May 24, 1938. I. THOMAS 2,118,242

LATCH FOR CASING CUTTERS AND THE LIKE

Filed May 11, 1936 2 Sheets-Sheet 1

Fig. 1.

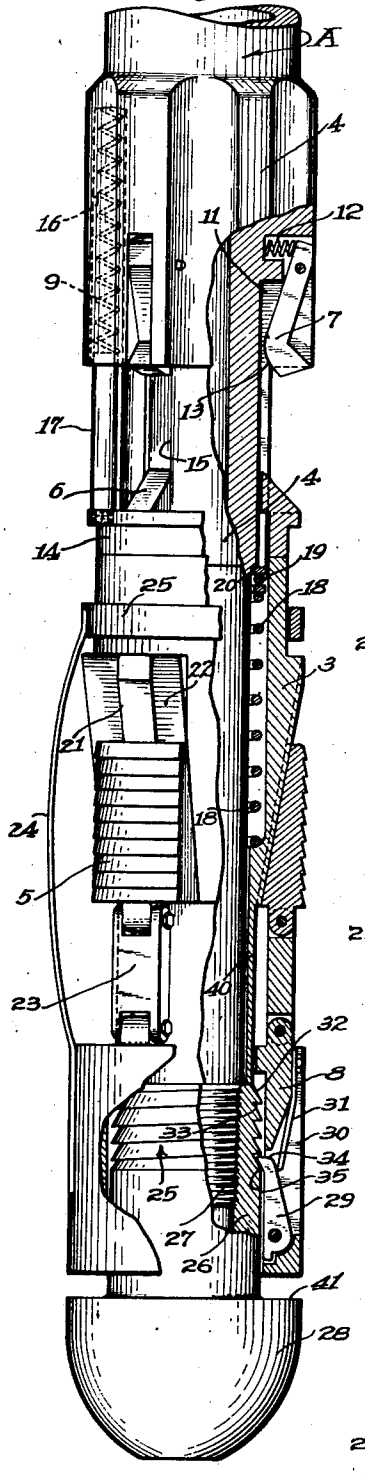


Fig. 2.

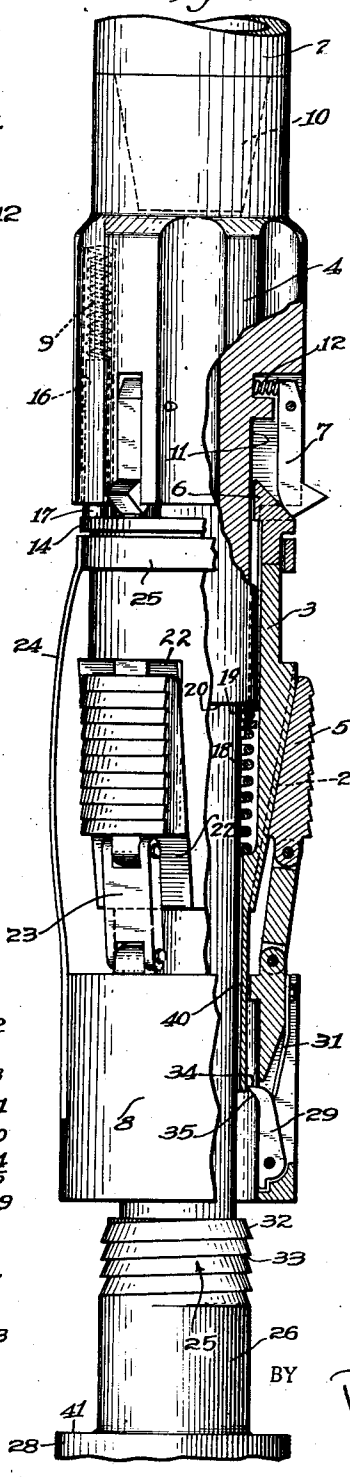
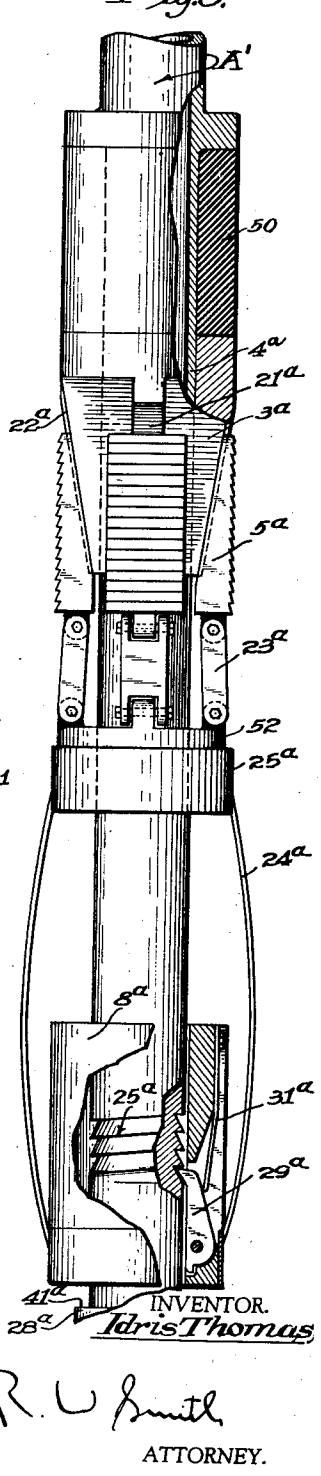


Fig. 3.



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Fig. 4.

