Nov. 17, 1953

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BAILER FOR OIL WELL BORES

2,659,442

Filed June 1, 1951

2 Sheets-Sheet 1

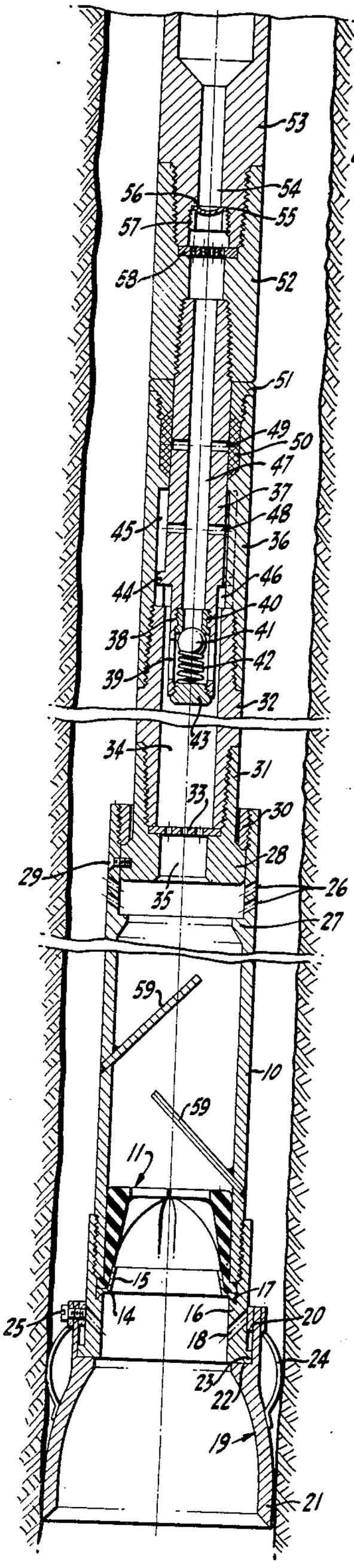


FIG. 1

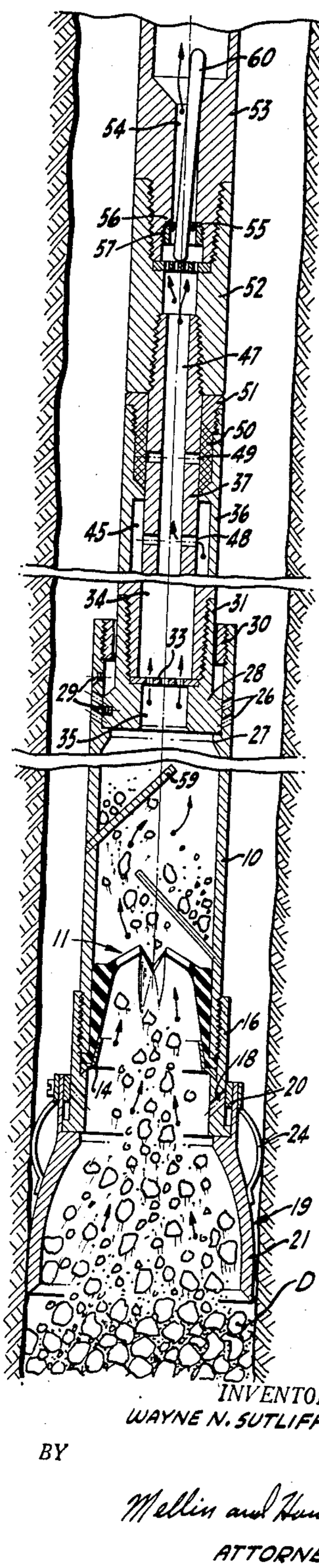


FIG. 2

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2 Sheets-Sheet 2

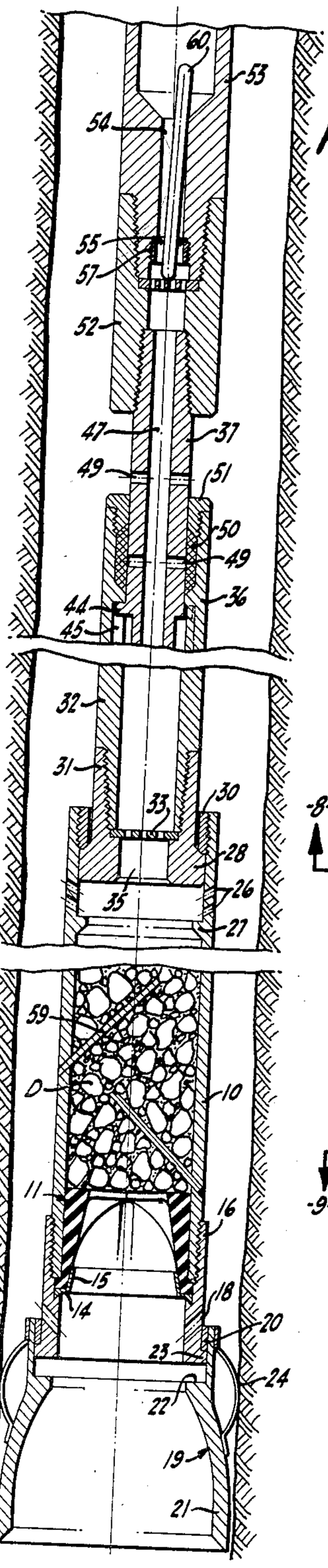


FIG. 3

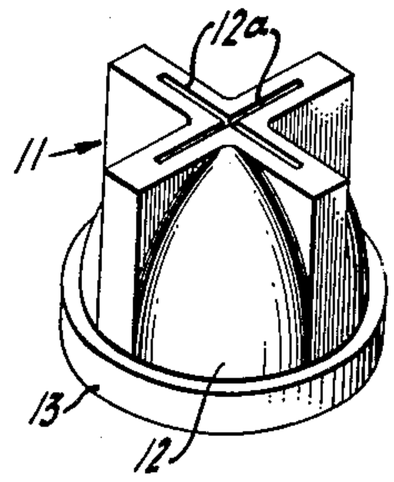


FIG. 4

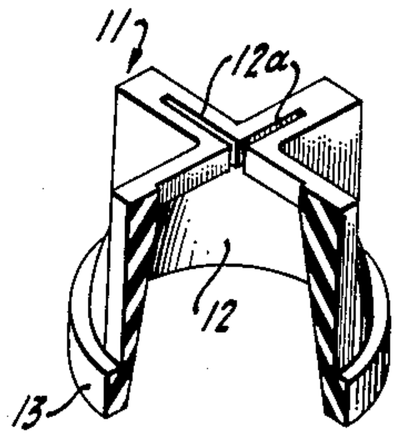


FIG. 5

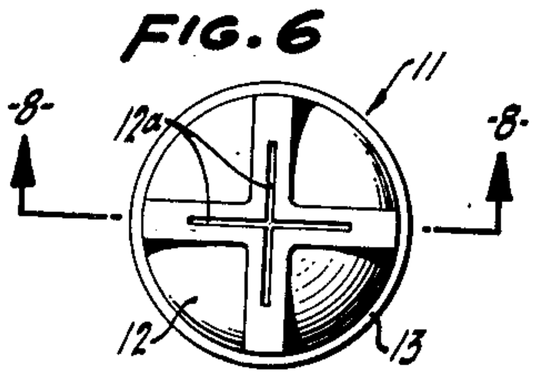


FIG. 6

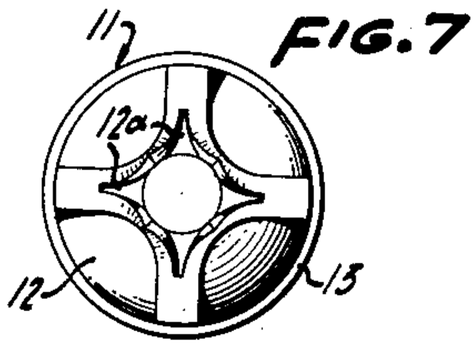


FIG. 7

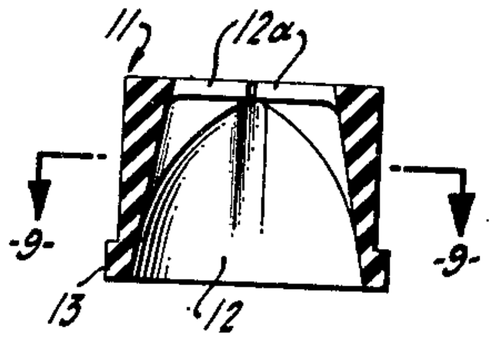


FIG. 8

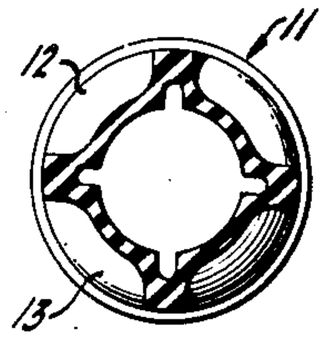


FIG. 9

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# UNITED STATES PATENT OFFICE

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## BAILER FOR OIL WELL BORES

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Application June 1, 1951, Serial No. 229,389

11 Claims. (Cl. 166—19)

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The present invention relates to subsurface well tools, and more particularly to bailers for catching and entrapping debris in the well bore and removing it to the top of the hole.

An object of the present invention is generally to improve subsurface well bailers for cleaning the well bore of junk, detritus, and other debris that might be contained therein.

