

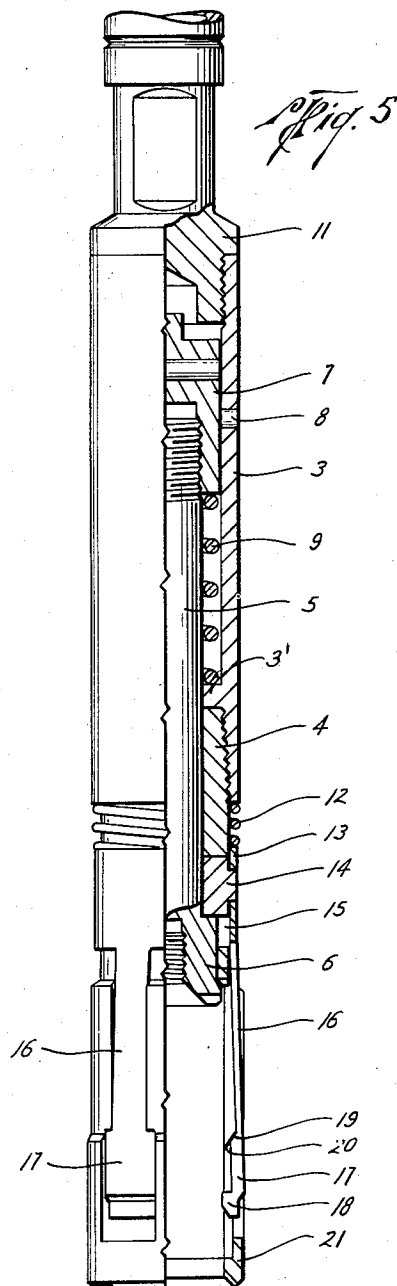
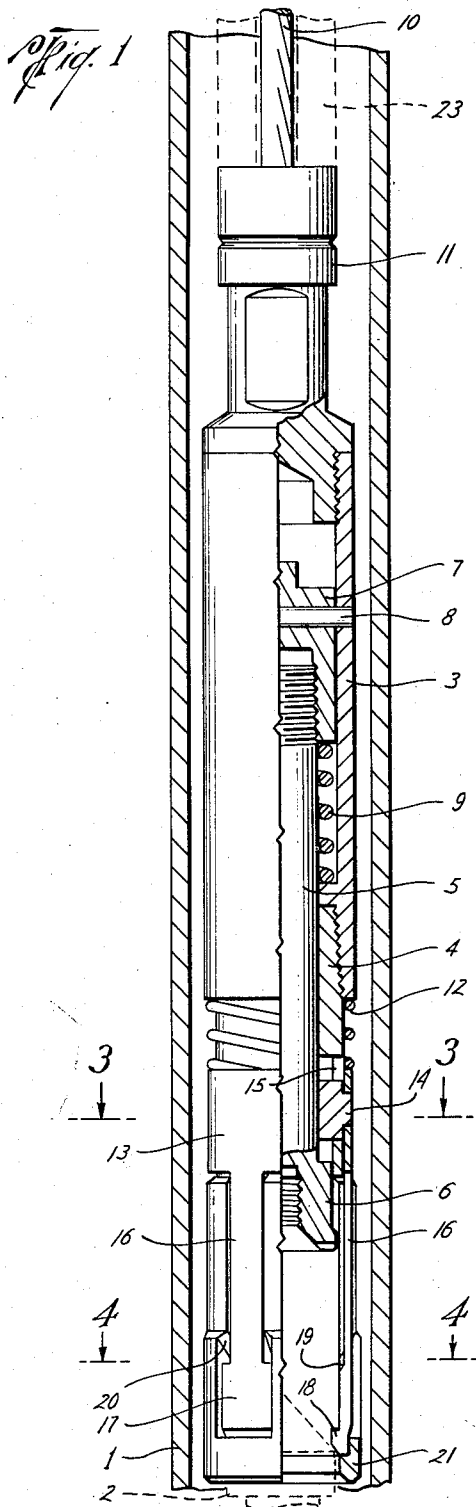
Feb. 3, 1959

