FLUID MATERIAL APPLICATOR

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ABSTRACT

Apparatus for applying a precise, predictable quantity of fluid material at a precise location on the inside wall of a fitting and/or on the outside wall of a pipe. The present apparatus may be inserted into the fitting or over the pipe and when it bottoms, a slight pressure activates a volumetric pump that opens a low pressure seal and delivers the correct quantity of fluid material into an annular area between the pipe or fitting surface and the apparatus. As the apparatus is withdrawn from the fitting or the pipe is withdrawn from the apparatus, a serrated distributor ring uniformly distributes the fluid material onto the surfaces thereof.

17 Claims, 14 Drawing Figures
FLUID MATERIAL APPLICATOR

BACKGROUND OF THE INVENTION

1. Field of the Invention
The present invention relates to fluid material applicators and, more particularly, to apparatus for coating the outside surface of a pipe and/or the inside surface of a fitting with a predetermined quantity of fluid material for a predetermined distance from the end thereof.

2. Description of the Prior Art
Recent years have evidenced a marked increase in the use of plastic pipes in a wide variety of piping systems. Plastic pipes have gained this acceptance and have largely replaced copper, brass, cast iron, and other metal pipes for a variety of reasons. In the first instance, the plastic pipes are much cheaper to manufacture and are, therefore, much less expensive. Second, plastic pipes are potentially easier and faster to use because they may not contain threads and may be joined together with a solvent cement.

The principle of solvent cementing is not based upon a theory of gluing together a pipe and a fitting. To the contrary, available solvent cements actually dissolve the plastic material to permit a fusion or welding of the pipe to the fitting. Thus, the typical procedure for connecting a pipe to a fitting is to coat the inside surface of the fitting with the solvent cement, to coat the outside surface of the pipe with the solvent cement, and then to insert the pipe into the fitting until it is bottomed. The solvent cement softens the outer layer of the pipe and the inner layer of the fitting and acts as a lubricant so that the pipe is readily insertable into the fitting. As the cement dries, a potentially strong and reliable fitting is produced.

The typical means for storing and applying the solvent cement uses a can, the cap of which incorporates a swab. Alternatively, a separate swab or paint brush may be used. The cap is removed whereupon the swab coated with the cement is available for application to the inside surface of the fitting and the outside surface of the pipe.

The single greatest cause of plastic piping system failures is poor solvent cementing. This is because a number of variables affect the efficiency and integrity of the joints. Among these variables are time, temperature, moisture, incompatible foreign substances, discontinuities, movement and stresses, pipe and fitting tolerances, and workmanship. All of these operate singly and in combination to render the task of solvent cementing difficult.

It is highly important to carefully control the handling of the solvent cement in that it is not only sensitive to contamination, but capable of giving off potentially toxic fumes. The solvents employed are very hygroscopic and will change radically in effectiveness when exposed to the air, especially in higher humidity conditions. When using a swab and can system, every time the swab is applied, the solvent is exposed to available moisture in the air. Furthermore, the evaporation of selective components of the cement during repeated exposure to the air will certainly effect its efficiency.

The variable elements of time are related to the workman’s proficiency, the difficulty of the installation, the size of the pipe, the type of joint, the environment of the installation, and the workman’s ability and strength to handle the materials. If the application of the cement, in a difficult installation, takes too long to accomplish and the assembly surfaces are not fluid enough to allow easy insertion and/or rotation of the pipe and fitting, a dry fit will result that may preclude bottoming of the pipe in the fitting. This will reduce or eliminate adhesion of all or part of the surface. The worst part is that the workman will not know, for sure, what has happened before it is too late to remove the joint.

Often, the job of solvent cementing plastic pipe is overly simplified and the job is relegated to an unskilled workman in the belief that it takes no special talent or skill. When working in the field, the workman often cannot see inside of the fitting or all the way around the pipe. Thus, if the workman is not proficient or inattentive, an incomplete coating will be applied. The workman, with an insufficient coating, stuffs the pipe halfway in, wiggles the joint about in his zeal to get to the next joint, and moves on. There is no means to monitor this type of work until the workman has ruined a good amount of material.

