

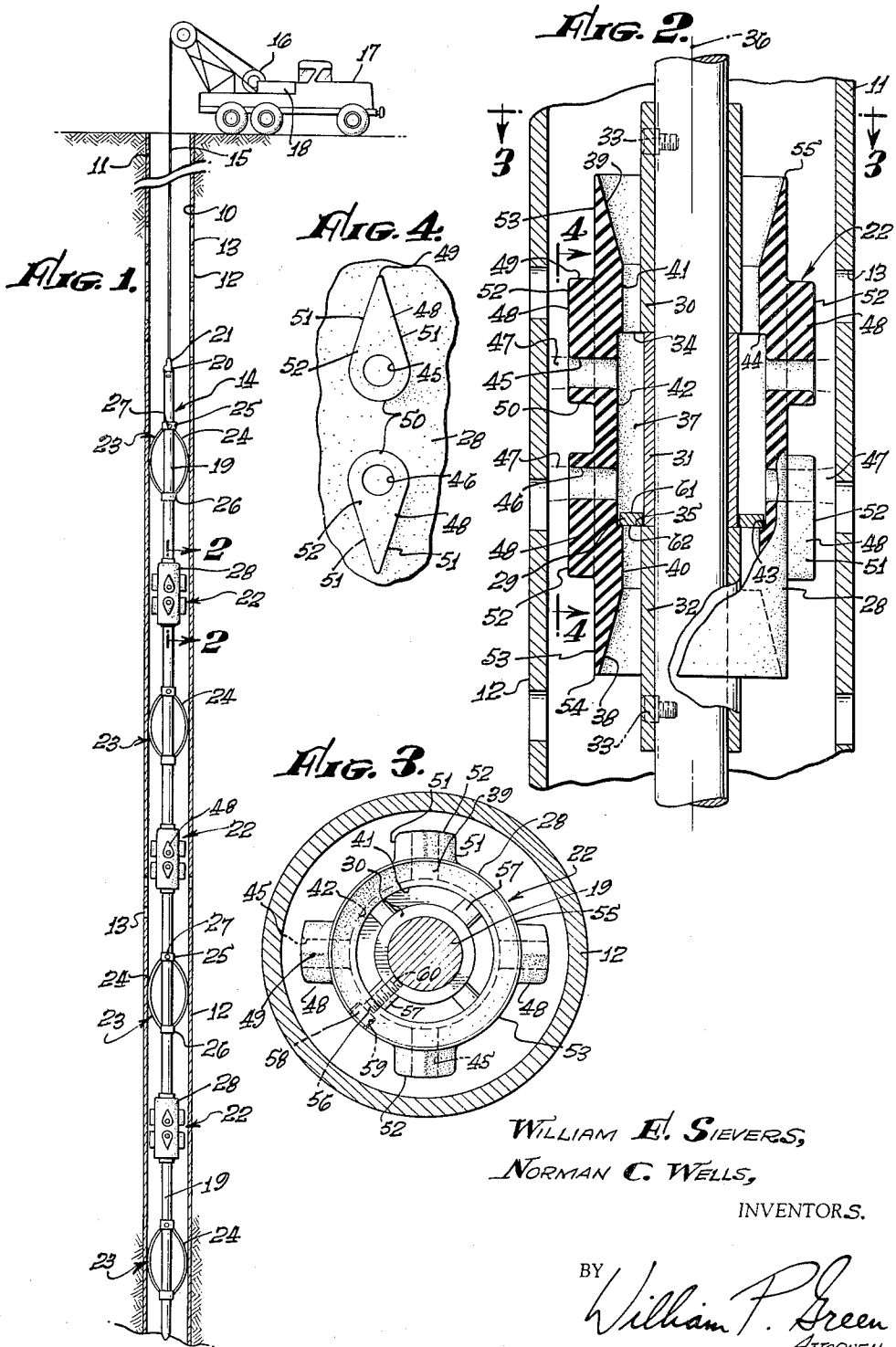
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W. E. SIEVERS ET AL

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WELL CLEANING APPARATUS

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WILLIAM E. SIEVERS,
NORMAN C. WELLS,
INVENTORS.

BY *William P. Green*
ATTORNEY.

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WELL CLEANING APPARATUS

William E. Sievers, 5140 Vista Hermosa, Long Beach, Calif., and Norman C. Wells, Long Beach, Calif.; said Wells assignor to said Sievers

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This invention relates to a new type of apparatus for cleaning the earth formation at a predetermined zone in a well, usually at a production zone after the formation has become partially or wholly closed by accumulations of wax or other materials.

