Feb. 28, 1967 J. E. EDWARDS, JR 3,306,359

WIRE LINE WELL TOOL

Filed April 27, 1964 3 Sheets-Sheet 1

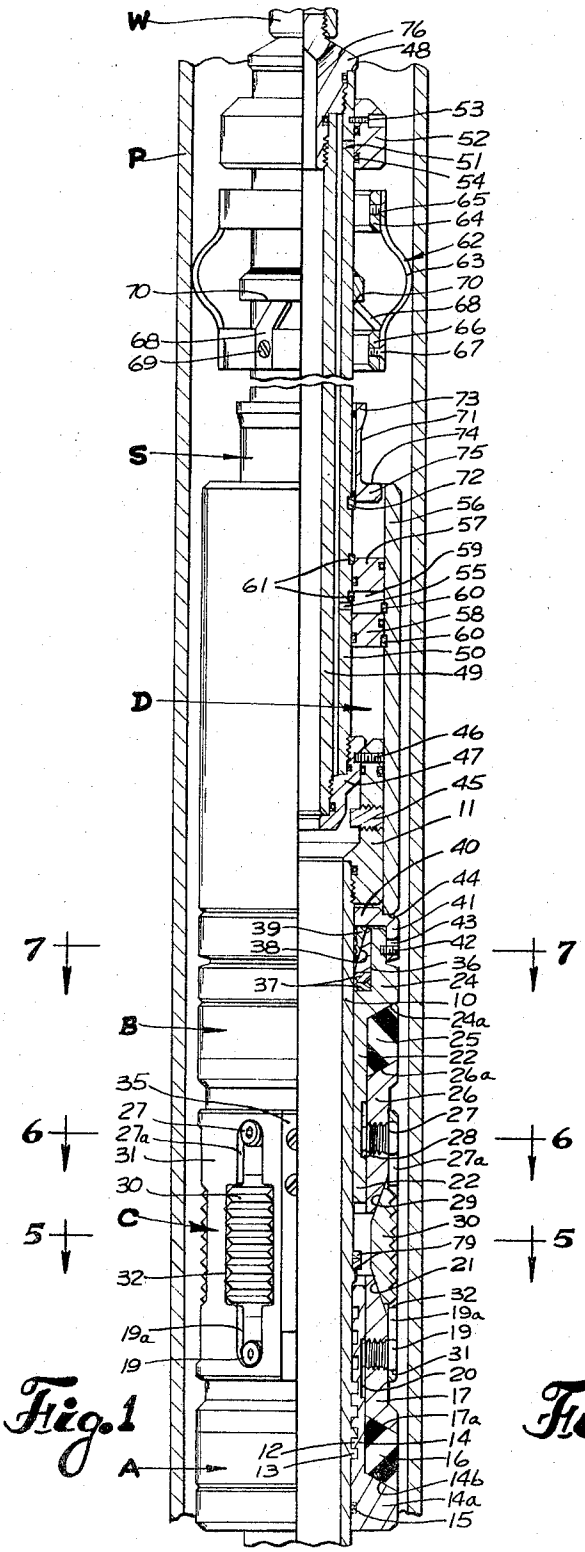



Fig. 1

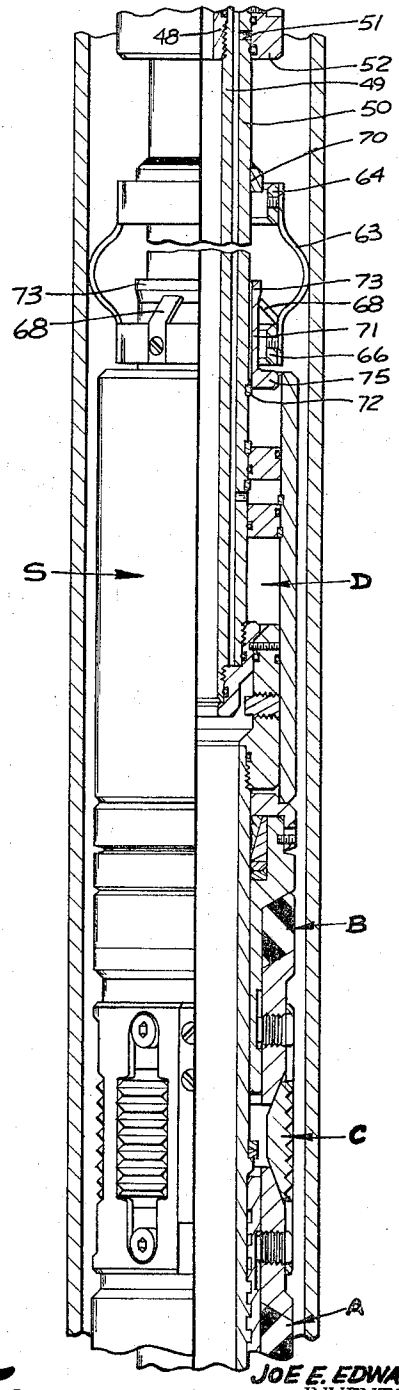



Fig. 2

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WIRE LINE WELL TOOL

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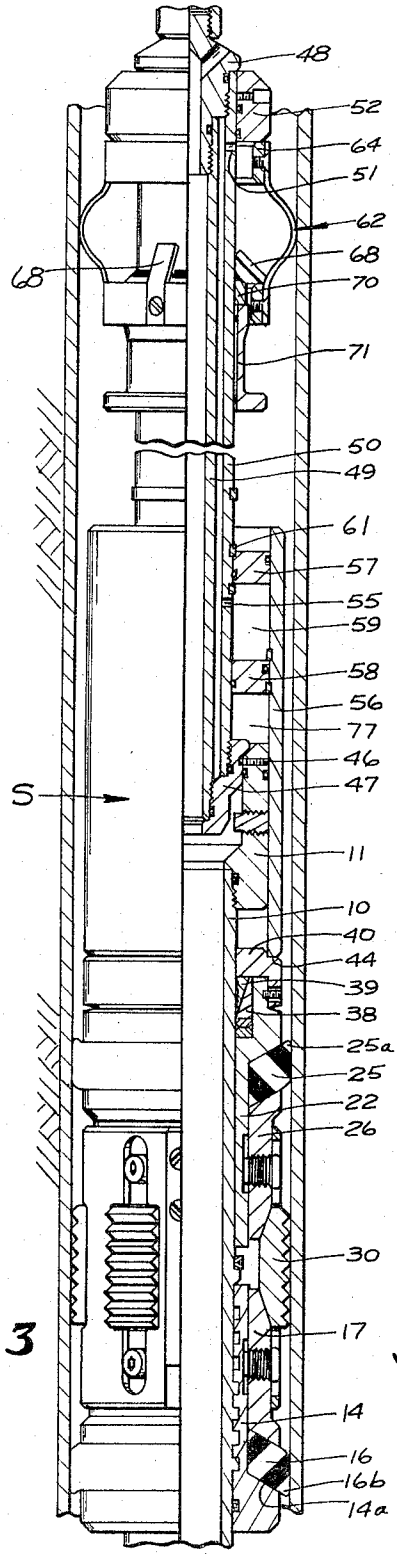