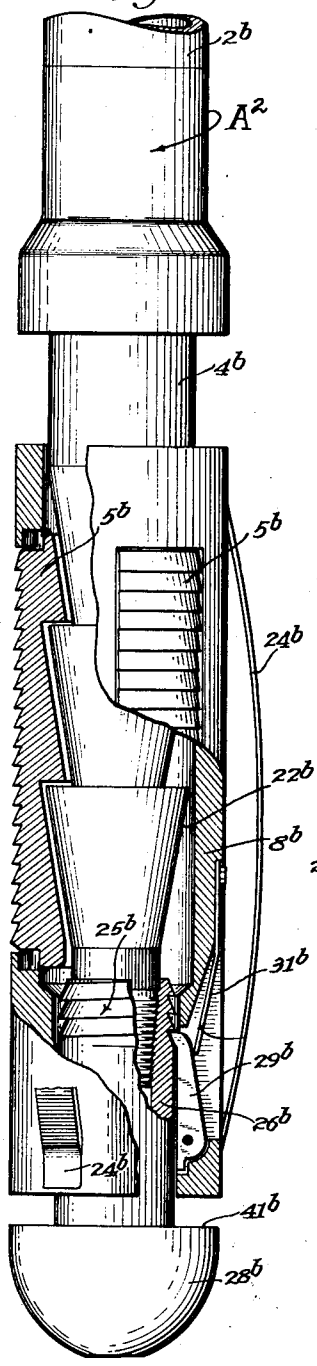


Fig. 5.

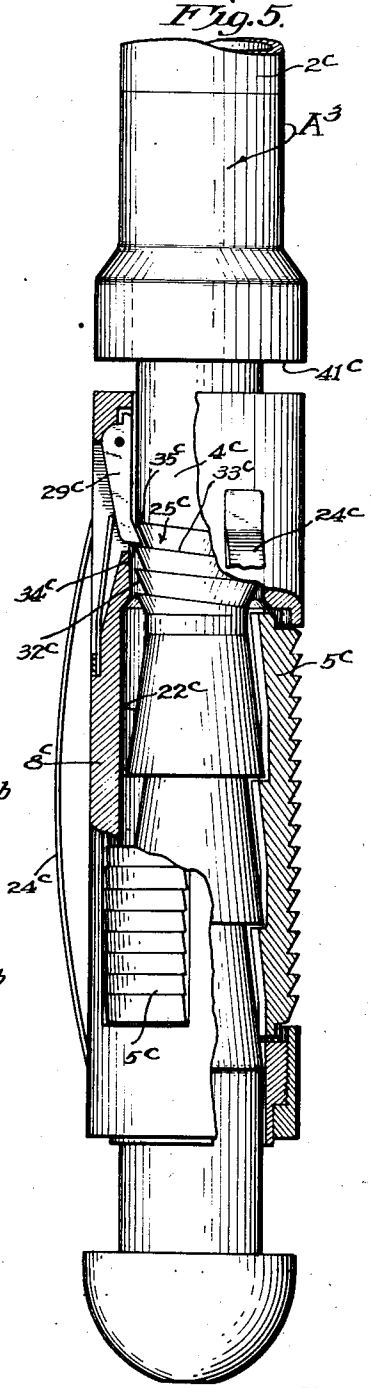
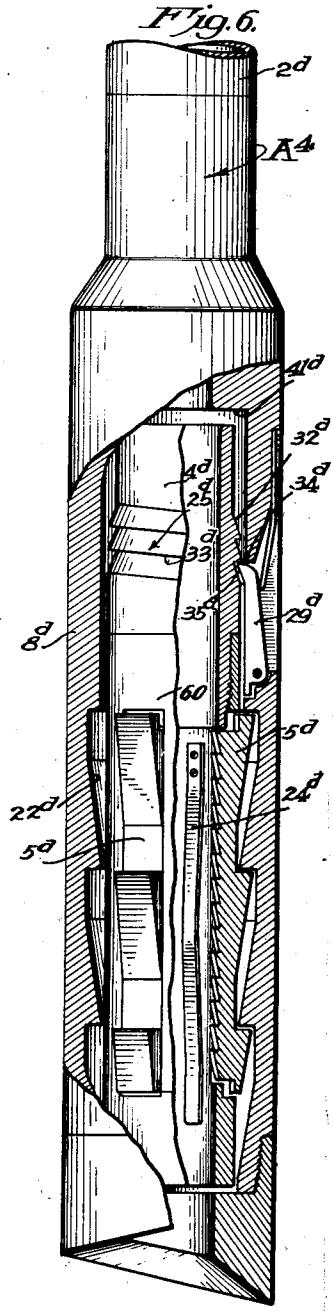


Fig. 6.



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UNITED STATES PATENT OFFICE

2,118,242

LATCH FOR CASING CUTTERS AND THE LIKE

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Application May 11, 1936, Serial No. 79,037

12 Claims. (Cl. 164—0.8)

This invention is a latch for securing cooperating elements against relative longitudinal displacement, the latch being readily releasable by relative rotation of the elements. The invention is particularly applicable to oil well tools wherein actuating mechanism which is supported by a well string, e. g. mechanism for expanding slips or the like, is inoperative when held against longitudinal displacement relative to the well string but is operative when longitudinally displaced relative thereto, the latch holding the actuating mechanism against longitudinal displacement relative to the well string while the latter is being run in a well, but being readily releasable by rotating the well string, to permit longitudinal displacement of the well string with relation to the actuating mechanism for operating the latter.

It is an object of the invention to provide a latch for the purpose described, which is of extremely simple construction but positive in operation, and which is readily releasable by rotating the well string.

