This invention has to do with apparatus for depositing materials such as cement, sand and the like at intermediate depths in wells, and is concerned particularly with a novel type and form of apparatus whereby in a single run into the well, it is possible to position and secure a plug at any predetermined depth and to deposit on the plug a body of material to form an obstruction or bridge in the well or casing. The various situations in well drilling, cementing or reconditioning, where it becomes necessary or desirable to bridge the well at intermediate depths with cement or sand, are well known and require no detailed discussion.

One of my primary objects is to provide a combination apparatus, comprising generally a suitable means, such as a dump-type bailer, for conducting or lowering into the well a quantity of the material to be deposited therein, and a barrier or plug adapted to be lowered in the well ahead of the bailer, the plug and bailer being so associated that in a single run and series of operations, the plug may be set at the desired depth and the material dumped from the bailer on top of the plug. Preferably, though not necessarily in certain broad aspects of the invention, setting of the plug and opening of the bailer closure to discharge material from the bailer on to the plug, occur during or are controlled by movement of the bailer relative to the plug. As in the later described typical form of the invention, I may use a plug having radially expandable but normally contracted means adapted to engage the wall of the well or casing to hold the plug in set position, and a releasable connection between the plug and bailer operable upon relative upward movement of the bailer to cause the plug holding means to expand into gripping engagement with the wall of the well. In the same operation and upon upward movement of the bailer from the plug, the bottom closure of the bailer is opened, causing the bailer contents to be dumped directly on the plug.

Although the invention contemplates broadly the use of any suitable dumping apparatus, I preferably employ a dump bailer of the type disclosed in Patent Number 2,155,785 issued April 25, 1939, to me on Cement dump bailer, for one reason, among others, that the form of releasable bottom closure in that bailer lends itself particularly to association or connection with the plug, so that as the bailer is raised, the closure is immediately opened and an undiluted body of the bailer charge is deposited on the plug. In the patented bailer referred to, the bottom closure comprises a disc that is releasable, free from the bailer, upon upward movement of the bailer body. In accordance with the preferred form of the present invention, the plug is integrally connected to the bailer closure so that when the latter is released, it remains in the well together with the body of the plug.

The invention embodies various additional objects and details, but these as well as the features mentioned in the foregoing, will be understood to better advantage from the following description of the invention in one of its typical and illustrative forms. Throughout the description reference is had to the accompanying drawings, in which:

Fig. 1 is a view showing an illustrative form of the invention, a portion of the bailer body appearing in longitudinal section;

Fig. 2 is a similar view showing the plug in section and the bailer parts in changed positions;

Fig. 3 shows the bailer released from the plug with the latter held in engagement with the casing;

Figs. 4 and 5 are enlarged cross sections on lines 4—4 and 5—5 of Fig. 1;

Fig. 6 is an enlarged cross section of the plug taken on line 6—6 of Fig. 3;

Fig. 7 is a fragmentary vertical sectional view of the plug showing the pipe engaging pins in expanded position; and

Fig. 8 is a similar view showing the pins held in their retracted positions.

The typical form of bailer bottom assembly shown in the drawings comprises a body generally indicated at 10 composed of an elongated tube 11, the upper end of which is connected by coupling '12 or in any other suitable manner, with an upper tubular section or extension 13 of the body. As will be understood, the bailer is lowered in the well on a suitable suspension means, not shown, such as a wire cable. The tubular body 11 preferably has a straight cylindrical bore 13 defining the material containing chamber 14 from which, upon opening of the later described closure, the material has unobstructed passage as the bailer is elevated. The bottom of chamber 14 is closed at or near the lower end 11b of the body preferably by a form of closure which, when opened, leaves the outlet 15 through which the material is discharged from the chamber, substantially entirely open and unobstructed. As typical, I may employ a disc closure 16 formed of suitable material such as Bakelite, aluminum alloy or other friable mate-

UNITED STATES PATENT OFFICE

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COMBINATION PLUG AND DUMP BAILER

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rial that may be disintegrated by a drill, and which normally seats upwardly against an annular shoulder on the body. The disc seat may be formed by a plug 17 secured to the body and sufficiently thin that the seat offers no substantial obstruction to the flow of material from the bailer.

