

[54] LATCH FOR GAS LIFT VALVE OR THE LIKE

3,638,988 2/1972 Brown..... 294/86.18

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[57]

ABSTRACT

[52] U.S. Cl..... 294/86.18, 294/86.31, 294/86.33

[51] Int. Cl..... E21b 31/02

[58] Field of Search..... 294/86.3, 86.22, 294/87.26, 102 A, 102 R, 86.17, 86.18, 86.1, 86.31, 86.33; 166/217, 206, 209

A latch is disclosed which includes a central core, a sleeve mounted to slide on the core and a collet mounted to slide on the sleeve. Positioning, locking and removal of the latch is effected by controlling the relative axial position of the central core, the sleeve and the collet.

[56] References Cited

UNITED STATES PATENTS

3,074,485 1/1963 McGowen, Jr. 166/217

10 Claims, 7 Drawing Figures

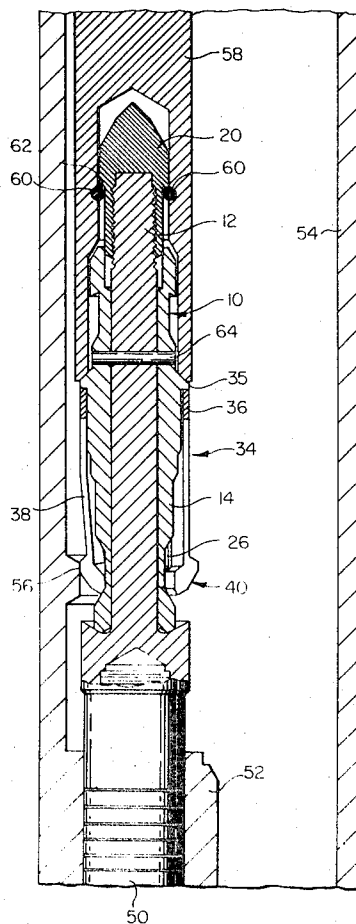


Fig. 1

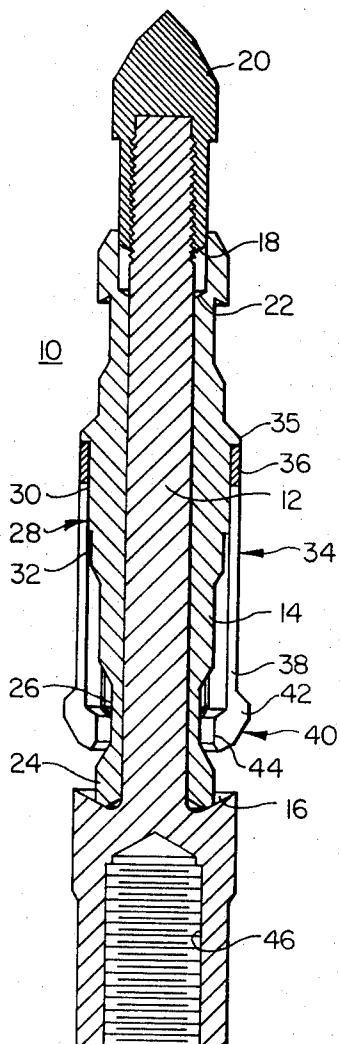


Fig. 3

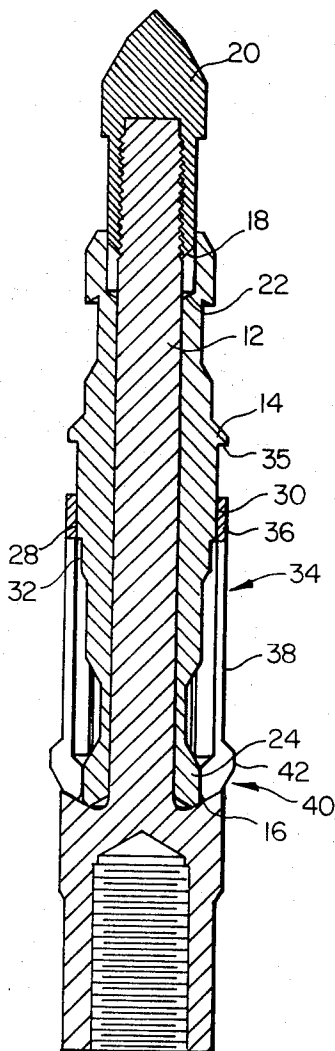
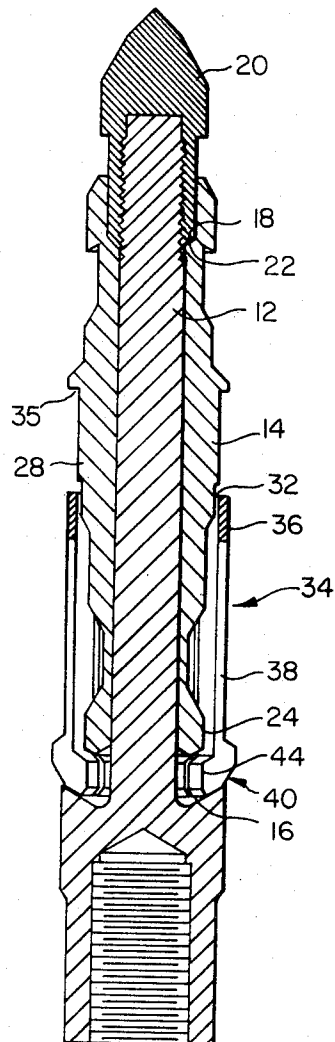


Fig. 4



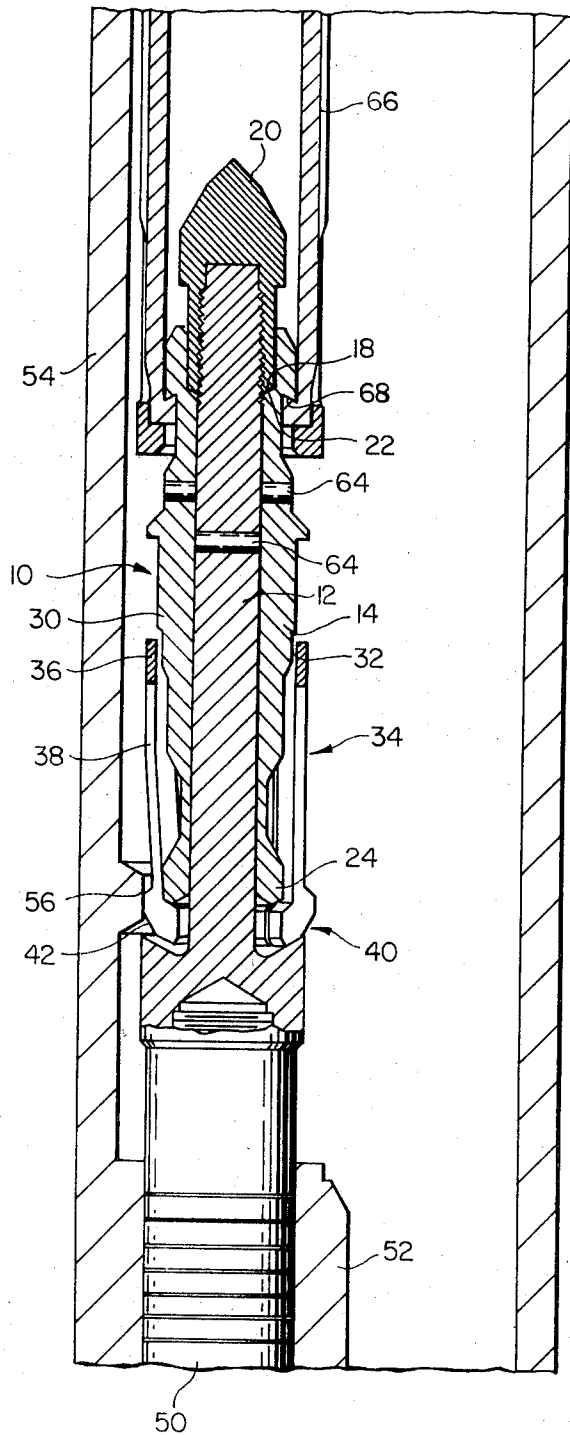
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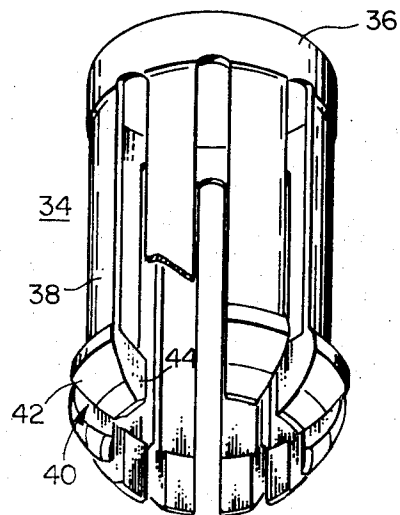
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Fig. 7