Contrary to common belief, the complex requirements of solvent cementing are highly specific and follow logic for those skilled in the trade. It is important to take care to wet all surfaces to be joined to reduce the possibility of a dry area. The socket should receive the cement sparingly to preclude heavy buildup inside the fitting. On the other hand, an excess on the pipe will be scraped off to form a bead outside the fitting that may be removed. It becomes obvious that if a bead does not form at the fitting entrance, there may be insufficient cement in the annulus.

All things considered, what is required to fully realize the advantages of plastic pipes is a device for applying a precise, predictable amount of solvent cement compound at a precise location on the inside wall of a fitting and on the outside wall of a pipe. However, hitherto, no simple apparatus to achieve this function has been available.

SUMMARY OF THE INVENTION

According to the present invention, there is provided a pair of fluid material applicators which solve these problems in a manner unavailable heretofore. One of the present fluid material applicators is designed for coating the outside surface of a pipe whereas the other applicator is designed for coating the inside surface of a fitting. Both applicators are operative to apply a predetermined quantity of fluid material, for a predetermined distance from the end of the pipe and the fitting, quickly and efficiently so as to avoid the effect of the variables of time, temperature, discontinuities, workmanship, and the like. With the present applicators, the great bulk of the solvent cement is entirely enclosed, at all times, and only that portion being used is exposed to the air so that fewer fumes are released and so that the solvent is not subject to contamination or loss of effectiveness by exposure to the air. Regardless of the difficulty of the installation, the present applicator permits the application of the solvent cement to the pipe and the fitting rapidly and efficiently so that a consistent joint is achieved under all circumstances. With the present applicator, the job of solvent cementing plastic pipe is indeed so simplified that it may be relegated to an unskilled workman. The complex requirements of solvent cementing are all but eliminated and reduced to a simple routine that may be readily followed with a minimum amount of training.
Briefly, each of the present fluid material applicators comprises a unitary housing including a first body section having a first enclosed chamber therein for containment of the fluid material and a second body section connected to and movable relative to the first body section. In one applicator, the second body section has a second, open-ended chamber therein for receipt of the end of a pipe which is insertable into the second chamber for a predetermined distance. In the other applicator, the second body section is extendable into the open end of a fitting for a predetermined distance. In either case, continued movement of the pipe or fitting moves the second body section toward the first body section by a predetermined maximum amount. Each applicator further includes means in the housing responsive to such movement of the second body section toward the first body section by the predetermined amount for pumping a predetermined quantity of fluid into an annular area between the pipe or fitting and the second body section. Each applicator further includes means in the second body section and responsive to subsequent withdrawal of the pipe from the open end thereof or withdrawal of the second body section from the fitting for uniformly distributing the pumped predetermined quantity of fluid across the end of the pipe or the fitting.

OBJECTS

It is therefore an object of the present invention to provide a fluid material applicator.

It is a further object of the present invention to provide apparatus for applying a precise, predictable amount of fluid material at a precise location on the inside wall of a fitting and/or on the outside wall of a pipe.

It is a still further object of the present invention to provide a fluid material applicator in which an adjustable volumetric pump is activated by the single action of insertion of the applicator into a fitting of the insertion of a pipe into the applicator and withdrawal provides a proper distribution of the fluid material on the pipe or in the fitting.

It is another object of the present invention to provide a fluid material applicator which does not rely on a gravity feed or a pressurized can but derives its energy from the force used to insert a pipe into the applicator or the applicator into a fitting.

It is still another object of the present invention to provide a fluid material applicator wherein the quantity of fluid dispensed is adjustable.

Another object of the present invention is the provision of a fluid material applicator in which the area over which the fluid material is applied is adjustable.

