

Oct. 5, 1948.

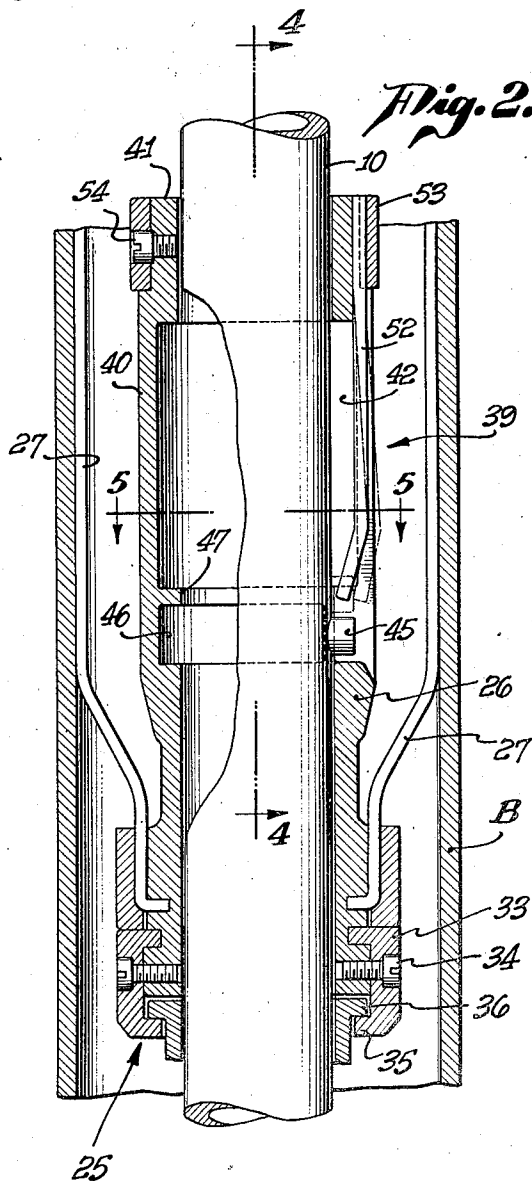
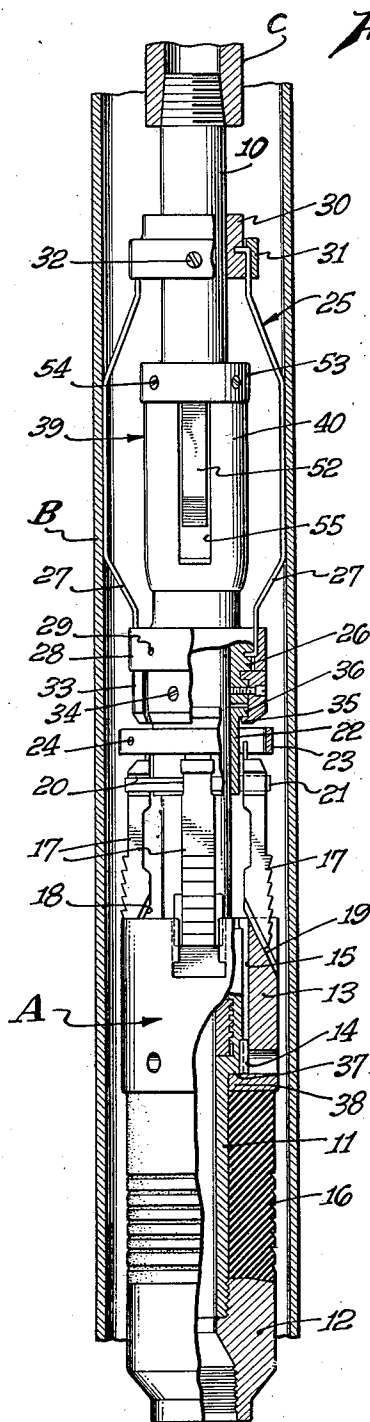
A. A. BAKER

2,450,822

LOCK DEVICE FOR WELL TOOLS

Filed April 15, 1944

2 Sheets-Sheet 1



AARON A. BAKER,
INVENTOR.

