

Oct. 14, 1952

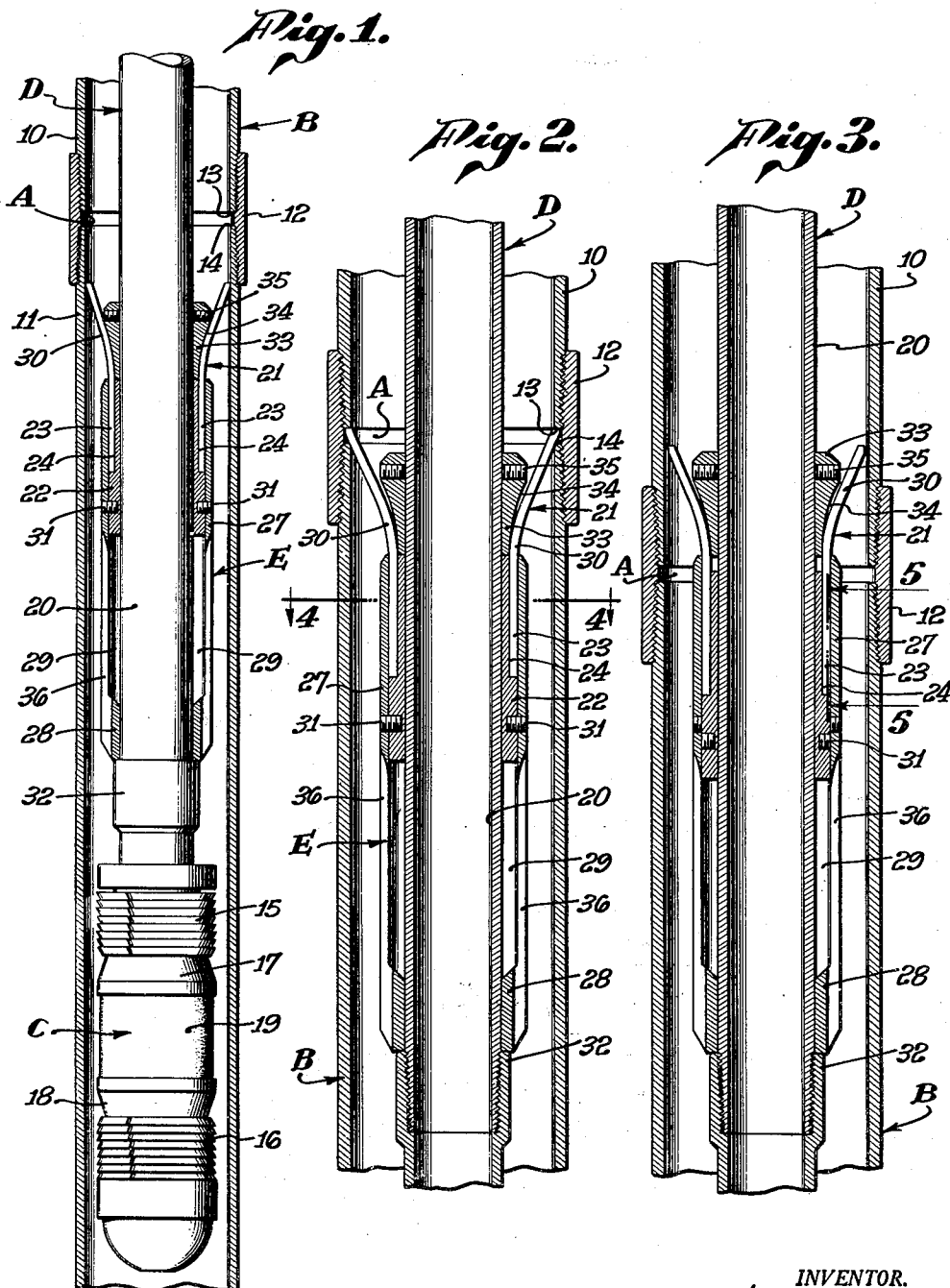
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2,613,746

COLLAR LOCATING AND TOOL OPERATING DEVICE

Filed April 23, 1948

3 Sheets-Sheet 1



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Fig. 4.

