Feb. 4, 1941. R. BASSINGER 2,230,447

WELL PLUG

Filed Aug. 26, 1939 3 Sheets-Sheet 1

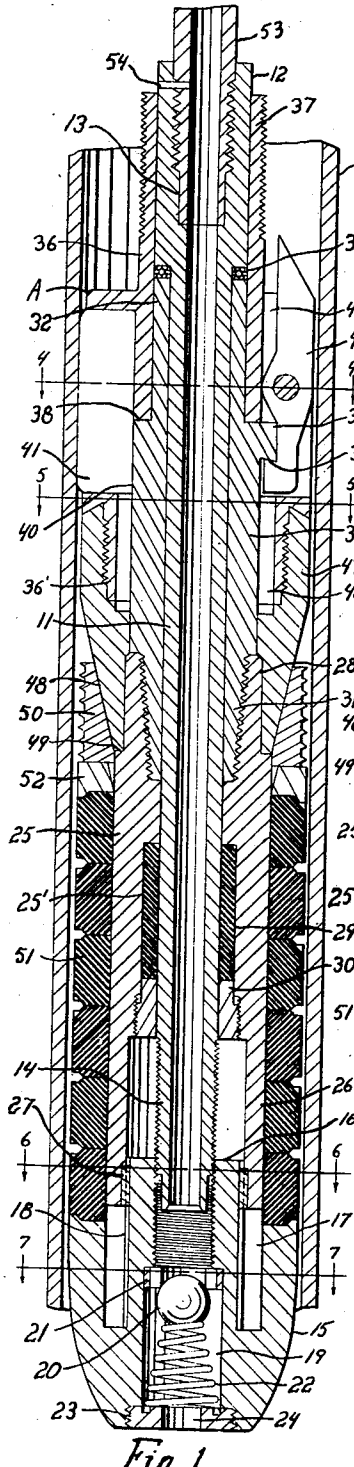

Fig. 1

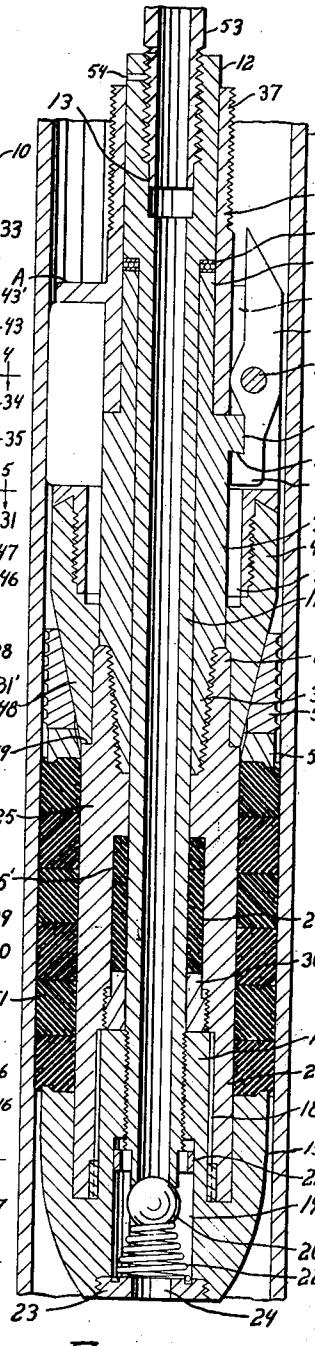

Fig. 2

