Feb. 13, 1940. O. T. BROYLES 2,189,937

DEEP WELL APPARATUS

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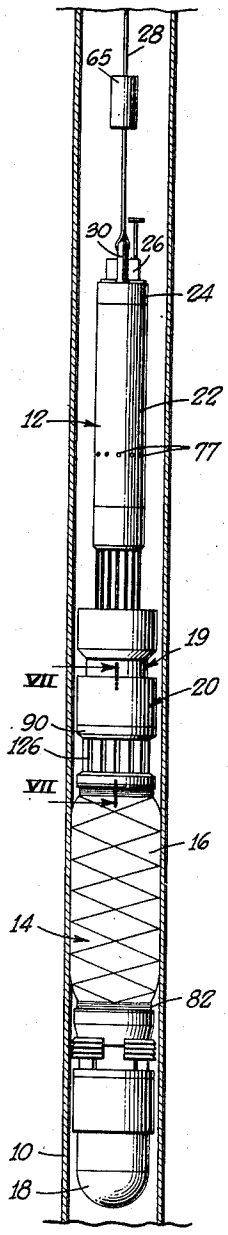

FIG. 1.

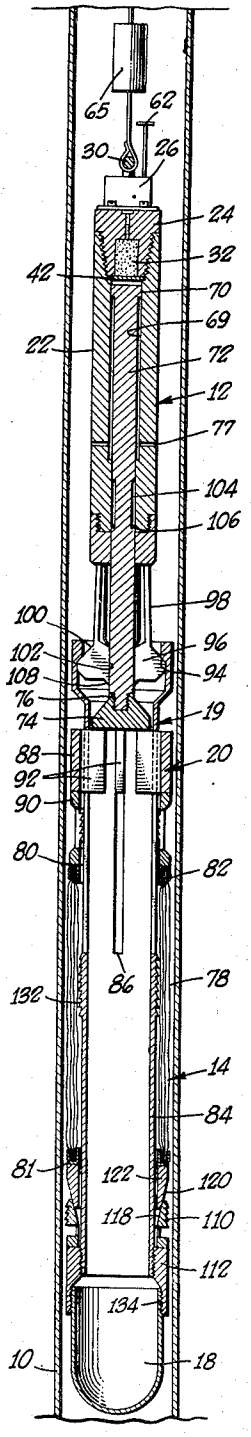

FIG. 2.

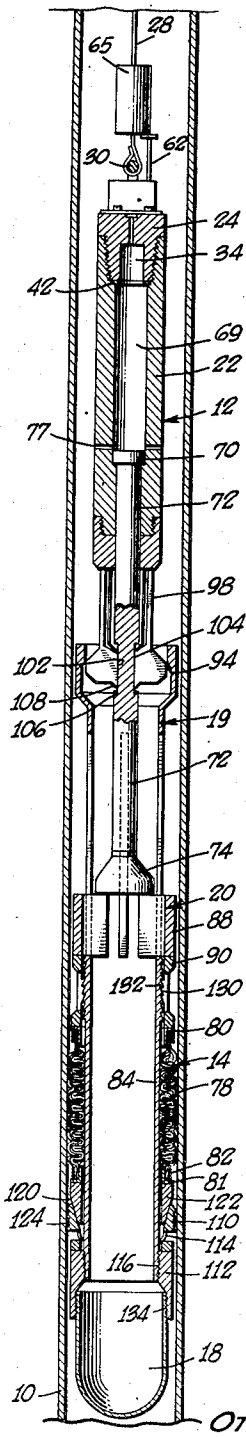

FIG. 3.

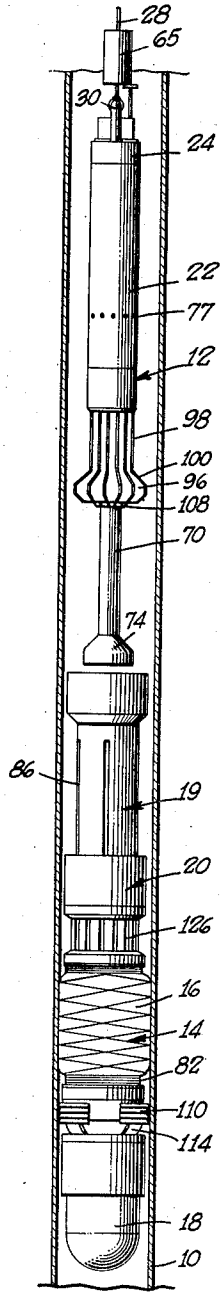

FIG. 4.