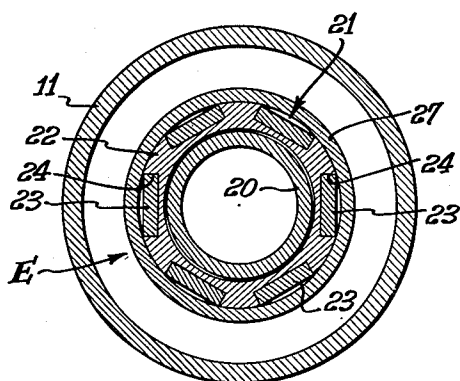


Fig. 5.

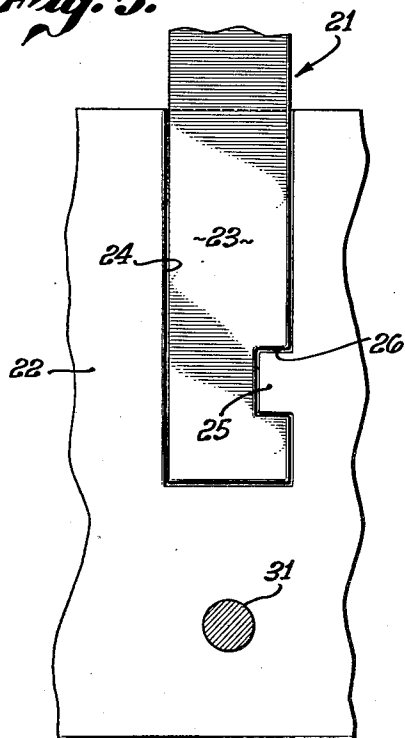
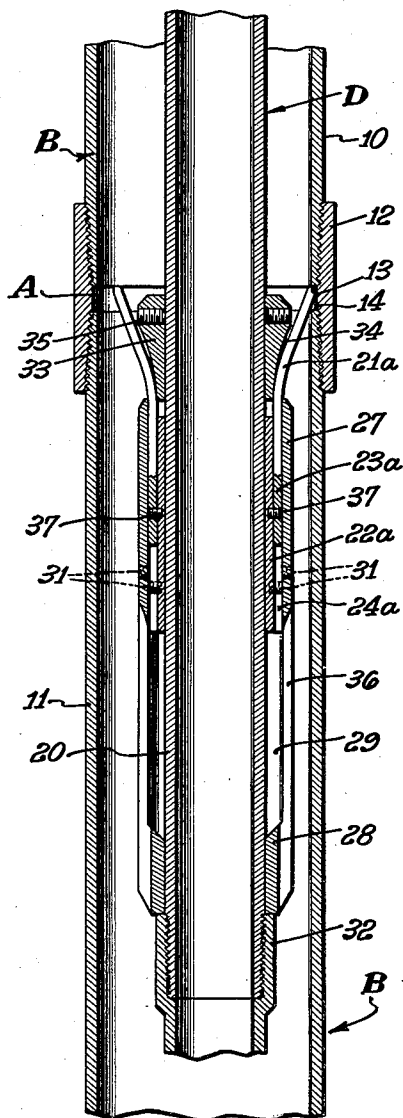


Fig. 6.



