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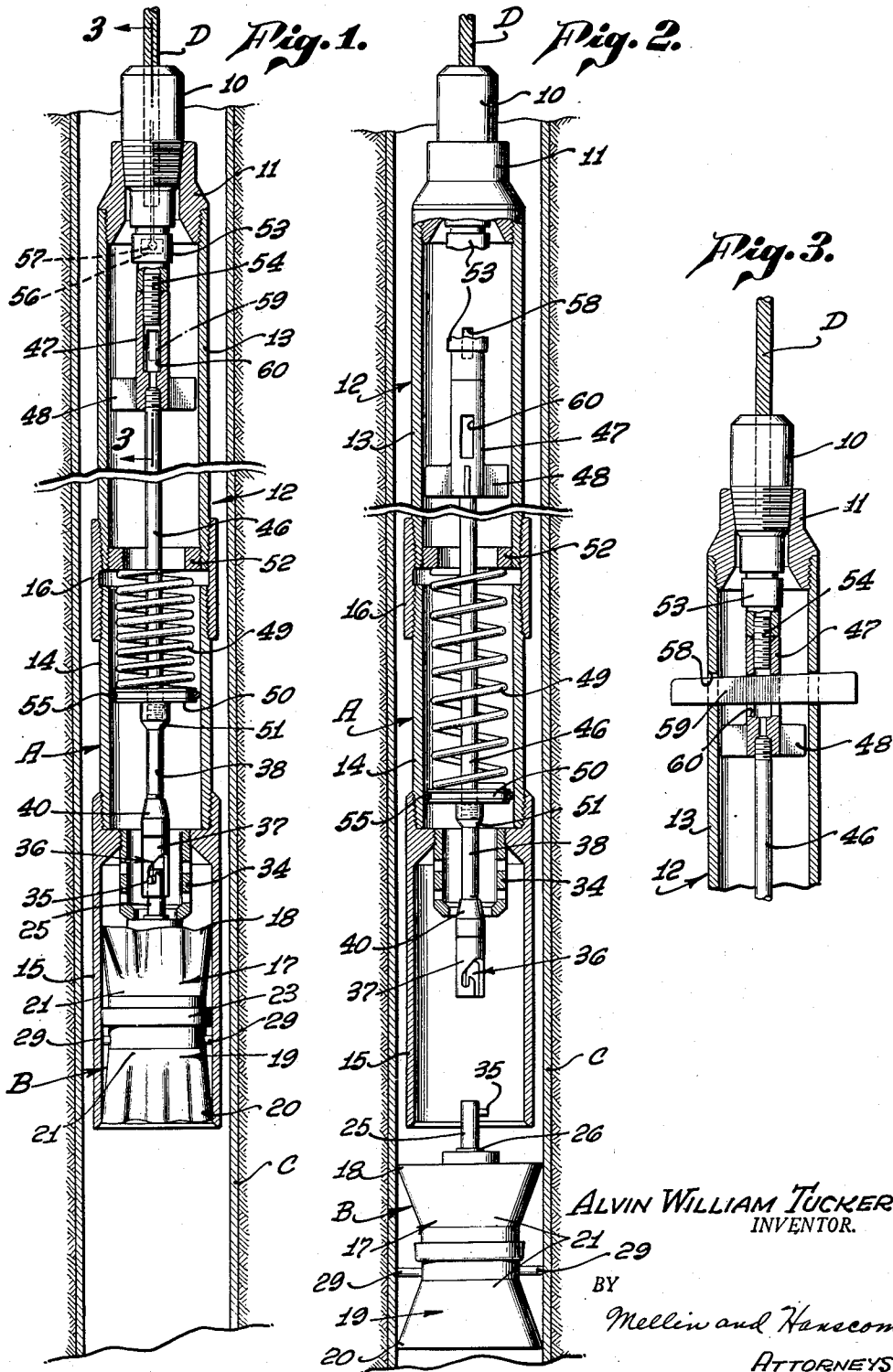
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BRIDGE PLUG AND DUMP BAILER