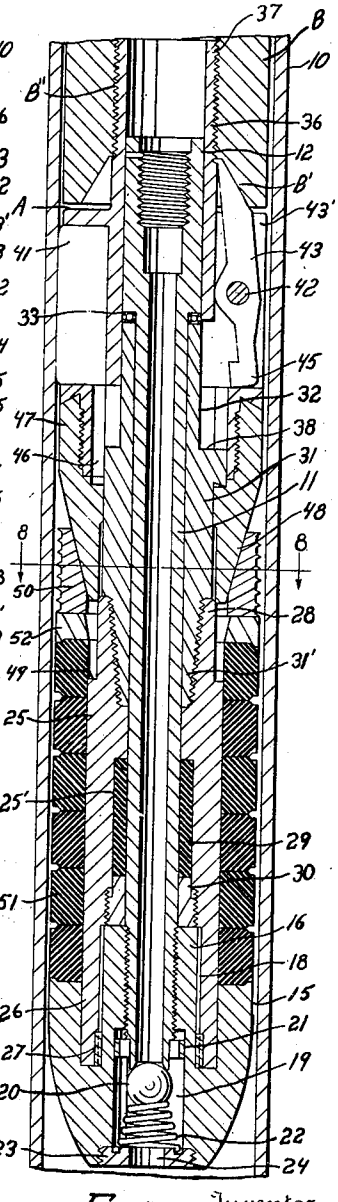

Fig. 3

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WELL PLUG

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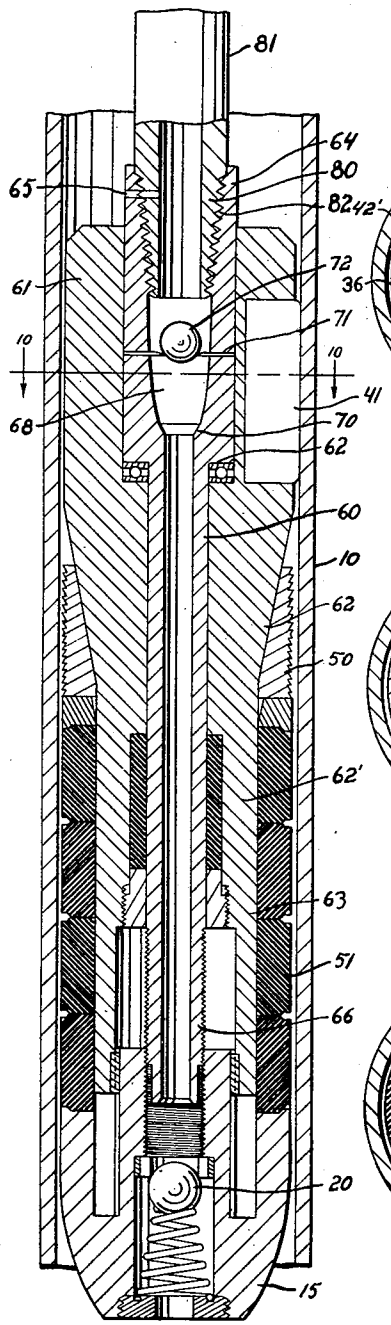

