July 9, 1968 J. E. EDWARDS, JR 3,391,740

HYDRAULICALLY SET RETRIEVABLE WELL TOOL

Filed July 28, 1965 3 Sheets-Sheet 1

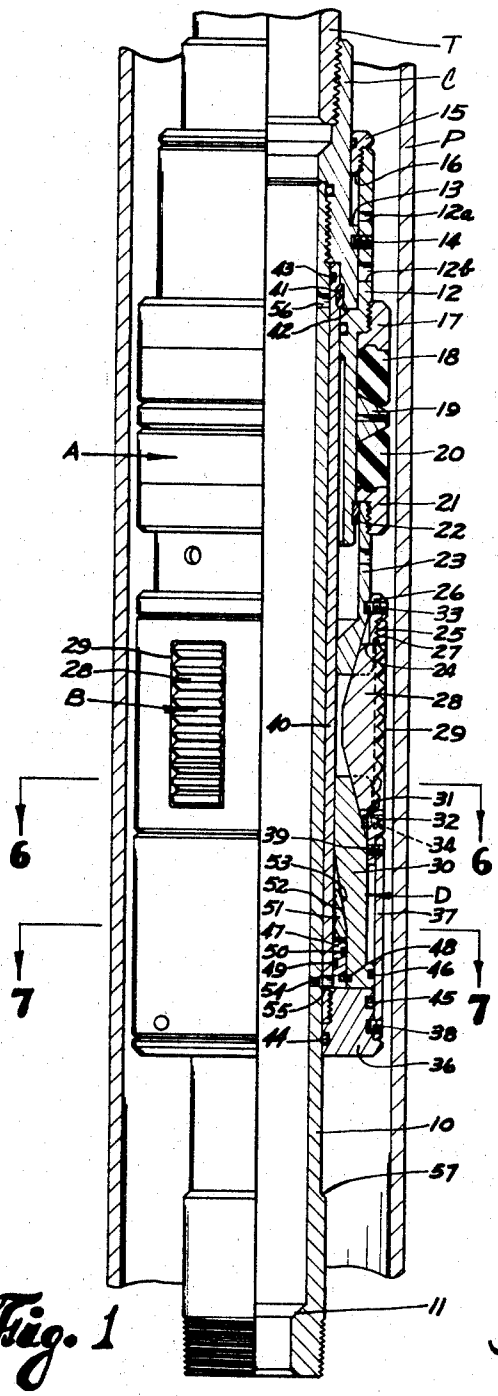

Fig. 1

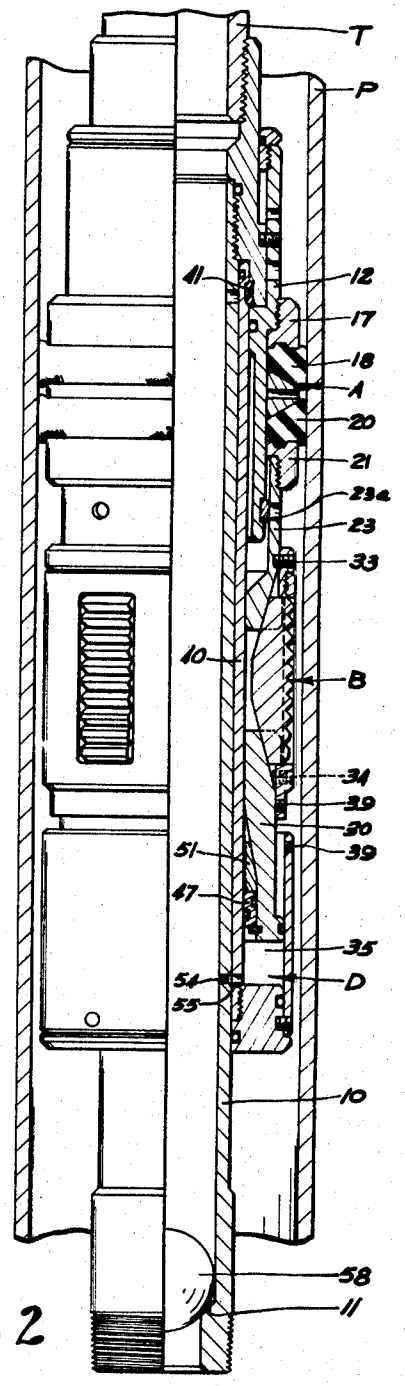

Fig. 2

JOE E. EDWARDS JR.
INVENTOR.

