

[72] Inventors **Cicero C. Brown;
Chudleigh B. Cochran, both of Houston,
Tex.**
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[73] Assignee **Brown Oil Tools, Inc.
Houston, Tex.
by said Cochran**

[56]

References Cited

UNITED STATES PATENTS

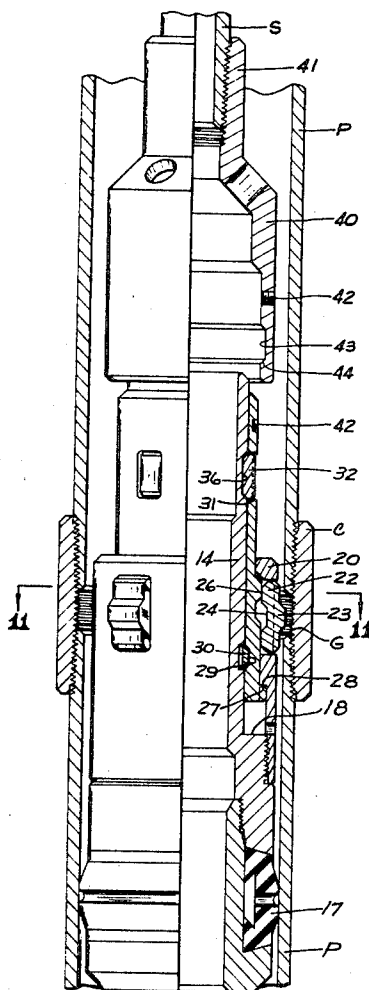
2,217,986	10/1940	Knox	166/140 X
2,401,119	5/1946	Taylor	166/125
2,862,560	12/1958	Bostock et al.	166/217 X
2,887,163	5/1959	McGowen et al.	166/217
2,972,381	2/1961	Raulins	166/125
2,980,185	4/1961	Daffin	166/125 X
3,002,565	10/1961	Moore	166/217
3,100,533	8/1963	Fredd	166/125

Primary Examiner—David H. Brown
Attorney—R. Werlin

[54] **ANCHOR ASSEMBLY FOR WELL TOOLS SUCH AS
PACKERS AND THE LIKE**
14 Claims, 12 Drawing Figs.

[52] U.S. Cl. **166/125,
166/217**
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[50] Field of Search. **166/125,
123, 135, 138, 140, 216, 217**

ABSTRACT: An anchor assembly for anchoring well tools such as packers and the like, inside a pipe string adapted particularly for running on a wire line tool string. The assembly includes safety latch means arranged to provide assurance against premature or accidental release of the assembly from the running string while being run but which is readily releasable upon actuation of the anchor elements.