Still other objects, features, and attendant advantages of the present invention will become apparent to those skilled in the art from a reading of the following detailed description of the preferred embodiments constructed in accordance therewith, taken in conjunction with the accompanying drawings wherein like numerals designate like parts in the several figures and wherein:

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a perspective view of a first embodiment of fluid material applicator for coating the outside surface of a pipe;

FIG. 2 is an enlarged cross-sectional view taken through the longitudinal axis of the applicator of FIG. 1;

FIG. 3 is an enlarged, exploded, perspective view of a portion of the applicator of FIGS. 1 and 2;

FIG. 4–3 are partial cross-sectional views, similar to FIG. 2, but showing the sequence of operation of the applicator of FIG. 1;

FIG. 7 is a perspective view of a pipe showing the pattern of fluid material applied to the end thereof by the applicator of FIGS. 1–6;

FIG. 8 is a perspective view of a second embodiment of fluid material applicator for coating the inside surface of a fitting;

FIG. 9 is an enlarged cross-sectional view taken through the longitudinal axis of the applicator of FIG. 8;

FIG. 10 is an enlarged, exploded, perspective view of a portion of the applicator of FIGS. 8 and 9;

FIGS. 11–13 are partial cross-sectional views similar to FIG. 9 but showing the sequence of operation of the applicator of FIG. 8, and

FIG. 14 is a perspective view of a fitting showing the pattern of fluid material applied to the end thereof by the applicator of FIGS. 8–13.

DESCRIPTION OF THE FIRST PREFERRED EMBODIMENT

According to the present invention, there are two preferred embodiments of the present fluid material applicator. The first embodiment, shown in FIGS. 1–7, is designed for coating the outside surface of a cylindrical object with a fluid material, which cylindrical object will hereinafter be referred to as a pipe. The second embodiment, shown in FIGS. 8–14, is designed for coating the inside surface of a cylindrical object with a fluid material, which cylindrical object will hereinafter be referred to as a fitting. The majority of the parts of each applicator are common to both, as are the basic functions. The unit for applying the fluid material to the male pipe will hereinafter be referred to as the female unit and will be generally designated 10. However, it will be recognized that female unit 10 may be used for applying fluid material to the outside of a male fitting and that the word "pipe" is used in the broadest sense of the word. The unit for applying the fluid material to the female socket fitting will hereinafter be referred to as the male unit and will be generally designated 100. Again, it will be recognized that male unit 100 may be used for applying fluid material to the inside surface of a pipe and that the word "fitting" is used in the broadest sense of the word. Furthermore, while female and male units 10 and 100 will be described in their preferred embodiments as solvent cement applicators for plastic pipe, it will be apparent to those skilled in the art that both units may be used to apply any flowable product to the surface of a pipe or fitting and that the two units can be used independently of each other.

Referring now to the drawings and, more particularly, to FIGS. 1–3 thereof, female unit 10 comprises a unitary housing including a first body section 11 and a second body section 12, second body section 12 being movable relative to first body section 11 in a manner to be described more fully hereinafter. First body section 11 includes a cylindrical, thin-walled, open-ended, removable can 13 which defines a chamber 19 for con-
tainment of the fluid material (solvent cement). Can 13 is positioned within a cylindrical, open-ended, can housing 14 which is externally threaded at the open end thereof. The threads of can housing 14 are adapted to engage the internal threads of a cap 15. Cap 15 has a planar central section 16, an internally threaded cylindrical section 17 which extends downwardly from the outer periphery of section 16 to engage the threads on can housing 14, and an externally threaded, decreased diameter cylindrical section 18 which extends upwardly from section 16.

Can 13 is positionable within can housing 14 with a loading spring 20 between the bases of the two members to urge can 13 upwardly relative to can housing 14 and into contact with section 16 of cap 15. An annular seal 21 is positioned between the top edge of can 13 and planar section 16 of cap 15.

Planar section 16 of cap 15 has a central opening 22 through which extends the body of an externally threaded, hollow bolt 23, the head 24 of which is positioned above planar section 16. The body of bolt 23, which extends into can 13, engages the internal threads at the enlarged, upper end of a hollow proboscis 25, the other end of which extends close to the bottom of can 13. An annular seal 26 is positioned between the upper end of proboscis 25 and planar section 16 of cap 15.

