March 6, 1956 R. C. BAKER ET AL 2,737,243

APPARATUS FOR SETTING EQUIPMENT IN WELL BORES

Filed April 27, 1953 2 Sheets-Sheet 1

Fig. 1.

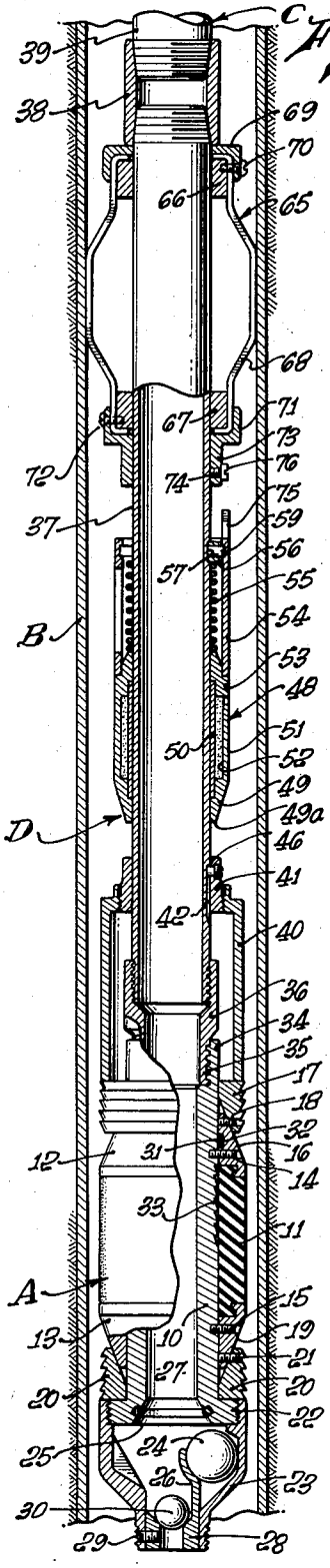


Fig. 2.

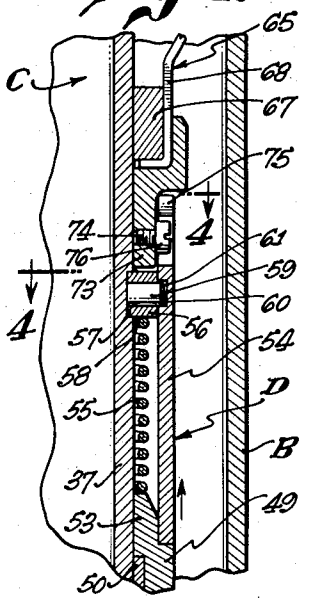


Fig. 3.

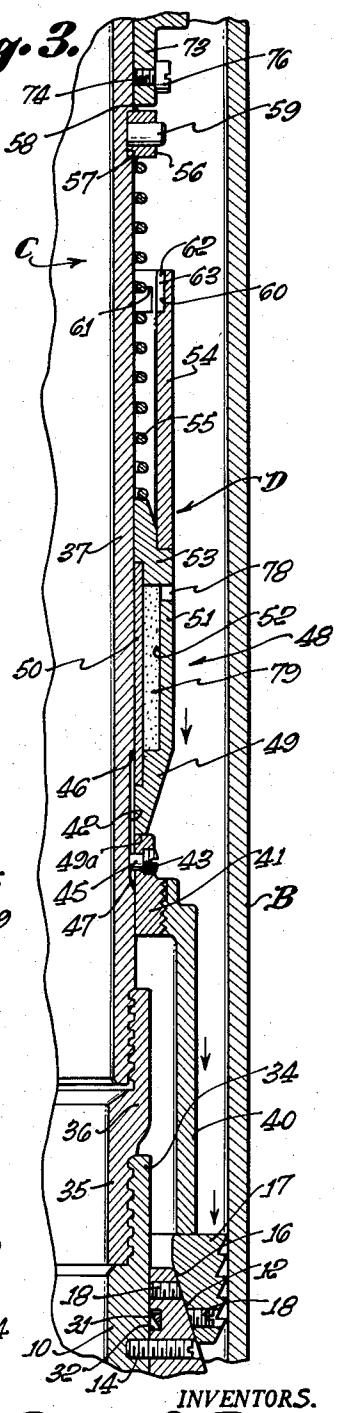


Fig. 4.

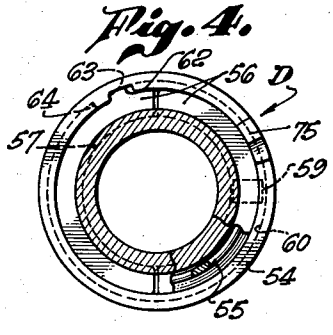


Fig. 5.

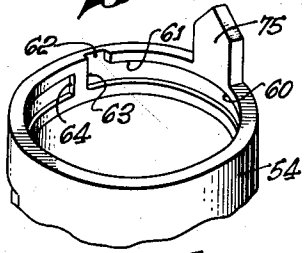
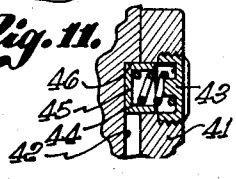


Fig. 11.



