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RETRIEVABLE WELL PACKER AND ANCHOR

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FIG. 1.

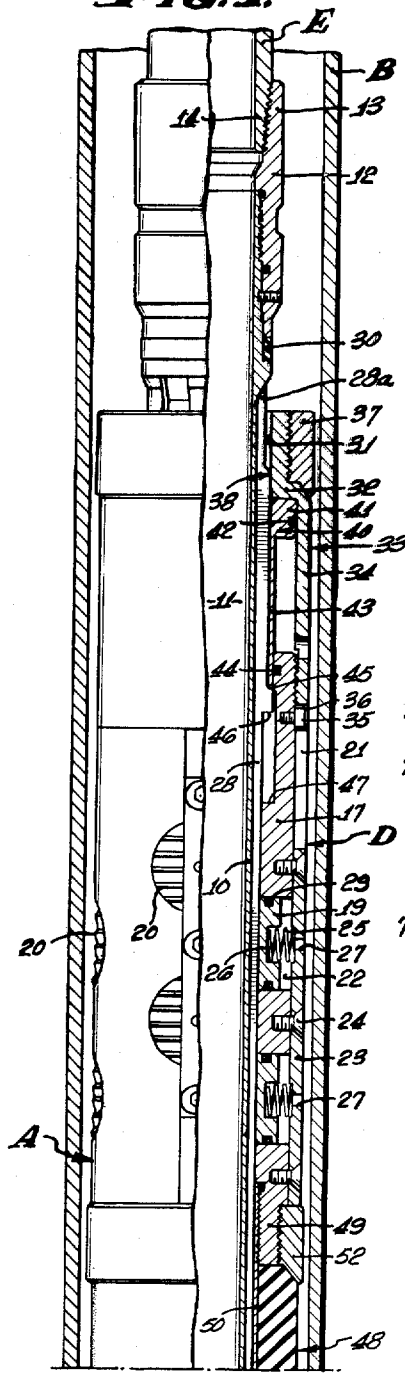


FIG. 1a.

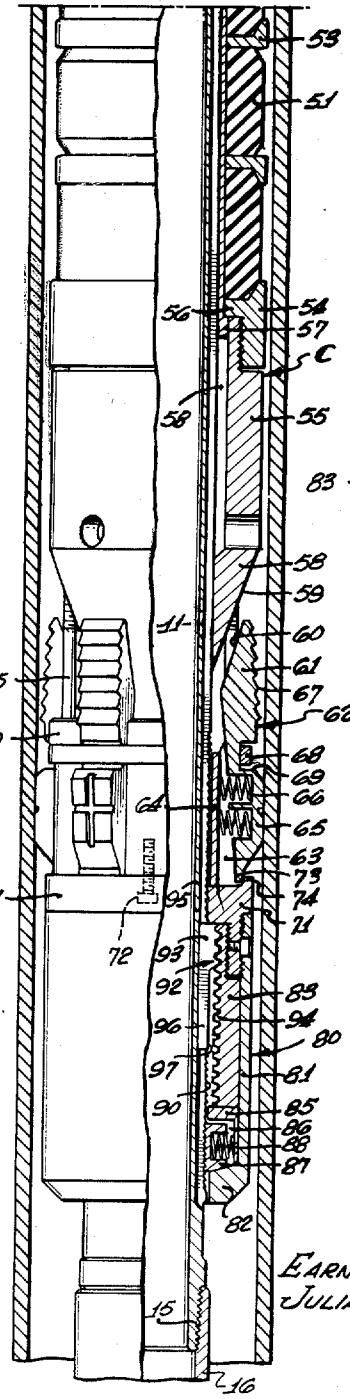
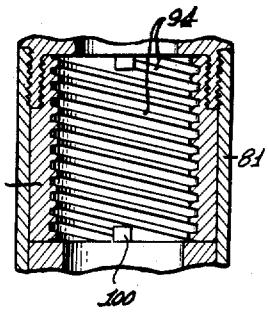


FIG. 11.



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FIG. 2.

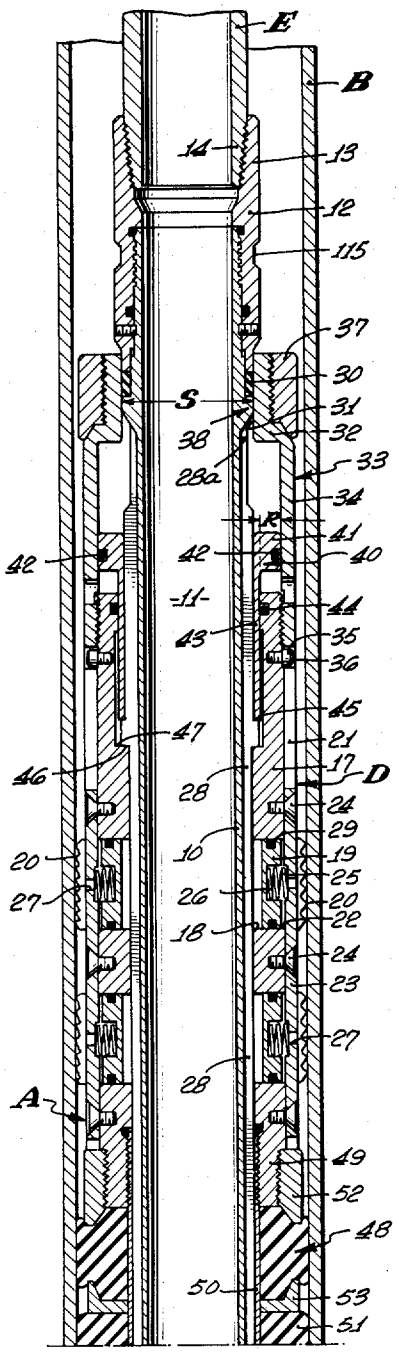


FIG. 2a.

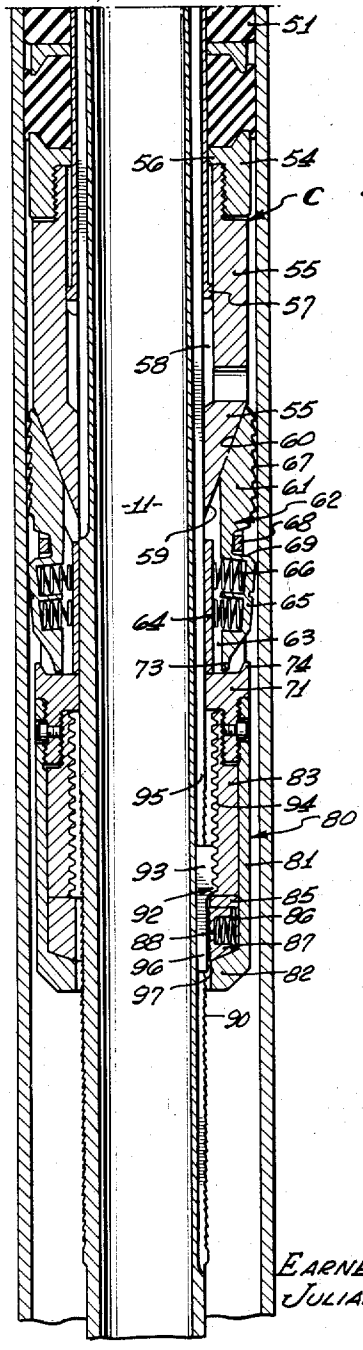
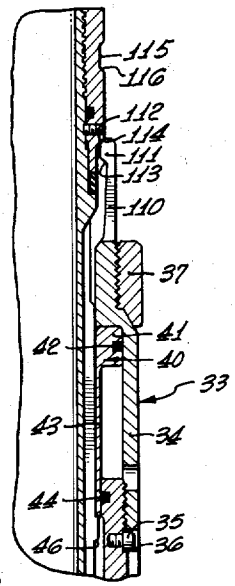


FIG. 10.



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FIG. 3.