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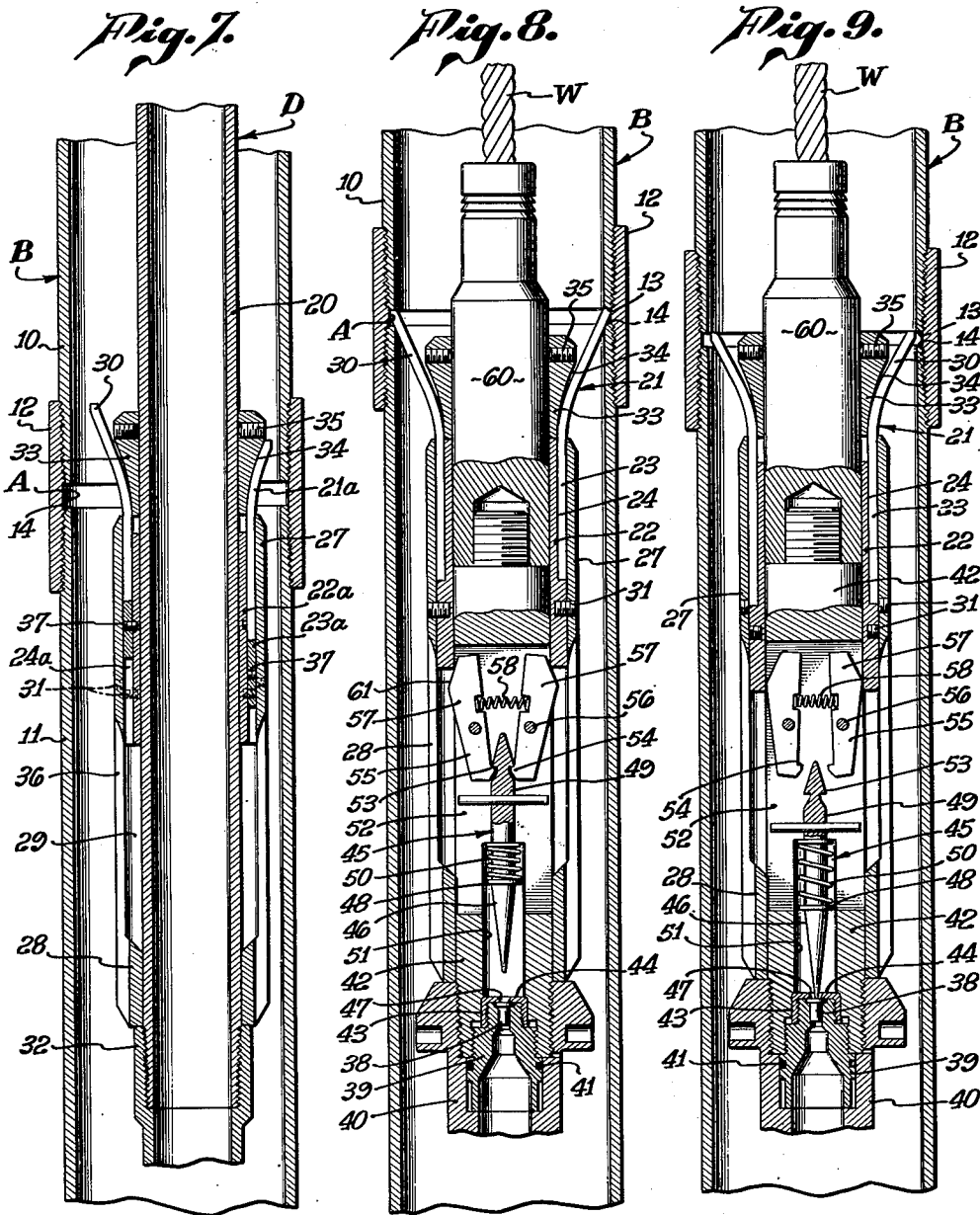
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3 Sheets-Sheet 3



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UNITED STATES PATENT OFFICE

2,613,746

COLLAR LOCATING AND TOOL OPERATING
DEVICE

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10 Claims. (Cl. 166—1)

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The present invention relates to well apparatus and, more particularly to apparatus for performing functions or operations in well casing, liners and similar conduits located in well bores.

Well conduits, such as casing strings, are usually composed of a plurality of sections coupled together by collars. At each coupling point, there is a space between the ends of adjacent casing sections. It is not desirable to operate certain well tools in the casings adjacent these spaces, since they might interfere with the proper functioning of the tools. As an example, the setting of a well packer across a casing coupling or collar space might prevent proper sealing of its packing element against the casing, with resultant leakage. The packer should be set preferably in the casing above or below the collar space.

The depth at which one type of sub-surface well equipment is to be operated must sometimes be related to the depth at which a prior operation, by other well equipment, had been performed. Reliance cannot be placed too strongly upon measurements of the length of running-in string as it is lowered in the hole, because of several variable factors, including the use of different running-in strings for different tools, stretch of the particular strings, their expansion or contraction as the result of well temperature, etc.