Fig. 9

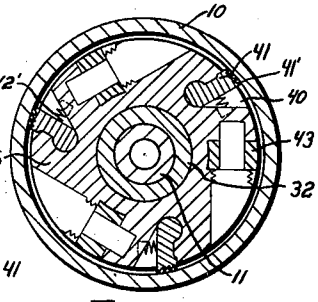

Fig 4

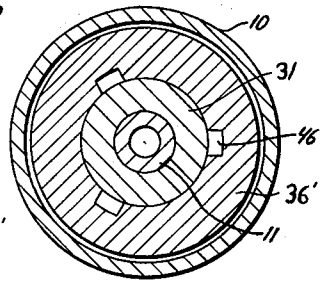

Fig. 5

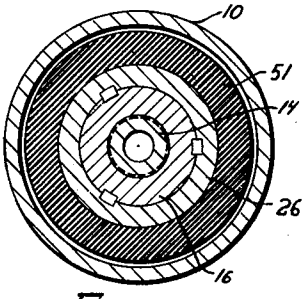

Fig. 6

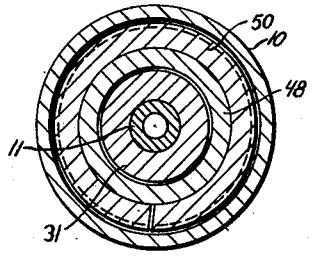

Fig. 8

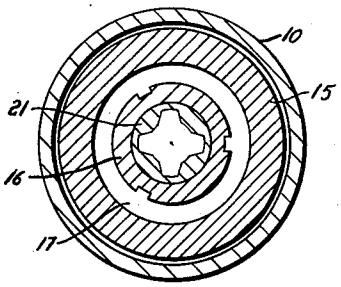

Fig. 7

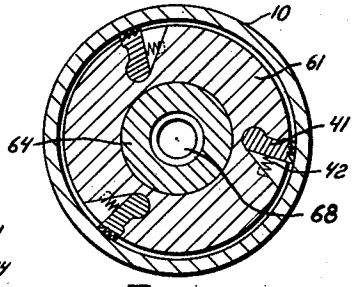

Fig. 10

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WELL PLUG

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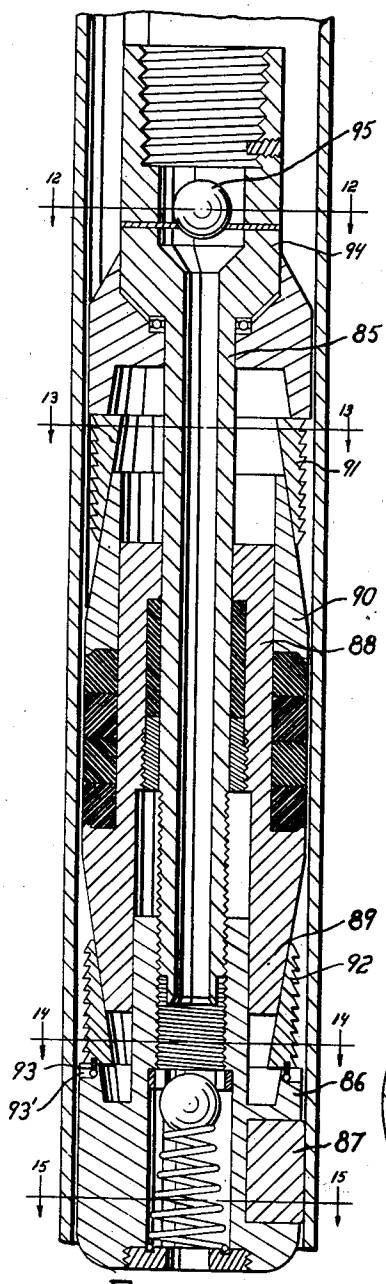

Fig. 11

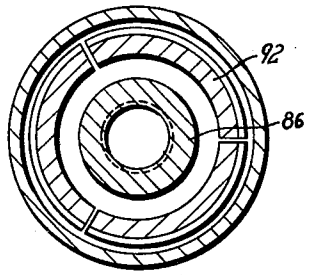

Fig. 14

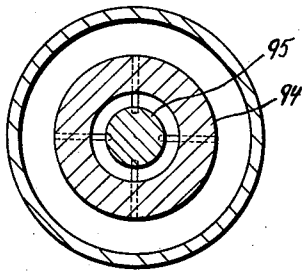

Fig. 12

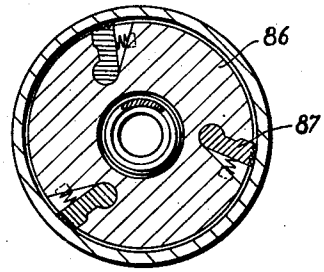

Fig. 15

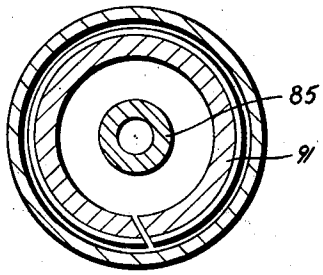

Fig. 13

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Patented Feb. 4, 1941

2,230,447

UNITED STATES PATENT OFFICE

2,230,447

WELL PLUG

Ross Bassinger, Houston, Tex.

Application August 26, 1939, Serial No. 292,029

13 Claims. (Cl. 166—13)

This invention relates to new and useful improvements in a well plug.

One object of the invention is to provide an improved plug, wherein a single operation compresses the packing and sets the slips, and also the use of shear pins to hold the plug from setting are eliminated.

A particular object of this invention is to provide an improved device for retaining cement which is preferably retractable after the cement has set, and which constitutes a plug easily set, and through which cement or other material may be pumped; the device being capable of repeated uses.

An important object of the invention is to provide a device of the character described having improved means for anchoring and packing it off, at the desired location in the well, together with latching means arranged to be operated by an overshot, whereby the anchoring and packing means are released so the device may be removed from the well.

A further object of the invention is to provide a plug having a shoe and a mandrel co-acting with other elements together with anchoring and packing means, whereby rotation of the mandrel raises the shoe, distorts the packing to seal off the casing, and anchors the device in place.

