Sept. 28, 1943. R. C. BAKER 2,330,258

TRIP DEVICE FOR WELL APPARATUS

Filed Sept. 22, 1941

Fig. 1.

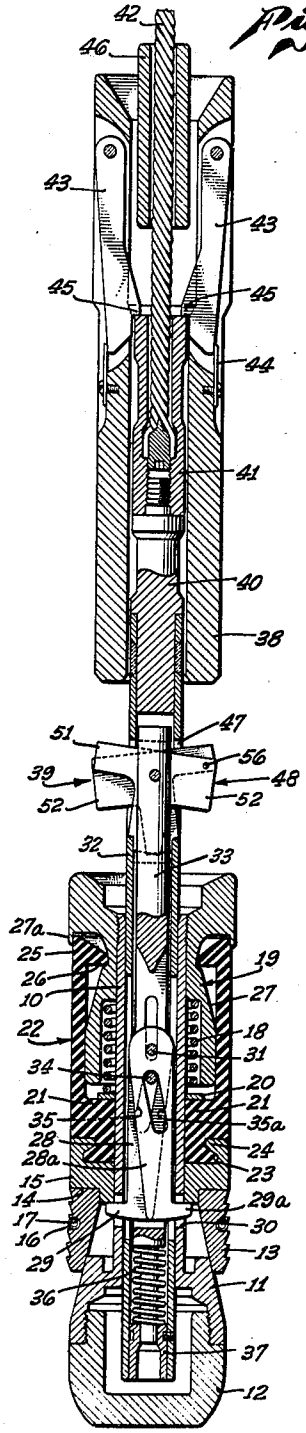


Fig. 2.

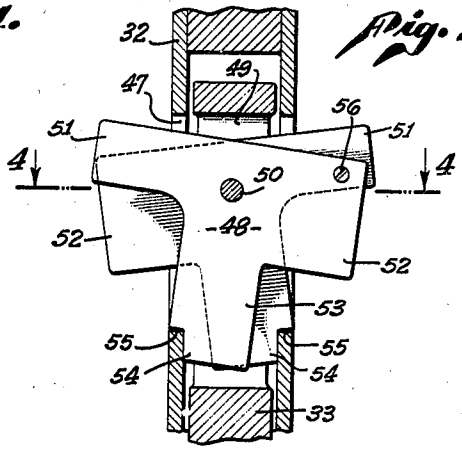


Fig. 3.

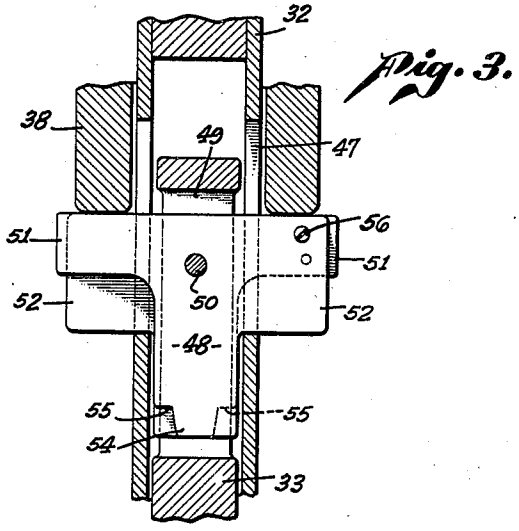
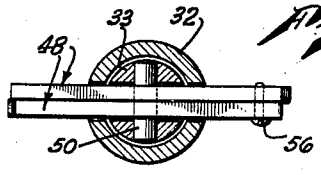


Fig. 4.



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Patented Sept. 28, 1943 2,330,258

UNITED STATES PATENT OFFICE

2,330,258

TRIP DEVICE FOR WELL APPARATUS

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Application September 22, 1941, Serial No. 411,801

14 Claims. (Cl. 166—12)

This invention relates to devices capable of effecting operation of well apparatus lowered and supported in a well bore on a tubular string or wire line.

Certain apparatus, such as bridge plugs, gun perforators, bailers, etc., are lowered in a well bore or casing on a suitable string of tubing, drill pipe, or wire line. Upon reaching the desired point in the casing at which the well apparatus is to be employed, its operation is effected by a suitable tripping device. At times, the tripping device acts prematurely, causing operation of the particular apparatus to occur at the wrong position in the well bore or casing.

It is an object of the present invention to provide a device which overcomes the above-noted defect of premature tripping, and which, therefore, offers assurance that operation of the well apparatus will not occur until desired.