Accordingly, it is an object of the present invention to provide an improved device for furnishing a definite reference point in the well casing string by accurately locating a collar or coupling space, to which the setting or operating depths of sub-surface well equipment can be related.

Another object of the invention is to insure against setting or operating sub-surface well tools at the casing coupling spaces.

Another object of the invention is to provide for the definite location of a casing coupling space at any selected region along the length of the casing string.

A further object of the invention is to utilize a casing coupling space, or equivalent recess, in effecting the operation of sub-surface well apparatus.

A further object of the invention is to utilize a casing coupling space, without interfering with the operation of well equipment in the casing, and without preventing removal of the running-in string to the top of the well bore.

This invention possesses many other advantages, and has other objects which may be made more clearly apparent from a consideration of several forms in which it is embodied. These forms are shown in the drawings accompanying

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and forming part of the present specification. They will now be described in detail, illustrating the general principles of the invention; but it is to be understood that this detailed description is not to be taken in a limiting sense, since the scope of this invention is best defined by the appended claims.

Referring to the drawings:

Figure 1 is a longitudinal view, partly in elevation and partly in section, disclosing well equipment embodying the invention located in a string of casing;

Figure 2 is an enlarged longitudinal section through the collar locating device shown in Fig. 1, disclosed in its collar locating position.

Figure 3 is a view similar to Fig. 2, with the parts in another operating position;

Figure 4 is a cross-section taken along the line 4—4 on Fig. 2;

Figure 5 is an enlarged fragmentary side elevation, looking in the direction of the arrows 5 on Fig. 3, disclosing the manner of securing a locating spring on its mounting sleeve;

Figure 6 is a longitudinal section through another form of well casing and collar locating device, certain parts being shown in retracted position;

Figure 7 is a view similar to Fig. 6, with the parts occupying another relative position;

Figure 8 is a longitudinal section through a well casing containing another embodiment of the invention; and

Figure 9 is a view similar to Fig. 8, with the parts in another operative position.

As disclosed in Figs. 1 to 5, inclusive, it is desired to definitely locate a collar space A in a casing string B, in order that a well packer C can be set in packed-off condition below this space. The well packer C is run in the well casing on a tubular string D, which carries the collar locating apparatus E on it immediately, or at a predetermined distance above, the well packer C.

As is well known, the casing string B includes a plurality of casing sections 10, 11 threadedly secured in longitudinally spaced relation by a collar or coupling 12. The collar 12 and the adjacent ends 13, 14 of the upper and lower casing sections provide a circular internal groove, recess or space A. The lower end 13 of the upper casing section 10 provides a shoulder, which can be utilized in definitely locating the coupling recess or space A.

The particular tool secured to the lower end of the tubing string D is disclosed as a well packer C, which can be of any desired type. As shown in the drawings, the packer includes upper and

lower slips 15, 16 and associated expanders 17, 18 for moving the slips outwardly into firm anchoring engagement with the casing wall. A packing element 19 is also adapted to be expanded outwardly into firm sealing engagement with the casing wall. The specific construction and operation of the packer C is not essential to an understanding of the present invention. A full description of a packer of the type illustrated may be found in several United States patents, including Patent No. 2,204,648.

The main elements of the collar locating device C are mounted on a tubing section or nipple 20 forming part of the tubing string D. A plurality of locating members 21, in the form of leaf springs disposed circumferentially around the tubing, are secured to a sleeve 22 adapted for slidable movement along the exterior of the tubing nipple 20. The lower portion 23 of each spring is received within a longitudinal groove 24 in the sleeve 22 (see Fig. 5), movement of the spring relative to the sleeve being prevented by a lug or projection 25 extending from one side wall of the groove 24 into a notch or recess 26 formed in the spring 21.

The springs 21 are prevented from transverse movement outward of the sleeve 22 by a retaining and retracting sleeve 27 disposed over the spring sleeve 22 and the springs 21 themselves. This retaining sleeve extends downwardly along the tubing nipple 20 a substantial distance below the end of the spring sleeve 22. Its lower end is formed as a head 28 slidably mounted on the tubing nipple 20, while the portion of the sleeve above the head is spaced from the nipple 20 to form an elongate annular space 29 in which the spring sleeve 22 is received, and in which it may move relatively in a downward direction.