In order to clean a zone in a well, it is customary to utilize a well cleaning liquid, and to in some way attempt to force that liquid out into the surrounding formation to remove accumulations therefrom. One disadvantage in this method as previously practiced has been the difficulty encountered, with conventional types of apparatus, in forcing the liquid into all portions of the desired formation before the liquid has had time to escape from the well or otherwise dissipate. This is particularly true where the formation to be treated may be relatively extended vertically. Another disadvantage of prior systems has resided in the rather expensive type of equipment that has been required in order to effect any displacement of the liquid into the formation. Frequently, this equipment has necessitated the use of a string of tubing extending downwardly from the surface of the earth to the treated zone to convey the liquid under pressure to the zone. In other instances, other similarly complicated and time consuming arrangements have been employed.

The general object of the present invention is to provide a cleaning system which will overcome the above discussed disadvantages of prior arrangements, and will allow for very rapid and effective cleaning of a zone with an absolute minimum of equipment. In accordance with the invention, the forcing of the fluid into the zone is attained by a tool which may be suspended in the well by a simple wire line, so that the tool can be lowered into the well and removed therefrom with facility and speed.

In performing a cleaning operation in accordance with the invention, the tool is moved vertically rather rapidly through the cleaning liquid (which may in some cases be the well's own fluid), and as a result of that movement develops forces which produce a jet or jets of the liquid flowing laterally from the tool and against the bore wall. Assuming that the cleaning operation is performed at a production zone in the well, at which zone there is an apertured liner, the laterally directed jets can then flow laterally through the apertures of the liner, and thus into the surrounding formation, to effect the desired cleaning action. Preferably, the tool will function to produce such cleaning jets upon movement either upwardly or downwardly, so that a few vertical reciprocations of the tool in the well will result in a very thorough overall cleaning action.

To produce the fluid jet or jets, the tool may contain an inlet passage which faces generally vertically in the direction of tool movement to cause a rapid flow of liquid in that passage upon vertical movement of the tool. This flow of liquid is then directed laterally through a discharge passage for ejection as a jet toward the bore wall. Desirably, there are two inlet passages, which may be the opposite end portions of a single passage, facing oppositely to receive fluid from opposite directions. Fluid from either of these inlets may be directed to a common set of discharge passages or nozzles. Valve means may be provided for opening and closing the communication between the inlet and discharge passages, preferably in a manner such that only the downwardly facing inlet is open during downward movement of the tool, and only

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the upwardly facing inlet is open during upward movement. These valve means may be automatically actuated by the forces exerted by the liquid as a result of the reversal of the direction of movement of the tool.

A particular feature of the invention resides in a unique manner of protecting the laterally directed jet streams against undue distortion by reason of the rapid vertical movement of the tool in the main body of liquid. In order to protect some of the jet streams against such distortion, without providing a structural element actually projecting out into contact with the casing or bore wall, we design the tool so that the shielding function is performed by specially located additional jets. Specifically, one jet may be located near and in substantially direct vertical or axial alignment with an associated jet, so that the leading jet will clear the path for the second jet and allow it to flow outwardly with little or no distortion. The fluid directing body of the tool may be formed of elastomeric material such as rubber, and should be held in spaced relation to the well casing by suitable spacer means.

The above and other features of the present invention will be better understood from the following detailed description of the typical embodiment illustrated in the accompanying drawing in which:

FIG. 1 shows apparatus constructed in accordance with the invention, with the apparatus shown as it appears in use;

FIG. 2 is an enlarged vertical section taken essentially on line 2-2 of FIG. 1;

FIG. 3 is a horizontal section taken on line 3-3 of FIG. 2; and

FIG. 4 is a fragmentary view taken on line 4-4 of FIG. 2.