A still further object of the invention is to provide an improved device, wherein accidental packing off of said device, while being lowered into the well, is eliminated.

A construction designed to carry out the invention will be hereinafter described, together with other features of the invention.

The invention will be more readily understood from a reading of the following specification and by reference to the accompanying drawings, in which an example of the invention is shown, and wherein:

Figure 1 is a vertical, transverse, sectional view of a device constructed in accordance with the invention, before it is anchored in the well.

Figure 2 is a similar view of the same device in its set or anchored position.

Figure 3 is a similar view of the same device in its retractable position.

Figure 4 is a horizontal, cross-sectional view taken on the line 4—4 of Figure 1.

Figure 5 is a similar view taken on the line 5—5 of Figure 1.

Figure 6 is a similar view taken on the line 6—6 of Figure 1.

Figure 7 is a similar view taken on the line 7—7 of Figure 1.

Figure 8 is a similar view taken on the line 8—8 of Figure 3.

Figure 9 is a transverse, vertical, sectional view of another form of the invention.

Figure 10 is a horizontal, cross-sectional view taken on the line 10—10 of Figure 9.

Figure 11 is a transverse, vertical, sectional view of another form of the invention.

Figure 12 is a horizontal, cross-sectional view taken on the line 12—12 of Figure 11.

Figure 13 is a similar view taken on the line 13—13 of Figure 11.

Figure 14 is a similar view taken on the line 14—14 of Figure 11.

Figure 15 is a similar view taken on the line 15—15 of Figure 11.

In the drawings the numeral 10 designates a well tubing or casing which has been previously set in the well bore. A plug A is constructed so as to be lowered into the casing to the desired location and anchored. This device includes a central or axial tubular mandrel 11, having an internally screw-threaded (preferably left-handed) box 12 at its upper end, which is provided with a smooth bore 13 below its internal screw-threads, communicating with the bore of the mandrel. A bull-nose shoe 15 is carried by the lower end of the mandrel and includes an upstanding central nipple 16, which is internally screw-threaded to receive the externally screw-threaded lower end 14 of the mandrel. The shoe has an annular well 17 surrounding the nipple, and the nipple is provided with vertical keyways 18 in its outer surface.

The shoe is formed with an axial valve chamber 19, which is preferably cylindrical. A valve seat spider 21 (Figures 1 and 7) is held at the upper end of the chamber and receives a valve ball 20, which is held up against the seat of said spider by a helical coiled spring 22. The spring is supported and confined in the chamber by an annular nut 23 screwed into the bottom of the shoe and having a comparatively large central opening 24.

An elongated sleeve 25 surrounds the mandrel and has a counterbore 25' below which it is bored out to form a depending annular apron 26 at its lower end into which the nipple 16 telescopes. The apron carries internal keys 27, engaging in the keyways 18, whereby relative rotation between the sleeve and the shoe is prevented when the sleeve is slid down into the well 18, as is shown in Figures 2 and 3. A cylindrical elastic packing 29, confined in the counter-

bore 25', snugly embraces the mandrel and packs off the same at this point. The packing is confined by a follower nut 30, screwed into the lower end of the counterbore. The sleeve has an internally screw-threaded box 28 at its upper end, shaped to receive a tapered screw-threaded pin 31', depending from the lower end of a tubular core 31, surrounding the mandrel 11. The mandrel is rotatably disposed in the sleeve 25 and core 31, and when said mandrel is rotated, the parts 15, 25, and 31 are held against rotation, as will be hereinafter described. Upon rotation of the mandrel, its screw-threaded lower end 14 is moved downwardly into the nipple 16, from the position shown in Figure 1 to the position shown in Figures 2 and 3, whereby the ball valve 20 is dislodged from its seat. The upper end of the core 31 is externally reduced to form an elongate collar 32. Ball bearings 33 are confined between the upper end of the collar and the bottom of the box 12, so as to take the longitudinal thrust of the elements.