Filed July 3, 1948

2 SHEETS—SHEET 1



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2 SHEETS—SHEET 2

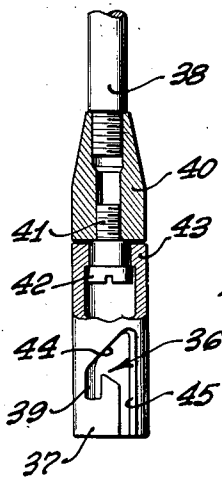
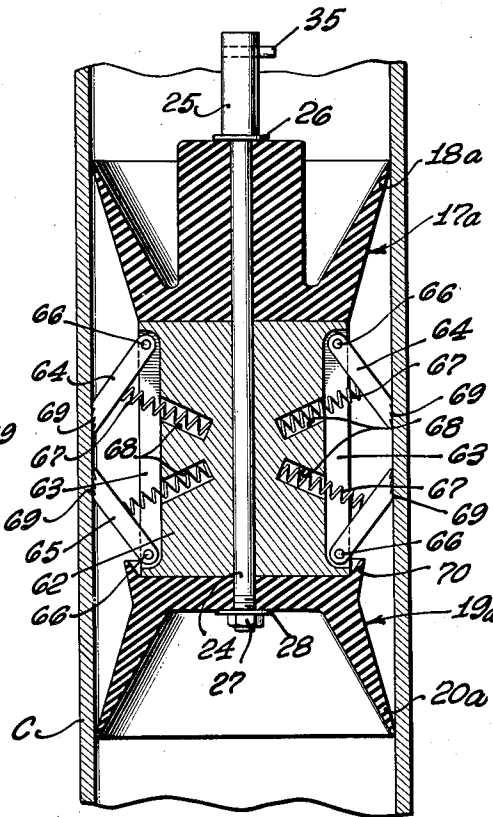
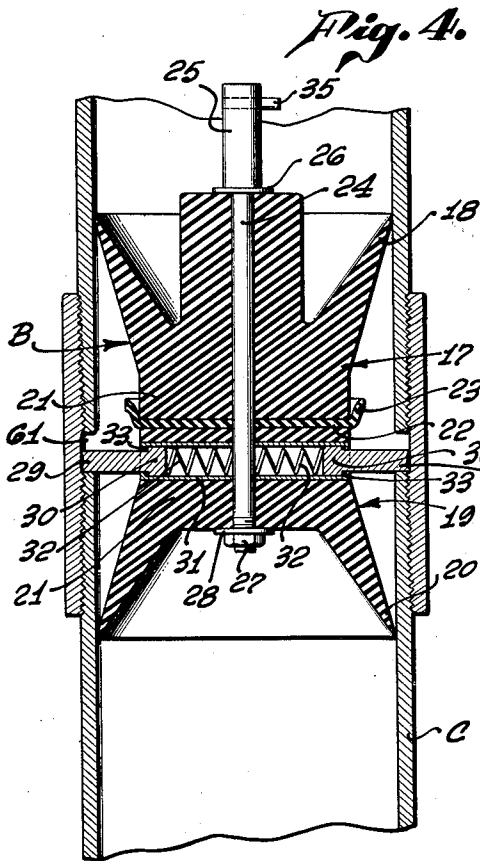


Fig. 6.

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BRIDGE PLUG AND DUMP BAILER

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20 Claims. (Cl. 166—19)

1

The present invention relates to subsurface well apparatus, and more particularly to apparatus for forming a plug in a casing or liner string, or in the bore hole itself.

Under some conditions encountered in a well bore, it is desirable to set a bridge plug in a casing, liner, or similar conduit string, and then dump cementitious material on top of the plug. Heretofore, the bridge plug has first been set in the well casing and then a dump bailer run in the casing to deposit the cement or other material upon the plug. The separate setting of the plug and use of the dump bailer obviously is a time consuming and relatively costly series of operations.

Accordingly, it is an object of the present invention to effect the setting of a bridge plug and the discharge of the cementitious material upon the plug with a single trip in the well casing or well bore.