BY Vincent Martin
Joe E. Edwards
Jack R. Springgate
ATTORNEYS

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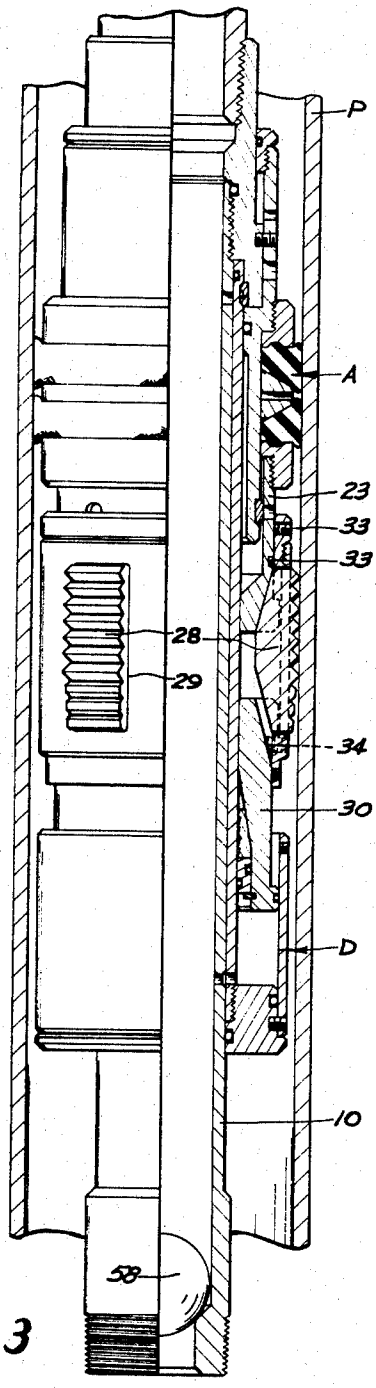

Fig. 3

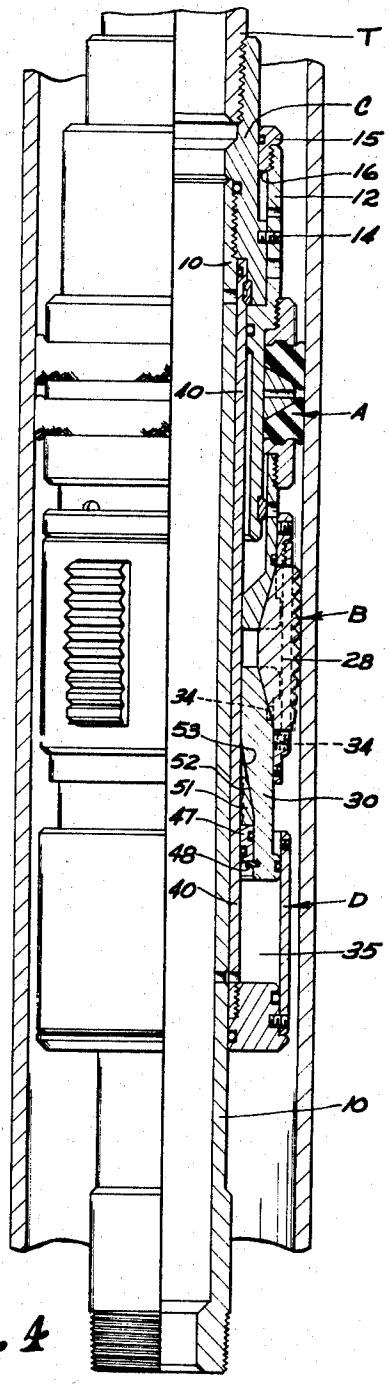

Fig. 4

JOE E. EDWARDS JR.
INVENTOR.

BY Vincent Martin
Joe E. Edwards
Jack L. Springgate
ATTORNEY

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HYDRAULICALLY SET RETRIEVABLE WELL TOOL

