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WELL CLEANING SYSTEM

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Fig. 1.

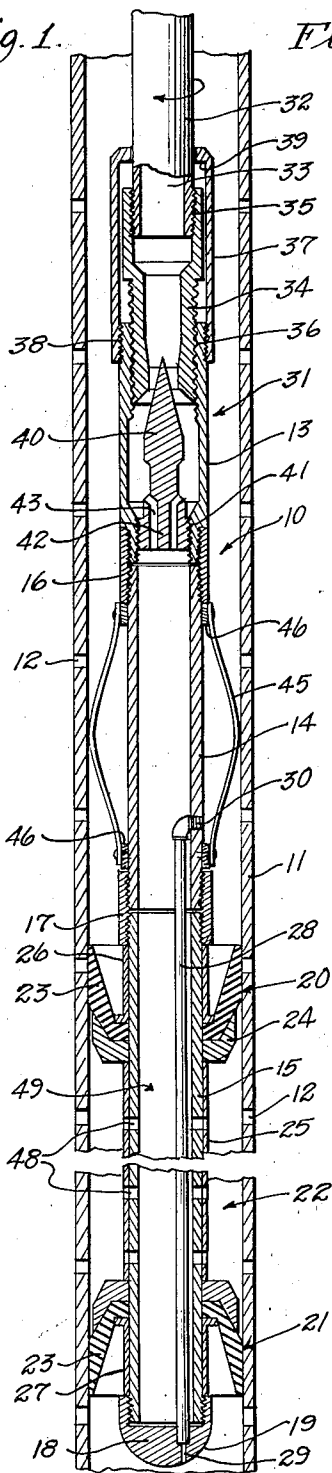
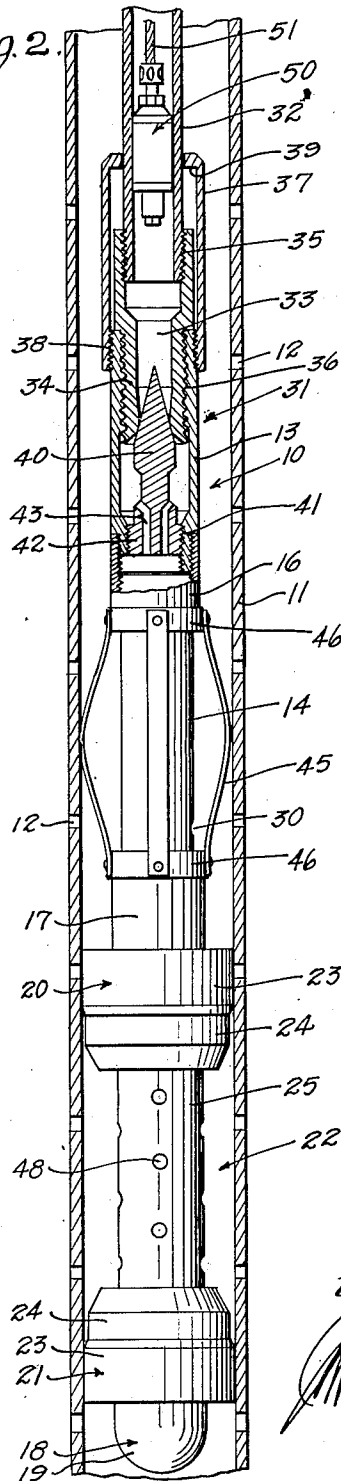


Fig. 2.



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WELL CLEANING SYSTEM

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1 Claim. (Cl. 166—19)

This invention has to do generally with well cleaning devices and is more particularly concerned with such devices wherein there is provided a low-pressure-holding or charge-receiving chamber with a normally closed inlet adapted to be opened at predetermined points in the well, whereby the well fluid, under relatively high pressure, charges that chamber with sand or other foreign matter adjacent the inlet, or sets up such pressure actions or high velocity fluid-movements as to dislodge foreign matter which may be offering obstruction to free passage of fluid through fissures in the formation or perforations in the well casing. The device will here be described as utilized in the cleaning of casing perforations, to which use it is particularly well adapted, but this particularized description is not to be considered as in any way limitative on the adaptability of the device for other cleaning operations.

One of my general objects is to provide a system for cleaning wells, whereby a succession of individual cleaning operations may be rapidly performed to remove restrictions to the entry of fluid through the perforations of a length of casing. More particularly, the objects of the invention are directed to the provision of a well cleaning system whereby any number of successive cleaning operations may be performed without having to remove the apparatus from the well, so that the entire cleaning operation may be accomplished with a minimum expenditure of time and labor. Generally speaking, the present system involves the use of a pipe lowered in the well to substantially the depth of the zone to be cleaned, and means operative from the ground surface for opening and closing the lower end of the pipe to the entry of well liquid. The invention differs characteristically from other well cleaning devices in that it utilizes the interior of the suspension pipe itself as the low pressure or charge receiving chamber, and further in that it is capable of any successive numbers of cleaning operations, each of which involves the drawing in of well liquid into the charge receiving pipe chamber and removal therefrom upwardly through the pipe, without having to pull the pipe string from the well.