INVENTOR.
OTIS T. BROYLES

BY Harold W. Mellinger

ATTORNEY.

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DEEP WELL APPARATUS

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FIG. 5.

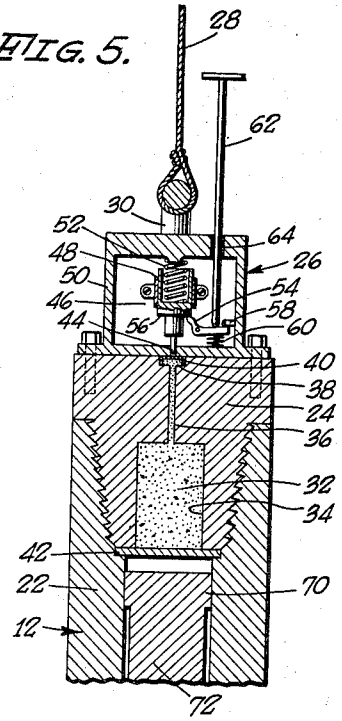


FIG. 6.

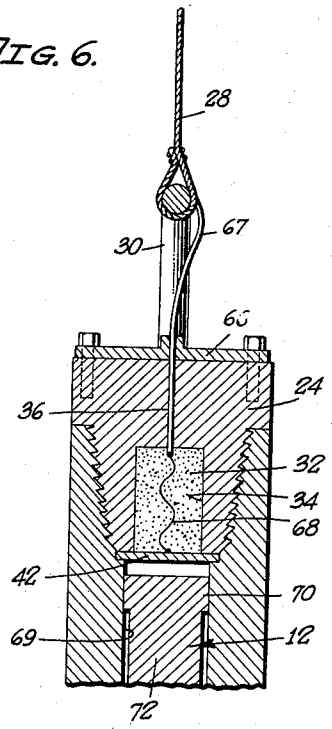


FIG. 7.

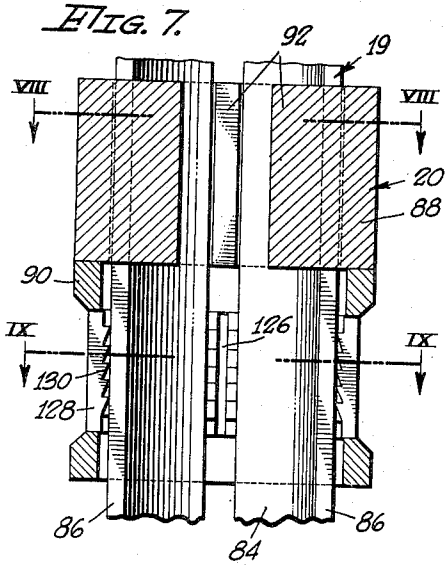


FIG. 8.

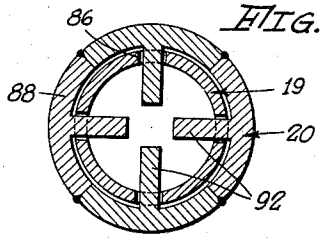
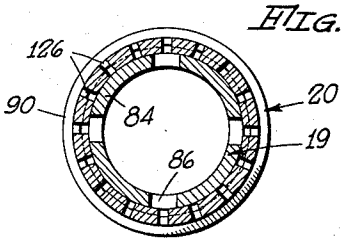


FIG. 9.



INVENTOR.
OTIS T. BROYLES
BY Harold W. Spratling
ATTORNEY.

Patented Feb. 13, 1940 2,189,937

UNITED STATES PATENT OFFICE

2,189,937

DEEP WELL APPARATUS

Otis T. Broyles, Los Angeles, Calif.

Application August 22, 1938, Serial No. 226,012

13 Claims. (Cl. 166—13)

My invention relates to deep well apparatus and refers especially to a packer setting device having particular utility in the oil producing industry.