Another object of the invention is to provide an apparatus capable of being lowered into the well on a wire or other flexible line, and of effecting substantially simultaneous setting of the plug and the placement of the cementitious material thereon.

A further object of the invention is to provide a bridge plug and dump bailer combination, which can be run in the well bore together and operated to set the plug and dump the cementitious material on the plug, the bailer being removable from the well bore after the job has been performed.

Still another object of the invention is to provide a comparatively simple bridge plug, which can be run in the well on a wire line and anchored to the casing against longitudinal movement in both directions.

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, 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 through one form of the apparatus, with the parts in position for running the apparatus through a conduit string, or the well bore itself;

2

Fig. 2 is a view similar to Fig. 1, disclosing the apparatus in released position, with the bridge plug portion disposed against the wall of the conduit string;

Fig. 3 is a longitudinal section through the upper portion of the apparatus, illustrating the manner of assembling certain of its parts;

Fig. 4 is a longitudinal section, on an enlarged scale, of one form of bridge plug anchored in packed-off condition to a well casing string;

Fig. 5 is a longitudinal section, partly in elevation, of the swivel and latch portion of the apparatus; and

Fig. 6 is a longitudinal section through a modified form of bridge plug, with its parts in expanded condition.

The apparatus disclosed in the drawings consists of a dump bailer A and bridge plug B adapted to be run through a string of well casing C, or other conduit string, on a wire line D to a position at which the plug is to be set in the casing and the contents of the dump bailer discharged thereupon. The apparatus includes a head 10 secured to the lower end of the wire line D in any suitable fashion, the head being threaded into a sub 11 forming the upper end of a tubular body 12, consisting of several sections 13, 14, 15, 16. The upper body section 13 depends from the head and is threaded into a coupling 16, which, in turn, is threaded onto an intermediate body portion 14 forming a container for the cementitious material. The lower body portion 15 forms a container for both the lower portion of the charge of cementitious material and the bridge plug B, being threadedly attached to the intermediate body portion 14.

The external diameter of the container or body 12 of the apparatus is substantially less than the internal diameter of the casing string C in which the apparatus is to be used, to allow the apparatus to be lowered with facility through the casing string to the desired point at which the bridge plug B is to be set. The latter is held initially within the confines of the lower container 15 with its parts in retracted position.

In the form disclosed most clearly in Fig. 4, the bridge plug includes an upper body 17 of flexible or elastic material, such as rubber, having an upwardly directed lip 18 thereon which is adapted to engage the wall of the casing in leak-proof fashion. The plug also includes a similar lower elastic body 19 having a downwardly directed lip 20 adapted to engage the casing wall. These lip portions 18, 20 of the upper and lower plug bodies may expand outwardly to a substan-

tial extent beyond the diameters of the base portions 21 of the bodies. The latter are made substantially smaller than the inside diameter of the casing string to enable the plug to be confined originally within the lower container 15.

Between the upper and lower bodies 17, 19 is located a packing cup 22 having an upwardly directed lip portion 23 adapted to seal with the interior of the lower container 15. The plug parts are held in assembled relation by a bolt 24 extending centrally therethrough. Its upper head 25 engages a washer 26 bearing upon the upper end of the upper body 17; while a nut 27 is threaded on its lower end, which can be tightened against a washer 28 engaging the lower body 19, for the purpose of clamping the parts together.

If desired, the plug may also include positive locking elements in the form of laterally disposed dogs or latches 29 whose inner head portions 30 are disposed within sleeves 31 mounted transversely within the lower plug body 19. The latches 29 are urged in an outward direction by coil springs 32 disposed within the sleeves 31 and compressed between the latch heads 30 and the bolt 24. Outward movement of the latches is limited by engagement of the latch heads with terminal flanges 33 on the sleeves.

The plug B is inserted within the lower body container 15 with its latches 29 retracted by bearing against the inner wall of the container, and with its upper and lower sealing portions 18, 20 forced or folded inwardly to fit within the container. Since these sealing portions will not necessarily effect a continuous circumferential seal with the container, the intermediate packing element 22 is provided for this purpose, in order to prevent any cementitious material disposed within the container above the plug from dropping from the container 15 or dump bailer (see Fig. 1).

