Jan. 22, 1957 R. W. MASTERS 2,778,429

WELL APPARATUS

Filed May 18, 1953 3 Sheets-Sheet 1

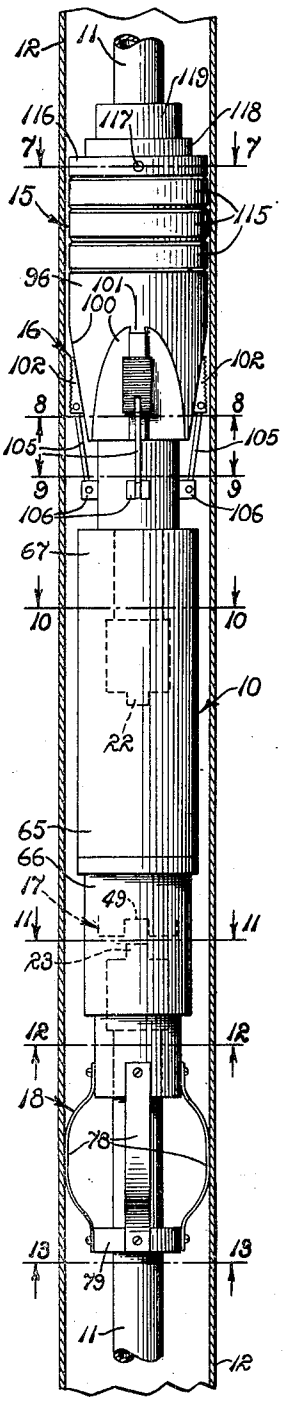


FIG. 1.

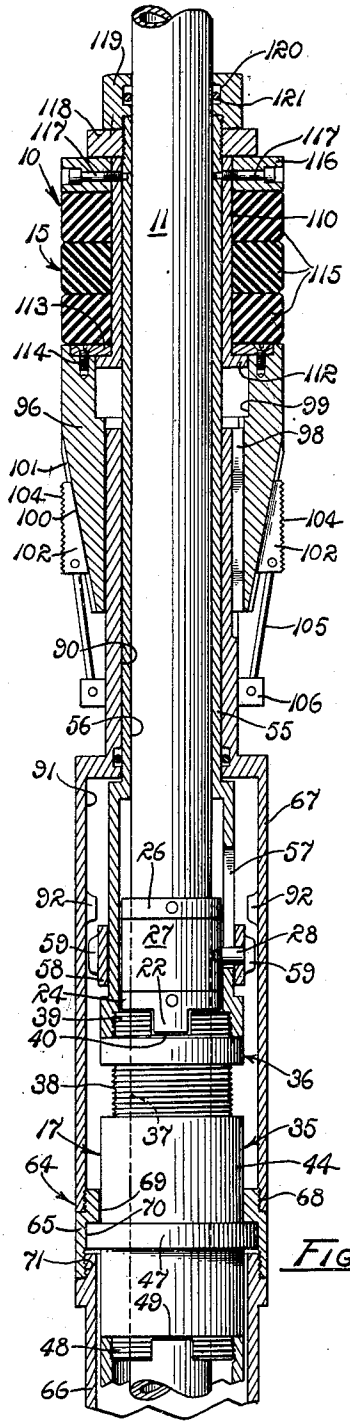


FIG. 2.

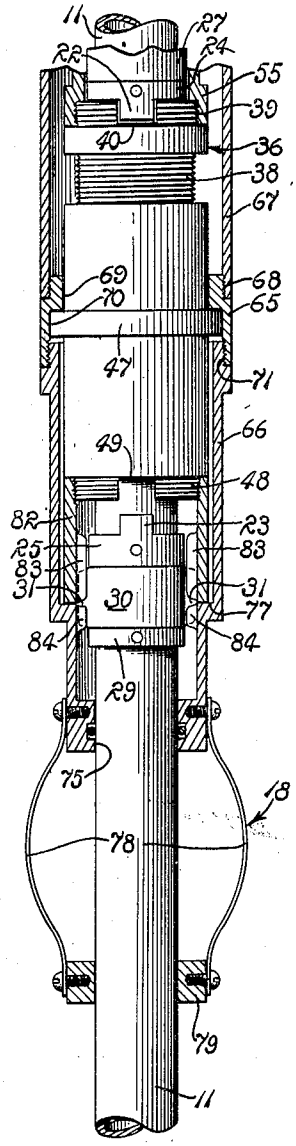


FIG. 3.

