

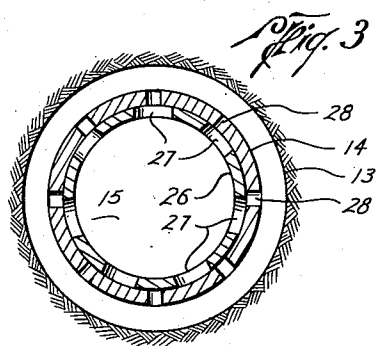
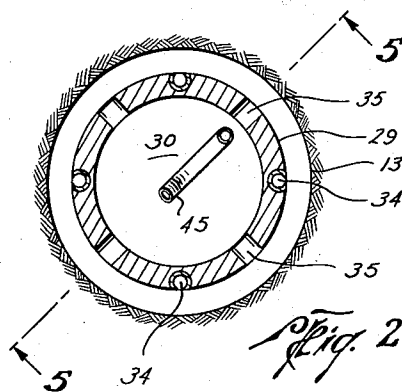
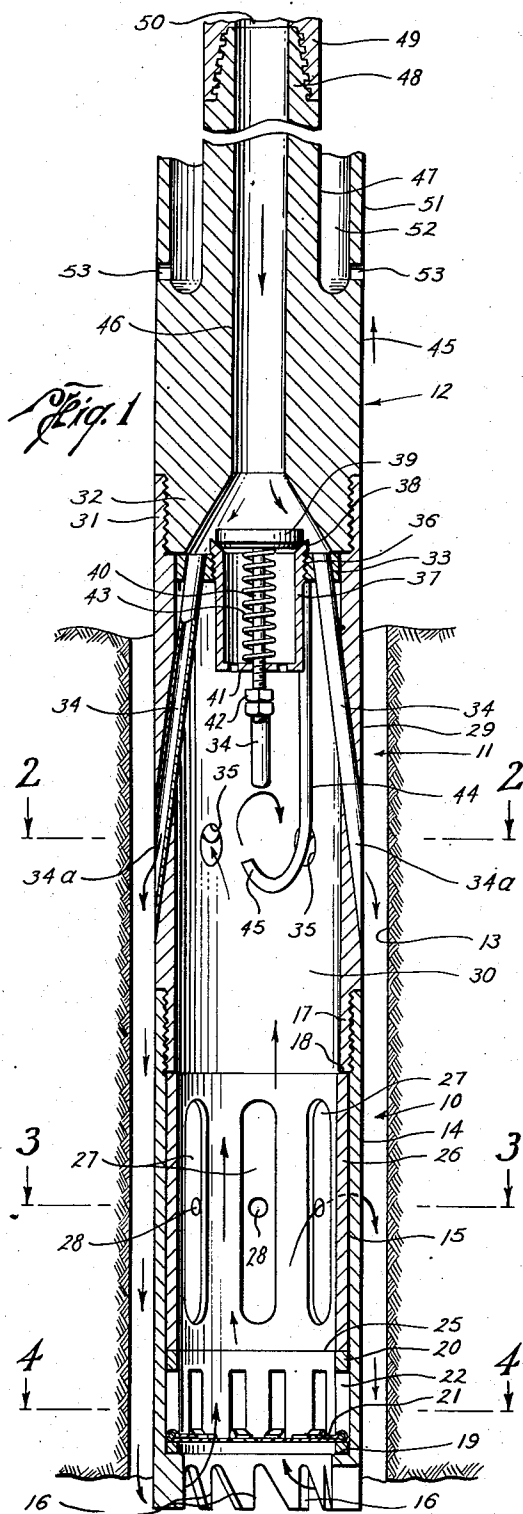
Dec. 22, 1953