Fig. 3

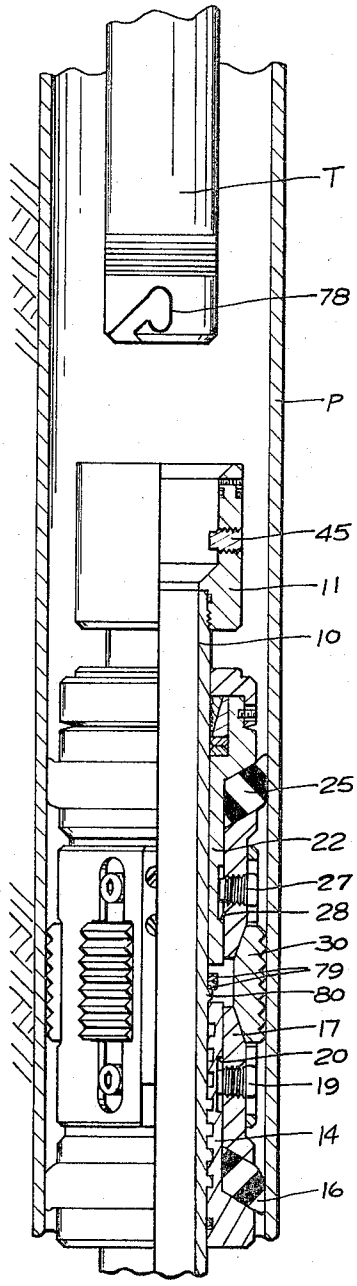



Fig. 4

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WIRE LINE WELL TOOL

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Fig. 5

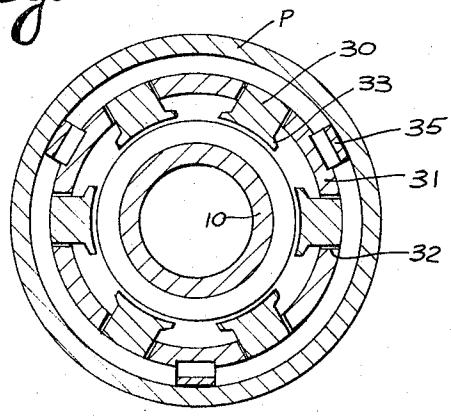



Fig. 6

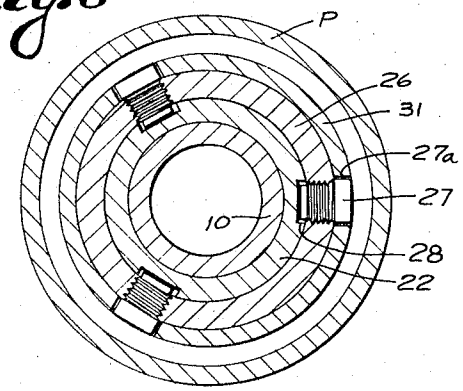



Fig. 7

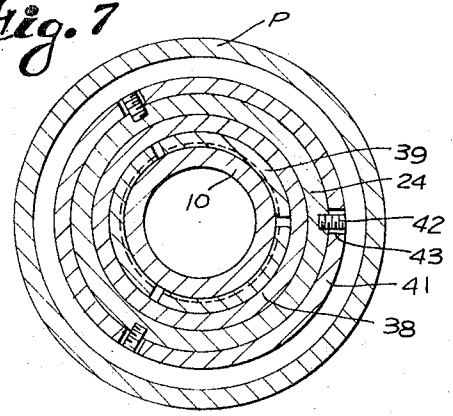
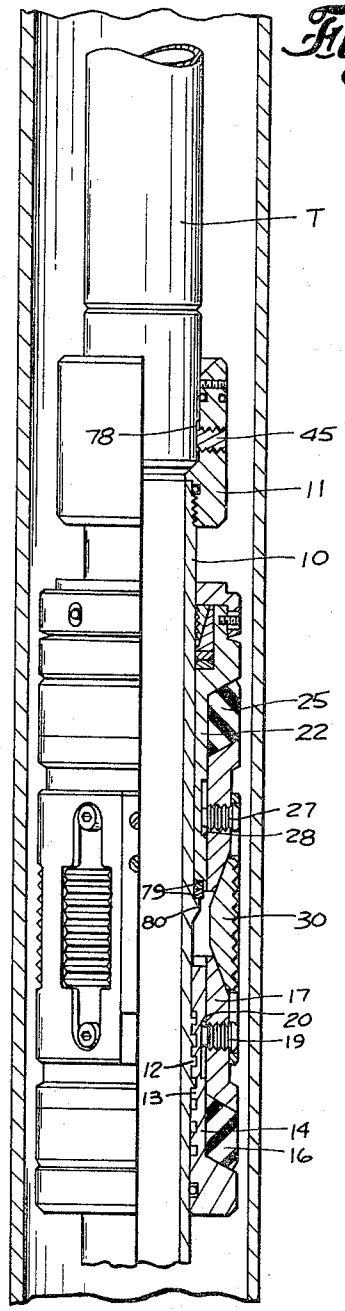



Fig. 8




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United States Patent Office 3,306,359 Patented Feb. 28, 1967



3,306,359

# WIRE LINE WELL TOOL

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Filed Apr. 27, 1964, Ser. No. 362,622
14 Claims. (Cl. 166—120)

This invention relates to new and useful improvements in well tools, and relates particularly to a retrievable packer, anchor or bridging plug apparatus adapted to be set in well casing or similar conduits disposed within well bores.

One object of the invention is to provide a well packer, anchor, or bridging plug apparatus capable of being run and anchored in a well pipe, such as a casing, against longitudinal movement in both directions and being so constructed that it may be positively released from said position to permit it to be removed and retrieved whenever desired.

Another object is to provide a well packer, anchor or bridging plug apparatus adapted to be run in on a wire line and to be anchored in a well casing against both up and down movement and which is preferably set by hydrostatic head pressure within the well casing and which may be subsequently released by rotation of the production tubing or pipe string to which it is attached, whereby said string may be utilized to remove said apparatus from the well.

An important object is to provide an apparatus, of the character described, in which spaced assemblies are associated with an anchoring means, which assemblies and anchoring means are adapted to be set and anchored within a well pipe by means of fluid pressure and are releasable by rotation of the tubing or other string connected with the apparatus; the construction being such that a positive force is applied directly to the anchoring means during the releasing operation to assure release of said assemblies from their set and anchored position.

Another object is to provide a well packer apparatus wherein each sealing element is supported upon a mandrel which encircles the main support of the apparatus and also wherein each sealing element is connected with the expander member which connects with anchoring means; each expander member having a lost motion connection with one of the mandrels whereby, after the anchoring means has been set, the mandrels may undergo sufficient movement with respect to the expanders to assure proper deformation of the sealing elements into sealing position.