Cap 15 also has a pair of air passages 34 and 35 which extend therethrough, from the outer surface thereof, passage 34 terminating above section 16 and passages 35 terminating below section 16. In order to enclose the upper end of chamber 19 to prevent passage of fumes out of chamber 19 through air passage 35 and to prevent the passage of moisture into chamber 19 through passage 35, first body section 11 may include a traveling membrane, generally designated 5. Traveling membrane 5 includes a central collar 6 which surrounds and contacts proboscis 25. Extending outwardly from collar 6 is a disc-shaped member 7 which terminates in an upwardly extending can-contacting lip 8. The operation of traveling membrane 5 will be described more fully hereinafter. The lower end of proboscis 25 terminates in a tip 27 which houses a first one-way valve means, generally designated 28. One-way valve means 28 may include a ball 30 held against an opening 32 in tip 27 by a spring 31. In this manner, spring 31 may be compressed, elevating ball 30, to permit the flow of fluid material from can 13 into proboscis 25. On the other hand, spring 31 will return ball 30 into contact with tip 27, blocking opening 32, to prevent the flow of fluid material in an opposite direction. Tip 27 may be made separate from proboscis 25 to assist in the installation of ball 30 and spring 31. Thus, after ball 30 and spring 31 are positioned in tip 27, the lower end of proboscis 25 may be inserted into tip 27, as shown, and the two parts may be welded together, as shown at 33.

Second body section 12 includes a cylindrical, hollow, outer body 37, the lower end 38 of which extends into and approximately in contact with cylindrical section 18 of cap 15. Positioned within upper end 39 of outer body 37 is a cylindrical, hollow, inner body 40 which is enclosed at the lower end thereof by an integral disc 41, body 40 and disc 41 defining an opened-ended chamber 42. Outer body 37 has a pair of annular flanges 43 and 44 which extend inwardly from the inner surface thereof, flange 43 being positioned at the top of upper end 39 and flange 44 being positioned inter-
Flange 65 operates to guide a pipe into chamber 42, as will be described more fully hereinafter.

Second body section 12 also includes a ring-shaped guide and seal member 67 positioned within chamber 42, the outer surface of which contacts the inner surface of inner body 40. A portion of the outer surface of guide and seal 67 is tapered, at the top thereof, at 68, such taper matching that of annulus 59. Guide and seal 67 is movable within chamber 42, between a first position in contact with annulus 59 and lip 57, as shown in FIG. 2, and a second position in contact with a shoulder 69 made integral with the inner surface of inner body 40, as shown in FIG. 4. In the upper position, guide and seal 67 maintains annulus 59 in contact with inner body 40 so as to insure the seal of grooves 61. Guide and seal 67 has a plurality of inwardly extending fingers 70 which are adapted to contact the outer surface of a pipe extending into chamber 42, as will be explained more fully hereinafter.

In order to permit the flow of fluid material from can 13 and prosbics 25 to passageway 45, the lower end of inner body 40 has a plurality of grooves 72 therein, as shown most clearly in FIG. 3. Disc 41 of inner body 40 is positioned at the closed ends of grooves 72 so as to provide a space 73 between disc 41 and housing 48.

Fluid is permitted to pass into space 73 through a central opening 74 in housing 48. Extending downwardly from housing 48, surrounding central opening 74, is a cup-shaped member 75 having an opening 76 in the bottom thereof. Positioned within member 75 is a second one-way valve means 77 including a ball 78 and a spring 79. Spring 79 is positioned between ball 78 and disc 41, being held in place by a central post 80 made integral with the bottom surface of disc 41. Spring 79 maintains ball 78 in contact with member 75 to prevent passage of fluid material from space 73 through opening 76. On the other hand, fluid material may pass in the opposite direction by compressing spring 79, as will be explained more fully hereinafter.

Female unit 10 includes a bellows assembly 82 which defines a compressible metering chamber 83. The upper end of bellows 82 may be connected to the lower surface of housing 48, surrounding member 75, such as by soldering at 84, and the lower end of bellows 82 may be connected to head 24 of bolt 23, such as by soldering at 85. In this manner, the opposite ends of bellows 82 are connected to first and second body sections 11 and 12, respectively, whereby movement of second body section 12 toward first body section 11 compresses metering chamber 83 and whereby movement of second body section 12 away from first body section 11 expands metering chamber 83.