INVENTORS.
REUBEN C. BAKER,
JOHN R. BAKER,
By
Mellin and Hanscom
ATTORNEYS

March 6, 1956 R. C. BAKER ET AL 2,737,243

APPARATUS FOR SETTING EQUIPMENT IN WELL BORES

Filed April 27, 1953 2 Sheets-Sheet 2

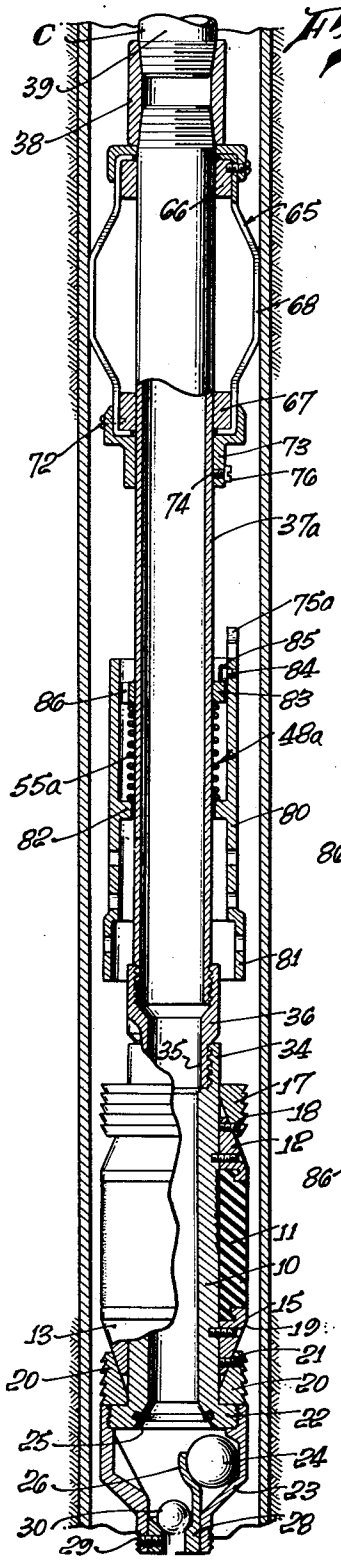


Fig. 6.

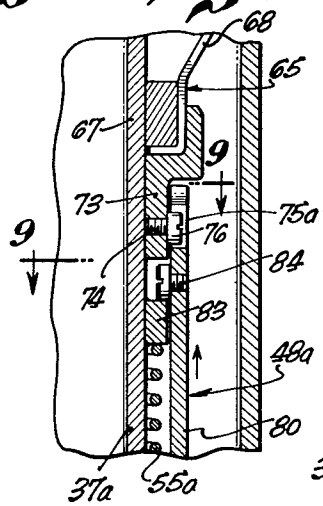


Fig. 7.

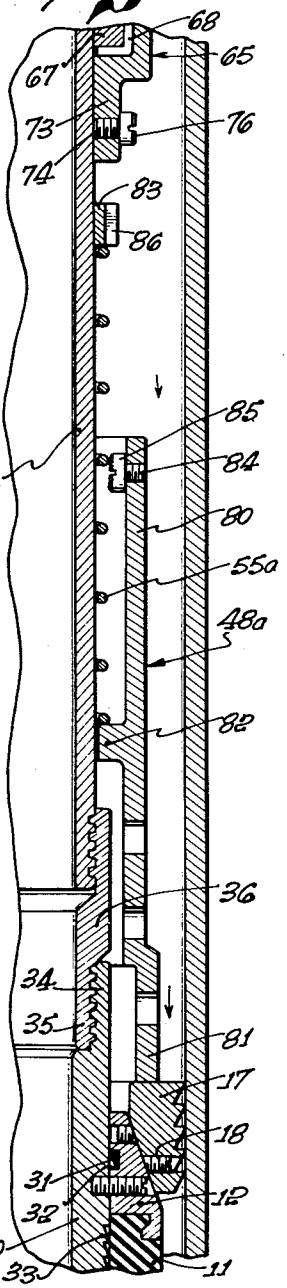


Fig. 8.

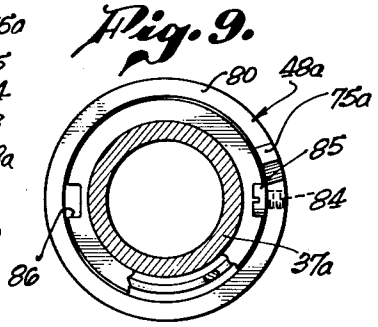


Fig. 9.

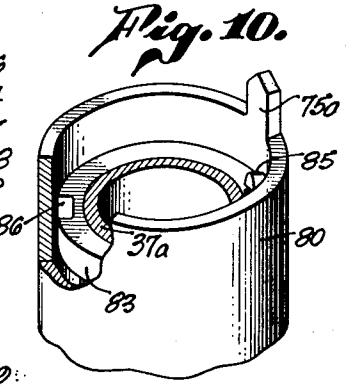


Fig. 10.

INVENTORS.
REUBEN C. BAKER,
JOHN R. BAKER,
By
Mellin and Hanscom
ATTORNEYS

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2,737,243

APPARATUS FOR SETTING EQUIPMENT IN WELL BORES

Reuben C. Baker, Coalinga, and John R. Baker, Pasadena, Calif., assignors to Baker Oil Tools, Inc., Los Angeles, Calif., a corporation of California

Application April 27, 1953, Serial No. 351,381

12 Claims. (Cl. 166—123)

The present invention relates to subsurface well tools, and more particularly to tools for setting or operating other equipment, such as well packers, in well bores.

An object of the present invention is to provide an improved apparatus for setting or anchoring a well tool, such as a well packer, in a well casing or similar well conduit.

Another object of the invention is to provide apparatus for setting or anchoring a well tool in a well conduit by rotating the running-in string to which the apparatus is connected, in which the extent of rotation required is greatly minimized.