Referring first to FIG. 1, I have shown at 10 a conventional oil well, having the usual casing 11 carrying a perforated liner 12 at the producing zone deep within the well. This liner 12 contains apertures 13 through which the interior of the well is placed in communication with the earth formation surrounding the well, to pass oil from the formation into the liner. The well cleaning apparatus of the present invention includes a tool 14 which is lowered into the well at the lower end of a flexible wire line or cable 15, which wire line is windable on a drum 16 carried by a truck 17 at the surface of the earth. The winding drum 16 is of any conventional construction, having an electric motor or other power driven motor or engine 18 operatively connected to the drum 16 to drive it in either its winding or unwinding direction. The motor 18 and drum 16 are preferably capable of moving tool 14 very rapidly in either vertical direction, preferably at least about 400 feet per minute, and for best results between about 600 and 1200 feet per minute. The weight of the tool 14 is sufficiently great to cause the tool to fall downwardly within the well at these relatively great speeds, solely by the force exerted on the tool by gravity, when the drum is actuated sufficiently rapidly in lowering direction to permit such rapid movement of the tool.

The tool 14 includes a vertically elongated preferably externally cylindrical center core or carrier member 19, whose upper end is threadedly connectible at 20 to a member 21 attached to the lower end of wire line 15. The center carrier member 19 may be essentially rigid, having only such limited flexibility as will permit it to follow slight curvatures or deviations of the well bore, and may typically be formed of a suitable steel. The external diameter of member 19 is of course small as compared with the internal diameter of the liner or casing 12 to which tool 14 is to be lowered.

At a number of vertically spaced locations, member 19 carries several jet producing units 22, with spacer units 23 being carried by member 19 between successive

units 22, as well as above the upper one of these units 22 and beneath the lower unit 22. Spacer units 23 function to hold member 19 in an essentially central position within liner 12 and casing 11, and in a position such that units 22 are at all times spaced from all portions of the liner or casing. For this purpose, units 23 may be essentially conventional centering devices, each including several evenly circularly spaced leaf springs 24 which are connected at their upper and lower ends respectively to a pair of spaced rings 25 and 26 disposed about member 19. One of these rings, typically ring 25, may be secured in fixed axial position on member 19, as by set screws 27, while the other ring 26 is slidable along member 19 in response to flexure of springs 24. The springs 24 normally curve or are bowed outwardly as they extend from the rings 25 and 26 to their central portions, and those central portions normally project outwardly to a diameter which may be slightly less than (but approximately equal to) the diameter of liner 12 and casing 11, so that the springs will function to effectively hold member 19 in substantially the exact center of the horizontal cross sectional area of the liner. If the tool passes through a curving or restricted portion of the casing or liner, the springs can of course flex to a reduced diameter as necessary.

With reference now to FIG. 2, each of the jet producing units 22 includes an outer generally annular body part 28, an axially movable valve element 29, and three tubular inner members 30, 31 and 32. The two members 30 and 32 may be both internally and externally cylindrical, having an inner diameter corresponding to the outer diameter of member 19, so that these parts 30 and 32 may be received about member 19 as shown. In the assembled condition of the apparatus parts 30 and 32 are secured in fixed relation to member 19, as by screws 33. The intermediate tubular member 31 is also desirably both internally and externally cylindrical, having the same internal diameter as members 30 and 32, but having a somewhat reduced external diameter, so that the transverse end faces 34 and 35 of members 30 and 32 form a pair of annular transverse shoulders or valve seat elements projecting radially beyond member 31. The transverse end faces of member 31 abut against the shoulders 34 and 35 of members 30 and 32, so that elements 30 and 32 function to hold member 31 in its illustrated position on member 19.

Outer body member 28 of unit 22 may be formed of an elastomeric material, such as a suitable neoprene or other rubber compounded to withstand the cleaning liquid to be used and other chemicals or substances which may be encountered in the well. The member 28 may be sufficiently hard to hold its shape under the forces exerted by the liquid in use, but should be sufficiently deformable to prevent damage to the member 28 if it happens to contact the casing 11 or liner 12. The member 28 is disposed about member 19 and the parts 30, 31 and 32, being centered about the same axis 36 as are all of the parts, but being annularly spaced from rings 30, 31 and 32 to provide an annular liquid flow passage 37 between member 28 and the three parts 30, 31 and 32.

To describe more specifically the construction of member 28, and first to describe its internal configuration, this member has at its opposite ends a pair of axially flaring frusto-conical inner surfaces 38 and 39, which flare axially away from the rest of member 28 and in opposite upward and downward directions. Axially inwardly of the inlet throat portions or surfaces 38 and 39, the member 28 has a pair of inner cylindrical surfaces 40 and 41 of a common diameter greater than the diameter of parts 30 and 32, and spaced annularly from members 30 and 32. Axially between surfaces 40 and 41, member 28 has an inner cylindrical surface 42, which is of a somewhat greater diameter than surfaces 40 and 41 to provide annular shoulders or seat surfaces 43 and 44 at the juncture between surface 42 and the two sur-

faces 40 and 41. The seat surfaces 43 and 44 extend directly transversely of axis 36, and are in transverse alignment with the associated seat surfaces 34 and 35 respectively. As will be apparent, all of the surfaces 40, 41 and 42, and the annular seat surfaces 43 and 44, are centered about axis 36.