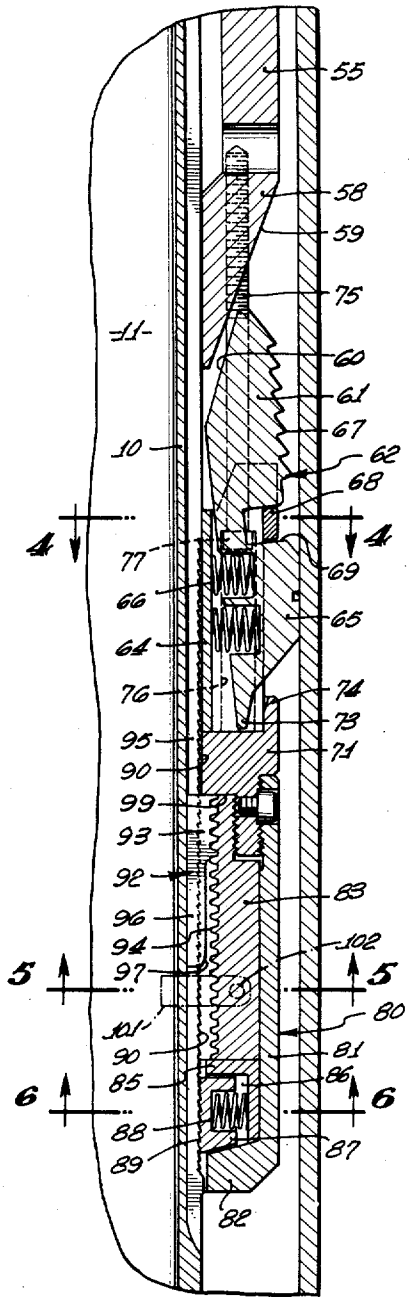


FIG. 4.

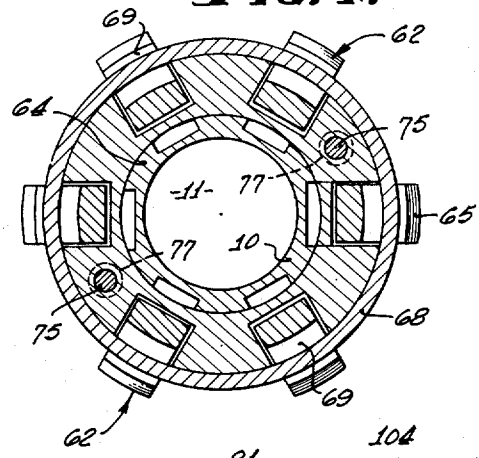


FIG. 5.

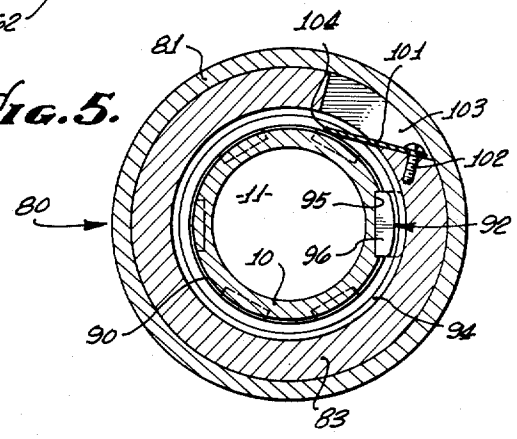
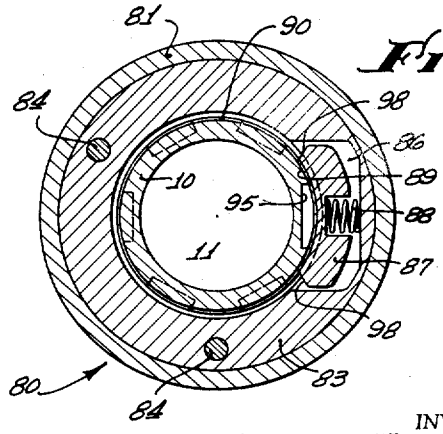


FIG. 6.



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FIG. 7.

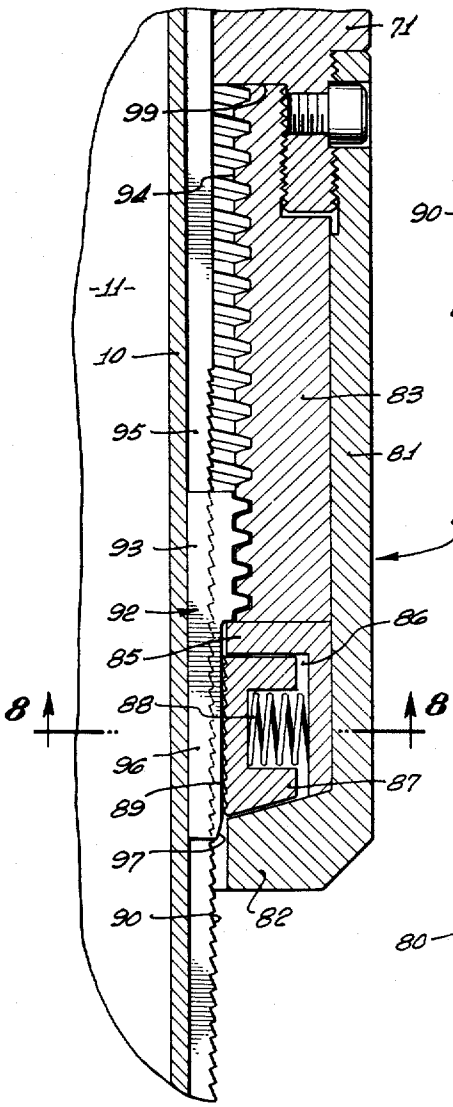


FIG. 9.

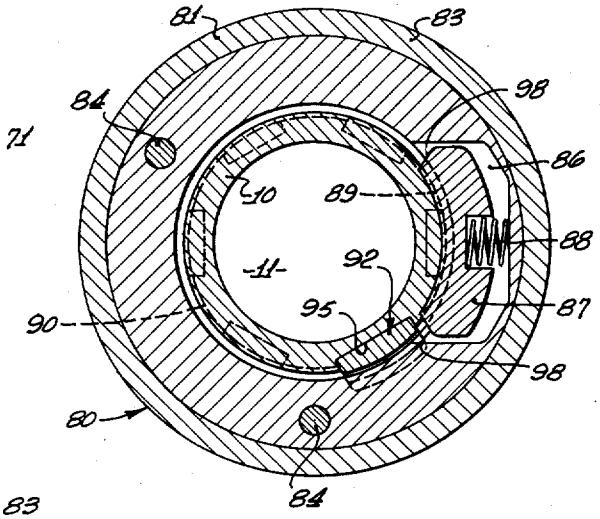
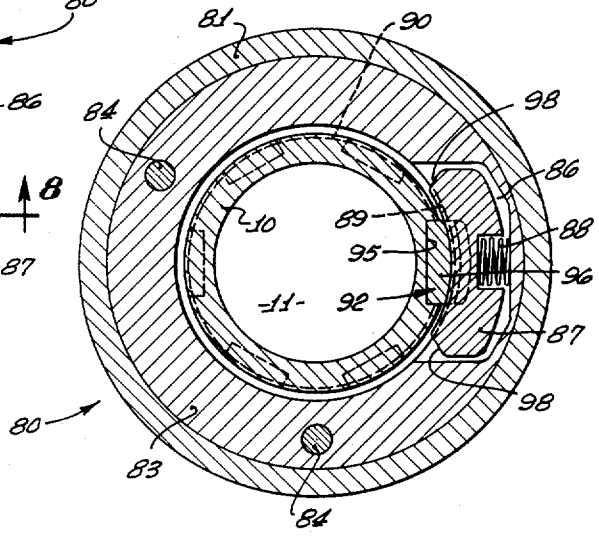


FIG. 8.



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RETRIEVABLE WELL PACKER AND ANCHOR

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Original No. 3,008,523, dated Nov. 14, 1961, Ser. No. 750,951, July 25, 1958. Application for reissue Sept. 9, 1963, Ser. No. 307,758

25 Claims. (Cl. 166—129)

Matter enclosed in heavy brackets [ ] appears in the original patent but forms no part of this reissue specification; matter printed in italics indicates the additions made by reissue.

The present invention relates to subsurface well bore equipment, and more particularly to packers and anchors adapted to be run and set in well casing and similar conduit strings disposed in well bores.

