

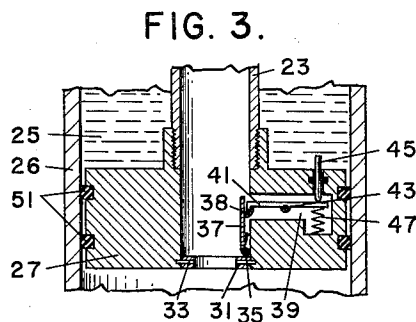
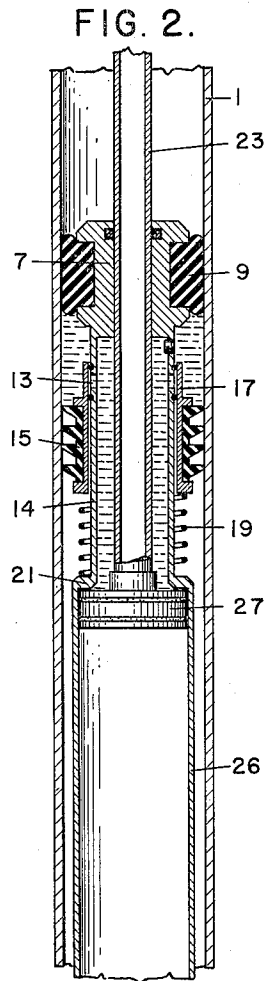
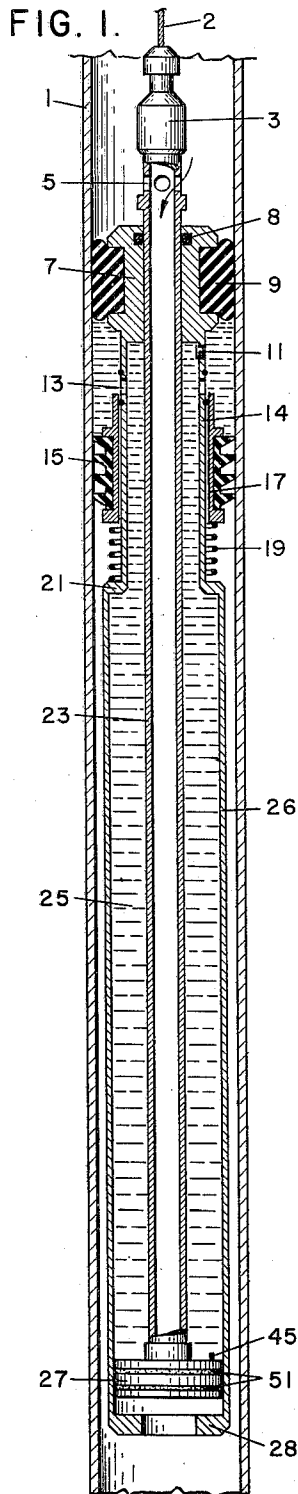
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LIQUID COATING APPLICATOR FOR INNER SURFACES OF PIPE STRINGS

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LIQUID COATING APPLICATOR FOR INNER SURFACES OF PIPE STRINGS

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This invention relates to liquid coating applicators, and more particularly to wire line apparatus for effectively and uniformly applying a coating of liquid materials to the inside of pipe strings such as are employed in oil and gas wells.

Pipe strings employed in the production of oil and gas from wells in the earth often are deleteriously affected by the chemical action of fluids produced therethrough. Various expedients have been used to minimize damage to the pipe strings. For example, compositions of liquid materials have been applied to the inner surfaces of pipes for inhibiting corrosion. Additionally, it is known to apply plastic coatings to the inner surfaces of pipe strings to insulate the pipe strings from the corrosive action of the fluids. During the productive life of the wells, the effectiveness of the corrosion inhibitor may be reduced, or the plastic coatings may be damaged during workover operations. Therefore, it is desirable to apply protective plastic or inhibitor coatings to the inner surfaces of well pipes, or to renew such coatings, while the pipes are in place in the well. Prior art apparatus for this purpose is described in U.S. Patent No. 2,941,500 to John G. Adams.