The plug B is held in its confined position within the container 15 against a perforated stop 34 threaded into the lower body member 15. The holding means includes a releasable latching device, consisting of a transversely extending pin 35 fixed to the bolt head and received within an inverted J type of slot 36 formed in a latch sleeve 37, that is swivelly connected to a holding and actuating rod 38. Initially, the pin 35 is received within the saddle or slot 39 of the sleeve, and serves to prevent the plug from dropping out of the container 15.

The swivel connection (see Fig. 5) between the rod 38 and the latch sleeve 37 includes a connecting element 40 threaded on the lower end of the rod, and also threadedly receiving a screw 41 whose head 42 engages an inturned flange 43 on the upper end of the latch sleeve 37. It is apparent that the latch sleeve 37 may turn relative to the rod 38. Such turning action is availed of in effecting relative shifting of the lock pin 35 from the slot portion 39 along an interconnecting inclined slot portion 44 to a long slot portion 45, whose lower end is open in order to permit disconnection between the plug B and sleeve 37.

The lower rod portion 38 is threaded onto an intermediate rod 46 extending upwardly through the body members, where it is attached to a centering sleeve 47 having radial wings or lugs 48 for centering the rod within the body or container 12.

The plug B and cementitious material contained in the body members are adapted to be ejected by means of a compressed spring 49 whose lower end bears upon a piston 50 resting

on the head 51 of the rod 38, and whose upper end bears upon an annular spring seat 52 threadedly secured to the upper body portion 13. The compressed spring 49 is prevented from expanding, and is held in its compressed state by a device which connects the centering member 47 to the head 10 at the upper end of the apparatus. This device consists of a frangible connector 53 threaded into the head 10 and also onto a stud 54 which is threadedly attached to the centering member 47. When the frangible connector 53 is broken, the spring is released, expanding downwardly to discharge the plug B and the cementitious material from the container 13, 16, 14, 15. To insure appropriate discharge of the cementitious material, the piston 50 may have a suitable packing ring 55 slidably engageable with the wall of the container body 14.

The frangible connector 53 may be made of cast iron and is adapted to contain an explosive charge 56 that may have a heating filament 57 therein. The wire line is of the electrical type, containing an electrical conductor connected to the filament 57, in a known manner. The completion of the circuit through the filament will cause the charge 56 to explode and disrupt the connector 53, whereupon the spring 49 can expand.

In order to facilitate assembly of the device, the upper tubular body 13 has a pair of aligned slots 58 through which a bar or key 59 may be inserted for extension through corresponding slots 60 in the centering sleeve 47. The cementitious material is placed in the container 14, 15 and the plug B retracted within its lower end 15 by use of a suitable tool, such as a jack screw, compressing the spring 49 until the slots 58, 60 are aligned, whereupon the key 59 may be inserted through the aligned slots to hold the parts in this position and prevent expansion of the spring. The head 10, with the frangible connector and stud 54 attached, is then threaded into the body 12, and the stud 54 threaded into the sleeve 47, thereby effecting a connection between the rod 38 and the head 10, which will hold the spring 49 in its compressed condition in the absence of the locking key 59, which is then removed.

The apparatus is lowered in the well casing to the desired setting point, the plug B remaining in retracted position and prevented from dropping from the apparatus because of the location of the lock pin 35 in the short slot portion 39 of the lock sleeve 37. The annular sealing ring 22 prevents the cementitious material in the container 14, 15, which may be cement slurry or a liquid synthetic resin, from dropping out of the container.

When the desired point is reached at which the apparatus is to be operated, the circuit through the filament 57 is completed, causing the charge 56 to explode and break the frangible connection 53 (Fig. 2). This action releases the spring 49, which shifts the piston 50 and rod 38 downwardly, moving the plug B out of the container 15 and allowing its sealing members 18, 20 to expand against the wall of the casing C. During the downward forcing of the plug, the pin 35 is engaged by the inclined surface 44 of the lock slot, which rotates the swivel sleeve 37, and aligns the pin with the long leg 45 of the slot, which is open at its lower end.

