

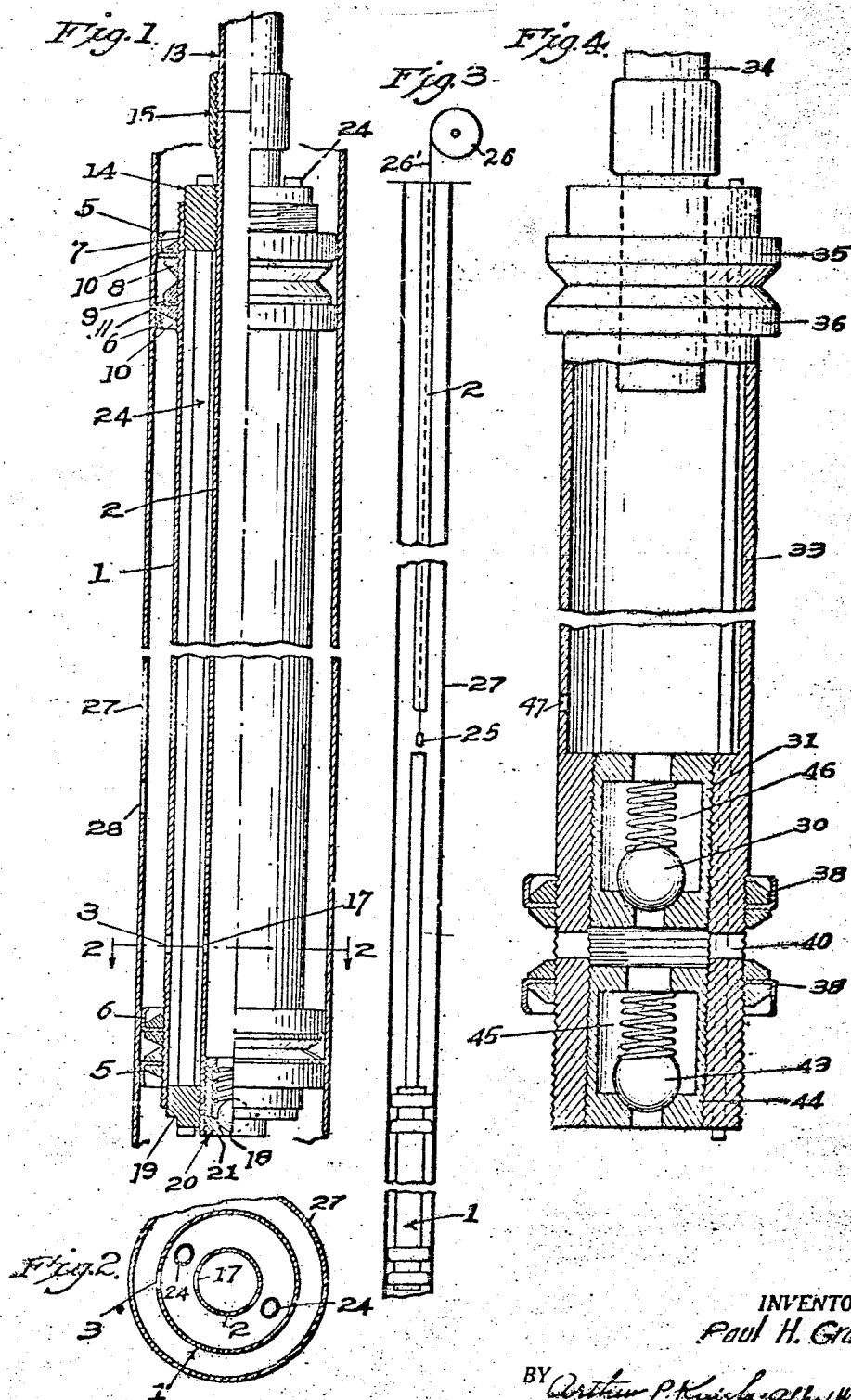
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P. H. GRANGER

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MEANS FOR INDICATING AND CEMENTING OFF LEAKS IN WELL CASINGS

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INVENTOR.

Paul H. Granger.

BY

Arthur P. Knight & Alfred W. Knight

ATTORNEYS.

UNITED STATES PATENT OFFICE

PAUL H. GRANGER, OF LOS ANGELES, CALIFORNIA

MEANS FOR INDICATING AND CEMENTING OFF LEAKS IN WELL CASINGS

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This invention relates to means for indicating and cementing off leaks in well casings, and an important object of the invention is to provide a device which can be used for both indicating the position of the leak and for cementing off the leak in the casing.

A further object of the invention is to provide a device which can be used to indicate a leak in the well casing without necessitating the closing or bridging of the well casing below the leak.

The accompanying drawings illustrate embodiments of my invention and referring thereto:

Fig. 1 is a partly sectional elevation of the device constituting the invention.

Fig. 2 is a section on line 2-2 in Fig. 1.

Fig. 3 is a diagrammatic vertical section of a well casing showing the application of the invention in connection therewith.

Fig. 4 is a vertical section of a modified form of the invention.

