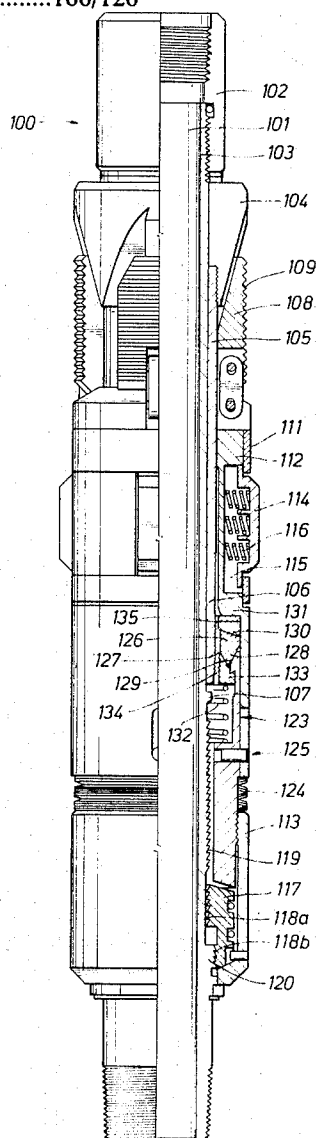


FIG. 1A

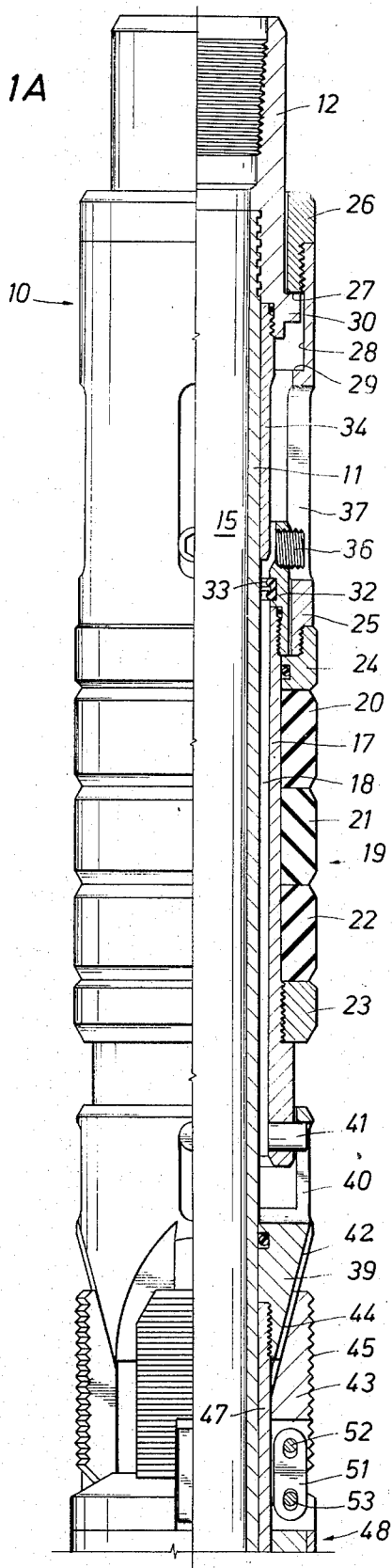
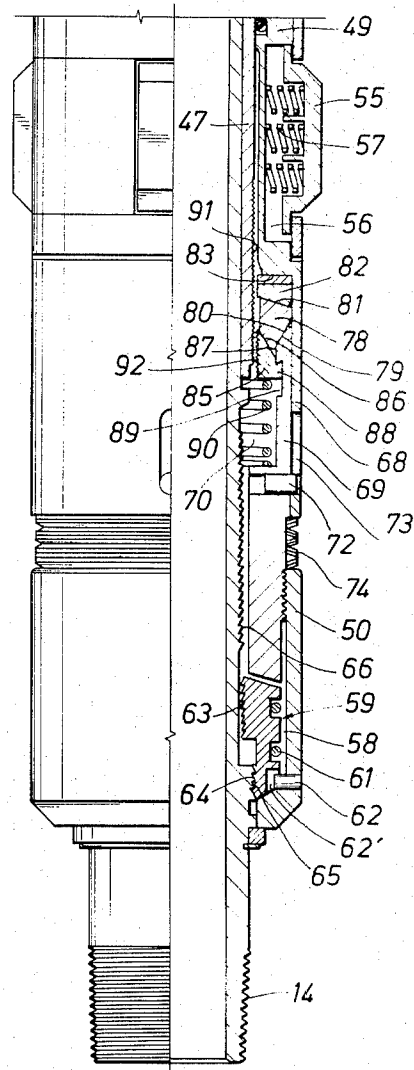


FIG. 1B



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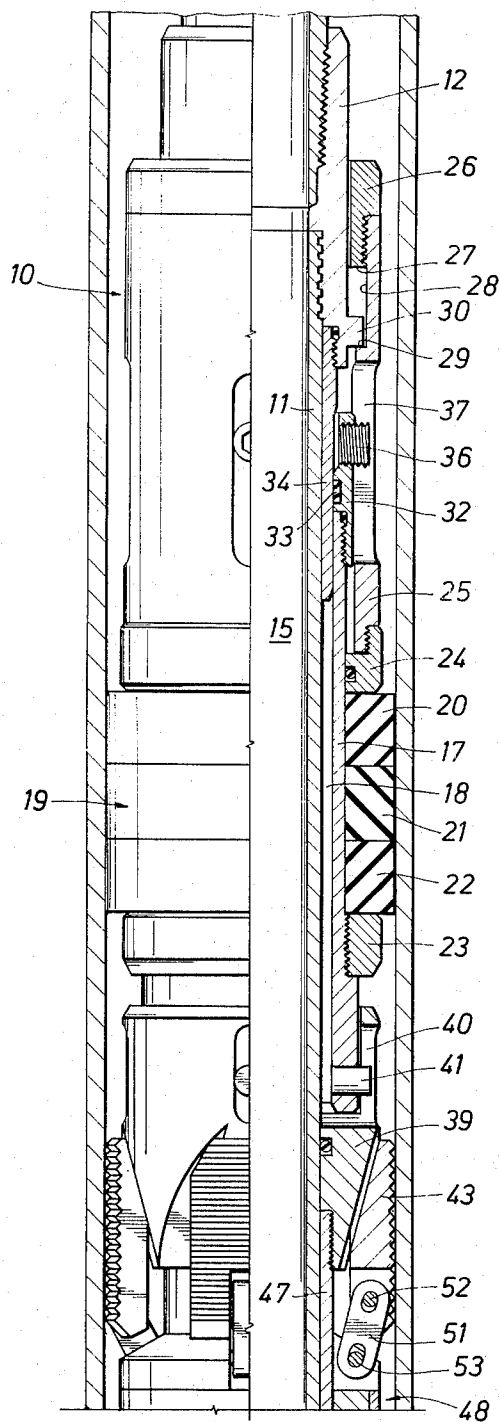