It is a further object of the invention to provide a latch which, subsequent to release and relative longitudinal displacement of the well string for operating the actuating mechanism, is adapted to again provide a locking engagement and thus again secure the actuating mechanism in its inoperative position, merely by longitudinally shifting the well string in the opposite direction with relation to the actuating mechanism. The actuating mechanism may thus be operated at any desired level in a well by rotating the well string and longitudinally shifting the well string in one direction, and then by merely longitudinally shifting the well string in the opposite direction the actuating mechanism may be again secured in its inoperative position, whereby the well string may be raised or lowered and the actuating mechanism then again operated at any desired level in the well.

It is a still further object of the invention to provide a construction whereby relative rotation of the well string in one direction releases the latch as previously described, but the well string may be freely rotated in the opposite direction with relation to the latch structure without releasing the actuating mechanism and without liability of jamming the parts so as to render the device inoperative.

Further objects of the invention will be readily understood from the following description of the accompanying drawings, in which:

Fig. 1 is a side elevation of a casing cutter, partly in axial section, showing the latch incorporated therein for securing a well string against longitudinal displacement with relation to the mechanism which expands the cutter blades.

Fig. 2 is a similar view with the latch released and the cutter blades expanded.

Fig. 3 is a side elevation of a packer, partly in axial section, showing the latch incorporated therein for securing a well string against longitudinal displacement with relation to the actuating mechanism for the packer.

Fig. 4 is a similar view of a spear for supporting a well string in a well, with the latch incorporated therein for releasably holding the spear against operation.

Fig. 5 is a similar view of a spear for use in fishing jobs and the like.

Fig. 6 is a similar view of a socket for fishing jobs, etc.

In each of the illustrated embodiments of the invention, the latch is employed between a well string and a cooperating actuating mechanism which is run into the well on the well string, with release of the latch permitting longitudinal displacement of the well string with relation to the actuating mechanism whereby the actuating mechanism functions for any particular purpose for which it is designed.

The latch is particulary applicable to a casing cutter such as shown at Figs. 1 and 2, in which embodiment of the invention spring means are included in the actuating mechanism, cooperating with the latch to insure positive operation of the tool. As an instance of this arrangement the casing cutter may be incorporated in a well string 2, and the actuating mechanism for the casing cutter comprises a downwardly tapering wedging sleeve 3 slidable on a mandrel 4, with slips 5 cooperating with the sleeve for anchoring the sleeve in the casing by downward movement of the sleeve with relation to the slips. When the wedging sleeve has been anchored, downward movement of the well string relative thereto causes fingers 6 to engage and expand the blades 7 of the cutter which are mounted on the mandrel 4, and this relative displacement of the mandrel, sleeve and slips is controlled by a latch which is provided between the mandrel 4 and a sleeve 8 on which the slips are mounted.

The latch, when engaged as shown at Fig. 1, locks the sleeve 8 against longitudinal displacement on the mandrel 4, thereby holding the slips 5 in retracted inoperative position with relation to the wedging sleeve 3, and the latch is released by turning the well string and its depending

mandrel 4 with relation to the sleeve 8. When the latch has been released the well string is lowered, whereby the mandrel 4 shifts the sleeve 3 downwardly with relation to the slips 5 for expanding the slips and thereby anchoring the sleeve 3, and continued downward movement of the well string then slides the mandrel 4 through the anchored sleeve until the blades 7 are engaged and expanded by the fingers 6 as shown at Fig. 2.

The mandrel 4 may be suspended from the well string 2 by a usual threaded joint 10, and the upper end of the mandrel may have a plurality of recesses 11 in which the blades 7 are pivoted for normal retraction by springs 12, with the swinging ends of the blades provided with wedging surfaces 13 which are adapted for engagement by the fingers 6 for operatively projecting the blades. Below the recesses 11 the mandrel 4 may be of reduced diameter, with the fingers 6 preferably projecting longitudinally from a collar 14 which is slidable on this reduced diameter of the mandrel, and with the fingers 6 preferably seating in grooves 15 in the mandrel, permitting relative longitudinal movement of the finger supporting collar 14 while maintaining alinement of the fingers 6 with the respective blades 7.

Spring means cooperate with the latch mechanism, to positively retract the fingers 6 when the latch is engaged, and to permit operative projection of the fingers and tension the gripping engagement by the slips when the latch has been released. For this purpose the collar 14 is supported on the sleeve 3, with springs 9 seating in recesses 16 in the mandrel 4 and engaging pins 17 which project upwardly from the collar 14; and a spring 18 is mounted in a counterbore of the sleeve 3, with the lower end of the spring engaging the end of said counterbore and with the upper end of the spring engaging an anti-friction bearing 19 which preferably longitudinally abuts a shoulder 20 of the mandrel.

The slips 5 preferably have dove-tail connections 21 with downwardly tapering wedging surfaces 22 of the sleeve 3, and may be supported on the sleeve 8 by link connections 23. The sleeve 8 is provided with frictional elements, shown as bowed spring 24, connected at their lower ends to the sleeve 8 and connected at their upper ends to a collar 25 which is slidable on the sleeve 3; and the springs 24 are adapted to yieldingly engage the wall of a well bore into which the tool is lowered, for frictionally holding the sleeve 8 against rotation in the well bore.

The latch which is provided between the mandrel 4 and the sleeve 8, includes a trapezoidal thread 25 on one of these relatively displaceable cooperating elements, with a cooperating pawl 29 on the other of said cooperating elements.

