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SOLUBLE PLUG INJECTOR

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This invention relates to a soluble plug injector for paraffin control and is adapted particularly for use in relatively small pipelines transporting crude oil.

The prevention of paraffin deposition in the piping systems of producing oil wells and in crude oil transporting lines is a major factor of expense to the oil trade. Hence considerable time and effort are expended in operations for effectively controlling deposition of paraffin that would produce restriction of flow and finally cause total plugging of the lines. Such paraffin deposits comprise generally wax, gums, resins and asphaltic materials entrained in crude oil and disposed to crystallize and adhere to pipe walls in regions of temperature changes.

The various methods employed in combating paraffin deposition include entraining chemicals with the crude oil to inhibit precipitation of wax crystals, continuous heating of oil, and periodic insertion of scrapers or plugs for travel with the flow in oil lines to shear paraffin deposition from wall surfaces before the accumulation reaches the point of substantial obstruction.

Where non-soluble plugs or scrapers are employed, they involve the problem of retrieval near the end of the line. Therefore an increasingly popular improvement has been the introduction of soluble plugs compounded of oil soluble materials. These soluble plugs are cylindrical in shape and of a length suitable for the intended purpose. When such a plug is inserted in a line it acts to shear the desposition during the course of its travel and will in due time dissolve so that there is no need for retrieving. Since the plug insertion operation must be performed every few days and offers quite a problem in the labor involved, there is considerable objection to more extensive application of soluble plugs. The various injector devices and procedures presently in use also involve additional objections. Where a simple T is installed in a line to provide an entrance for such plugs, the flow must be stopped and, during the plug insertion operation, considerable spillage occurs. This procedure is accordingly time consuming and generally unpopular. A more common practice comprises providing a by-pass line equipped with gate valves to divert flow during the plug injection operation. Although this avoids shutdowns, spillage and time consumption are still a problem.

A still further improvement concerns plug injectors in the form of specially built three-way valves having a built-in by-pass system which enables the operator to rotate the valve port into alignment with the side opening of the valve. The plug can then be inserted while the flow of fluid is directed through the by-pass opening, and rotating the valve to normal position places the plug in the line of flow. This improvement also has inherent disadvantages of a substantial nature. One of these is a tendency for the fluid to move the plug prematurely as the valve is rotated to normal setting, which results in shearing or distorting of the plug in a way that minimizes its effectiveness for paraffin removal. Another is the problem of the plug stalling in the port due to flow bypassing therearound in cases of low volume or low velocity

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flow rate, with the result that the plug dissolves in the valve and is wasted.

It is, therefore, the principal object of this invention to provide an improved plug injector that affords economical and positive control of paraffin deposition in flow lines and is so easy to operate that very considerable saving in time results from its use.

A further object is to provide a soluble plug injector that is positive in action so that the plug moves into the flow line regardless of flow rate and without any tendency to shear, distort, or stall in the injector.

An additional and specific object of the invention resides in the provision of a soluble plug injector having a plug receiving chamber that remains dry by reason of exclusion of fluid from said chamber.

Another important object of the invention resides in the provision of a soluble plug injector in which the plug receiving chamber is adapted to discharge the plug outwardly through a biased check valve opening and is equipped with a closure plug actuatable as a piston to impose pressure on fluid confined within the chamber and thus balance the pressures on opposite sides of the check valve opening.

A still further object is to provide the chamber of the soluble plug injector with push rod means adapted to shove a soluble plug past the check valve.

Another specific object is to provide a soluble plug injector that in operation avoids spillage of oil.

