March 28, 1961 D. E. DAFFIN 2,976,931

WELL CONNECTOR DEVICE

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Fig. 1

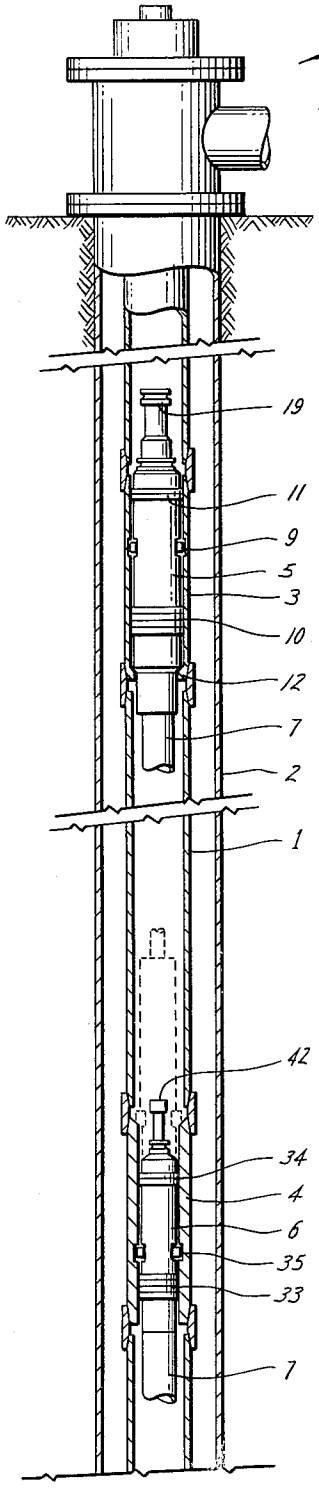
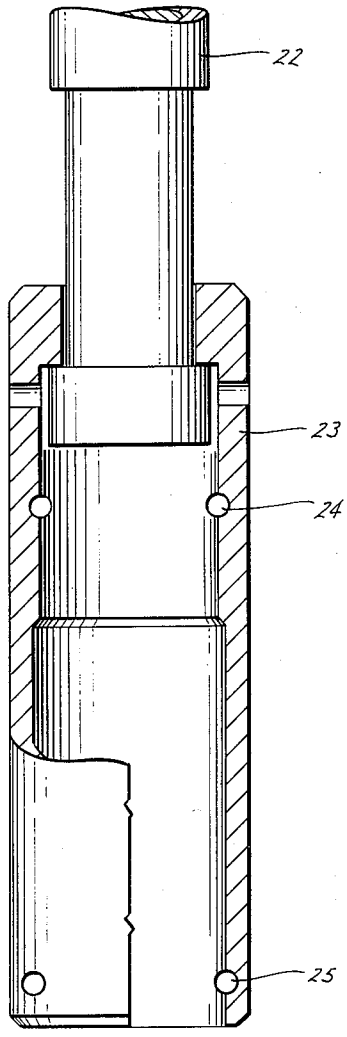


Fig. 5



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Fig. 2

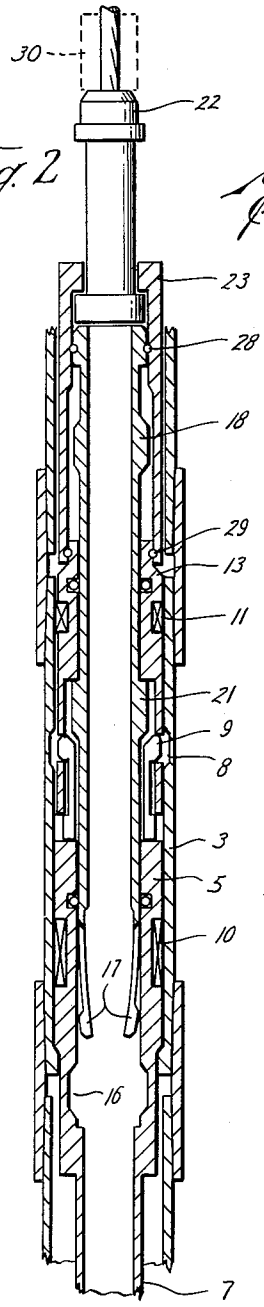


Fig. 3

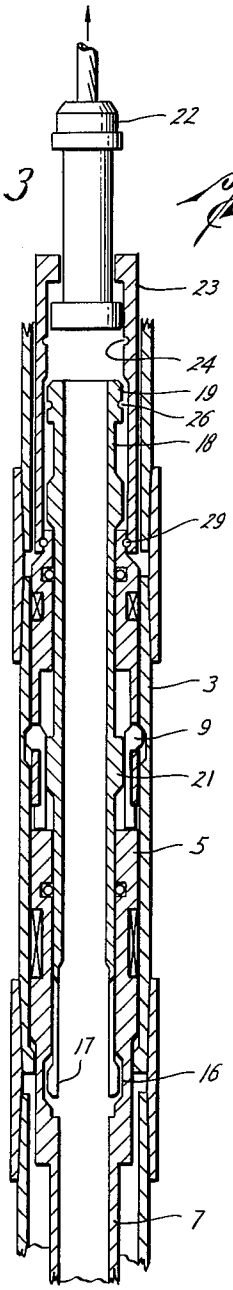
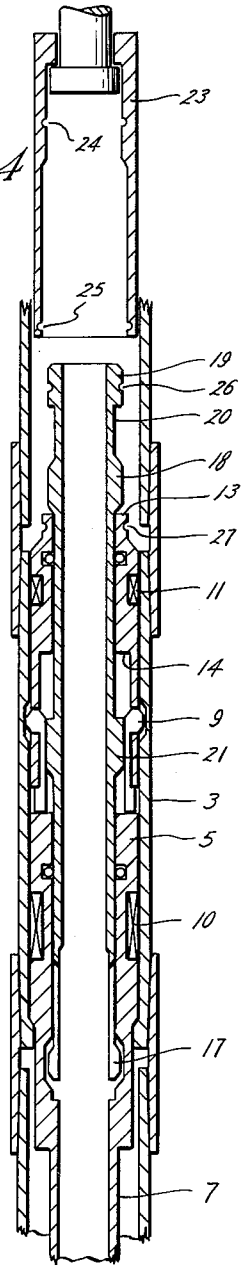