BY *Oscar A. Mellin*

ATTORNEY.

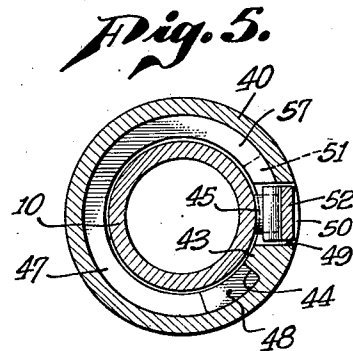
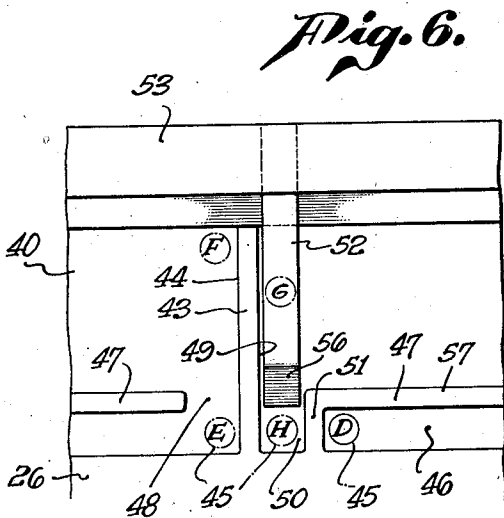
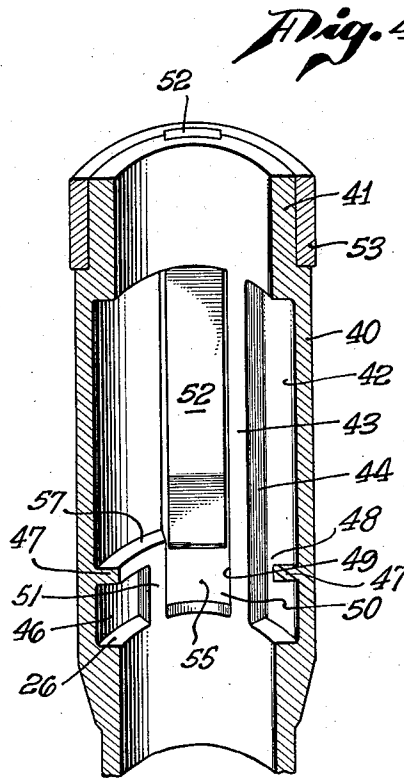
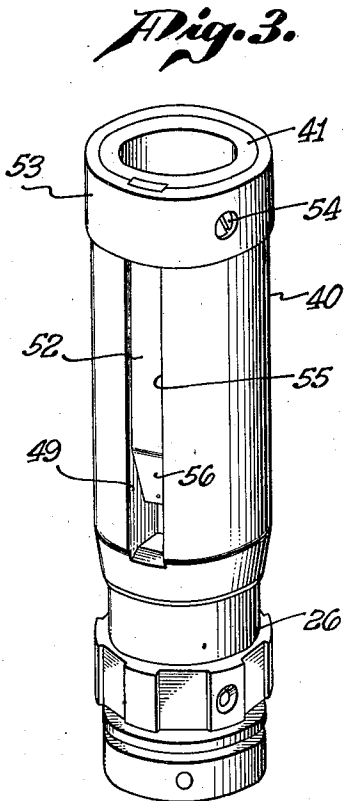
Oct. 5, 1948.

A. A. BAKER
LOCK DEVICE FOR WELL TOOLS

2,450,822

Filed April 15, 1944

2 Sheets-Sheet 2



AARON A. BAKER,
INVENTOR.

BY Oscar A. Mellin

ATTORNEY.