The closure 16 is releasably held against its seat by a latch mechanism comprising a plurality of individually arranged individual latch elements in the form of levers 19 pivotally mounted at 20 intermediate their ends within a ring 21 attached to the body, the ring being interiorly slotted at 22 to receive the levers. Each of the levers is contained within a longitudinal body groove 23, the lower disc engaging ends 18a of the levers projecting inwardly through slots 24 formed in the body. A curved surface sleeve or flange 25 applied to the lower end of the body is provided for the purpose of facilitating passage by the bailer of obstructions that it may encounter in its descent within the well, when the bailer is used independently of the plug.

Operation of the latch elements 19 is controlled by vertical movement of the tube 14 with relation to a body carried assembly, generally indicated at 26, that is maintained in frictional contact with the wall of the well by spring means. The type of connection between the parts that is described and shown in detail in the bailer patent referred to above. Further description of these details will be unnecessary to an understanding of the present invention.

The upper ends of the latch levers 19 normally project downwardly within the lower sleeve 29 in the position shown in Fig. 1, and the levers are yieldably held in retaining engagement with the closure 16 by leaf springs 30 attached to the levers and bearing against the bases of body grooves 23. The spring and sleeve assembly 26 is releasably locked against downward movement with relation to the body and latch levers 19 by one or more springs 31 depending from and attached to the upper sleeve 28, in the position of the parts shown in Fig. 1, the lower end of spring 31 is received within the upper grooved end of a segmental keeper 32 secured to the outer surface of the body. It will be understood of course that the lock spring or springs 31 are arranged in circularly spaced and offset positions relative to the bowed springs 21. The lock springs are releasably held in the holder by leaves or arms 26, in a predetermined upper position with relation to the body and latch levers, by a coil spring 33 confined between the upper end of sleeve 28 and an adjustable nut 34 threaded on the body. In this manner, relative movement of the body and friction in the spring assembly tends to cause the lock springs 31 to have become released from keepers 32, as will presently appear.

Associated with the lower end of the bailer is a plug, generally indicated at 35, which may be of any suitable type and construction, capable of forming a fixed barrier in the well or casing, and adapted to be controlled in its setting operation by upward relative movement of the bailer, as will presently appear. In the typical form illustrated, the plug includes an upper and lower sections 36 and 37 held together by screws 38 and formed of a suitable drillable material or metal such as to render the plug disintegratable by drill bit should it at any time be desired to open the well bore through the plugged section. The plug preferably carries an outer jacket 39 which is shown to be clamped between the body sections 36 and 37 and to comprise a lower disc or annulus 40 having clearance from the well bore or casing 41 and made of a relatively stiff material, such as fabric reinforced belting. The upper layer 42 is made of relatively flexible material such as impregnated canvas, and is sufficiently larger in diameter than the casing bore to assume an inverted cup shape, and thereby effectively seal around the plug against downward flow of fluid discharged onto it from the bailer. The stiffer reinforcing layer 40 prevents the more flexible material 42 from turning down under the weight of material above. The plug 35 also carries suitable means for frictionally engaging the casing at least with sufficient tightness to prevent the plug from being withdrawn from the bailer in the plug setting operation, after release of the closure holding latches. As a convenient means for thus frictionally engaging the casing, I may provide a series of circularly arranged stiff wire bristles 43 which may be mounted on the lower section 37 of the plug in the form of individual brushes 44, the bodies 45 of which are supported by depending leg portions 46 of the plug castings. As best illustrated in Fig. 6, the bodies 45 of the brushes are inserted in vertically extending ways 47 in the plug, the brushes being clamped between the body 44 and the legs 46 and the packer 39 and retained within the ways by the overlaps at 48.