D. E. DAFFIN
WELL PULLING TOOL

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2 Sheets-Sheet 1



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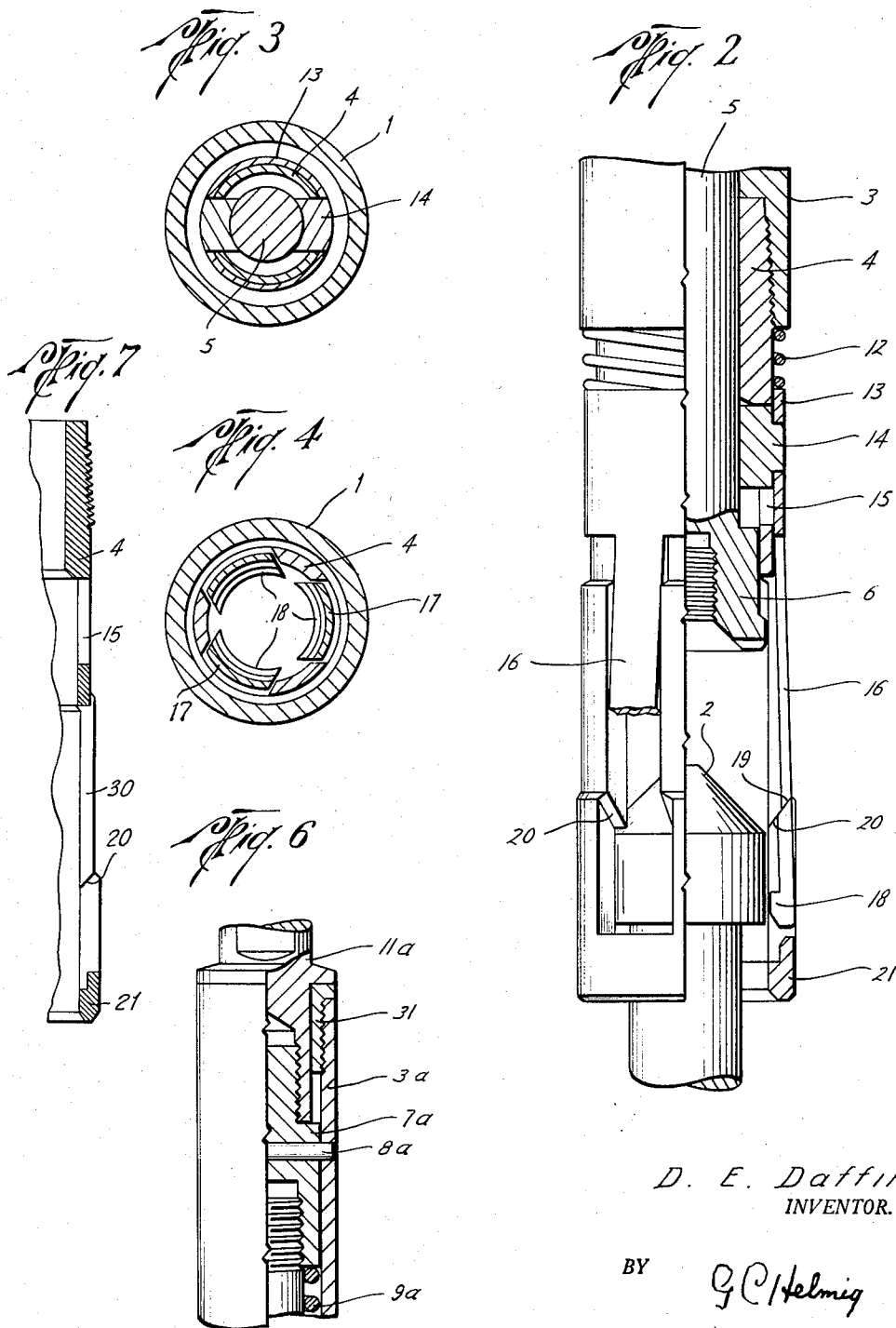
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WELL PULLING TOOL

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5 Claims. (Cl. 294—86)

In oil and gas field work, various types of tool mechanisms including control valves, chokes, packers, and the like are placed at subsurface locations within wells. For the placement or removal of such well tools as the need arises from time to time, a current practice is to employ light equipment including a wire line by which a tool can be quickly run into a well and fixed in operating position and from which the tool can later be pulled back to the surface, and such wire line operations are performed without disturbing the casing, tubing, or drilling string sections. For detachable connection of the wire suspension line with a well tool, the tool upper terminal usually has a necked and headed formation for releasable coupling with clutching dogs in a lower terminal device on the suspension line.

It is an object of the present invention to provide an improved suspension line coupling tool of simplified design having a minimum number of readily manufactured and assembled parts which, in response to an easy manipulative control at the surface, will co-operate with one another for positive action in the suspension of a retrievable well tool and in the making and breaking of a tool connection at a selected well depth.