My application is a continuance in part of my co-pending application, Serial No. 105,592, filed October 14, 1936, entitled "Deep well apparatus".

Packers are often used in the oil producing art for the purpose of sealing off the lower portion of an oil or gas well in cases where a lower oil producing zone has ceased to be productive and it is desired to produce from an upper producing zone. They are also used to close off the passage of gas or fluid between a well casing and a liner or screen which is inserted in the well. Packers are usually set many feet below the surface of the ground and numerous mechanisms have been devised for this purpose.

Most of the packer setting devices in use at the present time operate to set the packer by rotating the packer setting device relative to the packer when it is lowered to the proper position in the well bore. This requires that the packer setting device be lowered on a supporting medium which is relatively rigid in torsion as a rod or drill pipe. This method of setting packers requires a lengthy process of coupling and uncoupling the rod or drill pipe during the removal of the device as well as during the lowering of the device, and is of course, very expensive as compared to the operation of a device which may be lowered from a cable, which may be easily wound on a reel.

In most cases, it is also infeasible to set packers of this type at any location in the well except at the bottom, inasmuch as the packer must rest upon some supporting surface such as the bottom of the hole, in order to hold the packer setting device against the rotational force applied to the drill string for the purpose of operating the packer setting device.

It is also common practice to remove the packer setting device from the packer after it has been set, either by a rotation of the drill string to unscrew the setting device from the packet unit, or by a direct upward pull to break a shear pin which is used to support the packer during the lowering operation. Both of these methods of release have the same major disadvantage; namely, operation of the releasing mechanism has a distinct tendency to loosen the packer.

It is therefore a primary object of my invention to provide a device for setting a packer at any desired location in a well bore.

It is a further object of my invention to provide a device for setting a packer at any desired location in a well bore and to provide a means incorporated therewith for releasing said setting device without applying any force to the packer which would tend to loosen the same.

It is also an object of my invention to provide a device of this class which may be lowered into the well bore on a cable in contra-distinction to a rod or drill pipe, thereby affecting great economy in the operation of the device.

It is a further object of my invention to provide a device of this class in which the control of the setting operation is entirely independent of manipulation of the cable or other means which is used to lower and support the packer in the well bore.

It is also an object of my invention to provide a device of this class in which the control of the releasing operation for releasing the packer setting device from the packer is entirely independent of manipulation of the means which is used to support the packer in the well bore.

In accordance with the preceding objects, it is an additional object of my invention to provide a novel controlling device for operating the packer setter.

It is a further object of my invention to provide a novel releasing mechanism for releasing the packer setting device from the packer after the packer has been set.

It is an additional object of my invention to provide a packer setting device of this class, which is entirely protected against accidental operation.

It is a further object of my invention to provide a packer setting device in which the energy required for setting the packer is supplied by the packer setting device as opposed to a device in which the energy required for setting is transmitted down the supporting medium from the ground surface.

Other objects and advantages of my invention will be apparent from a study of the following specifications, read in connection with the accompanying drawings, wherein

Fig. 1 is an elevation of the packer setting device of my invention as it appears when being lowered in a well and illustrates the relation of the packer setting device, packer and bull plug associated therewith;

Fig. 2 is a longitudinal section of the device of my invention showing the relation of the parts prior to the performance of the setting operation;

Fig. 3 is a longitudinal section similar to Fig. 2, but showing the relation of the parts upon completion of the setting operation;

Fig. 4 is an elevation similar to Fig. 1, but shows the relation of the packer setting device and the packer upon the removal of the setting device from the packer after setting;

Fig. 5 is an enlarged longitudinal section showing the details of construction of a firing mechanism and firing chamber employed in my device;

Fig. 6 is a section similar to Fig. 1 showing an alternative form of the firing mechanism and firing chamber;

Fig. 7 is a fragmentary longitudinal section taken on the line VII—VII of Fig. 1 to show the construction of a sliding collar portion of my device;

Fig. 8 is a section taken along the line VIII—VIII of Fig. 7 showing the details of construction of the upper portion of the sliding collar; and

Fig. 9 is a section taken on the line IX-IX of Fig. 7 showing the construction of the lower portion of the sliding collar.