ROMNEY W. MASTERS
INVENTOR
HUEBNER, BEEHLER,
WORREL & HERZIG
ATTORNEYS
BY Richard M. Worrel

Jan. 22, 1957 R. W. MASTERS 2,778,429

WELL APPARATUS

Filed May 18, 1953 3 Sheets-Sheet 2

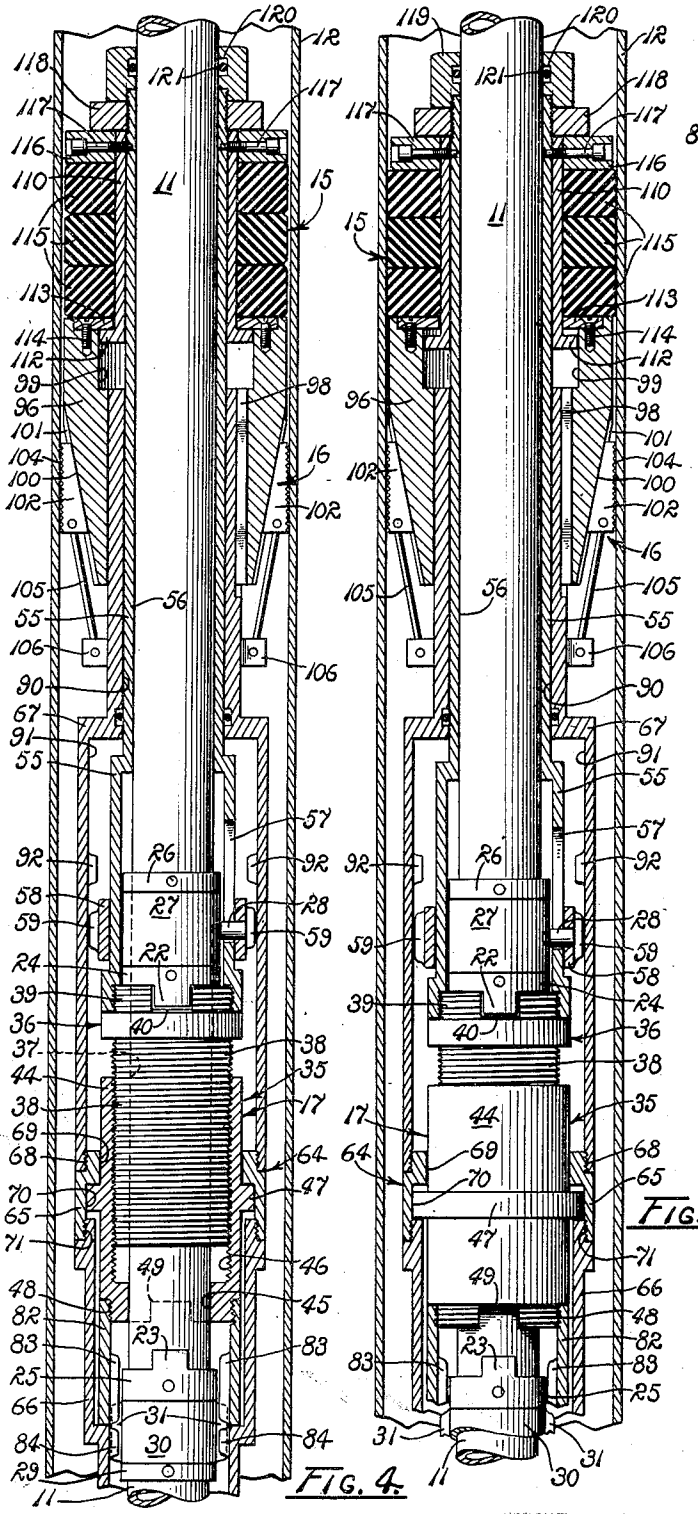


FIG. 4.

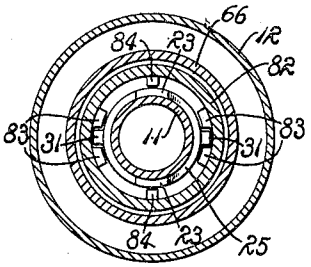


FIG. 11.

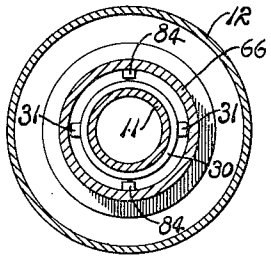


FIG. 12.

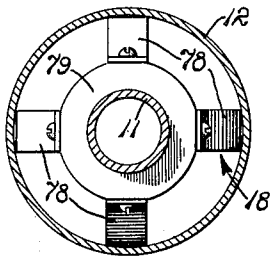


FIG. 13.

FIG. 5.

ROMNEY W. MASTERS
INVENTOR
HUEBNER, BEEHLER,
WORREL & HERZIG
ATTORNEYS
BY Richard M. Worrel

Jan. 22, 1957 R. W. MASTERS 2,778,429

WELL APPARATUS

Filed May 18, 1953 3 Sheets-Sheet 3

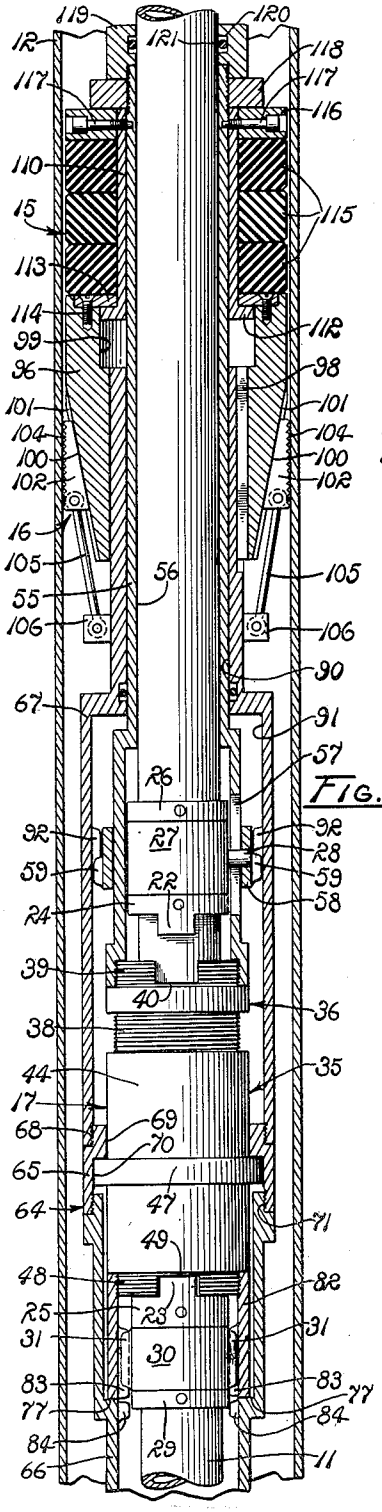


FIG. 6.

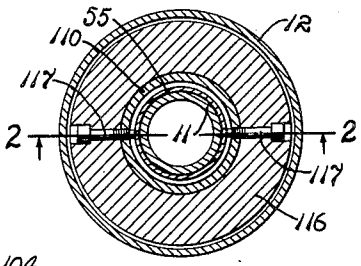


FIG. 7.

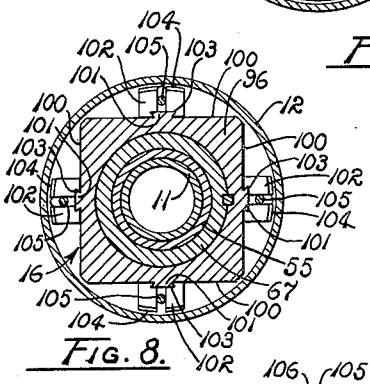


FIG. 8.

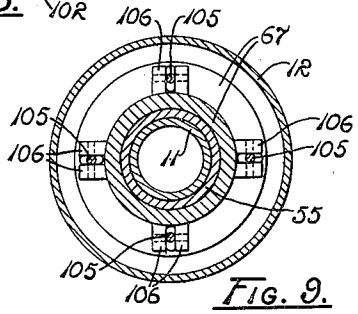


FIG. 9.