This invention has other objects that will become apparent from a consideration of the embodiment shown in the drawing accompanying and forming part of the present specification. This form will now be described in detail, but it is to be understood that such detailed description is not to be taken in a limited sense, since the scope of the invention is best defined by the claims appended hereto.

Referring to the drawing:

Figure 1 is a longitudinal section showing a well packer and its associated tripping device in relative positions for running in a well bore or casing prior to setting of the packer therewithin;

Figure 2 is an enlarged longitudinal section disclosing part of the tripping device in latched position;

Figure 3 is a view similar to Figure 2, showing the parts of the tripping device in unlatched or unlocked position; and

Figure 4 is a cross section taken as indicated by the line 4—4 in Figure 2.

The present invention is illustrated in connection with a well packer, particularly described and claimed in United States Patent No. 2,225,143. This well packer is disclosed as connected to a wire line for lowering in a well casing to the position at which it is to be set in packed off condition.

As described in the patent referred to, the well packer is in the form of a bridge plug, and includes a main tubular body 10 having a conical slip expander 11 at its lower end. A guide 12 is threaded in this expander for the purpose of guiding the tool past obstructions as it is being lowered in the well bore. A plurality of segmental slips 13 is arranged around the body with their interior tapered surfaces cooperable with the corresponding tapered surface on the expander cone 11. These slips 13 are initially held against their cooperable cone and within a recess 14 formed in the periphery of a rubber packing retainer ring 15 by an encircling tension spring 16 seated within a circular groove 17 formed in the exterior of each slip.

The slips are urged longitudinally of their associated expander cone by a helical spring 18 having one end seating against a spring retainer 19 threadedly or otherwise secured to the upper end of the main body 10. The other end of the spring engages a ring 20 seated within the base portion 21 of the rubber cup-shaped packing 22, which is secured to the retainer 15 by their respective interlocking flanges 23, 24.

Although initially prevented from elongating by suitable latch or pawl means later to be described, when released, the spring 18 effects movement of the rubber packing 22 and retainer 15 longitudinally along the tubular body 10, causing the retainer to move the slips 13 along the cone 11 radially into engagement with the casing. In pursuing this movement, the free end 25 of the cup-shaped packing is forced radially into fluid tight engagement with the casing through the cooperation of its inturned flange 26 with a conical expander cone 27 formed on the spring retainer 19. As a precautionary measure, the spring retainer possesses a depending annular lip 27a engaging the outer free end 25 of the packing, so as to protect it until the packing is disengaged from the lip upon moving longitudinally in the manner described.

The cup-shaped packing 22 and slips 13 are initially secured in their upper retracted positions with the spring 18 compressed by a pair of oppositely disposed levers 28, 28a whose lower ends 29, 29a are formed as latches or pawls extending through holes 30 in the body for engagement with the end of the packer retainer 15. These levers are fulcrumed on a hinge pin 31 secured to a trip sleeve 32 extending through the body. A trip rod 33 is disposed within the trip sleeve, and has a pin 34 fixed to it for cooperation with the sides of oppositely directed inclined slots 35, 35a formed in the trip levers 28, 28a. This rod 33 is normally supported in an elevated position with its pin 34 at the upper end of the slots 35, 35a by a cushioning spring 36 whose lower end seats on an abutment 37 fixed to the sleeve 32 and whose upper end engages the trip rod 33.

In order to remove the latches or pawls 29, 29a

from engagement with the retainer ring 15, so as to allow the helical spring 18 to expand and shift the packing 22 and slips 13 into engagement with the casing, the trip rod 33 is moved downwardly to cause its pin 34 to engage the sides of the oppositely directed slots 35, 35a and swing the trip levers 28, 28a inwardly on their hinge pin 31 within the confines of the sleeve 32. Such movement of the trip rod is obtained by dropping a hollow weight 38 along the sleeve and into engagement with an anvil or abutment device 39 fixed to the trip rod 33.

The upper end of the sleeve 32 is welded or otherwise secured to a sinker bar 40 attached to a wire line socket 41 in which the lower end of a wire line 42 is suitably secured, by means of which the entire mechanism is lowered in the well casing. The tubular weight 38 is initially held above the anvil 39 by latches 43 pivoted at their upper ends on the weight, with their free ends urged inwardly by leaf springs 44 fixed to the weight to position and hold inwardly directed latch fingers 45 on the upper end of the wire line socket 41.