Certain types of well packers or anchors are set hydraulically in casing disposed in a well bore, fluid pressure in a tubular running-in string to which the particular tool is attached forcing its gripping elements into anchoring engagement with the wall of the well casing. Lowering of the tool on the tubular string through the fluid in the well casing oftentimes creates substantial pressure differentials in the well tool, resulting in undesired hydraulic expansion of the gripping elements and dulling of their wickers or teeth, which slide along the casing walls during downward movement of the tool. Consequently, the gripping elements cannot subsequently anchor the tool in the well casing, particularly when the tool is subjected to comparatively high pressures.

Accordingly, it is an object of the present invention to provide a hydraulically set subsurface well tool in which the gripping elements do not become dulled during lowering of the tool in the well bore.

Another object of the invention is to equalize the fluid pressure on the gripping elements while the tool is being run in the well bore to prevent their outward expansion hydraulically.

A further object of the invention is to provide a well packer or anchor having gripping elements hydraulically shiftable to casing anchoring position, in which the pressure on the elements can be equalized while running the tool in the casing by holding a control valve open, the valve being closed when the gripping elements are to be expanded hydraulically against the casing, the hydraulic pressure developed in or externally of the tool being incapable of shifting the valve to open position.

Yet another object of the invention is to provide a well packer or anchor embodying an equalizing or by-pass valve for equalizing the pressure on the gripping elements of the packer or anchor, the valve being readily shiftable from closed to open position despite the presence of relatively high pressures in or externally of the tool.

An additional object of the invention is to provide a well packer embodying a rubber or rubber-like packing structure, the tool having a relatively large diameter passage therethrough and a by-pass around the packing structure, the packing structure being comparatively thick to insure the presence of a large volume of packing material for effecting a seal against a companion casing wall.

This invention possesses many other advantages, and has other objects which may be made more clearly apparent from a consideration of several forms in which it may be embodied. Such forms are shown in the drawings accompanying and forming part of the present specification. These forms will now be described in detail for the purpose of illustrating the general principles of the invention; but it is to be understood that such detailed description is not to be taken in a limiting sense, since the scope of the invention is best defined by the appended claims.

Referring to the drawings:

FIGURES 1 and 1a together constitute a longitudinal section and side elevational view through a well packer of the retrievable type with its parts in retracted position for lowering the tool in a well casing, FIG. 1a constituting a lower continuation of FIG. 1;

FIGS. 2 and 2a together constitute a longitudinal section through the well tool illustrated in FIGS. 1 and 1a with the well tool anchored in packed-off condition against the well casing, FIG. 2a being a lower continuation of FIG. 2;

FIG. 3 is an enlarged fragmentary longitudinal section through the lower portion of the tool disclosed in FIG. 1a;

FIG. 4 is a cross-section taken along the line **4—4** on FIG. 3;

FIG. 5 is a cross-section taken along the line **5—5** on FIG. 3;

FIG. 6 is a cross-section taken along the line **6—6** on FIG. 3;

FIG. 7 is an enlarged fragmentary section through the clutch or control unit portion of the apparatus;

FIG. 8 is a cross-section taken along the line **8—8** on FIG. 7, with the clutch disengaged;

FIG. 9 is a view similar to FIG. 8, showing the clutch in engaged position;

FIG. 10 is a fragmentary longitudinal segment through a modified portion of the apparatus;

FIG. 11 is a longitudinal section through the control sleeve and clutch housing portion of the apparatus.

The specific well tool shown in the drawings is a retrievable well packer A adapted to be anchored to a well casing B against movement in both an upward and a downward direction, and to be packed-off thereagainst to prevent leakage of fluid thereby. The lower portion C of the tool is a set down type of well packer, whereas the upper portion D of the tool is an anchor to prevent upper movement of the apparatus in the well casing. The apparatus A is lowered in the well casing on a tubular string E, such as tubing or drill pipe extending to the top of the well bore, and through which fluent substances under pressure, such as cement slurry, acid, and the like, can be pumped through a passage of the tool and discharged from its lower portion.

The well packer A includes a central main body or mandrel **10** having a passage **11** therethrough that may be of relatively large diameter and no smaller than the diameter through the tubular string E thereabove. The upper portion of this body is threadedly secured to a body sub **12** having a threaded box **13** for screwing the sub to the lower pin end **14** of the tubular string. The mandrel extends downwardly throughout the entire length of the tool and has a lower threaded pin **15** for threadedly attaching the tool to a lower section of tubing **16** or a lower tool.

The upper portion D of the tool includes an anchor body **17** surrounding the mandrel **10** and relatively slidable with respect thereto. This anchor body has a plu-

rality of circumferentially spaced cylindrical bores **18** therethrough, each of which contains a piston gripping element **19** slidably radially therein. The cylindrical bores open to the interior of the anchor body **17** and also to the exterior thereof. The piston gripping elements **19** have external wickers or teeth **20** that may face in an upward direction, so as to be capable of anchoring the apparatus to the well casing B against upward movement therewithin. As disclosed, a plurality of cylinders **18** and gripping elements **19** are provided in longitudinal alignment with one another, there being sets of such longitudinally aligned gripping elements staggered relative to one another around the circumference of the anchor body **17**.

The anchor body has an external groove **21** extending across each set of aligned cylinders which merge into companion grooves **22** formed in the outer portions of the longitudinally aligned gripping elements **19**. Disposed in the body and gripping element grooves **21**, **22** is a retainer member and spring seat in the form of a bar **23** which is suitably secured to the anchor body, as by means of the screws **24**. Each bar will retain the piston gripping elements **19** properly oriented with their wickers or teeth **20** facing in an upward direction. It also serves as the outer spring seat for a helical compression spring **25** disposed in and bearing against the socket portion **26** of each piston gripping element, tending to urge the piston gripping element inwardly to its fullest extent to facilitate inward and outward radial movement of each gripping member **19**. The bar may be provided with bleeder holes **27** therethrough opening into the pistons **19**.

The piston gripping elements **19** are expanded outwardly whenever fluid pressure differential sufficient to overcome the compressive force of the springs **25** is present interiorly of the anchor body **17**. In the present case, such fluid pressure is derived from the exterior of the tool below the anchor portion D of the apparatus, which pressure can pass through longitudinally extending external grooves **28** in the mandrel or body of the tool to the interior of the anchor body **17**. These grooves **28** extend from a location adjacent the upper end of the mandrel **10** to a location near its lower portion. Actually, the grooves **28**, when their upper ends **28a** are open, serve as a by-pass through *the body structure 10, 17 of* the tool as described hereinbelow. However, when bypassing of fluid is prevented, pressure differential of the fluid within the grooves **28** can pass to the interior of the cylinders **18**, acting upon the pistons **19** to urge them outwardly and bring their teeth **20** into anchoring engagement with the wall of the well casing B. Leakage of fluid along each piston **19** is prevented by providing a suitable piston ring or side seal ring **29** in the piston for slidable sealing against the wall of each cylinder **18**.

The inner mandrel **10** is shiftable longitudinally with respect to the anchor body **17** to open and close the by-pass grooves **28**. The mandrel carries a suitable seal ring **30**, which is held between the body sub **12** and the main portion of the body, this seal ring being adapted to move downwardly within a cylindrical seat **31** formed in a cylinder head portion **32** of a cylinder **33**. A cylinder skirt **34** depends from the head **32** and is threadedly secured to the upper end of the anchor body **17**. Inadvertent threaded detachment between these parts is prevented by a cap screw **35** threaded in the anchor body with its head disposed in a recess **36** in the lower end of the skirt. A gauge ring **37** may be threaded on the cylinder head **32** to provide the desired clearance with the adjacent wall of the well casing B.

When the mandrel **10** is shifted downwardly relative to the anchor body **17** and cylinder **33**, its valve head **38** and seal ring **30** therein are moved within the cylinder seat **31**, closing the upper portion **28a** of the by-pass grooves **28** extending along the exterior of the body **10**. To enable the pressure below the tool, and tending to elevate the mandrel **10**, to be counterbalanced, an annular balancing piston **40** is disposed in the annular cylinder **33**. Thus, the annular piston includes a head **41** that may initially occupy an upper position adjacent the cylinder head **32**, this piston head being slidable along the wall of the cylinder skirt **34**, leakage of fluid between the piston and cylinder skirt being prevented by a suitable piston ring **42** carried by the piston and slidably sealing against the wall of the skirt. The piston has a skirt **43** depending from its head **41**, which is slidable along and within the upper portion of the anchor body **117**, leakage of fluid therebetween being prevented by a suitable side seal **44** mounted in the upper portion of the anchor body and slidably sealing against the periphery of the skirt. The piston skirt **43** terminates above an upwardly facing thrust shoulder **45** on the mandrel, the mandrel having a downwardly facing shoulder **46** which is spaced initially above a companion shoulder **47** on the anchor body **17**. Downward force between the mandrel **10** and anchor body **17** can be transmitted from the mandrel shoulder **46** to the anchor body shoulder **47**, as described hereinbelow.