A further object is to provide a well packer, anchor, or bridging plug apparatus which has means for anchoring it in a well pipe against movement in both longitudinel directions; which is run into the well pipe on a wire line; which is simple and compact in construction; which is moved to set position by hydraulic pressure; which requires no auxiliary hold-down gripping members; and which is provided with a mechanical means which maintains it in set and anchored position, whereby the pressure which affects the setting may be subsequently relieved and yet the apparatus will be maintained in such set and anchored position.

A further object is to provide a wire line well packer apparatus, wherein the sealing elements of the sealing assembly are constructed and arranged so that upon being moved into set position, each sealing element will function in the manner of a sealing cup, whereby any pressure tending to flow past the sealing assembly will act upon the element to move it into tighter sealing position.

A further object of the present invention is to provide a well packer, anchor or bridging plug apparatus which



may be run into a well casing on a wire line and set in the desired position within the well casing by the hydrostatic head pressure within the well casing, and which may be subsequently released by rotation of a tubing or pipe string engaging the upper portion of the apparatus.

Still another object is to provide a wire line well packer apparatus which is readily lowered through well fluids in a well bore and set responsive to fluid pressure in the well bore.

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

The invention will be more readily understood from reading the following specifications 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 ready for being set and anchored with trip springs on the drag spring assembly being released preparatory to setting and anchoring the apparatus;

FIGURE 3 is a similar view showing the apparatus in its set and anchored position;

FIGURE 4 is a similar view of the apparatus showing the apparatus with the setting tool removed and production tubing being lowered into the device;

FIGURE 5 is an enlarged horizontal cross-sectional view taken along the line **5—5** of FIGURE 1;

FIGURE 6 is an enlarged horizontal cross-sectional view taken along the line **6—6** of FIGURE 1;

FIGURE 7 is an enlarged horizontal cross-sectional view taken along the line **7—7** of FIGURE 1;

FIGURE 8 is a view partly in elevation and partly in section of the apparatus illustrating the position of the parts of the apparatus after it has been released.