FIG. 2A

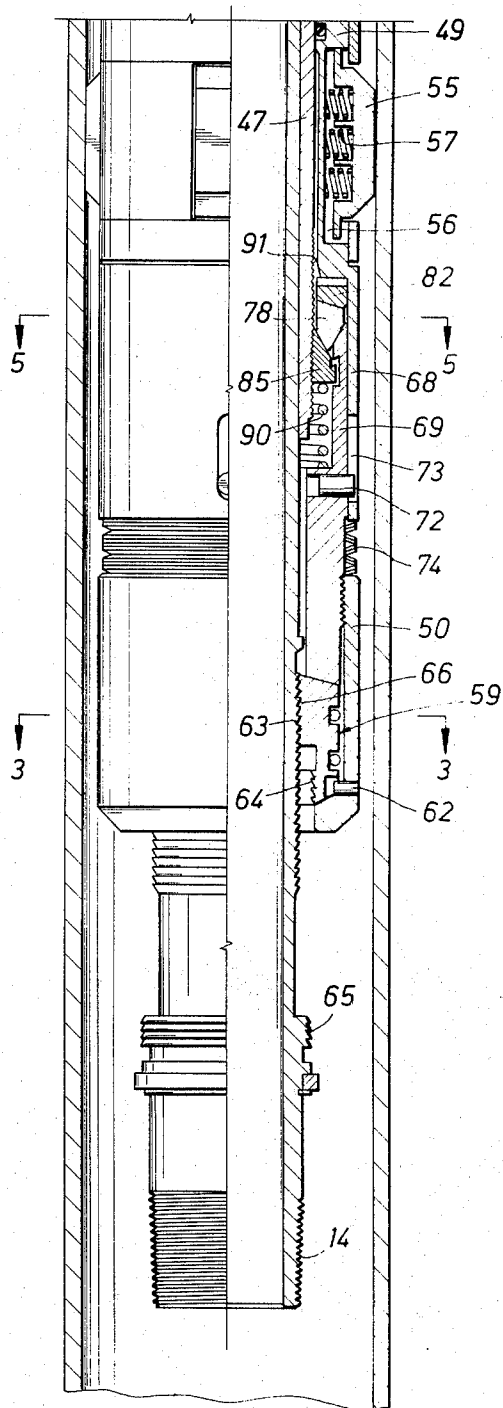


FIG. 2B

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FIG. 4

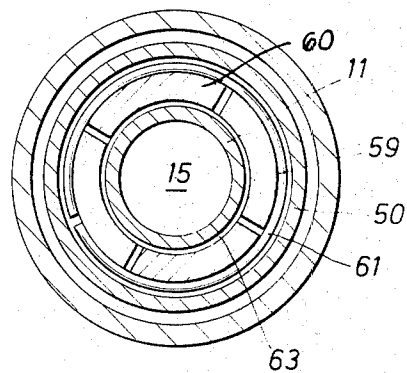
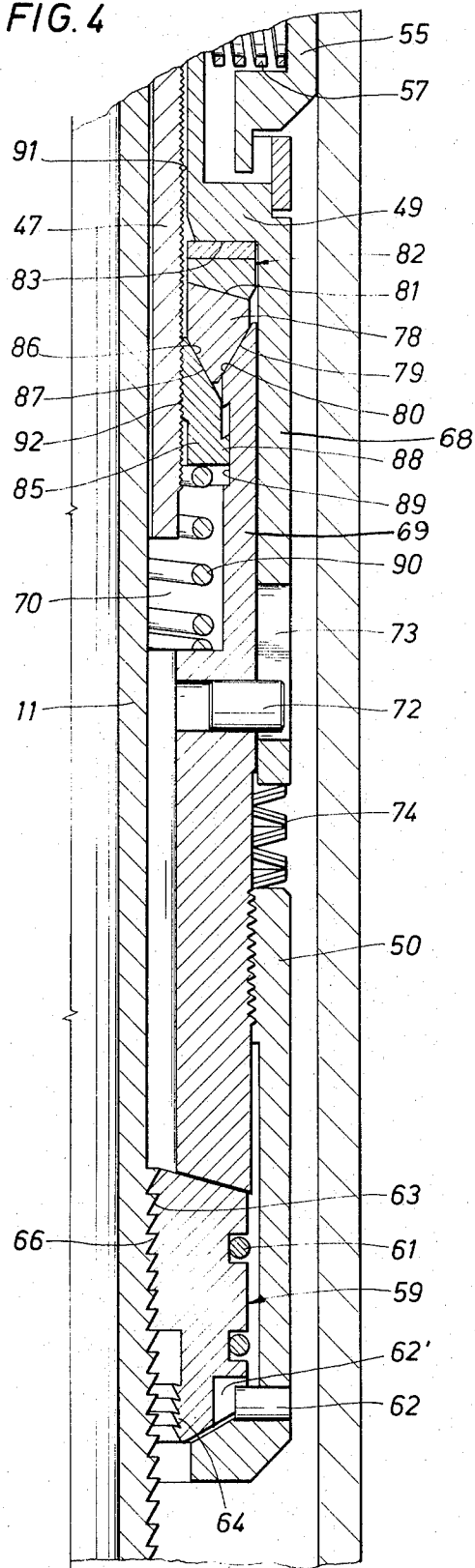