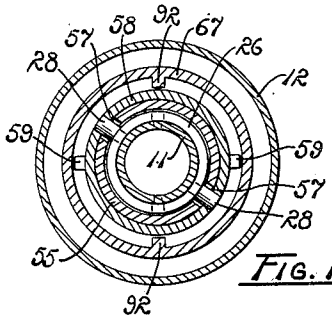


FIG. 10.

ROMNEY W. MASTERS
INVENTOR
HUEBNER, BEEHLER,
WORREL & HERZIG
ATTORNEYS
BY
Richard M. Worrel

United States Patent Office

2,778,429

Patented Jan. 22, 1957

2,778,429

WELL APPARATUS

Romney W. Masters, Avenal, Calif.

Application May 18, 1953, Serial No. 355,497

10 Claims. (Cl. 166—139)

The present invention relates to well apparatus and more particularly to a packer suitable for sealing between a control member, such as a string of tubing, and a cylindrical member in concentric housing relation thereto, such as a well casing.

While a great many types of well packers and control mechanisms therefor exist, even the most popular thereof are subject to difficulties which the present invention is believed to overcome. For example, one of the most popular types of packers utilizes a J pin slot control mechanism and the packer is expanded and contracted in response to opposite rotational movement of a control member such as a pipe, running-in tubing string, or the like. Inasmuch as such pipe and tubing usually consists of longitudinally screw-threadably interconnected segments, the control of such apparatus by opposite rotational movement of the pipe or tubing is effected only by encountering the hazards incident to possible disconnection of the segments. These hazards are particularly onerous in crooked wells or other bore holes and the like which impose relatively high frictional resistance to rotation of the pipes or tubing.

Other well known packers utilize the weight of the pipes or tubing on which they are mounted to compress packing rings so as to effect sufficient distortion thereof to seal against a circumscribing well casing or the like. The sealing action attained by such packing has not proved thoroughly dependable, particularly where high pressures are to be resisted. Further, such pipes and tubing are objectionably cork screwed when rested downwardly upon the packers in an effort to effect dependably sealing action. In addition, such pipes and tubing are subject to pulsations, conventionally referred to as breathing, in response to pumping action conducted therein. Many other packers require special tools for setting and resetting purposes and are difficult to employ.

An object of the present invention is to provide an improved packer that may be run into a bore hole upon an operating string of tubing or the like and accurately controlled for setting and releasing purposes by manipulation of the string at the mouth of the bore hole.

Another object is to provide a packer which is operable with equal advantage as a production packer, bridge plug or the like.

Another object is to provide a well packer operable by subsurface rotation of tubing, drill pipe, or the like on which the packer is mounted, in a single rotational direction.

Another object is to provide a packer adapted to resist even extreme pressure in sealing portions of wells or the like from other portions longitudinally of the well therefrom.

Another object is to provide an improved packer permitting the tensioning of the string on which it is mounted subsequent to expansion of the packer into sealing condition so as to avoid the conventional cork screwing and breathing described.

Another object is to provide a dependable well packer which is positively expandable and retractable and avoids the utilization of the weight of pipes or tubing on which it is mounted to effect sealing operation.

Another object is to provide a packer conducive to improved speed of packing or plugging of wells and the like.

Another object is to provide a packer of the character described which is dependably and speedily releasable for retrieving or repositioning.

Another object is to provide a well packer of the character described which utilizes only a single set of slips.

Another object is to provide a packer having improved means for anchoring the packer against elevational movement in a casing or other tubular member in housing relation thereto which is dependably employable separate and apart from packing operations.

Further objects are to provide improved elements and arrangements thereof in a device of the character and for the purposes set forth.

Additional objects and advantages will become apparent in the subsequent description in the specification.

Referring to the drawings:

Fig. 1 is a side elevation of an embodiment of the well packer of the present invention located in a well casing shown in vertical section.

Fig. 2 is a fragmentary vertical axial section taken along a plane indicated by line 2—2 of Fig. 7 through an upper portion of the well packer on a larger scale than that employed in Fig. 1 and with the well casing omitted.

Fig. 3 is a view similar to Fig. 2 and taken along the same plane but showing a lower portion of the well packer which is a continuation of the upper portion shown in Fig. 2 and likewise omitting the well casing.

Fig. 4 is an enlarged, fragmentary, vertical, axial section taken along the same plane as Fig. 2 through an upper portion of the well packer and its well casing illustrating slips of the packer in grasping engagement with the interior of the well casing as during an early step in the packing of a well.

Fig. 5 is a view similar to Fig. 4 and taken along the same plane demonstrating a successive step in the well packing operation in which a tubing string on which the packer is mounted is supported on the slips and showing packing rings of the packer under compression and squeezed outwardly and tightly against the well casing.

Fig. 6 is a view similar to Fig. 4 and taken along the same plane illustrating the tubing string raised to packer releasing position.

Fig. 7 is a horizontal section through the well packer and its well casing, taken on line 7—7 in Fig. 1.

Figs. 8, 9, 10, 11, 12 and 13 are horizontal sections taken on lines 8—8, 9—9, 10—10, 11—11, 12—12, and 13—13, respectively, in Fig. 1 of the drawings.

Referring in greater detail to the drawings:

The well packer of the present invention, indicated generally by the reference numeral 10, is adapted to hold a tubing string 11 in predetermined longitudinal position in a well casing 12 and has means for providing a seal at the packer separating the space thereabove in the well casing from the space therebelow. Although the packer is illustrated as providing a seal about a tubing string located in a well, it will be apparent that the packer may be utilized to advantage in many other operational environments requiring a seal between an inner member and an outer member in circumscribing relation thereto.

The packer employs a ring assembly 15 at its upper end, an expansion slip assembly 16 therebelow, a control assembly 17 below the expansion slip assembly, and a resistor assembly 18 at the lower end thereof. The primary purposes of these assemblies are as follows: The resistor assembly 18 frictionally engages the interior of the well

casing 12 to resist relative movement both axially and rotationally between the packer and the well casing. The resistor assembly, however, does not preclude such relative movement. The control assembly has connection with the slip assembly and provides for selective engagement and disengagement of the slip assembly with the interior of the well casing on proper manipulation of the tubing string as will subsequently become apparent. The packer ring assembly, after the slip assembly is secured against the well casing, is compressed so as to expand radially against the interior of the well casing to provide a seal between the packer and the well casing.