A further object of the invention is to provide apparatus for setting or anchoring a well tool in a well conduit by delivering a hammer-like blow to the well tool.

Still another object of the invention is to provide setting apparatus for expanding normally retracted segmental slips of a well tool into anchoring engagement with a well conduit, the setting apparatus insuring the transverse alignment of the slips during the outward expansion in order to secure the well tool in a coaxial position in the well conduit.

Yet a further object of the invention is to provide a spring actuated setting apparatus for setting or anchoring a well tool in a well bore, in which the spring is readily energized for operation in the well bore.

This invention possesses many other advantages, and has other objects which may be made more clearly apparent from a consideration of several forms in which it may be embodied. Such forms are shown in the drawings accompanying and forming part of the present specification. These forms will now be described in detail, for the purpose of illustrating the general principles of the invention; but it is to be understood that such detailed description is not to be taken in a limiting sense, since the scope of the invention is best defined by the appended claims.

Referring to the drawings:

Figure 1 is a longitudinal section, with parts shown in elevation, of a well apparatus disposed within a well casing;

Fig. 2 is an enlarged fragmentary longitudinal section of a portion of the well apparatus shown in Fig. 1, with the parts occupying a different relative position;

Fig. 3 is a longitudinal sectional view of a portion of the apparatus disclosed in Fig. 1, with parts shown in another operative position;

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

Fig. 5 is an isometric projection of the holding sleeve portion of the apparatus;

Fig. 6 is a view similar to Fig. 1 of another embodiment of the invention;

Fig. 7 is a fragmentary longitudinal section, on an enlarged scale, disclosing parts of the apparatus in another operative position;

Fig. 8 is a longitudinal section, on an enlarged scale,

of a portion of the device shown in Fig. 6, the parts occupying another relative position;

Fig. 9 is a cross-section, on a reduced scale, taken along the line 9—9 on Fig. 7;

Fig. 10 is an isometric projection, with parts broken away, of a portion of the actuating mechanism.

Fig. 11 is a longitudinal section, on an enlarged scale, disclosing the parts of the detent device in the setting tool.

The several forms of invention illustrated in the drawings are intended for connection to a well packer A, which is to be run into a well casing B, or similar well conduit, on a tubular string C, and which is to be anchored in packed-off condition within the well casing by appropriate manipulation of a setting tool or device D carried by the tubular string, which actually forms part of the setting device. The well packer A disclosed may be of any suitable construction, the one specifically shown being of the type described in United States Letters Patent No. 2,121,050.

Essentially, the packer A consists of a tubular body **10** to which the setting tool D is detachably secured. The body has a packing sleeve **11** surrounding it, the upper and lower ends of the latter being suitably secured to upper and lower conical expanders **12**, **13**, respectively, attached to the body initially by one or more screws **14**, **15**. The outer surface **16** of the upper expander tapers upwardly and inwardly, engaging correspondingly tapered upper segmental slips **17** which are secured to it initially in retracted position by shear screws **18**. In similar fashion, the outer surface **19** of the lower expander **13** is tapered inwardly in a downward direction, engaging correspondingly tapered lower segmental slips **20** secured to the lower expander **13** initially in retracted position by shear screws **21**. The lower end of the body **10** is provided with a lower abutment **22**, in the form of an outwardly directed flange, for engagement with the lower end of the lower segmental slips **20**.

A valve housing and guide **23** is secured to the lower end of the body **10**. This housing contains a back pressure ball valve **24**, preferably buoyant in cement slurry, which is originally prevented from engaging its companion valve seat **25** at the lower portion of the body by a retainer arm **26** holding the ball against the housing to one side of the central passage **27** through the body. The arm **26** extends upwardly from a trip ball seat **28** secured initially in the lower end of the valve housing by a suitable shear screw **29**. A ball **30** may be disposed on the trip seat to preclude the downward flow of fluid through the central passage **27** of the body and to enable sufficient pressure to be built up in the body to shear the screw **29**, to eject the seat **28** from the valve housing **23**, so as to remove the arm **26** from its holding engagement against the ball **30**, allowing the latter to shift upwardly into engagement with its companion seat **25**.

The shear screws **18** holding the upper slips **17** to the upper expander **12** have a lesser shear value than the screws **14** holding the upper expander **12** to the body **10**. The shear screws **15**, **21** securing the lower expander **13** to the body **10** and the lower slips **20** to the expander **13** have a greater shear value than the shear screws **14** securing the upper expander **12** to the body. The relative strength of the various shear screws are selected in order that the upper slips **17** may first be released from their normally retracted positions through disruption of the slip screws **18**, to enable the upper slips **17** to expand outwardly against the well casing B. Following this action, the shear screws **14** attaching the upper expander **12** to the body **10** are disrupted, allowing the body **10** to be elevated to move the lower expander toward the upper expander, for the purpose of foreshortening the packing sleeve **11** and expanding it radially outward into firm

sealing engagement with the well casing B. A continuation of the upward strain on the body 10 will then disrupt the lower screws 15, 21, shifting the lower slips 20 upwardly along the lower expander 13 and radially outward into firm anchoring engagement with the well casing. Downward movement of the body 10 with respect to the expanders 12, 13 and the packing sleeve 11 is precluded by the engagement of a split lock or ratchet ring 31 contained in a groove 32 in the upper expander 12 with one of a series of circumferential ratchet teeth 33 formed on the exterior of the packer body 10.