FIG. 3

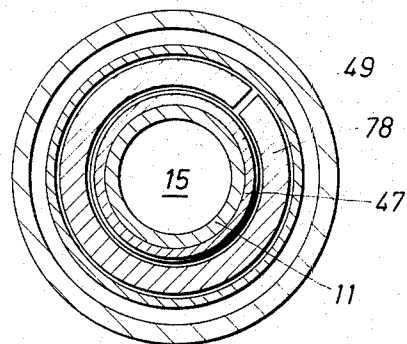


FIG. 5

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FIG. 6

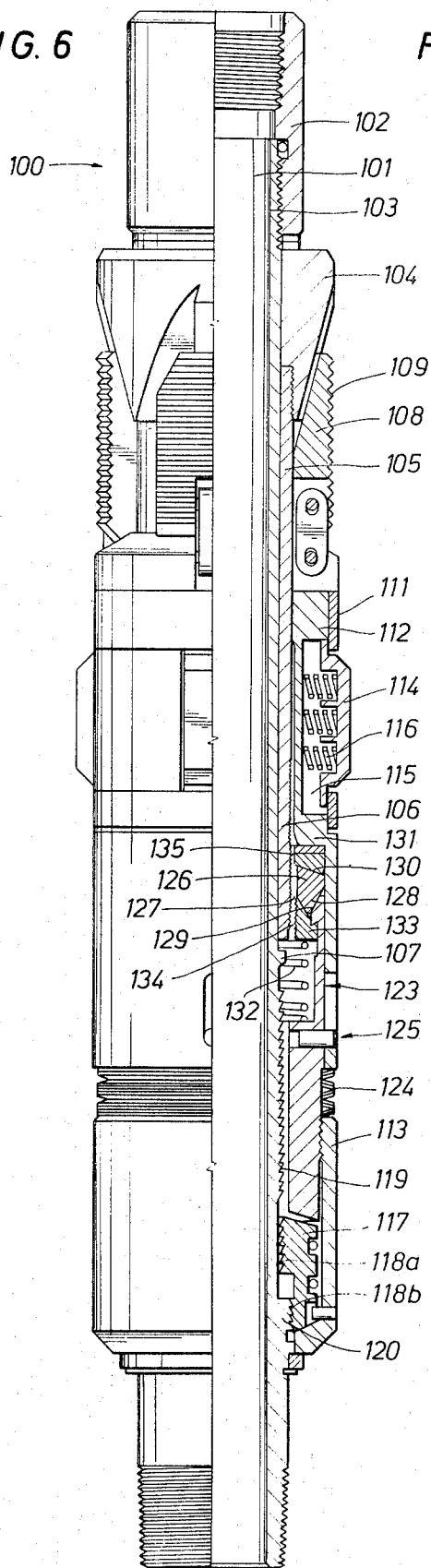
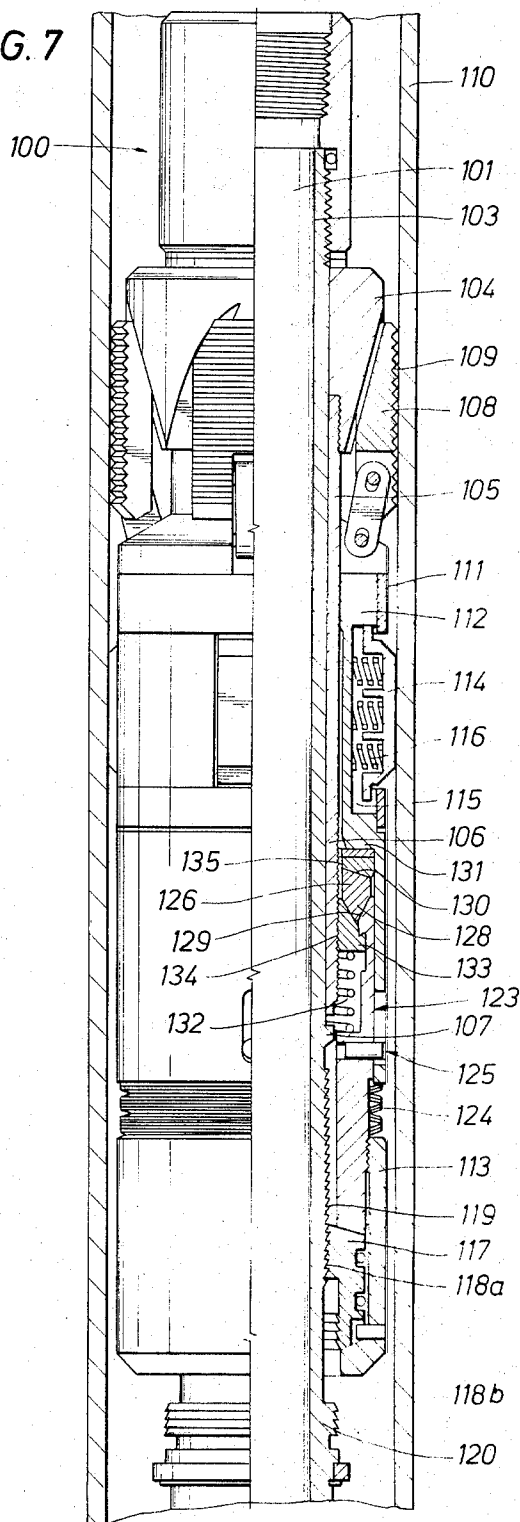


FIG. 7



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SELECTIVELY-ANCHORED WELL TOOLS

This is a continuation-in-part of application Ser. No. 855,155, filed Dec. 15, 1969, now abandoned.

Several proposals have been made in the past for anchoring a retrievable packer or plug against movement in either direction by using only one expander cone and slip assembly. This approach, as compared to independently operable upper and lower anchor assemblies, considerably simplifies well tool construction and eliminates problems in running and retrieving. One particularly successful tool is shown in U. S. Pat. No. 3,437,136 wherein the slip and expander combination is set mechanically against downward movement, and a hydraulic system including a piston on the expander that is responsive to greater fluid pressure from below the tool functions to hold the slips in set position and prevent upward movement. Another proposal, shown in U. S. Pat. No. 3,508,610, is generally similar to the first mentioned system except that a greater pressure in the well bore below the packing acts on a plurality of pistons coupled in series relationship to the expander cone in order to provide a sufficiently adequate retaining force for the slips over a wide range on casing sizes and tools. Still another proposal is shown in U. S. Pat. No. 3,507,326 wherein a downwardly facing transverse surface on the expander forms a wall of an enclosed, variable volume chamber. A hydraulic means that is responsive to greater fluid pressure in the well bore below the packer is effective to increase the volume of the enclosed chamber, thereby reducing the pressure acting on the downwardly facing surface of the expander and providing a retaining force to keep the slips set against the casing.