The control assembly 17 is provided with downwardly disposed upper dogs or coupling members 22 and upwardly disposed lower dogs or coupling member 23 in elevationally spaced relation. The dogs 22 and 23 are integral with dog rings 24 and 25, respectively, which circumscribe the tubing string 11 and are attached thereto. An upper collar 26 circumscribes the tubing string and is secured thereto in spaced relation above the upper dog ring 24. An upper clutch cylinder 27 is rotatably supported on the tubing string between the upper dog ring 24 and the collar 26 in fixed position longitudinally of the tubing string. A pair of drive pins 28 extend diametrically oppositely from the upper clutch cylinder 27 for a purpose hereinafter fully described. A lower collar 29 circumscribes the tubing string below the lower dog ring 25 and is attached thereto in spaced relation to the ring. A lower clutch cylinder 30 is rotatably supported in the tubing string between the lower dog rim 25 and the collar 29. Diametrically opposite lugs 31 extend radially outwardly from the lower clutch cylinder for the purpose hereinafter described. The lugs 31 are elongated longitudinally of the tubing string.

The expansion slip assembly 16 is selectively engaged with, and disengaged from, the interior of the well casing 12 by the selective interconnection of the dogs 22 and 23 with a telescopicaly adjustable control member 35 located between the dogs about the tubing string 11. One portion of the control member comprises a cylindrical nipple 36 having a concentric bore rotatably mounted on the tubing string. The nipple has a downwardly extended elongated portion 38 which is externally threaded. The nipple also has a short externally threaded upward extension 39 having a pair of upwardly disposed diametrically opposite dog recesses 40 formed therein. The dog recesses are adapted to receive the upper dogs 22 in driven connection therewith upon movement of the line tubing downwardly relative thereto. The control member also includes a cylindrical collet 44 having a bore 45 rotatably fitted to the tubing string 11. The collet is screw-threaded internally at 46 a substantially portion of its length with threads complementary to the threads 38 on the nipple. The screw-threaded portions 38 and 46 on the nipple and collet are threaded together to complete the telescopic control member. The collet provides a radially disposed circumscribing flange 47 midway of its length and the lower end thereof has a male screw-threaded extension 48. The collet provides a pair of diametrically related downwardly disposed dog receiving recesses 49. The recesses 49 are adapted to receive the lower dogs 23 in driving connection to the control member when the tubing string is raised relative thereto.

A packing ring mounting sleeve 55 has an inner bore 56 slidably fitted on the tubing string and provides an enlarged lower end which encloses the upper dogs 22 and the upper clutch cylinder 27 and screw-threadably or otherwise is securely connected to the upper extension 39 of the nipple 36. A slot 57 is formed longitudinally through the sleeve 55 through which the drive pins 28 on the upper clutch cylinder extend. The pin also extends through a clutch sleeve 58 circumscribing the packing ring mounting sleeve. The lugs 59 are radially disposed from the clutch sleeve 58 and elongated longitudinally thereof.

A housing 64 encloses the control assembly 17 with the collet 44 rotatably mounted therein in predetermined

relative longitudinal position. To this end, the housing includes a connector sleeve 65, a resistor mounting sleeve 66 and a slip mounting sleeve 67. The connector sleeve 65 is externally threaded at its upper end, is bored at 69 rotatably to receive the collet 44, and is counterbored at 70 rotatably to receive the flange 47 of the collet. The connector sleeve is internally threaded at its lower end at 71 and tightened downwardly on the resistor mounting sleeve 66. The lower end of the slip mounting sleeve is screw-threadedly mounted on the upper end of the connector sleeve.

The resistor mounting sleeve 66 has a constricted lower end slidably fitted to the tubing string 11 and provides an inwardly and upwardly disposed shoulder 77 substantially midway of its length of an internal diameter less than the external diameter of the collet 44. A plurality of elongated bowed leaf springs 78 are attached at their upper ends to the lower end of the resistor mounting sleeve 66 and at their lower ends are attached to an anchor ring 79 circumscribing the tubing string below the housing. The outwardly bowed portions of the springs frictionally engage the interior of the well casing 12 with sufficient outward pressure that longitudinal and rotational movement of the springs and housing in the casing are resisted but not precluded.

The collet 44 of the control member 35 is held nonrotatably in the housing when it is desired to contract the member by an extension sleeve 82 threadably received on the threaded extension 48 of the collet with the lower end of the sleeve engaging the shoulder 77. Longitudinal ribs 83 extend radially inwardly from the extension sleeve 82 and lugs 84 extend radially inwardly from the resistor mounting sleeve 66. When the tubing string is pulled upwardly, relative to the control assembly 17, the ribs 31 are situated between the ribs 83 and the collet is free to rotate in the housing but on lowering the tubing string, the ribs 31 are received between both the ribs 83 and the lugs 84 locking the collet against rotation in the housing. It will be observed that the collet is in fixed longitudinal position in the housing whether the collet is locked against rotation therein or is free to rotate.

The slip mounting sleeve portion 67 of the housing is cylindrically constricted at 90 to a sliding fit to the exterior diameter of the packing ring mounting sleeve 55, has an enlarged bore 91 housing the control assembly 17, and is screw-threadedly secured at its lower end to the screw-threaded upward extension 68 of the connector sleeve 65. A pair of diametrically opposite ribs 92 extend inwardly toward the packing ring mounting sleeve in the enlarged bore portion 91 and are located for engagement with the lugs 59 on the clutch sleeve 58 when the tubing string is raised relative to the housing 64 so that the packing ring mounting sleeve is locked against rotation in the housing. When the string tubing is lowered in the housing, the annular path of the lugs 59 is below that of the ribs 92 so that the nipple and packing ring mounting sleeve may rotate independently of the housing.