In Fig. 1, I have illustrated the appearance of the packer setting device of my invention as it appears when being lowered in a well casing 10. The packer setting device includes two main portions; namely, a setting device portion 12 and a packer portion 14. The packer portion 14 includes a packer 16 of a common type, well known to the oil producing art, and a bull plug 18 attached thereto. The packer unit 14 also includes a supporting cylinder 19 and a sliding collar 20, which is used to expand the packer 16 into the casing 10 through downward movement of the sliding collar 20 in a manner to be described hereinafter. The packer portion 14 is supported from the packer setting device 12, which includes a barrel 22, a firing chamber 24 and a firing mechanism 26. The entire assembly may be supported in the casing 10 by means of a cable 28 attached to a bail 30, which is in turn suitably attached to the packer setting device 12.

In accordance with the objects of my invention, I have provided in the packer setting device 12 a source of energy for setting the packer, which is independent of manipulation of the cable 28 and is best shown in Fig. 5. This source of energy comprises a charge of gun powder or other explosive material 32, which is carried by the explosive charge receiving means or firing chamber 24. Firing chamber 24 is provided with threads or other suitable means for attaching it to the barrel 22 and includes a recess 34 into which the explosive 32 is confined and a small pilot hole 36, which extends upwards from the back of the recess 34 and terminates in a smaller recess 38, in which I place a percussion cap 40.

In order that the ignition of the explosive material 32 may be complete and in order that a very high pressure may be built up in the chamber 24 prior to the release of this energy for operating the packer setting device, I have included a shear plate 42 which is confined between the firing chamber 24 and the barrel 22 and serves to completely close the otherwise open end of the recess 34.

In order that the time of ignition of the explosive 32 may be controlled from the surface of the ground at will by an operator, I have provided a novel firing mechanism which includes a firing pin 44 arranged to engage the percussion cap 40 whenever it is desired to fire the charge 32. The firing pin 44 is carried on a hammer mechanism 46, which includes a cylindrical-shaped portion guided in a suitable guide means 48 secured to a housing 50 and a recess in which is placed a compression spring 52. Spring 52 is arranged to engage the bottom of the recess in the hammer 46 and the upper portion of the housing 50 in such a manner as to force the hammer 46 downwardly and engage the firing pin 44 with the percussion cap 40.

In order that the operation of the hammer and firing pin may be controlled at will by the operator, I have provided a trigger 54 pivotally mounted on housing 50 and including a nose portion adapted to engage the underside of an overhanging edge 56 of the hammer 46. A trigger stop 58, suitably attached to the housing 50, is employed to restrain the trigger 54 against counter-clockwise movement tending to result from the hammer 46 being urged downwardly by the compression spring 52. The trigger 54 is urged into engagement with the hammer 46 by a means of a compression spring 60 engaging the underside of the trigger 54, as illustrated in Fig. 5. I have provided a trigger operating rod 62 which engages the trigger 54 and is guided by a hole 64 in the upper portion of housing 50.

When it is desired to operate the packer setting device by exploding the charge 32, a weight 65 (Figs. 2 and 3) is slid down the cable 28 from the ground surface. At the conclusion of the descent of the weight 65, it engages the upper end of the trigger operating rod 62, forcing said rod downwardly and causing clockwise rotation of the trigger 54. Clockwise rotation of the trigger 54 then disengages the nose thereof from the underside of the overhanging ledge 56 of the hammer 46 allowing the hammer 46 to be forced downwardly by the compression spring 52 in such a manner as to cause the firing pin 44 to engage the percussion cap 40 with sufficient violence to explode the charge contained therein. Explosion of the percussion cap 40 ignites the explosive contained in the recess 34 and the pilot hole 36. When the pressure in the chamber 34 reaches a very high value as a result of the explosion, the shear plate 42 will shear and allow the energy of the exploded mixture to expend itself downwardly into the upper portion of barrel 22.

I prefer to allow generous clearance for the rod 62 in the hole 64, so as to provide for the equalization of pressure inside and outside of the housing 50 in order to eliminate the danger of a pressure differential, resulting from fluid or gas pressure in the well, forcing the rod 62 down sufficiently to release the trigger and operate the device.