Filed July 28, 1965 3 Sheets-Sheet 3

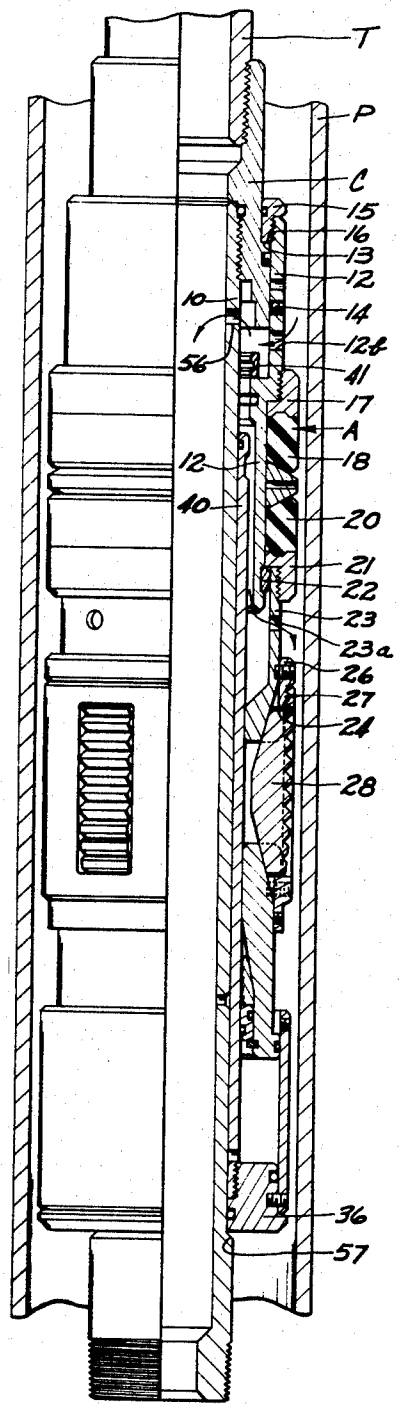

Fig. 5

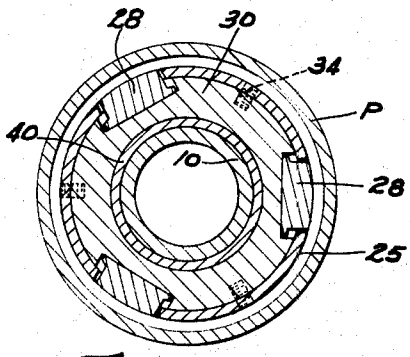

Fig. 6

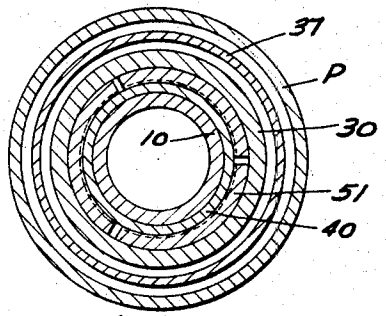

Fig. 7

JOE E. EDWARDS JR.
INVENTOR.

BY Vincent Martin
Joe E Edwards
Jack R. Springgate
ATTORNEYS

United States Patent Office 3,391,740 Patented July 9, 1968

3,391,740

HYDRAULICALLY SET RETRIEVABLE WELL TOOL

Joe E. Edwards, Jr., Houston, Tex., assignor to Brown Oil Tools, Inc., Houston, Tex., a corporation of Texas

Filed July 28, 1965, Ser. No. 475,342
14 Claims. (Cl. 166—120)

ABSTRACT OF THE DISCLOSURE

A well tool such as a well packer or anchor having a pressure actuated setting means, locking means to retain said pressure actuated setting in actuated position and a pair of releasable connections, one of which prevents release of the other, which are both released by an upward pull to cause unsetting of the well tool.

This invention relates to new and useful improvements in well tools and relates particularly to a retrievable packer or anchor apparatus adapted to be set in a well casing or similar conduit disposed within a well bore.

An object of the present invention is to provide an improved well packer or anchor capable of being anchored in a well pipe, such as a casing, against longitudinal movement in both directions by a single anchoring assembly and being so constructed that it may be released from set position by an upward pull on its support to permit it to be removed and retrieved whenever desired.

Another object is to provide a well packer or anchor apparatus which is lowered on a tubing or pipe string and is adapted to be anchored in a well casing against longitudinal movement, both upwardly and downwardly; said device being set by pressure within the tubing or pipe string to which it is attached and being subsequently released and retrieved by an upward movement of such tubing or pipe string.

A further object is to provide a well packer or anchor device adapted to be set by a single anchoring assembly in a well casing to hold against movement in either direction by reason of pressure differentials and to be released and retrieved from the well casing by a straight upward pull on its support, whereby rotative movement of the pipe is not required to effect release.

Still another object is to provide a well packer or anchor apparatus which is set by hydraulic pressure within a well casing and having a release arrangement such that a fluid bypass is provided around the assembly to equalize pressures and facilitate release of the device by an upward pull on its support.

A still further object is to provide a well packer or anchor apparatus which is set by hydraulic pressure within a well casing to be anchored against longitudinal movement, both upwardly and downwardly; said assembly including means preventing release when setting pressure is released but the assembly is released by a straight line upward pull on the assembly support.

Another object is to provide a well packer having an improved releasing assembly which includes means for normally preventing actuation of the release with said means being controlled by an upward pull on the tubing supporting the packer whereby release is effected.

Still a further object is to provide a well packer of the character described which is set by hydraulic pressure, released by an upward pull and is held against movement in either direction by the pressure differential thereacross; said packer including a releasing assembly which is not subjected to excess pressure from either direction which might otherwise actuate said releasing assembly.

The contruction designed to carry out the invention will be described hereinafter, together with other features thereof.

The invention will be readily understood from a reading of the following specification and by reference to the accompanying drawings forming a part thereof, wherein an example of the invention is shown and wherein:

FIGURE 1 is a view partly in elevation and partly in section of a well packer and anchor apparatus constructed in accordance with the invention and showing the same in its unset position as it is run into the well bore;

FIGURE 2 is a similar view showing the apparatus with its packing or sealing element in set position and its anchoring element in unset position;

FIGURE 3 is a similar view illustrating a position of parts of the apparatus with its packing or sealing assembly set and with a part of its anchoring assembly set;

FIGURE 4 is a similar view illustrating the position of the parts of the apparatus in its set and anchored position;

FIGURE 5 is a similar view illustrating the position of the parts of the apparatus after it has been released;

FIGURE 6 is a horizontal cross-sectional view taken along lines **6—6** in FIGURE 1; and

FIGURE 7 is a horizontal cross-sectional view taken along lines **7—7** in FIGURE 1.

In the drawings the well tool of the present invention is illustrated as a well packer apparatus although it may be employed as a pipe anchor. In its preferred form the apparatus includes a main tubular support or mandrel **10** upon which is mounted the sealing assembly A, the anchoring assembly B, the pressure actuated means generally indicated at D and the releasing assembly R. The anchoring assembly B is located between the sealing assembly A and the pressure actuating means D. Actuation of the pressure actuated means D effects the setting of the sealing assembly A into sealing position with the well casing or pipe P and thereafter effects a setting of the anchoring assembly B into set or pipe-gripping position with the well casing P. When in set position, the apparatus will seal against pressures and will be anchored against movement in both directions within the well casing or pipe P which is disposed in the well bore. The releasing assembly R is mounted above the sealing assembly A and is provided to prevent premature release of the well packer apparatus and to allow complete release and retrieval by an upward pull on the apparatus support. The well packer apparatus as illustrated is adapted to be connected to the support or tubing string T by a coupling C. As shown, the release assembly R provides a releasable connection between the upper and lower abutments within the upper portion of the well tool. Such location is not believed to be critical, and with changes in design of the well tool the release assembly could be located in the lower portion of the well tool.