The plug is provided with suitable radially expandable, normally retracted holding means adapted for the purpose of being brought into gripping engagement with the casing during the plug setting operation, by virtue of upward movement of the bailer. The holding means may comprise a suitable number of circularly spaced pins 49 having pointed ends 49a, and contained within radial bores 50 in the lower body section 37. Each pin 49 normally is held in radially retracted position by a locking pin 51, as shown in Fig. 8, inserted from above through bore 52 in the body sections and packer into a crossbore 53 in the pin 49. Upon removing pin 51, as will shortly appear, the plug holding pin 49 is projected radially into holding engagement with the casing by a coil spring 54 contained within the inner end of bore 50. As illustrated, pins 51 are suitably attached to the bailer so as to be withdrawn from the plug as the bailer is elevated, by a simple form of attachment comprising a wire 55 fastened to the pins and applied to the bottom of the bailer body 11 above the flange 25.

The plug 35 also is so associated with the bailer bottom closure 16 that relative upward movement of the bailer causes both setting of the plug in the casing and releasing of the bailer from the plug and closure, permitting the bailer charge to be dumped directly on the plug. As best shown in Fig. 2, the closure 16 is attached by screws 56 to the upset portion 57 of the plug body, so that after release the closure remains with the plug in the well.
In operation, the bailer with its cement or other charge is lowered together with the plug into the well or casing with the parts set in the position shown in Fig. 1. Upon insertion of the assembly within the well pipe, springs 27 may become radially contracted to an extent that will displace sleeve 33 upwardly against the resistance of spring 33, sufficiently to withdraw the lower ends of the lock springs 31 from keepers 32, whereupon the springs deflect outwardly to release the bailer body for subsequent upward movement relative to the spring and sleeve assembly. In some situations, where the charge is to be dumped within a liner of smaller diameter than the casing, the casing size may be such that springs 27 will not have become contracted sufficiently to release the lock springs 31, until springs 27 are thrust into the liner, in which event the bailer will descend in the casing with the parts positioned as in Fig. 1.

The bailer and plug assembly is lowered to a predetermined depth at which the plug is to be set and the charge dumped. When this depth is reached, the bailer is elevated to release its bottom end, and to set the plug, the bailer being caused to move upwardly relative to the plug in the plug setting operation, since upward displacement of the plug is resisted by the frictional engagement of brushes 44 with the wall of the casing. Elevating the bailer body 11 from the position of Fig. 1 causes sleeve 29 to cams the latch levers outwardly to closure releasing positions, see Fig. 2, as the inclined lever surfaces 19b are thrust upwardly within the sleeve. The latter is held against upward movement by reason of the engagement of springs 27 with the casing. After the closure 16 is released, the bottom outlet 15 of the bailer is fully opened for the unobstructed discharge of material from the chamber 14 as the bailer is progressively elevated. As illustrated in Fig. 3, upward movement of the body relative to the spring and sleeve assembly is limited by the engagement of stop 80 with the lower sleeve 23.

Simultaneously with release of the bailer from its bottom closure, the plug holding pins 49 are caused to be radially projected into engagement with the casing. As the bailer is raised, pins 51 are withdrawn from bores 53 in the plug holding pins, permitting the latter to be thrust outward by coil springs 54 to securely retain the plug in position and enable it to support the bailer charge deposited on the plug. As will be apparent, slight upward movement of the bailer before the bailer outlet 15 is fully opened, is sufficient to release pins 49, so that the plug is securely held in position before the bailer material load is placed on it. Thus, in a single operating sequence, and by straight upward movement of the bailer, the plug is set within the casing and the bailer outlet opened to deliver the charge directly upon the plug.

2. The combination comprising a container for flowable material adapted to be lowered in a well and having a normally closed outlet, a well plug releasably connected to the bottom end of said container and adapted to be lowered with and directly ahead of the container, means engageable with the wall of the well for holding the plug therein, said container being upwardly movable from the plug, and means for opening said outlet so that during such upward movement of the container said material is discharged directly upon the plug.

3. The combination comprising a container for flowable material adapted to be lowered in a well and having a normally closed outlet, a well plug at the bottom end of said container and adapted to be lowered with and directly ahead of the container, means engageable with the wall of the well for holding the plug therein, said container being upwardly movable from the plug, and means operable by virtue of such upward movement of the container to open said outlet to discharge material from the container upon said plug.