Following ejection of the plug B, the wire line D is elevated to move the dump bailer above the ejected plug, whose pin 35 passes through the slot 45 and out of the sleeve 37, becoming com-

5

pletely disengaged from the rod mechanism. The piston 50 moves downwardly to its fullest extent under the action of the spring 49, discharging the cement slurry, or other cementitious material, from the container 14, 15 on top of the plug B. The dump bailer portion A of the apparatus may now be removed from the well casing by elevating the wire line D.

In the event that the column of fluid in the well casing C below the plug B is immovable, the latching dogs 29 are not needed. The immovable or incompressible fluid will prevent the plug from moving down along the wall of the casing, the lower lip seal 20 preventing by-passing of fluid and any gravitation of the plug there-through. The upper lip seal 18 prevents the cementitious material deposited on top of the plug from moving therebelow. As a result, the plug B has been disposed in the casing string with additional material deposited upon it, which will set and harden to form an additional cementitious plug.

In the event that the fluid in the well casing below the plug B can move downwardly, the plug will be lowered by gravity, or the weight of the cement slurry on top of it, until a coupling space 61 is reached, into which the latches 29 will expand under the impetus of the compressed springs 32 to lock the plug to the casing. Its further downward movement is thereby prevented.

Another form of plug is disclosed in Fig. 6, which will prevent movement of the plug along the casing from the point at which it is ejected from the container or dump bailer, and without the necessity for seeking a coupling space. This plug includes upper and lower flexible packing members 17a, 19a that are secured to an intermediate metallic body 62, of readily drillable material, by means of a clamp bolt 24. The body 62 has a plurality of circumferentially spaced longitudinal slots 63 in which upper and lower gripping members 64, 65 may be disposed initially. The upper gripping members 64 are mounted upon pins 66 fixed in the body 62, and are urged outwardly by compressed springs 67 bearing against the members 64 and against the bases of inclined sockets 68 formed in the intermediate body portion. The lower gripping members 65 are also pivotally mounted on pins 66 secured to the body 62, and are urged outwardly in a similar manner by compressed springs 68. The ends 69 of the gripping members may be serrated or toothed, in order to grip the casing more effectively.

The upper gripping members 64 face in a downward direction and will engage the casing to prevent further downward movement of the plug B. On the contrary, the lower gripping members 65 face in an upward direction and will grip the casing to prevent upward movement of the plug.

The plug disclosed in Fig. 6 is adapted to be disposed in the lower container portion 15 in the same manner as the other plug, with the lip portions 18a, 20a of the packing cups or members retracted, and with the gripping members 64, 65 held in retracted position within the longitudinal slots 63 by the wall of the container. The upper end 70 of the lower packing member 19a may be provided with an upwardly directed lip seal for engagement with the wall of the container, to prevent inadvertent loss of the cementitious material therefrom.

Upon lowering of the dump bailer and bridge plug to the desired operating point, the explosive

6

56 is fired to allow the spring 49 to expand and eject the plug from the container. Following such ejection, the springs 67, 68 expand the gripping members outwardly to prevent longitudinal movement of the plug in the casing, the lip seals 18a, 20a preventing both upward and downward passage of fluent substances around the plug. The cementitious material is deposited on top of the plug in the same manner as before, to form a barrier in the casing above the plug.

It is preferred that substantially all portions of the plugs be made of readily drillable materials, in order to allow the cement plug and the bridge plug itself to be disintegrated by a drilling bit, if desired.

It is, accordingly, apparent that a bridge plug and dump bailer has been provided, which can be lowered in a well bore in a rapid manner by means of a wire line, and in which the plug is set in the casing and the cementitious material deposited thereon substantially simultaneously, at a substantial savings in time. Although the apparatus has been described specifically in connection with a well casing or similar conduit string, it is apparent that the plug can be set in an open hole, if desired, and cementitious material deposited thereon.