Fig. 4



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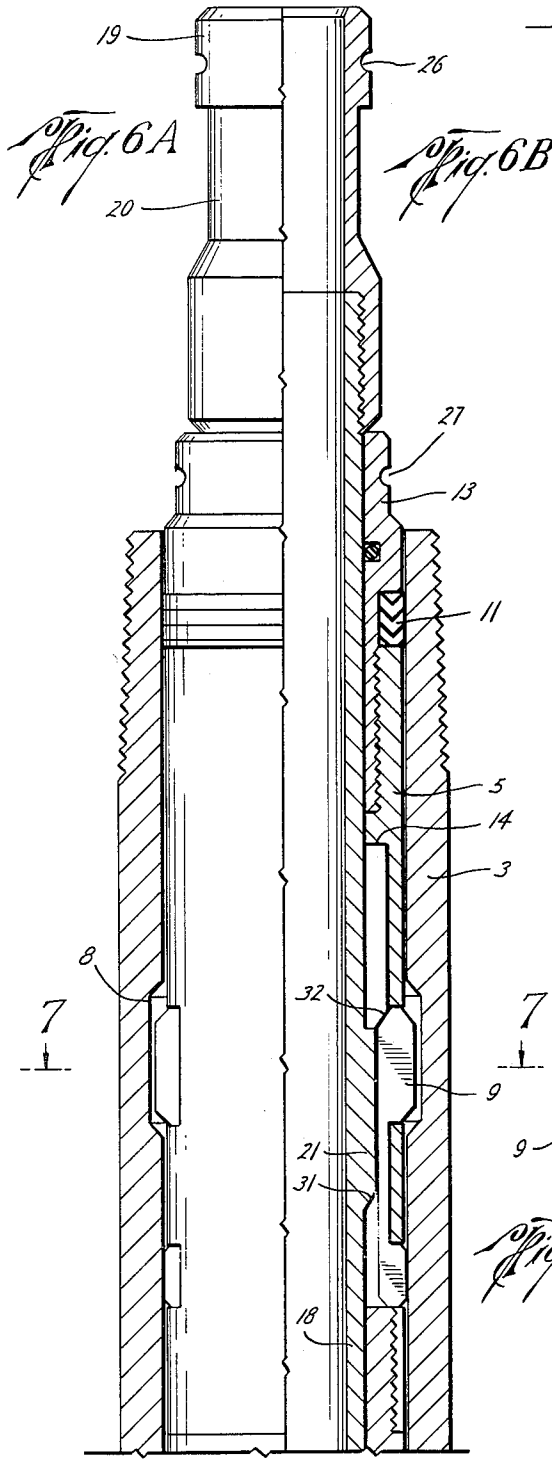