As stated above, the retainer sleeve 27 prevents the springs 21 from becoming disassembled from their mounting sleeve 22. The upper portions 30 of the springs are flared outwardly and tend inherently, when unconfined, to expand outwardly to a diameter greater than the inside diameter of the casing string B. That is, the upper ends of the springs tend inherently to move outwardly into the coupling space A when disposed in transverse alignment therewith. The ability of these springs 21 to expand outwardly to the extent indicated is permitted initially by allowing their upper portions 30 to project upwardly from the retainer sleeve 27 to a sufficient extent. The amount of such projection is assured initially by releasably attaching the sleeves 22, 27 together, as by use of frangible pins or shear screws 31 disposed below the lower ends of the springs 21.

The collar locator E is mounted on the nipple 20, with its head 28 engaging a collar or threaded box 32 on the tubing string below the nipple (Fig. 1). The shear screws 31 are intact, which permits the leaf springs 21 to project upwardly out of the retainer sleeve 27 to their maximum extent. Upward movement of the sleeves along the tubing nipple 20 may be prevented by a tapered stop member 33 whose outer surface 34 converges in a downward direction. This stop member is secured to the tubing nipple 20 by one or more headless screws 35, and may be positioned adjacent the upper end of the sleeve 22 when the head 28 is disposed adjacent the box 32. The tapered portion 34 of the stop member can also be effective in engaging the upper parts 30 of the springs 21 and urging them

outwardly against the wall of the well casing B.

With the parts assembled as disclosed in Figs. 1 and 2, the apparatus is lowered in the well casing on the tubular running-in string D until the appropriate setting depth for the packer C is reached immediately below a casing collar, such as the collar 12. During such lowering movement, the upper ends of the leaf springs 21 ride or slide along the casing wall and freely over the coupling spaces defined by adjacent casing sections. After reaching a position below one of the casing collars, with the well packer C disposed in the casing section below this collar, the tubing string D is elevated, the collar locator also being elevated by the engagement of the box or stop 32 with the head 28. Such upward movement slides the spring 21 along the wall of the lower casing section 11, until their free upper ends reach the collar space A. Those ends expand inherently into this space A and engage the lower end 13 of the upper casing section 10.

The operator at the top of the well bore is advised of the engagement of the springs 21 with the lower end 13 of the upper casing section 10, and of the location of the collar space A, by the resistance which the springs offer to further upward movement of the tubing string D. He can then make a suitable marking on the tubing string D above the usual rotary table of the depth of the collar space.

The shear screws 31 have a predetermined shear value. Accordingly, an upward strain of sufficient force can be taken on the tubing string D, the force being transmitted through the collar 32 to the retainer sleeve 27, shearing the screws 31 and moving the retainer sleeve 27 upwardly along the spring sleeve 22 and the springs 21 themselves. It is evident that the latter are incapable of moving upwardly by virtue of engagement of the springs with the shoulder or end 13 of the casing section 10. This upward movement of the retainer sleeve 27 causes the latter to force the springs 21 inwardly until they have been retracted from engagement with the casing end 13 and from the collar space or recess A (Fig. 3). The tubing string can now be moved freely upwardly without restraint by the locator members 21. Movement of the retainer sleeve 27 upwardly along the spring sleeve 22, or the relative movement of the spring sleeve downwardly within the annular space 29 between the retainer sleeve 27 and tubing nipple 20, can occur without interference by any fluid in the well casing, by providing a plurality of longitudinal slots 36 in the lower portion of the retainer sleeve through which the casing fluid can flow freely.

The well packer C can now be anchored in packed-off condition in the well casing in a normal and conventional manner. After the desired function has been performed with the well packer in the well bore, the tubing string D may be rotated to detach it from the anchored well packer, and the tubing string removed from the well casing without interference from the spring members 21. In the event that one or more of the spring members should enter a coupling space during its upward movement through the casing string B, the springs and their sleeve member 22 would be retracted automatically further into the retainer sleeve 27 and away from the casing wall.