The inventor claims:

1. In apparatus of the character described: a container adapted to be lowered in a well conduit; a plug disposed in said container to close its lower portion, said plug including a packing adapted to seal and form a barrier with the wall of said well conduit; means for holding said plug in said container with its packing in retracted position; and means for discharging said plug from said container.

2. In apparatus of the character described: a container adapted to be lowered in a well conduit; a plug disposed in said container to close its lower portion, said plug including sealing means engageable with the wall of said container and a packing adapted to seal and form a barrier with the wall of said well conduit; means for holding said plug in said container with its packing in retracted position; and means for discharging said plug from said container.

3. In apparatus of the character described: a container adapted to be lowered in a well conduit; a plug disposed in said container to close its lower portion; said plug including a packing adapted to seal and form a barrier with the wall of said well conduit; means in said container for discharging said plug from said container; holding means engageable with said discharging means for preventing operation of said discharging means; and means for releasing said holding means.

4. In apparatus of the character described: a container adapted to be lowered in a well conduit; a plug disposed in said container to close its lower portion, said plug including devices for anchoring said plug in said well conduit, said plug also including a packing adapted to seal and form a barrier with the wall of said well conduit; means for holding said plug in said container with its anchoring devices and packing in retracted positions; and means for discharging said plug from said container.

5. In apparatus of the character described: a container adapted to be lowered in a well conduit; a plug disposed in said container to close its lower portion, said plug including sealing means engageable with the wall of said container and a packing adapted to seal and form a barrier with

7

said well conduit, said plug also including devices engageable with said well conduit for anchoring said plug in said well conduit; means for holding said plug in said container with its anchoring devices and packing in retracted positions; and means for discharging said plug from said container.

6. In apparatus of the character described: a container adapted to be lowered in a well conduit; a plug disposed in said container to close its lower portion, said plug including sealing means engageable with said container and packing means adapted to seal with the wall of said well conduit to prevent fluid passage around said plug in both longitudinal directions, said plug also including devices engageable with said well conduit for preventing longitudinal movement of the plug in both longitudinal directions; means for holding said plug in said container with its devices and packing means in retracted positions; and means for discharging said plug from said container.

7. In apparatus of the character described: a container adapted to be lowered in a well conduit; a plug disposed in said container to close its lower portion; said plug including a packing adapted to seal and form a barrier with the wall of said well conduit; means in said container for discharging said plug from said container; holding means engageable with said discharging means for preventing operation of said discharging means; and means comprising an explosive for releasing said holding means to allow said discharging means to discharge said plug from said container.

8. In apparatus of the character described: a container adapted to be lowered in a well conduit on a wire line; a plug disposed in said container to close its lower portion, said plug including a packing adapted to seal and form a barrier with the wall of said well conduit; means for discharging said plug from said container; holding means engageable with said discharging means for preventing operation of said discharging means; and means comprising electrically operable instrumentalities for releasing said holding means to allow said discharging means to discharge said plug from said container.

9. In apparatus of the character described: a container adapted to be lowered in a well conduit; a plug disposed in said container to close its lower portion; said plug including a packing adapted to seal and form a barrier with the wall of said well conduit; spring operated means in said container operable for discharging said plug from said container; holding means engageable with said spring operated means for preventing operation of said spring operated means; and means for releasing said holding means.

10. In apparatus of the character described: a container adapted to be lowered in a well conduit; a plug disposed in said container to close its lower portion; said plug including a packing adapted to seal and form a barrier with the wall of said well conduit; spring operated means in said container operable for discharging said plug from said container; means comprising a frangible connection for engaging and preventing operation of said spring operated means; and an explosive for disrupting said frangible connection for permitting said spring operated means to discharge said plug from said container.