I have also illustrated in Fig. 6 an alternative method of firing the charge 32. In this alternate method the housing 50, containing the hammer and trigger mechanisms, is removed and a flat plate 66 is substituted. An electrical conductor 67 is led through a suitable hole in the plate 66 and down the pilot hole 36 to a suitable termination in the explosive recess 34. At this point a fusible wire 68 is attached to the electrical conductor 67 and is embedded in the explosive 32 with the other end thereof making electrical contact with the shear plate 42. The electrical conductor 67 extends with the cable 28 to the ground surface.

The charge may be fired by connecting one polarity of a suitable source of electrical energy to the electrical conductor 67 and the other polarity to the cable 28. The electrical current then flows down the conductor 67, through the fusible wire 68 to the metal shear plate 42, thence through the metal parts to the bail 30, and through the supporting cable 28 to the other side of the source of electrical energy. The electrical current flowing through the fusible wire 68 thereupon raises its temperature sufficiently to cause ignition of the explosive charge 32.

In order that the energy of the ignited explosive may be used to set the packer, I provide the

barrel 22 with a bore 69, into which is fitted a piston 70 formed on the upper end of a piston rod 72. Piston rod 72 is guided in its downward motion by the lower end of the barrel 22 in which the bore is reduced to a smooth sliding fit with the piston rod 72.

I provide at the lower end of the piston rod 72 a head 74 which is attached to the piston rod as by screw threads 76, and which is arranged to transmit to the packer 16 the downward movement of the piston 70 in a manner to be described hereinafter.

In order to insure that the piston 70 will travel sufficiently far to force the packer 16 securely in place and to prevent excessive movement of the piston 70 which might result in excessive stresses in some of the packer members, I provide ports 77 in the barrel 22 located at the end of the stroke of the piston 70 to allow the escape of the gases generated by the explosion after the expansion of these gases has properly set the packer.

The packer 16 usually consists of multiple layers of fabric or other similar material 78, secured to end rings 80 and 81 as by wire binding 82. In the present invention, the end rings 80 and 81 are arranged to slide freely upon a packer sleeve 84, which is fitted at the upper portion with a plurality of longitudinal slots 86. The sliding collar 20 is also arranged to slide on the outside of the packer sleeve 84, and includes an upper forcing collar portion 88 and a lower locking ring 90.

As best shown in Figs. 7 and 8, the forcing collar includes a collar shaped portion to which are attached inwardly extending ribs 92. The ribs 92 are so located and arranged as to extend from the forcing collar 88, which surrounds the exterior of the packer sleeve 84, through the slots 86 into the interior of the packer sleeve 84 in such a position as to be engaged by the head 74 of the piston rod 72. It will thus be readily seen that downward motion of the piston 70 and the head 74 connected therewith, will cause the forcing collar 88 to be moved downward therewith. The locking ring 90, located immediately below the forcing collar 88, is also arranged to slide freely over the packer sleeve 84 and rests upon the upper end ring 80 of the packer 16 so that downward movement of the piston 70, resulting from firing the charge 32, will be transmitted through the forcing collar 88 and the locking ring 90 to the upper end ring 80 of the packer, thereby causing downward movement of the end ring 80 to compress the packer as illustrated in Fig. 3.

I prefer to form the ribs 92 of such material that they will shear off when the packer has been "set" or compressed to a predetermined value, so that it will be impossible to injure the packer by the setting forces applied to it.

In order that the packer assembly be removably attached to the packer setting device for lowering into the well, I provide at the upper end of the packer sleeve 84 a socket, comprising an internally undercut recess 94, arranged to be engaged by a resilient expansive means, comprising a plurality of head-like members 96 supported by spring fingers 98 from the lower end of the barrel 22. The heads 96 are formed with an outer surface 100 adapted to engage the underside of the under-cut recess 94 and an inner surface 102 which lies parallel to and fits snugly against the side of the piston rod 72. The spring members 98 are flexed so as to force the heads 96 inwardly against the piston rod 72. The packer portion 14 of my device, therefore depends from the packer setting portion 12 by the overlap of the surfaces 94 and 100.