The upwardly anchoring portion D of the apparatus is secured to the downwardly anchoring portion C of the apparatus, which also includes a packing structure **48** for effecting a seal against the wall of the well casing B. The lower portion **49** of the anchor body **17** constitutes an upper abutment for the packing structure **48**. This packing structure may include a back-up or connector sleeve **50**, the upper end of which is threadedly attached to the lower portion **49** of the anchor body, the sleeve being slidable relative to the mandrel **10**, and extending through the packing elements **51** of the structure, which may be of any suitable type. As shown, the packing structure includes an upper rubber or rubber-like packing element **51** engaging the lower end **49** of the anchor body **17** and a gauge ring **52** threadedly secured thereto to provide the proper clearance with the adjacent wall of the well casing. This upper packing element engages a metallic spacing ring **53** which, in turn, contacts an intermediate rubber-like packing element **51**, the lower end of which engages a metallic spacing ring **53** which contacts the upper end of a lower rubber or rubber-like packing element **51** that engages a lower abutment **54** threadedly attached to a lower expander **55**. This lower abutment has an inwardly directed flange **56** adapted to contact an outwardly extending flange **57** at the lower end of the back-up sleeve **50**. When the upper abutment **49** is moved toward the lower abutment **54**, the packing members **51** are foreshortened and expanded outwardly into sealing engagement with the wall of the well casing B, as well as against the back-up sleeve **50**, which is disposed around all of the longitudinal grooves **28** in the inner mandrel or body **10**. When the upper abutment **49** moves toward the lower abutment **54**, the lower end of the back-up or connector sleeve **50** can shift downwardly in an annular space **58** between the lower expander **55** and the periphery of the mandrel **10**.

The lower portion of the expander has an external conical or expander surface **59** tapering in a downward and inward direction, which is adapted to coact with companion inner tapered surfaces **60** on the anchor portions **61** of rocking types of slips **62** disposed in a longitudinal grooves **63** in a slip ring **64** slidable relative to the body **10**. Each slip has a lower drag portion **65** which is urged outwardly into frictional engagement with the wall of the well casing B by one or a plurality of helical compression springs **66** mounted in each groove **63** and bearing against the base of the latter and against the drag portions **65** of the slips. The slips **62** are so designed that the springs **66** force the drag portions **65** into full frictional engagement with the wall of the well casing B, rocking the anchor portions **61** inwardly away from the wall of the well casing, the downwardly facing wickers or teeth **67** on the anchor portions being prevented from contacting the adjacent casing wall. However, when the expander **55** moves downwardly relative to the slips **62**,

its surface **59** will engage the anchor portions **61** and rock them outwardly into engagement with the casing wall, the rocking action at first occurring about the upper part of the drag portion **65** of each slip.

The slips **62** are movable jointly downwardly in the casing by a retainer ring **68** mounted in external grooves **69** provided in the slips between their drag and anchor portions **65**, **61**, the upper end of this retainer ring being engaged by an outwardly directed flange **70** at the upper end of the slip ring **64**. Thus, downward movement of the slip ring **64** will cause its flange **70** to engage the ring **68**, the latter engaging the lower sides of the slip grooves **69** to pull all of the slips **62** downwardly in the well casing. Joint upward movement of the slips **62** is provided by a stop ring **71** engaging their lower ends, this stop ring being suitably secured to the slip ring **64** by longitudinally extending screws **72**. When the apparatus is out of the well casing, outward movement of the slips **62** is prevented by the retainer ring **68** and also by the lower terminals **73** of the slips engaging a stop rim **74** projecting upwardly from the stop ring **71**.

Separating movement between the expander **55** and slips **62** is limited by the longitudinal limit pins or screws **75** threaded in the lower expander **55** and received within bores **76** in the slip ring, the heads **77** of the screws engage the upper ends of the bores or sockets **76**, causing the lower expander **55** to pull upon the slip ring **64** and the slips **62** by virtue of the engagement of the screw heads **77** with the slip ring **64**, while permitting the lower expander **55** to shift downwardly relative to the slips **62**, since the screws **75** merely slide within the longitudinal bores **76** in the slip ring **64**.

The lower expander **55** is shiftable downwardly relative to the lower slips **62** to anchor them against the well casing B, and the upper abutment **49** is movable toward the lower abutment **54** to expand the packing structure **48** against the well casing, in response to downward movement of the mandrel **10** relative to the parts that surround it. Such relative downward movement will also close the by-pass passages **28** of the apparatus, which, as shown in the drawings, may extend from a location below the expander **55** to the upper portion of the mandrel **10**. The ability of the body or mandrel **10** to move downwardly to effect setting of the apparatus is governed by a control unit or clutch mechanism **80** at the lower part of the apparatus. As shown, such control unit includes an outer clutch housing **81** threadedly secured to the stop ring **71** and terminating in an inwardly directed flange **82**. Contained within the housing **81** is a control sleeve **83**, the upper end of which is threadedly attached to the stop ring **71** and the lower end of which is attached, as by pins **84**, to a clutch sleeve or ring **85** having a recess **86** therein in which a dog or clutch element **87** is located. This clutch element is urged inwardly by a compression spring **88**, to place its upwardly facing wickers or teeth **89** in clutching engagement with downwardly facing external wickers or teeth **90** formed on the exterior of the mandrel **10** along a substantial longitudinal length thereof and extending circumferentially thereabout. When the clutch element **87** is engaged with the ratchet teeth **90** on the mandrel, relative downward movement between the mandrel **10** and the clutch **80** surrounding it cannot occur. Since the clutch housing **81** is secured to the slip structure, the latter will move downwardly with the mandrel, relative downward movement of the mandrel **10** with respect to the expander **55** and packing structure **48** also being prevented, in view of the fact that the slip sleeve **64** exerts a downward pull on the lower expander **55** through the longitudinal screws **75**, and the fact that the lower abutment **54** engages the flange **57** of the back-up sleeve **50** to pull such sleeve downwardly, which also pulls the anchor portion D of the apparatus downwardly with it, since the sleeve **50** is threadedly secured to the anchor body **17**.

When the clutch dog or element **87** is released from the ratchet teeth **90** on the mandrel, the latter can shift downwardly relative to the parts surrounding it, since downward movement of such latter parts is resisted by frictional engagement of the drag portions **65** of the slips **62** against the wall of the well casing. Release of the clutch element **87** is determined by a cam or key **92** having an upper head portion **93**, which has a segment of a thread formed thereon threadedly meshing with internal threads **94** formed on the interior of the control sleeve **83**. The key **92** is slidable relatively within a keyway **95** formed in the exterior of the mandrel **10**, and which may actually constitute a continuation of one of the by-pass grooves **28** in the mandrel. The lower portion **96** of the key is a cam portion that extends outwardly beyond the ratchet teeth **90** on the body, and which is adapted to engage the clutch dog **87** to cam it laterally outward from engagement with the body teeth **90**. The lower end **97** of the cam **96** is tapered in a downward and inward direction so that it can engage the dog **87** and shift it outwardly as a result of its downward movement along the control sleeve **83** and dog. The ends **98** of the dog are tapered or beveled to enable the cam portion **96** to engage the dog **87** rotationally and also effect its disengagement from the body ratchet teeth **90** against the force of its return spring **88**.

Initially, the key or cam element **92** is disposed in an upper position with respect to the control sleeve **83**, its threaded head engaging a stop **99** at the upper end of the control sleeve which limits the extent of upward movement of the key relative to the control sleeve. The threaded interconnection between the key head **93** and the control sleeve **83** is a right hand one, such that right hand rotation of the mandrel **10** and key **92** will effect a downward feeding of the key along the control sleeve **83** to bring the cam portion **96** of the key downwardly to a position in which it can turn across the inner face of the clutch element **87** and cam it out of engagement with the ratchet teeth **90** on the mandrel. The extent of downward movement of the key is limited by engagement of its head **93** with a rotational stop element **100** extending across the lower end of the control sleeve thread **94**. When the threaded head **93** of the key engages such stop element **100**, the cam **96** is disposed fully across the clutch or dog element **87** to hold it disengaged from the teeth **90** on the mandrel, thereby allowing the mandrel **10** to move downwardly within the clutch housing **81**.