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Fig. 2



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Fig. 5

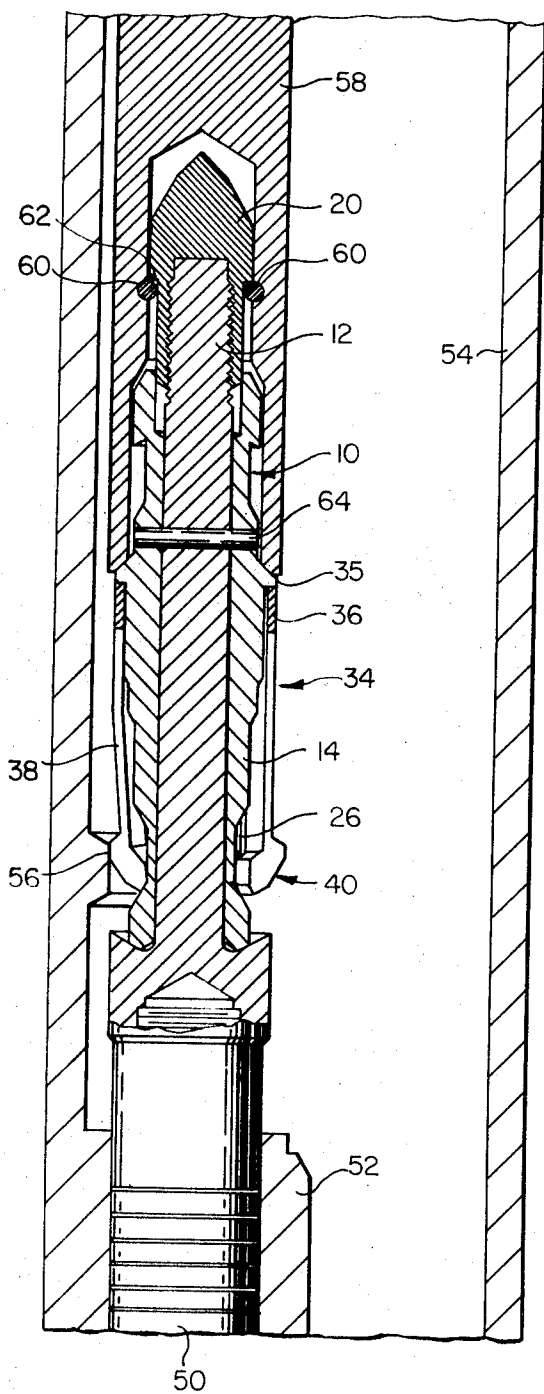
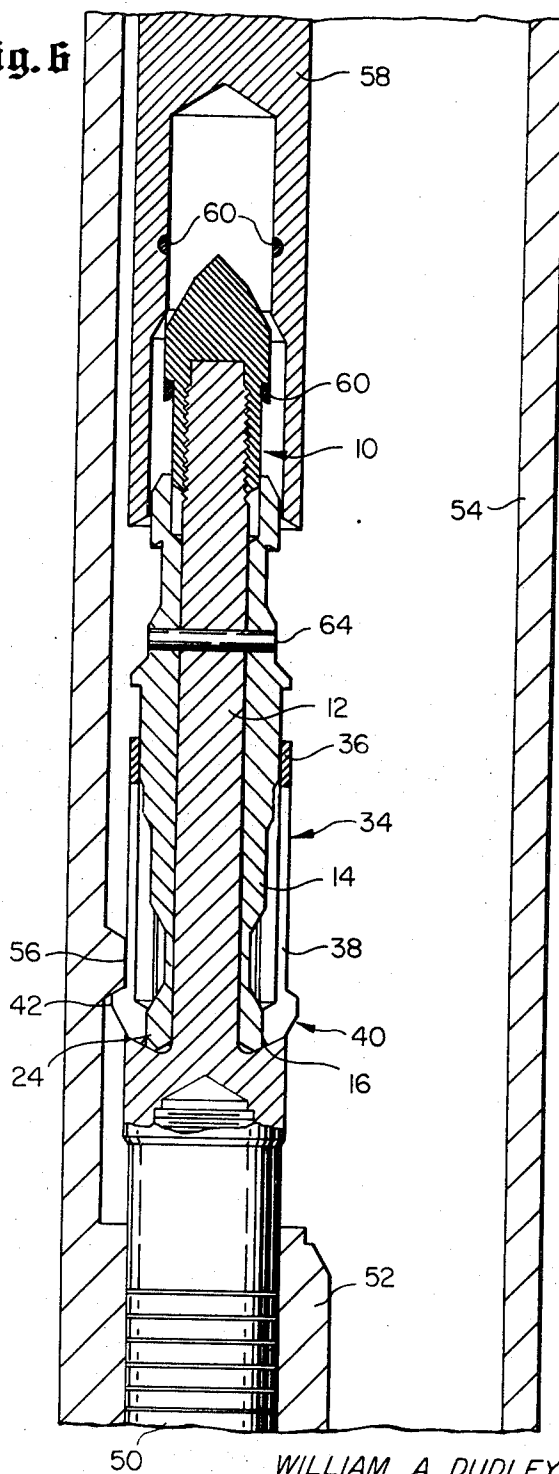