In the illustrated embodiment, the trapezoidal thread 25 is formed at the outer periphery of a collar 26 which is preferably threaded onto the lower end of the mandrel 4 as shown at 27 and which forms a prolongation of the mandrel 4, preferably terminating in a head 28. The cooperating pawl 29 is an upstanding pawl pivoted at its lower end in a slot 30 in the sleeve 8, with a head at the upper end of the pawl yieldingly spring projected as shown at 31, for releasable engagement with the thread 25. The upper surface of the trapezoidal thread is steeply inclined as shown at 32, with the lower surface of the thread forming a transverse abutment surface 33. The head at the upper end of the pawl has an upper abutment surface 34 adapted to engage the transverse abutment surface 33 for preventing relative longitudinal displacement in one direction between the pawl and the thread, except by screwing the pawl along the thread by relative rotation of said parts; and the head of the pawl has a lower inclined surface 35 adapted to engage the inclined surface 32 of the thread, whereby the pawl and thread are free for relative longitudinal displacement in the opposite direction, without relative rotation of the parts but merely by the pawl retracting against the tension of its spring 31 as its inclined surface 35 slides over the inclined surface 32 of the thread.

With the latch operatively engaged as shown at Fig. 1, the parts are held in position with the slips 5 inoperatively retracted with relation to the sleeve 3 and with the fingers 6 inoperatively retracted with relation to the cutter blades 7, and with an extension 40 of the sleeve 3 abutting the upper end of the collar 26. The casing cutter, suspended from the well string 2, may thus be lowered into a well to any desired level, with the friction springs 24 readily yielding to permit lowering of the tool through the well casing.

When the tool is at the desired level, the well string is rotated as indicated by arrow A, i. e. in the normal direction of rotation of a well string having a usual right-hand thread; and the thread 25 being in the same direction, i. e., a right-hand thread, and the springs 24 frictionally engaging the casing so as to hold the sleeve 8 against rotation, relative turning movement of the mandrel 4 screws the pawl 29 along the thread 25 until the upper end of the thread clears the pawl, thereby releasing the latching engagement. If the well string should have a left-hand thread, so that its normal direction of rotation is in the reverse direction, a latch would be provided having a corresponding left-hand thread. The sleeve 8 being held against downward displacement in the casing by means of its friction springs 24, the well string and the suspended mandrel 4 may be lowered relative to the sleeve 8, thereby expanding the slips 5 on the wedging surfaces 22 so as to anchor the sleeve 3, with the compressed spring 18 urging relative longitudinal movement of the slips and sleeve for tightening the gripping engagement by the slips, and by continuing the downward movement of the well string and its suspended mandrel with relation to the anchored sleeve, the springs 9 yield so that the fingers 6 engage and operatively expand the blades 7.

The parts then being in the position shown at Fig. 2, the well string and its suspended mandrel together with the blades 7 and the collar 14, may be rotated relative to the anchored sleeves 3 and 8, for cutting the well casing by means of the blades 7.

By then merely elevating the well string and its suspended mandrel, the parts are returned to their original inoperative position as shown at Fig. 1, with the spring 18 downwardly displacing the sleeve 3 on the mandrel 4, so that the springs 9 may retract the collar 14 to disengage the fingers 6 from the blades 7. The pawl 29 readily yields to clear the thread 25 during relative longitudinal movement between the mandrel 4 and the sleeve 8, and the pawl then automatically reengages the cooperating thread to provide a latch, without it having been necessary to reversely rotate the well string to thus reengage the latch. The tool may then be lowered with the latch again retaining the actuating mechanism in inoperative position, and the cutter may then again be operated at any lower level in the well.

In order to limit relative longitudinal displacement between the mandrel 4 and the sleeve 8 while the well string is being withdrawn from a well, the head 28 may form an abutment shoulder 41 which is adapted for engagement by the lower end of the sleeve 8; and means are preferably provided whereby if for any reason the tool is rotated in the opposite direction to that of arrow A, so that the pawl 29 is screwed downwardly along the thread 25, this threaded movement is arrested before the screw action has jammed the end of the sleeve 8 against the shoulder 41, as might otherwise so tighten the threaded engagement as to make it impossible to subsequently lower the mandrel 4 with relation to the sleeve 8 for operating the tool. As an instance of this arrangement the lower end of the thread 25 may merge into the surface of the collar 26, in such spaced relation from the shoulder 41 that when the pawl 29 is at the lower end of the thread as shown at Fig. 1, there is a clearance space between the shoulder 41 and the lower end of the sleeve 8. Therefore if the pawl is screwed downwardly along the thread it will finally clear the thread and merely idle on the surface of the collar 26 and thus discontinue the threaded longitudinal displacement of the mandrel 4 with relation to the sleeve 8 before the sleeve 8 jams against the shoulder 41.

At Fig. 3, I have shown the latch embodied in a packer for a well, for releasably securing the packer actuating mechanism in its inoperative position. The packer is incorporated in a well string, and includes a downwardly tapering wedging sleeve 3a, slidable on a mandrel 4a which supports a packing rubber 50, with slips 5a cooperating with the sleeve for anchoring the sleeve in a well by downward movement of the sleeve with relation to the slips. When the sleeve 3a has been anchored, downward movement of the well string relative thereto compresses the packing rubber against the anchored sleeve for operatively expanding the packing rubber.

The slips 5a are mounted on a sleeve 8a which is slidable on the mandrel 4a, and preferably have dove-tail connections 21a with downwardly tapering wedging surfaces 22a of the sleeve 3a, and may be supported on the sleeve 8a by means of bowed friction springs 24a which are adapted to yieldingly engage the wall of the well bore for frictionally holding the sleeve 8a against rotation therein. As an instance of this arrangement, the friction springs may be connected at their lower ends to the sleeve 8a, with their upper ends connected to a collar 25a which is slidable on the mandrel 4a, and a collar 52 may rest upon the collar 25a, with link connections 23a between the collar 52 and the slips 5a.