In the drawings, the well tool is illustrated as a well packer apparatus although, as will be hereinafter pointed out, it may be employed as a pipe anchor or bridging plug. As shown in FIGURES 1, 2 and 3, the well packer apparatus is connected to the setting tool S which is used during the running of the apparatus into the well on a wire line and during the setting of the tool in the well bore. The well packer apparatus includes the main tubular support **10**, upon which is mounted a lower sealing and expander assembly A, an upper sealing and expander assembly B, and a gripping means unit C. A pressure actuated means, generally indicated at D is contained within the lower portion of the setting tool S, above the upper sealing and expander assembly B. A gripping means unit C is located between the assemblies A and B. Actuation of the pressure actuated means D effects a setting of the gripping means of the unit C and movement of the seals of the assemblies A and B into sealing position. When in set position, the apparatus will be anchored against movement in either direction within a well casing or pipe P which is disposed in the well bore.

Referring specifically to FIGURE 1, the tubular support **10** forms the main supporting element of the apparatus and is threaded and engaged at its upper end to top connection **11**. Top connection **11** is secured to the lower portion of setting tool S as hereinafter more fully described, with the wire line connection W on the upper portion of the setting tool S.

The tubular support **10** projects throughout the length of the apparatus and is provided with relatively coarse

left-hand threads **12** formed in its external surface. The threads **12** are interengaged with complementary threads **13** formed within the bore of mandrel **14** which surrounds the support and which is a part of the lower sealing and expander assembly A. The threads **13** extend from the upper end of the mandrel **14**, but terminate short of the lower end thereof, and a suitable seal ring, such as O-ring **15**, provides a seal between the mandrel **14** and the support **10**. The threaded connection between mandrel **14** and support **10** remains in the position shown in FIGURE 1 during lowering of the apparatus and also while the apparatus remains anchored in the well.

An annular abutment or flange **14***a* is secured to the lower end of mandrel **14** and has its upper end **14***b* inclined inwardly and upwardly. Lower annular sealing element **16** surrounds mandrel **14** with its lower inclined end being supported on inclined surface **14***b* of flange **14***a*. The upper end of sealing element **16** is also similarly inclined and is confined by the lower inclined end **17***a* of lower expander sleeve **17**. The expander sleeve **17** encircles mandrel **14** and is connected therewith by a lost motion connection comprising a pin **19** secured in the expander sleeve **17** and projecting into a longitudinal groove **20** in the exterior of mandrel **14**. The pin **19** and groove **20** prevent rotation of the sleeve **17** on the mandrel **14** while permitting sufficient longitudinal movement between the expander sleeve and the mandrel to apply endwise force to the sealing element to deform it into sealing engagement with the pipe as shown in FIGURE 3; when in such position the lower peripheral portion of the sealing element forms a downwardly directed sealing lip **16***a*. The upper end of lower expander sleeve **17** is inclined inwardly and upwardly to form inclined expander surface **21** which is adapted to co-act with the gripping means of the unit C as will be hereinafter explained.

The upper sealing and expander assembly B, which is generally of similar construction to the lower assembly A, is spaced upwardly therefrom on support **10**. The assembly B includes a mandrel **22** which encircles said support having an annular external flange **24**. The lower surface **24***a* of flange **24** is inclined inwardly and downwardly. The upper sealing element **25** surrounds said mandrel with its upper surface abutting flange surface **24***a* and its lower surface confined by the upper inclined end **26***a* of upper expander sleeve **26**. Upper expander sleeve **26** encircles the mandrel **22** and is connected therewith by a lost motion connection comprising a pin **27** secured in the expander sleeve and projecting into a longitudinal groove **28** in the exterior of mandrel **22**. The pin **27** in groove **28** prevents rotation of sleeve **26** on the mandrel **22** while permitting sufficient longitudinal movement between said expander sleeve and mandrel to apply endwise force to the sealing element **25** to deform it into sealing engagement with the pipe as shown in FIGURE 3; when in such position, the upper peripheral portion of the sealing element forms an upwardly directed sealing lip **25***a*. The lower end of upper expander sleeve **26** is inclined inwardly and downwardly as shown at **29** and such inclined surface is adapted to connect with the gripping means of the unit C.

The gripping means unit C includes a plurality of gripping slips **30** which are mounted within a tubular slip carrier housing **31**. The housing **31** is located between the lower sealing and expander assembly A and the upper sealing and expander assembly B and encircles portions of expander sleeves **17** and **26**, being connected therewith by the pins **19** and **27** which project outwardly from the expander sleeves into the slots **19***a* and **27***a* cut in the housing **31**. The pins **19** and **27** non-rotatively couple the slip carrier housing to the expander sleeves, but permit longitudinal movement of the expander sleeves relative to said housing, and to the gripping slips **30** carried by said housing. The gripping slips **30** are movable radially through slots **32** formed in the housing and their outward displacement from the housing is limited by longitudinally extending stop ribs or projections **33** which are formed at the rear side portion of each slip member (FIGURE 5). The usual friction springs **35**, which drag on the bore of the well pipe as the device is lowered, are secured to the exterior of the slip carrier housing **31**.