Fig. 6



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LATCH FOR GAS LIFT VALVE OR THE LIKE

This invention relates to latching devices primarily for oil field equipment, and more particularly to a latch device for securing a gas lift valve or the like in a side pocket mandrel which includes an inwardly projecting locking shoulder therein.

Those skilled in the oil field art are familiar with gas lift valves and side pocket mandrels in which such gas lift valves are placed. It is common practice to include a latch device with such gas lift valves which hold the valve securely in place but which enable the valve to be removed with relative ease whenever it is desired to do so.

One of the most commonly used such latch devices presently used is described in U.S. Pat. No. 3,074,485, and particularly in FIGS. 17 through 22 thereof. As is described in detail therein, the side pocket mandrel in which the gas lift valve is to be positioned includes an inwardly projecting locking shoulder just above the valve seat or receiver. The latch device itself, which is secured to the top of the valve, includes a locking ring which is positioned around a sleeve which, if unrestricted, slides upon a central core. The sleeve is held in position upon the core by a shear pin. The sleeve includes a central portion of reduced diameter. The locking ring is held in its normal position by a compression spring. As the valve and the latch are lowered into the receiver in the side pocket mandrel, the inwardly projecting locking shoulder lifts the locking ring against the force of the compression spring until the locking ring is around the central portion of reduced diameter of the sleeve. By a camming action, the locking shoulder then shifts the locking ring laterally and the locking ring passes beneath the shoulder. The latch and the valve are then locked in position because the compression spring returns the locking ring to the enlarged diameter section of the sleeve where such lateral shifting is no longer possible.

When it is desired to remove the valve and the latch, a pulling tool is inserted into the well and attached to the sleeve of the latching device. As the pulling tool is raised upward, the shear pin is broken and the sleeve is pulled upward along the central core of the latching device. When this occurs, the locking ring can once again shift laterally beneath the enlarged diameter section of the sleeve, and again camming action of the locking shoulder shifts the latching ring laterally and allows the latch and the valve to be removed.

Experience in the field has revealed several shortcomings in latching devices such as those just described. For example, it is obviously desirable to be able to use the same latching device more than once, and it would seem that it would merely be necessary to replace the shear pin after the latching device has been removed in order to use it again. However, practice has shown that it is extremely difficult, because of the strong forces of the compression spring, to maintain the sleeve and the central core in the proper position to insert a new shear pin. In addition, difficulty in removing latching devices is sometimes experienced in side pocket mandrels which are not absolutely vertical, which is frequently the case. In such instances, if the locking shoulder is on the relatively lower side of the non-vertical mandrel, the weight of the locking ring itself may keep the locking ring from being shifted later-

ally by the locking shoulder, even though the retaining sleeve has been withdrawn.

It is accordingly an object of the present invention to provide an improved locking device.

It is another object of the present invention to provide an improved locking device which is interchangeable with the locking devices presently used in oil field equipment.

It is still another object of the present invention to provide an improved locking device which may be inserted and removed in exactly the same manner as is the prior art locking devices in order that operators need receive no additional training in the use of the devices and that no records need be kept to indicate what type of locking device is in a particular well.

It is yet another object of the present invention to provide an improved locking device which can easily be repinned after it has been removed from an oil well.