Fig. 6A

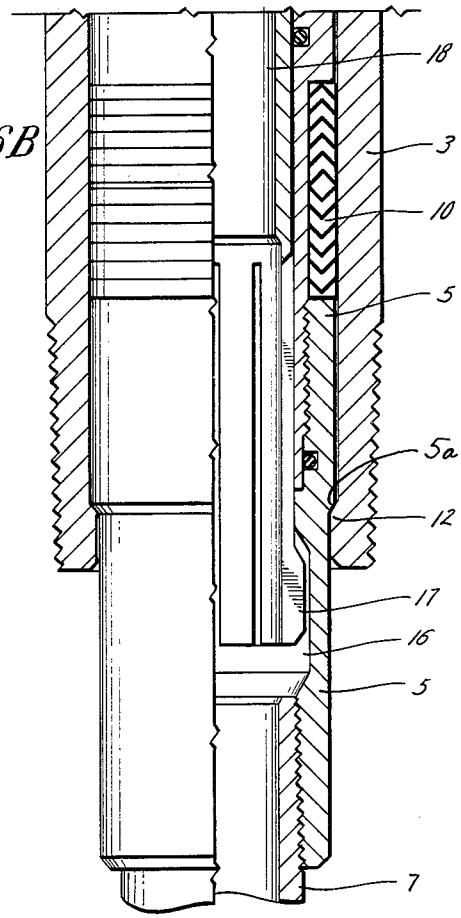


Fig. 6B

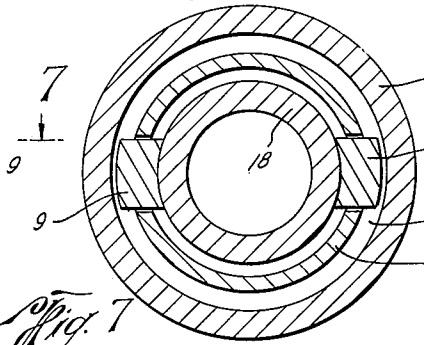


Fig. 7

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Fig. 8A

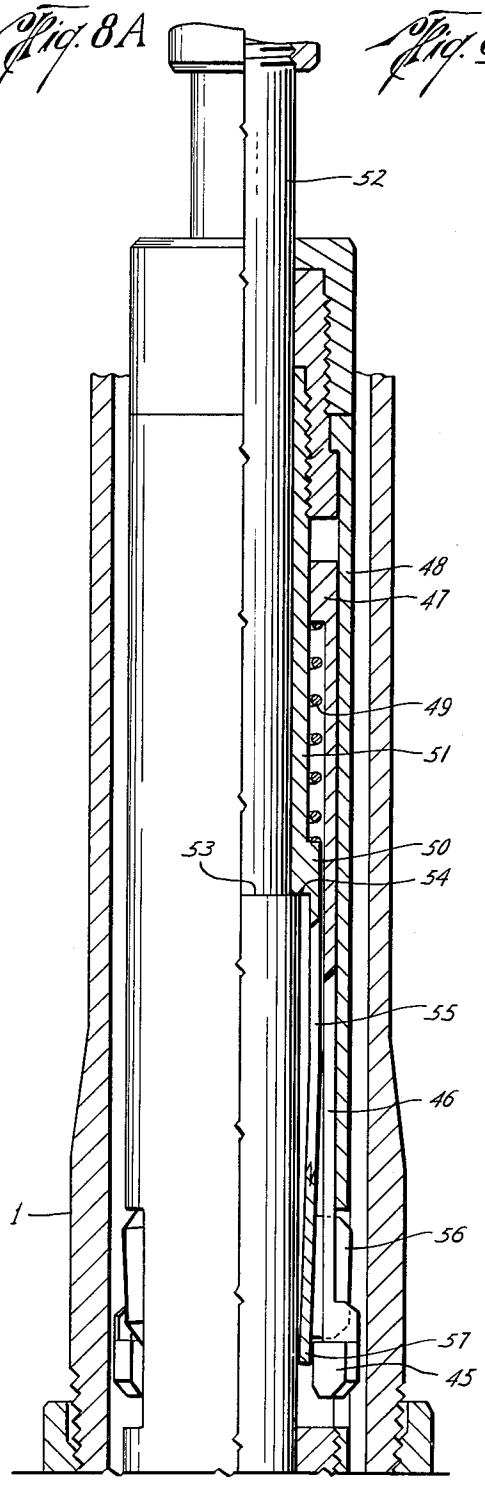
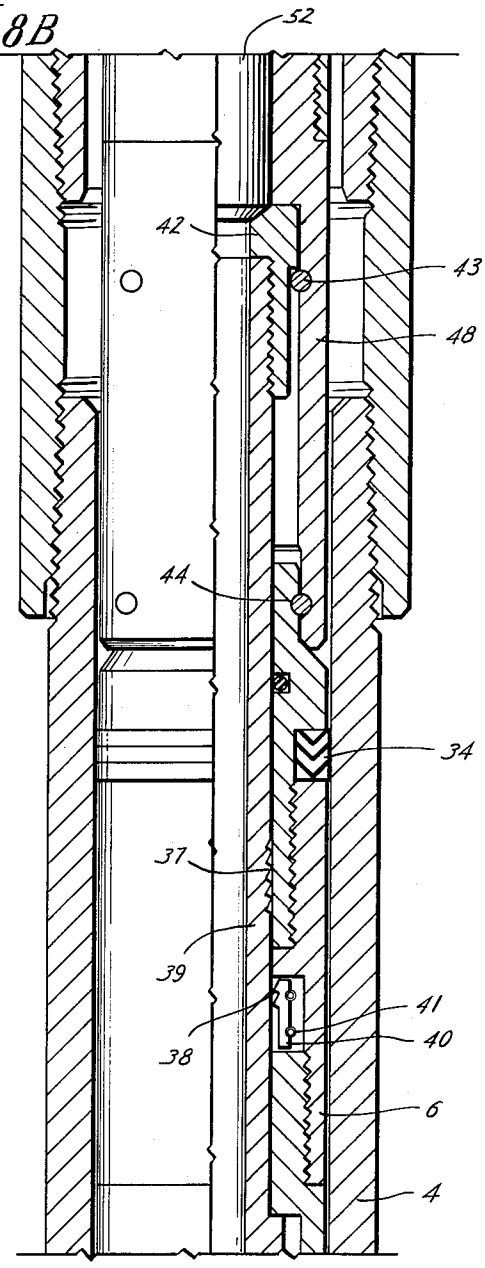