A slip mandrel 96 is slidably fitted concentrically exteriorly on the upper end of the slip mounting sleeve 67. The slip mandrel is keyed at 98 to the slip mounting sleeve to preclude relative rotation therebetween and provides an upper cylindrical end portion and a downwardly disposed frusto-conical portion. The mandrel is internally counterbored at 99 and externally formed with a plurality of angular faces 100 of uniform angular upward divergence from the upper end of the slip mounting sleeve. A vertical dovetail guide 101 is provided centrally on each of the faces and slips 102 are slidably mounted on the angular faces for reciprocal elevational movement. Each slip has a dovetail channel therein slidably fitted to the dovetail guide of its respective face of the mandrel. The outer faces of the slips are serrated at 104 with horizontal serrations adapted to have biting engagement with the interior surface of the well casing 12. The slips are connected to the exterior of the slip mounting

sleeve 67 for corresponding elevational movement therewith by individual links 105 pivotally connected to flanges 106 radially extended from the upper end of the slip mounting sleeve. Circumscribing the packing ring mounting sleeve near its upper end is a packing ring bearing sleeve 110 that is tightly fitted to the packing ring mounting sleeve 55. The lower end of the packing ring bearing sleeve has a radial flange 112 located in the counterbore 99 in the slip mandrel 96. The flange 112 is maintained in the counterbore by an annular plate 113 attached by screws 114 to the upper end of the slip mandrel. A plurality of annular resilient packing rings 115 are positioned about the packing ring bearing sleeve 110. The packing rings are made of rubber, plastic or other resilient distortable material. The packing rings are maintained on the packing ring bearing sleeve by a compression collar 116 located downwardly against the topmost packing ring and secured by bolts 117 passed inwardly thereof and screw-threadedly secured in the packing ring bearing sleeve 110 and disposed in a groove in the packing ring mounting sleeve 55 for freedom of movement relative thereto. A washer 118 is located around the upper end of the packing ring bearing sleeve and against the upper face of the compression collar with a nut 119 screwed downwardly on the upper end of the packing ring mounting sleeve against the washer. Formed in the nut, is an annular recess 120 in which is located an O-ring seal 121 engaging the tubing string 11 and preventing the entry of liquid into the packer.

Operation

The operation and utility of the present invention are believed to be apparent and are briefly summarized at this point.

Preconditional for use by the nipple 36 and the collet 44 of the control member 35 being longitudinally extended, as shown in Fig. 1, the slips 102 are in their retracted positions and the tubing string 11 with the packer 10 thereon is lowered into the well casing 12 to the position desired. The bowed leaf springs 78 frictionally engage the well casing and cause a drag on the downward movement of the packer into the well so that the packer is pushed downwardly by the engagement of the upper dogs 22 in the recess 40 of the nipple 36. When the desired level at which the packer is to be located is reached, the tubing string is rotated to the right, or clockwise, as viewed from the top. In this position, the lugs 59 on the clutch sleeve 58 are at a lower elevation than the ribs 92 on the slip mounting sleeve so that the packing ring mounting sleeve 55 may rotate independently of the housing 64. In this position also, the ribs 31 on the lower clutch cylinder 30 are at a level for engagement with both the ribs 83 on the extension sleeve 82 and the lugs 84 on the resistor mounting sleeve whereby the collet 44 is interconnected with the housing so as to preclude relative rotational movement. Upon rotation of the tubing string, the springs 78 frictionally resist rotation of the housing 64 and the collet 44 relative to the casing and the nipple 36 is screwed downwardly into the collet to shorten the control member. This shortening of the control member causes the packing ring mounting sleeve 55 to lower relative to the housing 64 which forces the packing rings 115 and slip mandrel 96 downwardly. The lowering of the slip mandrel forces the slips outwardly into engagement with the interior of the well casing 12. This right hand rotation of the tubing string is continued until the slips engage the well casing to the extent required dependably to hold the packer in place.

During continued rotation of the tubing string 11 in the same direction, the slips 102 hold the housing 64 in fixed position in the casing 12 but the packing ring mounting sleeve 55 continues to move downwardly relative to the housing compressing the packing rings 115 between the mandrel 96 and collar 116 until the rings are forced outwardly into dependable sealing engagement with the casing 12, as shown in Fig. 5.

To release the packer from the well casing, the tubing string 11 is first hoisted upwardly until the lower dogs 23 engage the dog recesses 49 and the upper dogs 22 are released from the dog recesses 40. In this raised position, the lugs 59 on the clutch sleeve 58 are at a level adapted to make contact with the ribs 92 on the slip mounting sleeve 67, as shown in Fig. 6 of the drawing, so that the packing ring mounting sleeve 55 is held nonrotationally in the housing. Also in this raised position, the ribs 31 on the lower clutch cylinder 30 are at a level in the horizontal annular path of the ribs 83 on the extension sleeve 82 but at a level above the lugs 84 on the resistor mounting sleeve 66 so that the collet is free to rotate relative to the housing. Upon rotation of the tubing string 11 to the right, or clockwise as viewed from above, the collet 44 is rotated in the same direction causing the control member 35 relatively to unscrew the collet from the nipple 36 lengthening the control assembly 17.

As the control member assembly 17 lengthens, the housing 64 is drawn downwardly by the collet 44 drawing the slips 102 downwardly on the mandrel 96 thus retracting the slips from engagement with the casing 12. It will be apparent that the same lengthening of the control assembly relieves the pressure on the packer rings 115 permitting their return to normal condition retracted from the casing. When this is accomplished, the tubing string 11 and the packer 10 can be withdrawn from the well casing 12 or moved to another position for repeated use in the manner described.

The advantages incident to operation of the packer to expand the same into casing sealing condition and retraction thereof from such position by rotation of the tubing string 11 in the same direction will be readily appreciated, the elevational position of the dogs 22 and 23 on the tubing string relative to the dog recesses 40 and 49, respectively, serving to determine the expansible or contractible effect of such rotation.

The positive compression of the packer rings 15 and the positive release of such compression under controlled actuation of the control member assembly 17 assures dependability of operation of the instant packer not believed to have been attained by prior packers.

If it is desired to plug the casing 12 or other tubular member in which the packer is inserted, such plugging action can be dependably effected by capping or plugging the tubing string 11 or substituting a solid rod therefor. The packer is suitable for resisting even excessive bottom pressures. Once expanded into position, the tubing string 11 can be tensioned to avoid "corkscrewing" thereof under compression, the weight of the string not being needed to effect dependable sealing. Such tensioning also permits avoidance of tubing string pulsation or "breathing" in response to pump operation. The packer is fully retrievable whether used as a bridge plug, production packer, or for other intended purpose.