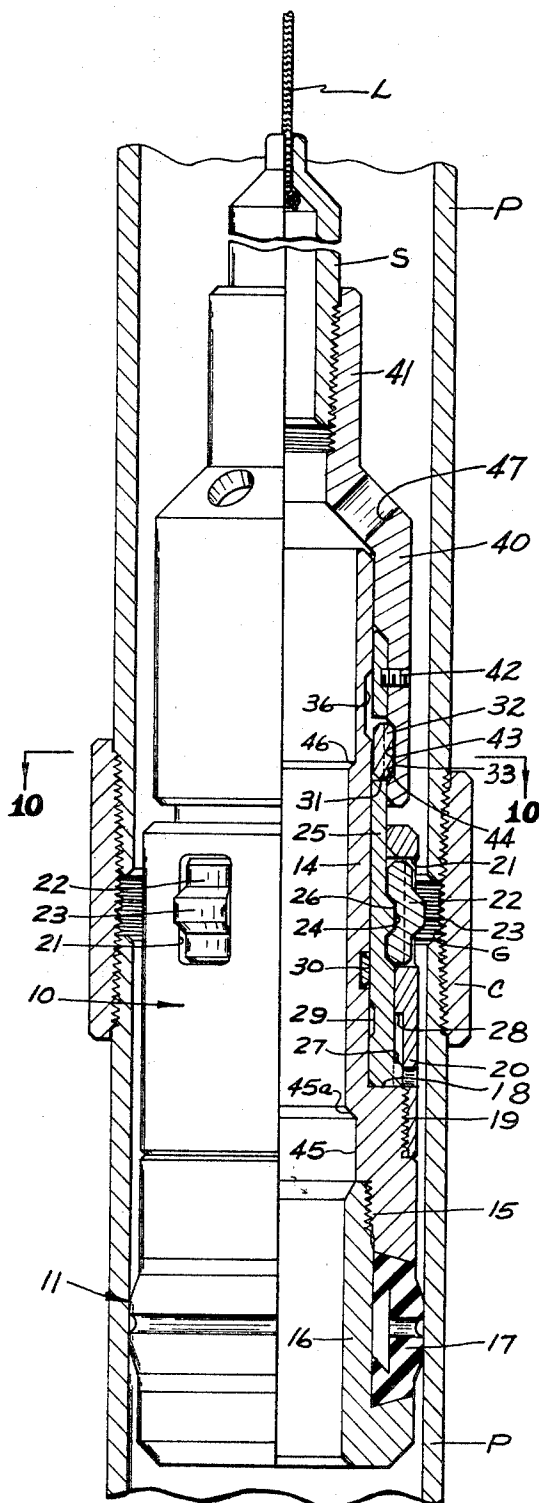


Fig. 1

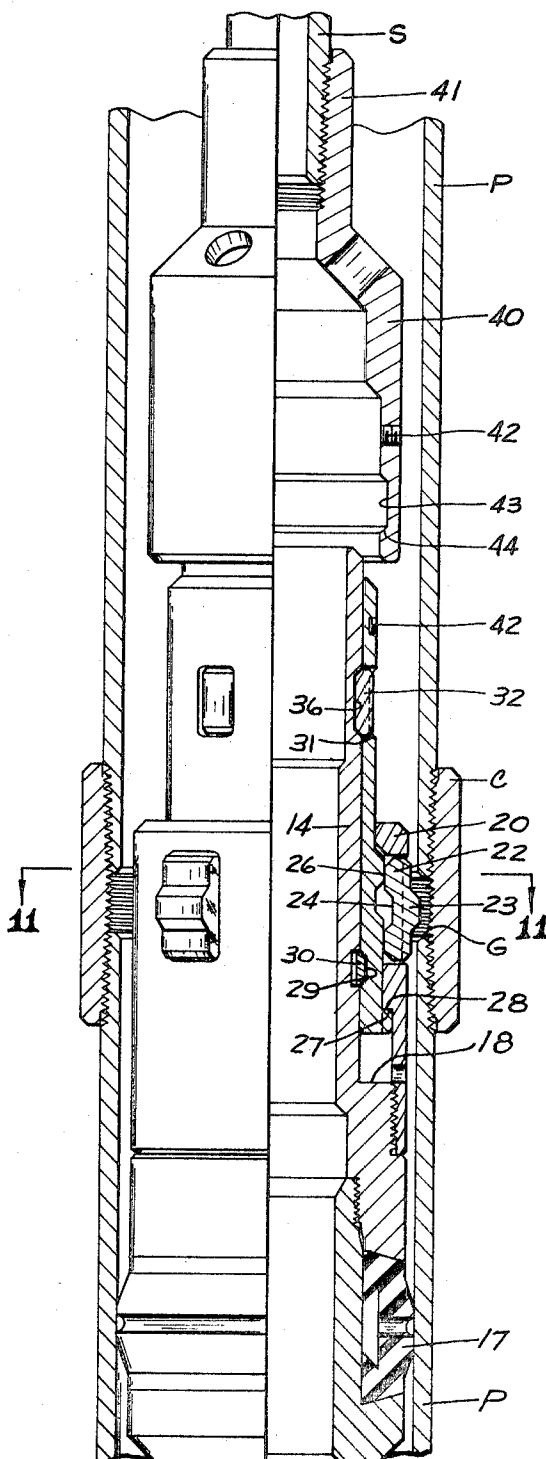


Fig. 2

CICERO C. BROWN
CHUDLEIGH B. COCHRAN
INVENTORS

BY

Lawrence

ATTORNEY

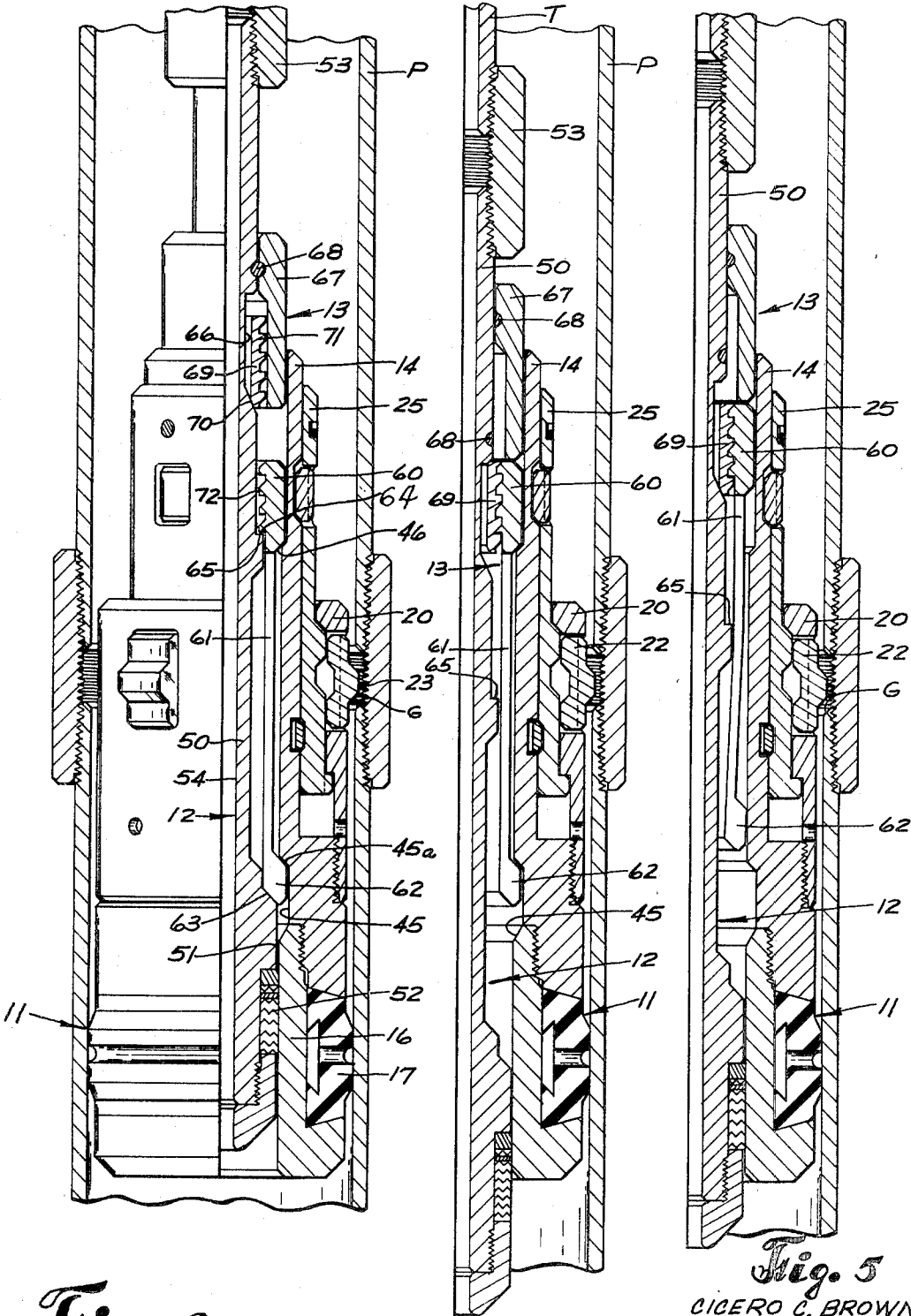


Fig. 3

Fig. 4

Fig. 5
CICERO C. BROWN
CHUDLEIGH B. COCHRAN
INVENTORS

BY

Lawrence
ATTORNEY

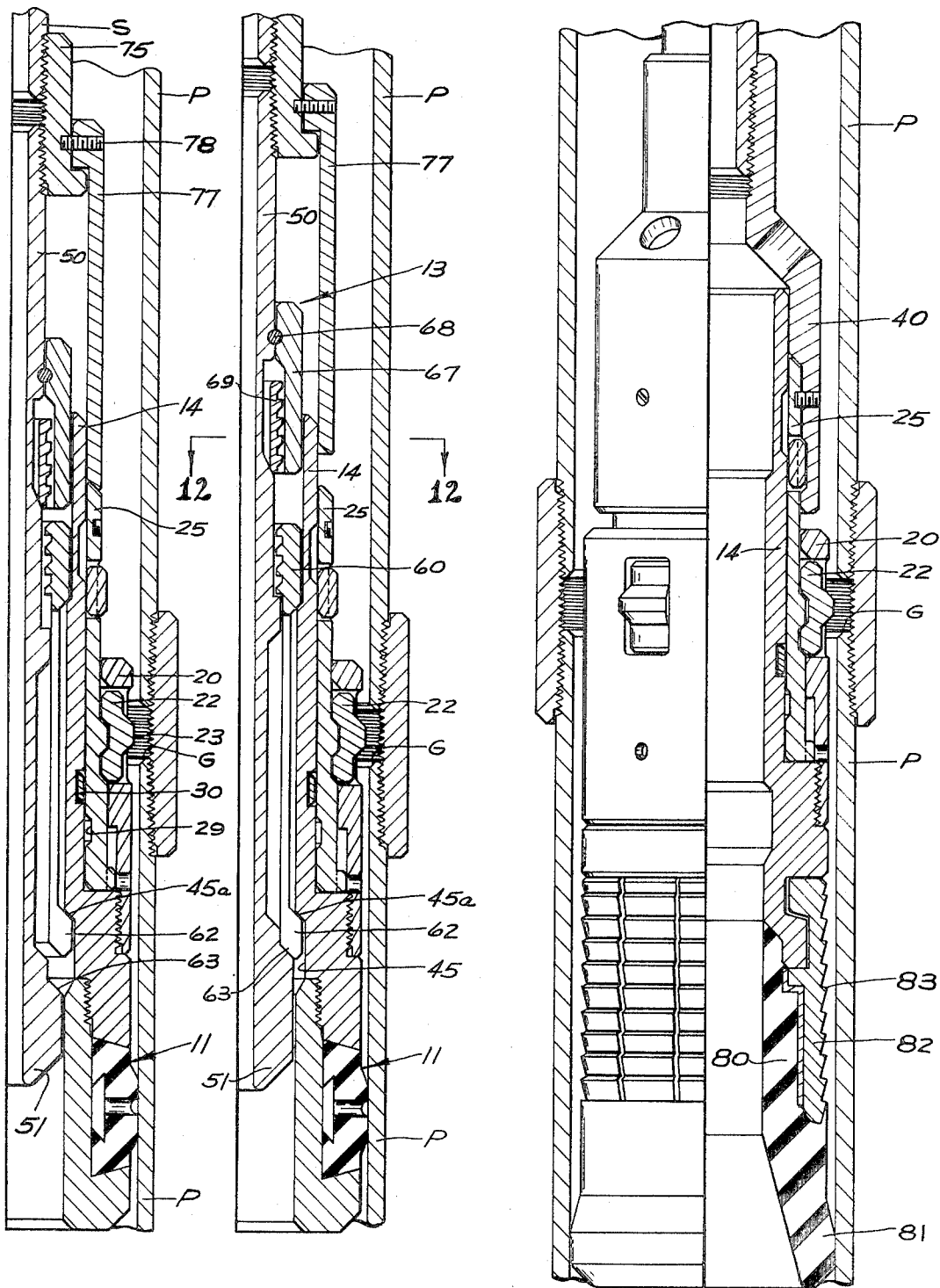


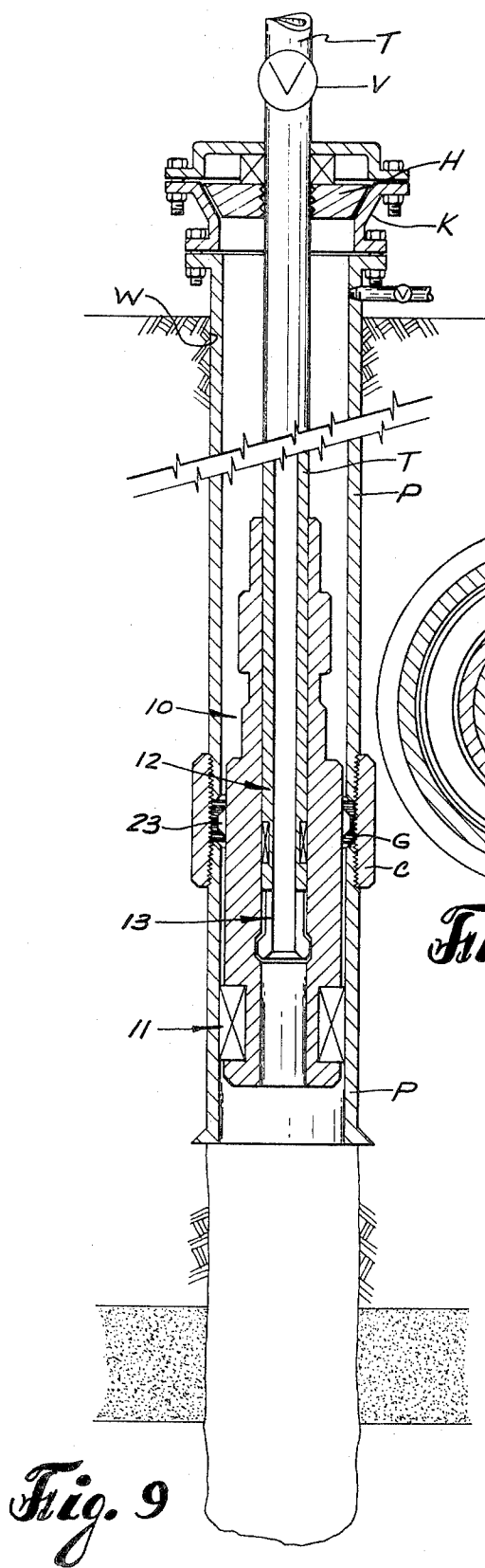
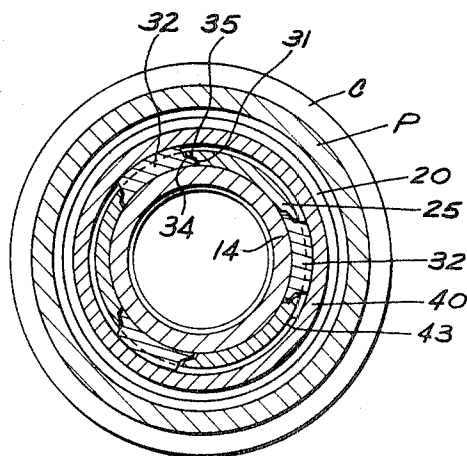
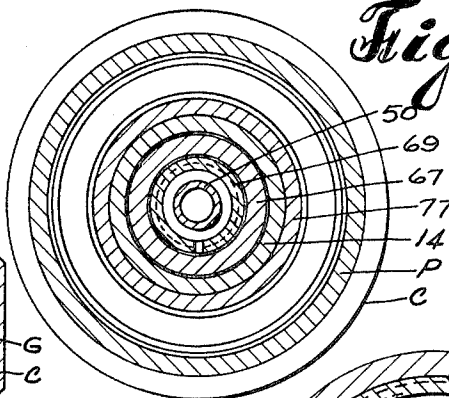