Rotation of the mandrel **10** and key **92** in the opposite direction, or to the left, is limited after the key has been threaded downwardly, to insure its disposition out of engagement with the clutch dog **87** to permit the ratchet teeth **89** on the latter to coengage with the ratchet teeth **90** on the mandrel. This latter stop is in the form of a one-way acting element, such as a leaf spring **101** suitably secured to the control sleeve **83**, as by means of a screw **102**, the leaf spring being disposed in a sleeve opening **103** and extending inwardly of the threaded portion **94** of the sleeve. It will be noted (FIG. 5) that the leaf spring **101** extends at an agle inwardly of the control sleeve **83** so that the key head **93** will engage the inner surface of the leaf spring, when rotated in a right hand direction, and deflect the leaf spring outwardly, the head moving thereby and continuing its downward threading along the control sleeve **83** until the head **93** of the key engages the rotational stop **100** at the lower end of the control sleeve **83**. However, once the head **93** has moved past the leaf spring **101**, reverse rotation, or rotation to the left, of the key will cause it to engage the end **104** of the leaf spring, which will then prevent any further rotary movement of the mandrel to the left relative to the control sleeve **83** and the clutch dog **87** carried within the clutch housing. Thus, the one-way leaf spring **101** will permit downward feeding of the key **92** along the control sleeve **83** to its dog camming position, but will prevent upward threading therealong beyond the end **104** of the leaf spring **101**, at which point the cam portion **96** is out

of engagement with the clutch element **87**. However, it can be turned in the right hand direction back into engagement with the clutch element **87** to cam and hold such element out of engagement with the mandrel teeth **90**.

In the use of the apparatus within the well casing, its parts initially occupy the retracted positions disclosed in FIGS. 1 and 1a. The key **92** is preferably in its upper position along the control sleeve **83**, the mandrel **10** being in its uppermost position as determined by engagement of the thrust shoulder **45** with the piston skirt **43**, the piston **40** engaging the cylinder head **32**, and the valve head **38** on the mandrel being disposed above its companion seat **31**, such that the by-pass passages **28** through the apparatus are fully opened, such by-pass passages communicating with the interior of all of the cylinders **18** containing the piston gripping elements **19**. Since the key **92** is in its uppermost position, it is substantially removed from the clutch dog **87** and cannot inadvertently release such clutch dog from clutching engagement with the mandrel **10**. The spring **88** retains the clutch dog **87** in engagement with the mandrel **10**, such that downward movement of the mandrel as a result of moving the tubular string E downwardly will cause the clutch mechanism **80** to move downwardly with the mandrel, pulling the slips **62** downwardly with it. Such downward movement of the slips will result in a downward pulling, through the screws **75**, of the lower expander **55**, which will exert a pull on the backing sleeve **50** in a downward direction, which is attached to the anchor body **17**, which will, in turn, also move downwardly with the mandrel **10**, as well as all of the parts secured thereto. During such downward movement through the fluid in the well casing B, a pressure differential cannot be built up behind the piston gripping elements **19** and urge them outwardly into engagement with the wall of the well casing, since the pressure externally of the gripping elements and the pressure internally thereof is the same, in view of the fact that the by-pass passages **28** are wide open. Accordingly, downward movement of the apparatus through the liquid in the well casing cannot develop any pressure differentials within the cylinders **18** of the anchor portion D of the apparatus and tend to urge the gripping elements **19** outwardly, which would cause the wickers **20** to engage the wall of the casing and slide therealong, resulting in their dulling.

When the location in the well casing is reached at which the tool A is to be anchored in packed-off condition against movement in both longitudinal directions, the tubular string E and the mandrel **10** connected thereto are rotated to the right, the drag portions **65** of the slips preventing rotation of the apparatus surrounding the mandrel, including the control sleeve **83**. As a result, he key **92** is rotated by the mandrel relative to the control sleeve **83**, which will cause the key to feed downwardly of the control sleeve and along the keyway **95** in he mandrel. The interconnecting threads between the ey **92** and control sleeve **83** may have a multiple pitch, uch as a double pitch, so that only several revolutions re necessary to feed the key downwardly to the position n which it will move past the spring stop element **101** nd fully into engagement with the lower rotational stop **00** on the control sleeve **83**, at which time the cam portion **96** of the key will have cammed the dog **87** outwardly and will be disposed fully across from the dog, s shown in FIGS. 7 and 8. The outer clutch portions re thereby disconnected from the mandrel **10**, which vill allow the mandrel to move downwardly relative to the arts surrounding it. Downward movement of the latter arts is prevented by the frictional engagement of the rag portions **65** of the slips **62** against the wall of the ell casing B. Such downward movement will first result the valve head **38** moving downwardly within its companion seat **31**, closing all of the by-pass passage grooves **8** in the mandrel and moving the mandrel shoulder **46** gainst the shoulder **47** on the anchor body **17**. When

such engagement occurs, further downward movement of the mandrel will shift the anchor body **17** downwardly with it, which will exert a downward force through the packing structure **48** on the lower expander **55**, this lower expander then shifting downwardly relative to the slips **62**, which are still prevented from moving downwardly by virtue of the frictional engagement of the slip drag portions **65** against the wall of the well casing. The expander will move behind the anchor portions **61** of the slips to rock them outwardly into anchoring engagement with the wall of the well casing about the upper ends of the drag portions **65**, until the wickers **67** of the slips are embedded in the wall of the well casing.

Downward movement of the lower expander **55** cannot occur to any further extent. Accordingly, continued downward moveemnt of the tubular string E and the mandrel **10** will shift the anchor body **17** and its upper abutment **49** downwardly toward the lower abutment **54** secured to the expander, foreshortening the packing structure and expanding it outwardly into firm sealing engagement with the wall of the well casing, as well as into firm sealing engagement with the periphery of the back-up sleeve **50**. The well tool A has now been anchored in packed-off condition in the well casing against downward movement therewithin.

The necessary operations can now be performed in the well casing. Fluid under pressure is pumped down through the tubular string E, passing downwardly through the passage **11** in the mandrel and out through the tool **16** therebelow. Such pressure will be exerted on the fluid surrounding the tool and below the packing structure **48**, passing upwardly through the by-pass passages **28**, the upper ends **28a** of which are now closed, and into the cylinders **18**, forcing the piston gripping elements **19** outwardly and into anchoring engagement with the wall of the well casing B, the pressure behind such gripping elements maintaining them anchored against the wall of the well casing. Any pressure below the apparatus A tending to force it up the casing B is prevented from doing so by the anchoring engagement of the wickers **20** of the gripping elements in the wall of the well casing. The upward fluid pressure is prevented from bypassing the apparatus by virtue of the packing structure **48** being sealed against the wall of the well casing B and the back-up sleeve **50**.

The rubber or rubber-like packing elements **51** can be made with a relatively small inside diameter, thereby increasing their thickness when in retracted position without increasing their outside diameter, since the back-up sleeve **50** can be made comparatively thin. The thin back-up sleeve capable of withstanding high pressures is more than adequate, since it is bearing inwardly against the periphery of the mandrel **10**, the back-up sleeve only being called upon to bridge the relatively narrow space of each longitudinally extending by-pass groove **28** formed in the exterior of the mandrel. By virtue of this arrangement, a greater volume of rubber material for the same outside diameter can be provided to insure an effective seal against the wall of the well casing, while a by-pass **28** is still present around the packing structure **48** when the by-pass is needed.