Whenever the packer or bridge plug is to be set, a go-devil 46 is dropped or lowered along the wire line for engagement with the inclined faces on the latch fingers 45, forcing them outwardly and from the upper end of the socket 41. Such release of the fingers allows the weight 38 to drop along the sleeve 32 and engage the anvil or abutment mechanism 39, which extends through oppositely directed elongated slots 47 in the sleeve. The weight 38 is heavy enough so that upon engaging the abutment mechanism 39, it can move the trip rod 33 downwardly and cause its pin 34 to swing the levers 28, 28a inwardly to a position permitting expansion of the spring 18.

The arrangement described is similar in all general respects to Figure 12 disclosed in the aforesaid patent. However, it has been found that premature tripping of the mechanism sometimes occurs while lowering the apparatus in a well bore and before the weight 38 is released by the go-devil 46. It is believed that the trip rod 33 is moved downwardly by some force to withdraw the trip levers 28, 28a and their latch ends from the packing retainer 15 without assistance from the weight. The present invention contemplates an expedient for preventing such unwarranted movement of the trip rod and the consequent premature setting of the bridge plug against the casing.

The trip rod 33 is held in elevated position by forming the anvil 39 as a latching device. This device consists of two oppositely directed generally T-shaped levers 48 pivotally mounted within a slot 49 in the trip rod on a hinge pin 50 secured to the trip rod. These levers can swing in the trip rod slot 49 and they can both swing and move longitudinally through the oppositely directed sleeve slots 47. The T-shaped levers 48 are similar but are oppositely disposed on the trip rod. Each lever has a light arm 51 on one side of the hinge pin 50 extending through one of the slots 47 in the sleeve, and a heavy arm 52 on the other side of the hinge pin extending in the other direction through the other sleeve slot, so as to exert a force tending to swing the T-shaped lever on the hinge pin and elevate the light arm 51, while at the same time positioning the depending latch leg 53 outwardly with its foot 54 engaging the inner surface of the sleeve 32 and with a detent 55 formed by a notch in the leg engaging the bottom end of a sleeve slot 47. This is the position that the oppositely disposed T-shaped levers occupy before the trip rod 33 is moved downwardly by the force of the weight 38 resting on the levers 48 (see Figures 1 and 2). However, upon release of the weight through the action of the go-devil 46, the lower end of the former 38 engages the light arms 51 of the oppositely disposed T-shaped levers 48 and swings them downwardly and their respective legs 53 inwardly to a position in which the detents 55 are disengaged from the bottom ends of the slots 47, allowing the force of the weight 38 to move the trip rod 33 downwardly and effect release of the trip levers 28, 28a from the packing retainer ring 15.

It is to be noted that upon engagement of the weight 38 with the T-shaped levers 48, the legs 53 are moved within the sleeve 32 centrally thereof and free from engagement with its inner surface, so as not to impede downward movement of the trip rod 33 within the sleeve. This central location of the legs is assured by engagement of the weight with the straight top surface provided by the light and heavy arms 51, 52 of each latch lever, due to the substantially right angular relationship between the arms and the leg 53.

It is apparent that the trip rod 33 cannot be moved downwardly until the T-shaped levers are released from engagement with the bottom ends of the sleeve slots 47. Premature tripping cannot occur despite jarring of the wire line 42 and other actions that might be imposed on the entire well apparatus while it is being run into the well bore or casing. The heavy arm 52 tends to maintain the detent 55 in engagement with the sleeve 32 at the bottom end of the slot, preventing any downward movement of the trip rod on which the T-shaped levers are pivoted. It is only after the hollow weight 38 has been allowed to drop and engage the upper sides of these levers that the legs 53 swing inwardly free from engagement with the sleeve, thereafter permitting the weight to force the trip rod downwardly and effect release of the packing and slip actuating spring 18.

As further assurance against premature tripping of the rod, a frangible pin of low shear value may be inserted through both T-shaped levers 48. This frangible pin may take the form of a shear screw 56 extending through one of the levers and threaded into the other lever. This screw assists the weighted arms 52 in maintaining the detents 55 in proper latching position on the sleeve 32. The shear screw is of sufficiently low strength as to be disrupted by the force of the weight 38 when it engages the latch levers 48 immediately prior to swinging of the legs 53 and their detents 55 inwardly of the sleeve 32.