Metering chamber 83 is in selective fluid communication with both fluid material containment chamber 19 and chamber 42. Communication between chambers 19 and 83 is permitted via hollow bolt 23, prosbics 25, and one-way valve means 28. Communication between chambers 42 and 83 is permitted via opening 76 in member 75, one-way valve means 77, opening 74 in housing 48, space 73, grooves 72 in inner body 40, annular passageway 45, grooves 61 in inner body 40, and annulus 59.

Second body section 12 further includes an adjustable depth plate 87 positioned within chamber 42 so as to adequately determine the depth to which a pipe is insertable into chamber 42. More specifically, plate 87 is a planar member positioned in the bottom of chamber 42, parallel to disc 41. Disc 41 has a threaded post 88 which may be made integral with the surface thereof facing chamber 42, post 88 extending into an internally threaded nut 89 made integral with adjustable depth plate 87. Nut 89 may have a slot 90 in the upper end thereof for receipt of a screwdriver insertable into chamber 42. In this manner, nut 89 may be rotated relative to post 88 to adjust the position of plate 87 in chamber 42.

OPERATION OF THE FIRST PREFERRED EMBODIMENT

Referring now to FIGS. 1–7, female unit 10 is operative to coat the outside surface of a pipe 92 with a predetermined quantity of fluid material for a predetermined distance from the end thereof. The starting position of unit 10 is shown in FIGS. 1 and 2, ready to receive the end of a pipe 92. After the end of pipe 92 is cut square, chamfered, cleaned, and primed, the end thereof is guided into chamber 42 by face of 65 of nut 89 and guide 63. As the end of pipe 92 enters chamber 42, it first contacts lip 57 of spreader and sealer 55, deflecting lip 57 downwardly, into chamber 42, as shown in FIG. 4. Continued movement of pipe 92 into chamber 42 next brings the end thereof into contact with fingers 70 of guide and seal 67, pushing guide and seal 67 downwardly, into chamber 42, until it stops in contact with shoulder 69. The end of pipe 92 now enters guide and seal 67 be deflecting the multiple fingers 70, as shown in FIG. 4. After passage through guide and seal 67, pipe 92 continues until bottoming, in contact with adjustable depth plate 87. As explained previously, plate 87 may be adjusted by rotating nut 89 to regulate the depth of the solvent application to the end of pipe 92 to suit the socket depth of the fittings being used.

After reaching depth plate 87, continued movement of pipe 92 moves second body section 12 towards first body section 11. More specifically, the entire structure of inner body 40, outer body 37, housing 48, and the remaining parts attached thereto, all move as a unit until the bottom of lower end 38 of outer body 37 contacts planar section 16 of cap 15, compressing bellows 82 and return spring 49. Compression of bellows 82 reduces the internal volume thereof, forcing the fluid material therein to exit therefrom. The fluid material therein cannot enter prosbics 25 because spring 31 is, at this time, maintaining ball 30 in contact with tip 27 and the pressure in chamber 83 only serves to increase this force. Therefore, the fluid material in chamber 83 compresses spring 79 and enters member 75 through opening 76. The material therefore fills space 73 and annular passageway 45.

Assuming that these areas are already filled with fluid material, as they would be, the movement of a new volume of fluid material thereinto, through opening 76, forces an equal volume of material through grooves 61 at the upper end of inner body 40. This material deflects annulus 59 and enters annular area 93 surrounding pipe 92, annular area 93 being defined by pipe 92, inner body 40, spreader and sealer 55, and guide and seal 67.

The quantity of fluid material which is pumped into annular area 93 is determined by the amount of permissible movement of second body section 12 relative to first body section 11 since this determines the amount of compression of bellows 82. As explained previously, the amount of such movement may be adjusted by ro-
tating nut 50 relative to can cap 15. The increase and decrease of volume of the area between bellows 82 and lower end 38 of outer body 37 is accomodated by air passage 34 which permits escape of excess air during compression of bellows 82 and entrance of air during expansion of bellows 82.

As the force on pipe 92 is released, and prior to such time as pipe 92 begins to be withdrawn from chamber 42, return spring 49 first moves second body section 12 away from first body section 11, expanding bellows 82. The expansion of bellows 82 increases the internal volume of metering chamber 83, creating a negative pressure therein, drawing fluid material thereinto. The fluid material cannot be withdrawn from space 73 because spring 79 immediately forces ball 78 into contact with member 75, blocking opening 76. On the other hand, such negative pressure readily displaces ball 30 from tip 27, compressing spring 31, as shown in FIG. 5. Thus, the return of second body section 12 relative to first body section 11 to the position shown in FIG. 2., draws a fresh supply of fluid material from chamber 19 in can 13 into prosbosis 25 and bellows 82.