Below the lower end of the collar 32, the core is provided with outwardly directed lugs 34 (Figure 1), each having an undercut bottom 35. The box 12 and the collar 32 have substantially the same outer diameter, and are slidably received within a latching and setting head 36, which has an annular shoulder 36a that rests upon an annular shoulder 38, provided on the core 31. Shoulder 38 is flush with the top faces of the lugs 34. Head 36 is counter-bored below the shoulder 36a to fit around the core. The head also has vertical slots 43' into which the lugs 34 extend and vertical inner grooves 46 in the lower shank portion 36' of the head 36, said grooves extending from the lower ends of slots 43' downwardly to the lower end of the head. This head has an upwardly extending neck 37, the major external portion of which is screw-threaded. Pivotally mounted within the slots 43' on pins 42, which extend transversely of slots 43', are a plurality of latches 43 which engage beneath the lugs 34 on the core 31 below the collar 32 and hold the lugs in this position until said latches are swung outwardly, as will be hereinafter explained. The head 36 is provided with external equally-spaced-vertical recesses 40, flared outwardly to the outer surface of said head (Figures 1 and 4). Upright dogs 41 are confined in said recesses so as to swing transversely with sufficient eccentricity that its outer upright serrated edges 41' will engage the inner wall of the casing 10. The dogs are urged into this engagement by coiled springs 42'. By this engagement of said dogs with the inner surface of the casing, the entire device will be held against rotation, so that the mandrel may be rotated without rotating the rest of the structure.

A setting collar 47, having its lower portion 48 reduced and tapered, overhangs the box 28 and abuts a shoulder 49 on the sleeve 25. This collar is screwed on to the shank 36'. A split-ring type slip 50 surrounds the lower end of the tapered portion 48. A plurality of elastic packing rings 51 are confined on the sleeve 25 between a packing retainer ring 52, underlying the slip 50 and the top of the shoe 15. When the mandrel 11 is rotated, and the shoe 15 is moved up due to its threaded engagement with the mandrel, the top of said shoe will move the packing rings upwardly. The slip 50 will be moved upwardly on the taper 48 and thereby be expanded, which will cause the teeth of said slip to bite into the inner surface of the casing 10 and thereby anchor said device. The packing rings 51 will undergo farther distortion, as they are confined between the said slips and the upwardly moving shoe, which will result in packing off said device.

For lowering the device into the well, the lower screw-threaded end of a section of tubing 53 is screwed into the box 12 and fastened by a shear pin 54, as indicated in Figures 1 and 2. The device and the lower tubing section being locked together, the device may be run into the well by making up the tubing string in the usual manner. When the device is lowered to the proper location, the shoe 15 being above the sand which is to be sealed, it is ready to operate. It will be noted that the dogs 41 will be in engagement with the inner surface of the walls of the pipe 10, and as said dogs are elongated, they will pass and bridge over a joint which may have a gap therein, thus, preventing the device from being caught or hung therein. The operation is as follows:

When the device has been lowered to the predetermined level, the pipe 53 is rotated in clockwise direction, and the dogs 41, already in slight engagement with the inner surface of the casing 10, will be forced into further engagement, due to the right-handed rotation. Thus, the head 36, together with the core 31 and sleeve 25, will be held against further rotation due to the keys 27, located in the lower end 26 of the sleeve 25 and in the nipple 16 of the shoe 15; also, said shoe will be held against rotation. However, the mandrel 11 will be rotated, and as the tubing 53 and mandrel 11 are rotated to the right, the shoe 15, through the medium of the screw-threaded connection 14 with the nipple 16 of the shoe 15, will move the shoe upwardly, thereby sliding the packing 51 upwardly, which in turn will move the slip ring 50 up the tapered surface 48 of the collar 47 whereby said slip ring will be expanded and engage the inner surface of the casing 10 (Figure 2). As the rotation of the mandrel 11 is continued, the packing rings 51 will be distorted, thereby sealing and packing off between the device and inner wall of the casing.

The slip rings 50, due to their positive engagement, will anchor the device in place. The lower end of the mandrel 11 will pass through the spider 21, engaging the valve ball 20 and pushing it downwardly against the tension of the spring 22. The lower end of the mandrel 11 is milled so as to form a valve seat for the ball. Thus, it can be seen that as the device is lowered into the well, fluid within the well may flow upwardly through the device; however, after the device has been set, fluid may be pumped downwardly through the mandrel 11, unseating the ball 20 and flowing out through the opening 24 into the sands or formation.