At several different locations about its periphery, preferably at 4 equally circularly spaced locations; the member 28 contains passages 45 and 46, which may be of circular cross section, and extend directly transversely of axis 36. These passages 45 and 46 communicate at their inner ends with the annular passage 37 between member 28 and the inner core structure, so that liquid from that annular space 37 may flow rapidly outwardly through passages 45 and 46 to eject therefrom at high velocity liquid jets or streams 47 for cleaning the earth formation surrounding the well. Desirably, there are two of the passages 45 and 46 at each of the four evenly spaced locations, with these passages 45 and 46 of each pair being in direct axial alignment. At the location of each of the passages 45 or 46, the material of member 28 may project laterally outwardly to form a nozzle portion 48 containing the associated passages 45 or 46. These nozzle portions 48 containing the two passages of each pair of passages are of course in axial alignment, with the nozzles 48 desirably being of externally streamlined configuration as seen in FIG. 4. More specifically, each of the nozzles 48 has an outer surface which tapers progressively in the axial direction away from the other associated passage, and to essentially a point 49. At the sides of the two nozzle portions which face each other, these nozzles may have cylindrical opposed surfaces 50. When the tool 14 is moving upwardly, the upwardly pointed nozzle 48 cuts smoothly into the liquid, to minimize turbulence, and similarly when the tool goes downwardly, the other pointed nozzle structure functions in this same manner to smooth the passage of liquid past the nozzles. It will of course be obvious that the converging surfaces 51 and the curving surfaces 50 of nozzles 48 extend essentially radially outwardly with respect to axis 36, with the nozzles 48 having outer surfaces 52 which face essentially radially outwardly and may be essentially cylindrically curved about axis 36. Except at the locations of nozzles 48, member 28 may be defined externally by an outer cylindrical surface 53 of a diameter somewhat smaller than the maximum diameter of nozzle portions 28. This outer surface 53 desirably meets inner end surfaces 38 and 39, at opposite ends of member 28, in a pair of annular essentially sharp edges 54 and 55.

Member 28 is held in its illustrated annularly spaced relation to the inner parts by means of a number of bolts 56 and tubular spacer elements 57. The bolts 56 extend radially of axis 36 through member 28 and either the element 30 or 32, with the head 58 of each bolt being received within an enlarged diameter portion of the opening 59 in member 28 through which the bolt extends. The inner end portion 60 is threadedly connected into the associated member 30 or 32. Spacer 57 is received axially between members 28 and 30 or 32, and has inner and outer surfaces curved in conformance with the parts 28 and 30 or 32 to engage those parts and hold them in radially spaced coaxial positions. Each of the screws 56 of course extends through one of the spacers 57. Desirably there are four of these screws 56 and spacers 57 provided at equally circularly spaced locations at each end of member 28, and more specifically at the locations of the surfaces 41 in element 28.

The valve element 29 may take the form of a simple annular ring, typically formed of aluminum, a suitable rigid resinous plastic material, or other relatively light but desirably rigid material. Ring 29 is movable axially within the space between ring 31 and inner surface 42 of member 28. At its opposite axial sides, ring 29 has two parallel surfaces 61 and 62 extending radially of axis 36. The inner and outer surfaces of ring 29 are

cylindrical and in closely spaced relation to element 31 and surface 42 respectively, but are sufficiently loose with respect to those surfaces to allow free movement of ring 29 within space 37. In one of its extreme positions, valve 29 has its surface 61 in simultaneous seating engagement with surfaces 34 and 44, so that ring 29 forms a bridge across and closes the space 37 at the location of seats 34 and 44. Similarly, in its other extreme position, ring 29 simultaneously engages surfaces 35 and 42, to close the annular passage 37 at the location of those seat surfaces. The ring is sufficiently light to be actuable between these two positions by the forces exerted against the ring by liquid when the device is moved vertically within a body of cleaning liquid in a well. More specifically, when the device is moved downwardly within the liquid, the ring 29 automatically engages upwardly against the upper seats 34 and 44, whereas when the tool is moved upwardly within the liquid, the ring engages downwardly against seats 35 and 43.