When expander sleeves **17** and **26** are moved toward each other from the position shown in FIGURE 1, their respective inclined surfaces **21** and **29** co-act with complementary inclined surfaces on the inner surface of each slip member **30** and thereby move said slip members radially outward into gripping position with the wall of the well casing or pipe P. A continued upward movement of the lower mandrel **14** with respect to the lower expander sleeve **17**, which movement is permitted by the lost motion connection **19**, **20**, applies endwise force to the lower seal **16** to deform it into sealing position. Continued downward movement of the upper mandrel **22** with respect to its expander sleeve **26**, which is permitted by the lost motion connection **27**, **28**, results in the application of an endwise force to the upper sealing element **25** to deform it into sealing position. Thus, the sealing elements are moved into sealing engagement with the wall of the well casing or pipe P as shown in FIGURE 3.

As has been noted, the lower peripheral edge portion **16***a* of the lower sealing element provides a sealing lip exposed to the pressure below the apparatus; similarly, the upper peripheral edge portion **25***a* of the upper sealing element **25** forms an upwardly directed lip which is exposed to the pressure above the apparatus. Therefore, any pressure tending to displace the apparatus in either direction acts against one of these sealing elements which transmits additional force to the expander to thereby wedge the slips into tighter engagement with the well pipe and assure the anchoring of the apparatus within the pipe.

The upper interior of mandrel **22** is counterbored as at **36** to receive bearings **37**, cone **38** and lock slips **39**. Actuator ring **40** surrounds support **10** and is provided with an outer depending flange **41** which is connected to mandrel **22** in a nonrotative sliding connection by pin **42**, threadedly engaging the exterior of mandrel **22** and positioned in slot **43** in flange **41**. The upper portion of ring **40** is provided with recessed shoulder **44** for cooperation with portions of the setting tool S as hereinafter more fully explained.

Top connection **11**, which is threadedly engaged to the upper portion of support **10**, is provided with a J pin **45** threaded therein and extending into the interior of top connection **11**. The top connection is releasably secured to setting tool S by shear pin **46**, which extends through the upper portion of top connection **11** into bottom cap **47**.

The setting tool S is provided with the bottom cap **47** and the top cap **48** which are both threadedly connected and sealed to inner and outer mandrels **49** and **50**. Wire line connection W is threadedly connected to top cap **48** as shown. Outer mandrel **50** is provided with upper ports **51** which are sealed by sleeve **52**. Sleeve **52** is detachably connected to outer mandrel **50** by shear pin **53** and is provided with seals **54** positioned above and below ports **51** to effectively close off ports **51** while the tool is being run into the well as shown in FIGURE 1. Ports **55** extend through outer mandrel **50** into the area which is defined by cylinder **56**, upper piston **57**, lower piston **58**, and the exterior surface of outer mandrel **50**. This space so defined is the setting chamber **59**. The lower portion of cylinder **56** rests upon shoulder **44** of actuator ring **40** and extends upwardly therefrom in sealing relationship to top connection **11**. Lower piston **58** is secured to the inner surface of cylinder **56** by the shoulders **60** which may be suitable snap rings as shown and is sealed against the exterior of outer mandrel **50** for sliding engagement therewith. Upper piston **57** is secured to the outer surface of outer mandrel **50** by shoulders **61** which may be suitable snap rings as shown,

and is sealed against the interior surface of cylinder **56** for sliding engagement therewith.

Drag spring assembly **62** is composed of drag springs **63** which are secured to upper ring **64** by screws **65** and to lower ring **66** by screws **67** and tripping springs **68** which are secured to lower ring **66** by screws **69**. Drag spring assembly **62** surrounds the upper portion of outer mandrel **50** and in position for lowering has tripping springs **68** engaging the under side of shoulder **70** which is secured to the outer surface of outer mandrel **50**.

Tripping sleeve **71** surrounds outer mandrel **50** at a position below shoulder **70** and is supported by shoulder **72** on the outer surface of outer mandrel **50** which may be a snap ring as shown. The upper portion of tripping sleeve **71** has an enlargement **73** whose outer diameter is slightly larger than the outer diameter of shoulder **70**. The lower portion of tripping sleeve **71** extends outwardly in flange **74** which terminates short of the interior of cylinder **56** when positioned as shown on FIGURES 1 and 2. The upper surface of flange **74** provides shoulder **75** for engagement with the under surface of ring **66** as hereinafter more fully explained.

Ports **76** extend through upper cap **48** of setting tool S and provide communication between the exterior of setting tool S and the interior thereof to allow fluid to flow through the bore of the packer and setting tool to enable the device to be quickly and easily run into the well on a wire line.

The position of the packer on running into the well casing P is shown in FIGURE 1. It is noted that the drag spring assembly is positioned with tripping springs **68** in engagement with the lower side of shoulder **70**. Shoulder **70** is positioned substantially below sleeve **52** so that the drag occasioned by the engagement of drag spring **63** against the interior of the well casing P will not cause upper ring **64** to engage sleeve **52**.

