METHOD AND APPARATUS FOR REMOVING OIL SANDS FROM OIL WELLS

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This invention relates to a method and apparatus for removing oil sand from oil wells, and more particularly to a circulating swab for use in removing sand during the development stage of oil wells.

It is necessary in many oil fields in North America, particularly in the Lloydminster area, to remove a large quantity of oil sand from the reservoir before placing the well in commercial production. The presence of such sand in the reservoir tends to prevent the oil from draining into the well bore due to the restrictive forces of the sand. Furthermore, if the sand breaks down and rises with the oil, it causes seizing in the standard oil well plunger pumps. It has been found, moreover, that the greater the amount of sand originally removed from the well, the less trouble and expense will be incurred during later operations, due to less pump wear and the smaller amount of servicing due to sand plugged oil pumps required. In addition, the productivity of the well is usually improved and faster rates of oil recovery are obtained.

Two general methods are currently in use for removing sand from oil wells. The most common of these is that of "Bailing" which is generally carried out by lowering through the conductor pipe casing a section of pipe equipped with a fluid type check valve at its lower end. As the oil comes into the well bore it is picked up by the bailer and deposited on the surface with the idea in mind that if the oil is removed fast enough the loose sand will be carried into the well bore and removed with the oil. Bailing operations, however, require a considerable amount of time, and the amount of sand removed is not commensurate economically to the cost of the operation.

The second method of removing sand which is currently in use is known as the "circulating" method. This method consists in lowering a string pipe to the bottom of the well and circulating the sand out by pumping a fluid down the pipe, forcing the oil sands out through the annulus between the string of pipe and the casing. However, the hydrostatic head of the fluid column on the sand face prevents the entrance into the bore of additional sand, so that only a limited amount of sand is capable of removal in this manner.

Economic considerations make it desirable to remove as large a quantity of sand as is as possible from a new well in as short a time as possible, in order speedily to bring the well into production and at the same time reduce the cost of the development of the well.

Accordingly, it is the object of the present invention to provide a method of removing a large quantity of oil sand from an oil well in a relatively short period.

It is another object of the invention to provide a relatively simple and rugged apparatus for carrying out the aforesaid removal.

It is a further object of the invention to provide such an apparatus which will not become clogged or fouled by sand during normal operating conditions.

It is a still further object of the invention to provide such an apparatus which, when removed from the oil well bore, will leave the same free from sand with the inside of the oil well casing clean.

Various other objects and advantages of the invention will become apparent as each embodiment thereof is described in detail in the following specification.

According to the invention I remove oil sand from the reservoir of an oil well by causing the sands to cave inwardly by producing a reduced pressure in the vicinity of the bottom of the well casing, circulating fluid to wash out the sands so dislodged, and repeating the operation to provide for a series of caving-ins and washings-out until sufficient sand has been removed to enable the well to be placed in operation. It is emphasized that when sufficient oil comes in with the sand so that the sand "floats" in the oil, the swabbing operation may be repeated without the circulation of fluid. The swab therefore becomes a bottom hole pump. It is to be hoped that the bottom hole condition allows this pumping action which will greatly increase the efficiency of the operation.

In order to carry out the method of the invention, I employ a swab which is lowered into the oil well casing on a string of pipe, the periphery of the swab being adapted closely to wipe the inside of the well casing. The swab itself is provided with a plurality of longitudinal channels connecting the lower part of the well bore with the part thereof above the swab. Valve means are provided in each of the said channels permitting flow in an upward direction, but preventing flow therethrough in a downward direction.

Preferably, according to my invention, I provide means for providing communication between the inside of the pipe and the interior of the bore casing, operable from the surface of the ground, so that when the swab is to be removed from the well, it may be raised in the
well casing without causing a reduced pressure and further caving in of sands. In addition, I prefer to provide a second communicating means between the interior of the pipe and the interior of the well casing at a higher elevation than the swab, and operable from the surface of the ground in cases where excess of sand or shale above the swab prevent operation of said first mentioned means. Also if bridging of shale or sand occurs above the swab the opening of the top ports only will allow the operator to apply pressure against the bridge without putting same against the oil sand itself.