The upper end of the packer body 10 is provided with a left-hand threaded box 34 receiving a companion left-hand threaded pin portion 35 of a sub 36, which is, in turn, threadedly secured to the tubular mandrel portion 37 of the tubular string C, the latter extending to the top of the well bore. The mandrel portion 37 and sub 36 may be considered as actually constituting part of the setting device D for shearing the upper slips screws 18 and effecting the downward movement of the upper slips 17 along the upper expander 12 and radially outward into anchoring engagement with the wall of the well casing B. To accomplish this purpose, a downward force is imposed on the upper slips 17, the packer body 10 being prevented from moving downwardly. Since, at this time, the shear screws 14 for securing the upper expander 12 to the body are intact, such downward movement of the slips 17 along the companion upper expander effects a radial shifting of the upper slips into engagement with the wall of the well casing B.

The setting tool D includes the mandrel 37 referred to above, the upper end of which may be threaded into a collar 38 threadedly receiving a section of tubing 39 forming a lower portion of the tubular string C extending to the top of the well bore. Surrounding the mandrel is a setting sleeve 40 whose lower end engages, or is disposed immediately adjacent, the upper end of the upper slips 17, the setting sleeve being threadedly secured to a setting ring 41 slidable relatively along the exterior of the mandrel 37. The upward position of the setting ring 41 and setting sleeve 40 along the mandrel 37 is limited by a suitable detent device secured to the setting ring 41 and riding in a longitudinal groove 42 in the mandrel. Thus, the detent includes an outer spring seat 43 threaded in the setting ring 41, against which a helical compression spring 44 bears, the other end of the spring being received within and bearing upon the base portion of a cup-shaped pin 45 sliding in the longitudinal mandrel slot 42. The pin engages the upper end 46 or wall of the slot, to prevent further upward movement of the setting ring 41 and setting sleeve 40 along the mandrel 37. The lower end 47 of the slot is provided with an outwardly and downwardly tapering wall that will urge the detent pin 45 out of the slot 42 when the ring 41 is moved in a downward direction along this tapered wall, for a purpose described hereinafter.

The setting ring 41 and setting sleeve 40 attached thereto are adapted to be driven downwardly along the mandrel 37 and with respect to the body 10, for the purpose of shearing the screws 18 attaching the upper slips 17 to the upper expander 12 and shifting the upper slips downwardly along the expander and radially outwardly into anchoring engagement with the wall of the well casing B. Such downward shifting is effected by means of a hammering or impact device. This device includes an impact or inertia member 48, consisting of a lower hammer head 49 to which inner and outer sleeves 50, 51 are secured in spaced relation, so as to form an annular chamber 52 therebetween. The upper ends of these sleeves 50, 51 are welded, or otherwise suitably secured, to an upper head 53, to which a holding sleeve 54 is welded, or otherwise suitably attached. This upper head 53 also acts as a spring seat for a compressed helical spring 55 having a substantial compressive force, the upper end of the spring engaging a ring 56 suitably attached to the mandrel. As disclosed, this ring may be made in two pieces inserted transversely into a peripheral groove 57 in the mandrel 37, and then secured to the mandrel as through use of welding material 58.

The compressed spring 55 tends to expand for the purpose of driving the impact or inertia member 48 downwardly into hammering engagement against the upper end of the setting ring 41. Initially, the lower end 49*a* of the hammer head is spaced upwardly away from the setting ring 41, to allow space for the impact member to accelerate sufficiently when the spring 55 is released, so as to impart a substantial hammer-like blow to the setting ring 41, for the purpose of shearing the slip screws 18 and driving the slips 17 downwardly along the tapered surface 16 of the upper expander 12. However, the spring 55 is prevented from expanding by a releasable holding device.

This holding device includes a pin 59 attached to the upper two-piece ring 56 extending radially outwardly therefrom into an internal circumferential groove 60 formed at the upper portion of the holding sleeve 54. The pin 59 engages the upper wall 61 of the groove and thereby secures the holding sleeve 54 and the hammer device 48 in its initial upward position, maintaining the heavy spring 55 in its compressed state. The upper wall 61 of the groove 60 has a vertical slot 62 therein which opens through the upper end of the wall and also into the circumferential groove 60. This vertical slot 62 is wider than the diameter of the holding pin 59, so that when the pin is brought into alignment therewith, the holding sleeve 54 is released to allow the spring 55 to expand and drive the impact device 48 downwardly against the setting ring 41. The pin 59 may be placed in alignment with the vertical slot 62 by rotating the mandrel 37, shifting the pin 59 in the circumferential groove 60 until it engages a vertical wall 63 in alignment with one side of the vertical slot 62. This vertical wall 63 has the purpose of also preventing the pin 59 from becoming aligned with the vertical slot 62 when the mandrel 37 is rotated in the opposite direction.

Originally, the pin is disposed against one surface 64 of the vertical wall 63, or almost a complete revolution from the vertical slot 62. When in this position, the spring 55 cannot expand. When the mandrel 37 is rotated sufficiently with respect to the holding sleeve 54, which, in the form of invention illustrated in the drawings, is almost a complete revolution, the pin 59 is placed in alignment with the vertical slot 62, thereby releasing the holding sleeve 54 and allowing the spring 55 to expand.