Another object of the invention is to provide a hydrostatic well bailer that can be lowered readily in the well bore by allowing the well fluid to by-pass or circulate through the well bailer. When the well debris is being forced into the bailer, such by-passing is prevented.

A further object of the invention is to provide a hydrostatic bailer in which the hydrostatic pressure on the equipment above the bailer internally and externally thereof is substantially equalized during elevation of the bailer in the well bore, thereby precluding removal of the debris from the bailer during such elevation.

Still another object of the invention is to provide a hydrostatic bailer adapted to be run in the well bore on a tubular string in which fluid is allowed to drain from the string during its elevation in the well bore, in order to avoid the pulling of a "wet job" as the stands of tubing above the derrick floor are unscrewed from the remainder of the tubular string.

Yet a further object of the invention is to provide a hydrostatic bailer adapted to be run in a well bore on a tubular string, in which circulation down through the tubular string and bailer can be established whenever desired.

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

Referring to the drawings:

Fig. 1 is a longitudinal section through a hydrostatic well bailer, with its parts disposed in their relative positions during lowering of the bailer through a well bore;

Fig. 2 is a view similar to Fig. 1, illustrating the bailer during movement of debris in the well bore thereinto;

Fig. 3 is a view similar to Fig. 1, illustrating the loaded bailer being elevated in the well bore;

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Fig. 4 is an isometric projection of the check valve element employed at the lower end of the bailer;

Fig. 5 is a view similar to Fig. 4, with a portion in longitudinal section;

Fig. 6 is a top plan view of the valve in closed position;

Fig. 7 is a top plan view of the valve in open position;

Fig. 8 is a longitudinal section taken along the line 8—8 on Fig. 6;

Fig. 9 is a cross-section taken along the line 9—9 on Fig. 8.

The bailer apparatus illustrated in the drawings can be lowered in a well bore on the lower end of a tubular string, such as tubing and drill pipe, to the location of debris in the well bore that is to be entrapped in the bailer and lifted to the top of the hole, for appropriate disposition. The bailer is of the hydrostatic type, in which the hydrostatic head of fluid externally of the apparatus is availed of for forcing the debris upwardly into the bailer.