UNITED STATES PATENT OFFICE

2,450,822

LOCK DEVICE FOR WELL TOOLS

Aaron A. Baker, Coalinga, Calif., assignor to Baker Oil Tools, Inc., Vernon, Calif., a corporation of California

Application April 15, 1944, Serial No. 531,237

5 Claims. (Cl. 166—12)

1

This invention relates to well tools, and more particularly to the locking portion of such tools designed for subsurface operations in well bores.

Locking devices are used in connection with many tools employed in well bores. One of the most common of such devices is a J or L pin and slot arrangement used with packers, liner hangers, tubing anchors, well washers, etc. Such J, L and similar types of locks function to maintain certain well tool parts in a definite relative position, or they can be manipulated to release such parts and permit their performance of the particular action or operation in the well bore, such as to set a packer or liner therein, control a valve, etc.

The use of these J or L devices in locking and unlocking well tools that are to be retrieved from the well bore entails the hazard that they might inadvertently be placed in an unlocked position while the tool is being elevated or withdrawn from the well bore. In the case of a packer of the retrievable type which is set by taking an upward strain on a tubular string to which the packer is attached, such inadvertent unlocking would cause the well tool to set in the casing while it was being removed from the well bore, and might result in parting of the tubing string or in pulling the packer in two.

It is an object of the present invention to overcome the above mentioned difficulties by providing a well tool whose parts can be positively and non-releasably locked in retracted position when it is desired to withdraw the tool from the well bore.

A further object of the invention is to provide a J or L type of lock in a well tool in which the parts of the lock can be so positioned with respect to each other as to permit locking and unlocking at will, but which can be positively locked to one another to prevent further unlocking or release until the tool has been removed to the surface of the well bore.

The invention has other objects that will become apparent from a consideration of the embodiment shown in the drawings accompanying and forming a part of the present specification. This form will now be described in detail, but it is to be understood that such detailed description is not to be taken in a limited sense since the scope of the invention is best defined by the claims appended hereto.

Referring to the drawings:

Figure 1 is a longitudinal view, partly in section and partly in elevation, of a well packer embodying the present invention with its parts

2

in retracted position for movement in a well bore or casing;

Figure 2 is a longitudinal section on an enlarged scale of part of the device illustrated in Figure 1;

Figure 3 is a perspective of part of the lock device;

Figure 4 is a section in perspective taken along the line 4—4 in Figure 2;

Figure 5 is a cross-section taken along the line 5—5 in Figure 2; and

Figure 6 is a diagrammatic view showing the lock device in different positions.

The invention is exemplified in the drawings as forming part of a well packer of the retrievable type. It is to be understood, however, that the invention is also applicable to other well tools, as the following detailed description of the apparatus shown in the drawings will bring out.

The packer illustrated in the drawings is specifically described and particularly claimed in the application of Reuben C. Baker for releasable well packers, Serial No. 419,061, filed November 14, 1941, now Patent No. 2,368,400, granted Jan. 30, 1945. This packer A is adapted to be run in a well bore or casing B on the end of a tubular string C threadedly or otherwise attached to the upper end of the tubular mandrel 10 of the packer. The lower end of this mandrel is threaded into the upper end of a tubular packer body 11, to the lower end of which is secured a packing actuator 12 in the form of a guide.

A tapered expander 13 is mounted on the body and is preferably prevented from turning with respect thereto by a key 14 secured to the exterior of the body 11 and received within a keyway 15 in the expander, so as to permit relative longitudinal movement between the body and expander, while preventing rotation therebetween. When the tubular string C, mandrel 10 and body 11 are elevated, the packing actuator 12 is moved towards the expander 13 to compress an intervening packing sleeve 16 surrounding the body and force it outwardly to effect an annular seal between the body 11 and casing B. Such actuation of the packing sleeve 16 only occurs when the tapered expander 13 is prevented from moving upwardly, which results from anchoring engagement by a plurality of slips 17, cooperating with the tapered expander, with the wall of the casing. The slips 17 have tapered surfaces 18 cooperable with companion tapered surfaces 19 on the expander, the inclination of such surfaces being such as to move the slips 17 outwardly toward the casing upon elevation

of the expander 13. Conversely, lowering of the expander with respect to the slips permits the latter to release from anchoring engagement with the wall of the casing and move inwardly to retracted position.