A further object of the invention is to provide an improved tool coupling device which in assembly is made up in effect as of only three relatively movable and co-operating parts involving an outer body member and an inner core member movable relative to one another under a biasing force and initially immobilized by a releasable connection and a third member having a deflectable tool engaging latch dog and being biased by a yieldable force of lesser value than and in a direction opposite to that of the first mentioned biasing force and toward a latch dog contracted position in which the dog bears on and is confined within a retaining seat formed as a part of one of the immobilized members, from which dog contracted position the third member can be shifted to bring mating camming abutments on it and on the retaining seat carrying member into engagement for forcibly outwardly projecting the latch dog into an expanded position; the relationship of the parts being such that movement of the third member can occur independently of the other of the immobilized members or conjointly with the movement thereof under the larger biasing force effect when the connection between the inner and outer members is released.

Other objects and advantages of the invention will become apparent during the course of the following specification relating to a preferred but not necessarily the only embodiment as illustrated in the accompanying drawing wherein Figure 1 is a view partly in elevation and partly in vertical section of a wire line tool coupling device in suspended position within a well string; Fig. 2 is a fragmentary view similar to Fig. 1 but on a larger scale and with the parts in a different co-operative relation; Figs. 3 and 4 are transverse sections on lines 3—3 and 4—4, respectively of Fig. 1; Fig. 5 is a part elevation and part vertical section showing of the coupling parts in

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fully released position; Fig. 6 is a fragmentary section and elevation of a modified detail and Fig. 7 is a vertical longitudinal section through a side wall portion of the tool body and corresponds with the sectional illustrations of the same side wall portion in the assembly views of Figs. 1, 2, and 5.

In Fig. 1 the coupling device is indicated as being suspended within a tubing string 1 which contains a well tool to be retrieved. In dotted lines there is indicated a necked and conically tipped head 2 as constituting the upper part of the retrievable well tool arranged to be received within an open-ended hollow chamber at the bottom of the wire line coupling device. The outer body or housing member of the improved coupling tool includes upper and lower tubular pieces 3 and 4 having their adjoining ends screw threaded together for slidable reception of an inner core or plunger member 5. The tubular member 4 comprises an annular wall whose internal and external diameters are stepped or are smaller from the wall upper end to a point midway of the wall length and are larger therebelow to the lower end of the tubular member, which terminates in a ring 21. The smaller diameter portion in its upper region is externally threaded and is secured within the lower end of the companion tubular member 3 and is internally machined to provide a cylindrical slide bearing surface for the core or plunger 5, whose lower end terminates in a head 6 located in the top of the open-ended chamber afforded by the internal space within the larger diameter lower half of the tubular outer member 4. At its upper end the plunger 5 is threadably connected within a skirted head 7 having a slide bearing on the internal cylindrical surface of the upper tubular member 3, and these parts 7 and 3 are releasably secured together by a shear pin 8 extending through them in a direction transversely of the tube axis. Pocketed within the space between the plunger 5 and the outer tube 3 and seated at opposite ends against an internal shoulder 31 of the tube 3 and the bottom of the head 7, is a relatively heavy spring 9 which is in compression between the parts 3 and 7 and is held against expansion while the parts are immobilized by the releasable shear pin connection 8. Breakage of the shear pin connection allows the coil spring 9 to exert its force axially and downwardly on the tube 3 and upwardly on the inner plunger member to spread these members apart to the position illustrated in Fig. 5.

The lower end of the wire line 10, as seen in Fig. 1, is fastened to a connector head 11 which terminates in a downwardly extending dependent skirt internally threaded into the upper end of the tubular member 3.

In relation to the biasing force of the coil spring 9, a weaker coil spring 12 surrounds the reduced diameter upper portion of the tubular member 4 and seats at one end against the underside of the upper member 3 and seats at its opposite end against a slide collar or sleeve 13 to yieldably bias the sleeve downwardly. At diametrically opposite points the collar 13 carries a pair of inwardly projecting lugs or keys 14 which are slidably guided within mating windows 15 in the form of axially extending and diametrically opposite slots in the wall of the tubular member 4 surrounded by the slide collar 13. The length of each window 15 is greater than that of the key 14, and the vertically spaced apart wall edges defining the opposite margins of the window opening provide abutment seats with which the top and bottom end faces of the key 14 may come into stop abutment, whereby the predetermined difference in lengths establishes the opposite limits of relative slide movement of the collar 13. The radial dimension of the key 14 is such that it extends inwardly beyond the thickness of the wall of the tubular member 4 and into the path of the upper shoulder afforded by the enlarged head 6 of the central plunger, so

that relative plunger movement under the heavier force of the spring 9 will bring the head 6 into abutment with the key 14 and carry the slide collar or sleeve 13 upwardly to its limit against the lesser force exerted by the coil spring 12.