R. DONNELL ET AL.
FISHING TOOL FOR WELLS

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Filed May 31, 1952

2 Sheets-Sheet 1



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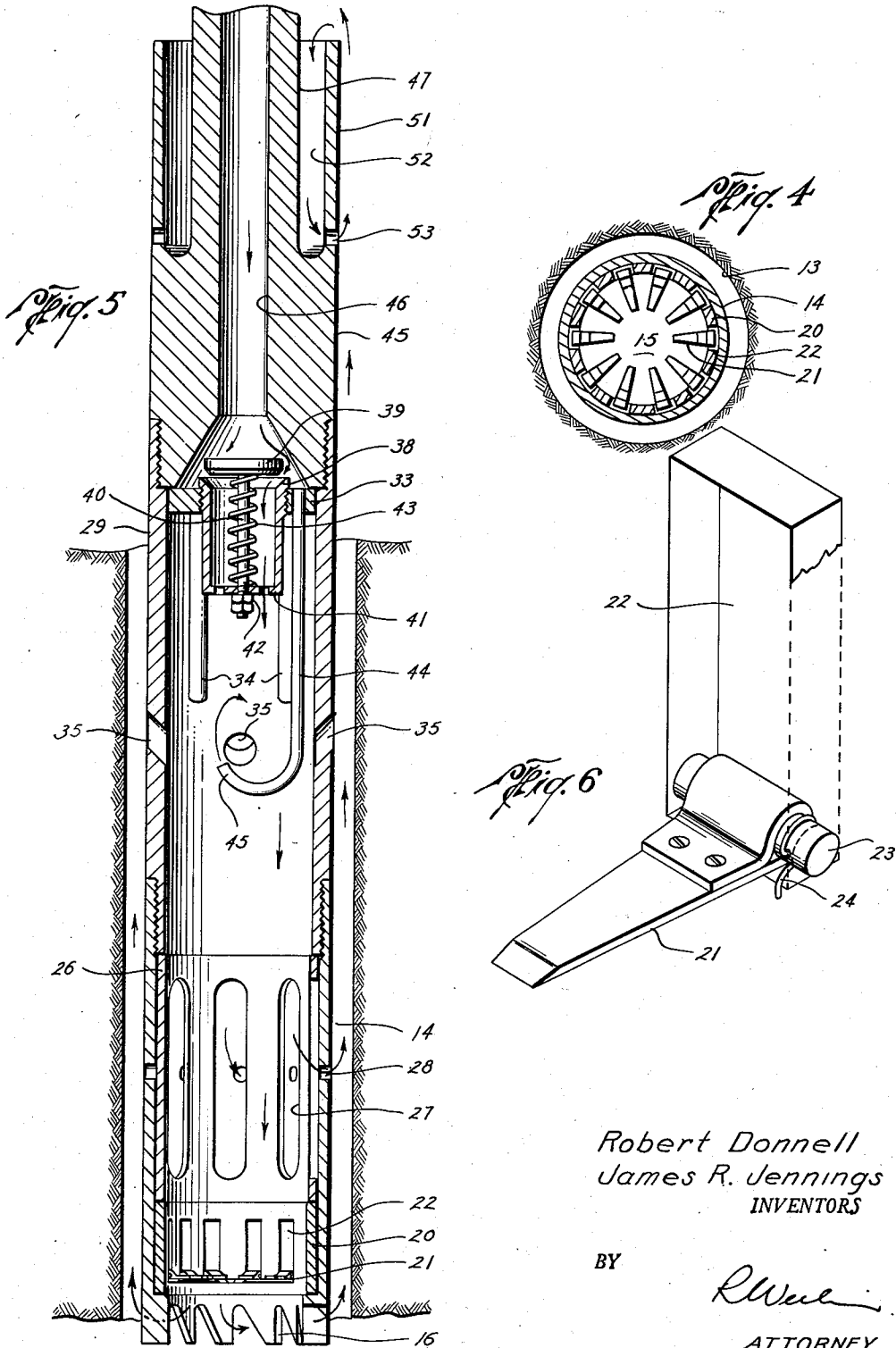
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FISHING TOOL FOR WELLS

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8 Claims. (Cl. 166—19)

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This invention relates to a well tool, and particularly to a fishing tool for use in recovering from the bottom of a well various objects such as broken parts of tools, loose pieces of metal, bit cones, and the like, which, unless removed, present obstacles to the further drilling of the well bore and are hazardous to the operation of the drilling tools. Fishing tools employed for this purpose are termed, in oil industry parlance, "junk baskets."