A latch such as previously described in connection with Figs. 1 and 2 is provided between the sleeve 8a and the mandrel 4a, the trapezoidal thread 25a of the latch being formed on the mandrel, and the cooperating pawl 29a being pivoted in the sleeve 8a and being yieldingly operatively projected by a spring 31a. A collar 28a at the lower end of the mandrel 4a and which provides for connecting the packer to a depending length of the well string (not shown), forms an abutment shoulder 41a which is adapted for engagement by the lower end of the sleeve 8a, and the lower end of the thread 25a terminates in such spaced relation from the shoulder 41a that when the pawl 29a is at the lower end of the thread, there is a clearance space between the shoulder 41a and the sleeve 8a.

The operation is the same as that previously described in connection with Figs. 1 and 2. While the packer is being lowered into a well the latch secures the mandrel 4a and the wedging sleeve 3a against downward displacement with relation to the sleeve 8a and the slips 5a, whereby the slips are inoperatively retracted as shown at Fig. 3. When the packer is to be operatively expanded, the well string and the mandrel 4a which is fixed thereto are rotated in the direction of arrow A', and the sleeve 8a being held against rotation by its springs 24a, the pawl 29a is screwed along the thread 25a so as to finally clear the upper end of the thread and thus release the latch. Downward movement of the well string with relation to the frictionally held sleeve 8a, then expands the slips 5a to anchor the sleeve 3a, and continued downward movement of the well string then compresses the packing rubber 50 against the anchored sleeve 3a, so as to operatively expand the packing rubber.

Subsequent elevation of the well string, without the necessity of rotating the same, and whereby the pawl 29a yields to clear the thread 25a and then automatically reengages the thread as shown at Fig. 3, again secures the actuating mechanism in its inoperative position whereby the packer may be lowered to any other level in the well and then again operated; or the packer may be withdrawn from the well, with the shoulder 41a engaging the sleeve 8a to limit relative longitudinal displacement of the parts. If the well string is reversely rotated, the pawl 29a idles on the surface of that portion of the mandrel 4a which is below the thread 25a and which is shown at 26a, to prevent the screw action tightly jamming the sleeve 8a against the shoulder 41a.

At Fig. 4, I have shown a latch such as previously described, incorporated in a spear for supporting a well string 2b in a well bore. The spear includes a mandrel 4b suspended from the well string and having downwardly tapering wedging surfaces 22b, with a sleeve 8b which is slidable on the mandrel 4b, forming a cage for slips 5b, which are operatively expanded by downward movement of the wedging surfaces 22b with relation to the slips. Springs 24b which are mounted on the sleeve 8b, yieldingly engage the wall of the well bore for frictionally holding the sleeve against rotation in the well; and the latch is provided between the mandrel 4b and the sleeve 8b. The trapezoidal thread 25b is formed on a collar 26b which is suspended from the mandrel 4b and which terminates in a head 28b forming an abutment shoulder 41b for the sleeve 8b, and the cooperating pawl 29b is pivoted in the sleeve 8b and is yieldingly operatively projected by a spring 31b.

While the spear is being lowered into a well the latch secures the mandrel 4b and the sleeve 8b against relative longitudinal displacement so that the slips 5b are retracted with relation to the wedging surfaces 22b, as shown at Fig. 4; and when the spear is to be operated the well string 2b is rotated as shown by arrow A2, screwing the pawl 29b along its cooperating thread 25b so as to clear the upper end of the thread, whereupon the well string may be lowered relative to the frictionally held sleeve 8b for operatively expanding the slips 5b. Upward movement of the well string, without rotation thereof, reengages the latch, with the slips 5b again retracted as shown at Fig. 4, so that the spear may be lowered to a different level; or the spear may be with-

drawn with the sleeve 8b engaging the shoulder 41b to limit relative longitudinal displacement of the parts.

At Fig. 5, I have shown the latch incorporated in a spear which may be run into a well on a suitable well string 2c, to engage the bore of a tubular element which it is desired to withdraw from the well, the construction and operation of the spear being the reverse of the spear shown at Fig. 4, i. e. the spear being set by upward movement of the well string 2c with relation to its slips 5c, instead of by downward movement of the well string, and the slips 5c being released and the latch again operatively engaged, by relative downward movement of the well string.

As an instance of this arrangement a mandrel 4c is suspended from the well string 2c, and upwardly tapering wedging surfaces 22c on the mandrel, cooperate with slips 5c which are mounted in a sleeve 8c which forms a cage for the slips. The latch between the mandrel 4c and the sleeve 8c includes a trapezoidal thread 25c on the mandrel and a cooperating spring projected pawl 29c pivoted at its upper end in the sleeve and having a depending head, with the pitch of the thread in the opposite direction to that of the threads of the latches which are shown at Figs. 1 to 4, so that with the sleeve 8c held against rotation and the well string rotated in the direction of arrow A3, the pawl 29c is screwed downwardly along the thread. The upper surface of the thread and the lower surface of the head of the pawl form the cooperating flat abutment surfaces 33c—34c, and the lower surface of the thread and the upper surface of the head of the pawl form the cooperating steeply inclined surfaces 32c—35c. Springs 24c on the sleeve 8c frictionally hold the sleeve against rotation in the tubular element into which the spear is lowered; and the mandrel 4c forms an abutment shoulder 41c above the sleeve 8c, with the upper end of the thread 25c terminating in such spaced relation from the shoulder 41c that in the event of reverse rotation of the well string, the pawl 29c will be screwed off the upper end of the thread and thus interrupt the screw action before it jams the sleeve 8c against the shoulder 41c.