It is still another object of the present invention to provide an improved locking device which functions equally well whether mounted vertically or at an angle.

Briefly stated, and in accordance with the presently preferred embodiment of the invention, a latching device for use in applications such as is described above is provided which includes a central core and a latch sleeve slidably mounted on the core, with the sleeve including an enlarged lower portion, a central portion having an outside diameter less than the outside diameter of the enlarged lower portion and an enlarged upper portion having an outside diameter greater than the outside diameter of the central portion. Upper and lower stop means are provided for limiting the axial movement of the sleeve relative to the core between a first top position and a second bottom position. A collet is slidably mounted on the sleeve. The collet includes a collar member surrounding the enlarged upper portion of the sleeve and a plurality of spring finger members which project downwardly from the collar. Each of the spring finger members includes a nose portion at its bottom which includes an outwardly projecting nose portion and an inwardly projecting nose portion. The collet is capable of axial movement relative to the sleeve from a first top position in which the ends of the finger members are on the level of the central portion of the sleeve to a second central position in which the ends of the finger members are on the level of the enlarged lower portion of the sleeve to a third bottom position in which the ends of the finger members are beneath the enlarged lower portion of the sleeve. Frangible means such as a shear pin normally secures the sleeve in its second or bottom position relative to the central core. When the sleeve is in its bottom position and the collet is in its first or top position, the finger members can be deflected radially inwardly and the latch can pass the locking shoulder in a side pocket mandrel of the type described above. When the collet then drops into its second or central position, the enlarged lower portion of the sleeve prevents radial inward deflection of the fingers of the collet, and the latch functions to secure the gas lift valve in its receiver. When it is desired to withdraw the latch and the valve, a pulling tool lifts the sleeve and shears the pin, in the manner described above, and the sleeve is lifted to its top position, at which time the inwardly projecting locking shoulder deflects the nose portions of the finger members inwardly so that the latch and the valve

can pass the locking shoulder and be withdrawn from the well.

For a complete understanding of the invention, and an appreciation of its other objects and advantages, please refer to the following detailed description of the attached drawings, in which:

FIG. 1 shows a cross sectional view of a latch in accordance with the present invention;

FIG. 2 shows a perspective view, partially broken away, of the collet of the latch of FIG. 1;

FIGS. 3 and 4 show cross sectional views similar to FIG. 1 and illustrate additional possible relative axial positions of the sleeve and the collet of the latch;

FIGS. 5 and 6 are sequential views illustrating the manner in which a gas lift valve or the like using the latch of FIGS. 1 through 4 is positioned into a valve seat and is held in position by the latch; and

FIG. 7 is a view similar to FIGS. 5 and 6 but illustrates the manner in which the latch and the valves are withdrawn from the valve seat, when this is desired.

FIG. 1 shows a cross-sectional view of a latch 10 in accordance with the present invention. As shown therein, the latch 10 includes a central core portion 12 and a latch sleeve 14 which is mounted on the central core 12 in snug sliding relation with the core 12 for axial movement along the core 12. Sleeve 14 is axially movable along core 12 between a bottom position, shown in FIG. 1, and a top position, shown in FIG. 4 below. Axial movement in the downward direction is limited by the shoulder 16 of central core 12, which thus serves as a lower stop means limiting movement in the downward direction. Similarly, axial movement in the upward direction is limited by the lower shoulder 18 of a running head 20 which is secured to the central core 12. Upward movement of sleeve 14 is stopped when the internal shoulder 22 of sleeve 14 contacts the lower shoulder 18 of running head 20, as is shown in FIG. 4 below.

The sleeve 14 includes an enlarged lower portion 24, a central portion 26 having an outside diameter less than the outside diameter of the enlarged lower portion 24 and an enlarged upper portion 28 which has an outside diameter greater than the outside diameter of either the central portion 26 or the enlarged lower portion 24. For reasons described in connection with the description of FIG. 7 below, the enlarged upper portion 28 includes a first top section 30 and a second bottom section 32 whose outside diameter is slightly less than the outside diameter of section 30, but whose outside diameter is still substantially greater than the outside diameter of central portion 26.

In accordance with one of the primary features of the present invention, a collet 34 is provided which is slidably mounted around sleeve 14. Upward axial movement of collet 34 is limited by shoulder 35 on sleeve 14, and downward axial movement of collet 34 is limited by shoulder 16 on central core 12.