Conventional junk baskets are made in various forms. Generally, the tool comprises a tubular body having a large bored chamber at its bottom which is lowered on the end of a string of pipe to the bottom of the well where the objects to be recovered are lodged. Where the objects to be recovered are relatively small in size, the tool may be provided with an external sleeve positioned above the lower end of the tool and open at its upper end to provide an annular pocket or basket to receive these smaller sized objects as they are washed upwardly in the annular space between the tool and the wall of the well bore by wash liquid which is circulated downwardly through the bore of the tool and thence upwardly in the annular space between the tool and the wall of the well bore. The reduction in velocity of the wash liquid as it flows upwardly past the tool allows the foreign objects to settle out and be trapped in the external basket.

Where the foreign objects are too large to be caught in the external basket, they may be washed or forced into the large-bored chamber in the lower end of the tool by providing by-pass channels in the tool body whereby the wash liquid may be directed from a point along the bore of the tool above the chamber to the exterior of the tool and thence downwardly around the bottom of the tool to the interior thereof to thereby wash the object into the interior of the tool by this so-called "reverse circulation." The bottom of the tool is normally provided with suitable retainer means to retain the objects inside the body. The bottom of the body may also be provided with cutting or milling teeth so that rotation of the body will cut a core from the bottom of the well which enters the interior of the tool carrying on its upper end the objects to be recovered.

One of the principal disadvantages of present types of junk baskets having means for both normal and reverse circulation of the wash liquid, is that once the tool is in the well and is operated to change the circulation from normal to reverse circulation, it cannot be changed back

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to normal circulation without removing the tool from the well, although in many instances it is highly desirable to be able to repeatedly alternate the circulation of the wash liquid from normal to reverse circulation.

A principal object of this invention is to provide an improved form of junk basket by which all of the several described types of recovery operation may be selectively performed individually or simultaneously.

A primary object is to provide a form of junk basket in which circulation of the wash fluid may be changed from normal to reverse circulation as often as desired, without removing the tool from the well.

Other and more specific objects and advantages of this invention will become apparent from the following detailed description when read in conjunction with the accompanying drawings which illustrate one useful embodiment in accordance with this invention.

In the drawings:

Fig. 1 is a longitudinal sectional view of the tool in accordance with the present invention, the parts being shown in the positions occupied during normal circulation of wash liquid through the tool;

Fig. 2 is a cross-sectional view along line 2—2 of Fig. 1;

Fig. 3 is a cross-sectional view along line 3—3 of Fig. 1;

Fig. 4 is a cross-sectional view along line 4—4 of Fig. 1;

Fig. 5 is a longitudinal sectional view along line 5—5 of Fig. 2 being generally similar to Fig. 1 but angularly oriented relative thereto, and showing the parts in the positions occupied during reverse circulation of the wash liquid through the tool; and

Fig. 6 is a perspective view of one of the details of the device.

Referring to the drawings, it will be seen that the tool is composed of three major portions, a bottom shoe, designated generally by the numeral 10, a reverse circulation sub, designated generally by the numeral 11, and a top basket, designated generally by the numeral 12. These portions are connected together in coaxial end-to-end relation to form a continuous cylindrical tool of substantially uniform external diameter adapted to be inserted in the bore of a well 13.

Bottom shoe 10 is composed of a tubular body 14 having a relatively large diameter bore 15 and provided at its lower end with downwardly projecting circumferentially arranged milling teeth

16. At its upper end the wall of body 14 is internally threaded to receive an externally threaded pin 17 forming the lower end of reverse circulation sub 11. The lower end of pin 17 which projects into bore 15 forms a downwardly facing annular shoulder 18. The lower end of body 14 just above teeth 16 is provided with an upwardly facing annular shoulder 19. A catcher collar 20 is rotatably seated on shoulder 19 and is provided with a plurality of radially inwardly projecting catcher fingers 21 adapted to retain in the bore of body 14 any objects which enter the bottom of the tool. The catcher collar may be of any generally conventional design suitable for this purpose. As illustrated, (see particularly Fig. 6), collar 20 is provided with a plurality of angularly spaced longitudinal slots 22 having the fingers 21 hingedly journaled therein by means of hinge pins 23. The bottoms of slots 22 from stops to hold the fingers in the generally horizontal position, the fingers being free to swing upwardly to the vertical position in slots 21 to permit entry of an object into the bore of the body. Coil springs 24 are connected between hinge pins 23 and collar 20 and are arranged to urge the fingers to the horizontal position to thereby retain within the body any object which has entered therein.