In brief, the operation of the device is as follows: The swab is first lowered on a string of pipe into the well and when it is desired to remove sand, a reduced pressure is created in the reservoir at the bottom of the bore casing, by raising the swab some 30 to 60 feet. This reduction in pressure causes caving in of the loose sands in the neighborhood of the bottom of the well casing and at this point, if necessary, circulating fluid is pumped down the string of pipe, to circulate in the reservoir, and rise through the annulus between the pipe and the well casing, carrying the loosened sand with it. As the fluid is being circulated in this manner, the swab is slowly lowered to the original position in accordance with the amount of fluid withdrawn from the top of the annulus. Circulation of fluid is continued until according to the judgment of the operator it is desirable to repeat the operation. Checking total depth of well or the drilling of new hole can be accomplished by the lowering of and/or rotation of the check valve equipped drilling bit installed on the bottom of the tail pipe.

If, in the opinion of the operator, a fluid mixture of sand and oil exists below the swab, the swab may be lowered without the circulation of fluid to the starting point. Another stroke may be taken, and again the results observed. If continued displacement of the fluid takes place it would be safe to continue the swabbing action above the swab without circulation. In these cases the swab actually acts as the plunger of a pump.

One embodiment of the apparatus, according to the invention, is illustrated in the accompanying drawings, which also illustrate diagrammatically the operation of the device.

In the drawings:

Figure 1 is a cross sectional view of the circulating swab according to the invention.

Figure 2 is a cross-sectional view of the portion of the tubing string above the swab and containing the secondary circulating means which are operable from ground level.

Figure 3 is a cross section taken along the line 3-3 of Figure 1.

Figure 4 is a diagrammatic illustration of the device according to the invention, and the accompanying equipment in position at the bottom of a well following drilling-out operation.

Figure 5 is a similar diagrammatic illustration during the swabbing out stage when a reduced pressure is being produced in the oil reservoir.

Figure 6 illustrates in similar manner, the circulating or displacement in which the oil and sand mixture is forced up out through the annulus.

Figure 7 illustrates in similar manner the preparation of the swab for removal from the hole.

Figure 8 illustrates in similar manner, the stage next after that shown in Figure 7 wherein communication has been established between the interior of the pipe string and the interior of the bore casing.

Figure 9 illustrates in similar manner, the pulling of the swab.

Figure 10 similarly illustrates the operation of the auxiliary means for preparing the swab for removal from the bore.

Figure 11 illustrates circulation of fluid above the swab following operation of the auxiliary means referred to above.

Referring now more particularly to the drawings, in Figures 1, 2 and 3 an oil well casing is indicated at A and a swab according to the invention is situated within the casing as illustrated generally at B. The swab is generally cylindrical in shape and comprises an inner tubular portion 10 and an outer cylindrical swab supporting portion 11 connected to the portion 10 by the web portion 12, in this case four in number, which divide the annular space between the portions 10 and 11 into four channels 13. It will be obvious, of course, that the number of channels 13 provided is purely arbitrary, a greater or lesser number than illustrated being equally effective. At the lower end of the device 11, the body of the swab B is suitably recessed to seat the valve seats 14 and suitable tapping is provided to permit the screwing into position of the tightening glands 15 which hold the valve seats 14 firmly in position. An annular recess 16 is provided on the outer end of the valve member 10 to allow for the proper entry of the glands 15 when the same are being screwed into position. The glands are also inside threaded to allow fitting of fluid screens to keep out large chunks of formation which might clog valves.

Above each of the valve seats 14 is provided a steel bell adapted to seat on the valve seat, to prevent flow of fluid therethrough in a downstream direction and a ball retainer pin 17 is provided for each ball 17 to permit only limited raising of the balls during flow through the valve in an upstream direction. The outside of the cylindrical swab supporting member 11 is suitably recessed as at 18 to provide for the seating of the lower swab ring 20. This lower ring is retained in position by the retaining ring 21 which also acts as a seat for the swabber 18a. Swabber rubber 19d and 19e are similarly seated and retained by the retaining rings 21a and 21b. The top swab rubber 19d is retained above by the retainer ring 21c which in turn is held tight by the gland ring 23 which is interposed between it and the swab ring 16d and retaining ring 22. The gland ring 23 is adapted to screw on left hand to a suitable screw threaded portion 24 on the tubular gland supporting portion 11. The retaining rings 21, 21a and 21c are held by Allan set screws 51 to provide separate loading for each swab ring. The bottom ring 23 is not intended to swab; it is made of hard rubber and will act as a guide and to stop hard formation particles which might work behind the softer swab rubbers and injure them. Any other arrangement of swab-ring designed to give a substantially fluid-tight seal between the swab and the casing would, of course, be equally effective.