The structure of collet 34 is best seen in FIG. 2, which is a perspective view, partially broken away, of the collet 34. Collet 34 includes a collar 36 at its top end and a plurality of downwardly projecting fingers 38. At the bottom end of each of the fingers 38 is a nose section 40. The nose section 40 includes an outwardly projecting nose portion 42 and an inwardly projecting nose portion 44.

As is best shown in FIGS. 1, 3 and 4, the dimensions of the various portions of the collet are chosen so that

the inside diameter of the collar 36 is somewhat greater than the outside diameter of the top section 30 of the enlarged upper portion 28 of sleeve 14, but is substantially smaller than the outside diameter of the shoulder 35 on sleeve 14, whereby collet 34 has a relatively loose sliding fit around this portion of sleeve 14. The dimensions of the nose portions 40 are chosen such that, when the spring finger members 38 are in a relaxed position, the outside diameter of outwardly projecting nose portions 42 is the maximum outside diameter of any portion of the latch 10. The inside diameter of the inwardly projecting nose portions 44 is chosen to be substantially equal to the outside diameter of the enlarged lower portion 24 of sleeve 14, when the spring finger members 38 are in their relaxed positions. As used herein, the term "substantially equal" can mean either slightly greater than or slightly less than the outside diameter of enlarged lower portion 24. It is only necessary that the nose portion 40 can be slid fairly easily over the enlarged lower portion 24 but that, when this is so done, the fit is not so loose that the nose portion 40 can be deflected radially inwardly for any substantial distance.

The latch 10 also includes means for securing the latch to a gas lift valve, or the like, such as the internally threaded aperture 46 in the bottom of latch 10.

As is shown in FIGS. 1, 3 and 4 respectively, the collet 34 is axially movable into three distinct positions relative to the sleeve 14. In the first or top position, shown in FIG. 1, the nose portion 40 of the finger members 38 are level with the central reduced diameter portion 26 of sleeve 14. When the members are in these relative positions, the finger members 38 can easily be deflected radially inwardly.

In its second and central position, as is shown in FIG. 3, the nose portions 40 of collet 34 are positioned on a level with the enlarged lower portion 24 of sleeve 14. At this time, the enlarged lower portion 24 prevents inward radial deflection of the nose portions 40 of finger members 38, and the outwardly projecting nose portions 42 represent, in effect, a rigid locking ring, at least against inwardly directed compressive forces. In this position, the shoulder 16 of central core 12 prevents further downward movement of both the sleeve 14 and the collet 34. In this position, the collar 36 of collet 34 is positioned around the top section 30 of the enlarged upper portion 28 of sleeve 14.

The third position of collet 34 relative to sleeve 14, which may be termed its bottom position, is shown in FIG. 4. In this position, collet 34 is positioned axially lower than the other shown positions such that the nose portions 40 of finger members 38 are beneath the enlarged lower portion 24 of sleeve 14. Collet 34 and sleeve 14 can assume this shown relative position only when sleeve 14 is in its top position relative to central core 12. At this time, further downward movement of collet 34 is prevented by shoulder 16 of central core 12. Also, at this time the collar 36 of collet 34 is positioned around the bottom section 32 of enlarged upper portion 28 of sleeve 14. It is seen that when the sleeve 14 and the collet 34 are in this relative position, the finger members 38 can once again be easily deflected radially inwardly, since the inwardly projecting nose portions 44 now pass beneath the bottom of the enlarged lower portion 24 of sleeve 14.

Sleeve 14 is usually secured in its bottom position relative to central core 12 by suitable frangible means

such as a shear pin, such as is shown in FIGS. 5 through 7 below, but for clarity of explanation, the shear pin is omitted from FIGS. 1, 3 and 4 since the purpose of these figures is to show the structure of latch 10 and the relative positions which can be assumed by central core 12, sleeve 14 and collet 34.

FIGS. 5, 6 and 7 illustrate the manner in which the latch 10 described above may be used to place a gas lift valve or the like in a side pocket mandrel in a oil or gas well, after which the latch 10 secures the valve in place and may subsequently be used to withdraw the valve when it is desired to do so. FIG. 5 shows the latch 10 secured to a gas lift valve 50 which is being placed into a receiver or valve seat 52 in a side pocket mandrel 54 in a gas or oil well and is to be retained therein by an arcuate locking shoulder 56. Such gas lift valves and their functions and such side pocket mandrels are well known to those skilled in the art. See, for example, U. S. Pat. No. 3,074,485, and particularly FIGS. 17 through 22 thereof for a description of such devices and the manners in which such gas lift valves may be placed into and retrieved from such side pocket mandrels using latch devices of the prior art such as was described above. Since the latch 10 of the present invention is functionally and structurally interchangeable with the prior art latch described above and with the latch shown in U. S. Pat. No. 3,074,485, the function of the devices and that portion of the operation are not described herein.