The upper end of collar 20 forms an upwardly facing annular shoulder 25. Supported between shoulders 18 and 25 is a tubular sleeve 26 which is dimensioned so as to be freely rotatable between these shoulders relative to body 14. Sleeve 26 is provided with a plurality of angularly uniformly spaced, longitudinally extending, elongated openings 27. The wall of body 14 opposite sleeve 26 is provided with a plurality of angularly uniformly spaced holes 28 having diameters smaller than the width of openings 27. A greater number of holes 28 than openings 27 is provided in order that one or more of the holes 28 will always be in registration with one or more of the openings 27 irrespective of the angular position of sleeve 26 relative to body 14.

Reverse circulation sub 11 comprises a tubular body 29 having a relatively large diameter bore 30 of substantially the same diameter as that of sleeve 26 with which it is in open communication. At its upper end body 29 is provided with an internally threaded socket 31 adapted to receive an externally threaded pin 32 formed on the lower end of upper basket 12. At its upper end adjacent the bottom of socket 31, the bore of body 29 is closed by means of a plate 33. A plurality of angularly spaced reverse circulation wash pipes 34 extend downwardly through plate 33 and thence outwardly through the wall of body 29 to the exterior thereof by way of ports 34a positioned at points somewhat above the lower end of the sub. Communication is thus provided between the interior of the tool above plate 33 and the exterior of body 29. A plurality of circumferentially spaced openings 35 are provided in a medial portion of the wall of body 29 at or slightly above the level of ports 34a to provide communication between bore 30 and the exterior of body 29. It will be understood that the area of openings 35 will be made sufficiently large to permit free circulation of wash liquid through the interior of the tool from the bottom thereof to its exterior, and will usually be at least as great as the area of wash pipes 34. Plate 33 is provided with a central opening 36 in which is mounted a downwardly extending tubular valve cage 37 having an annular seat 38 at its upper

end opening to the upper face of plate 33. A disk valve 39 is mounted above seat 38 and is provided with a stem 40 which projects downwardly through the bore of seat 38 and extends slidably through a guide spider 41 in the lower end of cage 37. The lower end of stem 40 which projects below spider 41 is threaded and carries one or more adjusting nuts 42. A coil spring 43 surrounds stem 40 and is held in compression between valve 39 and spider 41 to normally urge valve 39 to the open position relative to seat 38. By adjustment of nuts 42 the force of spring 43 exerted against valve 39 may be adjusted as desired.

An internal wash pipe 44 of relatively restricted diameter extends downwardly through plate 33 to an intermediate level inside bore 30, and terminates in an upwardly curved discharge nozzle 45.

Upper basket 12 comprises a generally cylindrical body 45 having a relatively narrow axial bore 46 which widens out at its lower end and communicates with the upper ends of wash pipes 34 and 44 and valve seat 38. At an intermediate point above pin 32 the external diameter of body 45 is reduced to form a shank 47 which terminates at its upper end in an externally threaded pin 48 by which the tool is connected to the end of an operating pipe string 49 having a bore 50 communicating with bore 46. Concentrically surrounding shank 47 and radially spaced therefrom is a collar 51 which may be formed as an integral upward extension of the outer surface of body 45. The annular space between collar 51 and shank 47 forms an annular chamber or basket 52 which is open at its upper end and adapted to trap and retain small objects or foreign particles which settle out of the wash liquid flowing upwardly in the well bore past the exterior of the basket. Openings 53 are provided in the wall of collar 51 adjacent the bottom of the basket to permit passage of liquid therethrough.

The above-described tool operates in the following manner: The tool, assembled as described and connected to operating pipe 50, is lowered thereby to the bottom of well 13.