In operation the latch holds the sleeve 8c against downward movement on the mandrel 4c and the shoulder 41c limits upward movement of the sleeve on the mandrel while the spear is being lowered, and when the spear is in place in the tubular element which it is to engage, the springs 24c hold the sleeve 8c against rotation and the well string 2c is rotated in the direction of arrow A3. The latch as described is for a well string having a right-hand thread, and the thread 25c is in the opposite direction if the well string has a left-hand thread so that left-hand rotation of the well string will operate the tool. The pawl 29c is thus screwed along the thread 25c to clear the lower end of the thread and release the latch, and upward movement of the well string with relation to the frictionally held sleeve 8c then expands the slips 5c to grip the tubular element which is to be withdrawn from the well. To release the spear the well string is lowered relative to the sleeve 8c, the pawl 29c yielding to clear the thread 25c and then reengaging the thread when the parts are again in inoperative position as shown at Fig. 5, without requiring rotation of the well string while the latch is being thus reengaged.

At Fig. 6, I have shown the latch incorporated in a socket which may be run into a well on a string 2d in order to slip over any element which it is desired to withdraw from the well, the socket being set in the same manner as that of the spear shown at Fig. 5, i. e. by upward movement of the well string with relation to the slips 5d of the socket, and the slips being released and the latch reengaged by relative downward movement of the well string.

As an instance of this arrangement a sleeve 8d may depend from the well string 2d with downwardly tapering wedging surfaces 22d in the bore of the sleeve, and the slips 5d which are adapted for operative contraction around the element which is to be recovered from the well, cooperate with the wedging surfaces 22d and are mounted in a cage 60. This cage is suspended from a mandrel 4d which is mounted in the bore of the sleeve 8d so as to permit rotation and longitudinal displacement of the sleeve with relation to the mandrel and the slips. The latch is provided between the mandrel 4d and the sleeve 8d, and includes a trapezoidal thread 25d on the mandrel and a cooperating upstanding spring projected pawl 29d pivoted at its lower end in the sleeve and having a head at its upper end. The pitch of the thread is in the same direction as that of the latch shown at Fig. 5, i. e. in the opposite direction to that shown at Figs. 1 to 4, so that with the mandrel 4d held against rotation and the well string turned in the direction of arrow A4, the pawl 29d is screwed upwardly along the thread. The cooperating surfaces of the thread and the head of the pawl are arranged the same as shown at Figs. 1 to 4, i. e. with the flat abutment surfaces 33d—34d at the lower surface of the thread and at the upper surface of the head of the pawl, and with the inclined surfaces 32d—35d at the upper surface of the thread and at the lower surface of the head of the pawl. Springs 24d in the bore of the cage 60 frictionally hold the cage and the mandrel 4d against rotation on the element over which the socket is lowered; and the sleeve 8d has an abutment shoulder 41d in its bore, above the mandrel 4d, with the thread 25d terminating at its lower end at such point that in the event of reverse rotation of the well string, the pawl 29d will be screwed off the lower end of the thread and thus interrupt the screw action before it jams the mandrel 4d against the shoulder 41d.

In operation the latch holds the mandrel 4d and the slip cage 60 against downward movement in the sleeve 8d so that the slips are inoperatively expanded while the socket is being lowered in a well; and when the socket has been slipped over an element which is to be recovered from the well, the springs 24d hold the mandrel and slip cage against rotation so that turning the well string in the direction of arrow A4 screws the pawl 29d along the thread 25d until it clears the upper end of the thread. The latch is oppositely threaded and the well string is oppositely rotated if the well string has a left-hand thread. The latch being thus released, the well string may be elevated with relation to the frictionally held slip cage so as to set the slips by means of the wedging surfaces 22d, whereupon the socket and the element which has been gripped thereby, may be withdrawn from the well. Downward movement of the well string and the sleeve 8d relative to the operated slip structure, returns the parts to inoperative position as shown at Fig. 6, with the

pawl 29d yielding to clear the threads 25d without the necessity of rotating the well string.

The invention is thus applicable to any telescopic elements which it is desired to releasably secure against relative longitudinal displacement, with the securing means releasable by rotating one of said elements with relation to the other, and readily reengaged by merely telescoping the elements without relative rotation thereof. The invention is thus particularly applicable to oil well tools, wherein a casing cutter, packer, fishing tool or the like is lowered into a well and is then set by relative longitudinal displacement of the well string on which the tool is mounted; the invention providing for securing the well string and the actuating mechanism against relative longitudinal displacement so that the actuating mechanism remains inoperative while the tool is being lowered, with rotation of the well string from the top of the well then releasing the securing means whereby the well string may be longitudinally displaced with relation to the actuating mechanism for setting the tool, and the tool being retracted to its inoperative position and the securing means being then reengaged, by merely shifting the well string in the opposite direction with relation to the actuating mechanism and without the necessity of rotating the well string. The invention also provides for limiting relative longitudinal displacement of the well string and the actuating mechanism in the direction opposite to that which sets the tool, and provides a construction wherein relative rotation of the well string in the direction opposite to that which releases the latch, cannot jam the parts so as to render the latch inoperable.