It is, therefore, apparent that elevation of the tubular string C, mandrel 10 and packer body 11 can effect anchoring of the tool through engagement of the slips 17 with the casing under the influence of the tapered expander 13, and they can also effect compression or shortening of the packing sleeve 16 between the expander 13 and guide 12 to produce its radial outward expansion into sealing engagement with the wall of the casing.

The slips 17 are held together for joint movement along the tapered expander 13 to and from engagement with the casing by providing recesses 20 in their side faces, which receive outwardly extending fingers 21 for guiding the slips to and from the casing and for preventing their longitudinal movement except in unison by engaging the ends of the recesses 20. These fingers 21 are integral with a sleeve 22 slidable on the mandrel 10, which has a stop ring 23 secured thereto by screws 24 or the like for the purpose of limiting the extent of outward movement of the slips.

This sleeve 22, and the slips 17 assembled thereon, are coupled to a drag and lock device 25, comprising a lower collar 26 slidable on the mandrel 10, which receives the lower ends of a plurality of circumferentially spaced outwardly bowed springs 27 held thereagainst in assembled relation by a ring 28 fastened to the collar by a plurality of screws 29. These springs are disposed around the mandrel with their upper ends secured to an upper drag collar 30 by an upper ring 31 suitably fastened thereto, as by screws 32.

The drag and lock device 25 is coupled to the slip assembly by means of a sectional tie or coupling ring 33 secured to the lower collar 26 by screws 34, and having a lower intumed flange 35 receiving and fitting under an external flange 36 at the upper end of the slip sleeve 22. Rotation of the tubular string C, mandrel 10 and drag device 25 is permitted without corresponding rotation of the slip assembly sleeve 22 and slips 17, due to the swivel type of action provided by the lower end of the coupling ring 33 and sleeve flange 36.

It is to be noted that the drag device 25 engages the casing wall and thereby tends to resist longitudinal movement of the slips 17 coupled thereto through the well casing. Upon reaching the desired setting point in the casing, if the tubular mandrel 10 is permitted to move upwardly with respect to the drag device, such elevation would also elevate the body 11 of the packer, and through the guide 12 and packing sleeve 16 elevate the expander 13 within the slips 17, since the latter are prevented from moving upwardly by the drag device, to force the slips radially outward into anchoring engagement with the casing wall. A continuation of such upward movement causes compression of the packing sleeve 16 into sealing engagement with the casing B and body 11, in the manner hereinbefore described. Conversely, lowering of the tubular mandrel 10 with respect to the drag device 25 permits retraction of the packing sleeve 16 from the casing wall and produces corresponding downward movement of the tapered expander 13, through engagement of the body shoulder 37 with the expander flange 38, so that the slips 17 are movable inwardly to

retracted position, since they are prevented from moving longitudinally by the drag device.

It is important to note that upward movement of the tubular mandrel 10 and body 11 can effect anchoring of the packer in packed off condition within the well casing, and that lowering of these members can effect release of the packer. It is, therefore, essential that some means be provided for preventing relative movement between the slips 17 and the tapered expander 13 in order to allow the tubular mandrel 10 to be elevated without anchoring the tool in the well casing when the entire tool is to be raised within the well casing.

One device for locking slips with respect to an expander, or for that matter for preventing relative movement until desired between cooperative parts of subsurface well tools generally, is a J or L type of lock. Such lock can include a pin operable within a horizontal slot and also within a longitudinal slot, or in some other member which will allow its longitudinal movement. When the pin is positioned in the horizontal slot, the tool parts, such as the slips and expander, are locked together, but when the pin is so positioned as to allow its longitudinal movement, the tool parts are unlocked and the tool may be manipulated in the desired fashion depending upon the design and purpose for which it is to be used.