Fig. 8B



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Fig. 8C

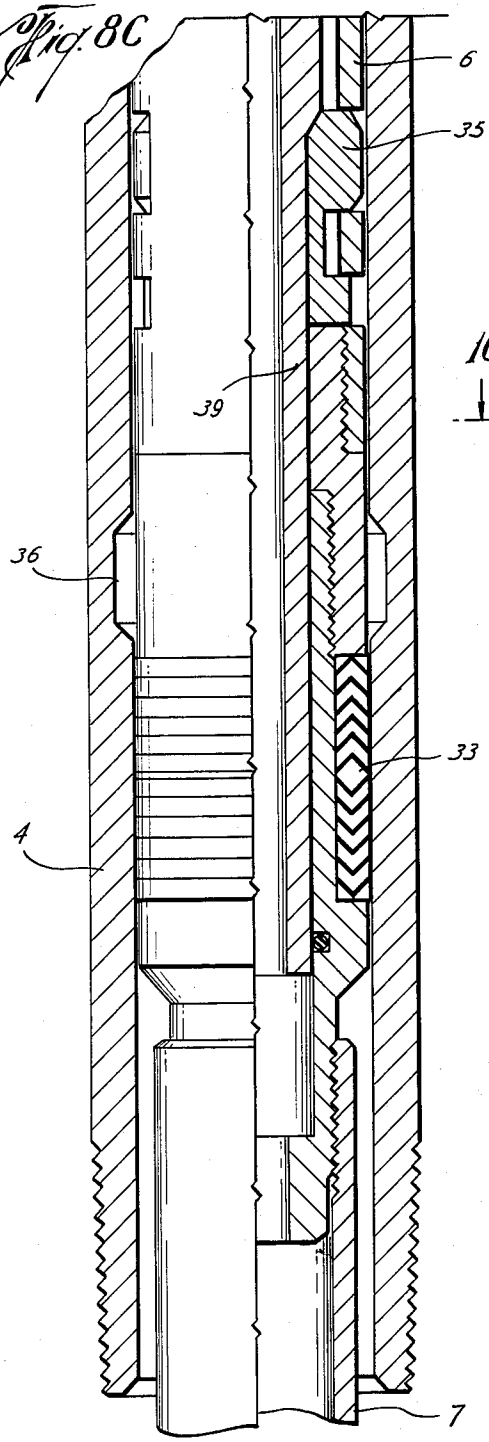


Fig. 9

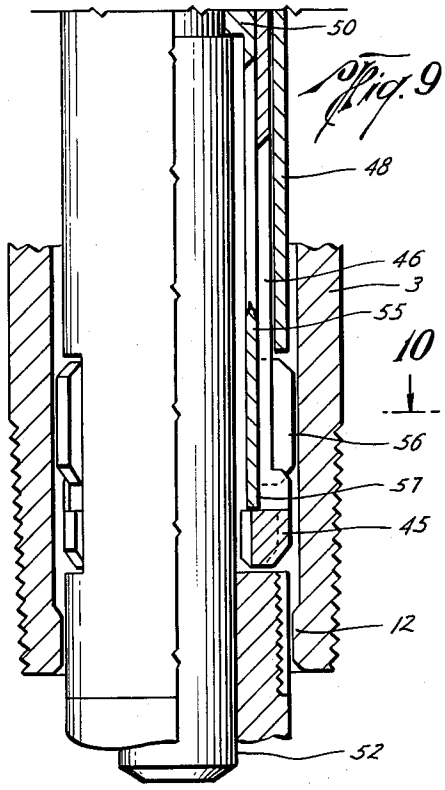
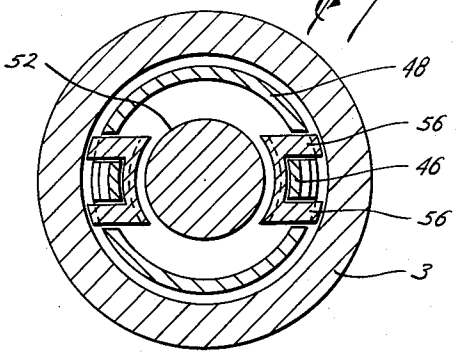


Fig. 10



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Fig. 11

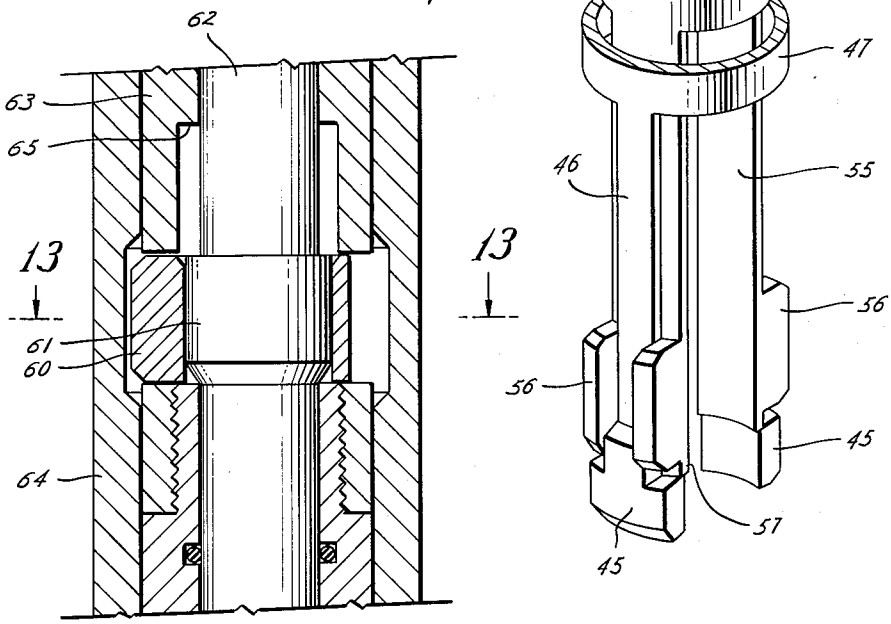


Fig. 12

Fig. 13

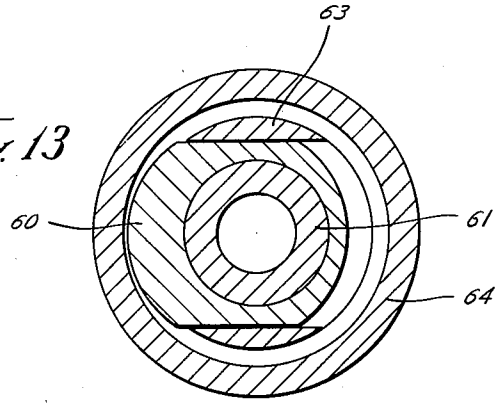
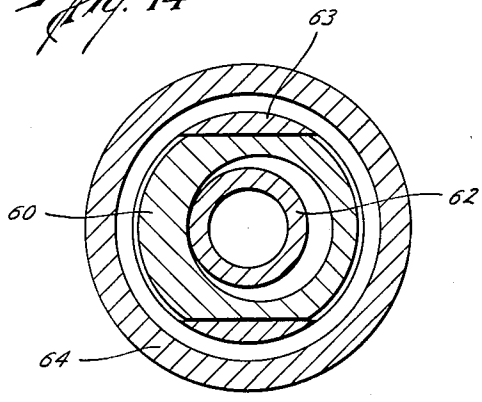


Fig. 14



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United States Patent Office 2,976,931 Patented Mar. 28, 1961

2,976,931

WELL CONNECTOR DEVICE

Douglas E. Daffin, Pasadena, Tex., assignor to Camco, Incorporated, Houston, Tex., a corporation of Texas

Filed Feb. 20, 1956, Ser. No. 566,646

5 Claims. (Cl. 166—125)

This invention relates to the mounting in oil and gas wells of well working and fluid production control devices, and more particularly to improved tool supports which can be easily and quickly installed and securely latched in place and which can be readily unlatched and removed from the well.