I claim:

1. In a cutter for casing, a support, a cutter on the support, a slip, a wedge movable relative to the slip for engaging the slip with casing, an expander for the cutter supported by the wedge, the wedge and the expander being movable relative to the support, yieldable means for relatively moving the expander and the support so as to disengage the expander from the cutter, tensioning means for relatively moving the wedge and the support so as to tighten engagement of the slip with the casing, a support for the slip slidable relative to the first mentioned support, a latch between the supports comprising a cooperating thread and pivoted pawl, means for yieldingly projecting the pivoted pawl for engaging the thread so as to be screwed therealong and thus relatively longitudinally displace the supports by relative rotation thereof, the thread and pawl having cooperating surfaces securing the supports against relative longitudinal displacement in one direction except by their relative rotation, relative longitudinal displacement of the supports in said direction anchoring the expander and operatively projecting the cutter, the thread and pawl having cooperating surfaces adapted to disengage the pivoted pawl from the thread to permit relative longitudinal displacement of the supports in the opposite direction, relative longitudinal displacement of the supports in said opposite direction releasing the anchored expander, and cooperating abutments on the supports for limiting their relative longitudinal displacement in the last mentioned direction, the thread terminating at such point that when the supports are relatively longitudinally displaced in said last mentioned direction the pivoted pawl clears the end of the thread and idles on the surface of the threaded support before the cooperating abutments engage.

2. In a cutter for casing, a support, a cutter on the support, a slip, a wedge movable relative to the slip for engaging the slip with casing, an expander for the cutter supported by the wedge, the wedge and the expander being movable relative to the support, yieldable means for relatively moving the expander and the support so as to disengage the expander from the cutter, tensioning means for relatively moving the wedge and the support so as to tighten engagement of the slip with the casing, a support for the slip slidable relative to the first mentioned support, a latch between the supports comprising a cooperating pawl and thread, means for yieldingly projecting the pawl for engaging the thread so as to be screwed therealong and thus relatively longitudinally displace the supports by relative rotation thereof, the thread and pawl having cooperating surfaces securing the supports against relative longitudinal displacement in one direction except by their relative rotation, relative longitudinal displacement of the supports in said direction anchoring the expander and operatively projecting the cutter, the thread and pawl having cooperating surfaces adapted to disengage the pawl from the thread to permit relative longitudinal displacement of the supports in the opposite direction, relative longitudinal displacement of the supports in said opposite direction releasing the anchored expander, and cooperating abutments on the supports for limiting their relative longitudinal displacement in the last mentioned direction, the thread terminating at such point that when the supports are relatively longitudinally displaced in said last mentioned direction the pawl clears the end of the thread and idles on the surface of the threaded support before the cooperating abutments engage.

3. In a cutter for casing, a support, a cutter on the support, a support slidable relative to the first mentioned support, an expander carried by the slidable support, a latch between the supports comprising a cooperating thread and pawl, means for yieldingly projecting the pawl for engaging the thread so as to be screwed therealong and thus relatively longitudinally displace the supports by relative rotation thereof, the thread and pawl having cooperating surfaces securing the supports against relative longitudinal displacement in one direction except by their relative rotation, relative longitudinal displacement of the supports in said direction engaging the cutter by the expander for operatively projecting the cutter, the thread and pawl having cooperating surfaces adapted to disengage the pawl from the thread to permit relative longitudinal displacement of the supports in the opposite direction, relative longitudinal displacement of the supports in said opposite direction disengaging the expander from the cutter to permit return of said cutter to inoperative position, and cooperating abutments on the supports for limiting their relative longitudinal displacement in the last mentioned direction, the thread being arranged whereby that threaded movement of the pawl along the thread which causes relative longitudinal displacement of the supports in said last mentioned direction terminates before the cooperating abutments engage.

4. In a well tool, a support adapted for incorporation in a well string, a support slidable relative to the first mentioned support, an element

on one of said supports adapted for projection to position defining operative position of the tool, an expander carried by the other support, a latch between the supports comprising a cooperating thread and pawl, means for yieldingly projecting the pawl for engaging the thread so as to be screwed therealong and thus relatively longitudinally displace the supports by relative rotation thereof, the thread and pawl having cooperating surfaces securing the supports against relative longitudinal displacement in one direction except by their relative rotation, relative longitudinal displacement of the supports in said direction engaging the aforesaid element by the expander for operatively projecting said element, the thread and pawl having cooperating surfaces adapted to disengage the pawl from the thread to permit relative longitudinal displacement of the supports in the opposite direction, relative longitudinal displacement of the supports in said opposite direction disengaging the expander from the aforesaid element to permit return of said element to inoperative position, cooperating abutments on the supports for limiting their relative longitudinal displacement in the last mentioned direction, the thread being arranged whereby that threaded movement of the pawl along the thread which causes relative longitudinal displacement of the supports in said last mentioned direction terminates before the cooperating abutments engage.

5. In a well tool, a support adapted for incorporation in a well string, a support slidable relative to the first mentioned support, an element on one of said supports adapted for projection to position defining operative position of the tool, an expander carried by the other support, and a latch between the supports comprising a cooperating thread and pawl, means for yieldingly projecting the pawl for engaging the thread so as to be screwed therealong and thus relatively longitudinally displace the supports by relative rotation thereof, the thread and pawl having cooperating surfaces securing the supports against relative longitudinal displacement in one direction except by their relative rotation, relative longitudinal displacement of the supports in said direction engaging the aforesaid element by the expander for operatively projecting said element, the thread and pawl having cooperating surfaces adapted to disengage the pawl from the thread to permit relative longitudinal displacement of the supports in the opposite direction, relative longitudinal displacement of the supports in said opposite direction disengaging the expander from the aforesaid element to permit return of said element to inoperative position.

6. In a well tool, a support adapted for incorporation in a well string, a support slidable relative to the first mentioned support, an element on one of said supports adapted for projection to position defining operative position of the tool, an expander carried by the other support, a latch between the supports comprising a cooperating thread and pawl, means for yieldingly projecting the pawl for engaging the thread so as to be screwed therealong and thus relatively longitudinally displace the supports by relative rotation thereof, the thread and pawl having cooperating surfaces securing the supports against relative longitudinal displacement in one direction except by their relative rotation, relative longitudinal displacement of the supports in said direction engaging the aforesaid element by the expander for operatively projecting said element, the thread and pawl having cooperating surfaces adapted to disengage the pawl from the thread to permit relative longitudinal displacement of the supports in the opposite direction, relative longitudinal displacement of the supports in said opposite direction disengaging the expander from the aforesaid element to permit return of said element to inoperative position, means for frictionally holding one of said supports against rotation.