As shown in FIGURE 1, the mandrel **10** is threadedly engaged with the coupling C and is provided with an internal seat **11** in the lower portion thereof. If desired, a tubing string may extend from the lower portion of the apparatus by utilizing the external threaded connection on the lower end of the mandrel **10**. The tubular support **12** for sealing assembly A, as best shown in FIGURE 1, surrounds the upper portion of the mandrel **10** and is provided with a portion thereof in surrounding engagement with the coupling C. It should be noted that the upper portion of tubular support **12** extends above the outer upwardly facing shoulder **13** on the coupling C and is retained in such position by the connection of the shear pin **14** extending through the support **12** into the coupling C. The ring **15** is threadedly engaged with the interior of the upper end of the tubular support **12** and

provides the downwardly facing shoulder 16 for the reasons hereinafter more fully explained.

The sealing assembly A comprises the upper abutment ring 17 which is threadedly engaged to the tubular support 12, the upper seal element 18, the tapered seal follower 19, the lower seal element 20 and the lower abutment ring 21. The lower outer surface of tubular support 12 is grooved to receive the snap ring 22. The snap ring 22 will provide an external shoulder on the lower exterior of tubular support 12 which will engage the lower abutment ring 21 to retain the sealing assembly A around the tubular support 12.

The tubular support 12 is provided with ports 12*a* and 12*b*; port 12*a* communicates with the space between shoulders 13 and 16, and port 12*b* communicates through support 12 below the shear pin 14.

The anchoring assembly B is secured to the lower part of the sealing assembly A by the threaded connection of the upper end of expander 23 with lower abutment ring 21. The anchoring assembly B comprises the upper expander 23, having upwardly facing shoulder 24; the cage 25; the upper cage ring 26, which is threadedly engaged with cage 25 and has downwardly facing shoulder 27 which, in FIGURE 1, is in engagement with shoulder 24; gripping elements 28, which are positioned for radial movement through the ports 29 in cage 25; and lower expander 30, which has a downwardly facing shoulder 31 in engagement with the inner upwardly facing shoulder 32 on cage 25.

For the reasons as hereinafter explained, cage ring 26 is releasably secured to upper expander 23 by the shear pin 33. The lower end of cage 26 is releasably secured to lower expander 30 by the shear pin 34.

The lower teeth of each of the gripping elements 28 are flattened to facilitate the release of the device as hereinafter more fully explained.

The lower end of lower expander 30 is positioned within the chamber 35 of the pressure actuated means D. The chamber 35 is defined by ring 36, outer sleeve 37, inner sleeve 40 and the lower end of expander 30. Outer sleeve 37 is secured to ring 36 by screws 38 and is releasably engaged to the lower portion of cage 26 by shear pin 39. Inner sleeve 40 is threadedly engaged with ring 36 and extends upwardly in surrounding relation to mandrel 10. The upper end of sleeve 40 is retained by the releasing assembly R. The releasing assembly R includes snap ring 41 which is held in position by the depending skirt S of the coupling C and by the upper shoulder 42 of tubular support 12. Relative movement of the release assembly parts is prevented until the pin 14 is sheared by an upward pull on the support or tubing T to release the parts as hereinafter described. As shown, the snap ring 41 is provided with internal teeth for engagement with the sleeve 40.

O-ring 43 provides a seal between the upper interior of sleeve 40 and the exterior of mandrel 10. O-ring 44 provides a seal between the interior of ring 36 and the exterior of mandrel 10. O-ring 45 provides a seal between the exterior of ring 36 and the interior of outer sleeve 37. O-ring 46 provides a sliding seal between the exterior of the lower part of lower expander 30 and the interior of outer sleeve 37.

Piston ring 47 is positioned within chamber 35 and is supported by snap ring 48 which is positioned in the lower interior of lower expander 30. O-rings 49 and 50 provide seals on the inside and outside, respectively, of piston ring 47. The locking segments 51 are positioned within the chamber 35 above the piston ring 47. The inner surface of each locking segment 51 is provided with downwardly facing teeth which will allow the segments to move upwardly on the exterior of sleeve 40 but will resist a downward movement. The outer surfaces 52 of segments 51 are inclined upwardly and inwardly to engage the inclined surface 53 on the lower expander 30.

The ports 54 through the mandrel 10 communicate with the ports 55 through the inner sleeve 40 to provide means for conducting a pressure fluid from the interior of mandrel 10 to the chamber 35. The port 56 extends through the upper end of mandrel 10. The upwardly facing shoulder 57 on the exterior of mandrel 10 is positioned below the ring 36 when the device is in position to be run in a well pipe or casing P.