The operation of forcing a fluid such as cement into the sands through the device may now be started. After a sufficient amount of cement has been forced into the well, the operator is now desirous of removing the tubing. This is accomplished by further rotation of said tubing in a clockwise direction, thus breaking the shear pin 54 and allowing the tubing to be unscrewed and pulled out of the well. The device is left as it was originally set until the cement has had sufficient time to harden, and the operator is then desirous of retrieving said retainer.

This is accomplished by attaching an ordinary overshot B to a string of tubing, said overshot having its lower end B' internally tapered. The overshot is provided with the usual internal

screw-threads B''. The overshot may be screwed on the head **36** by the screw-threads B'' and **37** and by rotation of the tubing as the overshot is screwed on to the head the tapered portion B' will strike the upper ends of the latches **43**. As the overshot is screwed down tightly, the lower ends **45** of the latches will move away from the body, thereby being disengaged from under the lugs **34** of the core **31**. When said latches become disengaged, it can be seen that the head **36** and the collar **47** are no longer retained in a locked relation and are free to slide upwardly. The elastic packing rings **51**, having been distorted in packing off said device, are now free to act on the unlocked members and will act to move the collar **47** upwardly, allowing said rings to resume their original undistorted position. The slip ring will also be attempting to resume its unexpanded position, which will act to force the collar **47** farther upwardly and allow said slip ring to resume its normal position. The grooves **46** allow the collar **47** to pass over the lugs **34** until said lugs strike the lower end of the grooves. Thus, the collar **47** is capable of moving up to that position shown in Figure 3, and allowing the device to resume its relatively original positions so that the same may be removed from the well.

In Figure 9, there is illustrated another form or modification of the packing assembly, embodying the same principle as in the first form. In this particular form, the device cannot be retrieved. It is used for entirely plugging a well. The numeral **60** designates a mandrel, similar to the mandrel in Figure 1. The lower construction of this device is substantially the same as that shown in Figures 1, 2, and 3, and operates in the same manner, however the upper construction is slightly different. In place of the head **36**, this form has a head **61** which extends downwardly from the top of the device and is reduced to provide a taper or collar **62**. Below the taper **62** the head is formed with a shank **62'**, from which depends an annular apron **63** similar in structure and operation to the apron **26**.

The screw-threaded pin **80**, of a tubing **81**, is screwed into the screw-threaded socket **82** of a box **64** on the upper end of the mandrel and is fastened by a shear pin **65**. In this form it is often-times desirous to pump a fluid through the plug after the same has been set in the well bore. When the device is set in the well bore, the lower end **66** of the mandrel will engage the valve ball **20** and will prevent any upper flow through said device. For closing the upper end of the mandrel **60**, there is provided in the box **64**, valve chamber **68** having a valve seat **70** at its lower end. Extending into the chamber **68**, are a plurality of frangible pins **71**, which are arranged to support a valve ball **72**. The chamber **68** is enlarged at the point of suspension of said ball, thus allowing fluid to pass around the ball and down through the mandrel **60**. After the device has been set, it can be seen that fluid may be pumped through said mandrel and below the device.

After any fluid, which may be desired, has been pumped through the device, it is then desirable to close the upper end of the mandrel **60**. To accomplish this, it is only necessary to drop into the tubing a suitable tool, or weight, which will strike the ball **72** and bend or break the pins **71**, and thus force said ball down upon the valve seat **70**, located in the lower end of the chamber **68**. It is pointed out that the plug is provided with substantially the same type dogs **41** as are shown in Figures 1, 2, and 3 (Figure 10). In operation, the plug is lowered to a predetermined depth, and the running means rotated to the right, thus engaging the dogs **41** firmly on the inner surface of the casing **10**. By continued rotation, the shoe **15**, at the lower end of the device, will travel upwardly, distorting the packing rings **51** and engaging the slip ring **50**, the same as was done in Figures 1, 2, and 3. Thus, the device is set, and the lower end **66** of the mandrel **60** will engage the valve ball **20**.