7. In a well tool, a support adapted for incorporation in a well string, a support slidable relative to the first mentioned support, an element on one of said supports adapted for projection to position defining operative position of the tool, an expander carried by the other support, a latch between the supports comprising a cooperating thread and pawl, means for yieldingly projecting the pawl for engaging the thread so as to be screwed therealong and thus relatively longitudinally displace the supports by relative rotation thereof, the thread and pawl having cooperating surfaces securing the supports against relative longitudinal displacement in one direction except by their relative rotation, the thread and pawl having cooperating surfaces adapted to disengage the pawl from the thread to permit relative longitudinal displacement of the supports in the opposite direction, the aforesaid element and the expander being arranged whereby relative longitudinal displacement of the supports in one direction engages said element by the expander for operatively projecting said element and relative longitudinal displacement of the supports in the opposite direction disengages the expander from said element to permit return of said element to inoperative position, and cooperating abutments on the supports for limiting their relative longitudinal displacement in one direction, the thread being arranged whereby that threaded movement of the pawl along the thread which causes relative longitudinal displacement of the supports in said last mentioned direction terminates before the cooperating abutments engage.

8. In a well tool, a support adapted for incorporation in a well string, a support slidable relative to the first mentioned support, an element on one of said supports adapted for projection to position defining operative position of the tool, an expander carried by the other support, and a latch between the supports comprising a cooperating thread and pawl, means for yieldingly projecting the pawl for engaging the thread so as to be screwed therealong and thus relatively longitudinally displace the supports by relative rotation thereof, the thread and pawl having cooperating surfaces securing the supports against relative longitudinal displacement in one direction except by their relative rotation, the thread and pawl having cooperating surfaces adapted to disengage the pawl from the thread to permit relative longitudinal displacement of the supports in the opposite direction, the aforesaid element and the expander being arranged whereby relative longitudinal displacement of the supports in one direction engages said element by the expander for operatively projecting said element and relative longitudinal displacement of the supports in the opposite direction disengages the expander from said element to permit return of said element to inoperative position.

9. In a well tool, a support adapted for incorporation in a well string, a support slidable relative to the first mentioned support, an element on one of said supports adapted for projection to position defining operative position of the tool,

an expander carried by the other support, a latch between the supports comprising a cooperating thread and pawl, means for yieldingly projecting the pawl for engaging the thread so as to be screwed therealong and thus relatively longitudinally displace the supports by relative rotation thereof, the thread and pawl having cooperating surfaces securing the supports against relative longitudinal displacement in one direction except by their relative rotation, the thread and pawl having cooperating surfaces adapted to disengage the pawl from the thread to permit relative longitudinal displacement of the supports in the opposite direction, the aforesaid element and the expander being arranged whereby relative longitudinal displacement of the supports in one direction engages said element by the expander for operatively projecting said element and relative longitudinal displacement of the supports in the opposite direction disengages the expander from said element to permit return of said element to inoperative position, and means for frictionally holding one of the supports against rotation.

10. In a well tool, a support adapted for incorporation in a well string, a support slidable relative to the first mentioned support, an element on one of said supports adapted for projection to position defining operative position of the tool, an expander carried by the other support, a cooperating projection and thread on the supports, the projection engaging the thread so as to be screwed therealong and thus relatively longitudinally displace the supports by relative rotation thereof, relative longitudinal displacement of the supports in one direction engaging the aforesaid element by the expander for operatively projecting said element, relative longitudinal displacement of the supports in the opposite direction disengaging the expander from the aforesaid element to permit return of said element to inoperative position, and cooperating abutments on the supports for limiting their relative longitudinal displacement in the last mentioned direction, the thread being arranged whereby that threaded movement of the projection along the thread which causes relative longitudinal displacement of the supports in said last mentioned direction terminates before the cooperating abutments engage.

11. In a well tool, a support adapted for incorporation in a well string, a support slidable relative to the first mentioned support, an element on one of said supports adapted for projection to position defining operative position of the tool, an expander carried by the other support, a cooperating projection and thread on the supports, the projection engaging the thread so as to be screwed therealong and thus relatively longitudinally displace the supports by relative rotation thereof, relative longitudinal displacement of the supports in one direction engaging the aforesaid element by the expander for operatively projecting said element, relative longitudinal displacement of the supports in the opposite direction disengaging the expander from the aforesaid element to permit return of said element to inoperative position, and cooperating abutments on the supports for limiting their relative longitudinal displacement in one direction, the thread being arranged whereby that threaded movement of the projection along the thread which causes relative longitudinal displacement of the supports in said last mentioned direction terminates before the cooperating abutments engage.

12. In a latch for relatively longitudinally displaceable elements of a well tool of that type in which a member is operatively or inoperatively positioned by relative longitudinal displacement of said elements; comprising a cooperating projection and thread on said elements, the projection engaging the thread so as to be screwed therealong and thus relatively longitudinally displace said elements by relative rotation thereof, and cooperating abutments on said elements for limiting their relative longitudinal displacement in one direction, the thread being arranged whereby that threaded movement of the projection along the thread which causes relative longitudinal displacement of said elements in said last mentioned direction terminates before the cooperating abutments engage.

IDRIS THOMAS.