The lower portion of the bailer apparatus includes a generally cylindrical container or barrel 10 having an upwardly opening check valve 11 secured to its lower portion. This check valve can assume any suitable form, being disclosed in the drawings as a rubber, or rubber-like, valve element having a generally dome-like body portion 12 having slots 12a and provided with a lower external flange 13 fitting upon and around a metallic protector 14 that engages the lower end of the flange, being provided with a protective skirt 15 extending upwardly along the inner wall of the body 12. The rubber flange 13 and metal protector 14 are clamped to the lower end of the barrel 10 by a sleeve 16 threaded on the latter and having a shoulder 17 bearing against a protector flange. This sleeve has a plurality of inclined by-pass ports 18 extending therethrough, which are adapted to be opened or closed by a shoe 19 slidable on the sleeve 16 and depending therefrom. The shoe has an inner seal ring 20 secured thereto adapted to be disposed over the exterior of the by-pass ports 18 to close the same, and it is also provided with a downwardly flaring portion 21 for guiding the debris into the lower portion of the bailer barrel or container 10.

The shoe 19 is slidable upwardly with respect to the clamp sleeve 16 until a shoulder 22 on the shoe engages the lower end of a stop flange 23 on the sleeve 16, which locates the seal ring 20 in closed position over the ports 18. The shoe is slidable downwardly with respect to the clamp sleeve to a position limited by engagement of the

seal ring 20 with the stop flange 23, wherein the by-pass ports 18 are open (Fig. 3). Movement of the shoe between the two positions described is facilitated by outwardly bowed friction or drag springs 24 engageable with the wall of the well bore or well casing, and secured to the upper portion of the shoe 19 by one or more screws 25 that may also attach the seal ring 20 to the shoe.

The bailer container or barrel 10 extends upwardly from its lower portion to the desired length, and has a plurality of fluid bleeder ports or holes 26 through its side wall above an inwardly directed barrel flange or stop shoulder 27. These bleeder ports 26 can be opened or closed by a slidable valve head 28 initially secured in an upward position above the ports by one or more shear screws 29 extending through the barrel and into the head. When in this position, the head 28 engages a stop ring 30 threaded into the upper end of the barrel, in order to suspend the barrel 10 and the parts secured thereto from the head 28.

The head 28 is integral with an upwardly extending sleeve portion 31 threadedly secured to a tubular sub 32, a perforated strainer 33 extending across the sub and head passages 34, 35 and being clamped therebetween. The upper end of the sub 32 is threaded into an elongate valve body 36, in which a tubular valve or plunger 37 is slidably mounted. The lower portion of this plunger 37 is formed as a circulating valve cage 38 having one or more slots 39 extending through its side wall and also containing a valve seat 40 threaded thereinto engageable by a valve ball 41 upon upward movement of the latter. The valve ball 41 is urged in an upward direction into engagement with its companion seat 40 by a helical compression spring 42 engaging the ball and a closure plug or seat 43 threaded into the lower end of the cage 38.

Rotation between the tubular plunger 37 and the valve body 36 is preferably prevented, as by forming one or more keys 44 on the plunger 37 slidable within companion elongate keyways 45 formed in the body 36. The valve cage 38 extends into the tubular sub 32, but has a substantially smaller diameter than the diameter of the passage 34 through the sub, to allow fluid to flow upwardly between the cage and the sub and into the valve body 36 thereabove. Similarly, the lower portion of the valve body passage 46 has a greater diameter than the diameter of the plunger 37; so as to allow fluid to flow therebetween. Such fluid is capable of passing into the central plunger passageway 47 through one or more side or circulation ports 48.

The plunger also has one or more upper drain or equalizing ports 49 spaced longitudinally from the circulation ports 48, and adapted to be disposed within a packing 50 clamped to the valve body 36 by a suitable packing nut 51, in which position the upper ports 49 are closed, or located above the packing nut 51, in which position such ports 49 are open, depending upon the position of the valve plunger 37 within the body 36. Such movement is effected by threading the upper end of the plunger 37 into a tubular sub 52, which is, in turn, threaded onto an upper sub 53 that may constitute the lower end of a tubular string extending to the top of the well bore, or of some other chamber. The lower entrance 54 to the tubular string or chamber 53 is closed initially by a frangible sealing disc 55 clamped against a shoulder 56 on the upper sub 53 by a suitable clamp nut 57 threaded into the latter.