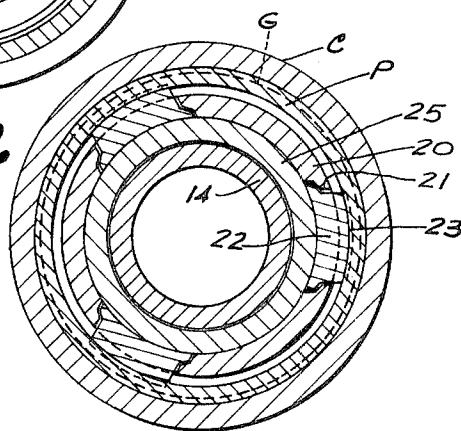
Fig. 6 Fig. 7 Fig. 8

CICERO C. BROWN
CHUDLEIGH B. COCHRAN
INVENTORS

BY

[Signature]

ATTORNEY



CICERO C. BROWN
CHUDLEIGH B. COCHRAN
INVENTORS

BY

R. W. [Signature]

ATTORNEY

ANCHOR ASSEMBLY FOR WELL TOOLS SUCH AS PACKERS AND THE LIKE

Various well tools such as packers, bridging plugs, and other down-hole tools are commonly run on wire line tool strings. The flexible character of such running strings and the reciprocatory movement which may be required to move the tool string through the well pipe to a desired location, particularly in passing obstructions and irregularities in the pipe strings, frequently causes premature release of the conventional release mechanisms between the running string and the tools being run with resultant improper setting of the well tools and other hazards and difficulties well known to those skilled in this art.

