

Jan. 14, 1941.

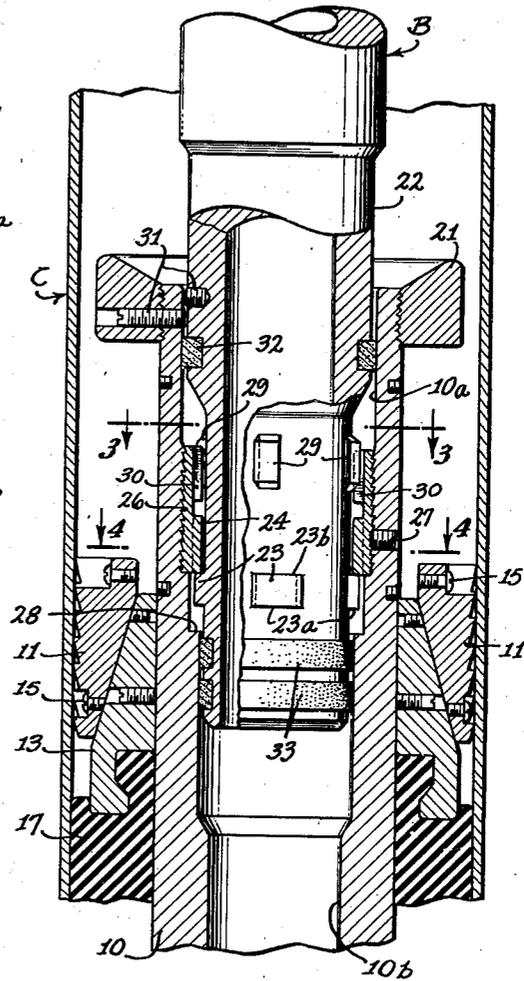
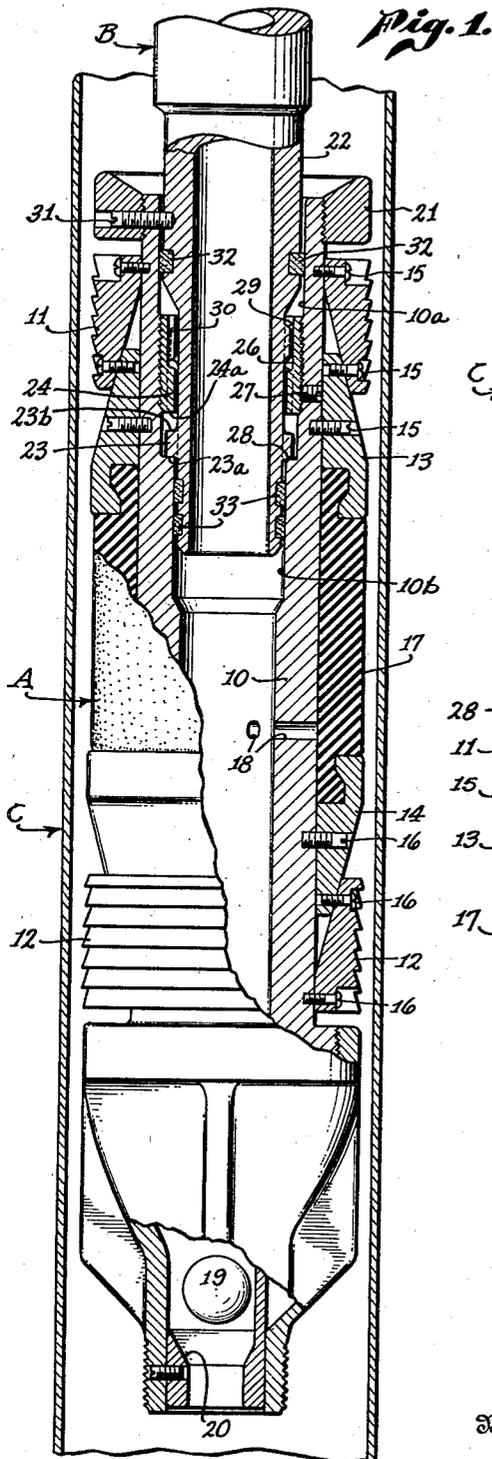
R. C. BAKER

2,228,243

RELEASEABLE COUPLING

Filed Dec. 23, 1939

2 Sheets-Sheet 1



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RELEASABLE COUPLING

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2 Sheets-Sheet 2

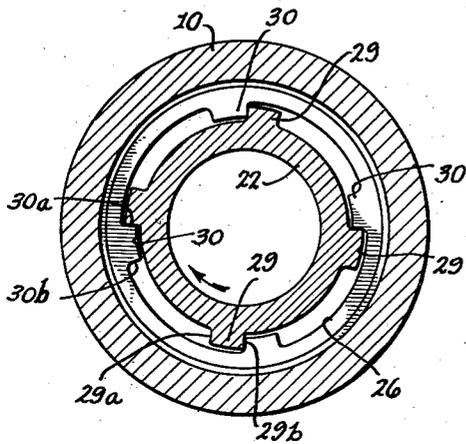


Fig. 3.