If it is desired to recover relatively small objects, circulation of wash liquid will be begun through bores 50 and 46 at a relatively low rate such that the force of spring 43 will be sufficient to hold valve 39 in the open position against the pressure exerted thereon by the wash liquid, as seen in Fig. 5. The wash liquid will then circulate normally, that is, the major portion will flow through the open valve and the bores of sub 29 and shoe 14 to the well bottom and thence upwardly between the exterior of the tool and the wall of the well bore. The velocity of the liquid washing across the bottom of the well will ordinarily be sufficient to carry the smaller foreign objects upwardly to a point above basket 52 where the increase in area of the annular space, because of the reduction in diameter of shank 47, will cause a lowering of the velocity of the wash liquid sufficient to allow the foreign particles to settle downwardly and be trapped in basket 52. It will be understood that some portion of the liquid will flow outwardly through wash pipes 34 and openings 27, 28. Also a portion of the liquid will be circulated by internal wash pipe 44 through the interior of sub 29 and will discharge into the well bore through openings 35, thereby aiding in keeping the interior of the tool cleared of mud and cuttings. Liquid entering basket 52 will return

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to the main stream thereof through openings 53. It will be understood also that by rotating operating pipe 49, the tool may be rotated to employ the milling action of teeth 16 to aid, if found necessary, in lowering the tool to the well bottom.

If objects larger than those which can be accommodated in basket 52 must be removed, the volume of wash liquid is increased sufficiently to exert a degree of pressure on valve 39 sufficient to overcome the opposing force of spring 43 and to thereby move valve 39 to the closed position on seat 38, as best seen in Fig. 1. The major portion of the wash liquid will thus be diverted through wash pipes 34 and will be discharged at relatively high velocity downwardly against and along the wall of well 13 and across the bottom of the well below the lower end of shoe 10 and into the bore of the shoe sweeping foreign objects into the interior of the tool. The wash liquid will discharge from the interior of the tool to the exterior thereof through openings 27, 28 and openings 35, whence the liquid will continue upwardly through the well bore to the surface.

If found necessary or desirable, the tool may be rotated as the washing is conducted to wash around the foreign objects and allow the open end of the tool to pass over and enclose the objects. The rotation of the tool may also be employed to cut a core from the well bottom which will enter the bottom of the tool lifting objects lying on its upper end into the bore of the tool. The wash liquid circulating through the tool will wash away sand, clay, cuttings and similar detritus to better enable the tool to accommodate the larger objects. Internal wash pipe 44 will also circulate wash liquid through the interior of the sub to keep it cleared of mud and cuttings.

When a core or large foreign object enters the bottom of the tool, it will frictionally engage sleeve 26 and fingers 21. The relatively rotatable arrangement provided between sleeve 26 and collar 20 and the body of shoe 10, permits continued rotation of the latter while sleeve 26 and collar 20 may be held stationary by a core or large object which has entered the interior of the tool. The described relative arrangement of openings 27 and 28 allows escape of wash liquid from the interior of the shoe irrespective of the relative positions of the shoe and sleeve 26.

When the large objects have been deposited in the interior of the tool, the volume of wash liquid may be reduced, allowing valve 39 to open and restoring normal circulation, whereby further washing of the wall to remove any additional small objects may be conducted.

It may be desired to repeatedly switch between normal and reverse circulation in order to effectively remove both small and large foreign objects. By means of the described valve arrangement this may be done as often as desired without removing the tool from the well, by merely changing the rate of introduction of wash liquid to pipe 50, thereby providing a great deal of flexibility for employing the tool to meet a wide variety of conditions encountered in a well.

It will be understood that numerous alterations and changes may be made in the details of the illustrative embodiment within the scope of the appended claims but without departing from the spirit of this invention.

What we claim and desire to secure by Letters Patent is:

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1. A fishing tool for wells, comprising, an elongated tubular body adapted to be lowered in a well on a pipe, an enlarged internal chamber in said body opening through its lower end, a closure for the upper end of said chamber, a port in said closure providing communication between said chamber and said pipe, fluid passages extending through said closure and outwardly and downwardly through the wall of said body to the exterior thereof at points above its lower end, openings through the wall of said chamber from the interior to the exterior thereof, and movable valve means controlling said port, said valve means including means normally resiliently urging the valve means to the open position and said valve means being closable by flow of fluid from said pipe exceeding a predetermined rate.

2. A fishing tool for wells, comprising, an elongated tubular body adapted to be lowered in a well on a pipe, an enlarged internal chamber in said body opening through its lower end, a closure for the upper end of said chamber, a port in said closure providing communication between said chamber and said pipe, fluid passages extending through said closure and outwardly and downwardly through the wall of said body to the exterior thereof at points above its lower end, openings through the wall of said chamber from the interior to the exterior thereof, movable valve means controlling said port, said valve means including means normally resiliently urging the valve means to the open position and said valve means being closable by flow of fluid from said pipe exceeding a predetermined rate, and an annular chamber open at its upper end mounted on the exterior of said body adjacent its upper end portion.