This invention is directed to an improved form of anchor assembly, designed to be run on a wire line, which is constructed to obviate the difficulties such as those noted above, particularly to assure against premature or accidental release of the running string from the tools being run.

In accordance with this invention, an anchor assembly is provided which is adapted for anchoring the well tools into an annular recess in the well pipe, which recess may be an annular groove in a landing nipple installed in the pipe string but more generally in the collar gaps formed between the adjacent ends of pipe sections coupled together by conventional threaded collars.

The anchor assembly in accordance with the illustrative embodiment comprises a tubular body for supporting a well tool, such as a well packer, bridging plug, tubing stop and the like, inside a well pipe. The body carries means for frictionally engaging the pipe wall and such means may conveniently be the seal element of the packer, conventional wiper blocks or springs, and the like.

Mounted about the exterior of the body are a plurality of radially movable anchor elements such as well known anchor dogs which are arranged to be projected into a recess in the well pipe to anchor the assembly thereto and to be released for retraction therefrom in response to the longitudinal movements of a setting sleeve slidably mounted about the tubular body between the latter and the anchor elements. The setting sleeve is connected to the wire line running string by a running collar which is connected to the setting sleeve by a safety latch means which is arranged to hold the setting sleeve in the position at which the anchor dogs are retracted and which permits release of the running collar from the anchor assembly only when the setting sleeve has moved to the position projecting the anchor dogs into anchoring engagement in the anchor recess in the well pipe.

Other and more specific objects and advantages of this invention will become more readily apparent from the following detailed description when read in conjunction with the accompanying drawings which illustrate a useful embodiment of this invention and modifications thereof.

In the drawings:

FIG. 1 is a longitudinal quarter-sectional view of an anchor assembly supporting a packer, the parts being shown in running position;

FIG. 2 is a view similar to FIG. 1 showing the anchor elements actuated and the running collar released;

FIG. 3 is a view similar to FIG. 1 showing a packoff mandrel together with a latch and retrieving tool installed in the packer;

FIGS. 4 and 5 are partial views similar to FIG. 3 showing stages in the operation of the retrieving tool during removal of the packoff mandrel;

FIGS. 6 and 7 are views similar to FIGS. 4 and 5 showing a modification of the retrieving tool for removing the anchor assembly and packer from the well pipe;

FIG. 8 is a view similar to FIG. 1 showing a modified form of packer attached to the anchor assembly;

FIG. 9 is a generally diagrammatic view, partly in section, of the anchor assembly, packer, and packoff mandrel installed in a well pipe;

FIG. 10 is a cross-sectional view taken on line 10-10 of FIG. 1;

FIG. 11 is a cross-sectional view taken on line 11-11 of FIG. 2; and

FIG. 12 is a cross-sectional view taken on line 12-12 of FIG. 7.

Referring first to FIG. 9, there is shown a well W lined with a casing made up of pipe sections P threadedly connected together by the usual threaded collar C to provide the collar gap G between the adjacent ends of the pipe sections. An anchor assembly, designated generally by the numeral 10, constructed in accordance with this invention, is shown anchored in collar gap G and supports a conventional well packer, designated generally by the numeral 11, which includes a packoff mandrel, designated generally by the numeral 12, which is latched into the bore of the packer by the latch tool, designated generally by the numeral 13. The packoff mandrel is connected to a tubing string T controlled by a valve V, the upper end of the tubing string extending through a casing head K which closes the upper end of the casing about the tubing string which is supported on a tubing hanger H mounted in the casing head.

Referring now to FIG. 1, the anchor assembly comprises a tubular body 14 having at its lower end an internally threaded box or socket 15 for attachment of a well tool which in the illustrative embodiment comprises the packer 11. The latter includes a tubular body 16 about which is mounted a deformable seal element 17 adapted to seal with the wall of pipe P and to provide frictional engagement with the latter to enable operation of the anchoring assembly as will be subsequently described. Packer 11 may be of any well known and suitable form adapted to provide the necessary seal as well as the frictional engagement referred to. The exterior of body 14 of the anchor assembly is reduced substantially in diameter above box 15 to form the upwardly facing shoulder 18 and a portion of the exterior of body 14 below shoulder 18 is externally threaded at 19 to receive a tubular cage 20 concentrically surrounding body 14 and spaced therefrom. Cage 20 includes a plurality of angularly spaced generally rectangularly shaped windows 21 in which are mounted a corresponding number of rectangular anchor dogs 22 of a well known form including a central outward projection 23 and an internal recess 24 opposite projection 23 and disposed between the opposite ends of the dog for purposes to be described subsequently.