To now describe the performance of a cleaning operation in accordance with the invention, assume that the well represented in FIG. 1 has gradually accumulated waxes and other materials in the earth formation around the perforated liner 12, so that the flow of oil into the well has been considerably reduced. If it is then desired to clean the well, the first step may be to lower the tool 14 to the production zone, that is, to a location within liner 12, following which a cleaning liquid is filled into the well up to the level of the upper end of the production zone. This cleaning liquid may be any of the conventional materials used for this purpose, which material may be a suitable wax solvent such as a highly refined hydrocarbon having high aromatic factors, an acid of either the organic or inorganic type, such as glacial acetic acid (organic) or hydrochloric acid (inorganic) (preferably inhibited to prevent corrosion), or a material such as an adequate dispersant and/or detergent of low surface tension requirements adapted to reduce surface tension of accumulated water in the producing formation. Also, as previously mentioned, the cleaning liquid may in some cases be the well fluid itself, that is, the fluid which is already present in the well and which came from the surrounding formation.

After the liquid has been filled into the liner, motor 18 and drum 16 are actuated to very rapidly move tool 14 vertically within the well and the cleaning liquid, and for the entire vertical extent of the production zone or perforated liner 12. The motor and drum may first be actuated to move the tool upwardly through this entire zone, and then downwardly through the entire zone, and to repeat this movement in opposite vertical directions through several cycles until the cleaning operation is completed. Desirably tool 14 is moved at a speed of at least about 400 feet per minute in each direction, and for best results between about 600 and 1200 feet per minute.

As the tool 14 moves upwardly within the cleaning liquid, the motion of each of the elements 28 causes the cleaning liquid to enter the converging upper throat portion 39 of that element 28, and to flow downwardly through the annular space 37 to the locations of jet discharge passages 45 and 46. Also, the movement of the tool relative to the liquid causes valve element 29 to be displaced relatively downwardly against seats 35 and 43, to thus close off communication between the lower inlet 38 and passages 45 and 46. Thus, all of the liquid which flows downwardly through passage 37 from its upper end 39 must flow laterally outwardly through passages 45 and 46, and is ejected laterally from those passages radially of axis 36 and against the bore wall. Some of this laterally ejected liquid passes through the aperture 13 of liner 12, and flows as a jet into the surrounding formation, to effectively clean or otherwise treat that formation. The jet passages 45 and 46 are so dimensioned as to assure relatively rapid ejection of

the liquid laterally toward the bore wall, preferably at a velocity of at least about 10 feet per second, and for this purpose, the combined cross sectional areas of all of the passages 45 and 46, transversely of the direction of liquid flow therethrough, should be not greater than about 80% of the minimum cross sectional area of the down-flow passage between element 28 and parts 30 and 31.

The upward movement of the jet stream 47 within the main body of liquid in the well of course has a tendency to distort those streams downwardly as they pass radially outwardly from the tool toward the bore wall. When the tool is moving upwardly, such distortion of the upper one of the streams 47 may be considerable, whereas the lower stream is effectively protected against any substantial tendency for such distortion by reason of the fact that the upper stream is directly above and in vertical alignment with the lower stream. This is the reason for positioning the jet nozzles in pairs, with one directly above the other.

When the tool moves downwardly within the well, the movement of the tool causes liquid to flow upwardly through lower entrance throat 38, and then to be ejected laterally through nozzle passages 45 and 46 against the bore wall into the surrounding formation. Also, such downward movement causes the valve element 29 to move upwardly against valve seats 34 and 44, to thereby close off the passage 37 at the location of seats 34 and 44, and require that all of the liquid entering the lower end of the tool may be ejected laterally as jets aimed at the bore wall. During downward movement, a lower jet of each pair functions to protect the upper jet against upper distortion, in a manner the reverse of that previously discussed in connection with upward movement of the tool. Also, the three different bodies 28 of the three vertically spaced units 22 are desirably so located on carrier 19 that the jet directing passages 45 and 46 of each body 28 are offset circularly with respect to the other two, so that there is a pair of jets directed outwardly from carrier 19 at virtually every location thereabout. Consequently, the entire circular extent of the liner is cleaned by the device. As will be apparent, a few upward and downward strokes of the tool 14 will serve to very quickly eject the cleaning liquid laterally through all of the different apertures 13 of liner 12, and deeply into the surrounding formation, to effect a thorough cleaning operation before the liquid has had an opportunity to flow away or otherwise dissipate.