In order to effect the necessary relative rotation between the holding pin 59 and the holding sleeve 54, for the purpose of releasing the latter, it is necessary to prevent rotation of the holding sleeve. Such rotation is prevented, in the form of invention disclosed in Figs. 1 to 5, inclusive, by a friction drag device 65, which includes longitudinally spaced upper and lower collars 66, 67 to which are suitably secured circumferentially spaced outwardly bowed friction springs 68 adapted to bear upon the wall of the well casing B. The upper ends of the springs 68 are secured to the upper collar 66 by an encompassing retaining ring 69 and screws 70; whereas the lower ends of the springs are secured to the lower collar 67 by a lower retaining ring 71 and lower screws 72. This lower retaining ring 71 has a depending skirt 73 which may have an element 74 attached thereto for cooperation with a lug or finger 75 extending upwardly from the holding sleeve 54. As disclosed, the coupling element 74 is provided by a cap screw threaded into the skirt 73, the head 76 of the cap screw extending radially outward from the axis of the mandrel substantially the same distance as the lug or finger 75.

Until it is desired to effect outward expansion of the upper slips 17 into engagement with the well casing B, it

is preferred to maintain the holding sleeve 54 disconnected or disengaged from the drag device 65. For this reason, the drag device is allowed to slide upwardly on the mandrel 37 during the lowering of the apparatus in the well casing, to locate the coupling element 74 above the lug 75. Such upward movement of the drag device along the mandrel may be limited by engagement of the upper retaining ring 69 with the upper coupling collar 38 of the tubular string C. Accordingly, during lowering of the apparatus in the well casing B, there is no possibility of the holding sleeve 54 being inadvertently prevented from rotation, so that inadvertent rotation of the tubular string C can effect release of the pin 59 from the groove 60, which would allow the spring 55 to expand, and thereby causing premature setting of the well tool in the well casing. It is only after the desired location in the well casing B has been reached at which the well packer A is to be set that the tubing string C is elevated a slight distance, for the purpose of elevating the holding device in an upward direction until the lug 75 is in circumferential alignment with the coupling element 74. In the event that these two parts happen to be in vertical alignment, which might cause the lug to bump against the lower end of the coupling element, the lug 75 has its upper end pointed, one or the other of the tapered pointed surfaces engaging the pin 59, sliding the sleeve 54 arcuately to a slight extent, so that the lug comes into full circumferential alignment with the coupling element 74, as disclosed in Fig. 2.

Thereafter, the entire tubular string C may be rotated almost a full revolution, which will rotate the pin 59 with the mandrel 37 relative to the holding sleeve 54, inasmuch as rotation of the latter is prevented by engagement of its lug 75 with the coupling element 74, the coupling element being prevented from rotating by the frictional engagement of the springs 68 against the wall of the well casing B. When the pin 59 has been rotated in the circumferential groove 60 until it is in alignment with the vertical slot 62, the pin is no longer effective to maintain the holding sleeve 54 in an upward direction, releasing the spring 55 and allowing it to expand. Such expansion accelerates the impacting device 48 and drives it downwardly in a rapid manner into engagement with the upper end of the setting ring 41, this hammerlike blow being transmitted through the setting sleeve 40 to the top slips 17, shearing the slip screws 18 and driving the slips downwardly over the expander 12 and radially outward into engagement with the well casing B. After this action has occurred, the tubular string C may be elevated, to shear the other screws 14, 15, 21, effecting foreshortening and outward expansion of the packing sleeve 11 into firm sealing engagement with the wall of the well casing B, and shifting the lower slips 20 upwardly along the lower expander 13 and outwardly into engagement with the wall of the well casing. Thereafter, pressure may be imparted to the fluid in the tubing string C and packer body 10 to shear the trip ball seat screw 29 and blow it, with the trip ball 30 and retaining arm 26, out of the bottom of the valve housing 23, which action will free the back pressure valve member 24 and allow it to move upwardly into engagement with its companion seat 25.

In the event it is desired to increase the blow struck by the impacting device 48 upon the setting ring 41 and setting sleeve 40, the weight of the impacting device can be readily increased. As described above, the inner and outer sleeves 50, 51 of the impact device are spaced from one another to provide an annular chamber 52 therebetween. The upper portion of the outer sleeve 51 may be provided with a hole or window 78 communicating with the chamber. Molten lead 79 may be poured through this window 78 into the chamber 52, which will substantially increase the weight of the impacting device 48 and correspondingly increase the hammer-like blow which is struck by it on the setting ring 41.

The impacting device 48 is easily cocked or disposed in condition to actuate the top slips 17. Prior to the threading of the sub 36 into the packer body 10, the setting ring 41 and the setting sleeve 40 are moved downwardly of the mandrel 37, the detent 45 riding along the lower tapered wall 47 of the slot 42 and onto the periphery of the mandrel 37. The setting ring 41 may then be turned a partial revolution, to disalign the detent 45 and the slot 42. The setting ring 41 can then be moved freely upwardly along the mandrel 37 until it engages the lower end 49*a* of the impact hammer head 49. By use of a suitable tool, the setting sleeve 40 and ring 41 can then be urged in an upward direction along the mandrel 37, to shift the impact member 48 and the holding sleeve 54 upwardly for the purpose of compressing the spring 55. The holding sleeve 54 is rotated until the pin 59 is aligned with the vertical slot 62 and the holding sleeve shifted upwardly to still a further extent until the pin 59 is in the circumferential groove 60, whereupon the sleeve 54 and impacting device 48 are rotated almost a complete revolution until the pin 59 is disposed adjacent the wall surface 64, or almost a complete revolution away from the vertical slot 62. The setting ring 41 may then be moved downwardly and its detent 45 allowed to snap back into the longitudinal slot 42 under the influence of the spring 44, the ring 41 then being moved upwardly in the slot 42 until the detent engages the upper wall 46 of the slot, which is substantially normal to the axis of the mandrel 37. The sub 36 is then threaded into the upper end 34 of the packer body 10, which will dispose the lower end of the setting sleeve 40 adjacent the upper slips 17.