All of the foregoing proposals are quite effective in preventing movement in either direction in response to fluid pressure changes that occur, for example, in stimulation, remedial or testing operations. However, in production operations when a pipe string is usually connected to the packer mandrel and is subject to variations in length due to temperature changes or may be in tension for one reason or another, a purely hydraulic system may not respond to the mechanical forces tending to move or loosen the packer. Moreover, typical O-ring seals and the like that are necessarily used in the hydraulic systems described above may tend to wear out or leak when used in a well for an extended period of time.

It is an object of the present invention to provide new and improved well bore apparatus having only a single slip and expander combination that is activated mechanically to prevent movement of the tools in either longitudinal direction.

This and other objects are attained in accordance with the concepts of the present invention by well tools including a body member carrying normally retracted slip means which are expandable outwardly into gripping contact with a well casing by a downwardly movable expander. Means are provided to releasably lock the slips in set condition. A cam structure coupled between the body member and the expander functions to translate upwardly acting forces on the mandrel or body member into downward force on the expander in order to retain or hold the slips in anchoring contact to prevent upward movement.

The present invention has other objects and advantages that will become more clearly apparent in connection with the following detailed description of a preferred embodiment, taken in conjunction with the accompanying drawings in which:

FIGS. 1A and 1B are longitudinal sectional views with portions in side elevation of a well packer arranged in accordance with the principles of the invention, the packer being shown in running-in or retrieving condition, FIG. 1B forming a lower continuation of FIG. 1A;

FIGS. 2A and 2B are views similar to FIGS. 1A and 1B but with the parts of the packer shown in set condition in a well casing;

FIG. 3 is a cross-section taken on line 3—3 of FIG. 2B;

FIG. 4 is an enlarged detailed view of the cam structure of the present invention;

FIG. 5 is a cross-section taken on line 5—5 of FIG. 2B;

FIG. 6 is a longitudinal sectional view with portions in side elevation of a tubing anchor arranged in accordance with the principles of the present invention, the anchor being shown in running-in or retrieving condition; and

FIG. 7 is a view similar to FIG. 6 but with the parts of the tubing anchor in set condition in a well casing.

Referring initially to FIGS. 1A and 1B of the drawings, a well packer apparatus 10 in accordance with the principles of the present invention is shown. It will be understood, of course, that the term "packer" is used in a general sense to encompass more specific types of well tools such as bridge plugs and casing packers. The packer 10 includes an elongated hollow mandrel 11 extending throughout the length of the tool and having a threaded box portion 12 at its upper end adapted for connection to a pipe string 13 (FIG. 2A) extending upwardly to the top of the well bore, and a threaded pin portion 14 at its lower end adapted for connection to another pipe string or well tool. The mandrel 11 can have a through bore 15 providing a fluid passage that preferably has a diameter at least as great as the internal diameter of the pipe string 13.

An elongated compression sleeve 17 is telescopically disposed on the mandrel 11 and has its inner peripheral surface spaced laterally away from the outer peripheral surface of the mandrel to provide an annular fluid passage space 18. An elastomeric packing structure 19 that may be constituted, for example, by a plurality of annular packing rings 20, 21 and 22 is carried by the compression sleeve 17. The lowermost packing ring 22 engages a fixed abutment 23 that may be provided by a gauge ring threadedly connected to the compression sleeve 17. The uppermost packing ring is engaged by a movable abutment 24 that is adapted to be advanced downwardly toward the lower abutment 23 in order to compress and expand the packing rings 22—22 therebetween into sealing contact with the surrounding well casing wall.

The movable abutment 24 forms the lower end portion of an elongated sleeve 25 that extends upwardly along the mandrel 11 and is terminated at its upper end by an annular cap 26 having a thickened cross-section to provide a downwardly facing shoulder 27. An annular recess 28 is provided within the sleeve 25 and is

bounded at its upper end by the shoulder 27 and at its lower end by an upwardly facing shoulder 29. An enlarged annular flange 30 on the mandrel 11 extends into the recess and is sized in relation thereto so that a limited amount of longitudinal relative movement can occur between the mandrel and the sleeve 25.

An annular valve seat 32 is threadedly coupled to the upper end of the compression sleeve 17, and the upper abutment 24 is sealingly slidable with respect to the compression sleeve below the valve seat ring. An internal annular recess in the valve seat ring 32 receives a suitable valve seal 33 that engages the outer peripheral surface of an enlarged valve sleeve 34 when the mandrel 11 is moved downwardly with respect to the compression sleeve 17 to enable closing off the upper end of the bypass passage 18. A plurality of circumferentially spaced, radially extending pins 36 on the upper end of the valve seat rings 32 extend into elongated slots 37 in the abutment sleeve 25 in order to prevent relative rotation between the compression sleeve 17 and the abutment sleeve.

A slip expander cone 39 is slidably mounted on the mandrel 11 for longitudinal movement relative to both the mandrel and the compression sleeve 17. The extent of relative movement between the expander cone 39 and the compression sleeve 17 is limited by the provision of elongated slots 40 in the upper end portion of the cone that receive radially extending pins 41 on the lower end portion of the compression sleeve. The slots 40 provide fluid communication between the lower end of the bypass passage 18 and the well bore below the packing structure 19, whereas the slots 37 in the abutment sleeve 25 provide fluid communication between the upper end of the bypass passage and the well bore above the packing structure.

A plurality of normally retracted but laterally extendible slip elements 43 are mounted about the mandrel 11 below and adjacent the expander cone 39. Each slip element 43 has a dovetail sliding connection 44 to the expander cone 39 along a downwardly and inwardly inclined outer surface 42 thereof that slidably engages a companion inner inclined surface on a respective slip element. Each slip element 43 has wickers or teeth 45 on its outer edge adapted to bite into the casing when the slip is shifted outwardly to anchor the tool 10 against movement. An elongated sleeve 47 is rigidly connected to the expander cone 39 by threads or the like and extends downwardly along the mandrel 11 and within the upper portion of an annular cage assembly 48 that is slidably mounted on the mandrel below the slip elements 43.