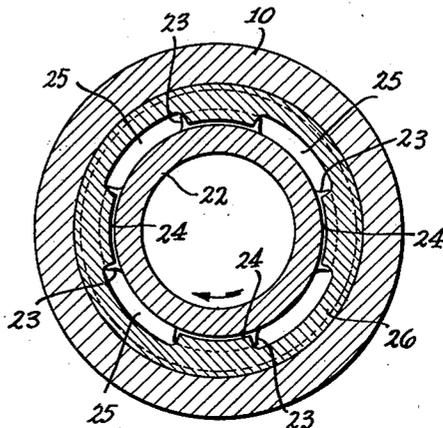


Fig. 4.

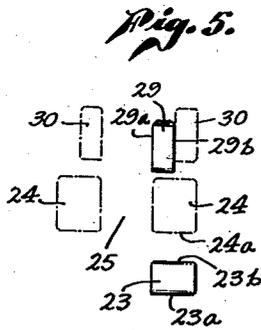


Fig. 5.

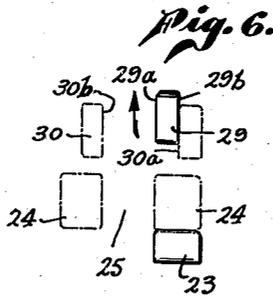


Fig. 6.

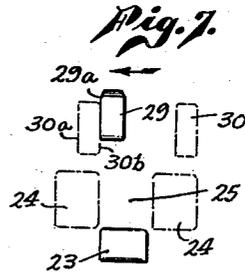


Fig. 7.

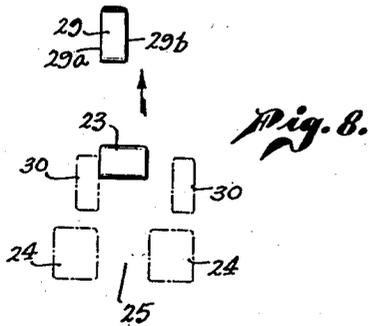


Fig. 8.

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UNITED STATES PATENT OFFICE

2,228,243

RELEASABLE COUPLING

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Application December 23, 1939, Serial No. 310,771

10 Claims. (Cl. 166—1)

The present invention relates to couplings of the releasable type, and more particularly to couplings for disconnectably securing a well device to a tubular string.

In order to perform certain operations within a well bore, a well packer is secured to the end of a tubular string, by means of which it is lowered to a desired setting point within the casing. Following the setting operation, the packer can remain anchored to the casing while the tubular string is disconnected from the packer for removal from the bore. Such disconnection may be permitted by providing a left-hand threaded interconnection between the packer and string, complete uncoupling occurring as a result of rotating the tubular string to the right a plurality of complete rotations, depending upon the number of threads in engagement. Under some operating conditions, the threads bind and either prevent uncoupling between the packer and tubular string or allow disconnection only after excessive torque has been imposed on the tubular string. Such situations are especially amplified when the packer has been set at a fairly remote point from the surface of the bore, since the longer the string of tubing, the greater may be the difficulty in causing its rotation to disconnect its lower end from the set well packer.

Accordingly, it is an object of the present invention to facilitate the disconnection of a tubular string from a well device.

It is a further object of the invention to provide a connection between a tubular string and a well packer which requires only a partial revolution to produce a disconnection therebetween.

Still another object of the invention resides in the provision of an improved disconnectable coupling between a tubular string and a well packer, requiring only a fraction of a revolution to produce disconnection, but which coupling is nevertheless capable of transmitting longitudinal thrusts in both directions between the tubular string and packer.

This invention has other objects that will become apparent from a consideration of the embodiment shown in the drawings accompanying and forming part of the present specifications. 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 appended claims.