In order that the packer setting portion 12 will be disengaged from the packer 16 as soon as the latter is set, to allow unhampered removal of the setting portion 12 from the well, I provided in the piston rod 72 an annular recess 104 located in such position as to lie directly opposite the inner surface 102 of heads 96 when the piston 70 has made a complete stroke for setting the packer. When in this position, as illustrated in Fig. 3, the heads are urged and move inwardly toward the axis of the piston rod 72 as a result of the resilience of the spring members 98. The movement of the heads 96 into the recess 104 reduces the diameter of the circle defined by the outer edges of the plurality of heads 96 sufficiently for the heads 96 to clear the reduced diameter of the portion of the packer sleeve 84 directly above the undercut surface 94. This then allows the packer setting device to be moved upwardly as by hoisting the cable 28 without in any way effecting the packer assembly 14.

In a device of this class, it is very important that the packer setting mechanism be detachably coupled to the packer unit, and that removal of the packer setting device may be accomplished without in any way disturbing the packer once it has been set. It will be seen that the device just described adequately meets these conditions, and that the operation of setting the packer automatically and completely frees the packer setting device from the packer unit.

I prefer to form the annular recess 104 in the piston rod 72 in such a manner as to provide an undercut portion 106, which is adapted to be engaged by complementary projections 108 formed on the lower edges of heads 96.

In operation it will be seen that whenever the annular recess 104 moves downwardly to a point where it lies opposite the heads 96, movement of the heads inwardly, under action of the springs 98, will place the fingers 108 in a position to engage the under-cut portion 106 of the annular recess 104. Should the piston rod 72 tend to move upwardly after making a complete stroke through release of the pressure above and having a tendency to rebound from the forcing collar 88, the fingers 108 will engage the under-cut portion 106 and operate in a wedge-like manner to prevent the heads 96 from being forced outwardly into a locking position.

The provision of a mechanism of this type for preventing rebound of the piston 70 is of the greatest importance. Should this mechanism be omitted, it is easily seen that the piston 70 might rebound a very short distance, but sufficiently to re-expand the fingers 98 and the heads 96 attached thereto, thus placing them in the initial over-lapping arrangement with the recess 94 so as to maintain the connection between the packer and the packer setting device. Should this occur, great expense and loss of time would be incurred in attempting to extract the setting device, or, both the setting device and the tightly set packer attached thereto from the well.

In order that the downward movement of the end ring 80 of the packer 16, resulting from the ignition of the explosive, will not only expand the packer 16 so as to completely fill the space between the packer sleeve 84 and the casing 10, but will also operate to lock the assembly rigidly to the casing, I provide slips 110 adapted to be

forced into engagement with the casing 10 by downward movement of the packer end ring 80.

For this purpose, I provide a collar 112 to which are securely attached spring members 114, also attached to the slips 110 and so flexed as to hold the slips inwardly away from the surface of the casing 10 until they are forced outwardly by the operation of setting the packer. The collar 112 is attached to the lower end of the packer sleeve as by screw threads 116.

I have provided means for forcing the slips outwardly against the casing 10, including tapered surfaces 118 on the slips 110, arranged to be engaged with a correspondingly tapered surface 120 of a wedging collar 122. Wedging collar 122 slides freely upon the packer sleeve 84 and is arranged to be engaged by the lower packer end ring 81. It will thus be seen that as the upper end ring 80 is urged downwardly by the forcing collar 88 and the locking ring 90, the fabric portion of the packer 78 will be compressed and will expand outwardly to fill the space between the packer sleeve 84 and the casing 10, as illustrated in Fig. 3.

However, as soon as the fabric 78 completely fills the space between the packer sleeve 84 and the casing 10, further downward movement of the upper end ring 80 will cause the entire packer 16 and its lower end ring 81 to move downwardly on the packer sleeve 84 as a unit. The downard movement of the lower end ring 81 will force the wedging collar 122 downward, and through inter-action of the tapered surfaces 118 and 120, force the slips 110 into engagement with the casing 10. The slips 110 are provided with serrations 124, which are adapted to bite into the metal casing 10, thereby securing the packer and the packer sleeve securely in position in the casing.