The fluid passing upwardly through the sub 52 and into the upper sub 53, following breaking of the disc 55, must flow through a perforated strainer 58 clamped between the subs.

If desired, the barrel 10 of the bailer may have a plurality of longitudinally spaced plates or debris supporting fins 59 secured thereto, and projecting inwardly of the barrel in an upwardly inclined direction.

The apparatus is assembled and mounted on the lower end of the tubular string 53 and is lowered in the well bore, the parts occupying the relative position illustrated in Fig. 1, in which the sealing disc 55 is closed, to prevent passage of fluid into the tubular string, which normally is dry, containing nothing more than air at atmospheric pressure. The downward movement engages the lower end of the sub 52 with the packing nut 51, which locates the upper ports 49 within the packing 50 and closes them. The lower ports 48, however, are disposed below the packing 50 within the enlarged portion 46 of the valve body 36; so that fluid can flow upwardly around the plunger 37 and through these circulation ports 48 into the central passage 47 of the plunger.

The weight of the barrel 10 and the one or more shear screws 29 securing the barrel to the valve head 28 hold the barrel in a lower position relative to the head, in which the upper bleeder ports 26 are open. The frictional engagement of the drag springs 24 against the wall of the well bore or well casing tends to resist downward movement of the shoe 19 and causes the latter to occupy an upward position relative to the sleeve 16, disposing the seal ring 20 in closed position over the lower bypass ports 18.

With the foregoing relationship of parts, the tool is lowered in the well bore, the fluid in the well by-passing upwardly through the check valve 11 and barrel 10 for outward passage through the upper bleeder holes or ports 26 in the barrel. The fluid cannot pass upwardly through the tubular sub 32 and through the circulation ports 48, since the passage through the tubular plunger 37 and lower sub 52 is effectively closed by the upper ports 49 being closed within the packing 50 and by the unbroken sealing disc 55.

When the apparatus reaches the debris D contained in the well bore, downward movement of the shoe 19 and barrel 10 is arrested. Down weight can now be imposed on the tubular string 53 and the lower sub 52, valve body 36, tubular sub 32 and valve head 28, shearing the screw 29 and moving the valve head 28 downwardly to the position disclosed in Fig. 2, in which it is disposed over the upper bleeder ports 26, to close the latter. A go-devil or breaker 60 is then dropped down the drill string 53, striking the sealing disc 55 and breaking it. Such breaking action allows fluid to enter the empty tubing string 53, which fluid can only be urged upwardly through the lower end of the shoe 19. As a result, the debris D in the well bore is subjected to a relatively high hydrostatic head pressure differential, which is the difference in the hydrostatic head between the fluid level externally of the apparatus and tubing string 53 and the fluid level internally thereof, which can be initially at a substantially zero value. This pressure differential forces the debris D upwardly through the shoe 19, stretching the valve body 12 laterally outwardly and somewhat upwardly to open the slots 12a, the debris passing into the bailer

barrel 10. The debris is prevented from passing upwardly above the barrel by the lower strainer 33. The fluid, however, entrapped and commingled in the debris can pass through such strainer into the tubular sub 32, flowing around the valve plunger 37 and through the lower circulation ports 48 for continued upward movement through the plunger passage 47, lower sub 52, and perforated strainer 58 into the lower end of the tubing string or chamber 53.