The bypass ports 25 are provided in the inner tubular portion 10 of the swab B providing communication between the interior thereof and each of the channels 13. The ports 25 are masked by the sleeve member 26 which is provided with the ball seating shoulder 27 and the inner sur-
face of which tapers upwardly as at 28 so that a ball 29 of suitable size dropped down the interior of the pipe will seat on the ball-seat shoulders 27. The sleeve member 26 is retained in position by the shearing pins 30, which are made of brass to prevent corrosion through the lower portion of the inner tubular portion 10 is shown in the drawings as being inside threaded as at 31 and adapted to be threaded to the sleeve retaining member 33, which is preferably of the slightly outwardly bulging shape indicated, and which carries the bypass pin 33 which is preferably made of steel. The sleeve retaining member 32 is designed to catch the sleeve member 26 when the pins 30 have been sheared, and prevent it from being dropped into the reservoir by raising the swab to the surface. The member 33 may be made of brass to prevent corrosion.

The lower portion of the sleeve retaining member 32 is threaded to a flush joint with the tail pipe 34 which is adapted to deliver the downwardly pumped fluid to the well reservoir through a check-valve-equipped drilling bit (not shown) on the bottom of the tail pipe. The check valve is arranged to keep fluid from backing up in the tail pipe. The upper end of the inner tubular member 10 is externally threaded at the portion 37 to connect to the auxiliary sleeve supporting member 38 which is of a larger internal diameter than the adaptor 36. The auxiliary sleeve-supporting member is screw-threaded at its upper end at the portion 39 for connection to the pipe 40, and the ports 41 are provided through the walls thereof to provide communication between the inside of the well casing and the inside of the tube 38. The ports 41 are masked by the auxiliary sleeve-member 42. This sleeve-member is equipped with a rubber seal ring, provided with a seating shoulder 44. The inner surface of the sleeve-member 43 is outwardly tapered over the portion 45 similar to the portions 25 in the sleeve-member 26. The auxiliary sleeve-member 43 is retained in position by the shear pins 46 which are similar in nature to the pins 30. A plug 47 is adapted to be lowered on the wire secured in the ball eye 48 and the lower end thereof carries a ball 49, which is adapted to seat on the seating shoulder 44 to prevent downward flow of fluid within the interior of the pipe string beyond that point. Increased downward pressure or a hammering action will cause the shear pins 46 to shear allowing the auxiliary sleeve-member 33 to drop down the tube and rest on the top of the adaptor member 36.

Figures 4 to 11 inclusive illustrate diagrammatically the operation of the device. In Figure 4 a swab B according to the invention is illustrated in position within a well casing. A prior to the carrying out of the removal of the sand. The swab B is supported on the pipe string C which passes through the header D. A flexible coupling E for the circulating line is provided at the top of the well. As part of the pipe string, a standard "junk basket" is secured above the swab (see Figure 22). The junk basket is provided with an outside ring 4 inches or 5 inches deep, open at the top, closed at the bottom, the purpose being to catch foreign materials which might drop down and foul the swab. The check valve means within the swab are illustrated by the channels F and the balls G, while the sleeve member within the swab is illustrated at H. The auxiliary sleeve member above the swab is illustrated at J. Fluid pumped down the pipe string C is delivered to the bottom of the well through the tail pipe K, and check valve equipped drilling bit (not shown). The tail pipe is made up in sections to allow for the various lengths required.

Figure 5 shows diagrammatically the operation of raising the swab to cause reduced pressure in the vicinity of the bottom of the well, so that the swab will be seen that the swab has been raised, which closes the valves G, reducing the pressure in space M thereby causing loose sands to cave inwardly.

Figure 6 illustrates the operation of circulating fluid to wash the loose sands out of the well. As indicated by the arrows, fluid is pumped down the pipe string C, out through the tail pipe K into the space M where loose sand is entrained. The fluid is then forced up through the casing, causing the balls G in the check valves to be unsheared and pass upwardly through the channels F and up through the annulus N to the surface where it is drawn off at the casing head and passed to the settling tanks (not shown) before being re-circulated. It will be noted that the swab B has been partially lowered to its original position. This is done in accordance with the amount of fluid removed through the casing head. Not specifically illustrated is the action previously referred to whereby the swab is lowered for a second stroke, without circulating fluid. The weight of the pipe string forces the swab through the sand-oil mixture, said mixture being retained in the hole by the formation's resistance and thereby being directed through the check valves to a position above the swab. The operator will repeat this operation as many times as necessary to obtain a satisfactory condition. Solid sand or particles not floated up from the bottom will be circulated out, as heretofore described.