Slidably mounted between body 14 and cage 20 is a tubular setting sleeve 25 provided about its exterior at a point spaced from its lower end with a section matching the shape of the inner faces of dogs 22 including a radial projection 26 adapted to be received in recess 24 of anchor dog 22 to allow the latter to retract inwardly a sufficient distance to clear the wall of pipe P in running the tools as will be described subsequently. The lower end of setting sleeve 25 is provided with an external shoulder 27 engageable with an inwardly projecting shoulder 28 formed in the bore of the cage 20 to limit upward movement of the setting sleeve relative to the cage. The inner wall of setting sleeve 25 near its lower end is provided with a latching slot or groove 29 adapted to receive a split latch ring 30 mounted in the exterior of body 14 at a point adapted to register with recess 29 when setting sleeve 25 has been moved upwardly a distance sufficient to dispose recess 29 opposite latch ring 30.

Near its upper end setting sleeve 25 is provided with a plurality of radial windows 31 in which are mounted latching dogs 32 which are arcuate in transverse cross section to fit snugly against the exterior of body 14. Latch dogs 32 are made to somewhat greater thickness than the wall of the upper end of setting sleeve 25 so that in the lower position of setting sleeve 25 seen in FIG. 1 the inner face of the latch dogs will bear against the exterior of body 14 and will thereby be forced to project outwardly of the windows so as to form downwardly facing shoulders 33. As best seen in FIG. 10, latch dogs 32 are provided with laterally extending ears 34 adapted to engage projections 35 formed in the sidewalls of windows 31 to

prevent the latch dogs from falling out of the windows at their released position as will be described subsequently. The exterior wall of body 14 is provided with an annular groove 36 adapted to receive latch dogs 32 when in registration with the latter in the course of operation of the tool as will appear subsequently.

A running collar 40 is provided for connecting setting sleeve 25 to a wire line tool string. The latter may be of any conventional form including the wire line L and connector S. Weight bars and jarring tools such as are conventionally incorporated in a wire line running string but are not shown here since they are well known to those skilled in the art. Running collar 40 is provided with an internally threaded socket 41 for attachment to connector S and is dimensioned to concentrically surround the upper end of body 14 and setting sleeve 25. Collar 40 is connected to the upper end portion of setting sleeve 25 at a point above windows 31 by one or more shear pins 42 which are adapted to be broken in the operation of the tool as will be described hereinafter. The lower end of collar 40 is provided with an internal annular recess 43 into which latch dogs 32 project and which provide a lower abutment or shoulder 44 for engagement by shoulder 33 formed by the outward projection of the latch dogs. Thus, in the position shown in FIG. 1, with the latch dogs 32 projected into recess 43 the thickness of the latches will be such that the latches will be closely held between the exterior surface of body 14 and the interior wall of recess 43 and with shoulders 33 and 44 engaged, collar 40 cannot be pulled off of the setting sleeve particularly while the latter is in the downward position as seen in FIG. 1.

The lower end of body 14 is provided internally with an annular recess 45 at a point just above socket 15 for the reception of other tools to be described hereinafter. Likewise, the bore of body 14 from a point extending from its upper end for some distance downwardly is increased in diameter to form the upwardly facing shoulder 46 also for reception of other tools employed in connection with the device. Running collar 40 is provided with a plurality of ports 47 through which fluid may freely circulate during running of the tools.

In operation, the anchor assembly carrying packer 11 and secured to the wire line string will be run inside the pipe P, the parts being in the inactive position illustrated in FIG. 1 wherein the anchor dogs 22 are retracted or are free to move inwardly to their retracted position while the tool string is run into the well and latch dogs 32 are in the position securing running collar 40 to setting sleeve 25. To set the anchor assembly, upward pull will be applied to the tool string whereby the resulting friction between seal 17 and the wall of pipe P will hold body 14 stationary allowing collar 40 to apply an upward pull through shear screws 42 and the engagement of shoulders 23 and 44 to setting sleeve 25. However, the latter cannot move upwardly until anchor dogs 22 are projected since they will drag the inner surface of the pipe until the dogs come into registration with a collar gap G. At that point the anchor dogs are freed to move outwardly into the collar gap, whereupon the upward pull being applied through running collar 40 will pull setting sleeve 25 upwardly to the position shown in FIG. 2 at which the enlargements on the setting sleeve will engage the inner ends of the anchor dogs 22 forcing them outwardly and moving projections 23 into collar gap G thereby anchoring cage 20 and the anchor assembly as a whole to pipe P.

When the pull on running collar 40 through the wire line string has raised setting sleeve 25 to the position projecting the anchor dogs into collar gap G, latch dogs 32 will be raised at the same time to a position registering with latch recess 36 as seen in FIG. 2. Thereupon, continued tension or jarring as may be required on the wire line string will break shear pins 42 and allow the running collar and the wire line string to be released from the anchor assembly and withdrawn from the well leaving the anchor assembly anchored in collar gap G. The upward movement of the setting sleeve in anchoring the assembly, as described, will also bring latch recess 29 into registration with latch ring 30 thereby locking the setting sleeve

in the anchor position projecting the anchor dogs into collar gap G and thereby preventing their release until such time as other tools may be run as will be subsequently described for purposes of removing the anchor assembly and its attached well tools from the well pipe. The upward movement of setting sleeve 25 to the dog-projecting position is also limited by engagement of shoulder 27 with shoulder 28 to assure both the holding of the anchor dogs in their anchored position in gap G as well as registration of the latch ring 30 in the locking position as is seen in FIG. 2.