Upon subjecting the apparatus to pressure, such pressure ordinarily tends to shift the mandrel **10** upwardly, which would shift its by-pass valve **38** to an open condition. The tendency of the hydraulic pressure to act on the cross-sectional area of the mandrel **10** and shift it upwardly is counter-balanced by the piston structure. It will be noted that whatever pressure is acting upwardly over the cross-sectional area of the mandrel **10** is also acting through the grooves **28** on the upper end of the piston **40**, urging the piston in a downward direction. Since this piston engages the mandrel shoulder **45**, the hydraulic force being exerted downwardly thereon is also being exerted in a downward direction on the mandrel **10**. If the pressure effective area R of the piston, which

extends from the periphery of its piston skirt **43** to the inner wall of the cylinder skirt **34**, is made equal to the cross-sectional area S of the mandrel, the same force from below the tool tending to move it upwardly is also acting in a downward direction on the piston **40**, tending to shift the latter and the mandrel **10** downwardly, so that there is no tendency for pressure to shift the mandrel in any direction.

In view of the fact that the proper proportioning of the areas R and S can be provided to prevent any pressure from tending to shift the mandrel **10** upwardly to an open position, which would result in the release of the anchoring portion D of the apparatus from the well casing, such balancing of areas enables the mandrel to be shifted upwardly mechanically as a result of taking an upward pull on the tubular string E, whenever the by-pass passages **28** are to be opened. Despite the fact that the pressure differential below the tool might be relatively high, the mandrel **10** is easily shifted to a position which will allow the pressure internally and externally of the apparatus, as well as above and below the well packer, to equalize, enabling the apparatus to be released from the well casing. The mandrel **10** is movable upwardly regardless of whether or not the clutch element **87** is engaging the mandrel teeth **90**, since the direction which the coengaging ratchet teeth **89**, **90** face permits the mandrel **10** to ratchet freely upwardly through the clutch element. As a result of such upward movement, the valve **38** is not only shifted to an open position to equalize the pressure internally and externally of the apparatus, as well as above and below the apparatus, but the pressure differential in the cylinder **18** is relieved, allowing the springs **25** to retract the gripping elements **19** from the well casing.

The mandrel **10** is moved upwardly to cause its shoulder **45** to move the piston **40** upwardly, until the piston engages the cylinder head **32**, whereupon the cylinder **33** and the anchor body **17** are moved upwardly to shift the upper abutment **49** away from the lower abutment **54**, permitting the packing structure **48** to retract. The upward motion is transferred through the back-up or connector sleeve **50** and the flange **57** of the latter to the lower abutment **54** and the lower expander **55**, pulling the latter upwardly relative to the slips **62**, since upward movement of the latter is resisted by the frictional engagement of the drag portions **65** against the well casing. The upward movement of the expander will allow the springs **66** to rock the drag portions **65** of the slips back into full surface engagement with the wall of the well casing, and their anchor portions **61** out of engagement with the well casing. Upward movement of the lower expander **55** is transferred through the pulling screws or limit pins **75** to the slip structure and the surrounding clutch mechanism **80**, all of the parts then moving upwardly as a unit, with the drag portions **65** of the slips sliding frictionally along the wall of the well casing. The apparatus can be elevated in the well casing and removed completely therefrom.

At any time after the apparatus has been released from the well casing it can be re-set merely by turning the mandrel **10** to the right, to cause the cam **96** to again disengage the dog **87** from the ratchet teeth **90**. If the apparatus is to be moved to a lower position in the well casing B, then the tubing string E and mandrel **10** are turned to the left sufficiently to insure that the key **92** engages the end **104** of the spring or one-way stop member **101**, which will insure that the dog is free to engage the mandrel, permitting the entire mechanism to be moved as a unit downwardly in the well casing.

The mandrel **10** may be releasably held in an elevated position, in which the by-pass **28** is open, as shown in FIG. 10, or in a by-pass closing position. Circumferentially spaced latch arms **110** may be formed integrally with the cylinder head **32**, extending thereabove. These latch arms terminate in heads **111** having upper and lower tapered or cam surfaces **112**, **113**. The upper cam surface **112** is adapted to engage a companion cam surface **114** on the body sub **12** tapering in a downward and inward direction, to resist downward movement of the mandrel **10** relative to the cylinder **33** (as in FIG. 10), thereby holding the by-pass valve in its open position. However, when sufficient downward force is imposed on the mandrel, its cam surface **114** will cam the spring-like arms **110** outwardly, enabling the mandrel **10** to shift downwardly to place its valve head **38** and seal **30** within the companion valve seat **31**, to close the by-pass passages **28**. When such position is reached, the latch heads **111** will spring inwardly into a retaining groove **115** provided in the body sub **12** above its lower cam shoulder **114**. The lower side **116** of this groove is inclined in a downward and outward direction to provide a cam surface coacting with the lower tapered surfaces **113** on the latch heads **111**. The coengagement between these surfaces will retain the mandrel **10** in a downward position within the apparatus surrounding it, to hold the valves **38**, **30**, **31** in a closed position. When a sufficient upward pull is taken on the tubular string E and the mandrel **10** to overcome the holding force of the latches **110**, **111** against the upper cam surface **116**, the latter will cam or spring the arms **110** in outward direction to remove the heads **111** from the groove **115**, whereupon the mandrel **10** moves upwardly to open the by-pass valve, at which time the latch heads **111** will spring inwardly once again into a position below the lower cam surface **114** on the body sub **12**.

The latch device provides for the releasable holding of the mandrel **10** in either its valve-open or valve-closed position. The spring force required to release the latches **110**, **111** can be made quite substantial. For example, a total force of about 3,000 pounds might be required before the latches will release and allow the mandrel to shift with respect to the valve seat **31**, to place the by-pass control valve in either an open or closed position.

The inventors claim:

1. In apparatus adapted to be anchored in a well casing disposed in a well bore: a body *structure having a central passage through which fluid can flow*; normally retracted casing gripping members on said body *structure* for anchoring said body *structure* in the well casing; *hydraulically operable* means for [hydraulically] expanding said gripping members into engagement with the well casing; means communicating with said [expanding] *hydraulically operable* means and providing a by-pass *externally of said central passage* for fluid in the well casing through the apparatus while the apparatus is being lowered in the well casing to prevent *fluid* pressure from being developed in said [expanding] *hydraulically operable* means *to operate the same to expand the gripping members*; *by-pass closing means for closing said by-pass adjacent one end portion thereof* after the apparatus has been lowered in the well casing to enable *fluid pressure to be developed in the well casing and transmitted through the other end portion of said by-pass and through the by-pass itself to* said [expanding] *hydraulically operable* means to hydraulically *operate the same to expand and thereby* engage said gripping members with the well casing; and releasable means holding said by-pass *closing* means in its open condition while the apparatus is being lowered in the well casing.

2. In apparatus adapted to be anchored in a well casing disposed in a well bore: a body *structure having a central passage through which fluid can flow*; normally retracted casing gripping members on said body *structure* for anchoring said body *structure* in the well casing; *hydraulically operable* means for [hydraulically] expanding said gripping members into engagement with the well casing; means providing a by-pass *externally of said central passage and* interiorly of said body *structure* com-

municating with said [expanding] *hydraulically operable* means through which fluid in the well casing can flow while the apparatus is being lowered in the well casing to prevent fluid pressure from [developing] *being developed* in said [expanding] *hydraulically operable* means *to operate the same*; *by-pass closing* means for closing said by-pass *adjacent one end portion thereof* after the apparatus has been lowered in the well casing to enable *fluid pressure to be developed in the well casing and transmitted through the other end portion of said by-pass and through the by-pass itself to* said [expanding] *hydraulically operable* means to hydraulically *operate the same to expand and thereby* engage said gripping members with the well casing; and releasable means holding said by-pass *closing* means in its open condition while the apparatus is being lowered in the well casing.

3. In apparatus adapted to be anchored in a well cas- disposed in a well bore: a body *structure having a central passage through which fluid can flow*; normally retracted casing gripping members on said body *structure* for anchoring said body *structure* in the well casing; *hydraulically operable* means for [hydraulically] expanding said gripping members into engagement with the well casing; means providing a by-pass *externally of said central passage and* interiorly of said body *structure* communicating with said [expanding] *hydraulically operable* means through which fluid in the well casing can flow while the apparatus is being lowered in the well casing to prevent fluid pressure from developing in said [expanding] *hydraulically operable* means *to operate the same to expand the gripping members*; *by-pass closing* means for closing said by-pass above said [expanding] *hydraulically operable* means after the apparatus has been lowered in the well casing to enable fluid pressure in the well casing below the apparatus to be developed and act *through the lower end portion of said by-pass and through the by-pass* upon said [expanding] *hydraulically operable* means [and] *to* hydraulically *operate the same to expand and thereby* engage said gripping members with the well casing; and releasable means holding said by-pass *closing* means in its open condition while the apparatus is being lowered in the well casing.