An object of the invention is to provide a simple and inexpensive tool support adapted to be lowered or run into a well and to be raised or pulled from a well on the end of a wire line and provided with telescopically fitted parts which can be actuated to latch and unlatch the support assembly in a special tubing string nipple or support receiver.

A further object of the invention is to provide an improved tool support having relatively movable parts which upon being actuated into nipple latched relation are securely clutched against release actuation until such time as a wire line pulling device is coupled to the support and applies a lifting force in the operation of retrieving the tool support.

Another object of the invention is to provide an arrangement in which retrievable tool supports can be selectively installed in either or both of a pair of special tubing string nipples positioned at predetermined depths and wherein the landing nipples co-operate with retractable-projectable landing detents on a lowering device for the lowermost tool support in a manner that downward passage of the lowering device through the uppermost nipple causes the detents to be projected radially outwardly and locked as locating abutments to finally land on the lowermost nipple and assist the operation of latching the tool support in the nipple and also that upward return passage of the lowering device through the uppermost nipple unlocks the previously projected detents and restores them to original positions.

Additional objects and advantages of the invention will become apparent during the course of the following specification having reference to the accompanying drawings, wherein Figure 1 is a vertical sectional view of a fragment of a well installation with a pair of vertically spaced apart tool supports in anchored positions; Figs. 2, 3, and 4 are vertical sectional views at the upper landing nipple and respectively illustrating the relation of the parts as the tool support is being run in and just before it is anchored in the landing nipple, the position of the parts in anchored relation but with the body still connected with the running tool and the position of the parts after both running tool suspension connections have been released; Fig. 5 is a vertical section on a larger scale of the running tool for the uppermost tool support; Figs. 6A and 6B are upper and lower companion sections showing the relation of the parts illustrated in Fig. 4 but on a larger scale; Fig. 7 is a transverse section on line 7—7 of Fig. 6A; Figs. 8A, 8B, and 8C are upper, intermediate, and lower companion views of a running tool and the tool support assembly for fitment in the lower nipple and in a relation just ahead of the landing position; Fig. 9 is a fragmentary elevation of the landing tool of Fig. 8A

with the landing dogs held in retracted position just prior to downward passage through the restricted throat of the upper nipple; Fig. 10 is a transverse section on line 10—10 of Fig. 9; Fig. 11 is a detail perspective view of the landing dog structure; Fig. 12 is a fragmentary vertical section illustrating a modified form of latch for the tool support body; Fig. 13 is a transverse section on line 13—13 of Fig. 12; and Fig. 14 is a transverse section similar to Fig. 13 but showing the latch retracted.

Referring to Fig. 1, the inner tubing and the outer casing strings of a well are indicated by reference numerals 1 and 2. Between certain joints and at selected levels in the tube string 1 are an upper nipple 3 and a lower nipple 4, in which are located support bodies 5 and 6 respectively, each suspending within the tubing a well tool generally indicated at 7 and which may be a tubing extension string or any of a variety of conventional chokes, valves or other devices commonly employed in oil field work. Both of the supports can be used concurrently, or either may be used alone in a given well according to predeterminable conditions. Furthermore, other tool support locating nipples may be installed above the illustrated upper nipple 3.

The uppermost nipple 3 is provided intermediate its opposite ends with an internal annular notch 8 for reception of a pair of diametrically opposite latch dogs 9 carried by the support body 5. The landing nipple 3 has an internal diameter generally corresponding with the internal diameter of the tubing string joints, and the outside diameter of the tool support body 5 is only slightly less than that of the nipple 3 for a fairly close fit thereto. For wiping the nipple surface clear of sand or dirty material and to minimize clogging of the internal cavities and fouling of latch dog operation, it is proposed to mount wiper rings 10 and 11 on the body 5 above and below the window openings for the latch dogs. Near its lower end the support body 5 has a landing seat or peripheral shoulder 5*a* to engage and seat on an internal annular shoulder formation 12 on the lower end of the nipple 3.

Referring more particularly to the enlarged detail views Figs. 6A and 6B, it will be seen that the tool support body 5 is formed for convenience of assembly of a number of tube or sleevelike parts threaded together in end to end succession, and has at its upper end a suspension head 13 and also an intermediate internal cavity terminating at its upper end in a pickup shoulder 14 and having through the wall thereof at diametrically opposite positions two pairs of vertically spaced windows to slidably receive and locate the upper and lower arms of C-shape latching dogs 9. The axial spacing between the windows and the seating shoulder 5*a* of the tubular support body 5 corresponds with the distance between the keeper notch 8 and the landing seat 12 of the nipple 3 whereby when the tool is landed in the nipple the latch dog windows and the keeper notch are in lateral alignment. Near its lower end and just above its threaded suspension connection with a tool 7, the support body 5 has an internal annular recess 16 for releasably pocketing a circular series of latch lugs 17 formed on a series of outwardly distending spring fingers which depend from and which may be formed as integral parts of a central plunger 18 slidably projecting through the body 5 and terminating at its upper end above the body suspension connecting head 13, in a connecting head 19 having a reduced diameter neck 20 therebelow. Within the internal cavity below the pickup shoulder 14 of the body 5, the slide plunger 18 has an annular enlargement or camming formation 21 whose exterior diameter is such that when it is moved behind the latching dogs 9 it holds them in projected position in which the longer upper arm of each dog has a radial dimension combined with formation

21, which exceeds the internal radius of the nipple 3 so that with the dogs aligned with the latching notch 8, they will project into the notch and anchor the body and tool assembly against relative axial movement. In the latch dog projected position, the spring lugs 17 at the bottom of the plunger will have snapped into the annular notches 16 and will serve to resist accidental displacement of the plunger 18 axially relative to the body 5. The height of the cam formation 21 is such that when the central plunger is elevated and the cam formation moves out of alignment with the latching dogs, the dogs can move inwardly so as to be wholly within the internal diameter of the nipple 3. In such elevated position the flat shoulder at the upper end of the cam formation 21 will engage with the pickup shoulder 14, and if in this relation of parts a wire line is in suspension connection with the plunger, the stop shoulder engagement will hold the parts against further relative axial travel.