Such a type of locking device 39 is illustrated in the drawings as incorporated in the lower portion of the drag device 25. It consists of an outer sleeve 40 spaced from the mandrel 10 and secured, as by welding, to the lower drag collar 26 and to an upper latch collar 41. Both of these collars are slidable on the mandrel and cooperate with the outer sleeve 40 to form an arcuate chamber 42 with the mandrel itself. This chamber, however, does not extend completely around the mandrel but is interrupted by a vertical or longitudinal wall or rib 43 extending within the sleeve between the lower drag collar 26 and the upper latch collar 41. The right portion 44 of the wall forms a guiding surface for cooperation with a pin 45 secured to the mandrel 10. This pin serves to lock certain parts of a well tool together when positioned within a generally horizontal slot 46, which is formed by securing an arcuate generally horizontal rib 47 to the interior of the sleeve and spacing it from the upper end of the lower drag collar 26. As seen in the drawings, the right end of this rib terminates short of the right surface 44 of the longitudinal wall to afford a space 48 through which the locking pin 45 can pass longitudinally, and the left portion of the rib terminates short of the left surface 49 of the longitudinal wall to form a space 50 sufficient in extent to receive the pin secured to the mandrel. However, the horizontal slot 46 does not communicate with the space 50, being prevented from doing so by the vertical stop member 51 extending between the left end of the rib 47 and the lower drag collar 26.

The locking pin 45 is positioned in the horizontal slot 46 under the rib 51 whenever the well tool parts are to be locked together. When the parts are to be released or unlocked, the tubing string C and attached mandrel 10 are turned counterclockwise to move the pin from under the horizontal rib and against the right surface 44 of the longitudinal wall 43, which allows the mandrel and tubing string C to be shifted longitudinally within the sleeve 40 and drag device 25. In the event that it is desired to relock the tool parts, the mandrel 10 is lowered with the pin

5

45 riding against the right surface 44 of the wall until it engages the upper end of the lower drag collar 26 (lower part of slot 46), whereupon the tubular string C and mandrel can be turned clockwise to reposition the pin 45 under the horizontal rib 47 and within the horizontal slot 46. This cycle of operations can be repeated as often as desired to lock and unlock the tool parts.

In order to lock the tool parts positively and non-releasably, the pin 45 can be held in its lower locked position within the sleeve by a latch arrangement. As illustrated in the drawings, this latch can take the form of a leaf spring 52 whose upper end is secured to the upper latch collar 41 in any suitable fashion, as by an encircling ring 53 secured to the collar 41 by one or more screws 54. The latch is spaced from the mandrel 10, extending downwardly within a longitudinal slot 55 in the sleeve 40 adjacent the left side 49 of the vertical wall 43, with its lower free end 56 turned inwardly toward the mandrel and spaced from the upper surface of the lower drag collar 26 a sufficient distance to accommodate the lock pin 45. The spring 52 is free to flex in an outward direction by the engagement of the pin 45 with the inturned lower end or nose 56 of the latch.

When it is desired to lock the parts of the well tool in non-releasable position, as when the tool is to be removed from the well bore, the lock pin 45 is shifted within the sleeve 40, through movement of the tubing string C and attached mandrel 10, to a position above the upper surface 57 of the horizontal rib 47. The tubing string and mandrel are then turned in a clockwise direction, as seen from the surface of the well bore, until the pin 45 engages the left surface 49 of the longitudinal wall 43, whereupon the tubing string and mandrel are lowered to cause the pin to engage the inturned nose 56 on the latch 52, forcing it laterally in an outwardly direction from its path of movement so that the pin may fit into the recess 50 between the vertical stop 51 and the lower end of the left wall portion 49. As soon as the pin passes below the latch the inherent resiliency of the latter will cause its lower end 56 to move back into the sleeve over the pin, preventing the pin from moving upwardly because of its engagement with the inturned nose 56 of the latch spring.