A modified form of the invention is disclosed in Figs. 6 and 7. As has been stated above, the

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retracted spring members 21 may catch upon an upper coupling space during upward movement of the tubing string D therewithin. In the form of invention shown in Figs. 1 to 5, inclusive, such occurrence would merely further retract the springs within the retainer sleeve 27. In Figs. 6 and 7, the retraction could occur in a somewhat different manner.

The springs 21a are not fixed to their mounting sleeve 22a, but instead, have their lower portions 23a disposed within grooves 24a that may extend the full length of the sleeve 22a. These springs 21a are attached to their mounting sleeve by shear screws 31 which have a much greater shear value than the screws 31 securing the retainer sleeve 27 and spring sleeve 22a together initially. Accordingly, as the tubing string D is elevated, the spring members 21a will expand outwardly into the collar space A and engage the lower end 13 of the casing section 10, as before. The taking of a sufficient upward strain on the tubing string D will shear the screws 31 and cause the retainer sleeve 27 to retract the springs 21a, as before (see Fig. 6).

The force required to shear the screws 31 holding the springs to their mounting sleeve 22a is substantially greater than the force required to shear the other screws 31, and, as a result, the spring shear screws 31 will remain intact during the foregoing operation. However, if the springs are not further retracted within the retainer sleeve 27, upon the subsequent engagement by one of the partially retracted springs 21a with a casing shoulder 13 in an upper part of the casing string B, the exertion of sufficient force will shear the screw 31 holding that particular spring to its sleeve 22a and move such spring relatively downwardly within its groove 24a, causing the upper end of the retainer sleeve 27 to retract such spring to a greater extent from the casing (see Fig. 7). The tubing string D can now continue its upward movement within the well casing B without interference.

The apparatus described above can be used not only for locating a coupling space A, or other recess in the casing string B, but also for effecting operation of well equipment. By way of example, the collar locator E shown in Figs. 8 and 9 is employed in firing a cartridge 38 and producing an explosion that can initiate the operation of other well equipment (not shown).

The cartridge 38 is contained within a gun barrel 39 inserted within the upper head end 40 of a cylinder in which a gaseous pressure may be developed for setting a bridge plug (not shown). Leakage between the barrel 39 and head 40 is prevented by a suitable side seal 41 on the barrel engaging the wall of the head. The barrel is threaded into a gun body 42 secured to the upper end of the cylinder head 40. This body also contains a breechblock or cap 43 threaded on to the upper end of the barrel and having an inwardly directed flange 44 firmly clamping the cap of the cartridge 38 to the barrel 39.

The cartridge 38 is fired by a pin 45 whose tapered end 46 can enter a tapered hole 47 in the breechblock 43 to strike and indent the cartridge 38 to effect its firing. As indicated above, firing of the cartridge can initiate certain other desirable operations in the well casing.

The tapered lower end 46 of the firing pin extends downwardly from a flange or spring seat 48 integral with the firing pin shaft 49, all of

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these elements being disposed within the gun body 42. A compressed, helical spring 50 is placed between the seat 48 and the upper end of the central bore 51 through the body, this spring exerting sufficient force to shift the pin 45 downwardly and strike its end against the cartridge 38, in order to fire the cartridge.

The shaft 49 of the pin extends upwardly through an elongate transverse slot 52 within the body 42. The upper end of the shaft is formed with a pair of wings or hooks 53 adapted to be engaged by inner latch fingers 54 on the lower ends of latch levers 55 disposed in the body slot 52 and pivotally mounted on pins 56 supported in the body. The upper arms 57 of the levers are urged in an outward direction, to maintain the latch fingers 54 engaged under the firing pin hooks 53, by an expansible spring 58 whose opposite ends are received within recesses 59 in the arms 57. So long as the spring 58 holds the upper lever arms outwardly and the latch fingers 54 under the firing pin hooks 53, the firing pin 45 is maintained in elevated position above the cartridge, holding the firing spring 50 in highly compressed condition.

