

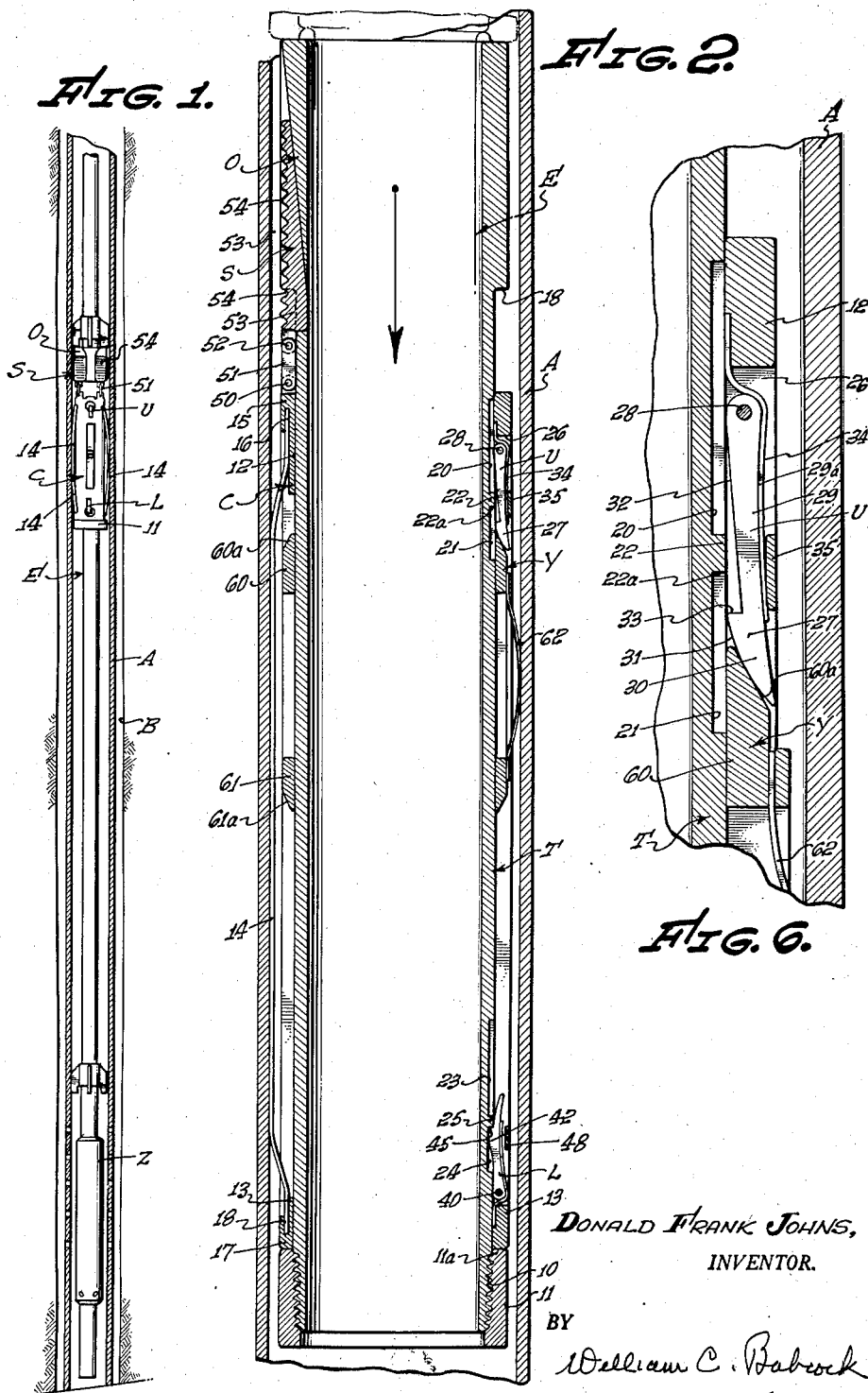
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D. F. JOHNS
ANCHORING DEVICE

2,829,718

Filed Nov. 29, 1954

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FIG. 4.