In accordance with the teachings of the present invention, there is provided an elongated housing of such diameter as to be slidable through a pipe to be coated, and an elongated plunger rod reciprocable within the housing and in telescoping relationship therewith. A plunger is provided at one end of the rod reciprocable in the housing with the rod. The plunger, housing, and plunger rod form a reservoir for the coating liquid. A discharge port is provided at the top end of the housing through which the fluid is ejected to the exterior of the housing, and annular sealing means are provided above and below the port. The upper sealing means is adapted to be in substantially fluid-tight sealing engagement with the pipe to be coated, while the lower sealing means is adapted to be in wiping frictional engagement with the pipe so that a thin coating of coating liquid is wiped on the inner surface of the pipe as the housing moves through the pipe. The lower sealing means is further slidable on the housing, and spring means is provided engaging the housing and the lower sealing means so that the lower sealing means is normally biased to cover the discharge port means. As the housing moves through the pipe string, the spring is adapted to yield under the frictional force between the lower sealing means and the inner surface of the pipe so as to uncover the discharge port.

In accordance with another aspect of the invention, there is provided a passageway extending through the plunger rod and plunger to equalize pressure above and below the housing, a flapper valve in the passageway, latch means for holding the flapper valve in an open position, and means tripping the latch means when the plunger reaches the upper extremity of its range of movement to release the flapper valve and close the passageway extending through the plunger rod. Thus, the tension in the wire line will suddenly increase when the coating liquid has been substantially entirely ejected through the discharge port means.

Objects and features of the invention not apparent from the above discussion will become evident upon consideration of the following detailed description thereof when

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taken in connection with the accompanying drawing, wherein:

FIG. 1 is an elevational view, partially in cross section, of an embodiment of the invention in place in a well pipe;

FIG. 2 is a view of a portion of the apparatus of FIG. 1 illustrating another operative position thereof; and

FIG. 3 is a fragmentary cross-sectional view of the piston portion of the apparatus of FIG. 1.

With reference now to FIGS. 1 and 2, there is shown a well pipe 1, which may be a tubing or casing of an oil and gas well in the earth. An elongated housing adapted to be slidable through the pipe 1 includes a lower, substantially cylindrical housing member 26 which may be termed an enlarged housing section, an upper reduced diameter housing section 14, and a connecting annular shoulder 21 between the reduced section 14 and the enlarged section 26 for connecting together the reduced section and the enlarged section. An upper closure member 7 is provided at the upper end of reduced section 14, and a lower closure member 28 is provided at the lower end of enlarged section 26. Discharge port means 13 in the reduced section 14 provides fluid communication between the exterior and interior of the housing.

A piston or plunger 27 and an elongated tubular plunger rod 23 secured to the plunger are disposed within the housing. The plunger rod 23 extends through a bore in the closure means 7 and extends thereabove. The outer diameter of the plunger is slightly less than the inner diameter of the enlarged section 26, and O-rings 51 are affixed to the outer surface of the plunger to provide a fluid seal between the plunger and the inner surface of the enlarged housing section 26. O-ring 8 provides a fluid seal between the plunger rod 23 and the closure means 7. By-pass ports 5 are provided in the plunger rod above the closure means 7. As the housing is pulled up the pipe 1, fluid in the well pipe 1 above the housing passes through a passageway including ports 5, the bore of the plunger rod 23, and a bore in the plunger 27 (see FIG. 3), so that pressure above and below the housing is substantially equalized. A wire line socket 3 is affixed to the upper end of plunger rod 23 to provide a connection between wire line 2 and the plunger rod 23.

The housing sections 14 and 26, the connecting shoulder 21, the plunger 27, and plunger rod 23 provide a reservoir for liquid corrosion inhibitor or liquid thermosetting plastic 25. The plastic may be an epoxy resin mixed with a suitable hardening catalyst therefor and may have a viscosity of between 5 cps. and 100,000 cps.

Affixed to the top closure means 7 is an annular fluid-tight sealing means 9 adapted to sealingly engage the inner surface of the pipe 1 so as to wipe the inner surface of the pipe substantially clean of well fluid.