Although the invention has been herein shown and described in what is conceived to be the most practical and preferred embodiment, it is recognized that departures may be made therefrom within the scope of the invention, which is not to be limited to the details disclosed herein but is to be accorded the full scope of the claims so as to embrace any and all equivalent devices and apparatus.

Having described my invention, what I claim as new and desire to secure by Letters Patent is:

1. In a well apparatus adapted for use with a rotatable string of tubing or the like inserted into a well, the combination of a pair of dogs mounted on the string in opposed facing relation and spaced longitudinally of each other, an adjustable member slidably and rotatably mounted on the string between the dogs including screw-threadably interconnected upper and lower elements, the

adjustable member being of a length less than the spacing of the dogs having means on said upper and lower elements for engaging respectively upon longitudinal movement of the tubing in the well the dog adjacent thereto for independent driving connection of the upper and lower elements, means mounted for rotation on one of the elements of the adjustable member in fixed longitudinal position thereon adapted frictionally to engage the walls of a well into which the apparatus is inserted, means releasably interconnecting the friction means and the element on which it is mounted to preclude relative rotational movement therebetween when the element of the adjustable member opposite to the element on which the friction means is mounted is engaged with its respective dog, and means releasably interconnecting said element opposite to the element on which the friction means is mounted and the friction means to preclude relative rotational movement therebetween when the element on which the friction means is mounted is engaged with its respective dog.

2. In a well apparatus adapted for use with a rotatable string lowered into a well, the combination of a pair of dogs mounted on the string in spaced relation longitudinally thereof, a screw-threadably telescopic member slidably and rotatably mounted on the string between the dogs, said member having an upper element providing an upwardly disposed recess adapted for driving engagement with the upper dog when the string is lowered relative to the telescopic member and a lower element screw-threadably connected to the upper element having a downwardly disposed recess adapted for driving engagement with the lower dog when the string is raised relative to the telescopic member, a pair of substantially concentric sleeves individually mounted on the elements of the telescopic member, the inner sleeve being rigidly mounted on its respective element and the outer sleeve being rotatably mounted in fixed longitudinal position on its element, means mounted on the outer sleeve for frictional engagement with the walls of a well into which the string is lowered frictionally to resist rotational and longitudinal movement of the outer sleeve in the well, means releasably interconnecting the outer sleeve and the element on which it is mounted to preclude relative rotational movement therebetween when the element on which the inner sleeve is mounted is in driving engagement with the dog associated therewith, and means releasably interconnecting the inner sleeve and the outer sleeve to preclude relative rotational movement therebetween when the element to which the outer sleeve is connected is engaged by its respective dog whereby the sleeves can be longitudinally telescopically adjusted by rotation of the string in a single direction with the dogs selectively engaged with their respective elements.

3. A well packer adapted for use on a rotatable tubing string or the like inserted into a well comprising a pair of dogs mounted on the string in spaced relation longitudinally thereof, a screw-threadably telescopic member slidably and rotatably mounted on the string between the dogs, said member having an upper element providing an upwardly disposed recess adapted for driving engagement with the upper dog when the string is lowered relative to the telescopic member and a lower element screw-threadably connected to the upper element having a downwardly disposed recess adapted for driving engagement with the lower dog when the string is raised relative to the telescopic member, a pair of substantially concentric sleeves individually mounted on the elements of the telescopic member and extended longitudinally of the string, the inner sleeve being rigidly mounted on its respective element and the outer sleeve being rotatively mounted in fixed longitudinal position on its element, means mounted on the outer sleeve for frictional engagement with the walls of a well into which the string is lowered frictionally to resist rotation and longitudinal movement of the outer sleeve in the well, means releasably interconnecting the outer sleeve and the element on which it is mounted to preclude relative rotation therebetween when the element on which the inner sleeve is mounted is in driving engagement with the dog associated therewith, means releasably interconnecting the inner sleeve and the outer sleeve to preclude relative rotation therebetween when the element to which the outer sleeve is connected is in driven engagement with its respective dog, the inner sleeve being extended longitudinally of the string beyond the outer sleeve, a compression collar mounted on the extended end of the inner sleeve, resiliently compressible annular packing means mounted concentrically on the inner sleeve against the collar and being movable between an outer expanded position and a retracted position, and means mounted on the outer sleeve engageable with the packing means upon movement of the outer sleeve longitudinally of the inner sleeve toward the collar to compress the packing means and move it toward its outer position.

4. A well packer adapted for use on a rotatable tubing string or the like inserted into a well comprising a pair of dogs mounted on the string in spaced relation longitudinally thereof, a screw-threadably telescopic member slidably and rotatably mounted on the string between the dogs, said member having an upper element providing an upwardly disposed recess adapted for driving engagement with the upper dog when the string is lowered relative to the member and a lower element screw-threadably connected to the upper element having a downwardly disposed recess adapted for driving engagement with the lower dog when the string is raised relative to the member, a pair of substantially concentric sleeves individually mounted on the elements of the control member and extended longitudinally of the string, the inner sleeve being rigidly mounted on its respective element and the outer sleeve being rotatably mounted in fixed longitudinal position on its element, means mounted on the outer sleeve for frictional engagement with the walls of a well into which the string is lowered frictionally to resist rotational and longitudinal movement of the outer sleeve in the well, means releasably interconnecting the outer sleeve and the element on which it is mounted to preclude rotational movement therebetween when the element on which the inner sleeve is mounted is in driving engagement with the dog associated therewith, means releasably interconnecting the inner sleeve and the outer sleeve to preclude rotational movement therebetween when the element to which the outer sleeve is connected is in driven engagement with its respective dog, the inner sleeve being extended longitudinally of the string beyond an adjacent end of the outer sleeve, a compression collar mounted on the extended end of the inner sleeve, a resiliently compressible packing ring mounted concentrically on the inner sleeve against the collar, a mandrel slidably mounted on the outer sleeve having an end engageable with the packing ring and laterally disposed convergent sides extended oppositely from the packing ring, slips slidably mounted on the convergent faces of the mandrel having outwardly disposed teeth engageable with the walls of a well into which the apparatus is inserted, and means interconnecting the slips at predetermined positions on the outer sleeve in fixed spaced relation whereby movement of the outer sleeve relatively toward the collar on the inner sleeve forces the mandrel beneath the slips urging the slips outwardly into engagement with the walls of the well and continued movement of the outer sleeve in the same relative direction on the inner sleeve compresses the packing ring between the collar and the mandrel.