The resultant reduction of volume of chamber 19 will move membrane 5 towards the bottom of can 13, in reaction to the pressure differential, ultimately assuring that prosbosis 25 will be fed fluid material until can 19 is substantially exhausted. The increase in volume of the portion of can 19 above membrane 5 is supplied with air via air passage 35.

When spring 49 and bellows 82 are completely expanded such that the second body section 12 has returned to the normal position, as shown in FIGS. 2 and 6, outer body 37 having been stopped by ring 52 of adjusting nut 50, the withdrawal of pipe 92 from chamber 42 will cause a frictional drag on guide and seal 67 by means of the contact between fingers 70 thereof and the outer surface of pipe 92. By controlling the flexibility of fingers 70 and the relative dimensions of fingers 70 relative to pipe 92, a sufficient frictional drag will be created to force guide and seal 67 forward with pipe 92, against the hydraulic restriction of the fluid material between it and lip 57 of spacer and sealer 55. This frictional drag will force the fluid material, at a controlled rate, through serrations 58 in lip 57 as lip 57 is now forced, by friction, to lay against flange 65. This action is shown in FIG. 6. Continued withdrawal of pipe 92 from chamber 42 while slowly rotating same will cause the distribution of the fluid material on the outside surface of pipe 92 in parallel strips 94 of uniform thickness, as shown in FIG. 7.

As the end of pipe 92 finally reaches lip 57, guide and seal 67 will contact spacer and sealer 55. This position of the apparatus corresponds to the starting position and is shown in FIG. 2. At this time, the matching tapers of annulus 59 and tapered portion 68 of guide and seal 67 will be in contact, holding annulus 59 against the inner surface of grooves 61, causing an effective sealing of grooves 61 against evaporation and leaking by residual pressure.

DESCRIPTION OF THE SECOND PREFERRED EMBODIMENT

Referring now to FIGS. 8-10, male unit 100 contains a number of parts which are identical to those previously described with regard to female unit 10. Since such parts are identical, they have been given the same number. Male unit 100 comprises a unitary housing including a first body section 101 and a second body section 102, second body section 102 being movable relative to first body section 101 in a manner to be described more fully hereinafter. First body section 101 is identical to first body section 11 of female unit 10 and includes a cylindrical, thin-walled, open-ended, removable can 13, a cylindrical, open-ended, can housing 14, a cap 15 having a planar central section 16, an internally threaded cylindrical section 17, and an externally threaded, decreased diameter cylindrical section 18, a loading spring 20, and a resilient annular seal 21. Cap 15 has a central opening 22 in planar section 16 and a pair of air passages 34 and 35 through section 18. First body section 101 also includes a hollow bolt 23 which extends through central opening 22 in section 16 of cap 15 and engages the upper end of a prosbosis 25. Prosbosis 25 terminates in a tip 27 which houses a one-way valve means 28 including a ball 30 held against an opening 32 in tip 27 by a spring 31. Also included is a seal 26 and a traveling membrane 5 including a central collar 6, a disc-shaped member 7, and a lip 8.

Second body section 102 of male unit 100 is different from second body section 12 of female unit 10 since second body section 102 must extend into the open end of a fitting. More specifically, second body section 102 includes an elongated, cylindrical, hollow body 103 having an upper end 104, an increased diameter central portion 105, and an increased diameter lower end 106. Lower end 106 of body 103 extends into and in contact with cylindrical section 18 of cap 15. Central port...
therein, lip 117 being adapted to contact the inside surface of a pipe fitting extending around upper end 104 of body 103, as will be explained more fully hereinafter. The sealing portion of spreader and sealer 115 comprises a tapered annulus 119, the wide end of which is made integral with ring 116 and which extends perpendicularly thereto in contact with the outer surface of upper end 104 of body 103. Annulus 119 operates to seal a plurality of grooves 121 in the upper surface of an inwardly extending ring-shaped flange 122 made integral with the top of upper end 104 of body 103, grooves 121 being shown most clearly in FIG. 10. Grooves 121 permit passage of fluid material out of body 103 by deflecting annulus 119. For this purpose, annulus 119 has a plurality of slits 123 therein.