These and other objects contributing to efficiency of operation and satisfaction in use will be more apparent from the following detailed description of a preferred embodiment and several modifications of the invention when taken in conjunction with the accompanying drawings, in which:

Fig. 1 is a vertical longitudinal section, partly in elevation, of the plug injector of this invention shown in association with a flow line and a surface line;

Fig. 2 is a semi-diagrammatic view similar to that of Fig. 1 and illustrating the manner of the insertion of an oil soluble plug into the plug injector;

Fig. 3 is another semi-diagrammatic view of the injector of Fig. 1 illustrating the operation thereof as the paraffin control plug enters the surface line;

Fig. 4 is a semi-diagrammatic view similar to that of Fig. 1 embodying a minor modification; and

Fig. 5 is another semi-diagrammatic view also similar to that of Fig. 1 and comprising a further minor modification.

Before proceeding with a detailed description of the invention and its operation, it is to be observed that the particular plug injector involved is used in low pressure service and generally on surface flow lines. These injectors are installed in an upright position at the well head so that the well flow discharges into a side opening thereof and then downward through a 90 degree pipe bend, whence it continues along the ground surface to storage tanks.

In the several figures of the drawing, and with particular reference to Fig. 1, a soluble plug injector designated generally by the reference numeral 10 is shown to have a main valve body 12 formed to provide a lateral flow port 14 in an intermediate position and a downward vertical flow port 16 at right angles thereto. An aligned and enlarged open end 18 is provided at the top of the valve body or housing 12 above the flow port 16. A flow line FL threadedly engages the valve port 14 and a surface line SL makes threaded engagement with the lower flow port 16.

The closure of the valve body or chamber 12 is completed by a bonnet 20 having a square-shaped flange 22 extending over the periphery of the upper open end 18 and detachably secured to portions of said body by four

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cap screws 24, only two of which are shown. An O ring seal 25 is fitted into the upper inner edge of the end 18 to insure fluid tightness.

An outwardly opening check valve 28 is mounted over an opening of like shape and size in the lower and depending inner end of the bonnet 20, as shown. The upper and outwardly extending end of the bonnet 20 is internally threaded at 30 in the top portion thereof for fast threaded engagement and disengagement with a threaded plug 32 having a winged portion 34 of relatively large diameter at its top end. A reduced size lower end 36 of the plug 32 fits smoothly within an elongated bore 38 extending from a position above the bonnet flange 22 to the lower open end portion of the bonnet 20 within the valve body 12. An O ring seal 40 inset in the reduced lower end 36 of the plug 32 insures the gas tightness of the variable sized chamber between the check valve 28 and the adjacent end of plug 32.

A push rod 42 with a hand knob 44 on its outer end and a relatively small ejecting head 46 on its inner end has a close sliding fit within a bore 48 formed in the lower end portion of plug 32 for operation as a plug ejector. The upper end of the bore 48 is formed with a shoulder 50 receiving an O seal ring 52 engaging the push rod 42. A threaded counterbore 54 is formed in the center portion of the plug 32 for receiving a threaded inner end 56 of a bushing 58 that provides an upward bore extension 60 of the guiding means for the extendible push rod 42 and retains the seal ring 52.

A lateral opening 62 of substantial size is provided in the wall of the bonnet 20 closely below the internal threading 30 in order to vent trapped gas from the variable sized chamber beneath the threaded plug 32, there being an annular space within the outer portion of the bonnet 20 in communication with said opening 62.

Turning now to the mounting and operating means for the check valve 28, it will be observed that a pair of lugs or ears 64, only one of which is shown, extend outwardly in spaced relation from the lower outside wall or plug chamber portion of the bonnet 20 adjacent the flow port 14 for pivotally supporting, by means of a received pivot pin 66, one end of a valve lever arm 68. The other end of the lever arm 68 extends beneath the outside face of the check valve 28 and is resiliently biased into upward valve closing position by means of a coiled spring 70 mounted on the pivot pin 66 and having ends 72 and 74 abutting and acting respectively against the adjacent outer side of the depending portion of bonnet 20, and a back-up plate 76 for a resilient seal disc 78 overlapping the check valve 28 and the adjacent lower end surface of the part of bonnet member 20 providing the soluble plug chamber PC. An aperture 80 is formed in the valve supporting end of the lever arm 68 for receiving a central depending valve stem 82 that is secured to the arm by means of a washer 84 and a cotter pin 86 extending through the lower end portion of said stem outside the washer.