5. In a well apparatus adapted for use on a rotatable tubing string or the like lowered into a well having a casing, the combination of an upper dog secured to the string; a lower dog secured to the string in spaced relation to the upper dog; a telescopic control member rotatably supported on the string between the dogs for slidable movement longitudinally of the string, the control member including a nipple and a collet screw-threadedly

interconnected in circumscribing relation to the string, the nipple having an upwardly disposed recess adapted to receive the upper dog in driving connection therewith upon downward movement of the string relative to the control member and the collet having a downwardly disposed recess adapted to receive the lower dog in driving engagement therewith upon upward movement of the string relative thereto; a mounting sleeve rigidly secured to the nipple and extended upwardly therefrom slidably on the tubing string; a housing rotatably supported on the collet in fixed longitudinal relation thereon and upwardly extended therefrom enclosing the control member and having an upper end portion slidably mounted on the mounting sleeve; resilient means on the lower end of the housing adapted frictionally to engage the interior of the well casing; means mounted on the string interconnecting the mounting sleeve and the housing in fixed rotational relation when the string is raised relative thereto to engage the lower dog in the recess of the collet; means mounted on the string interconnecting the collect and the housing in fixed rotational relation when the string is lowered relative thereto to engage the upper dog in the nipple recess; a slip mandrel slidably mounted on the upper end portion of the housing having downwardly convergent sides; a plurality of slips each having outwardly disposed teeth slidably mounted on the faces of the mandrel for reciprocal movement longitudinally thereof; a flange secured to the housing in substantial alignment longitudinally of the string below each slip; a link pivotally interconnecting each flange with its respective slip thereabove; and means mounted on the upper end of the mandrel to resist upward movement of the mandrel relative to the mounting sleeve when the control member is telescopically shortened to raise the housing relative to the mounting sleeve.

6. In a well packer adapted for use on a rotatable tubing string for lowering into a well casing, the combination of a packing ring mounting sleeve mounted for longitudinal slidable movement and rotation on the string and having upper and lower end portions, a male screw threaded nipple rotatably mounted on the string connected to the lower end of the packing ring mounting sleeve for slidable movement longitudinally of the string with the packing ring mounting sleeve, the male nipple having an upwardly disposed driving recess, a female element screw-threadably mounted on the nipple for telescopic adjustment thereon incident to relative rotational movement thereto, the female element having a downwardly disposed driving recess therein, an upper dog rigidly mounted on the string within the packing ring mounting sleeve engageable with the driving recess in the nipple when the string is lowered relative to the packing ring mounting sleeve, a lower dog rigidly mounted on the string below the female element engageable in the driving recess thereof upon upward movement of the string relative to the packing ring mounting sleeve, a compression collar mounted on the upwardly extended end of the packing ring mounting sleeve, a plurality of annular packing rings of compressible material mounted concentrically on the packing ring mounting sleeve against the compression collar, a slip mounting sleeve rotatably mounted on the female element in fixed longitudinal position thereon and upwardly extended therefrom having an upper end portion rotatably and slidably fitted to the packing ring mounting sleeve, a slip mandrel mounted on the upper end of the slip mounting sleeve for slidable movement longitudinally thereof having a plurality of diametrically opposite downwardly convergent faces thereon, a slip slidably mounted on each face of the mandrel for movement longitudinally thereof, flanges radially extended from the slip mounting sleeve downwardly adjacent to the mandrel, links pivotally interconnecting the flanges and slips in fixed spaced relation, means mounted on the slip mounting sleeve adapted frictionally to engage the casing into which the string is lowered to resist rotational and longitudinal movement of the mounting sleeve relative to the casing, means releasably interconnecting the female element and the slip mounting sleeve in fixed rotational relation when the string is lowered relative to the female element, and means releasably interconnecting the nipple and the slip mounting sleeve in fixed rotational relation when the string is raised relative to the nipple.

7. A well packer, adapted for use on a rotatable tubing string or the like lowered into a well having a casing, comprising an upper dog secured to the string; a lower dog secured to the string in spaced relation to the upper dog, the dogs having ends disposed toward each other; a telescopic expansion member rotatably supported on the string between the dogs for slidable movement longitudinally of the string, the expansion member including a nipple and a collet screw-threadedly interconnected with the nipple, the nipple having an upwardly disposed recess adapted to receive the upper dog upon downward movement of the string relative thereto and the collet having a downwardly disposed recess adapted to receive the lower dog upon upward movement of the string relative thereto; a packer ring mounting sleeve secured to the nipple and extended upwardly therefrom slidably on the tubing string; a housing rotatably supported on the collet in fixed longitudinal relation thereon enclosing the expansion member and having an upper end portion slidably mounted on the packing ring mounting sleeve; resilient members on the lower end of the housing adapted frictionally to engage the interior of the well casing; means mounted on the string interconnecting the packing ring mounting sleeve and the housing in fixed rotational relation when the string is raised relative thereto to engage the lower dog in the recess of the collet; means mounted on the string interconnecting the collet and the housnig in fixed rotational relation when the string is lowered relative thereto to engage the upper dog in the nipple recess; a slip mandrel mounted on the upper end portion of the housing having downwardly convergent sides, said mandrel being non-rotatably keyed to the housing for reciprocal movement longitudinally thereof; a plurality of slips each having outwardly disposed teeth slidably mounted on the faces of the mandrel for reciprocal movement longitudinally thereof; a lug secured to the housing in vertical alignment below each slip; a link pivotally interconnecting each lug with its respective slip thereabove; a packing ring bearing sleeve mounted in circumscribing relation on the packing ring mounting sleeve above the slip mandrel; an enlarged compression collar secured in circumscribing relation on the packing ring bearing sleeve in spaced relation to the mandrel; and a plurality of resiliently compressible packing rings located in superimposed relation between the slip mandrel and the compression collar in circumscribing relation to the packing ring bearing sleeve.