In the form of apparatus disclosed in Figs. 6 to 10, inclusive, essentially the same operation occurs as was described in connection with the embodiment shown in Figs. 1 to 5, inclusive. However, a setting ring and setting sleeve intervening between the impacting device and the upper slips is not used. Instead, the impacting device 48*a* is caused to operate directly upon the upper slips 17.

As disclosed, the impacting device 48*a* includes a sleeve-like member 80 that has a lower portion 81 adapted to engage the upper ends of the upper slips 17. This lower portion 81 is initially disposed in spaced relation to and above the upper slips. The hammering device possesses an intermediate inwardly directed flange portion 82 forming a seat for the lower end of the compressed helical spring 55*a*, the upper end of the spring engaging a ring or spring seat 83 welded, or otherwise suitably secured, to the mandrel 37*a*. The impacting device is initially disposed in the upper position shown in Fig. 6, with the heavy spring 55*a* held in its highly compressed condition by a holding or retaining device. As disclosed, this holding or retaining device includes a pin or cap screw 84 disposed in a radial direction and threaded into the sleeve 80 above the spring seat 83. The head 85 of the screw engages the upper surface of the spring seat 83, to hold the spring 55*a* compressed. However, the ring 83 is provided with a vertical slot 86 that is wider than the diameter of the screw head 85. When this slot 86 is placed in alignment with the head 85, the spring 55*a* is allowed to expand, to rapidly shift the sleeve 80 in a downward direction, for the purpose of striking an impact blow upon the upper slips 17, shearing the screws 18 and shifting the slips downwardly along the upper expander 12 and radially outward into anchoring engagement with the wall of the well casing B.

As described in connection with the other form of the invention, a lug or finger 75*a* having a pointed end also extends upwardly from the setting sleeve 80, and this lug is initially disposed in a lower position with respect to the coupling element 74 extending from the skirt portion 73 of the drag device 65.

The parts are assembled in the manner disclosed in Fig. 6, and are lowered in the well casing B to the point

therewithin at which the well packer A is to be set. During this time, the drag device 65 engages the lower end of the coupling collar 38, which places the coupling element 74 upwardly away from the lug 75*a* of the impact sleeve. The holding pin 84 on the sleeve 80 is engaging the upper surface of the spring seat 83 and may be disposed substantially diametrically opposite the vertical spring seat slot 86. At this time, the lower end 81 of the impact or inertia sleeve is disposed above and in spaced relation to the upper slips 17.

When it is desired to trip the upper slips 17, the tubular string C is elevated, to elevate the entire apparatus, with the exception of the drag device 65, placing the lug 75*a* in circumferential alignment with the coupling element 74. Thereafter, the tubular string C is rotated, the entire apparatus, with the exception of the drag device, rotating until the lug 75*a* engages the coupling element 74, which then precludes further rotation of the impacting sleeve 80. Continued turning of the tubular string C and the mandrel 37*a* then rotates the upper spring seat 83 until its slot 86 is in alignment with the radial pin 84. Such alignment removes the restraint on the spring 55*a*, allowing the latter to expand and shift the impacting sleeve 80 downwardly to deliver a hammer-like blow upon the upper slips 17, shearing the screws 18 securing the latter to the expander 12 and expanding the slips 17 outwardly into engagement with the well casing B. Thereafter, an upward strain may be taken on the tubing string C, mandrel 37*a* and packer body 10 to complete the anchoring and packing-off of the well packer A against the casing, in the manner described above.

Following the setting of the well packer A in the well casing B, and the blowing out of the trip ball seat 28, all as described above, the required operation or operations can be performed in the well bore. For example, if cement is to be pumped out of the well packer A, it moves down the tubular string C, mandrel 37 and packer body 10, flowing around the back pressure ball 24, and out through the lower end of the well packer. When sufficient cement slurry has been displaced through the apparatus, the pressure at the top of the well bore can be relieved, the back pressure ball 24 moving upwardly into engagement with its companion seat 25, to preclude return flow of the cement slurry into the packer body 10 and the tubular string C. Thereafter, the tubular string C may be rotated to the right, to disconnect the sub 36 from the packer body at the left-hand threaded connection 34, 35, the tubular string C and the setting apparatus D then being withdrawn to the top of the well bore.

It is, accordingly, apparent that setting apparatus for the well packer, or corresponding tool, has been provided in which it is only necessary to rotate the tubing string C a partial revolution to effect tripping of the upper normally retracted members or slips 17. Rotation of the tubular string through a plurality of revolutions is not necessary. In addition, substantial time is saved in setting the well packer, since the setting operation can be instituted at any time and without delay, merely by rotating the tubing string C. It is not necessary to wait until the tripping ball 30 engages the tripping ball seat 28 for the purpose of hydraulically setting the well packer, as described in the patent above referred to. Such trip ball may take a substantial time in dropping or being pumped down through the tubing string C from the top of the well bore. The impacting device does not operate prematurely, since there is nothing in the well bore tending to prevent its rotation until desired. The drag device 65 is maintained out of connection from the impacting device until the well tool is to be set in the well casing. In addition, the rapidity with which the impacting device is driven down against the top slips 17 causes all of the slips to be shifted downwardly along the upper expander 12, and radially outward into anchoring engagement with the well casing, in a transversely aligned position. Accordingly, when the slips 17 engage the well casing, they will have centered the body 10 of the well packer A in the well casing B, preventing its being disposed in a tilted or cocked position. When the tubular string C, its mandrel 37 and the packer body 10 are moved upwardly, for the purpose of completing the setting of the well packer in the well casing, a bending moment is not placed upon the body 10, which might cause its disruption and failure. In many instances, such packer bodies are made of cast material, such as cast iron or cast magnesium, which do not have great strength in bending.