Before explaining the details of operation of the disclosed plug injector device 10, it will be noticed that the oil flow lines (FL) involved usually run from 2 inches to 4 inches in size. With a minimum 2-inch pipe size line and only 25 p. s. i. line pressure, the pressure thrust acting to hold the check valve 28 closed exceeds 75 pounds. From a practical standpoint this is too large a thrust to be overcome by manual push rod operation alone, even at the minimum force indicated.

A soluble paraffin control plug P as shown in Figs. 2 and 3, can be injected without shutting down, by-passing, or interrupting the flow in 30 seconds or less by the following operating procedure.

In first unscrewing the top winged plug 32 to the position shown in Fig. 1 the vent opening 62 is exposed permitting trapped gas to escape. At this time the swing check valve 28 that is normally held closed by action of the spring 70 seals off the plug receiving chamber PC

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from the flow line FL and flow chamber FC. With the winged plug 32 removed from the upper end of the bonnet 20 as indicated in Fig. 2, a plug P is dropped into the plug chamber PC, after which the winged plug 32 is replaced. Screwing down the winged plug 32 serves first to bring the ring seal 40 into engagement and thus close the plug receiving chamber PC from the atmosphere. Continued advance of the plug 32 compresses the trapped gas and tends to equalize the pressures between the flow line FL and the plug containing chamber PC so that the check valve 28 is held closed only by the action of spring 70.

In those cases where the flow line pressures are above average increased screw travel of the threaded plug 32 necessary to effect a greater degree of compressibility may be avoided by arranging for the inner end of the threaded plug 32 to contact the adjacent upper end of the soluble plug P and thus mechanically initiate opening of the check valve 28 for bringing the pressures into balance. Thereafter, inward movement of the hand operated push rod 42 downward moves plug P out past the swing check valve 28 into the flow line discharge, and partially into the surface line SL at flow port 16.

It has been found that through use of the plug injector of this invention as described above the receiving or loading chamber PC remains dry, the necessity of draining trapped fluid is eliminated, and the highly undesirable spillage of oil is avoided.

With the injector device 10 in an upright position, gas trapped in the upper chamber (PC) acts to keep the line fluid below the check valve 28.

The operation of the plug injector 10 as shown in Figs. 1, 2 and 3 and previously described in detail may be enhanced to some extent by slight modifications which are shown in Figs. 4 and 5 respectively. Like Figs. 2 and 3, these additional figures are semi-diagrammatic versions of the injector shown and described in detail with respect to Fig. 1. Like parts will be referred to by the same reference numerals used in Figs. 1, 2 and 3 and only the features of modification and difference will be described.

In Fig. 4 the injector device 10a is formed with a small orifice 90 extending through the depending lower wall portion of the bonnet 20 beneath the flange 22 and above the check valve 28. The orifice 90 serves to equalize pressures in the flow chamber FC and the plug chamber PC and thus permits ejection of a plug P from the plug chamber PC with less manual effort on the part of the operator. Since this modification permits some fluid to enter the plug chamber PC and spill over, it sacrifices the feature of dry injection which characterizes the injector 10.

In the similarly modified plug injector 10b of Fig. 5 a line 95 of small diameter connects the upper portion of the flow chamber FC between the valve body and the plug chamber (PC) wall with the upper portion of the plug chamber immediately below the threaded plug 32. An externally accessible pilot valve 98 provided with a valve operating stem 97 controls the flow of gas through line 95 so as to shut it off entirely, or to provide a free flowing passage between the points connected by line 95. The pilot valve 96 will normally be closed, and after a soluble plug P is inserted in the plug chamber PC and the threaded plug 32 replaced it will be opened momentarily to equalize pressures. The amount of fluid spilling over with this valved line 35 is practically negligible.