Referring to the drawings:

Figure 1 is a longitudinal sectional and partial elevational view of a releasable coupling consti-

tuted by the ends of a tubular string and a well packer in the form of a cement retainer or bridge plug;

Figure 2 is an enlarged fragmentary section, similar to Figure 1, of the coupling device with its parts in another operative position and the packer set within the well casing;

Figure 3 is a transverse section taken as indicated by the line 3—3, in Figure 2;

Figure 4 is a transverse section taken as indicated by the line 4—4, in Figure 2; and

Figures 5, 6, 7 and 8 are diagrammatic views disclosing the relative positions that can be occupied by the various coupling elements.

The coupling device is illustrated as forming part of the upper end of a well packer A and the lower end of a tubular string B, by means of which the packer can be lowered to a desired position within a well casing C for the purpose of being anchored therein.

The well packer A is of the type described in United States Patent No. 2,121,051, and includes a body portion 10 carrying up-pressure slips 11 and down-pressure slips 12, which are adapted to be expanded into engagement with the walls of the casing C by the respective frusto-conical upper and lower expander members 13, 14 slidable on the packer body and having tapered surfaces cooperable with companion surfaces on the segmental slips. Initially, the slips and cones are held in ineffective or retracted positions by the various shear screws 15, 16 attaching them to the body and to each other. Relative longitudinal movement between the packer body, cones, and slips will shear the screws and produce radial outward movement of the slips into anchoring engagement with the casing.

In the instant case, the setting of the upper slips 11 is effected by fluid under pressure. Thus, a packing sleeve 17 encompassing the body is secured to and between the ends of the expander cones 13, 14. This packing can be elongated by the pressure of the fluid passing through the tubular string B into the body 10 and through ports 18 establishing communication between the interior of the body and the interior of the extensible sleeve 17. This pressure can be built up after a tripping ball 19 has been lowered through the tubular string and packer for seating engagement with a tripping ball seat at the lower end of the packer, which will close the longitudinal passage through the body and enable the fluid pressure to be increased.

The fluid under pressure will produce elongation of the packing sleeve 17 in an upward direc-

tion, shearing the various screws 15 and moving the cone 13 along the slips 11 to expand the latter members into contact with an abutment ring 21 secured to the body and into engagement with the casing. The taking of an upwardly directed strain on the tubular string and packer body will compress the packing sleeve 17 into sealing engagement with both the packer body and casing walls, whereupon a continuation of this strain and upward travel of the packer body 10 will shear the lower screws 16 and move the lower slips 12 along the tapered face of its associated cone 14 radially into engagement with the casing.

Further details of construction and operation of the packer A are not essential to an understanding of the present invention and may be found in United States Patent No. 2,121,051, above referred to.

The present invention embodies a leak-proof coupling between the tubular string B and packer body 10 whose cooperable elements can be readily disconnected by rotating the tubular string with respect to the packer only a fraction of a revolution. To achieve this purpose, the lower end or sub 22 of the tubular string is provided with external and circumferentially spaced lugs 23 adapted to cooperate with similarly spaced internal lugs 24 carried on the interior of the packer body. Adjacent cooperable lugs on the sub and packer body are of substantially the same arcuate extent, with the annular or arcuate spaces 25 between the lugs on each member greater in circular length than the arcuate extent of each adjacent lug on the other member, to permit alignment of the cooperable lugs when the sub 22 and packer body 10 are disposed in one relative load transmitting position, and alignment of the lugs 23 or 24 on one member with the intervening spaces 25 on the other member when the sub and packer body occupy another relative rotary position, in which complete disconnection between the body and sub can occur by moving one set of lugs 23 or 24 longitudinally through the spaces 25 between the other set. In the instant case, the lugs 24 are placed on the inner face of a sleeve 26 threadedly secured to the packer body and prevented from rotating therein by the set screw 27; but it is to be understood that these lugs could be formed integrally with the packer body, if desired, the specific construction disclosed being employed for convenience of manufacture and to obtain increased strength of the parts.

As will be apparent from the figures, the external and internal lugs 23, 24 cooperate to transmit upwardly directed pulling effort between the sub 22 of the tubular string and the packer body 10. Downwardly directed thrust between the sub and packer body is transmitted between the under surface 23a of the lugs on the sub and an internal shoulder or abutment 28 formed in the packer body.