In its preferred form, my improved cleaner comprises a body attached to the lower end of the pipe and carrying one or more packers engaging the well casing, and a valve operable by virtue of relative movement between the body and pipe, for opening and closing the lower end of the charge receiving chamber in the pipe. It is understood that in the broad aspects of the

invention, any suitable valve means may be provided that is capable of opening and closing the lower end of the charge receiving chamber and controllable from the ground surface. For purposes of convenience and in order to simplify the construction, I prefer to use a valve control that operates as a result of relative movement between the cleaner body and pipe and while, broadly speaking, the body and pipe may be connected for relative movement in any direction that may be utilized for valve operation, I have shown in the hereinabove described typical form of the invention a type of valve control that operates by virtue of relative rotation between the cleaner body and pipe.

In carrying out a well cleaning operation in accordance with the present system, the cleaner is lowered on the suspension pipe to the depth of the zone to be cleaned, with the charge receiving chamber within the pipe empty and the valve at its lower end closed to prevent entry of well liquid. When the cleaner is in position, the valve is opened to permit a sudden rush of well fluid through the casing perforations into the cleaner body, and thence upwardly into the charge receiving chamber. After the chamber has been charged, the valve is then closed and a swab is run down within the pipe to remove the charge. The valve may then again be opened to admit a successive charge into the pipe chamber, and the operation of alternately admitting and removing the charge from the chamber repeated as many times as desired. Any number of charges may be drawn through a particular area of the perforated casing, or the cleaner may be raised or lowered after each individual operation to progressively clean successive sections of the casing throughout any desired length. The only delay between successive cleaning operations is that occasioned by the swabbing operation, but since in common practice swabs can quickly be run into and out of the well to remove liquid from any desired depth, a cleaning job involving several individual operations may be completed in an unusually short time by the present method.

The above and various additional objects and aspects of the invention will be understood to best advantage from the following detailed description of a typical form of cleaner embodying the invention. In the description reference is made to the accompanying drawing, in which:

Fig. 1 is a longitudinal sectional view showing a typical form of cleaner embodying the invention lowered in a well casing; and

Fig. 2 is a view similar to Fig. 1, showing the valve parts in changed position.

The cleaner, generally indicated at 10, is shown to be lowered within a perforated section of the well casing 11 wherein the cleaning operation is performed for the purpose of removing clogging particles from the perforations 12 to permit a relatively unrestricted flow of well liquid from the surrounding formation into the casing. The cleaner 10 is shown to comprise a body which may be conveniently made up of a series of connected tubular sections 13, 14 and 15, although it is to be understood that this particular construction of the body and its sectional characteristics are in no way to be regarded as limitative of the invention. Body sections 13 and 14 are connected by a threaded coupling 16, and sections 14 and 15 by coupling 17. The lower end of section 15 is closed by a cap nut 18 having a tapered or rounded surface 19 in order to facilitate passing any obstructions that might be encountered while the device is being lowered in the well.

Section 15 carries a pair of longitudinally spaced packers, generally indicated at 20 and 21, which may be of any suitable type or construction capable of forming between them an annular confined space 22 between the body and the perforated casing 11. For purposes of illustration, the packers are shown somewhat conventionally and typically as comprising cup leathers or rubbers 23 confined within cup-shaped supporting members 24 spaced apart by a spacing sleeve 25 surrounding the body section 15. The packers are clamped against the ends of spacer sleeve 25 by sleeves 26 and 27 in engagement with coupling 17 and nut 18, respectively. Any suitable provision may be made for by-passing well liquid past the packers in order to relieve the resistance to raising or lowering the cleaner, that would otherwise be offered by the liquid column standing in the casing due to the close engagement of the packers with the casing. As a typical and conveniently simple form of by-pass, I have shown a pipe 28 in open communication with the interior of the casing below packer 21 by way of passage 29 in nut 18, and with the space surrounding the cleaner above the upper packer 20, by way of a connection at 30 opening through the wall of the intermediate body section 14. Thus as the cleaner is raised or lowered, liquid standing in the casing is by-passed past the packers through pipe 28.

In the upper interior of the body, I provide a valve control, generally indicated at 31, which is operable by movement of the suspension pipe 32 extending to the ground surface, to open or close the lower end of the charge receiving chamber 33 within the suspension pipe itself. More specifically, the valve control 31 is operated by virtue of relative movement between the pipe and body of the cleaner, and while, as previously mentioned, I may provide a valve means operable by relative movement between the body and pipe in any direction, I have illustrated as a typical example, a valve control (comprising the valve 40, seat 34 and their connections with the body and suspension pipe) that opens and closes upon relative rotational movement between the pipe and body.