Figure 7 illustrates the operation of preparing the swab for its removal from the well and shows the condition of the swab immediately before the ball 29 is dropped from the well head down the pipe string. At this stage the reservoir M is full of clean fluid and it is desired to raise the swab out of the well without dislodging any more sand which might become entrained with the oil and clog the pump. Figure 8 illustrates the opening of the bypass ports 25 in the swab permitting communication between the interior of the pipe string and the channels F in the swab. It will be seen that the ports are now open and the sleeve with the ball seated on the valve seat within it has dropped, and is held by the retainer at E. The shearing of the pins holding the sleeve has been accomplished by pump pressure applied in a downward direction by the fluid within the pipe string.

Figure 9 illustrates the next step which consists in the pulling of the swab, and as indicated by the arrows, the fluid above the swab within the annulus N flows down through the channels F, through the ports 25 into the pipe string and down past the valve retainer R, and down through the tail pipe K. The freedom of the fluid to move as indicated prevents any substantial lowering of pressure within the reservoir M so that there is no further tendency for sand to cave into it, and when the swab is finally removed the well is left free from sand.

Figure 10 illustrates the operation of the
auxiliary sleeve means J. In the event that circulation cannot be obtained due to a clogging of the swab, or a large amount of sand being left above the swab, preventing its being pulled, the auxiliary sleeve means are called into operation and the plunger bar S is lowered into the pipe string on the cable T to sit on the shoulders J in the auxiliary sleeve J. At this stage, circulating fluid is pumped down the pipe string from the circulating pump and forces the sleeve J in a downward direction, shearing the retainer pins and opening the ports U. This can also be done by a hammering action on the sleeve. The sleeve is prevented from falling down the pipe to any extent, by the shoulder V and in Figure 11, circulation about the swab through the ports U is illustrated. This circulation cleans out the casing, removing the sand and the like, which has lodged above the swab and prevented its removal. Following the circulation indicated in Figure 11, the plunger bar S may be removed, and the swab may be withdrawn without further loosening of the loose sands in the reservoir, as illustrated in Figure 9. It will be seen from the foregoing that the present invention provides a simple and easily operated method for removing as large a quantity of sand from an oil well as is desired. Furthermore, the operation is one which may be carried out in a relatively short time, and may be completely controlled from the surface without the necessity for continually pulling and replacing of operating parts.

I claim:

1. A method of removing oil sands and the like from oil wells comprising causing a reduced pressure at the lower end of an oil well by raising a swab in the lower portion of the well casing, whereby to cause inward collapse of loose sands in the vicinity of the end of the swab casing, washing the said loose sands out of the well by circulating fluid therethrough and simultaneously with such washing and substantially in accordance with the amount of fluid removed from below the said swab lowering the said swab to its original position, the sequence of operations being repeated until sufficient sand and the like has been removed from the well to render the same fit for further development, fluid communication being established in a downward direction through the swab, and removing the swab from the well casing whereby fluid may freely flow downwardly past the said swab during the removal thereof and the consequent maintenance of the pressure of the fluid column prevents further loosening of sand in the vicinity of the bottom of the well casing and the casing itself is left in a clear condition substantially free from sand and the like.

2. A method of removing oil sands and the like from oil wells comprising causing a reduced pressure at the lower end of an oil well by raising a swab in the lower portions of the well casing, whereby to cause inward collapse of loose sands in the vicinity of the end of the swab casing, washing the said loose sands out of the well by circulating fluid therethrough and simultaneously with such washing and substantially in accordance with the amount of fluid removed from below the said swab lowering the said swab to its original position, the fluid circulation being continued until the bulb of the sand which has been inwardly collapsed has been raised above the level of the swab, the sequence of operations being repeated until sufficient sand and the like has been removed from the well to render the same fit for further development, fluid communication being established in a downward direction through the swab, and removing the swab from the well casing whereby fluid may freely flow downwardly past the said swab during the removal thereof and the consequent maintenance of the pressure of the fluid column prevents further loosening of sand in the vicinity of the bottom of the well casing, and the casing itself is left in a clear condition substantially free from sand and the like.