There has thus been provided a relatively simple and rugged plug injector for paraffin control in oil flow lines, and one which through use for the purposes intended over a substantial period of time has been shown to have the following significant advantages. Damage to soluble plugs has been positively avoided, thereby eliminating the problem of shearing and distorting and providing maximum effectiveness in clearing lines of paraffin deposition. All tendency for plugs to stall in the injector and to dissolve therein without moving into the oil flowing line and

clearing paraffin has been completely obviated. It has been demonstrated that the injection operation can be performed faster and with greater ease than hitherto, with substantial saving of time and expense.

While the preferred form and several modifications of this invention have been fully disclosed, it is to be understood that various changes may be made in the construction and arrangement of parts without departing from the invention as claimed.

Having thus described my invention, what I claim as novel and desire to secure by Letters Patent of the United States is:

1. A soluble control plug injector having a valve housing body provided with a flow chamber having flow ports extending at an angle to each other and a plug chamber extending into the flow chamber in spaced alignment with one of the flow ports and terminating in an inner open end; an outwardly opening check valve closing said open end; and a closure plug in the other end of the plug chamber progressively advanceable to impose pressure on fluid confined within the plug chamber for balancing the pressures between the plug chamber and the flow chamber, said closure plug including means for ejecting a plug from the plug chamber.

2. A soluble control plug injector having a valve housing body provided with a flow chamber having flow ports extending at an angle to each other and a plug chamber extending into the flow chamber in spaced alignment with one of the flow ports and terminating in an inner open end adjacent the other flow port; an outwardly opening check valve closing said open end; a closure plug in the other end of the plug chamber progressively advanceable to impose pressure on fluid confined within the plug chamber for balancing the pressures between the plug chamber and the flow chamber; and pusher means acting through the plug chamber to engage and discharge the control plug therefrom.

3. A soluble control plug injector having a valve housing body provided with a flow chamber having flow ports in angular relation to each other and a plug chamber extending into the flow chamber in spaced alignment with one of the flow ports terminating in an inner open end; an outwardly opening check valve closing said open end; and a closure plug threadedly engaged in the other end of the plug chamber progressively advanceable to impose pressure on fluid confined within the plug chamber for adjusting the pressure in the plug chamber relative to the pressure in the flow chamber, said closure plug including means for ejecting a plug from the plug chamber.

4. A soluble control plug injector having a valve housing body provided with a flow chamber having flow ports in angular relation to each other and a plug chamber extending into the flow chamber in spaced alignment with one of the flow ports terminating in an inner open end; an outwardly opening check valve closing said open end; a closure plug threadedly engaged in the other end of the plug chamber progressively advanceable to impose pressure on fluid confined within the plug chamber for adjusting the pressure in the plug chamber relative to the pressure in the flow chamber; and a push rod extending through the closure plug to discharge the control plug from the plug chamber.

5. A soluble control plug injector having a valve housing body provided with a flow chamber having flow ports extending at an angle to each other and a plug chamber member extending into the flow chamber in spaced relation to the sides thereof in alignment with one of the flow ports and terminating in an open end adjacent the other flow port; an outwardly opening check valve closing said open end and connected with one side thereof for swinging movement opening the plug chamber member for discharge of a soluble plug; spring means holding the check valve in closed position; a closure plug in the other end of the plug chamber member progressively advanceable

to impose pressure on fluid confined within the plug chamber member for balancing the pressures between the plug chamber member and the flow chamber; and extendible means acting through the closure plug to discharge the control plug from the plug chamber member.

6. A soluble control plug injector comprising an elongated valve housing body having an open upper end, an aligned open lower end, and a lateral inlet flow port; a plug chamber member extending downwardly from said open upper end into the valve housing body in spaced relation to the inner wall thereof and terminating near the lateral inlet flow port; an outwardly opening and biased closed check valve forming the bottom of the plug chamber member; a closure plug threadedly engaged in the upper part of said plug chamber member and movable into the soluble plug containing part thereof to compress the gas contained therein sufficiently to balance the pressure on the outward side of the check valve; and a push rod sliding through the closure plug to eject the soluble plug from the lower end of the plug chamber member.