To limit and positively determine the positions of alignment between the various lugs and intervening spaces, stops or keys 29, 30 are provided externally on the tubular string and internally on the threaded sleeve. These keys or cooperable stops are circumferentially arranged so as to limit relative rotation between the lugs 23, 24 to either of two positions; the first being a position of longitudinal alignment between the lugs, permitting an upwardly directed strain to be exerted between them; and another position being complete disalignment between the lugs to permit one set to pass without restriction through

the spaces 25 between the other set. The stops or keys 29, 30 are accordingly arranged above the lugs in such manner that when the sub 22 is rotated clockwise (as seen from the surface of the bore) its extent of relative travel with respect to the sleeve 26 is limited by engagement of the forward faces 29a of its stops with the rear faces 30b of the stops on the sleeve, as seen in Figure 7. In this position, the lower lugs 23 on the sub can pass freely upwardly between the other lugs 24. On the other hand, counter-clockwise movement of the sub relative to the sleeve is limited by engagement of the rear face 29b of each of its stops with an adjacent forward face 30a of another stop positioned to the right of the first-mentioned sleeve stop, as seen in Figure 6. In this position, the lower lugs 23 on the sub are in alignment with the lugs 24 on the sleeve and disconnection between them cannot occur, but upwardly directed pulling effort can take place.

In the operation of the coupling device in connection with the well packer shown in the drawings, the parts are initially assembled (as shown in Figure 1) with the lugs longitudinally spaced apart but in alignment for interengagement, the external lugs 23 on the sub being arranged below the sleeve lugs 24 and abutting the shoulder 28 on the packer body. The parts are held in this position by one or more shear screws 31 extending through the abutment ring 21 and packer body 10 into holes in the sub 22. Leakage between the sub exterior and the interior of the packer body is prevented by spaced packing rings 32, 33 carried by the sub, both above and below the cooperable lugs and keys, for slidable sealing engagement with the cylindrical bores 10a, 10b in the packer body. The assembled packer and tubular string can be lowered in the casing, being pushed through the mud or other fluid in the well by the thrust exerted between the lower lugs 23 and the internal shoulder 28 on the packer body (see Figures 1 and 5).

When the packer has been lowered in the casing to the desired setting point, the upper set of slips 11 is hydraulically tripped to anchor the packer to the casing against thrust exerted in an upward direction, as previously described. The taking of an upward strain on the tubular string B will then shear the screws 31 holding the sub to the packer body, upward travel of the sub 22 with respect to the packer body 10 being limited by the engagement of the upper surfaces 23b on the lugs 23 with the under surfaces 24a of the internal lugs 24 on the threaded sleeve (see Figure 6). Despite this relative movement, the sealing rings 32, 33 continue to seal the joint against leakage. A continuation of the upward pull on the tubular string will move the packer body 10 upwardly with it, due to the engagement between the lugs, and effect a packing-off of the rubber sleeve 17 and the setting of the lower slips 12 in the manner aforementioned. The parts are now in position for the performance of the desired operation within the well. If the well packer is to be used as a cement retainer, the required amount of cement slurry or other fluid can be pumped through the tubular string and packer, after which the tubular string can be released or uncoupled from the packer.

Such release is easily accomplished, simply by rotating the tubular string and its terminal sub 22 a fraction of a revolution, to move the stops or keys 29 on the sub in a clockwise direction from the position shown in Figure 6 into abutment with the rear faces 30b of the sleeve stops 75

30, as disclosed in Figure 7. This brings the lugs 23 on the sub into alignment with the spaces 25 between the lugs 24 on the sleeve, and completely out of alignment with the latter lugs. All that need be done thereafter is merely to raise the tubular string, as exemplified in Figure 8, and remove the sub completely from cooperative position with the lugs and stops on the sleeve.

Instead of a large number of revolutions being essential, as when a left-hand threaded coupling is employed, the specific design shown on the drawings only requires the sub 22 to be rotated about $\frac{1}{2}$ of a revolution to produce complete disconnection between the tubular string B and the set packer A. The fraction of a revolution given is not intended to limit the invention since it is obvious that the extent of relative rotation between the tubular string and packer body is dependent upon the angular disposition and spacing of the lugs. Similarly, it is to be understood that it is not essential that the number of keys or stops employed equal the number of lugs. Only one key on one of the members cooperable with one or two keys on the other member would suffice to selectively position the lugs relative to one another. Moreover, the coupling can be employed with other well packers than the one specifically disclosed, and with other specific types of devices.

I claim:

1. An apparatus of the character described comprising a well packer adapted to be anchored in a well casing, a tubular member for lowering said packer through said casing, one or more lugs on said packer, one or more lugs on said tubular member normally arranged below said packer lugs, cooperable stop means fixed to said tubular member and packer engageable with each other for positively limiting the extent of relative rotation and the relative angular positions of said lugs, enabling them to be selectively positioned from the surface of the casing in longitudinal alignment or disalignment.