The apparatus may be lowered in the well bore on a running-in string, which may include a wire line W secured to a socket 60 threaded on the upper end of the gun body 42. The collar locator E, which may assume the specific form disclosed in Figs. 1 to 5, inclusive, is slidably mounted on the gun body 42 and socket 60, the lower head 28 of the retainer sleeve 27 resting upon the cylinder 40, and the lower end of the spring sleeve 22 being disposed immediately above the upwardly and inwardly tapering surfaces 61 of the latch lever arms 57. The tapered stop 33 is secured to the wire line socket 60 by the set screws 35 (see Fig. 8).

The apparatus is run in the well casing B, with the latch levers 55 holding the firing pin 45 in elevated position against the compression spring 50. The shear screws 31 secure the sleeves 27, 22 together, which permits the upper portions 30 of the locator springs 21 to expand outwardly to their fullest extent. When the approximate point in the well bore has been reached at which the cartridge 38 is to be fired and the well tool (not shown) operated, the wire line W is moved upwardly slowly until the springs 21 expand outwardly into the first collar space A they reach, which arrests further upward movement of the wire line W and the well apparatus attached to it. The operator at the top of the well bore is thus advised of the location of the well collar.

A strain is then taken on the wire line W, which is transmitted through the socket 60, gun body 42 and cylinder 40 to the retainer sleeve 27, shearing the screws 31 and moving the gun body 42 and sleeve 27 upwardly to a slight extent relative to the spring sleeve 22. The tapered surfaces 61 on the upper latch lever arms are caused to ride upwardly along the lower end of the sleeve 22, forcing the upper arms 57 inwardly and the fingers 54 outwardly of the firing pin hooks 53, which releases the firing pin 45 from the latches and allows the spring 50 to shift the firing pin downwardly in a rapid manner, indenting the cartridge 38 and effecting firing of the latter (Fig. 9).

The firing of the cartridge initiates certain operations in the well bore, such as the setting of a well packer secured to the cylinder 40. This packer would be set in the casing section between the upper and lower collars threaded on it.

When the apparatus is to be removed from the

well casing, the wire line W is moved upwardly, which causes the retainer sleeve 27 to shift up along the springs 21 and spring sleeve 22 to a further extent, retracting the upper portions of the springs completely from the collar space A and enabling the running-in string W and apparatus to be moved without restraint from the casing string B, in the same manner as removal is effected of the equipment described in the other forms of the invention.

It is, accordingly, apparent that apparatus has been described which definitely locates the desired coupling space in the well casing string, thereby providing a definite reference point for the setting or operating of the well equipment run in the well casing in conjunction with the locating device. The same, or similar, casing locating equipment can be utilized in the subsequent running of tools in the well casing. Assurance is, therefore, had against setting or operating the sub-surface apparatus at the casing coupling spaces themselves. The locating device can not only be used for the purpose of providing a definite reference point in the well casing for the operation of equipment, but it can also be used in actually operating such equipment. Moreover, despite its positive locating of the coupling space, the locating apparatus is readily removable from the casing string whenever desired.

The inventor claims:

1. In apparatus adapted to be run in a well casing having a recess therein: a member adapted to be lowered in said casing; a sleeve on said member; leaf springs on said sleeve expandible into said recess; a retaining sleeve disposable over said springs and first-mentioned sleeve and movable by said member along said springs to retract them from said recess upon longitudinal movement of said member relative to said first-mentioned sleeve; and yieldable means mounting said springs individually on said first-mentioned sleeve for longitudinal movement relative to each other and to said first-mentioned sleeve.

2. In apparatus adapted to be run in a well casing having a recess therein: a member adapted to be lowered in said casing; a sleeve on said member; leaf springs on said sleeve expandible into said recess; a retaining sleeve disposable over said springs and first-mentioned sleeve and movable by said member along said springs to retract them from said recess upon longitudinal movement of said member relative to said first-mentioned sleeve; frangible means securing said springs to said first-mentioned sleeve; and frangible means securing said sleeves together.

3. In apparatus adapted to be run in a well casing having a recess therein: a member adapted to be lowered in said casing; a sleeve on said member; outwardly bowed leaf springs on said sleeve expandible into said recess; a retaining sleeve disposed snugly over said springs and first-mentioned sleeve and movable along said springs to retract them from said recess upon longitudinal movement of said member in one direction; means preventing substantial longitudinal movement of said springs with respect to one of said sleeves; and means releasably securing said sleeves directly together, said means being releasable after entry of said springs in said recess.