With the apparatus as illustrated in FIGURE 1, it is properly positioned for running into a well pipe P. The components of the well tool are all held in inactive position by shear pins to prevent premature setting until the desired location within the well pipe P is reached. The setting of the well tool is accomplished by exposing the pressure actuated means D to a hydraulic pressure which will actuate the means D to move the lower abutment, the lower end of the lower expander 30, toward the upper abutment 17. This relative movement will set the sealing assembly A and the anchoring assembly B as hereinafter more fully explained in detail. The actuation of the pressure actuated means D to set the well tool will not disturb the releasing assembly R.

The pressure actuated means D is actuated by dropping a ball 58 downwardly through the tubing string T until it seats on the internal seat 11 in mandrel 10 and thereafter pressurizing the tubing string T. Pressure within the mandrel 10 will be conducted through the ports 54 and 55 into the chamber 35 to cause the lower expander 30 to try to move upwardly within the chamber 35. Shear pins 39, 34 and 33 will all resist such movement. The pressure will also attempt to force ring 36 downwardly, but its connection to inner sleeve 40, the engagement of snap ring 41 with sleeve 40 and the engagement of snap ring 41 on shoulder 42 will prevent such downward movement of ring 36.

Since it is desired that in setting the tool of the present invention the sealing assembly A be moved to set position first, the shear pins 39, 34 and 33 are designed to have different strengths with shear pin 39 being the weakest, designed to fail first, and shear pin 34 the strongest, designed to fail last.

Pressure in chamber 35 will therefore move lower expander 30, piston ring 47 and locking segments 51 upwardly when shear pin 39 fails. The shear pins 33 and 34 will hold and the whole anchoring assembly B will be moved upwardly as a unit as illustrated in FIGURE 2. This upward movement will be transmitted through the upper expander 23 to the lower abutment ring 21 of the seal assembly A. This moves the ring 21 upwardly with respect to tubular support 12 and upper abutment ring 17, thereby moving the sealing elements 18 and 20 outwardly into sealing engagement with the interior of the well casing P. The position of the well tool with sealing assembly A set as described is illustrated in FIGURE 2.

With sealing assembly A set, it will resist further upward movement of lower expander 23. Thereafter, shear pin 33 will shear responsive to the force exerted by the pressure actuating means D. With pin 33 sheared and expander 23 held by seal assembly A against upward movement, the force developed by pressure actuating means D will move the remainder of anchoring assembly B upwardly. This movement will result in the gripping elements 28 being forced out through the ports 29 by engagement with the sloping surface of upper expander 23. The gripping elements 28 will be moved into pipe-gripping engagement with the interior of the casing P as shown in FIGURE 3. When the gripping elements are set sufficiently to resist further upward movement, shear pin 34 will be sheared and lower expander 30 will be moved upwardly under the gripping elements 28 to assure that they are in gripping engagement with the casing P. This pipe-gripping position is illustrated in FIGURE 4. Further, both piston ring 47 and the locking segments 51 will have moved upwardly with respect to inner sleeve 40. The shape of the teeth on segments 51 will resist any downward movement of lower expander 30 through con-

tact of the sloping surfaces 52 and 53 to thereby lock the sealing assembly A and the anchoring assembly B in set position. The pressure in chamber 35 will be exerted against piston ring 47 to urge locking segments 51 upwardly to maintain their inclined surfaces 52 against the inclined surface 53 of expander 30. The snap ring 48 will also assure that piston ring 47 and locking segments 51 move upwardly with lower expander 30.

Thus, the well tool has been sequentially and completely set by the pressure actuated means D responsive to pressure in the tubing string T and mandrel 10. The ball 58 is then removed from mandrel 10 and tubing string T. As stated, the reduction of pressure on the unit will not unset the unit as the movement of the pressure actuated means D has been followed by the locking segments 51 which will prevent any unsetting of the unit even though pressure in the chamber 35 is completely released. While shear pins 33, 34 and 39 have all been sheared in the setting of the well tool, the shear pin 14 has not been sheared. Under all normal operating conditions to which the well tool will be exposed the shear pin 14 will be protected from exposure to forces which might be sufficient to cause the pin 14 to be sheared. While the abutment ring 17 serves as the usual upper abutment for the setting of the tool, it will not impart any force to the shear pin 14 during setting or when the seal is subjected to differential pressure from below since the shoulder of tubular support 12 is in engagement with the snap ring 41 which is locked into sleeve 40. Sleeve 40 is held down during setting by ring 36. Sleeve 40 is held down after setting by locking segments 51. Even when the well tool is exposed to pressure differentials, the maximum amount of pressure area which could be transmitted to shear pin 14 would be the cross-sectional area of the mandrel 10. This area, considering the usual pressures encountered in a well bore, would not shear the pin 14. In special circumstances it might be necessary to block off the lower end of the tubing below mandrel 10, and then a pressure differential from below the well tool would be exerted over the total area of the tubing string and could be sufficient to shear the pin 14. In this case pin 14 would have to be made stronger than the pin normally used and, of course, as a consequence, a stronger upward pull would be required to release the packer. If in an emergency it was necessary to plug the tubing with normal pins 14 installed, then it is only necessary to place some of the weight of the tubing string T above the well tool on the tool once it has been set. This weight would have the effect of counterbalancing any force on shear pin 14 resulting from a pressure differential across a blocked tubing string below the well tool.