When the packer has been run into the well to the position where it is to be set, the wire line is raised. The raising of the tool will not raise the drag spring assembly **62**. Thus, tripping sleeve **71** will move upwardly with respect to drag spring assembly **62** and engage tripping spring **68**, causing them to ride outwardly over enlargement **73** to the position shown in FIGURE 2 where lower ring **66** will engage shoulder **75** on flange **74**. When the packer has been lifted sufficiently to achieve this position, the wire line is thereafter quickly lowered and the shoulder **70** will move downwardly against the upper portion of tripping sleeve **71** and continued downward movement will push tripping sleeve **71** out from under tripping springs **68**. Tripping springs **68** will also pass over shoulder **70**. The downward movement will continue until the bottom of sleeve **52** is hit by upper ring **64** of drag spring assembly **62**, drag spring assembly **62** will remain stationary during this downward movement because of its frictional engagement with the inner wall of casing P. The impact force between upper ring **64** and sleeve **52** will be sufficient to shear the light shear pins **53**, whereby sleeve **52** will be moved upwardly exposing port **51** to the hydrostatic fluid head within the well casing P, and drag spring assembly **62** and sleeve **52** will be positioned as shown in FIGURE 3.

The pressure of the hydrostatic fluid head within well casing P will be transmitted through port **51**, through the annular space between inner and outer mandrels **49** and **50** and port **55** into setting chamber **59**. The pressure in setting chamber **59** will force lower piston **58** and cylinder **56** downwardly with the lower portion of cylinder **56** engaging shoulder **44** on actuator ring **40**. It should be noted that the movement of the lower piston **58** and cylinder **56** downwardly is possible since chamber **77** defined by the lower side of lower piston **58**, the upper portion of top connection **11** and lower cap **47** and between mandrel **50** and cylinder **56** will be at atmospheric pressure and the compression caused therein



by the downward movement of lower piston **58** will not be sufficient to resist the pressure of the hydrostatic fluid contained within the well casing. Chamber **77** is at atmospheric pressure since the pressure trapped therein will be the pressure prevalent when the device is assembled. Because the apparatus is normally located at a depth of several thousand feet below the surface, the hydrostatic head pressure is always sufficient to overcome the opposing force of the atmospheric pressure trapped in chamber **77**. As is well known, the hydrostatic head pressure in a well will vary from a few hundred pounds per square inch up to 15,000 pounds per square inch, or more, depending on the depth at which the apparatus is located and, therefore, the force is always sufficient at the depth where the apparatus is located to overcome the atmospheric pressure in the air chamber and set the apparatus.

The downward movement of actuator ring **40** will engage the upper portion of lock slips **39** and move them downwardly on cone **38** into engagement with the exterior portion of support **10**. It should be noted that the teeth on lock slips **39** are such that they will readily move downwardly when in engagement with support **10** but will resist any upward movement. This downward movement of actuating ring **40** will also be transmitted to mandrel **22** to move mandrel **22** downwardly, whereby upper sealing element **25** and upper expander sleeve **26** are moved downwardly.

As upper mandrel **22** moves downwardly, force is transmitted through the upper seal element **25** to the upper expander sleeve **26**; the expander sleeve engages the rear surface of the main gripping slips **30** and first moves the slips downwardly relative to the lower expander **17**, after which the slips are urged regularly outwardly into gripping engagement with the pipe wall. Thereafter, downward motion of the upper expander sleeve **26** is halted but, by reason of the lost motion connection **27**, **28**, the upper mandrel **22** can continue to move downwardly to apply endwise force to the upper sealing element **25** to move it to its set position. Thereafter, further downward movement of the upper mandrel is prevented.

The continued application of pressure within the setting chamber **59** reacts against the upper piston **57** and through shoulder **61** applies an upward force on outer mandrel **50** which transmitted through pins **46** will raise support **10** upwardly relative to the anchored assemblies A and B. Upward movement of the support is possible since it is only necessary to have sufficient pressure to lift the weight of the support and that of the setting tool. As the support **10** moves upward, it pulls the mandrel **14** and its abutment **14***a* upwardly to apply the required endwise force to the lower sealing element **16** to deform the same into sealing position. Upward movement of said lower mandrel relative to the lower expander sleeve **17**, which is anchored by main slips **30**, is permitted by the lost motion connection **19**, **20**. Once the device has been set, the lock slips **39** will prevent any upward movement of mandrel **22** and downward movement of support **10**, and therefore, until the device is unset as hereinafter explained, it will remain set and sealed in the position within the well casing P.

After the packer is set as described, the setting tool S is subjected to an upward jar force. This jar force may be created by a conventional wire line jar installed above upper cap **48**. This jar force shears out the pins **46** between top connection **11** and bottom cap **47**. The shearing of pins **46** will disconnect the setting tool S from the packer and thereafter the setting tool S is withdrawn from the well casing P by the wire line.

Subsequent to the removal of the setting tool S a tubing string T having J-slots **78** may be lowered and moved into engagement with top connection **11** of the device by J-slots **78** engaging the J-pins **45** and production from below the device may be commenced upwardly therethrough into the tubing string T.

Release of the packer is accomplished by rotating the tubing string T to the right. This rotation actuates the threaded connection between support **10** and lower mandrel **14** whereby mandrel **14** is moved downwardly and support **10** is moved upwardly. The downward movement of mandrel **14** will allow lower seal element **16** to relax and further downward movement will cause pin **19** to engage in the upper portion of slot **20** in the exterior mandrel **14** whereby lower expander sleeve **17** is retracted from under gripping slips **30**. The upward movement of support **10** will cause bearings **79** which are mounted on shoulder **80** on the exterior of support **10** to engage the lower portion of upper mandrel **22** moving upper mandrel **22** upwardly to allow seal element **25** to relax and disengage from well casing P. Further upward movement of upper mandrel **22** will cause pin **27** to engage in the lower portion of slot **28** whereby upper expander sleeve **26** will be moved upwardly and thereby allowing slips **30** to be released from well casing P.