Second body section 102 includes a hollow, elongated transfer tube 125 defining a fluid passageway 126. The upper end of transfer tube 125 extends through flange 122 and distributor ring 116 and is externally threaded to engage the internal threads of an enclosed front nut and guide 127. Nut and guide 127 includes an outwardly extending flange 128 which contacts the top surface of ring 116 and maintains spreader and sealer 115 in contact with flange 122. Flange 128 also operates to guide upper end 104 of body 103 into a pipe fitting, as will be explained more fully hereinafter.

In order to lock transfer tube 125 and nut and guide 127 to upper end 104 of body 103, the outer surface of transfer tube 125 has an integral shoulder 130 which supports a rigid ring 131 positioned therearound. Positioned around transfer tube 125, between ring 131 and flange 128, is a flexible annular seal 132. Thus, by tightening nut and guide 127 relative to transfer tube 125, ring 131 is brought towards flange 122, compressing seal 132 and providing a rigid connection between tube 125, nut and guide 127, and upper end 104 of body 103.

Second body section 102 also includes a ring-shaped guide and seal member 135 positioned around upper end 104 of body 103, the inner surface of which contacts the outer surface of body 103. A portion of the inner surface of guide and seal 135 is tapered, at the top thereof, at 136, such taper matching that of annulus 119. Guide and seal 135 is movable along the outside of upper end 104 of body 103, between a first position in contact with annulus 119 and lip 117, as shown in FIG. 9, and a second position in contact with a shoulder 137 made integral with the outer surface of upper end 104 of body 103, as shown in FIG. 11. In the upper position, guide and seal 135 maintains annulus 119 in contact with body 103 so as to insure the seal of grooves 121. Guide and seal 135 has a plurality of outwardly extending fingers 138 which are adapted to contact the inner surface of a pipe fitting, as will be explained more fully hereinafter.

Male unit 100 includes a bellows assembly 82 which is identical to that of female unit 10 and which defines a compressible metering chamber 83. The lower end of bellows 82 may be connected to head 24 of bolt 23, such as by soldering at 85. The upper end of bellows 82 may be connected to the outer periphery of a disc-shaped ball housing 140, such as by soldering at 141. Ball housing 140 has a central opening 142. Extending downwardly from housing 140, surrounding opening 142, is a cup-shaped member 143 having an opening 144 in the bottom thereof. Positioned within member 143 is a one-way valve means 145 including a ball 146 and a spring 147. Extending upwardly from ball housing 140, surrounding central opening 142, is a cylindrical collar 148 into which extends the lower end of transfer tube 125. Thus, after ball 146 and spring 147 are positioned in member 143, the lower end of transfer tube 125 may be inserted into collar 148, as shown, and the two parts may be welded together, as shown at 149.

By connecting the upper end of bellows 82 to ball housing 140 and the lower end of bellows 82 to head 24 of bolt 23, the opposite ends of bellows 82 are connected to first and second body sections 101 and 102, respectively. In this manner, movement of second body section 102 toward first body section 101 compresses metering chamber 83 and movement of second body section 102 away from first body section 101 expands metering chamber 83.

Metering chamber 83 is in selective fluid communication with both fluid containment chamber 19 and grooves 121 in upper end 104 of body 103. Communication between chambers 19 and 83 is provided via hollow bolt 23, procobscis 25, and one-way valve means 28. Communication between chamber 83 and grooves 121 is provided via opening 144 in member 143, one-way valve means 145, opening 142 in housing 140, passageway 126 in transfer tube 125, a plurality of holes 150 in the upper end of transfer tube 125, between shoulder 130 and the threads at the upper end thereof, and the annular space 151 between the outer surface of transfer tube 125 and the inner surface of flange 122.