3. Apparatus for removing sand and the like from oil wells comprising a swab adapted to be lowered into an oil well casing and raised and lowered therein on a string of pipe connected to said swab and designed closely to fit the interior of said casing, means within said casing for permitting flow of fluid between the portion of the well below said swab and the annular portion above said swab between said string of pipe and the casing in an upward direction only, and pumping means for pumping fluid down said string of pipe to a point of discharge below said swab, the said swab comprising an outer cylindrical portion designed to swab the inside of the casing, an inner tubular portion adapted to connect with said string of pipe and conduct fluid pumped therethrough, and a plurality of web members circumferentially spaced in the annular space between said inner tubular portion and said outer cylindrical portion, dividing said space into a plurality of channels, and check valve means disposed within said channels designed to permit flow of fluid therethrough in an upward direction only.

4. Apparatus for removing sand and the like from oil wells comprising a swab adapted to be lowered into an oil well casing and raised and lowered therein on a string of pipe connected to said swab and designed closely to fit the interior of said casing, means within said casing for permitting flow of fluid between the portion of the well below said swab and the annular portion above said swab between said string of pipe and the casing in an upward direction only, and pumping means for pumping fluid down said string of pipe to a point of discharge below said swab, the said swab comprising an outer cylindrical portion designed to swab the inside of the casing, an inner tubular portion adapted to connect with said string of pipe and conduct fluid pumped therethrough, and a plurality of web members circumferentially spaced in the annular space between said inner tubular portion and said outer cylindrical portion, dividing said space into a plurality of channels, and check valve means disposed within said channels designed to permit flow of fluid therethrough in an upward direction only.

5. Apparatus for removing sand and the like from oil wells comprising a swab adapted to be lowered into an oil well casing and raised and lowered therein on a string of pipe connected to said swab and designed closely to fit the interior of said casing, means within said casing for permitting flow of fluid between the portion of the well below said swab and the annular portion above said swab between said string of pipe and
of and the interior of said channels, the said means being operable from ground level, the said communicating means comprising a series of ports in said tubular portion communicating with said channels, a sleeve member being adjustable to fit the interior of said tubular portion and adapted to mask said ports, said sleeve member being retained in position masking said ports by shearable pin means passing through suitable bores in said tubular portion and said sleeve member, said sleeve member having a valve seat formed therein, a ball member insertable from the top of said pipe string and adapted to seat on said valve seat, said shearable pin means being shearable by pressure exerted by said pumping means when said ball member is seated on said valve seat in said sleeve member, and check valve means disposed within said channels designed to permit flow of fluid therethrough in an upward direction only.

8. Apparatus for removing sand and the like from oil wells comprising a swab adapted to be lowered into an oil well casing and raised and lowered therein on a string of pipe connected to said swab and designed closely to fit the interior of said casing, means within said swab for permitting flow of fluid between the portion of the well below said swab and the annular portion above said swab between said string of pipe and the casing in an upward direction, and pumping means for pumping fluid down said string of pipe to a point of discharge below said swab, the said swab comprising an outer cylindrical portion designed to swab the inside of the casing, an inner tubular portion adapted to connect with said string of pipe and conduct fluid pumped therethrough, a plurality of web members circumferentially spaced in the annular space between said inner tubular portion and said outer cylindrical portion, dividing said space into a plurality of channels, the said inner tubular portion having means therein for establishing fluid communication between the interior thereof and the interior of said channels, the said means being operable from ground level, and check valve means disposed within said channels designed to permit flow of fluid therethrough in an upward direction only.