Continuing now the description of FIG. 5, the latch 10, and thus the gas lift valve 50, are secured to a conventional running tool 58 by shear pins 60 beneath the shoulder 62 on running head 20, all in the conventional manner. A shear pin 64, such as was described above, secures sleeve 14 in its bottom position relative to central core 12. As valve 50 is lowered into the valve seat 52, the nose portion 40 of finger members 38 comes into contact with the locking shoulder 56, and locking shoulder 56 raises the collet 34 into its first or top position, such as was shown and described in FIG. 1 above. As latch 10 and valve 50 are lowered further by running tool 58, the nose portion 40 of finger members 38 are deflected radially inwardly against the reduced outer diameter central portion 26 of sleeve 14, thereby allowing the nose portions 40 of finger members 38 to pass the locking shoulder 56.

As is shown in FIG. 6, once the latch 10 and valve 50 are lowered to a point that the nose portions 40 on the finger members 38 are beneath locking shoulder 56, the running tool 58 is pulled upward. As this occurs, the outwardly projecting portion 42 of nose portions 40 contacts the lower surface of locking shoulder 56, and collet 34 is slid axially downward relative to sleeve 14 (in fact, sleeve 14 is being pulled upward while collet 34 is being held stationary) until the bottom of nose portions 40 are contacted by shoulder 16 of central core 12, at which time the collet 34 is in its second or central position relative to sleeve 14, as was shown in FIG. 3 above. As further upward force is exerted by running tool 58, the lower shoulder surface of locking shoulder 56 attempts to deflect the nose portions 40 of finger 38 radially inwardly, but this deflection is prevented by the enlarged lower portion 24 of sleeve 14. Latch 10, and thus valve 50, are now locking in position, and further upward motion of running tool 58 causes shear pins 60 to shear, and the running tool 58

is withdrawn, leaving the latch 10 and valve 50 securely latched in position in side pocket mandrel 54.

FIG. 7 shows the manner in which the latch 10 and the valve 50 may be withdrawn, when desired. As shown therein, a pulling tool 66 of conventional design is lowered into the well and is secured beneath the pulling shoulder 68 on the upper part of sleeve 14, all in a conventional manner. As upward force is applied to pulling tool 66, shear pin 64 shears into three pieces, as is shown in FIG. 7, and pulling tool 66 lifts the sleeve 14 upwardly until internal shoulder 22 of sleeve 14 contacts the bottom shoulder 18 of running head 20. At this time, sleeve 14 is in its top position relative to central core 12, as was shown in FIG. 4 above.

Now, continued upward movement of pulling tool 66 causes the nose portion 40 of the finger members 38 to be deflected radially inwardly by locking shoulder 56. This radial inward movement is now possible since the sleeve 14 has been lifted, and the interior surfaces of nose portions 40 are no longer restrained by the enlarged lower portion 24 of sleeve 14. As the finger members 38 deflect radially inwardly, it is now possible for the latch 10 and the valve 50 to pass the locking shoulders 56 and be withdrawn in a conventional manner.

It is seen from FIG. 7 that, at this time, the collar 36 of collet 34 is surrounding the bottom section 32 of enlarged upper portion 28 of sleeve 14, which section has a slightly reduced outside diameter. This allows the entire collet 34 to tilt slightly to put the nose portions 40 under the enlarged lower portion 24 of sleeve 14. Thus, less actual deflection of finger members 38 is required, while collet 34 is still held in its desired position.

It is noted that, in effecting the operations of placing the latch and valve in position and withdrawing the latch and valve as is described in FIGS. 5, 6 and 7 immediately above, an operator on the surface need not know whether he is placing or retrieving a latch in accordance with the present invention or a prior art latch as is described above. As far as the operator is concerned, the operation is the same. He need not receive any special training to use the latch of the present invention nor is it necessary to keep records as to which wells contain the prior art latches and which wells contain the latches of the present invention. Further, the latch of the present invention overcomes the defects of the prior art latch described above. Shear pin 64 can easily be replaced on the surface, since no compression spring is used which might cause difficult positioning problems. Also, since the collet 34 does not depend in any way upon gravity when being positioned, the latch works equally well at all angles, vertical and non-vertical.