In order to allow for very rapid movement of the tool within a well, the tool should be so designed that the entire maximum cross sectional area of the tool is not greater than about 60% of the total internal cross sectional area of the liner or casing 12 within which the device is to be used. This allows for relatively free flow of the cleaning liquid past the outside of the tool.

We claim:

1. A well cleaning tool comprising a vertically extending core structure adapted to be lowered into a body of liquid within a well and adapted to be rapidly moved vertically in the well through the liquid, an outer body disposed about said core structure and defining an essentially annular axially extending first passage about the core structure, said first passage having opposite inlet end portions facing upwardly and downwardly respectively and into which said liquid flows rapidly as a result of upward and downward movement respectively of the tool, said outer body containing a discharge passage extending laterally from said first passage at a location intermediate said ends and directing said rapidly flowing liquid from either inlet end of the first passage laterally from the tool as a jet against the bore wall to clean the surrounding formation and an essentially annular valve element movable axially within said first passage between two positions above and beneath said discharge passage, there being valve seats engageable by said valve element in said two upper and lower positions respectively and

in a relation such that the valve in its upper position closes off communication between the upper end of the first passage and said discharge passage, and in its lower position closes off communication between the lower end of the first passage and said discharge passage, said valve element being located for actuation to its upper and lower positions by fluid forces exerted thereagainst upon downward and upward movement respectively of the tool.

2. A well cleaning tool as recited in claim 1, in which said outer body is formed of elastomeric material and contains a number of circularly spaced pairs of said discharge passages with the passages of each pair being in substantially direct vertical alignment.

3. A well cleaning tool as recited in claim 2, in which said core structure carries a series of said outer bodies at vertically spaced locations, and carries spacer elements between said outer bodies holding the latter spaced from the bore wall.

4. A well cleaning tool as recited in claim 2, in which said two inlet portions of the first passage flare upwardly and downwardly respectively and away from one another.

5. A well cleaning tool comprising a vertically extending body structure adapted to be lowered into a column of liquid within a well and adapted to be rapidly moved vertically in the well through the liquid, means on the tool for connecting it to a suspension element by which the tool is to be suspended and moved vertically in the well with the body structure held in a predetermined orientation relative to the vertical, said body structure containing and defining a first passage extending generally vertically therethrough, said first passage having opposite inlet end portions facing upwardly and downwardly respectively at locations such that said liquid flows rapidly into said inlet end portions as a result of upward or downward movement respectively of the tool, said body structure containing at least one discharge passage communicating with and extending laterally from said first passage at a location intermediate said ends and directing said rapidly flowing liquid from either inlet end of the first passage laterally from the tool as a jet against the bore wall to clean the surrounding formation, means for directing said liquid from said first passage into said discharge passage to form said jet, said last mentioned means including valve means positioned for movement by said liquid within said first passage between two positions above and beneath said discharge passage in response to downward and upward movement of the tool, there being valve seats carried by the body structure and engageable by said valve means in said two upper and lower positions respectively and in a relation such that the valve means in its upper position closes off communication between the upper end of the first passage and said discharge passage, and in its lower position closes off communication between the lower end of the first passage and said discharge passage.

6. A well cleaning tool as recited in claim 5, in which said outer body is formed of elastomeric material and contains a number of circularly spaced pairs of said discharge passages with the passages of each pair being in substantially direct vertical alignment, each of said pairs of passages being contained within a pair of vertically aligned projections extending essentially radially outwardly from said body structure, said two projections of each pair being externally tapered in opposite vertical directions and away from one another.

7. A well cleaning tool comprising a body structure adapted to be lowered into a body of liquid within a well having a bore wall, said body structure being adapted to be rapidly moved in a predetermined vertical direction in the well and through the liquid, means on the body structure for connecting it to a suspension element by which said structure is to be suspended and moved vertically in the well and with said structure in a predetermined orientation relative to the vertical, said body structure containing and defining an inlet passage having an

inlet end opening and facing in a direction which has a component in the vertical direction in which said body structure is moved by said suspension element, whereby said liquid is scooped into said inlet passage during and by virtue of said vertical movement of the body structure, said body structure containing at least one discharge passage communicating with said inlet passage and positioned to receive liquid therefrom and then eject the liquid laterally from the body structure in jet form against the well bore wall to clean it, said tool including means for directing the liquid from said inlet passage to said discharge passage so that the liquid scooped into said inlet passage by said rapid vertical movement of the body structure in said predetermined direction will be forced out said discharge passage, said tool being constructed to leave an open path for said liquid to pass outwardly from said discharge passage and directly against the surrounding well bore wall in said jet form, and spacer means carried by said tool for engaging the bore wall and holding the body structure out of engagement with the bore wall at the location of said jet discharge.