No fluid can flow upwardly through the device, but the operator may pump any desired fluid downwardly through said device. Often-times in plugging a well, the operator will want to cement beneath the plug, and this may be done while the ball **72** is suspended within the chamber **68**. After the operator has pumped the fluid through the device, he inserts within the casing a tool, or weight, which shears the pins **71**, whereby the ball **72** will be seated on the valve seat **70**. Thus, he has completely plugged the bottom of the well. He then rotates his running means, shears the pin **65**, thus allowing him to disengage his running means from the plug. With this type of plug, it can be seen that the plug cannot be set until the operator intentionally sets the same, as there is no way of the device setting until it is rotated by the tubing to the right.

In Figure 11, there is illustrated another form or modification of the packing assembly, embodying the same principles as that shown in the first two forms. In this particular form the device cannot be retrieved, and a more secure anchor for the device is provided. The numeral **85** designates a mandrel similar to the mandrel in Figure 1. The lower construction of the mandrel and the shoe **86** is substantially the same as that shown in Figures 1, 2, 3, and 9, except a plurality of dogs **87**, substantially the same as the dogs **41** of Figures 1, 2, 3, and 9, are mounted within said shoe.

A sleeve **88** surrounds the intermediate portion of the mandrel and is formed at its lower end with a downwardly tapered collar **89**. An upwardly tapered collar **90** is fastened around the upper end of said sleeve. A plurality of slips **92** surround the lower portion of the collar **89** and rest upon the upper portion of the shoe **86**. Each slip is loosely connected to the shoe by a ball pin **93**, having its head confined in a radial groove **93'**, key shape in cross-section, whereby the slip may move radially of the shoe. As can be seen, the construction of the rest of the device is substantially the same as that shown in the first two forms. Thus, as the shoe **86** is moved upwardly by the screw-threaded engagement with the mandrel **85**, the slips **92** will be carried upwardly on the tapered surface of the collar **89**, and due to radial connections will be allowed to move outwardly and grip the side wall of the casing. At the same time the packing, together with the collar **90**, are moved upwardly, whereby the slip ring **91** will be expanded and bite into the casing.

Thus, it can be seen that with this type of plug, it is anchored by two sets of slips and will be positively prevented from undergoing any movement after it has been anchored. By connecting the slips **92** to the top of the shoe by the ball pins **93**, it can be seen that said slips are free to undergo any such movement that they

would ordinarily undergo but will prevent them from becoming accidentally set while running said tool in the well and will not become set until the operator is desirous of setting them. The box 94 and the ball 95 are constructed identically as the box 64 and ball 72 shown in Figure 9, so that the operation of this form will be substantially the same as that shown in Figure 9; except as the shoe 86 moves upwardly, it will set two sets of slips, instead of the split ring slip as shown in Figure 9.

Various changes, alterations and modifications may be made in the size, shape and arrangement of the herein described elements, within the scope of the appended claims.

What I claim and desire to secure by Letters Patents is:

1. A cementing device including, a packer, means for distorting the packer to seal off a well casing including a tubular conductor, means for anchoring the packer in said well casing, said tubular conductor extending through the packer and open when the packer is in unexpanded position, whereby the cementing device may be lowered into the well, an initially open valve arranged to close the conductor against upstream flow when the packer is expanded, whereupon the valve is downwardly openable and an opening in the shoe below the valve to permit cement to flow down through said conductor and discharge below the cementing device, and means operable from the top of the well for releasing the cementing device, whereby it may be removed from the well after the cementing is completed.

2. A device of the character described including, an axial rotatable mandrel, a shoe provided with an initially open flow passage and having means for holding the shoe against rotation when the mandrel is rotated, co-acting means between the mandrel and the shoe operable for elevating said shoe relatively of the mandrel when said mandrel is rotated, elastic packing means surrounding the mandrel, and anchoring means expanded to anchoring position when the shoe is elevated and then co-acting with the shoe to distort the elastic packing.

3. In a device of the character described, the combination of an axial tubular mandrel, a shoe connected with the lower end of the mandrel so as to be elevated when said mandrel is rotated, a setting member, means for holding the setting member against rotation in the well casing, an expansible anchor connected with the setting member, packing means connected with the shoe so as to elevate and cause the expansion of the anchor to set the device in the casing and to distort said packing when said shoe is elevated, and a valve below the mandrel and initially open, said valve being positioned to be engaged by said mandrel to shut off upward flow through said mandrel.