9. Apparatus for removing sand and the like from oil wells comprising a swab adapted to be lowered into an oil well casing and raised and lowered therein on a string of pipe connected to said swab and designed closely to fit the interior of said casing, means within said swab for permitting flow of fluid between the portion of the well below said swab and the annular portion above said swab between said string of pipe and the casing in an upward direction, and pumping means for pumping fluid down said string of pipe to a point of discharge below said swab, the said swab comprising an outer cylindrical portion designed to swab the inside of the casing, an inner tubular portion adapted to connect with said string of pipe and conduct fluid pumped therethrough, a plurality of web members circumferentially spaced in the annular space between said inner tubular portion and said outer cylindrical portion, dividing said space into a plurality of channels, the said inner tubular portion having means therein for establishing fluid communication between the interior thereof and the interior of said channels, the said means being operable from ground level, and said inner tubular portion having means therein for establishing fluid communication between the interior thereof and the interior of said channels, the said means being operable from ground level, the said communicating means comprising a series of ports in said tubular portion communicating with said channels, a sleeve member being adjustable to fit the interior of said tubular portion and adapted to mask said ports, said sleeve member being retained in position masking said ports by shearable pin means passing through suitable bores in said tubular portion and said sleeve member, said sleeve member having a valve seat formed therein, a ball member insertable from the top of said pipe string and adapted to seat on said valve seat, said shearable pin means being shearable by pressure exerted by said pumping means when said ball member is seated on said valve seat in said sleeve member, and check valve means disposed within said channels designed to permit flow of fluid therethrough in an upward direction only.
tion above said swab between said string of pipe and the casing in an upward direction only, and pumping means for pumping fluid down said string of pipe to a point of discharge below said swab, the said swab comprising an outer cylindrical portion designed to swab the casing, an inner tubular portion adapted to connect with said string of pipe and conduct fluid pumped therethrough, a plurality of web members circumferentially spaced in the annular space between said inner tubular portion and said outer cylindrical portion, dividing said space into a plurality of channels, the said inner tubular portion having means therein for establishing fluid communication between the interior thereof and the interior of said channels, the said means being operable from ground level, the said communicating means comprising a series of ports in said tubular portion communicating with said channels, a sleeve member designed closely to fit the interior of said tubular portion and adapted to mask said ports, said sleeve member being retained in position in said ports by shearable pin means passing through suitable bores in said tubular portion and said sleeve member, said sleeve member having a valve seat formed therein and a ball member insertable from the top of said pipe string adapted to seat on said valve seat, said shearable pin means being shearable by pressure exerted by said pumping means when said ball member is seated on said sleeve seat in said sleeve member, retaining by-pass pin means below said sleeve member, designed to prevent said sleeve member from dropping out of said tubular portion after the shear pin means have been sheared and the sleeve member has unmasked said ports, and check valve means disposed within said channels designed to permit flow of fluid therethrough in an upward direction only, the said check valve means comprising valve seat means within each of said channels, ball members adapted to seat upon said valve seat means and retaining means above said ball members adapted to limit upward motion thereof.

11. Apparatus for removing sand and the like from oil wells comprising a swab adapted to be lowered into an oil well casing and raised and lowered therein on a string of pipe connected to said swab and designed closely to fit the interior of said casing, means within said swab for permitting flow of fluid between the portion of the well below said swab and the annular portion above said swab between said string of pipe and the casing in an upward direction only, and pumping means for pumping fluid down said string of pipe to a point of discharge below said swab, the said swab comprising an outer cylindrical portion designed to swab the inside of the casing, an inner tubular portion adapted to connect with said string of pipe and conduct fluid pumped therethrough, and a plurality of web members circumferentially spaced in the annular space between said inner tubular portion and said outer cylindrical portion, dividing said space into a plurality of channels, and check valve means disposed within said channels designed to permit flow of fluid therethrough in an upward direction only.

12. Apparatus for removing sand and the like from oil wells comprising a swab adapted to be lowered into an oil well casing and raised and lowered therein on a string of pipe connected to said swab and designed closely to fit the interior of said casing, means within said swab for permitting flow of fluid between the portion of the well below said swab and the annular portion above said swab between said string of pipe and the casing in an upward direction only, and pumping means for pumping fluid down said string of pipe to a point of discharge below said swab, the said swab comprising an outer cylindrical portion designed to swab the inside of the casing, an inner tubular portion adapted to connect with said string of pipe and conduct fluid pumped therethrough, and a plurality of web members circumferentially spaced in the annular space between said inner tubular portion and said outer cylindrical portion, dividing said space into a plurality of channels, and check valve means disposed within said channels designed to permit flow of fluid therethrough in an upward direction only, the said check valve means comprising valve seat means within each of said channels, ball members
adapted to seat upon said valve seat means and retaining means above said ball members adapted to limit upward motion thereof.