With the anchor assembly and its connected tools anchored in pipe P as shown in FIG. 2 and with the running tools and running collar removed, the tools in the well are ready for attachment of other equipment as may be indicated. FIGS. 3 to 5 illustrate another series of operations employing tools used in connecting the packer to a string of well tubing for purposes of placing the well in production. As shown in FIG. 3, the additional tools may comprise packoff mandrel 12 and latch tool 13. Packoff mandrel 12 includes a tubular body 50 having an enlarged lower end portion 51 carrying external seal packing 52 adapted to be slidably inserted through the bore of body 14 into the bore of packer body 16 to seal off the latter. The upper end of body 50 is adapted to be connected to a collar 53 by which the mandrel may be connected to tubing string T leading to the top of the well (FIG. 9). Mandrel body 50 has an axial bore 54 extending therethrough to communicate with the bore of the tubing string so as to provide a passage for the production of well fluids through the tubing string or for the introduction of fluids into the well bore if desired.

Latch tool 13 which is supported on the exterior of packoff mandrel 12 is of the design illustrated and described in the pending application of Cicero C. Brown, Ser. No. 869,563, filed Oct. 27, 1969. For purposes of this description latch tool 13 comprises a collet 60 adapted to surround the upper portion of the exterior of mandrel body 50 and is provided with a number of separate elongate flexible fingers 61 depending therefrom and terminating at their lower ends in enlarged heads 62 having bevelled surfaces adapted to be received in recess 45 in the bore of body 14 and clamped therein by an external bevelled shoulder 63 formed on the exterior of enlargement 51 of the packoff mandrel. The bore of collet 60 is provided with a downwardly facing shoulder 64 adapted to abut an upwardly facing external shoulder 65 formed on the exterior of mandrel body 50 for limiting relative downward movement of the collet on the mandrel body. Shoulder 46 forms a seat for the collet in the bore of body 14 to position heads 62 opposite recess 45 (FIG. 3). Collet fingers 61 are free to swing inwardly when mandrel body 50 has been lowered relatively thereto as seen in FIGS. 4 and 5. The upper end of mandrel body 50 is provided with an external recess 66 and a collar 67 is mounted about the exterior of mandrel body 50 surrounding recess 66 and is secured to the mandrel by means of a shear pin 68. Mounted in recess 66 is a split lock ring 69 which rests on the shoulder 70 defining the lower end of recess 66. The exterior of lock ring 69 is provided with a plurality of ratchet threads 71 which are designed to ratchet over matching ratchet threads 72 formed on the inner surface of collet 60 when the latch ring and the collet are moved axially past one another.

In the position shown in FIG. 3, the latch tool will effectively latch the packoff mandrel in sealed-off relation to the anchor assembly and thereby enable passage of fluid through the tool to the surface or in the opposite direction if desired. Pressure from below will not be able to dislodge the packoff mandrel because heads 62 will be grippingly engaged between shoulder 63 and the upper end wall 45a of recess 45.

In order to remove the packoff mandrel, as may be required during the operation of the well, or when it is desired to also remove the anchor assembly and the packer, downward force will be applied through tubing string T to the upper end of the packoff mandrel sufficient to break shear pin 68 whereupon the lowering of the tubing string will lower the packoff mandrel and split ring 69 until the latter ratchets over

collet 60 and is locked thereto as seen in FIG. 4. The downward movement of the packoff mandrel will lower shoulder 63 below heads 62 of the latch tool allowing the latter to swing outwardly from recess 45. As upward pull is then applied to the tubing string and to the packoff mandrel and with heads 62 of the latching tool thus freed, the upward pull applied through the tubing string will then result in pulling both the packoff mandrel 12 and latching tool 13 from out of the bore of the anchor assembly and the packer, which will remain anchored in the well casing as seen particularly in FIG. 5.

If it is now desired to remove the anchor assembly and packer from the well a suitable type of fishing tool is employed to be run on a wire line or tubing string. This fishing tool includes the latch tool 13 and mandrel 12 substantially identical in all respects to the tool previously described. In this case, mandrel body 50 is attached by a collar 75 to connector S of the operating string, which is also equipped with a release collar 77 dimensioned to slide over the upper end of body 14 and to abut the upper end of setting sleeve 25. Release collar 77 is shear pinned to collar 75 at a point above the latch tool by means of shear pin 78. Downward pressure will be applied through release collar 77 to the upper end of setting sleeve 25 to urge the latter downwardly with a force sufficient to overcome the holding pressure of split ring 30 in recess 29 and thereby push shear sleeve 25 downwardly sufficiently to place setting sleeve projection 26 in registration with recesses 24 of the anchor dogs thereby allowing anchor dogs 22 to be freed for retraction from collar gap G, this position being shown in FIG. 6. Thereupon, upward pull applied to the operating string will cause the enlargement 51 on the mandrel body to be pulled upwardly so as to clamp heads 62 between shoulders 63 and 45a. This engagement will allow the running string to lift the entire anchor assembly and packer out of the well as upward pull continues to be applied.