7. A soluble control plug injector comprising an elongated valve housing body having an open upper end, an aligned open lower end, and a lateral inlet flow port; an open ended plug loading chamber extending downwardly through said open upper end into the valve housing body in spaced relation to the inner wall thereof and terminating near the lateral inlet flow port; an outwardly opening, normally closed, spring-biased check valve forming the bottom of the plug loading chamber; a closure plug threadedly secured and advanceable within the upper part of said plug loading chamber, the wall of the plug chamber member having a pressure equalizing orifice therethrough at a point above the check valve and within the valve housing body; and a push rod extending through the closure plug to eject the soluble plug from the lower end of the plug chamber member.

8. A soluble control plug injector comprising an elongated valve housing body having an upper end and a lower end and being formed with a lateral inlet flow port in an intermediate position, an outlet flow port in the lower end and an enlarged flow chamber between said flow ports, a plug chamber aligned with the outlet flow port extending upwardly from the upper part of the flow chamber as an extension of the elongated valve body and having a fully open inner end; a check valve closing the inner end of the plug chamber and connected with one side of said inner end for outward swinging movement opening the plug chamber for discharge of a soluble plug; means yieldingly holding the check valve in closed position; a closure plug threadedly engaged in the upper part of said plug chamber and movable therein sufficiently to impose substantial pressure of fluid confined within the plug chamber for balancing the pressure between the plug chamber and the flow chamber; and a push rod extending through the closure plug and having a sliding fit therein for moving the soluble plug past the check valve.

9. A soluble control plug injector comprising an elongated valve housing body having an upper end and a lower end and being formed with a lateral inlet flow port in an intermediate position, an outlet flow port in the lower end and an enlarged flow chamber between said flow ports, a plug chamber aligned with the outlet flow port and extending upwardly from the upper part of the flow chamber as an extension of the elongated valve body and having a fully open inner end; a check valve closing the inner end of the plug chamber and connected with one side of the said inner end for swinging movement outwardly opening the plug chamber for discharge of a soluble plug; spring means yieldingly holding the check valve in closed position; a closure plug threadedly engaged in the upper part of said plug chamber and movable into engagement with the upper end of a soluble plug contained therein to initiate opening of the check valve, the upper part of said plug chamber being formed with a lateral opening arranged to vent trapped gas from the

plug chamber when the closure plug is in an elevated position; and a push rod extending through the closure plug and having a sliding fit therein for moving the soluble plug past the check valve.

10. A soluble control plug injector comprising an elongated valve housing body having an open upper end, an aligned open lower end, and a lateral inlet flow port; a plug chamber member extending downwardly from said open upper end into the valve housing body in spaced relation to the inner wall thereof and terminating adjacent the upper limit of the lateral inlet flow port; an outwardly opening and biased closed check valve forming the bottom of the plug chamber member; a closure plug threadedly engaged in the upper part of said plug chamber member and movable into the lower part thereof; a gas bleed line connecting the space between the outer wall of the valve housing body and the plug chamber member above the

check valve and the upper space of the plug chamber member beneath the closure plug; a pilot valve controlling gas flow through the gas bleed line to equalize pressures between the said two spaces; and a push rod sliding through the enclosure plug to eject the soluble plug from the lower end of the plug chamber member.

References Cited in the file of this patent

UNITED STATES PATENTS

451,619	Leaycraft	May 5, 1891
681,534	Fordyce	Aug. 27, 1901
742,513	Stoddard	Oct. 27, 1903
2,028,779	Howe et al.	Jan. 28, 1936
2,430,976	Dutra	Nov. 18, 1947

FOREIGN PATENTS

309,344	Germany	Apr. 11, 1928
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