When the debris D has filled the barrel or container 10, the tubing string 53 can be elevated, which elevates the plunger 37 within the valve body 36 to the extent limited by engagement of the key 44 with the upper end of the keyway 45. This action disposes the upper plunger ports 49 above the packing nut 51, opening these ports and effecting communication between the tubular plunger passage 47 and the well bore around the apparatus. Also, such elevating movement raises the valve head 23 into engagement with the stop ring 30 to a position above the container bleeder holes 26 and also lifts the barrel 10 with respect to the shoe 19, disposing its seal ring 20 against the stop flange 23 on the sleeve 16 and below the by-pass or bleeder ports 18, effecting opening of the latter.

When the upper ports 49 through the plunger 37 pass above the packing 50 and packing nut 51, the well fluid can then flow freely into the tubing string 53, so as to equalize the hydrostatic head internally and externally of the tubing string, imposing no further hydrostatic head differential on the debris D below the shoe 19, tending to push the latter upwardly into the barrel 10. As a matter of fact, the debris entrapped within the barrel and resting on the downwardly closing check valve 11 and also on the supporting plates 59, if the plates are used at all, is not subjected to any further hydrostatic head pressure differentials, since both the upper and lower ports or holes 26, 18 through the barrel are in open position. As a result, there is very little force tending to urge the debris D out of the barrel 10 while the equipment is being elevated in the well bore to the top of the hole.

During elevation of the equipment in the well bore, the fluid therearound can by-pass the equipment by flowing past the exterior of the shoe 19, and also by passing through the open lower by-pass ports 18, thereby not interfering with upward movement of the equipment.

As noted above, the opening of the upper plunger ports 49 allows the hydrostatic head externally and internally of the tubing string 53 to be equalized, by allowing the tubing string to fill with the well fluid. These ports 49 remain open; so that the fluid in the tubing string can flow outwardly therethrough during raising of the tubing string in the well bore. As a result of the dropping of the level of the well fluid in the tubing string, the stands of tubing above the derrick floor will be in a dry condition when being unscrewed from the remainder of the tubing string therebelow; preventing a "wet job" from being pulled by the equipment. Moreover, during such upward movement of the equipment, the fluid in the tubing string 53 can have very little effect on the debris D entrapped within the barrel 10, since the upwardly seating check valve 41 offers some resistance to downward movement of the fluid through the lower portion of the tubular plunger 37, in view of the force exerted by the valve spring 42.

During lowering of the apparatus in the well bore, if, for some reasons, circulation is to be



established down through the tubing string 53, the circulation valve 40, 41, 42 will permit this action to occur, and will allow a large volume of fluid to be pumped through the apparatus. The go-devil 60 is dropped down the tubing string to break the disc 55, whereupon the tubing string 53 can be filled with fluid and this fluid pumped down the tubing string, disengaging the ball 41 from its companion seat 40, and flowing through the ports or slots 39 in the cage into the tubular sub 32, from where the fluid can pass through the strainer 35 and valve head 28 into the barrel 10, flowing outwardly through the upper barrel ports 26.

It is, accordingly, apparent that a hydrostatic bailer has been provided which allows the well fluid to by-pass readily through the bailer while the latter is being lowered in the well bore, and in which the hydrostatic head of fluid externally of the equipment is availed of to force the debris into the bailer. In addition, elevation of the equipment automatically equalizes the hydrostatic pressure internally and externally of the tubing string, as well as allowing the fluid to drain from the tubing string as it is being elevated in the well bore. The hydrostatic head of fluid in the well bore is prevented from acting on the debris entrapped within the bailer during its elevation, and the well fluid can also by-pass around the debris-containing portion of the bailer during its elevation.

Having thus described my invention, what I claim and desire to secure by Letters Patent is:

1. In a bailer to be lowered in a well bore on a running-in string: a barrel; a check valve at the lower portion of said barrel capable of allowing upward passage of substances through said valve and into said barrel; a by-pass opening through said barrel below said valve; a shoe slidable relatively upwardly on said barrel to close said opening, said shoe being slidable relatively downward on said barrel to open said opening; the upper portion of said barrel having an opening to allow fluid passage between the interior and exterior of said barrel; a valve member slidable in said barrel and operable by the running-in string to be shifted selectively downward to closed position over said upper opening or upwardly to open position above said upper opening; and means releasably holding said valve in its upward position to place said upper opening in open condition as the bailer is being lowered in the well, and being releasable upon the imposition thereto of a predetermined load to release the valve member to allow downward movement thereof to close said upper opening.