Referring now to the running-in tool shown in Fig. 5, this comprises merely a pair of nested parts having limited lost motion connection between them and one of the parts is a stem or plunger 22 arranged to be fixed to the lower end of a wire line or the like and it terminates at its lower end in a necked portion on which is slidable a reduced diameter upper end of a sleeve 23 for releasable connection with both the body 5 and the plunger 18 of the tool support. As shown in Fig. 5, the sleeve 23 has two vertically spaced apart sets 24 and 25 of two holes each extending transversely and in tangential relation to the interior surface of the sleeve 23. These holes are for the reception of shear pins, and the shear pins which are placed in the holes 24 and 25 will also extend into half-round notches 26 and 27 respectively in the plunger head 19 and body head 13, and which notches are best seen in Fig. 6A. Fig. 2 shows the upper and lower shear pins 28 and 29 in position to serve as releasable connections whereby both the plunger and the support body are fixedly suspended from the wire line with the latch parts retracted and the sliding plunger in its fully projected uppermost position in which its head 19 is immediately below the plunger 22 of the running-in tool. This relation of the parts is established on the ground and before the tool is run into position and obtains until the body 5 is lowered into the nipple 3 and lands on the bottom shoulder 12 of the nipple with the projectable latching dogs 9 in alignment with the latch receiving notch 8. In this relation of the parts, a jarring force applied through the plunger 22, as by means of a drop weight, shown schematically at 30 at the top of Fig. 2, will tend to push downwardly on the plunger 18 after first shearing the pins 28. That transmission of force will in no way impose a shearing action on the suspension pins 29, which thereafter continue to connect the body 5 with the running tool. As the plunger 22 is lowered by slack in the cable, the slide plunger 18 moves downwardly until the upwardly and outwardly inclined cam face 31 at the bottom of the cam formation 21 comes into engagement with the upwardly and outwardly inclined cam face 32 of the latch dog 9 for projecting the dog into the latch notch 8. Further downward movement of the plunger 18 brings the cam formation 21 solidly behind the projected latch dog and holds it against depression until the bottom of travel is reached, in which the snap lugs 17 project themselves into the latching notches 16. If this latching operation has proceeded normally, then the tool support and the tool assembled at the lower end thereof will have been landed and locked securely in position and thereafter an upward pull on the wire line will effect a shearing of the pin connection 29 between the running tool and the support body 5 and the running tool can be raised out of the well (Fig. 4). On the other hand, if for any reason a secure locking was not effected, then the upward pulling force on the wire line will not be resisted by the unsecured body 5 and the shear pin connection 29 will elevate the body with the running tool back to the surface.

With the parts set in the positions indicated in Figs. 4 and 6A, the time eventually will come when it is desired to retrieve the well tool, and for this purpose a conventional pulling tool having spring pressed clutching jaws can be lowered until the spring jaws or fingers expand and pass over the enlarged head 19 and snap into the necked portion 20 of the plunger or inner member 18. Thereupon upward pull of the wire line will be transmitted into the underside of the head 19, and with the projected latches securely holding in the landing nipple 3, the central plunger 18 will be raised relative to the outer member or tool supporting body 5, to break the spring lugs 17 out of their retaining pocket 16 and move the limit stop formation 21 upwardly from behind the projected dogs 9 until its upper shoulder seats against the internal suspension shoulder 14 of the body 5 and thereafter to carry the entire assembly bodily upwardly with the wire line.

The lower nipple 4, as best seen in Fig. 1, has an internal diameter substantially corresponding with that of the restricted throat through the internal landing shoulder 12 of the upper landing nipple 3, and the outside diameter of the lower tool support or tubular body 6 is such as to pass through the restricted throat and to fit with minimum clearance within the lower nipple 4. The support 6 is provided with annular wipers 33 and 34 above and below the windows for the projectable dogs 35 which are for latch reception within an annular notch 36 intermediate the ends of the nipple 4. When locked in projected position, the upper and lower edges of the latch dogs 35 cooperate with the upper and lower seating faces of the notch 36 as the sole means to preclude displacement of the tool support assembly upwardly and downwardly.

The interior structure of the tool support 6 may correspond substantially with that previously described in connection with the upper tool support. In place of the spring pressed latching lugs 17, shown in Fig. 6B, there may be employed an alternative disconnectible latch in the form of co-operating ratcheting teeth 37 and 38 formed respectively on the slide plunger or inner core 39 and on an expendable arcuate segment 40 replaceably carried in an internal pocket of the tubular support body 6. The receiving pocket preferably is an annular groove within which will be located about four arcuate segments 40 surrounded by a pair of contractile C or split spring rings 41 which yieldably crowd or bias the segments 40 inwardly against the inner slide core. The segments, or at least the ratchet tooth formations 38 thereon, will be formed of a relatively soft shearable material such as brass or aluminum, whereas the co-operating ratchet teeth 37 are permanently formed in the plunger 39, which will be of hard steel. In the relative descent of the plunger core 39 and after the latches 35 have been projected into locking relation, the ratcheting teeth will have come into engagement and will hold the plunger against accidental upward projection. However, the retaining teeth 38 will yield or be sheared off to release the connection at a later time when a pulling tool is lifted after having been lowered into the well and clutched onto the upper head 42 of the plunger. Thereafter the inner core returns to its upper limit of travel relative to the outer body member, allowing latch retraction and the suspension withdrawal of the tool support assembly.