My invention comprises a device secured to or adapted to be secured to the lower end of a string of tubing for insertion into a well casing; said device consists of a tubular body 1 provided with packing means at its upper and lower ends and having suitable means for connecting it to the tubing indicated at 2 for supporting the same, said tubular body having one or more perforations indicated at 3, for the purpose hereinafter set forth. The packing means at the upper and lower portions of the tubular body 1 may be of similar construction, each comprising two cups 5 and 6 mounted or secured between flanges 7, 8 and 9, screwing on the tubular body 1 so as to support said cups in position. The cups 5 and 6 may consist of suitable flexible wear-resistant material, such as leather, each cup having a flange 11 extending between the clamping rings 7 and 8 or 9 and 10 as the case may be, the cup 5 being bent from said flange portion 11 away from the central portion of body 1 and the cup 6 being bent away from the flange 11 in the direction toward the central portion of the body of water so that when these cups engage the walls of the casing, the pressure of the liquid above the upper cup 5 or below the lower cup

5 will force said cups outwardly so as to make a fluid tight joint with the casing and the pressure of fluid between the two inner cups 6 will force said cups outwardly so as to make a fluid tight joint with the casing. The tube 2 may be secured to the upper end of body 1, for example, by screwing in a plug or head 14 which screws into the upper end of said body 1, said tube 2 being connected by coupling or sleeve 15 to the lowermost section of the string of tubing indicated at 13 for supporting the device. Said tube 2 may extend down through the tubular body 1 and may be provided with one or more perforations indicated at 17, preferably opposite the perforations 3 aforesaid.

An upwardly opening check valve indicated at 18 is provided at the lower end of the tubular body 1 and may, for example, be mounted in a downward extension of tube 2, said tube in that case extending through the tubular body 1 and screwing at its lower end through a bushing 19 which screws into the body 1 and the cage 20 being provided, screwing into the lower end of the tube 13 and formed with a seat 21 for the ball check valve 18. A spring 22 mounted in said cage 20 presses on the check valve 18 so as to tend to hold the same in closed position but to open up under a predetermined pressure corresponding say to two hundred feet of water.

In order to obviate undue pressure on the packing means aforesaid when the device is submerged to great depth, a by-pass consisting for example of one or more tubes 24 extending vertically through the tubular body 1 and opening at the lower end thereof into the space within the well tubing below the body 1 and at the upper ends into the spacing in the well casing above the body 1.

The operation of my invention is based primarily upon the established fact that the water level in a well at a given time can be readily determined and generally remains substantially constant for a sufficient time to enable the operation of my invention as hereinafter set forth. This water level may be determined, for example, by lowering a float

25 on a wire line 26' into the casing and measuring the amount of line played out from the lowering means which may be an ordinary reel device which is indicated diagrammatically at 26 in Fig. 3, provided with a metering attachment. The normal fluid level having been thus determined and the measuring line having been withdrawn, the device above described is lowered into the well by means of the tubular supporting means 2.

When the device 1 reaches a body of liquid in the well and continues to descend, the liquid can pass through the by-pass pipes 24 so as not to offer undue resistance to the liquid, it being understood that the cups 5 and 6 make substantially liquid tight contact with the walls of the casing so that if it were not for the said by-pass means the column of liquid in the well would prevent the further descent of the device. As the said cups seal the portion of the casing between the upper and lower packing means from the portions of the casing above and below the device 1, it follows that the interior of the device 1 will remain empty or free of liquid as long as the device is passing a portion of the passage which is unperforated, or at which no leak is present so that the device acts as an exploring means for the condition of the casing, the device being lowered to a given position and the presence of liquid therein being determined in each setting of the device by means of a float lowered into the device as aforesaid or by swabbing. In order to expedite the operation, it is desirable to provide for exploring a considerable height of the casing at each setting and for this purpose the device 1 is preferably made upward of one hundred feet or so in length. In case the device has been brought to a portion of the casing 27 where there is a leak as indicated at 28 in Fig. 1 liquid can pass from the outside of the casing through said leak into the space between the upper and lower packing means of the device 1 and through the perforations 3 and 17 into the interior of the tubular member 2 and the liquid will rise in this operation to the normal water level in the well for the time being, which water level has already been determined as aforesaid so that when the measurement is taken by means of a line and float, or by swabbing, the presence of a leak will be indicated.

In some cases it will be necessary to lower the device to a great depth say one thousand feet or more below the normal water level and in that case in the absence of any leak in the casing, the hydrostatic pressure on the uppermost and lowermost packing means or cups will be so great as to tend to upset or reverse the leather cups. To prevent this effect, a check valve 18 is provided whose controlling spring 22 is of sufficient strength to withstand the pressure on the check valve

somewhat less than that which can be successfully withstood by the packing rings or cups so that when the submergence of the device increases to a sufficient extent to endanger the effective operation of the packing cups by reversing the outer cups as aforesaid, the check valve 18 will open and allow sufficient liquid to enter the device 1 to maintain a liquid column in the device sufficient to protect the packing cups. When the device reaches a leak under these conditions, liquid will flow into the device as aforesaid until the liquid level equalizes with the normal water level for the well so that if at each setting the level of the liquid in the device be measured by a float or by swabbing as aforesaid, the liquid level so determined will be the normal water level if a leak is present, but will be below the normal water level if a leak is not present.