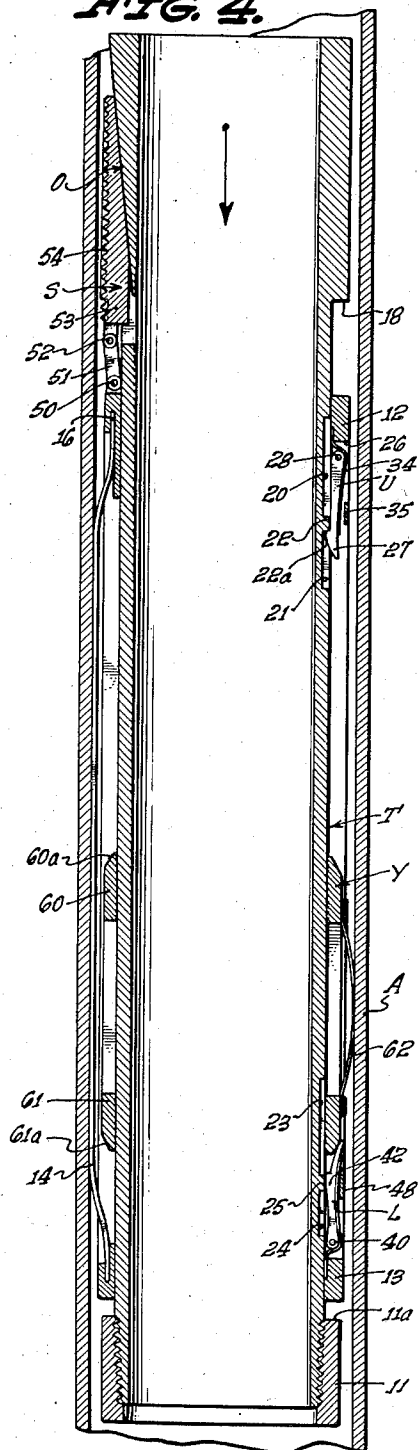
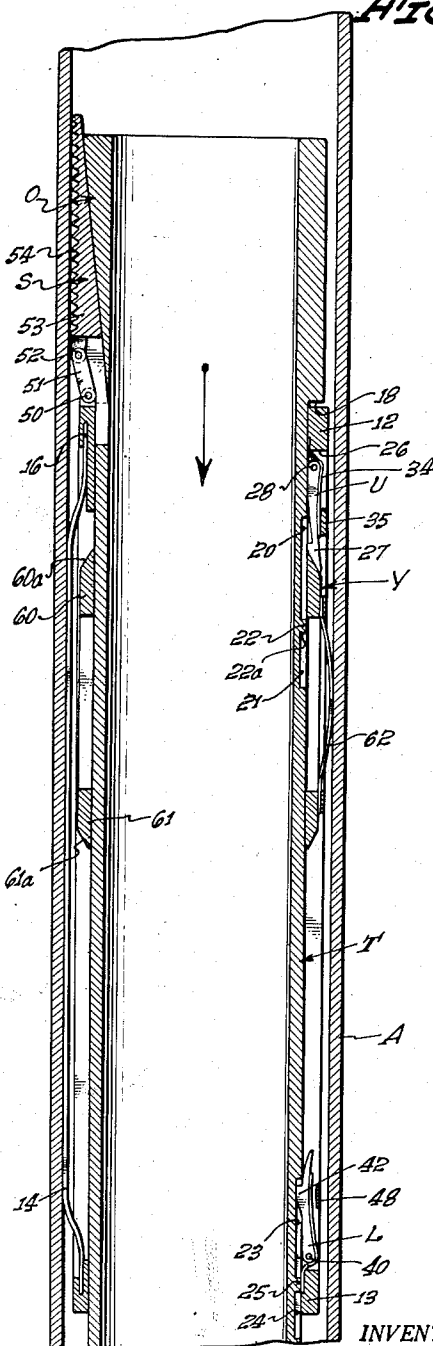


FIG. 5.



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ANCHORING DEVICE

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The present invention relates generally to the field of oil well tools, and more particularly to an anchoring device that may not only be set at any desired depth in a well bore, but which by means of subsequent vertical movement thereof may be released from its set position to be re-set or raised to the ground surface at will.

The primary purpose in devising the present invention is to provide an anchoring device for use within the confines of tubular members disposed in a well bore, and one that may be set and re-set solely by vertical motion thereof relative to the stationary tubular member whereby the device may be operated with equal effectiveness, irrespective of whether it is supported by a wire line or such rigid elongate members as a tubing string.

A major object of the invention is to provide an anchoring device particularly adapted for use in conjunction with tools, devices, and appurtenances employed in the drilling of wells or the production of fluid therefrom.