3. A fishing tool for wells, comprising, an elongated tubular body adapted to be lowered in a well on a pipe, an enlarged internal chamber in said body opening through its lower end, a closure for the upper end of said chamber, a port in said closure providing communication between said chamber and said pipe, fluid passages extending through said closure and outwardly and downwardly through the wall of said body to the exterior thereof at points above its lower end, openings through the wall of said chamber from the interior to the exterior thereof, movable valve means controlling said port, said valve means including means normally resiliently urging the valve means to the open position and said valve means being closable by flow of fluid from said pipe exceeding a predetermined rate, and a fluid conduit extending through said closure downwardly into the interior of said chamber.

4. A fishing tool for wells, comprising, an elongated tubular body adapted to be lowered in a well on a pipe, an enlarged internal chamber in said body opening through its lower end, a closure for the upper end of said chamber, a port in said closure providing communication between said chamber and said pipe, fluid passages extending through said closure and outwardly and downwardly through the wall of said body to the exterior thereof at points above its lower end, openings through the wall of said chamber from the interior to the exterior thereof, movable valve means controlling said port, said valve means including means normally resiliently urging the valve means to the open position and said valve means being closable by flow of fluid from said pipe exceeding a predetermined rate, and a tubular sleeve member mounted within the lower por-

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tion of said chamber for free relative rotation with respect to said body, said sleeve member carrying catcher elements for retaining objects entering the interior of said sleeve member.

5. A fishing tool for wells, comprising, an elongated tubular body adapted to be lowered in a well on a pipe, an enlarged internal chamber in said body opening through its lower end, a closure for the upper end of said chamber, a port in said closure providing communication between said chamber and said pipe, fluid passages extending through said closure and outwardly and downwardly through the wall of said body to the exterior thereof at points above its lower end, openings through the wall of said chamber from the interior to the exterior thereof, movable valve means controlling said port, said valve means being resiliently urged to the open position relative to said port and arranged to be acted upon by flow of fluid from said pipe exceeding a predetermined rate to close said port, a tubular sleeve member mounted within the lower portion of said chamber for free relative rotation with respect to said body, said sleeve member carrying catcher elements for retaining objects entering the interior of said sleeve member, and a plurality of circumferentially spaced registering openings through the wall of said sleeve member and the opposite portion of said body.

6. A fishing tool for wells, comprising, an elongated tubular body adapted to be lowered in a well on a pipe, an enlarged internal chamber in said body opening through its lower end, a closure for the upper end of said chamber, a port in said closure providing communication between said chamber and said pipe, fluid passages extending through said closure and outwardly and downwardly through the wall of said body to the exterior thereof at points above its lower end, openings through the wall of said chamber from the interior to the exterior thereof, movable valve means controlling said port, said valve means being resiliently urged to the open position relative to said port and arranged to be acted upon by flow of fluid from said pipe exceeding a predetermined rate to close said port, a tubular

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sleeve member mounted within the lower portion of said chamber for free relative rotation with respect to said body, said sleeve member carrying catcher elements for retaining objects entering the interior of said sleeve member, a plurality of circumferentially spaced registering openings through the wall of said sleeve member and the opposite portion of said body, and an annular chamber open at its upper end mounted on the exterior of said body adjacent its upper end portion.

7. A fishing tool for wells, comprising, an elongated tubular body adapted to be lowered in a well on a pipe, an enlarged internal chamber in said body opening through its lower end, a closure for the upper end of said chamber, passages providing communication between said pipe and the exterior of said body for reverse circulation of fluid from the pipe, a port in said closure providing a fluid circulation passage between said pipe and the interior of said chamber, and velocity actuated valve means controlling said port, said valve means being acted upon by the fluid flowing from said pipe to move between port-opening and port-closing positions in accordance with predetermined variations in the rate of flow of said fluid whereby to selectively direct the circulation of fluid either to said reverse circulation passages or to said fluid circulation passages.

8. A fishing tool for wells according to claim 7 having an annular object-receiving chamber open at its upper end mounted on the exterior of said body adjacent its upper end portion.

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