In some cases the submergence of the device in operation thereof may be so great that the column of liquid introduced in the device through the check valve 18 may be sufficiently high to bring undue pressure on the inner packing cups 5 of the upper and lower packing device tending to reverse said cups. To avoid this I may provide a second check valve as shown at 30 in Fig. 3 mounted in a cage 31 which is supported in the tube 33, said tube 33 being in this case mounted directly on the supporting tube or string 34 and being provided with a packing means 35 and 36 at its upper end similar to the packing means 5 and 6 at the upper end of the device shown in Fig. 1. At the lower end of the device 33 the packing means or cups 38 and 39 are spaced apart sufficiently to provide for an opening or passage 40 in the wall of the member 33 between said packing means. A lower upwardly opening check valve 43 is provided mounted in a cage 44 in the tubular member 33 and provided with an operating spring 45, the construction and operation of this check valve being similar to that shown at 18 in Fig. 1. The upper check valve 30 is provided with a controlling spring 46 of such strength that said check valve will open only at a pressure considerably in excess of that which suffices to open the check valve 43. A perforation 47 is provided in the wall of tube 33, near the inner end of the chamber within said tube, for entry of liquid from a leak as above described. The operation of this form of the invention is substantially the same as that of the form shown in Fig. 1 with the additional feature that in case of accumulation of too high a pressure within the device tending to reverse the upper one of the lower packing cups, fluid pressure is admitted to the space between the upper and lower cups of the lower packing means so as to hold the upper of said cups from reversing.

When the leak has been located as above

described, the cementing operation can be carried out by means of the same device, suitable cementing material being delivered through the supporting pipe 2 and flowing through the apertures 17 and 3 so as to enter the space between the upper and lower packing means on the device 1, and then forced through the perforation or leak in the casing which is at that time opposite said space. In order to minimize the amount of cement required and particularly to minimize the amount of cement accumulating within the device I prefer to make the openings 17 and 3 which are provided only at the lower end portion of the tubular body 1 and adjacent the lower packing means so that the cementing material will begin to pass out as soon as it enters the device and will not accumulate unnecessarily therein, the space above the leak and below the upper packing means and between the tubular body 1 and the casing being occupied with incompressible liquid so as to prevent any of the cementing material passing upwardly into said space above the leak, and when sufficient cementing material has been supplied in this manner it may be followed up by mud so as to eject all or substantially all of the cementing material from the interior of the device. With such an operation, the device being left substantially free of cement material, it is comparatively easy to remove the device from the casing after the cement has set.

I claim:

1. A device for indicating and/or cementing leaks in well casings, for the purposes set forth, comprising a tubular body having packing means at its upper and lower portions, and a tubular supporting means for the said tubular body communicating with the interior of said tubular body, said tubular body having perforation means between said packing means, for establishing communication between the interior of said tubular body and the space between the upper and lower packing means, said perforation means being provided only in the lower portion of said tubular body and adjacent the lower packing means.

2. A device for indicating and cementing leaks in well casings, for the purposes set forth, comprising a tubular body having packing means at its upper and lower portions, each packing means comprising an outer packing cup adapted to expand from pressure applied in the space above and below the tubular body, and an inner packing cup adapted to expand under pressure applied between said packing means, and a tubular supporting means for the said tubular body communicating with the interior of said tubular body, said tubular body having perforation means between said packing means, for establishing communication between the interior of said tubular body and the space

between the upper and lower packing means, and a check valve at the lower portion of said tubular body controlling communication between the interior of said tubular body and the space within the casing below said tubular body, and a spring means tending to hold said check valve closed, but permitting opening of the check valve on a predetermined excess of pressure below the tubular body as compared with the pressure within the tubular body.

3. A construction as set forth in claim 2 and comprising in addition an upwardly open check valve below said first named check valve, said tubular body being provided with an opening establishing communication between the space intermediate said check valves and the space intermediate the two packing cups at the lower end of the tubular body and a spring means to hold said lower check valve closed, said spring means for the upper check valve being of such strength that the upper check valve will open only at a pressure in excess of that which suffices to open the lower check valve.

4. The method of cementing off leaks in well casings, which consists in lowering into the well, packing means separating the space within a portion of the well casing including the leak from the spaces within the well casing above and below the same, the portion so separated extending from the bottom of the leak to a considerable distance above the leak, causing said space to become filled with liquid and then forcing cementing material into the lower portion of said space so as to cement the leak while preventing the cementing material from occupying the space above the leak, by reason of the occupation of said space by incompressible liquid, and then withdrawing the packing means, with any cementing material therein contained, from the well casing.

5. The method as set forth in claim 4, and comprising in addition the step of forcing mud into the lower portion of the space between said packing means to follow up the cement.

In testimony whereof I have hereunto subscribed my name this 13th day of May, 1929.
PAUL H. GRANGER.