A further object of the invention is to supply an anchoring device which when supported by a rigid elongate member within a well bore, may be set or released from a set position by vertical movement thereof, with actuation of the tool associated with the anchoring device being effected by rotation of said rigid supporting member.

Another object of the invention is to provide an anchoring device adapted for use in conjunction with a tubing anchor, liner hanger, tubing suspender, pump anchor, foundation for tubing cutters and spears for pulling liners or casing, which anchoring device also can be utilized in cooperation with a suitable tool to cut drill pipe and tubing. In addition, the invention may be used with suitable tools for perforating well casing and tubing, ripping casing, testing tubing, well cementing, formation testing, and in acidifying oil wells. The invention may also be employed in finding the "free point" of drill pipe and tubing which has become stuck.

Yet another object of the invention is to furnish an anchoring device that materially assists in reducing the time involved in performing many oil well operations due to the fact that the device may be rapidly run in and out of a well bore by wire line, and set and re-set at varying depths without the necessity of drawing it up to the ground surface.

Still a further object of the invention is to provide an anchoring device of relatively simple structure that may be fabricated from standard commercially available materials, and which with ordinary care in handling, requires little or no maintenance attention.

These and other objects and advantages of the invention will become apparent from the following description of a preferred form thereof, and from the drawings illustrating that form in which:

Figure 1 is a combined vertical cross-sectional and elevational view of the anchoring device shown supported on the lower end of a tubing string, and being lowered into the well casing for anchoring a pump, tool, or other piece of equipment at the desired depth therein;

Figure 2 is a vertical cross-sectional view of the device

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disposed in an oil well casing showing the component parts thereof occupying the positions they assume as the anchor is lowered into a well;

Figure 3 is a vertical cross-sectional view of the device as it is being moved upwardly to unlatch a lower dog thereof;

Figure 4 is a vertical cross-sectional view of the device as it is moved downwardly to engage the cage unit of the device with an upper set of dogs, to deactivate the lower dogs prior to setting the slips;

Figure 5 is a vertical cross-sectional view of the anchoring device after the cage unit of the device has been released from the tubular body portion and the slips in set position;

Figure 6 is an enlarged vertical cross-sectional view of said upper dog shown in the position it occupies in Figure 2;

Figure 7 is an enlarged, fragmentary vertical cross-sectional view of said lower dog occupying that position shown in Figure 2; and

Figure 8 is a fragmentary side elevational view of said lower dog, the mounting therefor, and the lower portion of one of the tripping assembly bow springs.

Referring now to the drawings for the general arrangement of the invention, and particularly to Figures 1 to 5 thereof, it will be seen that the anchoring device consists of three sub-assemblies, a tubular body T, a spring cage C, and a tripping assembly Y which in turn are assembled into one unit. Prior to insertion into casing A within well bore B, the assembled unit is connected to the lower end of a string of tubing E.

Both cage C and tripping assembly Y are axially slidably mounted on tubular body T. Vertical movement of tripping assembly Y relative to said body and cage is limited to substantially the length of cage C, while vertical movement of cage C relative to body T is limited between collar 11 connected to the lower end thereof and a slip cone portion of said body formed at the upper end thereof. Slip cone O includes a plurality of upwardly and outwardly inclined flat surfaces which are in sliding contact with the flat interior surfaces of a like number of slips S that are linked by and pivotally connected to the upper end of cage C. As is readily apparent, if tubular body T is allowed to move downwardly relative to cage C, as when the bow springs 14 of said cage frictionally engage the interior wall of well casing A, cone O will force the outwardly facing toothed surfaces of slips S into forceful, biting engagement with said casing, whereby the invention and a tool Z depending therefrom will be anchored in casing A.