8. A well packer, adapted for use on a rotatable tubing string lowered into a well having a casing, comprising an upper dog secured to the string; a lower dog secured to the string in downwardly spaced relation to the upper dog, the dogs having ends disposed toward each other; an upper clutch cylinder rotatably mounted on the string in fixed position longitudinally of the string upwardy adjacent to the upper dog; a lower clutch cylinder rotatably mounted on the string in fixed longitudinal position on the string downwardly adjacent to the lower dog, the lower clutch cylinder having ribs radially extended therefrom elongated longitudinally of the string; a telescopic control member rotatably and slidably mounted on the string between the dogs, the control member including a nipple and a collet screw-threadedly interconnected in circumscribing relation to the string, the nipple being above the collet and having an upwardly disposed recess adapted to receive the upper dog in driving connection thereto upon downward movement of the string relative to the control member and the collet having a downwardly disposed recess adapted to receive the lower dog in driving connection there-

to upon upward movement of the string relative to the control member; a packer ring mounting sleeve rigidly secured to the nipple and extended upwardly therefrom on the tubing string; a housing rotatably supported on the collet in fixed longitudinal relation thereon enclosing the control member and having an upper end portion slidably mounted on the packing ring mounting sleeve, the housing having ribs longitudinally thereof inwardly extended adjacent to the upper clutch cylinder and the packing ring mounting sleeve being longitudinally slotted adjacent to ribs of the housing; a drive pin rigidly mounted on the upper clutch cylinder and radially extended therefrom through the slot in the packing ring mounting sleeve; a lug mounted on the extended end of the pin externally of the packing ring mounting sleeve engageable with the ribs on the housing when the string is raised relative thereto releasably interconnecting the packing ring mounting sleeve and the housing in fixed rotational position; a plurality of elongated leaf springs arranged longitudinally of the string; means mounting the springs on the housing in frictional engagement with the casing of the well into which the string is lowered whereby the springs resist rotation and longitudinal movement of the housing in the casing; an extension sleeve rigidly mounted on the collet and downwardly extended therefrom within the housing; inwardly extended, longitudinally adjacent, ribs mounted on the extension sleeve and the housing; elongated lugs outwardly extended from the lower clutch cylinder concurrently engageable with the ribs on the extension sleeve and the housing when the string is lowered releasably interconnecting the extension sleeve and housing in fixed rotational relation; a slip mandrel mounted on the upper end portion of the housing in downwardly spaced relation to the upper end portion of the packing ring mounting sleeve having downwardly convergent sides, said mandrel being non-rotatably keyed to the housing for reciprocal movement longitudinal thereof; a plurality of slips each having outwardly disposed teeth slidably mounted on the faces of the mandrel for reciprocal movement longitudinally thereof; a flange secured to the housing in spaced relation below each slip; a link pivotally interconnecting each flange with its respective slip; an enlarged compression collar rigidly mounted in circumscribing relation on the upper end of the packing ring mounting sleeve in spaced relation to the upper end of the mandrel; and a plurality of resiliently compressible packing rings mounted in circumscribing relation on the packing ring mounting sleeve between the collar and the upper end of the mandrel.

9. In a well apparatus adapted for use with an elongated rotatable string of tubing inserted into a well casing; upper and lower coupling means rigidly mounted in longitudinally spaced relation on the string; an adjustable telescopic member longitudinally and rotatably slidably mounted on the string between the coupling means including upper and lower screw-threadably interconnected elements independently and alternately connected to the upper and lower coupling means, respectively, incident to longitudinal sliding movement of the string relative to the telescopic member; inner and outer concentric sleeves having upper and lower ends, the lower end of the inner sleeve being rigidly connected to the upper telescopic element, and the outer sleeve being rotatably mounted in longitudinally fixed relation on the lower telescopic element; means monuted on the outer sleeve frictionally engaging the well casing to resist longitudinal and rotational movement of the outer sleeve relative thereto; means releasably interconnecting the outer sleeve and the lower telescopic element to preclude relative rotation therebetween when the upper telescopic element is connected to the upper coupling means; means releasably interconnecting the outer sleeve and the inner sleeve to preclude relative rotation between the outer sleeve and the upper telescopic element when the lower telescopic element is connected to the lower coupling means; and expandable well casing engaging means mounted around the string having upper and lower end portions connected to the upper ends of the inner and outer sleeves, respectively, and being expandable and contractable into and out of well casing engagement incident to relative longitudinal movement of the inner and outer sleeves upon telescopic adjustment of telescopic member.

10. In a well apparatus adapted for use on a rotatable tubing string or the like lowered into a well having a casing, the combination of an upper coupling member secured to the string; a lower coupling member secured to the string in spaced relation to the upper coupling member; a telescopic control member rotatably supported on the string between the coupling members for slidable movement longitudinally of the string, the control member including upper and lower elements screw-threadably interconnected in circumscribing relation to the string, the upper element having coupling means adapted to engage the upper coupling member in driving connection therewith upon downward movement of the string relative to the control member and the lower element having coupling means adapted to engage the lower coupling member in connection therewith upon upward movement of the string relative thereto; an inner sleeve rigidly secured to the upper element and extended upwardly therefrom slidably on the tubing string; an outer sleeve rotatably supported on the lower element in fixed longitudinal relation thereon and upwardly extended therefrom enclosing the control member and having an upper end portion slidably mounted on the inner sleeve; means on the outer sleeve adapted frictionally to engage the interior of the well casing; means mounted on the string interconnecting the inner sleeve and the outer sleeve to preclude relative rotation therebetween when the string is raised to bring the lower coupling into engagement with the coupling means of the lower element; means mounted on the string interconnecting the lower element and the outer sleeve to preclude relative rotation therebetween when the string is lowered to bring the upper coupling member into engagement with the coupling means of the upper element; a slip mandrel slidably mounted on the upper end portion of the outer sleeve having downwardly convergent sides; a plurality of slips each having outwardly disposed teeth slidably mounted on the faces of the mandrel for reciprocal movement longitudinally thereof; means pivotally interconnecting the slips and the outer sleeve; and means interconnecting the upwardly extended end of the inner sleeve and the mandrel to enable movement of the slips on the mandrel incident to telescopic movement of the control member.

References Cited in the file of this patent

UNITED STATES PATENTS

2,589,506	Morrisett	Mar. 18, 1952
2,633,917	Baker et al.	Apr. 7, 1953