The running tool for the lower support initially suspends both the plunger 39 and the support body 6 by means of shear pins 43 and 44 in much the same fashion as does the running tool for the upper tool support, and the shear pin connections are released in the same fashion, as previously described. In the case of the lower nipple, a bottom landing shoulder is omitted and the landing of the tool support 6 for positioning the latching dogs 35 in alignment with the nipple notch 36 is effected by landing formations in the form of projectable-retractable detents arranged to seat on the upper face of the lower nipple 4. Such detents are outwardly projecting lugs 45 formed as

enlargements on the lower ends of a pair of relatively narrow diametrically oppositely disposed spring arms 46 depending from a slide collar 47 within the housing or outer sleeve 48 constituting the main supporting body of the running tool. A relatively weak coil spring 49 tends to bias the collar 47 upwardly within the sleeve 48 and the spring seats at opposite ends on the collar 47 and an external shoulder 50 on a tubular member 51 which at its upper end is threaded into a fitting rigid with the outer sleeve 48. The tubular member slidably receives therein the plunger 52, whose upper end is fixed to a wire line or the like. At its upper limit, the plunger 52 engages by a shoulder 53 with a mating internal shoulder 54 on the tube 51 for suspension purposes. This fixedly mounted internal tube 51 has depending therefrom and behind each of the landing detent arms 46, as best seen in Fig. 11, a wider spring detent arm 55 carrying at its lower end, a pair of outwardly extending lugs 56 which straddle and slightly overlap the upper ends of the detent 45. The upper and lower faces of each of the lugs 56 and the detent 45 are chamfered for inward camming engagement with the landing shoulder 12 of the upper nipple as these parts pass either upwardly or downwardly through the constricted throat of the landing shoulder. When these parts are introduced into the tubing and until they are lowered into contact with the internal shoulder 12 of the upper nipple, they will be positioned as seen in Fig. 9, wherein all of the spring arms 46 and 55 are radially projected and the bottom tangs or detent extensions 57 below the detent lugs 56 are engaged with rearwardly extending shoulders behind the rear face of the arm 46 and in the region of the forwardly projecting detent 45. This shouldered engagement latches the detent downwardly and the ring 47 against upward travel under the biasing force of the coil spring 49. As the descent continues and with the forward faces of the detents 45 and 56 projected in tandem relation through windows in the side wall of the sleeve 48, the lower detent 45 first comes into contact with the internal shoulder 12 and is depressed into the clearance space existing between its rear face and the peripheral surface of the slide plunger 52 and when so depressed, passes through the constricted throat. In succession, the lower portion of the upper detent 56 will also be depressed as it moves into the passing region of the shoulder 12 to clear the same and its rearward face is displaced backwardly toward the plunger 52. Further downward travel of the running tool will move the detent 45 into the space below the shoulder 12 while the shoulder is still retaining the upper detents 56 and their spring 55 depressed so that the rearward shoulder on the lower detent 45 moves outwardly and clear of the depressed tang 57, whereupon the resilient force of the spring 49 slides the collar upwardly and carries the lower detent in overlapping relation to the front face of the tang 57, as is seen in Fig. 8A. In this relation of the parts, the detent 45 is positively held or latched against retraction and in a projected position whereby its outside radius exceeds the radius of the landing nipple 4 and is blocked as shown by dotted lines in Fig. 1 from passage through the nipple.

The top edge of the landing nipple 4 constitutes a landing shoulder or seat for the running tool whose landing seat engaging means is afforded by the co-operation of the spring arms 46 and 55 carried by the supporting body 48 and the parts assembled as a unit therewith. The free end of the spring arm 55 as seen in Fig. 8A is backed up by bearing engagement with the slide plunger 52 and in turn backs up and is overlapped by the free end of the spring arm 46 in the region of the lug 45 for latching the arm 46 and lug 45 against retraction and in outwardly projected position in which the lug 45 extends radially outwardly a distance beyond the internal radius of the landing nipple 4. Thus the projected detent lug 45 is an abutment stop to seat against the upper end of the lower nipple 4 and present the dogs 35 in alignment

with the keeper notch 36. In this relation the latching dogs 35 of the lower tool support will be ready for projection and a larger force can be transmitted through the running tool plunger 52 and transmitted through its lower end into the upper end of the plunger 39, with which it abuts, as seen in Fig. 8B. After the pin 43 has been sheared, the plunger 39 will slide downwardly, projecting the latching dogs 35 and concurrently bringing the ratchet teeth 37 and 38 into locking engagement. Should a secure anchorage not result, then upon upward pull of the running tool, the shear pin 44 will carry along the entire assembly, but if a secure anchorage is had, then the shear pin 44 will release and leave behind the tool support.

On the return stroke of the pulling tool, the retracted detents 56 will enter and pass through the internal shoulder 12 of the upper nipple, and in their final range of travel through the constriction the upper edge of each projected detent 45 will bear against the underside of the shoulder 12, stopping further upward movement of the detent 45 against the force of the spring 49 until the detent passes beneath the plane of the bottom edge of the locking tab 57, whereupon it can be depressed for contraction of the detent 45 and passage into the constricted path. Then as the upper detents 56 move upwardly beyond the internal shoulder 12, their spring supporting arms 55 push them outwardly and bring the tab 57 back into the retaining position of Fig. 9. From the foregoing description of the operation it will be seen that the spring detent arm 55 and its integral terminal formations 56 and 57 co-operate with and constitute position control means for the complemental stop detent unit comprised of the spring biased slide collar 47 and its dependent spring arm 46 and terminal bearing abutment lug 45.