I have provided means for locking the packer 16 in its expanded position, said means including the locking ring 90, best shown in Figs. 1, 7 and 9. Locking ring 90 has longitudinal slots 126 formed in the mid-portion thereof so as to divide the locking ring into an upper and a lower collar portion, connected by vertical bar-shaped members 128. The members 128 are provided with ratchet-like serrations 130, facing inwardly toward the outer surface of the sleeve 84. I have provided similar serrations 132, formed on the outer surface of the packer sleeve 84 in such position as to be engaged by the serrations 130 of the locking ring 90 when the ring 90 is forced downwardly into a position corresponding to the expanded position of the packer 16, as shown in Figs. 2 and 3. I have arranged the serrations 130 and 132 to point in opposite directions so that through resilience of the bar-shaped members 128, the locking ring 90 may be forced down over the serrations 132, and so that upward movement of the locking ring 90 will be prevented by the interlocking of the serrations 130 and 132. It is thus apparent that the locking ring 90 operates not only to force the packer 16 into the expanded position, but also operates as a means of maintaining the packer in said position.

For the purpose of illustration, I have shown a bull plug 18 attached to the lower end of the packer 16 by means of screw threads 134 on the bull plug 18 and the collar 112. It is obvious that devices such as liners, flow tubing, whip stocks, screens, cement retainers, and other tools required to be forcibly set into the hole may be installed in a similar manner.

It will therefore be seen that I have provided a packer setting device which may be lowered by means of a cable into a well bore to any desired location and at that location operated to set the packer. The operation of setting the packer automatically disconnects the packer setting device from the packer unit, allowing the setting device and the cable used for supporting said device to be readily removed from the well.

It will also be noted that I have provided a novel method of supplying the energy required to set the packer, in which the energy or force required for setting is contained in the setting device and is not transmitted over the medium used for supporting the setting device in the well.

I have also provided a unique means of actuating the packer setting device so as to reduce to a minimum the possibility of accidental operation and the resultant setting of the packer at some undesirable location in the well.

While I have shown and described the preferred embodiment of my invention, I do not desire to be limited to any of the details of construction shown or described herein, except as described in the appended claims.

I claim:

1. In a tool setting device, the combination of: a tool to be set in a well by force exerted upon the tool when lowered to a desired location; means for lowering said tool into said well; means detachably securing said tool to said lowering means; power means on said lowering means for setting said tool; and means responsive to operation of said power means for detaching said tool from said lowering means.

2. In a packer setting device, the combination of: a packer to be set in a well; a setting device for carrying and setting said packer; flexible lowering means attached to said setting device for lowering said device and said packer in said well; a source of energy carried by said setting device releasable for applying a setting force to set said packer; actuating means on said device for releasing said energy; a sliding member encircling said lowering means and movable by gravity from the ground surface to the location of said setting device; and control means disposed in a position to be engaged by said sliding member for actuating said actuating means.

3. In a packer setting device, the combination of: a packer to be set in a well by compression; a setting device detachably secured to said packer for applying a compressive force to set said packer, said device including a housing, a source of energy restrained in said housing and a member movable by reaction of said energy when released for compressing said packer; a means for releasing said energy; and means on said housing responsive to movement of said member for limiting the distance through which said compressive force acts by detaching said packer from said setting device when said member is moved a predetermined distance.

4. In a packer setting device, the combination of: a packer to be set in a well by compression; a setting device for applying a compressive force to set said packer, said device including a barrel, an explosive confined in one end of said barrel and a piston movable in said barrel by reaction of said explosive for compressing said packer; a means for firing said explosive; and means on said barrel co-operating with said piston and said packer for limiting the distance through which said piston acts.

5. In a tool setting device, the combination

of: a tool to be set in a well by force exerted upon said tool when lowered to a desired location; a setting device for lowering said tool and for applying a setting force to set said tool, said device including a barrel, an explosive confined in one end of said barrel and a piston movable in said barrel by reaction of said explosive for exerting said force; coupling means detachably coupling said setting device to said tool; a means for firing said explosive; and means actuated by movement of said piston to operate said coupling means for detaching said setting device from said tool.

6. In a packer setting device, the combination of: a packer to be set in a well by compression; a setting device for applying a compressive force to set said packer, said device including a barrel, an explosive confined in one end of said barrel and a piston movable in said barrel by reaction of said explosive for compressing said packer; coupling means detachably coupling said setting device to said packer; a means for firing said explosive; and limiting means on said barrel co-operating with said piston and said packer for limiting the movement of said piston to a predetermined value and for operating said coupling means to detach said setting device from said packer when said value is reached.