8. A well cleaning tool comprising a body structure adapted to be lowered into a body of liquid within a well having a bore wall and adapted to be rapidly moved in a predetermined vertical direction in the well and through the liquid, means on the body structure for connecting it to a suspension element by which said structure is to be suspended and moved vertically in the well and with said body structure in a predetermined orientation relative to the vertical, said body structure containing and defining an inlet passage having an inlet end opening and facing in a direction which has a component in the vertical direction in which said structure is moved by said suspension element, whereby said liquid flows into said inlet passage during and by virtue of said vertical movement of the body structure, said body structure containing at least one discharge passage communicating with said inlet passage and positioned to receive liquid therefrom and then eject the liquid laterally from the body structure in jet form against the well bore wall to clean it, said tool including means for directing the liquid from said inlet passage to said discharge passage so that the liquid scooped into said inlet passage by said rapid vertical movement of the body structure in said predetermined direction will be forced out said discharge passage in said jet form, said means for directing the liquid from said inlet passage into said discharge passage including valve means positioned for actuation by said liquid upon movement of the body structure in a vertical direction the opposite of said predetermined direction and operable upon such actuation to essentially close off communication between said inlet passage and said discharge passage, said tool being constructed to leave an open path for said liquid to pass outwardly from said discharge passage directly against the surrounding well bore wall in said jet form, and spacer means carried by said tool for engaging the bore wall and holding the body structure out of engagement with the bore wall at the location of said jet discharge.

9. A well cleaning tool as recited in claim 7, in which said body structure is formed of resiliently deformable material.

10. A well cleaning tool as recited in claim 7, in which there are two of said discharge passages, one of which directs a jet laterally at a location ahead of and in direct vertical alignment with the jet from the other discharge passage to protect the second jet against distortion as a result of the body structure movement.

11. A well cleaning tool as recited in claim 7, in which said inlet passage has an entrance throat at said inlet end thereof progressively decreasing in cross-section in the direction of liquid flow therethrough.

12. Well cleaning apparatus comprising a tool, supporting and actuating means connected to the tool for suspending it in a body of liquid within a well having a

bore wall and in a predetermined orientation with respect to the vertical and operable to rapidly move said tool in a predetermined vertical direction in the well and through the liquid, said tool including a body structure containing and defining an inlet passage having an inlet end opening and facing in a direction which has a component in said direction of vertical movement of the tool, whereby said liquid flows into said inlet passage during and by virtue of said vertical movement of the tool, said body structure containing at least one discharge passage communicating with said inlet passage and positioned to receive liquid therefrom and then eject the liquid laterally from the body structure in jet form against the well bore wall to clean it, said tool including means for directing the liquid from said inlet passage to said discharge passage for ejection thereby so that liquid scooped into said inlet passage by said rapid vertical movement of the tool in said predetermined direction will be forced out the discharge passage by virtue of the movement of the tool, said tool being constructed to leave an open path for said liquid to pass outwardly from said discharge passage directly against the surrounding well bore wall in said jet form, and spacer means carried by said tool for engag-

ing the bore wall and holding the body structure out of engagement with the bore wall at the location of said jet discharge.

13. Well cleaning apparatus as recited in claim 12, in which said supporting and actuating means include a wire line connected to the tool and suspending it in the well, and power operated mechanism at the surface of the earth operable to move said line and suspended tool vertically in the well rapidly enough to produce said laterally directed jet discharge.

References Cited in the file of this patent

UNITED STATES PATENTS

1,333,390	Dickinson	Mar. 9, 1920
1,379,815	Hall	Mar. 31, 1921
1,770,207	Helmling	July 8, 1930
2,237,686	Parr	Apr. 8, 1941
2,257,080	Turner	Sept. 23, 1941
2,509,922	Hall	May 30, 1950
2,618,339	Glover	Nov. 18, 1952
2,802,640	Boucher et al.	Aug. 13, 1957