With the well tool completely set as illustrated in FIGURE 4, it will hold pressure differentials in both directions without moving in either direction. When the well tool is subjected to a higher pressure at the top of the sealing assembly A, such pressure will exert a downward force on the upper expander 23 which will act through the tapered surface to tend to set the gripping elements 28 tighter against the casing P and hold the packer in place. A higher pressure below the sealing assembly A will exert an upward force against the abutment ring 17 and tubular support 12. This force is transmitted to the snap ring 41, through the sleeve 40 and the locking segments 51 to exert an upward force on the lower expander 30 which will tend to set the gripping elements 28 tighter against the casing P and hold the well tool in place.

Release of the well tool is accomplished by lifting on the tubing string T with a force sufficient to shear the shear pin 14. When the pin 14 is sheared, an upward movement of the tubing string T will move mandrel 10 and the coupling C upwardly with respect to tubular support 12 and inner sleeve 40. This movement will continue until shoulder 16 on the ring 15 engages shoulder 13 on coupling C.

This movement of mandrel 10 and coupling C relative to support 12 will effect the removal of the means holding the release means inactive. This is accomplished by the movement of the skirt S out from behind the snap ring 41. Once the skirt S of coupling C is withdrawn, then the release means, the snap ring 41, is free to expand out of the grooves in the upper end of inner sleeve 40. This expansion of snap ring 41 releases sleeve 40 to allow relative movement between sleeve 40 and mandrel 10 until the ring 36 comes into engagement with the external shoulder 57 on the lower portion of the mandrel 10.

The relative movement of parts will accomplish the release of sealing assembly A and anchoring assembly B even though the pressure actuated means D remains locked in its extended position. The initial movement between the coupling C and the support 12 will uncover the port 12*b* through the support 12. The movement of mandrel 10 upwardly relative to inner sleeve 40 will uncover the port 56 through mandrel 10. The uncovering of the ports 12*b* and 56 provides a flow passageway through which the well fluids above the well tool may be unloaded or drained into the tubing. Continuing the lifting of the tubing string T will cause engagement between shoulders 15 and 16 and lift abutment ring 17 to release the sealing assembly A. The port 12*a* provides an outlet for any fluids trapped between the shoulders 15 and 16 on the inside of support 12.

The tubular support 12 will continue upward until the snap ring 22 engages the lower abutment ring 21, at which time sealing assembly A will be completely unset. Thereafter, the lifting of support 12 will raise upper expander 23 out from under the gripping elements 28. Upper expander 23 will continue to move upwardly until its shoulder 24 engages the shoulder 27 on the cage ring 26. Continued lifting of the tubing string T will cause the gripping elements 28 to tilt inwardly at their upper ends because of the lower flattened teeth and to release their engagement with the interior of the casing P. The action of these gripping elements in releasing, as mentioned above, is more completely disclosed and explained in the pending application of Cicero C. Brown, Ser. No. 299,982, filed Aug. 5, 1963, and entitled, "Anchoring Means Assembly," now Patent No. 3,294,172.

When the well tool is completely released, the support 12 will have moved up above the end of inner sleeve 40 so that fluid can pass through the ports 12*b* downwardly within support 12 and around mandrel 10 and sleeve 40 and out through the ports 23*a* in the upper expander 23 to establish a pressure equalizing bypass around the sealing assembly A. This bypass passageway greatly facilitates the retrieval of the well tool.

With the anchoring assembly B completely released, the well tool may then be retrieved by pulling it out of the well casing. Since the connection of inner sleeve 40 to mandrel 10 has been released, the shoulder 57 on the lower exterior of the mandrel 10 will engage the ring 36 as shown in FIGURE 5 to assure that the whole tool is removed.

From the foregoing it can be seen that the well tool of the present invention includes a single anchoring assembly which will resist movement in both directions within a well pipe and which may be released and retrieved by a straight line upward pull on the support for the well tool. Also, the well tool can be sequentially set in a well pipe by actuation of a pressure actuated means which sets the single anchoring assembly against both up and down movement and which includes a release means which is held inactive against premature accidental release until release is desired and then such release means is actuated by a straight upward pull on the support on which the well tool is mounted. The well tool also is set by pressure and released by an upward pull and is held in position by a single anchoring assembly against movement in either direction resulting from pressure differentials even when the setting pressure is completely released.

What is claimed is:

1. A well tool adapted to be set in a well pipe including:
a mandrel,
an anchoring assembly surrounding said mandrel,
means for setting said anchoring assembly within a well pipe,
means for locking said setting means in set position to prevent return of said setting means to its unset position,
said anchoring assembly when set holding said tool in said well pipe against movement in either direction, and
a releasing assembly providing a connection between said setting means and said mandrel whereby lifting of said mandrel effects release of said releasing assembly and unsets said anchoring assembly.

2. A well tool adapted to be set in a well pipe including:
a mandrel,
an anchoring assembly surrounding said mandrel,
pressure actuated means connected to said anchoring assembly,
means conducting pressure fluid to said pressure actuated means,
movement of said pressure actuated means responsive to fluid pressure setting said anchor into pipe-gripping engagement with said well pipe,
means locking said pressure actuated means in actuated position to prevent return of the pressure actuated means to its unset position, and
a releasable connection between said mandrel and said pressure actuated means,
lifting said mandrel effecting release of said releasable connection and unsetting said anchoring assembly.