The inventors claim:

1. In well apparatus: a well device having normally retracted means adapted to be expanded laterally outward into engagement with the wall of the well conduit; a member attached to the well device; means on said member engageable with said normally retracted means for expanding said normally retracted means outwardly, said means on said member comprising instrumentalities spaced from and movable toward said normally retracted means to impact said normally retracted means, spring means engaging said instrumentalities, holding means engaging said spring means and instrumentalities to hold said spring means in a stressed inoperative condition and to prevent movement of said instrumentalities relatively along said member toward said normally retracted means, and means for releasing said holding means to allow said spring means to propel said instrumentalities in a direction to impact said normally retracted means to expand said normally retracted means outwardly.

2. In well apparatus: a well device having normally retracted means adapted to be expanded laterally outward into engagement with the wall of the well conduit: a member attached to the well device; means on said member engageable with said normally retracted means for expanding said normally retracted means outwardly, said means on said member comprising instrumentalities spaced from and movable toward said normally retracted means to impact said normally retracted means, spring means engaging said instrumentalities, holding means engaging said spring means and instrumentalities to hold said spring means in a stressed inoperative condition and to prevent movement of said instrumentalities relatively along said member toward said normally retracted means, and means responsive to manipulation of said member for releasing said holding means to allow said spring means to propel said instrumentalities in a direction to impact said normally retracted means to expand said normally retracted means outwardly.

3. In well apparatus: a well device having normally retracted means adapted to be expanded laterally outward into engagement with the wall of the well conduit; a member attached to the well device; means on said member engageable with said normally retracted means for expanding said normally retracted means outwardly, said means on said member comprising instrumentalities spaced from and movable toward said normally retracted means to impact said normally retracted means, a spring compressed between said instrumentalities and a part on said member, first holding means secured to said instrumentalities, second holding means on said member releasably engaging said first holding means to hold said spring in a compressed inoperative condition and to prevent movement of said instrumentalities relatively along said member toward said normally retracted means, and means for releasing said second holding means from said first holding means in response to rotation of said member to allow said spring to expand and propel said instrumentalities in a direction to impact said normally retracted means to expand said normally retracted means outwardly.

4. In well apparatus: a well device having normally retracted means adapted to be expanded laterally out-

ward into engagement with the wall of the well conduit; a member attached to the well device; means on said member engageable with said normally retracted means for expanding said normally retracted means outwardly, said means on said member comprising instrumentalities spaced from and movable toward said normally retracted means to impact said normally retracted means, said member being rotatable relative to said instrumentalities, a spring compressed between said instrumentalities and a part on said member, first holding means secured to said instrumentalities, second holding means on said member releasably engaging said first holding means to hold said spring in a compressed inoperative condition, said second holding means being releasable from said first holding means in response to rotation of said member to allow said spring to expand and propel said instrumentalities in a direction to impact said normally retracted means to expand said normally retracted means outwardly, and means engageable with the well conduit for resisting rotation of said first holding means to enable said second holding means to be released from said first holding means.

5. In well apparatus: a well device having normally retracted means adapted to be expanded laterally outward into engagement with the wall of the well conduit; a member attached to the well device; means on said member engageable with said normally retracted means for expanding said normally retracted means outwardly, said means on said member comprising instrumentalities spaced from and movable toward said normally retracted means to impact said normally retracted means, said member being rotatable relative to said instrumentalities, a spring compressed between said instrumentalities and a part on said member, first holding means secured to said instrumentalities, second holding means on said member releasably engaging said first holding means to hold said spring in a compressed inoperative condition, said second holding means being releasable from said first holding means in response to rotation of said member to allow said spring to expand and propel said instrumentalities in a direction to impact said normally retracted means to expand said normally retracted means outwardly, and means engageable with the well conduit for resisting rotation of said first holding means to enable said second holding means to be released from said first holding means, said resisting means and first holding means having coengaging coupling elements adapted to be brought into engaging relation upon relative longitudinal movement of said first holding means with respect to said resisting means.

6. In well apparatus: a well device having normally retracted means adapted to be expanded laterally outward into engagement with the wall of the well conduit; a member attached to the well device; means on said member engageable with said normally retracted means for expanding said normally retracted means outwardly, said means on said member comprising instrumentalities spaced from and movable toward said normally retracted means to impact said normally retracted means, said member being rotatable relative to said instrumentalities, a spring compressed between said instrumentalities and a part on said member, first holding means secured to said instrumentalities, second holding means on said member releasably engaging said first holding means to hold said spring in a compressed inoperative condition, said second holding means being releasable from said first holding means in response to rotation of said member to allow said spring to expand and propel said instrumentalities in a direction to impact said normally retracted means to expand said normally retracted means outwardly, and a drag device on said member frictionally engageable with said well conduit and operatively connectible to said first holding means for resisting rotation of said first holding means to enable said second holding means to be released from said first holding means.