The cage assembly 48 is constituted by an upper housing member 49 and a lower housing member 50. The slip elements 43 are mounted on the upper housing member 49 by conventional reins 51 and pins 52 and 54. A plurality of circumferentially spaced, radially extending drag blocks 55 are received within recesses 56 in the upper housing member 49 and are urged outwardly into sliding contact with the well casing wall by a plurality of coil springs 57 or the like. The drag blocks 55 frictionally engage the well casing wall to resist motion of the cage assembly 48 in a typical fashion. The lower housing member 50 is provided with an internal annular recess 58 that receives a clutch nut assembly 59 more fully described in U.S. Pat. No. 3,470,951. As

shown in FIG. 3, the clutch nut assembly 59 is constituted by a plurality of segments 60 (FIG. 3) that are urged together as a cylinder by annular band springs 61 or the like. A pin 62 (FIG. 1B) on the lower housing member 50 extends into a recess 62 on at least one of the nut segments 60 to prevent relative rotation between the nut assembly 59 and the cage assembly 48. The upper portion of each nut segment 60 has inwardly-directed, downwardly facing, buttress-type threads 63 that are relatively fine and preferably formed on a left-hand helix, whereas the lower portion of each nut segment has inwardly-directed, upwardly-facing, buttress-type teeth 64 that are preferably formed on a right-hand helix and on a greater diameter than the upper threads. The lower threads 64 engage companion right-hand external threads 65 on the lower end portion of the mandrel 11 to prevent upward movement of the cage assembly 48 relative to the mandrel until these threads are released by right-hand rotation of the mandrel. The upper threads 63 on the nut segments are engageable with a series of companion left-hand external threads 66 formed on the mandrel 11 in spaced relation below the lower threads, and the threads 63 and 66 can be engaged by longitudinal movement of the mandrel and ratcheting action within the clutch nut assembly 59 as the packer 10 is set. The clutch nut assembly 59 cooperates with the mandrel teeth 65 and 66 to alternatively lock the packer 10 in both running-in and set conditions, and can be released only by rotating the mandrel 11 to the right.

The upper and lower housing members 49 and 50 have telescopically disposed sleeve portions 68 and 69 that provide an internal annular recess 70 surrounding the mandrel 11 and the sleeve 47. A limited extent of longitudinal relative motion between the upper housing member 49 and the lower housing member 50 is provided by one or more radially disposed pins 72 in the lower housing member that extend into vertically elongated slots 73 in the depending sleeve portion 69 of the upper housing member. If desired, a plurality of Bellville washers 74 or other spring-like means can be used to hold the upper housing member 49 and lower housing member 50 in a normally stretched out position. As shown in greater detail in FIG. 4, a uniquely arranged cam ring 78 is located adjacent the upper end of the sleeve portion 69. The ring 78 is radially split as shown in FIG. 5 so as to be expansible and contractible or in the alternative can be radially cut into a number of arcuate segments, and has a downwardly and inwardly inclined outer surface 79 that slidably engages an upwardly and outwardly inclined surface 80 on the upper end of the sleeve portion 69. The upper surface 81 of the cam ring 78 can be inclined slightly upwardly and inwardly if desired, and engages a bearing ring structure 82 located against a downwardly facing shoulder 83 on the sleeve portion 68 that defines the upper end of the annular recess 70. A clutch ring 85 that is either radially split, or formed of a number of segments which together define an annular arrangement with the capability for lateral movement, in the same manner as the cam ring 78, is located below the cam ring and has an upwardly and inwardly inclined surface 86 that slidably engages a downwardly and outwardly inclined surface 87 on the cam ring. The clutch ring 85 is mounted for limited longitudinal movement with respect to the

sleeve portion 69, and can have an outwardly extending annular flange 88 that is received within an annular recess 89 in the sleeve portion. If desired, the upper surface of the flange 88 and the upper end surface of the recess 89 can be inclined as shown so that engagement between these two surfaces tends to retain the clutch ring 85 in its expanded condition. The clutch ring 85 is normally biased toward an upward position by a compressed coil spring 90 or the like. The expander sleeve 47 has teeth 91 formed on the outer periphery of its lower end portion. The clutch ring 85 has matching internal teeth 92 that can grippingly engage the sleeve teeth 91 when the clutch ring is shifted laterally inwardly by the cam ring 78 as will be more fully described hereinafter.

In operation, the various parts of the packer 10 can be assembled as shown in FIGS. 1A and 1B for lowering into a well casing. The annular flange 30 at the upper end of the mandrel 11 prevents downward movement of the upper abutment sleeve 25 relative to the compression sleeve 17, and the stop pins 41 on the lower end portion of the compression sleeve prevent downward movement of the expander cone 39 relative to the slips 43. The lower teeth 65 on the mandrel 11 are in engagement with the clutch nut assembly 59 to prevent upward movement of the cage assembly 48 relative to the expander cone 39, so that the slips 43 are held in their normally retracted positions during lowering of the tool 10 into the casing. Consequently, the packing structure 19 and the slips 43 are retained in retracted positions until it is desired to set the packer 10. During lowering, any well fluids present in the casing can circulate both around the outside of the packing structure 19 as well as through the annular bypass passage 18 located between the compression sleeve 17 and the mandrel 11.

At setting depth, the mandrel 11 is rotated by the pipe string 13 a sufficient number of turns to the right to release the lower threads 65 on the mandrel from the clutch nut threads 64. The drag blocks 55 will frictionally engage the casing to prevent turning motion of the cage assembly 48 during this operation. Then the mandrel 11 is lowered relative to the cage assembly 48 to effect a setting of the packer 10. As the mandrel 11 is lowered, the expander cone 39 is advanced downwardly relative to the slip elements 43 to shift them outwardly into gripping engagement with the casing. Once the slips 43 engage the casing, the lower end of the compression sleeve 17 will advance somewhat downwardly until it abuts against the upwardly facing surfaces of the expander cone 39, whereupon the compression sleeve cannot move any further downwardly. The flange 30 on the mandrel 11 will engage the upwardly facing shoulder 29 on the abutment sleeve 25 so that application of the weight of the pipe string 13 to the mandrel will cause the upper abutment 24 to be advanced toward the lower abutment 23 to compress and expand the packing rings 20-22 into sealing contact with the well casing wall. Downward movement of the mandrel 11 relative to the compression sleeve 17 will move the valve sleeve 34 downwardly within the valve seat ring 32 to close off the bypass passageway 18. As the mandrel 11 moves downwardly relative to the cage assembly 48, the upper mandrel threads 66 will ratchet downwardly within the clutch nut assembly 59 and the

upper clutch threads 63 will trap the mandrel in the lowermost position to which it is moved in order to lock the packer 10 in set condition. The expander sleeve 47 will be shifted downwardly somewhat in relation to the clutch ring 85, but the threads 91 and 92 on the sleeve and the clutch ring respectively are not usually engaged at this point. The relative positions of the various parts of the packer after the packer is set in casing is shown in FIGS. 2A and 2B.