3. A well tool according to claim 2 wherein said anchoring assembly comprises:
a cage,
an upper expander,
a lower expander spaced therebelow, and
gripping elements spaced about and coacting with the expanders,
movement of the expanders toward each other expanding the gripping elements into pipe-gripping position.

4. A well tool according to claim 3 wherein
the upper portion of the outer surface of each of said gripping elements having a gripping area for gripping the wall of a well pipe and the lower portion of said outer surface having a non-gripping area whereby when said mandrel is lifted said upper expander is moved out from under said gripping elements and continued movement of said upper expander applies an upward force through said cage to the gripping elements to release the gripping elements from the holding action of the lower expander member and thereafter the well tool may be removed from the well bore.

5. A well tool adapted to be set in a well pipe including:
a mandrel,
a tubular support,
an anchoring assembly,
pressure actuated means,
means conducting fluid pressure to said pressure actuated means,
said pressure actuated means connected to said anchoring assembly whereby movement of said pressure actuated means sets said anchoring assembly into pipe-gripping engagement with said well pipe,
a first releasable connection between said mandrel and said tubular support, and
a second releasable connection between said tubular support and said pressure actuated means,
said tubular support holding said second releasable connection inactive,
release of said first releasable connection between said mandrel and said tubular support effecting release of said connection between said tubular support and said pressure actuated means,
lifting of said mandrel releasing said first releasable connection between said mandrel and said tubular support, releasing said second releasable connection and unsetting said anchoring assembly from pipe-gripping engagement with said well pipe.

6. A well tool adapted to be set in a well pipe including:
a mandrel,
a tubular support surrounding said mandrel,
a releasable connection between said mandrel and said tubular support preventing longitudinal movement between said mandrel and said tubular support,
an anchoring assembly encircling said mandrel and comprising a cage, an upper expander, a lower expander spaced therebelow and gripping members spaced about and coacting with the expanders,
movement of the expanders toward each other expanding the gripping members into pipe-gripping position and movement of the expanders away from each other allowing said gripping members to retract from pipe-gripping position,
an abutment secured to said mandrel,
pressure actuated means on said mandrel and having two parts movable longitudinally relative to each other, one part being releasably attached to said mandrel and the other part being attached to one of said expanders, said one part also being releasably attached to the anchoring assembly,
said anchoring assembly housing being releasably attached to said upper expander and releasably attached to said lower expander,
movement of said parts of said pressure actuated means in one direction effecting release of said one part from said housing to move said anchoring assembly against said abutment and movement of said parts in said one direction thereafter effecting release of said housing from said expanders and effecting a relative movement of the expanders in a direction to move the upper and lower expanders with respect to each other to thereby urge the gripping members into pipe-gripping position, and
means for conducting a pressure fluid to the parts of said pressure actuated means to move the parts thereof in that direction which urges the gripping members into pipe-gripping position,
the upper portion of the outer surface of each of said gripping elements having a gripping area for gripping the wall of a well pipe and the lower portion of said outer surface having a non-gripping area,
a releasable connection between said tubular support and said pressure actuated means,
upward movement of said mandrel initially releasing said connection between said mandrel and said tubular support, releasing said connection between said tubular support and said pressure actuated means and moving said upper expander out from under said gripping elements,
continued upward movement of said upper expander applying an upward force through said cage to the gripping elements to release the gripping elements from the holding action of the lower expander member, whereby the assembly may be removed from the well bore.

7. A well tool adapted to be set in a well pipe including:
a mandrel,
a tubular support surrounding said mandrel,
a releasable connection between said mandrel and said tubular support preventing longitudinal movement between said mandrel and said tubular support,
an anchoring assembly encircling said mandrel and comprising a cage, an upper expander, a lower expander spaced therebelow and gripping members spaced about and coacting with the expanders,
movement of the expanders toward each other expanding the gripping members into pipe-gripping position and movement of the expanders away from each

other allowing said gripping members to retract from pipe-gripping position,

an abutment secured to said mandrel,

pressure actuated means on said mandrel and having two parts movable longitudinally relative to each other, one part being releasably attached to said tubular support and the other part being attached to one of said expanders, said one part also being releasably attached to the anchoring assembly housing,

said anchoring assembly housing being releasably attached to said upper expander and releasably attached to said lower expander,

movement of said parts of said pressure actuated means in one direction effecting release of said one part from said housing to move said anchoring assembly against said abutment and movement of said parts in said one direction thereafter effecting release of said housing from said expanders and effecting a relative movement of the expanders in a direction to move the upper and lower expanders with respect to each other to thereby urge the gripping members into pipe-gripping position, and

means for conducting a pressure fluid to the parts of said pressure actuated means to move the parts thereof in that direction which urges the gripping members into pipe-gripping position,

the lower teeth on each of said gripping elements being flattened whereby lifting of said mandrel will release said releasable connection between said mandrel and said tubular support and continued upward movement of said mandrel will pull the upper of said expanders from under said gripping elements and said gripping elements will rock loose from pipe-gripping position to thereby cause complete release of said tool from said well pipe,

lifting said mandrel effecting release of said releasable connection between said mandrel and said tubular support and also release of the attachment of said one part of said pressure actuated means and said tubular support whereby said upward movement of said mandrel will release the set of said sealing elements and will cause said upper expander to be lifted from under said gripping elements and continued upward movement of said mandrel moving said upper expander to apply an upward force through said cage to the gripping elements to release the gripping elements from the holding action of the lower expander member whereby the well tool may be removed from the well bore.