4. In apparatus adapted to be run in a well casing having a recess therein: a member adapted to be lowered in said casing; a sleeve on said member; outwardly bowed leaf springs

on said sleeve expandible into said recess; means on said member engageable with said springs to urge them outwardly; a retaining sleeve disposed over said springs and first-mentioned sleeve and movable along said springs to retract them from said recess upon longitudinal movement of said member in one direction; means preventing substantial longitudinal movement of said springs with respect to one of said sleeves; and means releasably securing said sleeves together, said releasable means being releasable after entry of said springs in said recess.

5. In apparatus adapted to be run in a well casing having a recess therein: a member adapted to be lowered in said casing; a sleeve on said member; outwardly bowed leaf springs on said sleeve expandible into said recess; a retaining sleeve disposed snugly over said springs and first-mentioned sleeve and movable along said springs to retract them from said recess upon longitudinal movement of said member in one direction; means preventing substantial longitudinal movement of said springs with respect to one of said sleeves; and frangible means directly securing said sleeves together to prevent initially their relative longitudinal movement.

6. In apparatus adapted to be run in a well casing having a recess therein: a member adapted to be lowered in said casing; a sleeve on said member having circumferentially spaced longitudinally extending grooves; outwardly bowed leaf springs in said grooves and expandible into said recess; a retaining sleeve disposed snugly over said first-mentioned sleeve, grooves and springs and movable along said springs to retract them from said recess upon longitudinal movement of said member in one direction; means preventing substantial longitudinal movement of said springs with respect to one of said sleeves; and means releasably securing said sleeves together to initially prevent such movement of the retaining sleeve along the springs.

7. In apparatus adapted to be run in a well casing having a recess therein: a member adapted to be lowered in said casing; a sleeve on said member having circumferentially spaced longitudinally extending grooves; outwardly bowed leaf springs in said grooves and expandible into said recess; means securing said springs to said sleeve; a retaining sleeve disposed snugly over said first-mentioned sleeve, grooves and springs and movable along said springs to retract them from said recess upon longitudinal movement of said member in one direction; and means releasably securing said sleeves together to initially prevent such movement of the retaining sleeve along the springs.

8. In apparatus adapted to be run in a well casing having a recess therein: a member adapted to be lowered in said casing; a sleeve on said member having circumferentially spaced longitudinally extending grooves; outwardly bowed leaf springs in said grooves and expandible into said recess; frangible means releasably securing said springs individually to said sleeve; a retaining sleeve disposed over said first-mentioned sleeve, grooves and springs and movable along said springs to retract them from said recess upon longitudinal movement of said member in one direction; and means releasably securing said sleeves together to initially prevent such movement of the retaining sleeve along the springs.

9. In apparatus adapted to be run in a well casing having a recess therein: a member

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adapted to be lowered in said casing; a sleeve on said member having circumferentially spaced longitudinally extending grooves; outwardly bowed leaf springs in said grooves and expandible into said recess; a retaining sleeve disposed over said first-mentioned sleeve, grooves and springs and movable along said springs to retract them from said recess upon longitudinal movement of said member in one direction; means preventing substantial longitudinal movement of said springs with respect to one of said sleeves; and frangible means releasably securing said sleeves together to initially prevent such movement of the retaining sleeve along the springs.

10. In apparatus adapted to be run in a well casing having a recess therein: a member adapted to be lowered in said casing; a sleeve on said member having circumferentially spaced longitudinally extending grooves; outwardly bowed leaf springs in said grooves and expandible into said recess; frangible means releasably securing said springs individually to said sleeve; a retaining sleeve disposed over said first-men-

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tioned sleeve, grooves and springs and movable along said springs to retract them from said recess upon longitudinal movement of said member in one direction; and frangible means releasably securing said sleeves together to initially prevent such movement of the retaining sleeve along the springs; said last-mentioned frangible means having a combined shear value substantially less than the combined shear value of said first-mentioned frangible means.

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