Formed integrally with and downwardly dependent from the band collar 13 are one or more outwardly distensible spring fingers 16 which have widened lower portions 17 terminating in inwardly extending lugs or latch dogs 18. Three such fingers are employed in the device, as shown in the drawings, and each finger is slidably located within a window clearance opening or axially extending slot 30 formed in and projected throughout the length of the lower and larger diameter wall of the tubular body member 4 above its bottom terminal ring 21, and the lower portion of the slot is widened in relation to the widened tip portion 17 of the spring finger. In the latch dog unexpanded position, as seen in Fig. 1, the upwardly facing shoulder at the top edge of the widened flank of the enlarged tip portion 17 and the downwardly facing shoulder defining the upper margin of the co-operating window enlargement are each inclined upwardly and outwardly to form spaced apart camming formations 19 and 20 which come into action upon an upward movement of the latch dog assembly against the biasing force of the spring 12 and forcibly expand or distend the spring fingers 16 for moving the dogs 18 into an elevated and outwardly projected position, indicated in each of Figs. 2 and 5. Normally the spring 12 exerts a downward force to slide the camming surfaces out of engagement for the return of the spring fingers 16 into contracted position.

For taking a load which may be imposed on the contracted latch dogs and for retaining the latch dogs in retracted position under load, each spring finger has its terminal end and outer faces in ninety degree angular relation to one another or in horizontal and vertical planes, respectively, and these terminal portions are for mating abutment with corresponding angularly related upwardly and inwardly facing surfaces afforded by an internally stepped or shouldered formation on an annular ring 21 constituted by the lower terminal portion of the wall of the outer body member 4. Thus, as seen in Fig. 1, the external vertical side surface at the lower tip of the latch 18 is in bearing engagement with the inwardly facing and vertically or axially extending side surface of the reduced section downwardly spaced from the window and afforded by the internal step formation on the ring 21, and similarly the horizontal and downwardly facing terminal surface of the latch 18 bears against an upwardly facing and horizontal seat of the internally stepped ring 21. The abutting downwardly facing latch and ring surfaces extend in a plane normal to the axis of the tool, so that any load carried by the latch dog 18 is transmitted into the outer body member in the direction of thrust without imposing any outward wedging or expanding force such as might cause radial deformation of the seating ring 21 and end the useful life of the housing.

The underside of the plunger head 6 has an internally threaded socket to which may be detachably fitted a suitable actuating tool for conditioning the coupling assembly for use by telescopically sliding or depressing the plunger in the housing against the coil spring 9 and lining up the pin receiving openings for reception of a replaceable shear pin 8. With the shear pin in place, the actuating tool is detached from the plunger head and the assembly is ready for use as a pulling device for retrieving a well tool located below the surface. As a pulling tool, it will be lowered in the well on a suspension line 10, and as the latch dogs 18 on the free ends of the circumferentially spaced spring fingers concurrently come into abutment as seen in Fig. 1 with the conical tip of the well tool head 2, further descent of the reciprocable collar 13 is arrested, with the spring 12 being compressed as the coupling housing continues its downward movement and receives the tool head 2 within the open ended hollow

chamber within the tube 4 of the coupling device. As soon as the latch retainer ring 21 passes below and the window clearances 30 come into alignment with the free ends or terminal latch portions of the elastic fingers 16, the camming portions 19 and 20 come into engagement and ride on one another for expansively bending the spring fingers outwardly, as best seen in Fig. 2, whereby they clear the periphery of the head 2 and move on downwardly with the coupling tool into the region of the necked or reduced diameter portion below the head 2. As soon as that occurs, the expansive force of the compressed coil spring 12 is released and pushes the slide collar 13 down, first clearing the cam surfaces, whereupon the spring fingers snap inwardly under the head 2 and then drop into confined contracted seating engagement with the internally shoulder retainer ring 21. Subsequent elevation of the suspension line brings the upper faces of the confined clutching latch dogs 18 into suspension abutment with the underside of the tool head 2 for picking up the well tool and raising it to the surface. After removal from the well, declutching from the retrieved well tool can be achieved by lifting the collar 13 to latch expanded position of Fig. 2.