4. In apparatus adapted to be anchored in a well casing disposed in a well bore: a body *structure having a central passage through which fluid can flow and also* having a plurality of cylindrical bores therein opening to the interior of said body *structure externally of said central passage*; gripping members in said bores expandable outwardly against the well casing in response to fluid pressure within *the interior* of said body *structure* and bores; means providing [a fluid by-pass] *another fluid passage* within said body *structure externally of said central passage and* communicating with said bores; means holding said [by-pass] *another passage* means in its open condition while the apparatus is being lowered in the well casing; *another passage closing* means for closing said [by-pass] *another passage adjacent an end portion thereof* after said apparatus has been lowered in the well casing *to enable fluid pressure to be developed in the well casing and transmitted through the other end portion of said another passage means and through said another passage means itself to said bores communicating therewith to expand said gripping members against the well casing.*

5. In apparatus adapted to be anchored in a well cas- disposed in a well bore: a body *structure having a central passage through which fluid can flow and also* having a plurality of cylindrical bores therein opening to the interior of said body *structure externally of said central passage*; gripping members in said bores expandable outwardly against the well casing in response to fluid pressure within *the interior* of said body *structure* and bores; means providing [a fluid by-pass] *another fluid passage* within said body *structure externally of said central passage and* communicating with said bores; releasable means holding said [by-pass] *another passage* means in its open

condition while the apparatus is being lowered in the well casing; *another passage closing* means for closing said [by-pass] *another passage means* above said cylindrical bores after said apparatus has been lowered in the well casing to enable fluid pressure in the well casing below the apparatus to be developed for action through *the lower end portion of said another passage means and through* said [by-pass] *another passage means itself* upon the gripping members to expand said gripping members against the well casing.

6. In apparatus adapted to be anchored in a well casing disposed in a well bore: a body having a plurality of cylindrical bores therein opening to the interior of said body; gripping members in said bores expandable outwardly against the well casing in response to fluid pressure within said body and bores; a tubular mandrel within said body; said mandrel and body providing a fluid by-pass therebetween communicating with said bores; releasable means for holding said by-pass open while the apparatus is being lowered in the well casing; means operatively connected to said mandrel and body for closing said by-pass above said bores.

7. In apparatus adapted to be anchored in a well casing disposed in a well bore: a body; casing gripping members on said body; means for hydraulically expanding said gripping members into engagement with the well casing; a tubular mandrel within said body, said mandrel and body providing a fluid by-pass therebetween communicating with said expanding means; releasable means for holding said by-pass open while the apparatus is being lowered in the well casing; means operatively connected to said mandrel and body for closing said by-pass above the point of communication between said by-pass and expanding means *to enable fluid pressure in the well casing ing below said apparatus to be developed for action through the lower end portion of said by-pass and through said by-pass itself upon said expanding means to expand said gripping members against the well casing.*

8. In apparatus adapted to be anchored in a well casing disposed in a well bore: a body having a plurality of cylindrical bores therein opening to the interior of said body; gripping members in said bores expandable outwardly against the well casing in response to fluid pressure within said body and bores; a tubular mandrel within said body; said mandrel having external longitudinally extending grooves providing a fluid by-pass and communicating with said bores; means operatively connected to said mandrel and body for closing said by-pass; and releasable means for holding said by-pass open while the apparatus is being lowered in the well casing.

9. In apparatus adapted to be anchored in a well casing disposed in a well bore: a body; normally retracted casing gripping members on said body for anchoring said body in the well casing; means for hydraulically expanding said gripping members into engagement with the well casing; a tubular mandrel within said body; said mandrel having external longitudinally extending *by-pass* grooves *extending through said body and* providing a fluid by-pass communicating with said expanding means; *said body engaging the periphery of said mandrel between said grooves to be supported thereby;* means operatively connected to said mandrel and body for closing said by-pass; and releasable means for holding said by-pass open while the apparatus is being lowered in the well casing.

10. In apparatus adapted to be lowered in a well casing disposed in a well bore: a mandrel; a packing structure on said mandrel, including a sleeve on *and bearing against the periphery of* said mandrel, *to be supported thereby* normally retracted pliant, elastic packing means on said sleeve adapted to engage the well casing, and means for expanding said packing means against the well casing; said mandrel having a plurality of external longitudinally extending fluid by-pass grooves extending through said sleeve; and means for selectively opening and closing said grooves.

11. In apparatus adapted to be anchored in a well casing disposed in a well bore: a body having a plurality of cylindrical bores therein opening to the interior of said body; gripping members in said bores expandable outwardly against the well casing in response to fluid pressure within said body and bores; a tubular mandrel within said body; said mandrel and body providing a fluid by-pass therebetween communicating with said bores; means for holding said by-pass open while the apparatus is being lowered in the well casing; means operatively connected to said mandrel and body for closing said by-pass above said bores; and means responsive to hydraulic pressure in said by-pass for exerting a downward force on said mandrel.

12. In apparatus adapted to be anchored in a well casing disposed in a well bore: a body; casing gripping members on said body; means for hydraulically expanding said gripping members into engagement with the well casing; a tubular mandrel within said body; said mandrel and body providing a fluid by-pass therebetween communicating with said expanding means; means for holding said by-pass open while the apparatus is being lowered in the well casing; means operatively connected to said mandrel and body for closing said by-pass above the point of communication between said by-pass and expanding means; and means responsive to hydraulic pressure in said by-pass for exerting a downward force on said mandrel.

13. In apparatus adapted to be anchored in a well casing disposed in a well bore: a body having a plurality of cylindrical bores therein opening into the interior of said body; gripping members in said bores expandable outwardly against the well casing in response to fluid pressure within said body and bores to prevent upward movement of said body in the well casing; a tubular mandrel extending through said body and engageable with said body to transmit downward force thereto; a packing structure around said mandrel below said gripping members and adapted to seal against the well casing; means providing a fluid by-pass between the exterior of said mandrel and body and between said mandrel and packing structure; means for anchoring said body and packing structure to the well casing against downward movement; control means releasably coupling said mandrel to said anchoring means; and valve means operatively connected to said mandrel and body for opening and closing the upper portion of said by-pass; said control means being operative to hold said valve means in open position during lowering of the apparatus in the well casing.

14. In apparatus adapted to be anchored in a well casing disposed in a well bore: a body having a plurality of cylindrical bores therein opening into the interior of said body; gripping members in said bores expandable outwardly against the well casing in response to fluid pressure within said body and bores to prevent upward movement of said body in the well casing; a tubular mandrel extending through said body and engageable with said body to transmit downward force thereto; a packing structure around said mandrel below said gripping members and adapted to seal against the well casing; said mandrel having external longitudinal fluid by-pass grooves extending from a point below said packing structure to a point above said cylindrical bores; valve means operatively connected to said mandrel and body for opening and closing the upper portion of said by-pass grooves; means for anchoring said body and packing structure to the well casing against downward movement; and control means releasably coupling said mandrel to said anchoring means and adapted to hold said valve means in open position during lowering of the apparatus in the well casing.

15. In apparatus adapted to be anchored in a well casing disposed in a well bore: a body having a plurality of cylindrical bores therein opening into the interior of said body; gripping members in said bores expandable outwardly against the well casing in response to fluid pressure within said body and bores to prevent upward movement of said body in the well casing; a tubular mandrel extending through said body and engageable with said body to transmit downward force thereto; a packing structure around said mandrel below said gripping members and adapted to seal against the well casing; said mandrel having external longitudinal fluid by-pass grooves extending from a point below said packing structure to a point above said cylindrical bores; a cylinder connected to said body and communicating with said by-pass grooves; a piston in said cylinder engaging said mandrel and subject to the pressure of the fluid in said grooves and cylinder to exert a downward force on said mandrel; a valve head on said mandrel above said grooves; a valve seat connected to said cylinder and engageable by said head to close the upper ends of said grooves; means for anchoring said body and packing structure to the well casing against downward movement; and control means releasably coupling said mandrel to said anchoring means.