Since lower mandrel **14** and lower expander sleeve **17** are non-rotatively engaged and since upper mandrel **22** and upper expander sleeve **26** are also non-rotatively engaged and with pins **19** and **27** projecting into slots **19***a* and **27***a* of housing **31**, the assemblies A, B and C will not be rotated at any time during the release due to the engagement of the friction springs **35** on housing **31** with the interior of well casing P. When the device has been released, it may be removed from the well casing by pulling the tubing string T from the well casing. The fully unset position of the device is illustrated in FIGURE 8.

Although the preferred form of the invention shows the use of two seal elements, the packer would work with only one. For example, if the upper seal alone is used the lower mandrel **14** and lower expander sleeve **17** would be made integral. Also, the outward bevel **26***a* on the upper end of expander **26** would be reversed to an inward bevel. Then, in set position, differential pressure from above would act as before against the seal and be transmitted directly to the expander **17**. However, pressure from below acts against the seal **25**. This upward force is transmitted to the abutment **24***a* and mandrel **22**, lock slips **39**, support **10** and the threaded connection to lower mandrel **14**. This upward force would tend to set the slips **30** tighter preventing any movement of the device.

As mentioned, the device may be used as a bridging plug and in such event would be provided with a lower closure for support **10** or check valve (not shown). In such use of the device, the setting tool S may be made to have a slightly different configuration by eliminating the inner mandrel **49** and making the lower cap **47** solid. Also, the port **76** through upper cap **48** will not be needed since flow through the device and the setting tool will not be possible if the device is closed at its lower end.

As shown and described, the apparatus is a well packer apparatus. However, it may be employed as an anchor tool merely by omitting the sealing elements **16** and **25**. When such sealing elements are omitted, the lower mandrel **14** may be directly connected or made integral with the lower expander **17** while the upper mandrel **22** may be directly connected or made integral with the upper expander sleeve **26**. The operation would be as described with respect to setting the gripping slips **30** to anchor the device against movement in both directions within the well.

The foregoing disclosure and description of the invention is illustrative and explanatory thereof, and various changes in the size, shape and materials, as well as in the details of the illustrated construction, may be made within the scope of the appended claims without departing from the spirit of the invention.

What is claimed is:

**1.** In a well tool adapted to be set in a well pipe including,

a tubular support,



an anchoring assembly encircling the support and comprising 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 retracting said gripping members,

an upper mandrel connected with the upper expander and surrounding the support,

a lower mandrel connected with the lower expander and surrounding the support,

one of said mandrels being slidable on said support and the other of said mandrels being releasably connected to said support,

pressure-actuated means secured to said support and having two parts movable longitudinally relative to each other, one of said parts being connected to said support and the other of said parts being connected to that mandrel which is slidable on said support,

movement of said parts of said pressure-actuated means effecting movement of said upper and lower mandrels 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,

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

means releasably connecting said tubular support to a flexible line whereby said tool may be run into the well pipe on a flexible line.

**2.** A well tool as set forth in claim **1** including,

connecting means on said tubular support for joining said support to production tubing when said means connecting said support to the flexible line has been released and removed whereby well fluids are conducted from below said well tool through said support and into said production tubing.

**3.** A well tool as set forth in claim **2**, wherein rotation of said support relative to that mandrel releasably connected to said support actuates the releasable connection to move the support with respect to said releasably connected mandrel when the gripping members are in gripping position, and

means connecting said support to the slidable mandrel whereby movement between said support and said releasable mandrel results in movement of said mandrels away from each other to positively move the upper and lower expanders in directions releasing the gripping members from pipe-gripping position.

**4.** A well tool as set forth in claim **1**, together with

means establishing communication between the well bore and the means for conducting a pressure fluid to the pressure-actuated means whereby the latter is actuated by the hydrostatic head pressure within the well bore.

**5.** A well tool as set forth in claim **1**, together with

an upper sealing element associated with the upper expander,

a lower sealing element associated with the lower expander, and

means on the upper mandrel and on the lower mandrel coacting with the upper sealing element and lower sealing element respectively to apply endwise force to said sealing elements to deform the same into sealing position after the gripping members have moved into pipe-gripping position.

**6.** A well tool as set forth in claim **1**, together with

locking means actuated by said pressure-actuated means between said slidable mandrel and said support permitting sliding movement therebetween only in a direction to urge said gripping members into pipe-gripping position.

7. In a well tool adapted to be set in a well pipe including,
a tubular support,
an anchoring assembly encircling the support and comprising 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 retracting said gripping members,
a release mandrel connected with the lower expander and surrounding the support,
a releasable connection between said release mandrel and support, preventing longitudinal sliding movement between the mandrel and support,
a second mandrel connected with the upper expander and slidable on the support,
an actuator ring engaging the upper portion of said second mandrel,
pressure-actuated means secured to said support above said actuator ring and having two parts movable longitudinally relative to each other, one part being secured to said support and the second part engaging said actuator ring,
movement of said parts of said pressure-actuated means effecting movement of the release mandrel and the second mandrel 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,
means for conducting a pressure fluid to the parts of the pressure-actuated means to move the parts thereof in that direction which urges the gripping members into gripping position, and
means connecting said pressure-actuated means to a flexible line whereby said tool may be run into the well pipe on the flexible line and after setting said pressure-actuated means may be removed from the well pipe by the flexible line.