I claim:

1. In combination, a well apparatus adapted to be lowered in a well bore for the performance of a function therewithin, a first latch means for preventing functioning of said apparatus, and pivoted latch means coupled to said first latch means for preventing release of the latter until desired.

2. In combination, a well apparatus adapted to be lowered in a well bore for the performance of a function therewithin, latch means for preventing functioning of said apparatus, means coupled to said latch means and movable longitudinally of said well apparatus for releasing said latch means to permit functioning of said apparatus, and laterally movable latch means for locking said releasing means to prevent such longitudinal movement.

3. In combination, a well apparatus adapted

to be lowered in a well bore for the performance of a function therewithin, latch means for preventing functioning of said apparatus, means coupled to said latch means and movable with respect to said well apparatus for releasing said latch means to permit functioning of said apparatus, and laterally movable latch means for locking said releasing means to prevent such movement.

4. In combination, a well apparatus adapted to be lowered in a well bore for the performance of a function therewithin, a first latch means for preventing functioning of said apparatus, means coupled to said first latch means and movable with respect to said well apparatus for releasing said latch means to permit functioning of said apparatus, a second latch means for locking said releasing means to prevent such movement, and means for releasing said second latch means and for moving said releasing means with respect to said well apparatus, whereby said first latch means is released.

5. In combination, a well apparatus adapted to be lowered in a well bore for the performance of a function therewithin, a first latch means for preventing functioning of said apparatus, means coupled to said first latch means and movable with respect to said well apparatus for releasing said latch means to permit functioning of said apparatus, a second latch means for locking said releasing means to prevent such movement, and a weight member engageable with said second latch means to effect its release and for then moving said releasing means with respect to said well apparatus to release said first latch means.

6. A combination as defined in claim 4, wherein said second latch means comprises a pivoted lever having a light arm on one side of its pivot, a heavy arm on the opposite side of its pivot, and a depending leg provided with a detent.

7. A combination as defined in claim 5, wherein said second latch means comprises a pair of oppositely directed pivoted levers, each lever having a light arm on one side of its pivot, a heavy arm on the opposite side of its pivot, and a depending leg provided with a detent.

8. In combination, a well apparatus adapted to be lowered in a well bore for the performance of a function therewithin, latch means for preventing functioning of said apparatus comprising a holding instrumentality, a pivoted lever having a laterally extending arm and a depending leg provided with a detent engageable with said holding instrumentality, and means engageable with said laterally extending arm for swinging said lever and removing said detent from said holding instrumentality.

9. In combination, a well apparatus adapted to be lowered in a well bore for the performance of a function therewithin, latch means for preventing functioning of said apparatus comprising a sleeve, a rod within said sleeve, a lever pivoted on said rod and having an arm extending therefrom and a depending leg engageable with said sleeve to prevent movement of said rod therewithin, and means engageable with said laterally extending arm for swinging said lever to remove said leg from engagement with said sleeve.

10. In combination, a well apparatus adapted to be lowered in a well bore for the performance of a function therewithin, latch means for preventing functioning of said apparatus comprising a sleeve having a pair of opposed slots, a rod within said sleeve, a pair of oppositely directed levers pivoted on said rod, said levers having opposed arms extending laterally through said slots and legs engageable with the ends of said slots to prevent movement of said rod within said sleeve, and means engageable with said laterally extending arms for swinging said levers to remove said legs from engagement with the ends of said slots.

11. A combination as defined in claim 10, wherein each of said levers also has a weighted member extending through a slot opposite to the one through which the arm of the same lever extends.

12. In combination, a well apparatus adapted to be lowered in a well bore for the performance of a function therewithin, and latch means for preventing functioning of said apparatus comprising a pivoted lever having a light arm on one side of its pivot, a heavy arm on the other side of its pivot, and a depending leg provided with a detent.

13. In combination, a well apparatus adapted to be lowered in a well bore for the performance of a function therewithin, and latch means for preventing functioning of said apparatus comprising a pivoted lever having arms on opposite sides of its pivot extending in opposite directions and a depending leg provided with a detent, and means for maintaining one of said arms elevated above the other arm.

14. In combination, a well apparatus adapted to be lowered in a well bore for the performance of a function therewithin, and latch means for preventing functioning of said apparatus comprising holding means, a pair of oppositely directed pivoted levers, each lever having a laterally extending arm and a depending leg provided with a detent engageable with said holding means, and means for connecting said levers to one another to hold said detents in engagement with said holding means.

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