7. In a well apparatus, a packer setting device and a casing packer unit, a barrel included in said device, an explosive charge receiving means mounted on the barrel, means for firing the charge, a piston movable in the barrel by the impact of the fired charge, a slotted sleeve included in the packer unit, a compressible packing member surrounding the slotted sleeve, means engaging the packing member and including means slidably mounted in the slots and engaged by the piston to be moved thereby for compressing the packing member in sealed position against the casing, a plurality of headed spring fingers formed on said barrel and held expanded by the piston, means at the upper end of the slotted sleeve to receive the heads for detachably connecting said setting device to the packer unit, and said piston having a reduced portion to receive the heads upon movement of the piston to allow the fingers to contract for releasing the setting device from the packer unit to permit removal of the setting device from the well.

8. In a well apparatus, a packer setting device, a casing packer unit removably attached to the setting device, an explosive charge receiving means included in the setting device, means for firing the charge, a piston movable by the impact of the fired charge, a slotted sleeve including in the packer unit, a compressible packing member surrounding the sleeve, means engaging the packing member and including means slidably mounted in the slots and engageable by the piston to be moved thereby for compressing the packing member in sealed position against the casing and means for releasing the setting device from the packer unit to allow removal of the setting device from the well.

9. In a tool setting device for securing tools within a well casing at any desired location, the combination of: a tool to be set in said casing; a tool carrier secured to said tool and including means actuatable by a setting force exerted thereon to engage said casing and secure said tool therein when lowered to a desired location; a setting device detachably secured to said tool carrier; means for lowering said setting device and tool carrier in said well; power means on said setting device for applying said setting force to said tool carrier; and means responsive to operation of said power means for detaching said tool carrier from said setting device.

10. In a tool setting device for securing tools within a well casing at any desired location, the combination of: a tool to be set in said casing; a tool carrier secured to said tool and including means actuatable by a setting force exerted thereon to engage said casing and secure said tool therein when lowered to a desired location; a setting device for carrying said tool carrier and setting said tool; means for lowering said device and said carrier in said well; a chamber in said setting device; an explosive in said chamber for creating said setting force; means for applying said setting force to said tool carrier; and a firing control means on said device for firing said explosive.

11. In a tool setting device for securing tools within a well casing at any desired location, the combination of: a tool to be set in said casing; a tool carrier secured to said tool and including means actuatable by a setting force exerted thereon to engage said casing and secure said tool therein when lowered to a desired location; a setting device for setting said tool; coupling means detachably coupling said setting device to said tool carrier; means for lowering said device and said carrier in said well; a source of energy carried by said setting device, releasable to apply said setting force to set said tool carrier; and a mechanism operably responsive to the setting of said tool carrier to operate said coupling means for detaching said device from said carrier.

12. In a tool setting device for securing tools within a well casing at any desired location, the combination of: a tool to be set in said casing; a tool carrier secured to said tool and including means actuatable by a setting force exerted thereon to engage said casing and secure said tool therein when lowered to a desired location; a setting device for applying said setting force to said tool carrier including a barrel, an explosive confined in one end of said barrel and a piston movable in said barrel by reaction of said explosive for setting said tool carrier; coupling means detachably coupling said setting device to said carrier; a means for firing said explosive; and limiting means on said barrel cooperating with said piston and said tool carrier for limiting the movement of said piston to a predetermined value and for preventing the operation of said coupling means to detach said setting device from said carrier until said tool is set by said predetermined movement of said piston.

13. In a tool setting device, the combination of: a tool to be set in a well by force exerted upon said tool when lowered to a desired location; a setting device for lowering said tool and for applying a setting force to set said tool, said device including a barrel and a piston movable in said barrel for transmitting said setting force to said tool; means confining an explosive in one end of said barrel to prevent said explosive from acting upon said piston after firing until said fired explosive has developed a force of predetermined value and for releasing said force to act upon said piston when said predetermined value is reached; and a firing control means on said device for firing said explosive when said tool has been lowered to said desired location.

OTIS T. BROYLES.