Another advantage of the latch of the present invention is that it can be used in applications in which the locking shoulder extends 360 degrees, or completely around the valve seat, since the nose portions 40 of all of the spring finger members 38 of collet 34 can be deflected radially inwardly simultaneously. In the prior art latch described above, since the locking ring had to be deflected laterally its use was limited to side pocket mandrels or the like which included an area of enlarged cross section so that the latch could still drop after the locking ring was deflected.

While the invention is thus disclosed and the presently preferred embodiment described in detail, it is not intended that the invention be limited to this shown

embodiment. Instead, many modifications will occur to those skilled in the art which lie within the spirit and scope of the invention. It is thus intended that the invention be limited in scope only by the appended claims.

What is claimed is:

1. A latch for securing a gas lift valve or the like in a valve seat which includes a locking shoulder which prevents said latch from being withdrawn after said valve is seated, said latch comprising, in combination:

a central core,

a latch sleeve slidably mounted on said core for axial movement relative to said core, said sleeve including an enlarged lower portion, a central portion having an outside diameter less than the outside diameter of said enlarged lower portion and an enlarged upper portion having an outside diameter greater than the outside diameter of said central portion,

upper and lower stop means for limiting the axial movement of said sleeve relative to said core between a first top position and a second bottom position, and

a collet slidably mounted on said sleeve for axial movement relative to said sleeve, said collet comprising a collar member surrounding said enlarged upper portion of said sleeve and a plurality of spring finger members projecting downwardly from said collar member, each of said finger members including an outwardly projecting nose portion at the end thereof, said collet being capable of axial movement relative to said sleeve from a first top position in which the ends of said finger members are on the level of said central portion of said sleeve to a second central position in which the ends of said finger members are on the level of said enlarged lower portion of said sleeve to a third bottom position in which the ends of said finger members are beneath said enlarged lower portion of said sleeve, whereby: (1) when said sleeve is in its second bottom position and said collet is in its first top position, said finger members can be deflected radially inwardly until said nose portions contact said central portion of said sleeve; (2) when said sleeve is in its second bottom position and said collet is in its second central position, said enlarged lower portion of said sleeve prevents inward radial deflection of said finger members; and (3) when said sleeve is in its first top position and said collet is in its third bottom position, said finger members can be deflected radially inwardly as said nose portions pass beneath said enlarged lower

portion of said sleeve.

2. The latch of claim 1 in which each of said finger members in said collet further including an inwardly projecting nose portion, in which the inside diameter of said inwardly projecting nose portion is substantially equal to the outside diameter of said enlarged lower portion of said sleeve when said spring finger members are relaxed.

3. The latch of claim 2 which further includes frangible means for securing said sleeve in its second bottom position relative to said central core.

4. The latch of claim 3 in which said frangible means comprises a shear pin securing said sleeve in its second bottom position relative to said central core.

5. The latch of claim 4 in which said lower stop means comprises a shoulder on said central core having a diameter greater than the outside diameter of said enlarged lower portion of said sleeve, whereby said shoulder also prevents axial movement of said collet into its third bottom position whenever said sleeve is in its second bottom position.

6. The latch of claim 5 in which said sleeve further included a shoulder positioned above its enlarged upper portion which stops upward movement of said collet relative to said sleeve beyond said first top position of said collet.

7. The latch of claim 6 in which said enlarged upper portion of said sleeve comprises a first top section which has an outside diameter slightly less than the inside diameter of the collar of said collet and a second bottom section which has an outside diameter less than the outside diameter of said first top section of said upper portion of said sleeve but greater than the outside diameter of said central portion of said sleeve, thereby facilitating inward radial deflection of said finger members when said sleeve is in its first top position and said collet is in its third bottom position.

8. The latch of claim 7 which further comprises a running head secured to the top of said central core and in which said upper stop means for limiting the axial movement of said sleeve relative to said core at said first top position comprises a shoulder around said running head having a diameter greater than the inside diameter of said sleeve.

9. The latch of claim 8 which further comprises fastening means for securing a gas lift valve or the like to said latch.

10. The latch of claim 9 in which said fastening means comprises an internally threaded aperture in the bottom of said latch.

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