16. In apparatus adapted to be anchored in a well casing disposed in a well bore: a body having a plurality of cylindrical bores therein opening into the interior of said body; gripping members in said bores expandable outwardly against the well casing in response to fluid pressure within said body and bores to prevent downward movement of said body in the well casing; a tubular mandrel extending through said body and engageable with said body to transmit downward force thereto; a packing structure around said mandrel below said gripping members and adapted to seal against the well casing; said mandrel having external longitudinal fluid by-pass grooves extending from a point below said packing structure to a point above said cylindrical bores; said packing structure including a sleeve along said mandrel surrounding said grooves, normally retracted pliant, elastic packing means on said sleeve adapted to engage the well casing, and means for expanding said packing means against the well casing; valve means operatively connected to said mandrel and body for opening and closing the upper portions of said by-pass grooves; means for anchoring said body and packing structure to the well casing against downward movement; and control means releasably coupling said mandrel to said anchoring means.

17. In apparatus adapted to be anchored in a well casing disposed in a well bore: a body having a plurality of cylindrical bores therein opening into the interior of said body; gripping members in said bores expandable outwardly against the well casing in response to fluid pressure within said body and bores to prevent upward movement of said body in the well casing; a tubular mandrel extending through said body and engageable with said body to transmit downward force thereto; a packing structure around said mandrel below said gripping members and adapted to seal against the well casing; said mandrel having external longitudinal fluid by-pass grooves extending from a point below said packing structure to a point above said cylindrical bores; said packing structure including a sleeve on said mandrel surrounding said groove and pliant, elastic packing means on said sleeve adapted to engage the well casing; a cylinder connected to said body and communicating with said by-pass grooves; a piston in said cylinder engaging said mandrel and subject to the pressure of the fluid in said grooves and cylinder to exert a downward force on said mandrel; a valve head on said mandrel above said grooves; a valve seat connected to said cylinder and engaged by said head to close the upper ends of said grooves; means for anchoring said body and packing structure to the well casing against downward movement; and control means releasably coupling said mandrel to said anchoring means.

18. In apparatus adapted to be anchored in a well casing disposed in a well bore: a body having a plurality of cylindrical bores therein opening into the interior of said body; gripping members in said bores expandable out-

wardly against the well casing in response to fluid pressure within said body and bores; a tubular mandrel extending through said body; a packing structure around said mandrel adapted to seal against the well casing; said mandrel having external longitudinal fluid by-pass grooves extending around said packing structure and cylindrical bores; a cylinder connected to said body and communicating with said by-pass grooves; a piston in said cylinder engaging said mandrel and subject to the pressure of the fluid in said grooves and cylinder to exert a longitudinal force on said mandrel; a valve head on said mandrel to one side of said grooves; and a valve seat connected to said cylinder and engaged by said head to close said grooves.

19. In apparatus adapted to be anchored in a well casing disposed in a well bore: a body having a plurality of cylindrical bores therein opening into the interior of said body; gripping members in said bores expandable outwardly against the well casing in response to fluid pressure within said body and bores; a tubular mandrel extending through said body; a packing structure around said mandrel adapted to seal against the well casing; said mandrel having external longitudinal fluid by-pass grooves extending around said packing structure and cylindrical bores; a cylinder connected to said body and communicating with said by-pass grooves; a piston in said cylinder engaging said mandrel and subject to the pressure of the fluid in said grooves and cylinder to exert a longitudinal force on said mandrel; a valve head on said mandrel to one side of said grooves; a valve seat connected to said cylinder and engaged by said head to close said grooves; said packing structure including a sleeve on said mandrel surrounding its grooves and pliant, elastic packing means on said sleeve adapted to engage the well casing.

20. In apparatus adapted to be anchored in a well casing disposed in a well bore: a body; normally retracted casing gripping members on said body for anchoring said body in the well casing; hydraulically operable means for expanding said gripping members into engagement with the well casing; a tubular mandrel within said body, said mandrel and body providing a fluid passage therebetween communicating with said hydraulically operable means; passage closing means for closing said passage adjacent an end portion thereof after the apparatus has been lowered in the well casing to enable fluid pressure to be developed in the well casing and transmitted through the other end portion of said passage and through said passage itself to said hydraulically operable means to hydraulically operate the same to expand and thereby engage said gripping members with the well casing; and releasable means holding said passage closing means in its open condition while the apparatus is being lowered in the well casing.

21. In apparatus adapted to be anchored in a well casing disposed in a well bore: a body; normally retracted casing gripping members on said body for anchoring said body in the well casing; hydraulically operable means for expanding said gripping members into engagement with the well casing; a tubular mandrel within said body, said mandrel and body providing a fluid passage therebetween communicating with said hydraulically operable means which is open while the apparatus is being lowered in the well casing to prevent fluid pressure from developing in said hydraulically operable means to operate the same to expand the gripping members; passage closing means for closing said passage above the point of communication between said passage and hydraulically operable means after the apparatus has been lowered in the well casing to enable fluid pressure in the well casing below the apparatus to be developed for transmission through the lower end portion of said passage and said passage itself to said hydraulically operable means to hydraulically operate the same to expand and thereby engage said gripping members with the well casing; and releasable means holding said passage closing means in its open condition while the apparatus is being lowered in the well casing.

22. In apparatus adapted to be anchored in a well casing disposed in a well bore: a body having a plurality of cylindrical bores therein opening to the interior of said body; gripping members in said bores expandable outwardly against the well casing in response to fluid pressure within said body and bores; a tubular mandrel within said body, said mandrel and body providing a fluid passage therebetween communicating with said bores; means holding said passage in its open condition while the apparatus is being lowered in the well casing; and passage closing means for closing said passage adjacent an end portion thereof after said apparatus has been lowered in the well casing to enable fluid pressure to be developed in the well casing and transmitted through the other end portion of said passage and through said passage itself to said bores communicating therewith to expand said gripping members against the well casing.

23. In apparatus adapted to be anchored in a well casing disposed in a well bore: a body having a plurality of cylindrical bores therein opening to the interior of said body; gripping members in said bores expandable outwardly against the well casing in response to fluid pressure within said body and bores; a tubular mandrel within said body, said mandrel and body providing a fluid passage therebetween communicating with said bores; releasable means holding said passage in its open condition while the apparatus is being lowered in the well casing; passage closing means for closing said passage above said cylindrical bores after said apparatus has been lowered in the well casing to enable fluid pressure in the well casing below the apparatus to be developed for action through the lower end portion of said passage and through said passage itself upon the gripping members to expand said gripping members against the well casing.

24. In apparatus adapted to be anchored in a well casing disposed in a well bore: a body; normally retracted casing gripping members on said body for anchoring said body in the well casing; hydraulically operable means for expanding said gripping members into engagement with the well casing; a tubular mandrel within said body; a normally retracted packing structure around said mandrel below said gripping members; means for expanding said packing structure into sealing engagement with the well casing; means providing a fluid passage between the exterior of said mandrel and body and between said mandrel and packing structure communicating with said hydraulically operable means which passage is open adjacent to its upper end portion while the apparatus is being lowered in the well casing to prevent fluid pressure from developing in said hydraulically operable means to operate the same to expand the gripping members; passage closing means for closing said upper end portion of said passage above the point of communication between said passage and hydraulically operable means after the apparatus has been lowered in the well casing to enable fluid pressure in the well casing below the expanded packing structure to be developed and pass through a lower portion of said passage and said passage to said hydraulically operable means to hydraulically operate the same to expand and thereby engage said gripping members with the well casing; and releasable means holding said passage closing means in its open condition while the apparatus is being lowered in the well casing.

25. In apparatus adapted to be anchored in a well casing disposed in a well bore: a body having a plurality of cylindrical bores therein opening to the interior of said body; gripping members in said bores expandable outwardly against the well casing in response to fluid pressure within said body and bores; a tubular mandrel within said body; a normally retracted packing structure around said mandrel below said gripping members; means for expanding said packing structure into sealing engagement with the well casing; means providing a fluid passage

between the exterior of said mandrel and body and between said mandrel and packing structure communicating with said bores; releasable means holding the upper portion of said passage in its open condition while the apparatus is being lowered in the well casing; passage closing means for closing said upper portion of said passage above said cylindrical bores after said apparatus has been lowered in the well casing to enable fluid pressure in the well casing below the expanded packing structure to be developed and pass through a lower portion of said passage and said passage to said bores for action upon the gripping members to expand said gripping members against the well casing.

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