The present invention is directed to a wire line releasing tool and well plug for releasing a well plug previously set in a section of pipe. When conducting operations in a borehole, it is sometime desirable or necessary to set a well plug temporarily in the pipe and to release and retrieve it at some subsequent time. This case is directed to a hydraulic well plug and retrieving tool for releasing the well plug from its set position and withdrawing it from the string of tubing.

Other objects and advantages of the present invention may be seen from the following description taken in connection with the drawings in which—

Fig. 1 is a sectional view showing a well plug in set position in a section of pipe;

Fig. 2 is a view showing the releasing tool engaged with said plug in position prior to the release of the plug; and

Fig. 3 is an elevation, partly in section, showing the releasing tool engaged with the plug after the plug has been released and is ready to be retrieved from the string of pipe.

Turning now specifically to the drawing and first to Fig. 1, the well plug consists of a body A having a pulling head B at its upper end. A passage C connects the upper end of the body A with its central portion. The upper end of passage C has a check valve assembly D for controlling the discharge of fluid from passage C. A rubber sleeve E has its upper end secured to the body A in a fluid-tight seal with a sleeve F and its lower end secured to the body A in a fluid-tight seal with a sleeve G. The well plug is within a section of pipe H with the packer body I expandable in the pipe to make a fluid-tight seal therewith by means of a suitable means such as a hydraulic fluid. In the drawing Figs. 1 and 2 chamber 11, passages 12 and central passage 13 below check valve member 14 of assembly D contain a suitable hydraulic fluid under pressure to retain the packer E in its expanded position.

Passage C includes annular passage 15, lateral passage 12 and axial bore passage 16. Passage 13 extends from approximately midway the length to the top of cylindrical body A. Passages 12 communicate with passage 13 and extend laterally from the center to the periphery of body member A. Passage 11, formed when the packer is in an expanded position, extends substantially the length of and circumferentially around body member A.

The upper and lower portions of body member A are cut inwardly in tapered steps 42, 43, respectively. The lowermost portion is provided with threads 44 to threadedly engage the cup-shaped sleeve member G. Sleeve member G is provided with an inner annular shoulder 45 to support one end of rubber packer E. The upper end of body A is also provided with threads 46 for securing upper sleeve member F. The uppermost portion of body A narrows at 47 to form pulling head B. Head B has an annular downwardly sloping wedge-shaped surface 48 for engaging with an annular upwardly sloping wedge-shaped surface 49 of retrieving arms 50.

Axial passage 13 is provided with an enlarged portion 51 having threads 52 for securing the valve retainer member 53. Enlarged passage 51 contains helical spring 54 and ball 14. Ball 14 is normally biased upwardly by spring 54 to seat against and close narrow axial passage 56 in retainer 53.

The releasing assembly consists of a body J which has a lower cylinder K and an upper cylinder L and a head engaging assembly M at its lower end. A piston N is slidably arranged in the lower cylinder with a pin 15 secured thereto. Piston O is slidably arranged in the upper cylinder L and is secured to piston rod P whose upper end extends through a central passage 16 of body J and terminates in a pulling head 17. A spring 18 is arranged around piston rod P between the upper end 19 of chamber L and piston O to bias the piston O to its lowestmost position.

A plurality of retrieving arms 50, pivotally suspended at 57, extend below body member J for engagement with the pulling head B. Resilient V-shaped members 58 normally urge arms 50 inwardly.

Body or housing J includes lower hollow cylindrical member 59, middle hollow cylindrical member 60 and cap member 61. The lower member 59 is provided with a base portion 59a through which axial passage 40 extends. The lower end of middle member 60 is screw threaded connected to the upper end of lower member 59 thereby closing the upper end of lower member 59 by partition 62 except for the vertically and horizontally extending passages 27, 28, respectively, which communicate the upper end of middle member 60 with the upper end of lower member 59. These passages are circumferentially spaced and formed within the cylindrical wall of middle member 60. Partition 62 constitutes the base of chamber L and the top of chamber K. Cap member 61 is screw threadedly connected to middle member 60 and is provided with an axial passage 16 through which piston rod P slidably and sealingly extends. Piston N divides chamber K into an upper portion 25 and lower portion 26, upper portion 25 being connected by longitudinally extending passages 27 and side ports 28 to the upper portion 29 of chamber L. Piston O is in sealing engagement with the walls of the chamber by means of seals 63. Seals 60 are provided to seal openings 16 through which piston rod P extends.

The lower end of body J is provided with a central passage 40 through which pin 15 of cylinder N slidably extends. Pin 15 is in vertical alignment with the opening 41 at the upper end of passage C of plug body A so that as the lower end of pin 15 enters the upper end of passage C through axial passage 56 and unseats valve member 14 from its seat it serves to release the pressure from the sealed chamber consisting of passages 11, 12, and 13 of the well plug assembly.