In order to prevent the anchoring of the unit at any point in casing A other than at a desired predetermined depth therein, latching means are provided to at all times connect cage C to body T during downward movement of the invention, thereby preventing relative movement between slips S and cone O, except after release of said means by tripping assembly Y. Such release is accomplished merely by upward movement of body T and cage C, while tripping assembly Y, being at all times in frictional engagement with the interior wall of casing A, remains stationary therein. Said latching means include a lower latching dog L pivotally connected to the lower end of cage C and an upper latching dog U pivotally connected to the upper portion of said cage. Both upper and lower dogs U and L are spring biased to at all times be urged into latching contact with adjacent slots formed in body T, later to be described in detail. It should be noted that both dogs are adapted to engage body T to be moved in unison therewith only upon downward movement of body T, but lower dog L is released from body T only upon upward movement of the body relative to tripping assembly Y, while upper dog U is adapted to be released from

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body T only upon downward movement thereof relative to tripping assembly Y. Before the invention is lowered into casing A, cage C is moved to its lowest position relative to body T whereupon lower dog L engages the body and slips S are in retracted position. Therefore, upon subsequent lowering of the unit, cage C moves in unison with body T to the selected predetermined depth, carrying tripping assembly Y along with it, but in its upper end, as is seen in Figure 2. Upon reaching the desired depth, downward movement is stopped. Thereafter, upon upward movement of body T, as shown in Figure 3, spring cage C is lifted therewith by collar 11 despite its frictional engagement with the wall of tubing A, but tripping assembly Y is not moved upwardly, instead remaining stationary by virtue of its frictional engagement with the wall of casing A until lower dog L strikes the lower cammed face of tripping assembly Y, releasing the dog from body T. Upper dog U is then connected to body T so that subsequent downward movement of body T carries cage C with it. But upon such downward movement, tripping assembly Y is again relatively stationary so that upon its upper cammed face striking upper dog U, the dog is also released from body T whereby cage C is frictionally held immobile against casing A. Continued downward movement of body T then forces slips S outwardly into engagement with casing A, as aforesaid.

In common with oil tools of relatively heavy construction, tubular body T has threads 10 on the bottom portion thereof that are threadedly engaged by a collar 11 from which various forms of oil tools Z, packers or the like, may be supported, as shown in Figure 1. Cage C (Figure 2) includes an upper sleeve 12 and a lower sleeve 13, both of which are slidably mounted on tubular body T in longitudinal spaced relationship. A number of substantially vertically positioned bow springs 14 are provided which extend between sleeves 12 and 13, and are circumferentially spaced thereon. Springs 14 are of such size that they frictionally engage the interior surface of casing A. Sleeve 12 preferably has a plurality of circumferentially spaced upwardly extending slots 16 formed therein, and an end portion of one bow spring 14 is situated in each slot. The lower ends of springs 14 are inserted into identical slots formed in sleeve 13, and these springs are tack welded or otherwise affixed to the sleeves to provide cage C which may slide the exterior length of tubular body T between the upper edge 11a of the collar and a body shoulder 18 formed on the upper exterior portion of the body (Figure 5).

First and second elongate recesses 20 and 21 are formed in the upper exterior portion of body T and are separated by a first lug 22. Likewise, first and second elongate slots 23 and 24 are formed in the lower portion of body T, and are separated by a second lug 25. A downwardly extending narrow recess 26 is provided in sleeve 12 (Figures 2 and 6), and a vertically disposed detent 27 is pivotally supported therein by means of a pin 28. Detent 27 is elongate in shape, having a substantially straight shank portion 29 that taperingly develops into a pointed portion 30 of enlarged area on its lower end. The outermost limit of shank portion 29 is defined by a substantially straight outer edge 29a, and the pointed portion 30 has a slightly curved upwardly and outwardly inclined inner edge 31. Edge 31 terminates in an upwardly facing horizontal seat 33 that may removably engage the lower horizontal face of lug 22 when the anchoring device is being withdrawn from the hole, as shown in Figure 4. A straight edge 32 extends upwardly from seat 33 and defines the innermost limit of shank 29. A resilient clip spring 34 extends downwardly from the sleeve 12 over edge 29a of dog U, which spring at all times tends to press the lower portion 30 of the dog into one of the recesses 20 or 21. Total outer movement of dog U is limited by a stop 35 affixed to sleeve 12 (Figures 2 and 6).

Sleeve 13 also has a cavity 39 formed therein in which a horizontally disposed pin 40 is positioned from which the

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lower dog L is pivotally supported. As may best be seen in Figure 7, the shank 41 of dog L develops into a pointed upper portion 42 of enlarged area that is defined by an upwardly and outwardly inclined curved cam edge 43 and a curved downwardly and outwardly inclined cam edge 44, which two edges provide an upwardly facing horizontal seat 45 at their junction. An outer edge 46 of dog L is slightly concave in configuration, and is engaged by an elongate clip spring 47 affixed to sleeve 13 that at all times tends to urge the dog into the confines of either slot 23 or 24. Outward movement of the dog relative to sleeve 13 is restricted by a stop 48 affixed to body T.