Several positions which the pin 45 can occupy within the locking device are illustrated in the drawings. The pin can occupy the position D anywhere within the horizontal slot 46, in which the mandrel 10 is in its lowermost position within the drag device 25 to hold the slips 17 and packing 16 locked in retracted position. The tubing string C and connected mandrel 10 can be turned in a counterclockwise direction to position the pin 45 against the right surface 44 of the longitudinal wall 43 (position E) to allow the tubing string and mandrel to be elevated within the drag device in order to set the slips and packing against the casing wall. This position of the pin within the sleeve when the well packer is set is designated by the letter F. By maintaining the pin against the right surface 44 of the wall, the locking device may be manipulated to shift the locking pin 45 to and from the horizontal slot 46 in order to position the slips and packing in retracted or expanded position.

When the pin 45 is to be permanently immobilized under the latch spring 52, the mandrel 10 is turned in a clockwise direction to position the pin against the left surface 49 of the longitudinal wall, as shown by the letter G, and the tubing string and mandrel then lowered within the drag

6

device 25 to cause the pin to shift the latch out of its path of travel and position itself below the lower end 56 of the latch in the recess 50 formed between the left wall portion and the vertical stop (as designated by letter H). When in this latter position, the slips 17 and packing 16 have been shifted to and locked in retracted positions, and the tool may be removed from the well bore without fear of inadvertent expansion of the slips and packing against the casing caused by elevation of the mandrel 10 within the drag device 25 to which the slips are coupled. The position of the pin in the lower portion of the locking sleeve below the latch 52, at substantially the horizontal position of the slot 46, ensures that the parts are in retracted position and are incapable of being moved from such position.

It is preferred that the upper surface 57 of the horizontal rib 47 be not too far above the horizontal slot 46 in order that the mandrel 10 and attached lock pin 45 may be lowered sufficiently within the drag device 25 to release the slips 17 and packing 16 from the well casing B before turning the pin 45 to permanently locked position under the latch nose 56. Upon simultaneously lowering and turning the mandrel, the pin will engage the upper surface 57 of the horizontal rib and advise the operator that the tool parts are in retracted position, which facilitates further turning of the tubing string and mandrel toward the surface 49 of wall 43.

It is, therefore, apparent that a lock device for well tools has been provided in which the tool parts may be manipulated in a normal fashion until it is desired to remove the well tool from the hole; whereupon the tool parts can be positively and permanently locked in retracted position, in order to prevent inadvertent setting of the tool or unlocking of its parts while it is being elevated to the surface of the well bore. At the surface, a suitable tool can be inserted under the latch 52 to lift its nose 56 from the pin 45 and allow the mandrel 10 to be moved to again position the pin in the horizontal slot 46, or any other desired position. The tool can again be run in the well bore and manipulated to perform its required purposes.

I claim:

1. A tool for use in a well bore and having relatively movable parts, means for controlling movement of said parts with respect to one another, including a first member having a generally horizontal slot with an opening into said slot and connected to one of said parts, a second member having a pin and connected to another of said parts, said members being movable relative to one another to position said pin in said slot to lock said parts together against relative longitudinal movement, said members also being movable relative to one another to move said pin through said opening out of said slot to unlock said parts and allow their relative longitudinal movement, said members being further movable relative to one another to locate said pin out of said slot in a position lying in the same horizontal plane as said slot, and means comprising a latch engageable with said pin when in said last-mentioned position to prevent substantial longitudinal movement between said members in order to hold said parts locked together, said last-mentioned means being constructed and arranged to confine said pin in said last-mentioned position to prevent its removal therefrom and return movement into said slot regardless of the direction of movement of said second member.