When the releasing assembly, as shown in Fig. 2, is prepared for lowering into the well bore, the chamber portion 29 of cylinder L, side ports 28, longitudinal passages 27, and chamber portion 25 are filled with a suitable hydraulic fluid while piston N is in its upper position as shown in the drawing and is retained in this position by the friction of piston N with the walls of cylinder K. The device is secured with a wire line through head 17 of piston rod P and is lowered in the string of pipe until the engaging assembly M engages with plug B. When the engaging assembly has engaged with the pulling head of the well plug which is shown in Fig. 2, an upward pull on the wire line causes piston rod P with attached piston to move upwardly compressing spring 18 and forcing hydraulic fluid from chamber portion 29 into chamber passage 28 and 27 into chamber portion 25 and driving piston N with attached pin 15 downwardly so that pin 15 enters through opening 41 of passage C of the well plug as—
assembly and moves downwardly to contact with valve member 14 and then to force valve member 14 from its seat so that pressure may be released from the well plug and discharged into the interior of pipe 11 through opening 41. As the excess pressure is released within the body of the well plug, rubber sleeve E contracts and the packer is released as shown in Fig. 3. The releasing tool with the well plug engaged therewith and the packer member deformed may be withdrawn to the surface of the earth by means of the wire line.

While a specific embodiment of the present invention has been disclosed, it will be obvious that various changes in the sizes, shapes and proportions of the several parts may be made without departing from the scope of the invention.

What is desired to be claimed is:

1. A releasing tool for an expanded well plug, said plug including an expandable sleeve adapted to contain a supply of expanding fluid therein, a pulling head, a passage in said head for the supply and release of fluid in said sleeve, and a check valve in said passage which normally retains fluid in said sleeve, said tool comprising a housing enclosing first and second spaced apart chambers adapted to have a confined fluid in said first chamber, passages fluidly communicating said chambers, a first movable piston in said first chamber having a piston rod attached thereto, said piston rod sealingly extending through the upper end of said first housing, biasing means in said first chamber adapted to urge said first piston to one end of said first chamber, a second movable piston in said first chamber normally held at one end of said second chamber and movable in response to the action of the confined fluid from said first chamber through said communicating passages to said second chamber, means attached to said second piston and slidable through the lower end of said housing to engage and unseat said check valve and permit fluid to escape from said sleeve, means on the lower portion of said housing adapted to engage the pulling head to prevent relative upward movement therebetween, and means for moving said piston rod against said biasing means to elevate said tool and plug.

2. A releasing tool for an expanded well plug, said plug including an expandable sleeve adapted to contain a supply of expanding fluid therein, a pulling head, a passage in said head for the supply and release of fluid in said sleeve, and a check valve in said passage which normally retains fluid in said sleeve, said tool comprising a housing enclosing vertically aligned first and second spaced apart chambers adapted to have a confined fluid in said first chamber, passages fluidly communicating said chambers, a first movable piston in said first chamber having a piston rod attached thereto, said piston rod sealingly extending through the upper end of said first housing, biasing means in said first chamber adapted to urge said first piston to the lower end of said first chamber, a second movable piston in said second chamber held at the upper end of said second chamber and movable in response to the action of the confined fluid when said first piston is moved to the upper end of said first chamber to displace said confined fluid from said first chamber through said communicating passages to said second chamber, means attached to said second piston and slidable through the lower end of said housing adapted to engage and unseat said check valve and permit fluid to escape from said sleeve, means on the lower portion of said housing adapted to engage the pulling head to prevent relative upward movement therebetween, and means for moving said piston rod against said biasing means to elevate said tool and plug.

3. A releasing tool for an expanded well plug, said plug including an expandable sleeve adapted to contain a supply of expanding fluid therein, a pulling head, a passage in said head for the supply and release of fluid in said sleeve, and a check valve in said passage which normally retains fluid in said sleeve, said tool comprising a housing enclosing vertically aligned first and second spaced apart chambers adapted to have a confined fluid in said first chamber, passages fluidly communicating said chambers, a first movable piston in said first chamber having a piston rod attached thereto, said piston rod sealingly extending through the upper end of said first housing, biasing means in said first chamber adapted to urge said first piston to the lower end of said first chamber, a second movable piston in said second chamber held at the upper end of said second chamber and movable in response to the action of the confined fluid when said first piston is moved to the upper end of said first chamber to displace said confined fluid from said first chamber through said communicating passages to said second chamber, a pin member attached to said second piston and slidable through the lower end of said housing adapted to engage and unseat said check valve and permit fluid to escape from said sleeve, retrieving arms arranged on the lower portion of said housing adapted to engage the pulling head to prevent relative upward movement therebetween, and means for moving said piston rod against said biasing means to elevate said tool and plug.

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