Positioned below the discharge port 13 is an annular sleeve 17 functioning as a swab cup carrier for swab cup 15. The swab cup wipingly and frictionally engages the inner surface of the pipe string 1 so as to prevent free passage of coating liquid downwardly therepast, and to wipe a thin coating of coating liquid on the inner surface of the pipe as the housing is moved through the pipe string. A coil spring 19 is positioned between the lower end of sleeve 17 and shoulder 21. Spring 19 normally biases sleeve 17 and swab cup 15 upwardly so that discharge ports 13 are covered to prevent coating liquid from issuing into the annulus between the reduced section 14 and the pipe 1. The spring 19 is yieldable to the frictional opposition of pipe 1 to passage of swab cup 15 through the pipe as the housing is moved upwardly as shown, so as to uncover ports 13 to permit coating liquid to be ejected therethrough.

With reference now to FIG. 3, there is shown a flapper valve in the bore of plunger 27. The flapper valve includes a ring member or annular flange 31 having a cen-

tral opening therethrough, a flapper 37 pivoted on the ring member, and a spring 35 urging the flapper 37 to rotate so as to cover the central opening of the ring member 31. The ring member 31 is affixed to the plunger 27 by one or more shear pins 33 so as to control fluid flow through the bore of the plunger.

A recess 39 is provided in the plunger 27 opening into the bore thereof. A latch member 41 centrally pivoted as at 43 is positioned within the recess so that the hooked end thereof engages a catch 38 on flapper 37 to hold the flapper away from the central opening of ring member 31 to permit fluid flow therethrough. A coil spring 47 engages latch member 41 at the opposite end thereof from the hooked end, to hold the latch 41 in engagement with the catch 38. Above latch member 41 and spring 47 an actuating rod 45 extends through and above the plunger 27 from the recess 39. When plunger 27 is at the upper end of enlarged section 26, rod 45 engages the shoulder 21 to rotate catch 41 and release the flapper 37 to close the flapper valve.

In operation, the housing is filled with coating liquid 25 through fill plug 11, and the flapper 37 is rotated until catch 38 is engaged by latch member 41. The apparatus thereupon is lowered into pipe 1 on wire line 2. Swab cup sleeve 17 will cover ports 13 while the apparatus is being lowered so that the plunger 27 will remain at the bottom of enlarged housing section 26. When the apparatus has reached either the bottom of pipe 1 or the lowest depth from which it is desired to apply the coating, the apparatus is pulled upwardly through the tubing. The frictional force between the swab cup 15 and the inner surface of the pipe 1 immediately will move the sleeve 17 downwardly relative to the housing against the force of spring 19 to open discharge ports 13 so that coating liquid will be ejected into the annulus between the reduced housing section 14 and the pipe 1 as plunger 27 moves upwardly in housing section 26. A thin coating of coating liquid will be wiped on the inner surface of the pipe as the apparatus moves through the pipe. Should the liquid in the enlarged section 26 become exhausted during application of the coating, as shown in FIG. 2, rod 45 will engage the shoulder 21 to trip the latch member 41 and close the flapper valve. Immediately the tension on the wire line 2 will increase and the operator will know that the coating liquid is exhausted. A jar on the apparatus will shear the shear pins 33 to release the flapper valve so that the apparatus may be readily retracted from the tubing.

The invention is not necessarily to be restricted to the specific structural details or arrangement of parts described above and illustrated in the drawing, as various modifications thereof may be effected without departing from the spirit and scope of this invention.

The objects, features, and operation of the invention having been fully described, what we wish to claim is:

1. Apparatus for depositing a thin liquid film on the inner surface of a tubular pipe, comprising:

an elongated tubular housing member having an enlarged section, a reduced section near its upper end, and a connecting annular shoulder between said reduced section and said enlarged section, said housing member being of such diameter as to be slidable through a pipe to be coated;

an elongated annular plunger rod in telescoping arrangement within said housing member, said plunger rod being in sliding engagement with the end portion of said reduced section of said housing member and extending thereabove;

annular plunger means affixed to one end of said plunger rod, in sealing engagement with the inner wall of the enlarged section of said housing member;

discharge port means in said reduced section providing fluid communication between the exterior and the interior of said housing member;

said plunger means being adapted to force liquid disposed between said plunger rod and said housing member through said discharge port means as said plunger rod and said housing member are moved out of telescoping arrangement;

annular sealing means slidably fitting around said reduced section and adapted to wipingly engage the pipe to be coated, further adapted to slide longitudinally along said housing member to cover said discharge port means to prevent fluid passage there-through;

a coil spring positioned between said shoulder section and said annular sealing means adapted to urge said annular sealing means into the discharge-port-covering position thereof, said coil spring being adapted to yield to the frictional force of said annular sealing means against the inner surface of said pipe as said housing member is moved through said pipe to uncover said port means; and

an annular fluid-tight sealing means affixed to said housing member above said port means for sliding, substantially fluid-tight sealing engagement with the inner wall of the pipe.