The existence of a greater fluid pressure in the well bore above the packing structure 19, or the imposition of additional pipe weight on the mandrel 11, will only serve to set the packer 10 more tightly in the well casing. Any additional downward movement of the mandrel 11 is trapped by the clutch nut assembly 59. According to the concepts of the present invention, the well packer is also arranged such that the slip elements 43 are retained in anchoring contact with the casing in response to the application of an upward force on the mandrel 11. The upward force could be occasioned, for example, by a strain taken in the pipe string 13 or by the existence of a greater fluid pressure in the well bore below the packing structure 19 than above it. When either of these circumstances occur, it will be remembered that the lower housing member 50 of the cage assembly 48 can move upwardly to some extent relative to the upper housing member 49. When this occurs, movement of the upper inclined surface 80 along the surface 79 forces the cam ring 78 radially inwardly toward the sleeve 47. By virtue of the surfaces 86 and 87, radial inward movement of the cam ring 78 in turn forces the clutch ring 85 radially inwardly to move the ring threads 92 into gripping engagement with the teeth 91 formed on the external surface of the sleeve 47 as shown in FIG. 4. Once the teeth 91 and 92 are engaged, it can be demonstrated that an upward force on the lower housing member 49 is reversed by the arrangement of the cam surfaces and applied as a downward force on the expander sleeve 47, the downward force being transmitted to the expander cone 39 and functioning to retain the slips 43 in gripping contact with the casing to anchor the tool against movement.

Due to the lost-motion connection afforded by the pins 41 and slots 40 between the compression sleeve 17 and the expander cone 39, upward force due to a greater fluid pressure acting on the lower end of the expanded packing 19 is not transmitted to the expander cone. Moreover the greater fluid pressure can act on a transverse area equal to the cross-sectional thickness of the compression sleeve 17 to apply an endwise force on the packing 19 and keep it packed off tightly against the well casing wall.

When it is desired to release the packer 10 for retrieval from the well casing or for movement to another setting location therein, the mandrel 11 is rotated by torquing the pipe string 13 to the right while pulling upwardly thereon. The left-hand formation of the upper threads 66 on the mandrel 11 and the clutch nut segments 60 cause the mandrel to be advanced upwardly relative to the cage assembly 48. Upward movement of the mandrel 11 releases the endwise compression force on the packing elements 20-22 so that they will inherently retract. Eventually the upper abutment sleeve 25 will be lifted by the annular flange 30 on the mandrel 11 which will in turn lift the compression

sleeve 17 upwardly relative to the expander cone 39. When the clutch nut assembly 59 disengages from the left-hand mandrel threads 66, the absence of an upward force on the lower housing member 50 will enable the clutch ring 85 to expand laterally outwardly and disengage from the teeth 91 on the lower end section of the expander sleeve 47. Now the expander cone 39 can be drawn upwardly relative to the slip elements 43 to cause the slips to shift inwardly to their retracted positions. When the mandrel 11 reaches the upper limit of its travel relative to the cage assembly 48, the lower mandrel teeth 65 will ratchet back inside the clutch nut assembly 59 and the lower teeth 64 and 65 will coengage to again lock the tool 10 in its initially retracted and running position.

Turning now to FIGS. 6 and 7, an alternative embodiment of the present invention is shown in the form of a tubing anchor 100 which is also arranged in accordance with the principles of the present invention. As illustrated, the tubing anchor 100 includes an elongated tubular mandrel 101 having a threaded collar 102 on its upper end and having threads 103 for coupling the anchor to the lower end of a string (not shown) so that rotational and translational manipulations of the pipe string cause a corresponding rotation or displacement of the mandrel. A slip expander cone 104 is mounted on the mandrel 101 below the collar 102 and carries a depending sleeve 105 extending downwardly along the mandrel and having a set of external teeth 106 formed around its lower end. A plurality of normally retracted slip elements 108 are mounted about the mandrel 101 below the expander cone 104; each such element having a typical dovetail sliding connection therewith allowing positive radial displacement of the slips as the expander cone 104 is moved downwardly in relation to the slips. Each slip element 108 has wickers or teeth 109 adapted to bite into a well casing 110 (FIG. 7) as the slip is shifted outwardly to secure the tubing anchor 100 against movement.

An annular cage assembly 111 is slidably mounted on the mandrel 101 below the slip elements 108. The cage assembly 111 is formed as two telescoped members, an upper housing member 112 and a lower housing member 113. A plurality of circumferentially spaced, radially extending drag blocks 114 are disposed within recesses 115 in the upper housing member 112 and cooperatively arranged to be urged outwardly into frictional engagement with the well casing wall 110 by a plurality of coil springs 116 or the like to secure the cage assembly 111 upon movement of the mandrel 101.

The lower housing member 113 is provided with an internal annular recess 116 that receives a clutch nut assembly 117 which is similar to that shown at 59 in the tool 10. As shown, the clutch nut assembly 117 has upper and lower sets of buttress-type threads or teeth 118a and 118b for selectively securing the cage assembly 111 upon their respective engagement with complementally shaped teeth 119 and 120 on the mandrel 102 to alternatively lock the tubing anchor 100 in its alternate running-in and set positions. The mandrel 101 may only be released from the clutch nut assembly 117 by rotating to the right.

Here as previously discussed in relation to FIGS. 1 and 2, the upper and lower housing members 112 and

113 of the tubing anchor 100, assembled in telescoping arrangement as seen at 123, are maintained in normally stretched out position by spring like means 124, while limited longitudinal relative motion is permitted by the pin and slot arrangement as at 125. A cam ring 126 similar to that shown in FIG. 4 is located in a recess 127 formed adjacent the upper end of the inner telescoping member 112. The cam ring 126 has a downwardly and inwardly inclined outer surface 128 which is cooperatively associated with a companion surface 129 on the upper end of the sleeve portion of the inner telescoping member (123). The upper surface of the cam ring 126 slidably engages a bearing ring structure 130 located against a downwardly facing shoulder 131 that defines the upper end of an annular recess 132. A clutch ring 133 is located below the cam ring 126 in sliding relation thereto. The clutch ring 133 is provided with internal teeth 134 sized for gripping engagement with companion teeth 135 formed around the lower portion of the expander sleeve 105 as the clutch ring is shifted inwardly by the cam ring 126.