2. In a bailer to be lowered in a well bore on a running-in string: a barrel; a check valve at the lower portion of said barrel capable of allowing upward passage of substances through said valve and into said barrel; an opening through the upper portion of said barrel to allow fluid passage between the interior and exterior of said barrel; a tubular valve member slidable in said barrel and having a head movable downwardly to closed position over said opening and upwardly to open position above said one or more openings; a tubular plunger telescoped with respect to said valve member and being progressively exposed to the well fluid during withdrawal movement thereof with respect to said valve member and having a fluid passage closed by said valve member when said plunger is shifted downwardly with respect to said valve member, said fluid passage being opened to allow fluid flow between the interior and

exterior of said plunger when said plunger is shifted upwardly with respect to said valve member.

3. In a bailer to be lowered in a well bore on a running-in string: a barrel; a check valve at the lower portion of said barrel capable of allowing upward passage of substances through said valve and into said barrel; a by-pass opening through said barrel below said valve; a shoe slidable relatively upward on said barrel to close said opening, said shoe being slidable relatively downward on said barrel to open said opening; the upper portion of said barrel having an upper opening to allow fluid flow between the interior and exterior of said barrel; a tubular valve member slidable in said barrel and having a head movable downwardly to closed position over said upper opening and upwardly to open position above said upper opening; a tubular plunger telescoped within said valve member and having a fluid passage closed by said valve member when said plunger is shifted downwardly with respect to said valve member, said fluid passage being opened to allow fluid flow between the interior and exterior of said plunger when said plunger is shifted upwardly with respect to said valve member.

4. In a bailer to be lowered in a well bore on a running-in string: a barrel; a check valve at the lower portion of said barrel capable of allowing upward passage of substances through said valve and into said barrel; a by-pass opening through said barrel below said valve; a shoe slidable relatively upward on said barrel to close said opening, said shoe being slidable relatively downward on said barrel to open said opening; the upper portion of said barrel having an upper opening to allow fluid flow between the interior and exterior of said barrel; a tubular valve member slidable in said barrel and having a head movable downwardly to closed position over said upper opening and upwardly to open position above said upper opening; means releasably holding said valve member in its upward position releasable upon the imposition thereto of a predetermined load to permit downward movement of said valve member; a tubular plunger telescoped within said valve member and having a fluid passage closed by said valve member when said plunger is shifted downwardly with respect to said valve member, said fluid passage being opened to allow fluid flow between the interior and exterior of said plunger when said plunger is shifted upwardly with respect to said valve member; and friction drag means on said shoe engageable with the wall of the well bore.

5. In a bailer to be lowered in a well bore on a running-in string: a barrel; a check valve at the lower portion of said barrel capable of allowing upward passage of substances through said valve and into said barrel; a tubular valve member operatively connected to said barrel; a tubular plunger telescoped with respect to said valve member and being progressively exposed to the well fluid during withdrawal movement thereof with respect to said valve member and having a fluid passage closed by said valve member when said plunger is shifted downwardly with respect to said valve member, said fluid passage being opened to allow fluid flow between the interior and exterior of said plunger when said plunger is shifted upwardly with respect to said valve member.

6. In a bailer to be lowered in a well bore on a running-in string: a barrel; a check valve at the lower portion of said barrel capable of allowing



upward passage of substances through said valve and into said barrel; a tubular valve member operatively connected to said barrel; a tubular plunger slidable within said valve member and having an upper fluid passage closed by said valve member when said plunger is shifted downwardly with respect to said valve member, said fluid passage being opened to allow fluid flow between the interior and exterior of said plunger when said plunger is shifted upwardly with respect to said valve member; said plunger having a lower opening below said passage to allow fluid flow between the interior of said plunger and the interior of said valve member below said passage.