8. A well tool as set forth in claim 7, wherein rotation of the support relative to the release mandrel actuates the releasable connection to move the support upwardly with respect to the release mandrel when the gripping members are in gripping position,
means connecting the second mandrel to the support whereby upward movement between the support and release mandrel also results in upward movement of the second mandrel, whereby said mandrels move away from each other to positively move the upper and lower expanders in directions releasing the gripping members from pipe-gripping position.

9. A wire line well tool as set forth in claim 7, including
means releasably connecting said pressure-actuated means to said tubular support whereby said pressure-actuated means may set the tool and then be released from the tool and withdrawn from the well pipe.

10. In a well tool adapted to be set in a well pipe including,
a tubular support,
an anchoring assembly encircling the support and comprising 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 retracting said gripping members,
a release mandrel connected with the lower expander and surrounding the support,
a threaded connection between said release mandrel and support, preventing longitudinal sliding movement between the mandrel and support,
a second mandrel connected with the upper expander and slidable on the support,



pressure-actuated means having a mandrel, a cylinder and piston means forming a setting chamber whereby said cylinder and said mandrel are movable longitudinally relative to each other, said mandrel being releasably connected to said support and means transmitting downward movement of said cylinder to said second mandrel,
movement of said mandrel and said cylinder of said pressure-actuated means effecting movement of the release mandrel and the second mandrel 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,
means for conducting a pressure fluid to said setting chamber of said pressure-actuated means to move the mandrel and cylinder in that direction which urges the gripping members into pipe-gripping position, and
means connecting said pressure-actuated means to a flexible line for lowering the tool in the well pipe.

11. A well tool as set forth in claim 10, together with with
means releasably secured to the mandrel of said pressure-actuated means blocking said pressure fluid conduction means, and
means for releasing said blocking means when the tool is positioned within the well pipe at the desired set position whereby the pressure-actuated means is actuated by the hydrostatic head pressure within the well bore.

12. The subcombination with a well tool apparatus adapted to be set in a well pipe and having a main support defining a central bore, gripping members spaced about said main support and movable outward into pipe-gripping position and inward from pipe-gripping position, and means coacting with said main support to move said gripping members outward and inward of a setting tool comprising,
a mandrel defining a central bore,
a cylinder surrounding said mandrel,
means between said mandrel and said cylinder forming a setting chamber,
means releasably connecting said mandrel with said main support of said well tool apparatus with the central bore of the mandrel in communication with the central bore of said main support,
means providing communication between the central bore of said mandrel and the exterior of said setting tool whereby well fluids flow readily through said central bores and said communication, means during lowering of said well tool apparatus and said setting tool in a well bore,
a flexible line connection to said mandrel, and
means conducting fluid pressure to said setting chamber,
said mandrel and said cylinder being movable longitudinally with respect to each other when fluid pressure is conducted to said setting chamber,
said longitudinal movement of said mandrel and said cylinder actuating said co-acting means whereby said gripping members are moved outwardly into pipe-gripping position.

13. The subcombination as set forth in claim 12, including,
a cap connected to the upper end of said mandrel adapted to receive said flexible line connection,
said cap closing the upper end of said central bore through said mandrel and defining said communication means.

14. The subcombination with a well tool apparatus adapted to be set in a well pipe and having a main support, gripping members spaced about said main support and movable outward into pipe-gripping position and inward from pipe-gripping position and means coacting with said main support to move said gripping members outward and inward, of a setting tool comprising,

an inner mandrel,
an outer mandrel surrounding said inner mandrel,
means closing the annular space formed between said inner and outer mandrels at each end,
means releasably connecting the lower of said closure means to said main support,
a flexible line connection to the upper of said closure means,
a cylinder surrounding the lower portion of said outer mandrel and engaging said coacting means,
a setting chamber formed between said outer mandrel and said cylinder,
a first port extending through said outer mandrel,
a second port extending through said outer mandrel into said setting chamber,
a releasable sleeve normally closing said first port,
a drag spring assembly surrounding said outer mandrel,
said drag spring assembly being held out of engagement with said releasable sleeve during the running of the well tool into the well pipe, and
means releasing said drag spring assembly responsive to upward movement of said tool whereby subsequent



downward movement of said tool causes said drag spring assembly to release said releasable sleeve whereby communication is established from the space surrounding said tool into said setting chamber,
said outer mandrel and said cylinder being movable longitudinally with respect to each other when fluid pressure is conducted to said setting chamber,
said longitudinal movement of said outer mandrel and said cylinder actuating said coacting means whereby said gripping members are moved outwardly into pipe-gripping position.

**References Cited by the Examiner**

UNITED STATES PATENTS

| | | | |
|---|---|---|---|
| 3,011,555 | 12/1961 | Clark | 166—122 |
| 3,057,406 | 10/1962 | Patterson et al. | 166—120 |
| 3,139,140 | 6/1964 | Brown | 166—120 |
| 3,181,614 | 5/1965 | Brown | 166—134 |


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