2. An apparatus of the character described comprising a well packer adapted to be anchored in a well casing, a tubular member for lowering said packer through said casing, circumferentially spaced lugs on said packer, cooperable circumferentially spaced lugs on said tubular member normally positioned below said packer lugs and adapted to be in longitudinal alignment with said packer lugs when in one relative angular position to allow thrust to be transmitted therebetween, and in longitudinal disalignment with said packer lugs when in another relative angular position to permit complete uncoupling between said tubular member and packer, and cooperable stops fixed to said tubular member and packer engageable with each other to positively limit the relative angular positions occupied by said lugs.

3. An apparatus of the character described comprising a well packer adapted to be anchored in a well casing, a tubular member for lowering said packer through said casing, one or more lugs on said packer, one or more lugs on said tubular member normally arranged below said packer lugs, cooperable stop means on said tubular member and packer engageable with each other for positively limiting the extent of relative rotation and the relative angular positions of said lugs, enabling them to be selectively positioned in longitudinal alignment or disalignment, and frangible means connecting said tu-

bular member and well packer for maintaining said lugs in longitudinal alignment.

4. An apparatus of the character described comprising a well packer adapted to be anchored in a well casing, a tubular member for lowering said packer through said casing, one or more lugs on said packer, one or more lugs on said tubular member normally arranged below said packer lugs, cooperable stop means on said tubular member and packer engageable with each other for positively limiting the extent of relative rotation and the relative angular positions of said lugs, enabling them to be selectively positioned in longitudinal alignment or disalignment, frangible means connecting said tubular member and well packer to prevent their relative rotation, and an abutment on said packer below said packer lugs engageable with the under surfaces of the lugs on said tubular member.

5. An apparatus of the character described comprising a well packer adapted to be anchored in a well casing, a tubular member for lowering said packer through said casing, one or more lugs on said packer, one or more lugs on said tubular member normally arranged below and spaced from said packer lugs, cooperable stop means on said tubular member and packer engageable with each other for positively limiting the extent of relative rotation and the relative angular positions of said lugs, enabling them to be selectively positioned in longitudinal alignment or disalignment, and frangible means connecting said tubular member and well packer for maintaining said lugs in longitudinal alignment and spaced from one another.

6. An apparatus as defined in claim 5, means being provided between said tubular member and packer for preventing leakage of fluid therebetween.

7. An apparatus of the character described comprising a well packer adapted to be anchored in a well casing, a tubular member for lowering said packer through said casing, one or more lugs on said packer, one or more lugs on said tubular member arranged below said packer lugs, cooperable stop means on said tubular member and packer engageable with each other for positively limiting the extent of relative rotation between said tubular member and packer to position the lugs completely in longitudinal alignment or disalignment, and frangible means connecting said tubular member and well packer for preventing their relative rotation and for maintaining said lugs in longitudinal alignment.

8. An apparatus of the character described comprising a pair of tubular members one positioned within the other, one or more lugs positioned on each of said members with the lugs of one set arranged below those of the other set, stop means on said members engageable with each other for positively limiting the extent of relative rotation between said lugs to position them completely in longitudinal disalignment, and disconnectable means securing said members against relative rotation to maintain said lugs in longitudinal alignment.

9. An apparatus of the character described comprising a pair of tubular members one positioned within the other, one or more lugs positioned on each of said members with the lugs of one set arranged below and spaced from those of the other set, stop means on said members engageable with each other for positively limiting the extent of relative rotation between said lugs to position them completely in longitudi-

nal disalignment, and shear means securing said members against relative movement to maintain said lugs initially in spaced relation and in longitudinal alignment.

5 10. An apparatus of the character described comprising a tubular member piloted within a second tubular member, a set of circumferentially spaced lugs on the inner surface of said second member, a cooperable set of circumferentially spaced lugs on the exterior of said first-
10 named member arranged below and spaced from those of the other set, the arcuate extent of each lug being less than that of the adjoining

space between the lugs of the other set, stop means on said members engageable with each other for positively limiting the extent of relative rotation between said sets of lugs to position each lug in alignment with a space between lugs of the other set, and shear means securing said members against relative movement to maintain said sets of lugs in spaced relation and in longitudinal alignment with each other, whereby failure of said shear means will permit engagement between said sets of lugs and the transmissions of thrusts therebetween.

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