13. Apparatus for removing sand and the like from oil wells comprising a swab adapted to be lowered into an oil well casing and raised and lowered therein on a string of pipe connected to said swab and designed closely to fit the interior of said casing, ball means within said swab for permitting flow of fluid between the portion of the well below said swab and the annular portion above said swab between said string of pipe and the casing in an upward direction only, pumping means for pumping fluid down said string of pipe to a point of discharge below said swab, the said swab comprising an outer cylindrical portion designed to swing the inside of the casing, an inner tubular portion adapted to connect with said string of pipe and conduct fluid pumped therethrough, and a plurality of web members circumferentially spaced in the annular space between said inner tubular portion and said outer cylindrical portion, dividing said space into a plurality of channels, and check valve means disposed within said channels designed to permit flow of fluid therethrough in an upward direction only, the said check valve means comprising valve seat means within each of said channels, ball members adapted to seat upon said valve seat means and retaining means above said ball members adapted to limit upward motion thereof, secondary means above said swab and carried by said pipe string and the annulus between said pipe string and and the annulus between said pipe string and the well casing, said means being operable from ground level, the said secondary means comprising at least one fluid port in said string wall, sleeve means adapted to mask said port on the inside thereof, valve seat means within said sleeve large enough to permit passage of the ball means which operates said communication means in the swab, and valve closing means adapted to be lowered into said pipe string from the top thereof, said sleeve being retained in position masking said ports by shear pin means, shearable by the pressure of the pump means when said valve closing means is seated on said valve seat.

14. Apparatus for removing sand and the like from oil wells comprising a swab adapted to be lowered into an oil well casing and raised and lowered therein on a string of pipe connected to said swab and designed closely to fit the interior of said casing, ball means within said swab for permitting flow of fluid between the portion of the well below said swab and the annular portion above said swab between said string of pipe and the casing in an upward direction only, pumping means for pumping fluid down said string of pipe to a point of discharge below said swab, the said swab comprising an outer cylindrical portion designed to swing the inside of the casing, an inner tubular portion adapted to connect with said string of pipe and conduct fluid pumped therethrough, and a plurality of web members circumferentially spaced in the annular space between said inner tubular portion and said outer cylindrical portion, dividing said space into a plurality of channels, and check valve means disposed within said channels designed to permit flow of fluid therethrough in an upward direction only, the said check valve means comprising valve seat means within each of said channels, ball members adapted to seat upon said valve seat means and retaining means above said ball members adapted to limit upward motion thereof, secondary means above said swab and carried by said pipe string and the annulus between said pipe string and the well casing, said means being operable from ground level, the said secondary means comprising at least one fluid port in said string wall, sleeve means adapted to mask said port on the inside thereof, valve seat means within said sleeve large enough to permit passage of the ball means which operates said communication means in the swab, and valve closing means adapted to be lowered into said pipe string from the top thereof, said sleeve being retained in position masking said ports by shear pin means, shearable by the pressure of the pump means when said valve closing means is seated on said valve seat.

15. Apparatus for removing sand and the like from oil wells comprising a swab adapted to be lowered into an oil well casing and raised and lowered therein on a string of pipe connected to said swab and designed closely to fit the interior of said casing, ball means within said swab for permitting flow of fluid between the portion of the well below said swab and the annular portion above said swab between said string of pipe and the casing in an upward direction only, pumping means for pumping fluid down said string of pipe to a point of discharge below said swab, the said swab comprising an outer cylindrical portion designed to swing the inside of the casing, an inner tubular portion adapted to connect with said string of pipe and conduct fluid pumped therethrough, and a plurality of web members circumferentially spaced in the annular space between said inner tubular portion and said outer cylindrical portion, dividing said space into a plurality of channels, and check valve means disposed within said channels designed to permit flow of fluid therethrough in an upward direction only, the said check valve means comprising valve seat means within each of said channels, ball members adapted to seat upon said valve seat means and retaining means above said ball members adapted to limit upward motion thereof, secondary means above said swab and carried by said pipe string and the annulus between said pipe string and the well casing, said means being operable from ground level, the said secondary means comprising at least one fluid port in said string wall, sleeve means adapted to mask said port on the inside thereof, valve seat means within said sleeve large enough to permit passage of the ball means which operates said communication means in the swab, and valve closing means adapted to be lowered into said pipe string from the top thereof, said sleeve being retained in position masking said ports by shear pin means, shearable by the pressure of the pump means when said valve closing means is seated on said valve seat.