7. In a bailer to be lowered in a well bore on a running-in string: a barrel; a check valve at the lower portion of said barrel capable of allowing upward passage of substances through said valve and into said barrel; a tubular valve member operatively connected to said barrel; a tubular plunger slidable within said valve member and having an upper fluid passage closed by said valve member when said plunger is shifted downwardly with respect to said valve member, said fluid passage being opened to allow fluid flow between the interior and exterior of said plunger when said plunger is shifted upwardly with respect to said valve member; said plunger having a lower opening below said passage to allow fluid flow between the interior of said plunger and the interior of said valve member below said passage; a chamber attached to said plunger and having an inlet; and releasable means initially closing said inlet to prevent upward flow of fluent substances from said plunger into said chamber.

8. In a bailer to be lowered in a well bore on a running-in string: a barrel; a check valve at the lower portion of said barrel capable of allowing upward passage of substances through said valve and into said barrel; a tubular valve member operatively connected to said barrel; a tubular plunger slidable within said valve member and having an upper fluid passage closed by said valve member when said plunger is shifted downwardly with respect to said valve member, said fluid passage being opened to allow fluid flow between the interior and exterior of said plunger when said plunger is shifted upwardly with respect to said valve member; said plunger having a lower opening below said passage to allow fluid flow between the interior of said plunger and the interior of said valve member below said passage; a chamber attached to said plunger and having an inlet; and a breakable disc initially closing said inlet.

9. In a bailer to be lowered in a well bore on a running-in string: a barrel; a check valve at the lower portion of said barrel capable of allowing upward passage of substances through said valve and into said barrel; a tubular valve member operatively connected to said barrel; a tubular plunger slidable within said valve member and having an upper fluid passage closed by said valve member when said plunger is shifted downwardly with respect to said valve member, said fluid passage being opened to allow fluid flow between the interior and exterior of said plunger when said plunger is shifted upwardly with respect to said valve member; said plunger having a lower opening below said passage to allow fluid flow between the interior of said plunger and the interior of said valve member below said passage; and a downwardly open check valve in said plunger below said lower opening.

10. In a bailer to be lowered in a well bore on

a running-in string: a barrel; a check valve at the lower portion of said barrel capable of allowing upward passage of substances through said valve and into said barrel; an opening through the upper portion of said barrel to allow fluid passage between the interior and exterior of said barrel; a tubular valve member slidable in said barrel and having a head movable downwardly to closed position over said opening and upwardly to open position above said opening; a tubular plunger telescoped with respect to said valve member and having a fluid passage closed by said valve member when said plunger is shifted downwardly with respect to said valve member, said fluid passage being opened to allow fluid flow between the interior and exterior of said plunger when said plunger is shifted upwardly with respect to said valve member; a chamber attached to said plunger and having an inlet; and releasable means initially closing said inlet to prevent upward flow of fluent substances from said plunger into said chamber.

11. In a bailer to be lowered in a well bore on a running-in string: a barrel; a check valve at the lower portion of said barrel capable of allowing upward passage of substances through said valve and into said barrel; a by-pass opening through said barrel below said valve; a shoe slidable relatively upward on said barrel to close said opening, said shoe being slidable relatively downward on said barrel to open said opening; the upper portion of said barrel having an upper opening



to allow fluid flow between the interior and exterior of said barrel; a tubular valve member slidable in said barrel and having a head movable downwardly to closed position over said upper opening and upwardly to open position above said upper opening; a tubular plunger telescoped within said valve member and having a fluid passage closed by said valve member when said plunger is shifted downwardly with respect to said valve member, said fluid passage being opened to allow fluid flow between the interior and exterior of said plunger when said plunger is shifted upwardly with respect to said valve member; a chamber attached to said plunger and having an inlet; and releasable means initially closing said inlet to prevent upward flow of fluent substances from said plunger into said chamber.

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