By employment of the described safety latched provided in the connection between running collar 40 and setting sleeve 25, the running collar cannot be released from the anchor assembly until anchor dogs 22 are projected into a recess in the pipe wall such as collar gap G, and this is so even if shear pins 42 are broken in the course of running the tools. Assurance is thus provided the operator that when running collar is released, the anchor assembly and its attached tools are effectively anchored to the pipe wall.

FIG. 8 illustrates a modification of the previously described embodiment, differing only in the form of the well packer. In this modification, the packer, which is of a well known form, includes a cup-type flexible seal body 80 having an outwardly flaring lip 81 about its lower end adapted to frictionally engage the wall of pipe P. Seal body 80 above lip 81 carries a plurality of segmented slip elements 82 having upwardly facing buttress teeth 83 adapted to grippingly engage the surrounding pipe wall upon expansion of body 80 by internal pressure. With this arrangement, lip 81 provides the friction means enabling the relative movement between setting sleeve 25 and anchor body 14 necessary for actuating the anchor elements.

Various alterations and modifications may be made in the details of the illustrative embodiments without departing from the invention.

What we claim and desire to secure by Letters Patent is:

1. An anchor assembly for well tools, comprising:
 - a. a tubular body for supporting a well tool in a well pipe;
 - b. friction means carried by the body for frictionally engaging the well pipe;
 - c. anchor elements mounted about the body for radial movement between extended and released positions respectively affecting anchoring engagement with and release from said well pipe;
 - d. a setting sleeve cooperating with said anchor elements mounted about the body for nonrotative relative axial movement thereon between positions extending and releasing said anchor elements;

- e. a running collar for releasably connecting a running string to said setting sleeve; and
- f. safety latch elements initially securing the running collar to the setting sleeve and releasable from the latter upon axial movement of the setting sleeve only to said position extending said anchor elements into anchoring engagement with the well pipe.
2. An anchor assembly according to claim 1 including a tubular cage concentrically surrounding said body and said setting sleeve and having a plurality of radial openings in which said anchor elements are mounted.
3. An anchor assembly according to claim 1 including frangible means initially securing said running collar to said setting sleeve in the anchor element-releasing position.
4. An anchor assembly according to claim 1 wherein said safety latch elements comprise holding dogs mounted in the setting sleeve for radial movement between an outwardly projecting position engageable by the running collar when the setting sleeve is in the anchor element release position and a retracted position releasing said running collar when the setting sleeve is in the anchor element-extending position.
5. An anchor assembly according to claim 1 wherein said well tool is a packer.
6. An anchor assembly according to claim 4 wherein said packer defines said friction means.
7. In combination with the anchor assembly according to claim 1:
 - a. a packoff mandrel insertable in the bore of said body; and
 - b. a latch tool carried by the mandrel for releasably securing the same to said body.
8. The combination according to claim 7 wherein said mandrel includes:
 - a. a tubular stem member connectable at its upper end to a pipe string; and
 - b. seal means mounted about the lower end of said stem member for slidable sealing engagement with the bore wall of said body.
9. An anchor assembly according to claim 1, including cooperating latch means on said body and said setting sleeve positioned for latching engagement when said setting sleeve is moved to the anchor element-extending position to maintain said setting sleeve in said position.
10. An anchor assembly according to claim 9 wherein said latch means comprise:
 - a. a split expansible latching ring mounted about said body; and
 - b. an annular recess in the exterior of said setting sleeve engageable by said latching ring when in registration therewith.
11. A well packer assembly, comprising:
 - a. a tubular body;
 - b. an annular seal unit carried by the body frictionally engaging a surrounding well pipe;
 - c. a plurality of angularly spaced anchor dogs mounted about the outer wall of the body for radial movement between positions actuating and releasing said dogs from anchoring engagement with a recess in the surrounding well pipe;
 - d. a setting sleeve concentrically disposed about said body cooperable with said anchor dogs in response to nonrotative longitudinal movement of the setting sleeve to effect said radial movement of said anchor dogs;
 - e. a running collar connectable to a running tool string telescopically enclosing the upper ends of said body and said setting sleeve; and
 - f. radially movable holding dogs disposed between the running collar and said setting sleeve operable in response to movement of the setting sleeve to the position actuating said anchoring dogs to release said running collar from said setting sleeve.
12. A well packer assembly according to Claim 11, including:
 - a. a tubular cage mounted about the body concentrically enclosing said setting sleeve;

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- b. said cage having angularly spaced openings in which said anchor dogs are mounted;
- c. said anchor dogs and said setting sleeve having complementary projections and recesses cooperable to effect said radial movement of said anchor dogs.

13. The well packer assembly according to claim 11, including cooperating latch means on said body and said setting sleeve positioned for latching engagement when said setting

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sleeve is moved to the anchor dog-actuating position to maintain said setting sleeve in said position.

14. The well packer assembly according to claim 11, including:

- 5 a. a packoff mandrel insertible in the bore of said body; and
- b. latch means carried by the mandrel for releasably securing the same to said body.

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