Pipe 32 and the upper section 13 of the cleaner body are connected for relative rotational movement by bushing 34 threaded at 35 on the lower end of the pipe and screw-threaded at 36 into the upper end of the body. The threads at 36 will be comparatively heavy or coarse and will have sufficient pitch to give the bushing 34 sub-

stantial movement longitudinally of the body by a few turns of the suspension pipe 32. In order to preclude the possibility of bushing 34 being disconnected from the body by unscrewing the threaded connection at 36, I provide a safety sleeve 37 attached at 38 to the upper end of the body and having a stop shoulder 39 normally spaced sufficiently above the top of bushing 34 to permit the normal relative movement of the latter within the limits of valve opening and valve closing positions, by acting to prevent the bushing from being unscrewed out of the body.

The valve proper, indicated at 40 and which preferably is of an elongated tapered or needle type, is screwed at 41 into the lower interior of body section 13, the bottom portion 42 of the valve having a plurality of longitudinal passages 43 to permit the upward flow of fluid past the valve. As illustrated in Fig. 2, the lower end of bushing 34 seats against the valve 40 to close the lower end of the charge receiving chamber 33 against the entry of well fluid from the interior of the body. In order to permit relative rotation between the body and pipe at the threaded connection 36, any suitable means may be provided for holding the body against substantial rotation relative to the casing 11. As typical of such means, I have shown the body to carry a plurality of bowed radial springs 45 terminally attached to collars 46 surrounding the intermediate body section 14, these springs being radially compressed sufficiently when inserted in the casing to hold the body against rotation while the valve control 31 is being opened or closed.

In operation, the cleaner is lowered within the casing on the lower end of the pipe 32 preferably with the valve control 31 closed as illustrated in Fig. 2. After the cleaner has been lowered to the depth at which the annular space 22 surrounding the body between the packers 20 and 21 is brought opposite the section of the perforated casing 11 to be cleaned, the pipe 32 is rapidly rotated to unscrew the threaded connection at 36 between bushing 34 and body section 13 to substantially the position of Fig. 1, in which the valve control is opened to permit well fluid under the formation pressure to flow through the casing perforation 12 and body perforations 48 into the interior 49 of the body, and thence through passages 43 upwardly into the charge receiving chamber 33 within the suspension pipe. By reason of the pressure differential between the formation pressure and the substantially atmospheric pressure within chamber 33, there is produced a sudden rush of the well fluid through the casing perforations which acts effectively to dislodge any clogging particles. The valve control is permitted to remain open until the charge taken into the low pressure chamber rises within the pipe 32 until substantially a pressure balance exists, and the pipe is then rotated to close the valve control and to thereby seal the lower end of the charge receiving chamber against further entry of well fluid.

It will be understood that the threads at 36 connecting the bushing 34 and body section 13, may be either right-handed or left-handed and that the bushing may be turned with sufficient ease to preclude the possibility of any of the other threaded connections in the pipe string becoming unscrewed. Preferably, the threads at 36 will be right-handed, so that to close the valve control, pipe 32 will be rotated in a clockwise direction, as indicated by the arrow, and rotated in a counter-clockwise direction to open the valve.

After the charge has been taken into the low pressure chamber and the valve closed, a swab 50 is run down in the pipe 32 on cable 51 to the bottom of chamber 33 and the swab then elevated to the ground surface, to remove all liquids standing in the pipe above it. The conventional illustration of the swab at 50 will suffice since such devices have long been in common use and require no detailed description or illustration. The swab may be allowed to remain in the pipe during the course of a series of operations, so as to be immediately available for lowering after each successive charge is drawn into the pipe. It may be mentioned that while ordinarily I would prefer to swab substantially all the liquid from the pipe after each admission of the charge, cleaning operations may be carried out by elevating the swab each time only part way to the ground surface, since a partial elevation of the swab will serve to empty the charge receiving chamber in preparation for the subsequent cleaning operation.

After chamber 33 has been emptied, the valve control 31 may again be opened to admit a second

charge of fluid through the casing perforations, and the above described operations repeated as many times as may be necessary to completely clean the perforations. Also, after each individual operation, the cleaner may be raised or lowered in the well to act upon successive lengths of the casing, and thus progressively clean the perforations throughout any desired length.

I claim:

In a well cleaning device, the combination comprising, a body carried on the lower end of a pipe, said body and pipe being relatively movable and the lower portion of the pipe forming a low pressure chamber, and valve means operable by virtue of relative movement between said pipe and body to intermittently admit well liquid through the body into said chamber, said valve means comprising an upwardly projecting valve member carried by said body, and a tubular valve seat attached to the lower end of said pipe, and a screwthreaded connection between said body and the tubular valve seat.

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