8. A well tool adapted to be set in a well pipe including:

a mandrel,

a tubular support surrounding said mandrel,

a releasable connection between said mandrel and said tubular support preventing longitudinal movement between said mandrel and said tubular support,

a sealing assembly surrounding said tubular support having an upper abutment ring, a sealing element and a lower abutment ring,

relative movement of said abutment rings toward each other moving said sealing element into sealing engagement with said well pipe,

an anchoring assembly encircling said mandrel and comprising a cage, an upper expander, a lower expander spaced therebelow and gripping elements spaced about and coacting with the expanders,

movement of the expanders toward each other expanding the gripping elements into pipe-gripping position and movement of the expanders away from each other allowing said gripping elements to retract from pipe-gripping position,

the upper portion of the outer surface of each of said gripping elements having a gripping area for gripping the wall of a well pipe and the lower portion of said outer surface having a non-gripping area,

pressure actuated means on said mandrel and having two parts movable longitudinally relative to each other, one part being secured to said mandrel and the other part being attached to said expanders, said one part also being releasably attached to the anchoring assembly cage,

said anchoring assembly cage being releasably attached to said upper expander and also releasably attached to said lower expander,

movement of said parts of said pressure actuated means in one direction effecting release of said one part from said cage to move said anchoring assembly toward said sealing assembly whereby said sealing assembly is set,

continued movement of said parts in said one direction thereafter effecting release of said cage from said upper expander and effecting a relative movement of said upper expander and said gripping elements to thereby urge said gripping elements into pipe-gripping position,

continued movement of said parts in said one direction thereafter effecting release of said lower expander and effecting a relative movement of said lower expander and said gripping elements to further urge said gripping elements into pipe-gripping position,

means for conducting a pressure fluid to the parts of said pressure actuated means to move the parts thereof in that direction which urges the gripping elements into pipe-gripping position,

lifting said mandrel effecting release of said releasable connection between said mandrel and said tubular support and also release of the attachment of said one part of said pressure actuated means and said tubular support whereby said upward movement of said mandrel will release the set of said sealing elements and will cause said upper expander to be lifted from under said gripping elements and continued upward movement of said mandrel moving said upper expander to apply an upward force through said cage to the gripping elements to release the gripping elements from the holding action of the lower expander member whereby the well tool may be removed from the well bore, and

a lower abutment on the exterior of said mandrel whereby after said release of parts of said pressure actuated means from attachment to said mandrel said parts will be supported by said lower abutment for removal of the well tool from the well bore.

9. A well tool according to claim **8** wherein said pressure actuated means comprises:

an inner sleeve surrounding said mandrel and releasably attached to said mandrel,

a ring secured to one end of said inner sleeve,

an outer sleeve secured to said ring and releasably attached to said cage of said anchoring assembly,

said sleeves and said ring defining a chamber,

said lower expander positioned in said chamber to move therein responsive to fluid pressures.

10. A well tool according to claim **9** including:

a snap ring engaging said inner sleeve and said tubular support whereby upon release of said releasable attachment between said tubular support and said mandrel said snap ring will be released from engagement with said inner sleeve allowing relative movement of said mandrel and said inner sleeve to effect complete release of said well tool.

11. A well tool according to claim **10** wherein:

the lower end of said lower expander forms an annular piston in said chamber, and

locking means allowing upward movement of said lower expander with respect to said chamber and preventing downward movement of said lower expander with respect to said chamber.

12. A well tool according to claim 11 wherein said locking means includes:

locking segments having an inclined surface engaging with a surface on said lower expander whereby upward movement of said lower expander moves said segments upwardly and a downward force of said lower expander forces said locking segments into locking engagement with one wall of said chamber to prevent downward movement of said lower expander.

13. A well packer adapted to be set in a well pipe and supported on a tubing string including:

a releasable connection between the well packer and the tubing to allow limited longitudinal movement of the tubing relative to the well packer during release of the packer,

an upper abutment,

a lower abutment,

a mandrel on which said abutments are mounted,

said abutments being spaced apart a fixed distance,

an expandable sealing means,

an expandable anchoring means,

a pressure actuated setting means mounted on said mandrel and adapted to move one of said abutments toward the other to thereby confine and force said sealing means and said anchoring means outward into pipe engaging position,

a locking means to hold the setting means in the actuated position, and

a releasable connection between one of the abutments and the mandrel whereby a straight upward pull on the tubing on which the packer is mounted will release the releasable connection between the tubing and packer and allow limited relative longitudinal movement of the tubing, which movement will disconnect the releasable connection between the abutment and the mandrel and allow the abutments to be moved apart to effect a release of the formerly confined seal and anchor means.

14. A well packer as set forth in claim 13 wherein:

said releasable connection between the tubing and the well packer having only a negligible area effected by differential pressure so that under normal well pressures premature release of this connection is prevented.

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JAMES A. LEPPINK, *Primary Examiner.*