2. Apparatus for depositing a thin liquid film on the inner surface of a tubular pipe, comprising:

an elongated tubular housing member having a reduced section near its upper end, an enlarged section, and a connecting annular shoulder between said reduced section and said enlarged section, said housing member being of such diameter as to be slidable through a pipe to be coated;

an elongated annular plunger rod in telescoping arrangement within said housing member, said plunger rod being in sliding engagement with the end portion of said reduced section of said housing member and extending thereabove;

annular plunger means affixed to one end of said plunger rod, in sealing engagement with the inner wall of the enlarged section of said housing member;

discharge port means in said reduced section providing fluid communication between the exterior and the interior of said housing member;

said plunger means being adapted to force liquid disposed between said plunger rod and said housing member through said discharge port means as said plunger rod and said housing member are moved out of telescoping arrangement;

an annular swab cup carrier in sliding fit around said reduced section, adapted to slide longitudinally along said housing member to cover said discharge port means to prevent fluid passage therethrough;

a coil spring positioned between said shoulder section and the lower end of said swab cup carrier adapted to urge said swab cup carrier into the discharge-port-covering position thereof;

annular swab cup means on said swab cup carrier for wiping frictional engagement with the pipe to uncover said discharge port means against the force of said spring, said swab cup means being adapted to wipe a thin film of liquid on the inner surface of the pipe; and

annular fluid-tight sealing means affixed to said housing member above said port means for sliding, substantially fluid-tight sealing engagement with the inner surface of the pipe.

3. Apparatus for depositing a thin liquid film on the inner surface of a tubular pipe, comprising:

an elongated tubular housing member having a reduced section near its upper end, an enlarged section, and a connecting annular shoulder between said reduced section and said enlarged section, said housing member being of such diameter as to be slidable through a pipe to be coated;

an elongated annular plunger rod in telescoping arrangement within said housing member, said plunger

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rod being in sliding engagement with the end portion of said reduced section of said housing member and extending thereabove;

annular plunger means affixed to one end of said plunger rod, in sealing engagement with the inner wall of the enlarged section of said housing member; 5

discharge port means in said reduced section providing fluid communication between the exterior and the interior of said housing member;

said plunger means being adapted to force liquid disposed between said plunger rod and said housing member through said discharge port means as said plunger rod and said housing member are moved out of telescoping arrangement; 10

an annular swab cup carrier in sliding fit around said reduced section, adapted to cover said discharge port means to prevent fluid passage therethrough; 15

a coil spring positioned between said shoulder section and the lower end of said swab cup carrier adapted to urge said swab cup carrier into the discharge-port-covering position thereof; 20

annular swab cup means on said swab cup carrier for wiping frictional engagement with the pipe to uncover said discharge port means against the opposition of said spring, said swab cup means being adapted to wipe a thin film of liquid on the inner surface of the pipe; 25

annular fluid-tight sealing means affixed to said housing member above said port means for sliding, sub-

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stantially fluid-tight sealing engagement with the inner surface of the pipe;

passageway means extending through said plunger means and plunger rod and establishing continuous communication through said housing member to establish equalized pressure above and below the housing;

a flapper valve including an annular flange having a central opening therein and a spring-biased flapper pivotally supported on said annular flange adapted to pivot over the opening of said annular flange;

shear pin means connecting said flange within said annular plunger means;

a recess in said plunger means;

a latch pivotally supported in said recess;

a catch on said flapper adapted to be engaged by said latch to hold said flapper away from the opening of said annular flange; and

a rod extending from said recess through said plunger means and engaging said latch to urge said latch out of engagement with said catch when forced against said shoulder whereby said flapper is released to cover the opening of said annular flange.

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UNITED STATES PATENTS

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2,941,500	Adams	June 21, 1960