7. In well apparatus: a well device having normally retracted means adapted to be expanded laterally outward into engagement with the wall of the well conduit; a member attached to the well device; means on said member engageable with said normally retracted means for expanding said normally retracted means outwardly, said means on said member comprising instrumentalities spaced from and movable toward said normally retracted means to impact said normally retracted means, said member being rotatable relative to said instrumentalities, a spring compressed between said instrumentalities and a part on said member, first holding means secured to said instrumentalities, second holding means on said member releasably engaging said first holding means to hold said spring in a compressed inoperative condition, said second holding means being releasable from said first holding means in response to rotation of said member to allow said spring to expand and propel said instrumentalities in a direction to impact said normally retracted means to expand said normally retracted means outwardly, and a drag device on said member frictionally engageable with said well conduit and operatively connectible to said first holding means for resisting rotation of said first holding means to enable said second holding means to be released from said first holding means, said drag device being relatively movable longitudinally of said member into coupling relation with said first holding means upon longitudinal movement of said member.

8. In well apparatus: a well device having normally retracted means adapted to be expanded laterally outward into engagement with the wall of a well conduit; a member attached to the well device; means on said member engageable with said normally retracted means for expanding said normally retracted means outwardly, said means on said member comprising a sleeve spaced from and movable along said member toward said normally retracted means to impact said normally retracted means, said member being rotatable relative to said sleeve, a spring seat on said member, a spring adapted to be compressed between said seat and sleeve, releasable latch means between said member and sleeve to prevent longitudinal movement of said sleeve in one direction along said member to hold said spring in a compressed inoperative condition, and means responsive to rotation of said member within said sleeve for releasing said latch means to allow said spring to expand and propel said sleeve in a direction to impact said normally retracted means to expand said normally retracted means outwardly, and means engageable with the well conduit and operatively connected to said sleeve for resisting rotation of said sleeve.

9. In well apparatus: a well device having normally retracted means adapted to be expanded laterally outward into engagement with the wall of a well conduit; a member attached to the well device; means on said member engageable with said normally retracted means for expanding said normally retracted means outwardly, said means on said member comprising a sleeve spaced from and movable along said member toward said normally retracted means to impact said normally retracted means, said member being rotatable relative to said sleeve, a spring seat on said member, a spring adapted to be compressed between said seat and sleeve, releasable latch means between said member and sleeve to prevent longitudinal movement of said sleeve in on direction along said member to hold said spring in a compressed inoperative condition, and means responsive to rotation of said member within said sleeve for releasing said latch means to allow said spring to expand and propel said sleeve in a direction to impact said normally retracted means to expand said normally retracted means outwardly, a friction drag device relatively movable longitudinally along said member, said device being adapted to be spaced longitudinally from said sleeve and being moved relatively into coupling relation with said sleeve upon longitudinal

movement of said member and sleeve in one direction to resist rotation of said sleeve.

10. In well apparatus: a well device having normally retracted means adapted to be expanded laterally outward into engagement with the wall of a well conduit; a member attached to the well device; means on said member engageable with said normally retracted means for expanding said normally retracted means outwardly, said means on said member comprising a sleeve spaced from and movable along said member toward said normally retracted means to impact said normally retracted means, said member being rotatable relative to said sleeve, a spring seat on said member, a spring adapted to be compressed between said seat and sleeve, releasable latch means between said member and sleeve to prevent longitudinal movement of said sleeve in one direction along said member to hold said spring in a compressed inoperative condition, means responsive to rotation of said member within said sleeve for releasing said latch means to allow said spring to expand and propel said sleeve in a direction to impact said normally retracted means to expand said normally retracted means outwardly, means engageable with the well conduit and operatively connected to said sleeve for resisting rotation of said sleeve, said sleeve having a chamber therein, and weighting material in said chamber.

11. In well apparatus: a well device having normally retracted means adapted to be expanded laterally outward into engagement with the wall of a well conduit; a member attached to the well device; a setting sleeve slidable on said member and engageable with said normally retracted means for expanding said normally retracted means outwardly; an impact sleeve initially spaced from and movable along said member toward said setting sleeve to impact said setting sleeve and normally retracted means, said member being rotatable relative to said sleeve; a spring adapted to be compressed between said seat and impact sleeve; releasable latch means between said member and impact sleeve to hold said impact sleeve spaced from said setting sleeve and to hold said spring in a compressed inoperative condition; means for releasing said latch means in response to rotation of said member within said impact sleeve to allow said spring to expand and propel said impact sleeve in a direction to impact said setting sleeve and normally retracted means to expand said normally retracted means outwardly; and means engageable with the well conduit and operatively connectible to said impact sleeve for resisting rotation of said impact sleeve.

12. In well apparatus: a well device having normally retracted means adapted to be expanded laterally outward into engagement with the wall of a well conduit; a member attached to the well device; a setting sleeve slidable on said member and engageable with said normally retracted means for expanding said normally retracted means outwardly; an impact sleeve initially spaced from and movable along said member toward said setting sleeve to impact said setting sleeve and normally retracted means, said member being rotatable relative to said sleeve; a spring adapted to be compressed between said seat and impact sleeve; releasable latch means between said member and impact sleeve to hold said impact sleeve spaced from said setting sleeve and to hold said spring in a compressed inoperative condition; means for releasing said latch means in response to rotation of said member within said impact sleeve to allow said spring to expand and propel said impact sleeve in a direction to impact said setting sleeve and normally retracted means to expand said normally retracted means outwardly; means engageable with the well conduit and operatively connectible to said impact sleeve for resisting rotation of said impact sleeve; and means on said setting sleeve engageable with said member to limit movement of said setting sleeve toward said impact sleeve.

References Cited in the file of this patent

UNITED STATES PATENTS

2,266,382 Quintrell et al. ---------- Dec. 16, 1941
2,326,411 Taylor et al. ---------- Aug. 10, 1943