In operation the assembled device is lowered to setting depth in a well casing. To achieve setting, the mandrel 101 is rotated a sufficient number of turns to the right to release the threads 120 on the mandrel from the clutch nut threads 118b. The drag clocks 114 frictionally engage the casing 110 to prevent turning of the cage assembly 111 during this operation. Downward travel of the mandrel 101 advances the expander cone 104 downwardly thereby shifting the slip elements 108 outwardly into gripping engagement with the casing. As the mandrel 101 travels downwardly relative to the cage assembly 111 the upper mandrel threads 119 will ratchet downwardly within the clutch nut assembly 117 and the upper threads 118a thereon will trap the mandrel in the lowermost position to which it is moved in order to lock the tubing anchor 100 in the set condition. The expander sleeve 105 will be shifted downwardly somewhat in relation to the clutch ring 133, but the respective threads 135 and 134 on the sleeve and clutch ring are not engaged at this point. The relative positions of the various parts of the tubing anchor 100 after setting is shown in drawing FIG. 7.

The tubing anchor 100 remains securely set in the casing 110 irrespective of the direction of a force exerted thereon. As easily appreciated, additional downward movement of the mandrel 101 is trapped by the clutch nut assembly 117. An upwardly exerted force causes movement of the lower housing member 113 relative to the upper housing member 112 forcing the cam ring 126 radially inward toward the sleeve 105 which in turn forces the clutch ring 132 radially inwardly into gripping engagement with the teeth 106 on the external surface of the sleeve. Thereafter, owing to the particular arrangement of the camming surfaces of the present invention as hereinbefore described an upward force on the lower housing member 113 is reversed and applied as a downward force on the expander sleeve 105, which force is transmitted to the expander cone 104, thereby retaining the slips 108 in gripping contact with the casing to anchor the tool 100 against movement relative thereto.

When it is desired to retrieve the tubing anchor 100, the mandrel 101 is rotated by torquing the pipe string

to the right and pulling upwardly thereon. The left-hand formation of the upper threads 119 on the mandrel 101 and the clutch nut 117 cause the mandrel to be advanced upwardly relative to the cage assembly 111. As the clutch nut assembly 117 disengages from the left-hand mandrel threads 119, the clutch ring 133 will expand laterally outwardly and disengage from the teeth 135 on the lower portion of the expander sleeve 105. Now the expander cone 104 can be drawn upwardly relative to the slip elements 108 to cause the slips to shift inwardly to their retracted positions. As the mandrel 101 continues its upward travel relative to the cage assembly 111, the lower mandrel teeth 120 will ratchet back inside the clutch nut assembly 117 and the lower teeth of the clutch nut 186 and the lower teeth 120 on the mandrel will co-engage to lock the tool 100 in its initially retracted and running-in position.

New and improved well tools have been disclosed which respectively have a single slip and expander combination that prevents movement in either longitudinal direction due to either pressure or mechanical force applied thereto. Since various changes or modifications may be made without departing from the inventive concepts involved, it is the aim of the appended claims to cover all such changes and modifications falling within the true spirit and scope of the present invention.

I claim:

1. A well packer apparatus comprising: a body member; packing means carried by said body member for packing off a well conduit; slip means for anchoring against movement in the well conduit; expander means movable downwardly relative to said slip means for expanding said slip means into anchoring engagement; and means for translating upward force on said body member to downward force on said expander means to retain said slip means in anchoring engagement.

2. The well packer apparatus of claim 1 wherein said translating means comprises a member coupled to said body member and movable upwardly relative to said slip means, and cam means responsive to upward movement of said member for applying downward force on said expander means.

3. The well packer apparatus of claim 2 wherein said cam means includes wedge means having a downwardly and inwardly inclined surface cooperable with an upwardly and outwardly inclined surface on said member, and a clutch member coupled to said expander means, said wedge means having an upwardly and inwardly inclined surface cooperable with a downwardly and outwardly inclined surface on said clutch member.

4. The well packer apparatus of claim 3 wherein said clutch member is laterally expansible and contractible relative to said expander means and has clutch teeth cooperable with companion clutch teeth on said expander means, said clutch teeth being engaged to transfer downward force to said expander means and disengaged to enable longitudinal relative movement between said expander means and said slip means.

5. A well packer apparatus comprising: a body member; packing means carried by said body member for packing off a well conduit; slip means for anchoring against movement in the well conduit; expander means

movable downwardly relative to said slip means for expanding said slip means into anchoring engagement; means for translating upward force on said body member to downward force on said expander means to retain said slip means in anchoring engagement; and a lost-motion connection between said packing means and said expander means to enable the application of downward force on said expander means independently of said packing means.

6. The well packer apparatus of claim 5 where said packing means includes a sleeve member and an elastomeric packing element mounted on said sleeve member, said lost-motion connection coupling said sleeve member and said expander means together for limited longitudinal movement.

7. The well packer apparatus of claim 6 wherein said translating means includes a housing member coupled to said body member and movable upwardly relative to said slip means, and cam means responsive to upward movement of said housing member and said body member for applying downward force on said expander means.

8. The well packer apparatus of claim 7 wherein said cam means includes wedge means having a downwardly and inwardly inclined surface cooperable with an upwardly and outwardly inclined surface on said housing member, and a clutch member coupled to said expander means, said wedge means having an upwardly and inwardly inclined surface cooperable with a downwardly and outwardly inclined surface on said clutch member.

9. The well packer apparatus of claim 8 wherein said clutch member is laterally expansible and contractible relative to said expander means and as clutch teeth cooperable with companion clutch teeth on said expander means, said clutch teeth being engaged to transfer downward force to said expander means and disengaged to enable longitudinal relative movement between said expander means and said slip means.

10. A well packer apparatus comprising: a body member; packing means on said body member for packing off a well bore; normally retracted slip means shiftable to expanded positions for anchoring against movement in a well conduit; expander means movable downwardly relative to said slip means for shifting said slip means into anchoring positions; housing means on said body member including upper and lower relatively movable housing members, said slip means being mounted on said upper housing member; means for coupling said housing members together for limited longitudinal relative movement; clutch means for coupling said body member to said lower housing member in longitudinally spaced relative positions, whereby longitudinal force on said body member is transmitted to said lower housing member; and mechanical means coacting between said lower housing member and said expander means for applying an upward force on said body member and lower housing member as a downward force on said expander means to retain said slip means in anchoring positions.

11. The well packer apparatus of claim 10 wherein said mechanical means includes cam means having at least two pair of coengageable inclined surfaces for reversing the direction of a component of the upward force on said body member and said lower housing

member, and clutch means for transmitting said force component to said expander means.

12. The well packer apparatus of claim 11 further including a lost-motion connection between said packing means and said expander means to enable limited longitudinal motion therebetween.