A number of horizontal pins 50 are supported on the upper extremity of cage C, each of which pins pivotally mounts the lower end of a link 51 on sleeve 12. Each link 51 is pivotally connected on its upper end by a pin 52 to the lower extremity of a slip segment 53 that has a toothed or corrugated exterior surface 54 adapted to grip the casing interior when the segments are moved outwardly by the slip cone O and brought into forcible engagement therewith.

The tripping assembly Y embodies an upper ring 60, and a lower ring 61 in longitudinal spaced relationship, with both rings being slidably mounted on the exterior surface of tubular body T and the degree of ring movement is limited by the position of the cage C thereon, as best seen in Figure 2. Rings 60 and 61 are provided with circumferentially extending cam surfaces 60a and 61a respectively, and a plurality of circumferentially spaced, vertically disposed bow springs 62 which frictionally engage the interior surface of casing A extend between these rings.

In use, operation of the present invention is extremely simple. When it is desired to lower the anchoring device into a bore hole, the component parts thereof are disposed as shown in Figure 2. As the device is lowered in the hole, the bow springs of both cage C and the tripping assembly Y are in slidable contact with the interior surface of casing A, and this frictional engagement tends to move same relative to the tubular body T. In Figure 2 it will be seen that cage C cannot move upwardly relative to tubular body T beyond the position shown during lowering of the device, due to the spring-loaded dog L which is so disposed that the seat 45 thereof engages the lower edge of lug 25.

As the anchoring device is lowered into the hole, the tripping assembly Y moves upwardly on the tubular body T to the position shown in Figure 2, where further upward movement of the assembly relative to the body is prevented when the cam edge 60a engages the edge 31 of the dog U. The dog U is unable to pivot outwardly and permit the assembly to move upwardly as it is in removable engagement with stop 35, as shown in Figure 6. Lowering of the anchoring device can be continued until the depth at which it is desired to set the device is obtained. When the desired depth is reached, the tripping assembly Y will be situated on the tubular body T in that position shown in Figure 2. Downward relative movement between the tubular body T and cage C at the desired depth in the bore, which is necessary to enable the cones O to expand the slips S into a casing gripping position, is prevented by the seat 45 of dog L which engages the lower edge of lug 25. In order to disengage dog L and lug 25, it is necessary to cause the support E to move the tubular body T upwardly. The body T and cage C move upwardly together relative to the tripping assembly A which remains stationary due to the frictional engagement of its bow springs 62 with the interior surface of the casing A.

Upward movement of support E is continued until the dog L contacts cam edge 61a of the tripping assembly, and is pivoted outwardly to separate it from engagement with lug 25. Dog U holds the tubular body T and cage C together during this upward movement and accordingly, the seat 33 of dog U is in engagement with the under side of lug 22 as shown in Figure 4. After the lower dog

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L encounters the cam surface 61a it occupies that position also shown in Figure 4.

To set slips S, the support E is caused to move downwardly a slightly greater distance than it had been raised. During this downward movement tubular body T and cage C move relative to assembly Y as a unit, until cam face 60a of the tripping assembly meets edge 21 of the upper dog U. Dog U is then pivoted outwardly from engagement with lug 22. Tubular body T is then free to move downwardly relative to the cage, which in turn tends to remain stationary within the bore hole due to the frictional engagement of bow springs 14 with the interior casing surface. This relative movement of body T and cage C also causes relative downward movement between cones O and slips S, whereby slips S pivot outwardly on links 51 into a casing gripping position (Figure 5). When the slips are so positioned, the seat 45 and edge 43 of dog L are in first slot 23, and seat 33 of dog U is adjacent the first recess 20.

After the device has been anchored in a well bore in the manner above described, it may be brought to the ground surface by simply moving the support E upwardly. Upon such upward movement, the cage C and tripping assembly Y tend to remain stationary due to the frictional engagement of the bow springs with the interior surface of casing A. Initial upward movement of the tubular body relative to the cage and tripping assembly causes upward movement of the slip cone, which permits slips S to move out of gripping position with the casing (Figure 5) to that position shown in Figure 4. During this upward movement of body T, the dog U is urged inwardly by clip spring 34. Relative upward movement between tubular body T and cage C, the inward force exerted on dog U by spring 34, and the action of cam edge 31 in pivoting the dog outwardly as the cam edge slidably engages lug 22 causes dog U to change position from that shown in Figure 5 to that shown in Figure 4 as the device is removed from the bore hole. As this relative upward movement between tubular body T and cage C occurs, the dog L changes its position from that shown in Figure 5 to the position shown in Figure 1. Tubular body T and cage C are held together as an integral unit during the upward trip within the well bore due to engagement of seat 33 with the lower edge 22a (Figure 4).