To take care of those situations likely to occur on occasion in which a retrievable tool is frozen fast or cannot be dislodged without the risk of a pulling force such as might cause breakage, the coupling device can be caused to release itself from its latched connection with the tool by the imposition thereon of a jarring shock. The shock can be imposed through a conventional jar mechanism, schematically illustrated at 23 in Fig. 1, or simply by a sudden slack in the suspension line. In either event, the conical tool head provides an anvil or stop with which the bottom of the plunger head 6 engages, so that a forced downward movement of the tool body 3 relative to the connector head 2 and within the limit of the initial space between the connector head and the plunger head 6, will give a hammer blow through the plunger stem for the breaking or shearing of the pin 8, which occurrence releases the parts for action under the heavy spring 9. Under spring expanding force the inner plunger and the outer tool body 4 tend to shift their relative positions from that shown in Fig. 1 to that shown in Fig. 5 and the latches 18, having been carried with the forced downward movement of the tool body, are well below the connector head 2 so that the latches can be lifted clear of the retainer 21 and into alignment with the window openings as the plunger head 6 through its abutment with the ring 14 carries the collar 13 upwardly to the top limit of the slot 15 and overcomes the biasing force of the light spring 12. Upward travel of the collar 13 and the outward camming action of the inclined surfaces 19 and 20 will expand the latches 18. This relation of the parts is shown in Fig. 5, and enables the pulling tool to be raised to the surface. Replacement of the shear pin 8 will condition the assembly for further use. While such use is primarily in connection with the pulling or removal of the retrievable tool, yet the structure is adapted for a running-in operation by fitting the coupling to the tool above the surface and then, after the tool is properly positioned in the well, by causing a shearing of the pin for the release of the parts.

In the assembly of the parts as thus far described, the load of a suspended tool is transmitted through the outer body 3 to the wire line without any strain being imposed on the shear pin. That arrangement is to be preferred for many applications. As a modification of the shear pin mounting, Fig. 6 shows the upper end of the outer body 3a as having threaded therein a bearing sleeve 31 for the skirted portion of a suspension head 11a which is internally threaded into fixed connection with the head 7a of the central plunger. The head 7a and the outer tube 3a are joined together by a shear pin 8a, which in this instance will transfer normal loads between the parts but which will yield to an abnormal force for allow-

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ing the spring 9a to come into action for compressing the lighter spring and outwardly camming the elastic latch fingers as previously described.

Various modifications in the novel and improved arrangement and relation specifically disclosed can be made without departure from the invention as set forth in the following claims.

What is claimed is:

1. In a pulling tool, a tubular member, an axially shiftable collar slidably surrounding and non-rotatable on the tubular member, a dependent spring finger integral with the collar and disposed in a normal position free of outward bending stress, the lower tip portion thereof having an internally projecting lug, comprising a latch dog and said tip portion also having a peripheral side surface and a bottom surface right angularly related to each other, the bottom surface being in a transverse plane substantially normal to the axial extent of the tubular member, the wall of the tubular member in the lower portion being provided with a lateral window opening therethrough for axially slidably receiving said finger and with an internally reduced section downwardly spaced from the window opening, said finger tip portion being axially slidable into and out of the reduced section and when out of the reduced section being above the same and out of contact therewith, the bottom of said reduced section comprising an upwardly facing surface and an inwardly facing side surface in substantially right angular relation in correspondence with the aforesaid angular relation of said finger tip portion, upwardly and outwardly inclined camming formations on the tubular member and said dependent spring finger respectively and positioned intermediate the slide collar and the finger tip portion, said cam formations being axially spaced apart when the finger tip portion is within the reduced section and said cam formations being slidable one on another for bodily displacing the tip portion outwardly through the window when said lower tip portion is above said reduced section.

2. The pulling tool as in claim 1 wherein said finger

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tip portion has a widened flank enlargement and said window in its lower portion is correspondingly widened to receive the widened flank enlargement and wherein the downwardly facing upper edge of the widened lower portion of the window and the upwardly facing upper edge of said widened flank enlargement carry said upwardly and outwardly inclined camming formations.

3. In a pulling tool, according to claim 1, together with a plunger slidably enclosed by said tubular member, spring means bearing on the tubular member and the plunger and biasing the plunger upwardly relative to the tubular member, a releasable connection joining the plunger and the tubular member and immobilizing the upwardly biased plunger in a downward position and interengageable pick up abutments on the slidable collar and said plunger engageable for compelling upward slide travel of the collar upon release of said connection.

4. The pulling tool of claim 3 wherein the wall of said tubular member in the region of the slide collar has an axially extending slot therethrough, and wherein said pickup abutments include a key fixedly carried by and internally of said slide collar and projected inwardly beyond the wall and through said slot and slidable therein with slide collar travel and a radially extended key engageable head on the plunger, said head being located below the travel range of said key when the plunger is immobilized by said releasable connection and being engageable with the key to lift the same when the plunger is released.

5. The pulling tool of claim 1 in which a spring is mounted by the tubular member and exerts yielding downward force on the slide collar.

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