4. A well packing device including, an elongate core member extending longitudinally of the device, a mandrel rotatably mounted within said member, a shoe at the lower end of the device, means interconnecting said shoe and core member in non-rotatable slidable relationship, a connection between the lower end of the mandrel and shoe for moving the shoe longitudinally of the device when the mandrel is rotated, casing-engaging dogs for holding the device against rotation, a setting member disposed around the core member, an expansible anchor mounted on the setting member for expansion and having connection whereby it is moved to anchoring position when the shoe is elevated, and external packing disposed around the core member and mounted to be distorted, said packing being distorted when the shoe is moved longitudinally of the mandrel.

5. A well packing device including, a longitudinal support, a shoe member mounted on the support, a setting member, an expansible anchor mounted on the setting member, a packing carried by the support, a connection between the support and one of the said members for moving said shoe member longitudinally on the support to expand the anchor and set the packing, and casing engaging dogs carried by said setting member and having means for positively gripping the well casing to hold said setting member against rotation when the support is rotated, the shoe member, setting member and anchor being interconnected so as to be held against rotation when said element is so held.

6. A well packing device including, a longitudinal support, a shoe member mounted on the support, a setting member, an expansible anchor mounted on the setting member, a packing carried by the support, a connection between the support and one of the said members for moving said shoe member longitudinally on the support to expand the anchor and set the packing, and casing engaging dogs carried by said setting member and having projections for gripping a well casing and holding the device against rotation when the support is rotated, the shoe member, setting member and anchor being interconnected so as to be held against rotation when said setting member is so held.

7. The combination in a well packing device, of a rotatable tubular support, an actuating member at the lower end of the support, a packing above said member, an anchor above said member, means for setting the anchor, a connection between the actuating member and the support for elevating the said member on the support to set the anchor and the packing when the support is rotated, and means on the device offset longitudinally from the packer actuable for gripping a well casing and holding the device against rotation when the support is rotated.

8. The combination in a well packing device, of a rotatable tubular support, an actuating member at the lower end of the support, a packing above said member, an anchor above said member, means for setting the anchor, a connection between the actuating member and the support for elevating the said member on the support to set the anchor and the packing when the support is rotated, and means having teeth for gripping a well casing and holding the device against rotation when the support is rotated.

9. A plug for a well casing, including a rotatable tubular support, a shoe, means to connect the shoe to the lower end of the support so as to elevate the shoe upon rotation of the support, setting means, means for holding the setting means against rotation, anchoring means connected to the setting means, packing means operable by the shoe to actuate the anchoring means to set the plug in the well casing and to cause distortion of the packing means when the shoe is elevated, and an initially open valve at the lower end of the support engageable by the latter to shut-off upward flow through the support upon predetermined elevation of the shoe.

10. A well plug in accordance with claim 9, wherein there is a normally open second valve

for closing the bore of the upper end of the support, and wherein there is means for supporting the second valve in open position, the supporting means being distortable whereby upon subjecting the second valve to pressure, the supporting means will be distorted so as to enable the second valve to move to a position closing the upper end of the bore of the support.

11. A plug for a well casing, including a body, a packer carried by the body and movable to seal a well casing, means carried by the body to anchor same in the well casing, a tubular conductor in the body open when said packer is in unexpanded position, an initially open valve for closing the conductor against the ingress of fluid thereinto, and means operable from the top of the well to actuate said conductor to close the valve when the packer is being simultaneously moved into sealing position.

12. A plug for a well casing, including a rotatable tubular support, a shoe, means to connect the shoe to the lower end of the support so as to elevate the shoe upon rotation of the support, anchoring means, packing means operable by the shoe to actuate the anchoring means to set the plug in the well casing and to cause distortion of the packing means when the shoe is elevated, and an initially open valve at the lower end of the support engageable by the latter to shut off upward flow through the support upon predetermined elevation of the shoe.

13. A plug for a well casing including, a body, a packer carried by the body and movable to seal a well casing, means carried by the body to anchor the same in a well casing, a tubular conductor in the body open when said packer is in an unexpanded position, a valve having an open seat, whereby fluid may enter the body and flow upwardly through the conductor when said valve is seated on said open seat, means operable from the top of the well to move said conductor into engagement with said valve and unseat said valve, whereby said valve closes said conductor against the ingress of fluid thereinto, and means coacting with the conductor for moving the packer into its sealing position.

ROSS BASSINGER.