When the present device is in a set position within a well bore, such as shown in Figure 5, and it is desired to re-set it at a lower depth therein, the elongate support E is simply moved upwardly a few inches, whereby the movement of the support is then reversed and the anchoring device is lowered the required distance. Initial upward movement of support E causes slips S to move out of casing engagement to the retracted position shown in Figure 4. Concurrent with retraction of slips S, the tubular body T moves relative to cage C and changes the positions of the dogs U and L from those shown in Figure 5 to those shown in Figure 2, which positions are the same as first described relative to lowering the present device into a bore hole. Accordingly, the device can thereafter be lowered in the bore hole to the depth at which it is desired to re-set same. After the desired depth is reached, the device may be re-set in precisely the same manner as in the first setting thereof.

In actual use the operation of the present device is extremely simple. As previously described, the device may be employed to anchor a variety of oil tools and fluid handling equipment at desired depths within a well bore. Furthermore, when the invention is positioned at any desired depth, the slips thereon may be set to grip the interior surface of casing A by raising the invention approximately twelve inches and then lowering it about fourteen inches.

To remove the device from an anchored position within a well bore, the support E is moved upwardly which causes the slips S to assume a retracted position. Re-setting of the device is accomplished by moving the sup-

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port E upwardly approximately four inches and then lowering the support to place the anchoring device at the desired depth to anchor same. Setting and re-setting operations are identical.

Although the anchor device herein shown and described is fully capable of achieving the objects and providing the advantages hereinbefore mentioned, it is to be understood that it is merely illustrative of the presently preferred embodiment thereof, and there is no intention to limit the invention to the details of construction other than as defined in the appended claims.

I claim:

1. An anchor actuable solely by vertical movement when disposed in casing in a well bore, comprising: an elongate tubular body vertically movable in said casing; a cage mounted on and axially movable on said body throughout a predetermined range; a plurality of radially movable slips movably mounted on said cage; first spring means mounted on said cage that frictionally engage the interior surface of said casing and tend to hold said cage at a fixed elevation therein; slip actuating means mounted on said body that expand said slips to grip said casing when said body is moved downwardly relative to said cage; first latching means movably mounted on said cage that initially releasably engage said body to hold said body and cage in fixed relationship when concurrently lowered in said casing; second latching means movably mounted on said cage that releasably engage said body to hold said body and cage in fixed relationship when concurrently lowered in said casing after said first latching means is disengaged from said body; a tripping member mounted on and axially movable on said body within limits defined by said cage, said member defining a lower cam surface which when brought into pressure contact with said first latching means is capable of disengaging same from said body, with said member defining an upper cam surface which when brought into pressure contact with said second latching means is capable of disengaging same from said body; and second spring means mounted on said tripping member that frictionally engage said casing with sufficient force so that when said body and cage are moved upwardly relative to said tripping member said lower cam face exerts pressure on said first latching means to disengage same from said body to permit said body and cage to be thereafter lowered relative to said tripping member until said upper cam face thereof contacts said second latching means and exerts sufficient pressure thereon to disengage same from said body, which disengaged body is thereafter downwardly movable relative to said cage to expand said slips into gripping contact with the interior of said casing.

2. An anchor as defined in claim 1 wherein spring means are provided for said first and second latching means that at all times urge said first and second latching means into pressure contact with said body.

3. An anchor as defined in claim 2 wherein said cage is defined by two longitudinally spaced sleeves slidably mounted on said tool, with said sleeves being rigidly connected by said first spring means.

4. An anchor as defined in claim 3 wherein said first spring means are a plurality of circumferentially spaced vertically extending bow springs.

5. An anchor as defined in claim 3 wherein said slip actuating means is a cone rigidly mounted on said body and axially movable relative to said slips.

6. An anchor as defined in claim 5 wherein said first and second latching means include first and second dogs respectively that are pivotally supported from said sleeves.

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