13. A well packer apparatus comprising: a body member; a sleeve member mounted for limited longitudinal motion on said body member, said sleeve member and said body member defining a fluid bypass passage therebetween; coengageable valve means on body member and said sleeve member for closing off one end of said bypass passage; expansible packing means mounted on said sleeve member for packing off a well conduit; normally retracted slip means movable to expanded positions for anchoring against movement in the well conduit; a housing assembly on said body member for supporting said slip means; expander means below said packing means and movable downwardly relative to said slip means for expanding said slip means into anchoring engagement; releasable means on said housing assembly for securing said packing means and said slip means in both retracted and expanded positions; said releasable means transmitting longitudinally directed force on said body member to a portion of said housing assembly; and means for translating upward force on said body member and said portion to downward force on said expander means to retain said slip means in anchoring engagement.

14. The well packer apparatus of claim 13 wherein said housing assembly includes upper and lower housing members coupled together for limited longitudinal relative movement, said lower housing member constituting said portion, said translating means including relative slidable means having coengageable inclined surfaces for reversing the direction of a component of the upward force on said body member and said lower housing member, and clutch means for applying said force component to said expander means.

15. The well packer apparatus of claim 14 further including a sliding connection between said sleeve member and said expander means to enable downward movement of said expander means relative to said packing means when said packing means is in expanded position.

16. A well packer apparatus comprising: a body member; packing means carried by said body member for packing off a well conduit; slip means for anchoring against movement in the well conduit; expander means below said packing means and movable downwardly relative to said slip means for expanding said slip means into anchoring engagement, said expander means including an expander member having inclined surfaces engageable with said slip means and a sleeve member extending to a location below said slip means; and means coupled to said body member and said sleeve member for reversing the direction of a component of an upward force on said body member and for applying the resultant downward force component to said sleeve member, thereby forcing said expander member in a downward direction to retain said slip means in anchoring engagement.

17. The well packer apparatus of claim 16 wherein said reversing means includes cam means having at

least two pair of coengageable and relatively slidable inclined surfaces, said applying means including a laterally shiftable clutch member having clutch teeth cooperable with companion teeth on said sleeve member, said clutch teeth being engaged to apply downward force on said sleeve member and disengaged to enable longitudinal relative movement between said expander means and said slip means.

18. The well packer apparatus of claim 17 further including a lost-motion connection between said packing means and said expander means to enable the application of downward force on said sleeve member and said expander means independently of said packing means.

19. A well packer apparatus comprising: a body member; a sleeve member surrounding said body member and having an upwardly facing fixed abutment and a downwardly facing slidable abutment; means for sealing said sleeve member with respect to said body member; packing means on said sleeve member between said abutments and adapted to be compressed and expanded by advancement of said abutments toward each other; means for coupling said slidable abutment to said body member; normally retracted slip means adapted to be shifted outwardly into gripping engagement with a well conduit; expander means movable downwardly relative to said slip means for shifting said slip means outwardly; housing means on said body member including upper and lower relatively movable housing members, said slip means being mounted on said upper housing member; means for coupling said housing members together for limited longitudinal movement; clutch means for coupling said body member to said lower housing members, whereby longitudinal force on said body member is transmitted to said lower housing member; and means coaxing between said lower housing member and said expander means for reversing the direction of a component of an upward force on said body member and said housing member and for applying the resultant downward force component to said expander means, thereby retaining said slip means in gripping engagement with the well conduit.

20. A well tool comprising:

a body;
slip means for anchoring said well tool against movement in the well conduit;
expander means movable downwardly relative to said slip means and adapted for extending said slip means into anchoring engagement with a well conduit; and
means for translating upward force on said body to downward force on said expander means to retain said slip means in anchoring engagement.

21. The well tool of claim 20 wherein said force translating means comprise a member coupled to said body and movable upwardly relative to said slip means, and cam means responsive to upward movement of said movable member for applying a downward force on said expander means.

22. The well tool of claim 21 wherein said cam means include a clutch member coupled to said expander means, and wedge means operatively associated with said movable member and said clutch means for transmitting an upward force on said movable member as a downward force on said expander means.

23. The well tool of claim 22 wherein said wedge means has a first downwardly and inwardly inclined surface and a second upwardly and inwardly inclined surface; said movable member has an upwardly and outwardly inclined surface slidably coengageable with said first inclined surface; and said clutch member has a downwardly and outwardly inclined surface slidably coengageable with said second inclined surface.

24. A well tubing anchor comprising:

a central tubular body member adapted for connection to a string of well tubing;

normally-retracted anchor means shiftable to extended positions for anchoring a well tubing string against movement in well bore;

housing means on said body member including upper and lower relatively-movable housing members, said anchor means being mounted on said upper housing member;

means for coupling said housing members together for limited longitudinal relative movement;

clutch means adapted for coupling said body member to said lower housing member in longitudinally-spaced positions and transmitting longitudinal forces on said body member to said lower housing member; and

mechanical means coacting between said lower housing member and said expander means for applying an upward force on said body member and lower housing member as a downward force on said expander means to retain said anchoring means in an anchoring position.

25. The tubing anchor of claim 24 wherein said mechanical means include wedge means having a first downwardly and inwardly inclined surface and a

second upwardly and inwardly inclined surface; and wherein said lower movable housing member has an upwardly and outwardly inclined surface cooperatively associated with said first inclined surface and said clutch means has a downwardly and outwardly inclined surface cooperatively associated with said second inclined surface providing camming action for reversing an upward force on said body member and said lower housing member and transmitting said force downwardly to said expander means to retain said anchor means in extended anchoring positions.

26. The tubing anchor of claim 25 wherein said wedge means has a third upwardly and inwardly inclined upper surface; and further including a downwardly-facing fixed abutment on said upper housing member; and a bearing member having a lower portion forming a downwardly and outwardly inclined lower surface cooperatively co-engageable with said third surface, said bearing member having a flat upper portion engaging said abutment for transmitting an upward thrust on said upper housing member as a radial thrust on said wedge means and translating said radial thrust as a downward thrust on said clutch means.

27. The tubing anchor of claim 26 wherein said clutch means are laterally expansible and contractible relative to said expander means and includes clutch teeth selectively cooperable with companion clutch teeth on said expander means for transferring downward force to said expander means upon coengagement of said clutch teeth and enabling longitudinal relative movement between said expander means and said slip means upon disengagement of said clutch teeth.

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