8

11. In apparatus of the character described: a container adapted to be lowered in a well conduit and capable of holding a volume of cementitious material; a plug disposed in said container to close its lower portion; said plug including a packing adapted to seal and form a barrier with the wall of said well conduit; means for discharging said plug from said container, said means including a piston slidable along the wall of said container at the upper end of said volume of cementitious material for ejecting said cementitious material from said container; holding means for maintaining said piston and discharging means in an upward position and for holding said plug in said container; and means for releasing said holding means.

12. In apparatus of the character described: a container adapted to be lowered in a well conduit; a plug disposed in said container to close its lower portion; said plug including a packing adapted to seal with said well conduit; means for discharging said plug from said container; holding means engageable with said discharging means for preventing operation of said discharging means; means for releasing said holding means; and means providing a releasable connection between said plug and discharging means.

13. In a plug adapted to be placed in a well conduit: a body means having upwardly and downwardly facing flexible well conduit sealing elements; a flexible sealing member on said body means of substantially lesser external diameter than the maximum external diameter of said sealing elements; and means connected to said body means and extending upwardly coaxially therefrom to provide a connection for releasably securing said body means to another member.

14. In a plug adapted to be set in a well conduit: body means having upwardly and downwardly facing flexible well conduit sealing elements; a flexible sealing member on said body means of substantially lesser external diameter than the maximum external diameter of said sealing elements; anchoring elements carried by said body means; means for urging said anchoring elements outwardly; and means connected to said body means and extending upwardly coaxially therefrom to provide a connection for releasably securing said body means to another member.

15. In apparatus of the character described: a container adapted to be lowered in a well conduit; a plug disposed in said container to close its lower portion, said plug including a packing adapted to seal and form a barrier with said well conduit; means for holding said plug in said container with its packing confined in retracted position within said container; and means for discharging said plug from said container to enable said packing to expand and seal with said well conduit.

16. In apparatus of the character described: a container adapted to be lowered in a well conduit; a plug disposed in said container to close its lower portion, said plug including sealing means engageable with the wall of said container and a packing adapted to seal and form a barrier with said well conduit; means for holding said plug in said container with its packing confined in retracted position within said container; and means for discharging said plug from said container to enable said packing to expand outwardly into sealing engagement with said well conduit.

9

17. In apparatus of the character described: a container adapted to be lowered in a well bore; a plug disposed across the lower portion of said container to close the same, said plug including a packing adapted to seal and form a barrier with said well bore; means extending upwardly and secured within said container for holding said plug in closed position across said container; and means for shifting said holding means longitudinally of said container to release said plug from said container.

18. In apparatus of the character described: a container adapted to be lowered in a well bore; a plug disposed across the lower portion of said container to close the same, said plug including a packing adapted to seal and form a barrier with said well bore; means extending upwardly and secured within said container for holding said plug in closed position across said container, said holding means including a connection releasably secured to said plug; and means for shifting said holding means longitudinally of said container to release said connection and enable said plug to be released from said container.

19. In apparatus of the character described: a container adapted to be lowered in a well conduit; a plug disposed in said container to close its lower portion, said plug including sealing means engageable with the wall of said container and a packing adapted to seal and form a barrier with said well conduit, said plug also including devices for anchoring said plug in said well conduit; means for holding said plug in said container with its packing and anchoring

10

devices confined in retracted position within said container; and means for releasing said holding means to release the plug for removal from said container to enable its packing and anchoring devices to expand into engagement with the well conduit.

20. In apparatus of the character described: a container adapted to be lowered in a well bore and capable of holding a volume of cementitious material; a plug closing the lower portion of said container, said plug having means engageable with the wall of said well bore to form a bridge in said well bore upon ejection of said plug from said container; means movable downwardly within said container and engageable with said plug for removing said plug from said container and for forcing the cementitious material from said container; and power operated means for urging said means downwardly in said container.

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REFERENCES CITED

25 The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
1,829,666	Minster	Oct. 27, 1931
1,872,855	Walker	Aug. 23, 1932
2,076,307	Wells et al.	Apr. 6, 1937
2,086,409	Emery	July 6, 1937
2,189,445	Dale	Feb. 6, 1940
2,257,784	Brown	Oct. 7, 1941