When it is later desired to remove the well tool, a wire line pulling tool can be lowered and clutched with the upper terminal head 42 of the plunger 39 and an upward pull will shear the retaining ratchet teeth 38 and move up into latch retracting and body suspension position for tool removal. Once the support is out of the well, a new set of ratchet segments 40 can be installed before the tool is again put into use.

A modified type of supporting latch is shown in Fig. 12, wherein a locking ring 60 having eccentric inner and outer surfaces is fitted to an enlargement 61 on a projectable plunger 62 within the body support 63. In this relation of parts, the eccentric ring is projected beyond the periphery of the body 63 and into a latching notch in the landing nipple 64. Whenever the enlarged head 61 is moved upwardly and completely out of the ring 60 so that the upper shoulder of the enlargement engages a mating lifting shoulder 65 in the body 63, then the reduced bottom portion of the plunger stem below the head 61 will enable the ring to shift itself out of the locating notch of nipple 64 and it will lie completely within the peripheral dimension of the body 63. For laterally slidably receiving the ring 60, the body 63 has a transverse slot therethrough with parallel sides, as shown in Figs. 13 and 14, and the ring has similar parallel-sided seating surfaces for the guided radial travel thereof.

Various modifications of the structure specifically described herein may be made within the contemplation of the appended claims.

What is claimed is:

1. In combination, a tubing string having vertically spaced apart nipples, an internal rib in one of the nipples, a latch dog keeper in a nipple spaced below the nipple having said internal rib, a tool hanger body to be passaged through the tubing string for removable mounting in the nipple having said keeper, said body having a laterally projectable latch dog mounted therein and receivable within the keeper and a dog actuating plunger slidable in the body, and a running tool comprising an outer tube, releasable connections joining the outer tube to said

plunger and to said body, a force transmitting plunger slidable in said tube and engageable with the dog actuating plunger for concurrent slide travel of said plungers to effect latch dog projection, a first spring blade having a laterally depressible free end and being fixed at its other end to said outer tube, a lug on the blade free end projected outwardly therefrom and engageable with said internal rib on passage thereby to laterally depress said blade free end, a second spring blade adjacent and outwardly of the first blade and having a laterally depressible free end terminating below the free end of the first blade, means slidably mounting the opposite end of the second blade on said outer tube, a spring interposed between the outer tube and said second spring blade and biasing the blade upwardly and a lug enlargement on the free end of the second blade bearing upwardly on the free end of the first blade in the undepressed position of the latter and which blocks spring biased travel of the first blade and bearing rearwardly on the free end of the first blade in the laterally depressed position of the latter and upon upward spring biased travel of the first blade, said lug enlargement having outward projection for engagement with and depression by said internal rib on passage therethrough and for engagement with the nipple having said latch dog keeper as a limit stop to downward passage of the running tool outer tube in said tubing string.

2. In a well tool adapted to be run into and pulled from a well tubing and to have stop abutment with a landing seat spaced vertically below an upper constriction in the well tubing, a supporting body, landing seat engaging means carried by the body and arranged to be secured in a projected position in which its outside radius exceeds the inside radius of the upper well tubing constriction, said seat engaging means including a pair of radially movable detents, detent supporting means mounting said detents on the body one above the other in tandem vertical succession and accommodating their relative radial movement and their relative axial slide travel into and out of radially overlapping relation in which overlapping relation the uppermost detent of the pair fits behind and resists radial depression of the other detent, said detent supporting means being resilient and cooperating with said detents to resiliently urge them radially outwardly to projected position, said detents having stop abutment surfaces interengageable axially with one another when the detents are out of radially overlapping relation to hold the detents against slide travel to the aforementioned overlapping relation and said last mentioned means being yieldable for radial depression of said detents independently of one another and yieldable biasing means active to shift the detents into axially overlapping relation when the uppermost detent is depressed while the other detent is projected.

3. In a well tool of the character described, a supporting body, a pair of radially retractable detents, means movably mounting said detents on the body for their relative movements in directions both axially and laterally of the body and including yieldable force exerting means active to bias said detents laterally outwardly from the body, said detents being initially resiliently projected laterally from the body and positioned in tandem relation axially of the supporting body and in axial stop abutment with one another and resilient means exerting resilient force on and biasing one of said detents to shift the same axially of the body and into radially overlapping relation with theo ther detent when the latter is radially retracted out of axial stop abutment relation and to thereby releasably latch the axially shifted detent in laterally projected position.

4. In a well tool of the character described, a supporting body, a laterally projectable-retractable detent slidably mounted in the body for movement in the longitudinal direction thereof, laterally projectable-retractable detent positioning means resiliently carried by the body for longitudinal alignment with said detent, said means and detent having co-operating seating surfaces extending in planes transverse to the longitudinal direction of the body and abutting one another when both are laterally projected and thereby positioning the detent against longitudinal slide travel and having co-operating longitudinally extending seating surfaces longitudinally slide abutting one another when said means is depressed and the detent is projected against depression.

5. In a running tool for travel into and out of a well tubing and past a constriction in the tubing, a supporting body, a laterally depressible detent axially slidably carried by the supporting body for travel between upper and lower positions, reslilient means mounted on the supporting body and acting on the detent to yieldably urge the detent to slide upwardly relative to the supporting body from said lower position and toward said upper position, a laterally depressible locking tab carried by the supporting body and provided with a bottom edge to extend immediately above and to be engaged by said detent for blocking detent upward slide travel from its lower position while accommodating detent lateral depression, said locking tab being depressible inwardly of the detent to remove the bottom tab edge from detent blocking engagement and having a front face which on tab depression affords a bearing for the detent in its upper position and thereby holds the upwardly positioned detent against lateral depression.

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