16. Apparatus for removing sand and the like from oil wells comprising a swab adapted to be lowered into an oil well casing and raised and lowered therein on a string of pipe connected to said swab and designed closely to fit the interior of said casing, ball means within said swab for permitting flow of fluid between the portion of the well below said swab and the annular portion above said swab between said string of pipe and the casing in an upward direction only, pumping means for pumping fluid down said string of pipe to a point of discharge below said swab, the said swab comprising an outer cylindrical portion designed to swing the inside of the casing, an inner tubular portion adapted to connect with said string of pipe and conduct fluid pumped therethrough, and a plurality of web members circumferentially spaced in the annular space between said inner tubular portion and said outer cylindrical portion, dividing said space into a plurality of channels, and check valve means disposed within said channels designed to permit flow of fluid therethrough in an upward direction only, the said check valve means comprising valve seat means within each of said channels, ball members adapted to seat upon said valve seat means and retaining means above said ball members adapted to limit upward motion thereof, secondary means above said swab and carried by said pipe string and the annulus between said pipe string and the well casing, said means being operable from ground level, the said secondary means comprising at least one fluid port in said string wall, sleeve means adapted to mask said port on the inside thereof, valve seat means within said sleeve large enough to permit passage of the ball means which operates said communication means in the swab, and valve closing means adapted to be lowered into said pipe string from the top thereof, said sleeve being retained in position masking said ports by shear pin means, shearable by the pressure of the pump means when said valve closing means is seated on said valve seat.
said swab and designed closely to fit the interior of said casing, ball means within said swab for permitting flow of fluid between the portion of the well below said swab and the annular portion above said swab between said string of pipe and the casing in an upward direction only, pumping means for pumping fluid down said string of pipe to a point of discharge below said swab, the said swab comprising an outer cylindrical portion designed to swab the inside of the casing, an inner tubular portion adapted to connect with said string of pipe and conduct fluid pumped therethrough, and a plurality of web members circumferentially spaced in the annular space between said inner tubular portion and said outer cylindrical portion, dividing said space into a plurality of channels, and check valve means disposed within said channels designed to permit flow of fluid therethrough in an upward direction only, secondary means above said swab and carried by said string of pipe and the annulus between said pipe string and the well casing, said means being operable from ground level, the said secondary means comprising at least one fluid port in said string wall, valve means adapted to mask said port on the inside thereof, valve seat means within said sleeve large enough to permit passage of the ball means which operates said communication means in the swab, and valve closing means adapted to be lowered into said pipe string from the top thereof, comprising a plunger bar having a substantially hemispherical lower end adapted to seat on the valve seat and holding means connected to the upper end of said plunger bar, said sleeve being retained in position masking said ports by shear pin means, shearable by the pressure of the pump means when said valve closing means is seated on said valve seat.

18. Apparatus for removing sand and the like from oil wells comprising a swab adapted to be lowered into an oil well casing and raised and lowered therein on a string of pipe connected to said swab and designed closely to fit the interior of said casing, ball means within said swab for permitting flow of liquid between the portion of the well below said swab and the annular portion above said swab between said string of pipe and the casing in an upward direction only, pumping means for pumping fluid down said string of pipe to a point of discharge below said swab, the said swab comprising an outer cylindrical portion designed to swab the inside of the casing, an inner tubular portion adapted to connect with said string of pipe and conduct fluid pumped therethrough, and a plurality of web members circumferentially spaced in the annular space between said inner tubular portion and said outer cylindrical portion, dividing said space into a plurality of channels, and check valve means disposed within said channels designed to permit flow of fluid therethrough in an upward direction only, the said check valve means comprising valve seat means within each of said channels, ball members adapted to seat upon said valve seat means and retaining means above said ball members adapted to limit upward motion thereof, secondary means above said swab and carried by said pipe string and the annulus between said pipe string and the well casing, said means being operable from ground level, the said secondary means comprising at least one fluid port in said string wall, sleeve means adapted to mask said port on the inside thereof, valve seat means within said sleeve large enough to permit passage of the ball means which operates said communication means in the swab, and valve closing means adapted to be lowered into said pipe string from the top thereof, comprising a plunger bar having a substantially hemispherical lower end adapted to seat on the valve seat and holding means connected to the upper end of said plunger bar, said sleeve being retained in position masking said ports by shear pin means, shearable by the pressure of the pump means when said valve closing means is seated on said valve seat.

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