4. The combination comprising a container for flowable material adapted to be lowered in a well and having a normally closed outlet, a well plug at the bottom end of said container and adapted to be lowered with and directly ahead of the container, said container being upwardly movable from the plug, means operable by virtue of such upward movement of the container for holding said plug in the well, and means for opening said outlet so that as the container is raised from the plug, said material is discharged from the outlet upon the plug.

5. The combination comprising a container for flowable material adapted to be lowered in a well and having a normally closed outlet, a well plug at the bottom end of said container and adapted to be lowered with and directly ahead of the container, said container being upwardly movable from the plug, means operable by virtue of such upward movement of the container for holding said plug in the well, and means for opening said outlet by upward movement of the container to discharge said material upon the plug.

6. The combination comprising a dump bailer including a tubular body adapted to be lowered in a well and having a normally closed outlet, a well plug at the bottom end of the bailer and adapted to be lowered with and directly ahead of the bailer, means engageable with the wall of the well for holding the plug therein, said body being upwardly movable from the plug, and means for opening said outlet so that during upward movement of the body, material contained therein is discharged directly upon the plug.

7. The combination comprising a dump bailer including a tubular body adapted to be lowered in a well and having a normally closed outlet, a well plug releasably connected to the bottom end of the bailer and adapted to be lowered with and directly ahead of the bailer, means engageable with the wall of the well for holding the plug therein, said body being upwardly movable from the plug, and means for opening said outlet so that during such upward movement of the body, material contained therein is discharged directly upon the plug.

8. The combination comprising a dump bailer including a tubular body adapted to be lowered in a well and having a normally closed outlet, a well plug at the bottom end of the bailer and...
adapted to be lowered with and directly ahead of the bailer, means carried by the plug and frictionally engaging the wall of the well while the plug is being lowered therein, means engageable with the wall of the well for holding the plug therein, said body being upwardly movable from the plug, and means for opening said outlet so that during upward movement of the body, material contained therein is discharged directly upward from the plug.

9. The combination comprising a dump bailer including a tubular body adapted to be lowered in a well and having a normally closed outlet, a well plug at the bottom end of the bailer and adapted to be lowered with and directly ahead of the bailer, means engageable with the wall of the well for holding the plug therein, said body being upwardly movable from the plug, and a closure for said outlet connected to the plug so that upon upward movement of the body relative thereto, the outlet is opened to discharge material from the body upon the plug.

10. The combination comprising a dump bailer including a tubular body adapted to be lowered in a well and having an outlet at its bottom end, a well plug directly below and movable downwardly with the bailer, means for holding said plug against upward movement in the well so that the bailer may be independently raised, and a closure for said outlet adapted to be opened by virtue of upward movement of said body from the plug.

11. The combination comprising a dump bailer including a tubular body adapted to be lowered in a well and having an outlet at its bottom end, a well plug directly below and movable downwardly with the bailer, means for holding said plug against upward movement in the well so that the bailer may be independently raised, and a closure for said outlet attached to the plug and adapted to be opened by virtue of upward movement of said body from the plug.

12. The combination comprising a dump bailer including a tubular body adapted to be lowered in a well and having an outlet at its bottom end, a well plug directly below and movable downwardly with the bailer, means for holding said plug against upward movement in the well so that the bailer may be independently raised, and a closure for said outlet adapted to be opened by virtue of upward movement of said body from the plug, and means carried by said body for releasably holding said closure in closed position.

13. The combination comprising a dump bailer including a tubular body adapted to be lowered in a well and having an outlet at its bottom end, a well plug directly below and movable downwardly with the bailer, means for holding said plug against upward movement in the well so that the bailer may be independently raised, and a closure for said outlet adapted to be opened by virtue of upward movement of the body relative to the plug.

14. The combination comprising a dump bailer including a tubular body adapted to be lowered in a well and having an outlet at its bottom end, a well plug directly below and movable downwardly with the bailer, means for holding said plug against upward movement in the well so that the bailer may be independently raised, and a closure for said outlet, said holding means being expan-
a well plug directly below and movable downwardly with the bailer, radially projecting bristles carried by the plug and frictionally engaging the wall of the well during its downward movement therein, means for holding said plug against upward movement in the well so that the bailer may be independently raised, and a closure for said outlet adapted to be opened by virtue of upward movement of said body from the plug.

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