2. A tool for use in a well bore and having relatively movable parts, means for controlling movement of said parts with respect to one another, including a first member having a generally horizontal slot with an opening into said slot and connected to one of said parts, said first member having means thereon forming a recess separate from said slot and disposed in substantially the same horizontal plane as said slot, a second member having a pin and connected to another of said parts, said members being movable relative to one another to position said pin in said slot to lock said parts together against relative longitudinal movement, said members also being movable relative to one another to move said pin through said opening out of said slot to unlock said parts and allow their relative longitudinal movement, said members being further movable relative to one another to position said pin in said recess, and means comprising a latch on said first member engageable with said pin when said pin is disposed in said recess to hold said pin confined in said recess, to hold said parts locked together, said recess having an entrance therinto affording the only path through which said pin can move between said horizontal slot and recess.

3. A tool for use in a well bore and having relatively movable parts, instrumentalities for controlling movement of said parts with respect to one another, including a first member connected to one of said parts, said first member having means thereon providing a generally horizontal slot having an upper opening therinto, said means also providing a recess separate from said slot, said recess having an upper entrance therinto and said recess being disposed in substantially the same horizontal plane as said slot, a second member having a pin and connected to another of said parts, said members being movable relative to one another to position said pin in said slot to lock said parts together against relative longitudinal movement, said members also being movable relative to one another to move said pin upwardly through said opening out of said slot to unlock said parts and allow their relative longitudinal movement, said members being further movable relative to one another to move said pin downwardly through said entrance into said recess, and a latch on said first member at the entrance to said recess engageable with said pin when disposed within said recess to prevent upward removal of said pin from said recess, in order to hold said parts locked together, said entrance affording the only path through which said pin can move between said horizontal slot and recess.

4. A tool for use in a well bore and having relatively movable parts, instrumentalities for controlling movement of said parts with respect to one another, including a first member connected to one of said parts, said first member having an arcuate generally horizontal rib providing a generally horizontal slot and a vertical wall spaced from one end of said rib to form an upper opening into said slot, said first member also having a vertical rib at the other end of said horizontal rib closing said slot and forming a recess in con-

junction with said vertical wall which is separate and spaced from said slot, a second member having a pin and connected to another of said parts, said members being movable relatively to one another to position said pin in said slot to lock said parts together against relative longitudinal movement, said members also being movable relative to one another to move said pin upwardly through said opening out of said slot to unlock said parts and allow their relative longitudinal movement, said members being further movable relative to one another to move said pin downwardly into said recess, and a one-way latch on said first member adjacent said recess engageable and shiftable by said pin from its path of movement to permit entry of said pin into said recess, said latch returning to its original position upon entry of said pin into said recess and engaging said pin to prevent its upward removal from said recess, in order to hold said parts locked together.

5. A well tool having expander means and co-operable slip means engageable with a well casing for anchoring said tool therein against upward movement; the combination therewith of instrumentalities for locking said slip means with respect to said expander means to hold said slip means in retracted position, comprising a first member connectable to a running-in string for moving said tool within said well casing, a second member movable with respect to said first member, one of said members surrounding the other, one of said members being provided with a pin and operatively connected to one of said means, and the other of said members being provided with a generally horizontal slot having an upper opening and operatively connected to the other of said means, said slotted member also having a recess separate from said slot and disposed in substantially the same horizontal plane as said slot, said recess having an upper entrance therinto, said pin being removable from said slot and shiftable upwardly with respect thereto through said opening upon movement of said first member by said running-in string to allow said expander means to engage said slip means with the casing, and latch means on said slotted member engageable and shiftable by said pin to permit entry of said pin through said entrance into said recess, said latch means engaging said pin to prevent its upward movement from said recess, to hold said slip means in retracted position with respect to said expander means, said entrance affording the only path through which said pin can move between said horizontal slot and recess.

AARON A. BAKER.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
1,520,803	Brown	Dec. 30, 1924
1,874,673	Waters	Aug. 30, 1932
2,248,211	Young	July 8, 1941
2,400,970	Baker	May 28, 1946