It should be noted that male unit 100 contains no part corresponding to the adjustable depth plate 87 of female unit 10. The reason for this is that a typical pipe fitting 160, as shown in FIGS. 11 and 13, has an internal shoulder 161 which contacts nut and guide 127 and determines the amount upper end 104 of body 103 is insertable into pipe fitting 160.

OPERATION OF THE SECOND PREFERRED EMBODIMENT

Referring now to FIGS. 8-14, male unit 100 is operative to coat the inside surface of a pipe fitting 160 with a predetermined quantity of fluid material for a predetermined distance from the end thereof. The starting position of unit 100 is shown in FIGS. 1 and 2, ready to be inserted into the open end of pipe fitting 160. Unit 100 is guided into pipe fitting 160 by flange 128 of nut and guide 127. As the upper end 104 of second body section 102 enters pipe fitting 160, pipe fitting 160 contacts lip 117 of spreader and sealer 115, deflecting lip 117 downwardly, as shown in FIG. 11. Continued movement of male unit 100 relative to pipe fitting 160 next brings the end of pipe fitting 160 into contact with fingers 138 of guide and seal 135, pushing guide and seal 135 downwardly, until it stops in contact with shoulder 137. Guide and seal 135 now enters pipe fitting 160 by deflecting the multiple fingers 138, as shown in FIG. 11.

After guide and seal 135 enters pipe fitting 160, relative movement of body 103 continues until flange 128 of nut and guide 127 contacts the internal shoulder 161 of pipe fitting 160. After reaching this position, continued movement of unit 100 relative to pipe fitting 160 moves first body section 101 towards second body section 102.
More specifically, the entire structure of body 103, transfer tube 125, and ball housing 140 all move as a unit until the bottom of lower end 106 of body 103 contacts planar section 16 of cap 15, compressing bellows 82 and return spring 49. Compression of bellows 82 reduces the internal volume thereof, forcing the fluid material therein to exit therefrom. As explained previously, the fluid material therein cannot enter proboscis 25 because spring 31, at this time, maintaining ball 30 in contact with tip 27 and the pressure in chamber 83 only serves to increase this force. Therefore, the fluid material in chamber 83 compresses spring 147 and enters member 143 through opening 144. The material therefore fills ball housing 143 and transfer tube 126, as seen in FIG. 11.

Assuming that these areas are already filled with fluid material, as they would be, the movement of a new volume of fluid material thereinto, through opening 144, forces an equal volume of material out of holes 150 in transfer tube 125 and through grooves 121 in flange 122 at the top of upper end 104 of body 103. This material deflects annulus 119 and enters an annular area 163 surrounding body 103, annular area 163 being defined by fitting 160, body 103, spacer and seal 115, and guide and seal 135.

The quantity of fluid material which is pumped into annular area 163 is determined by the amount of permissible movement of second body section 102 relative to first body section 101 since this determines the amount of compression of bellows 82. As explained previously, the amount of such movement may be adjusted by rotating nut 110 relative to cap 15. The increase in decrease of volume of the area between bellows 82 and the lower end 106 of body 103 is accomodated by air passage 34 which permits escape of excess air during compression of bellows 82 and entrance of air during expansion of bellows 82.

As the force on first body section 101 is released, and prior to such time as second body section 102 begins to be withdrawn from pipe fitting 160, return spring 49 first moves first body section 101 away from second body section 102, expanding bellows 83. As explained previously, the expansion of bellows 82 increases the internal volume of metering chamber 83, creating a negative pressure therein, drawing fluid material thereinto. The fluid material cannot be withdrawn from transfer tube 125 because spring 147 immediately forces ball 146 into contact with member 143, blocking opening 144. On the other hand, such negative pressure readily displaces ball 30 from tip 27, compressing spring 31, as shown in FIG. 12. Thus, the return of second body section 102 relative to first body section 101 to the position shown in FIG. 9, draws a fresh supply of fluid material from chamber 19 in can 13 into proboscis 25 and bellows 82.

The resultant reduction of volume of chamber 19 will move membrane 5 towards the bottom of can 13, in reaction to the pressure differential, ultimately assuring that proboscis 25 will be fed fluid material until can 19 is substantially exhausted. The increase in volume of the portion of can 19 above membrane 5 is supplied with air via air passage 35.

When spring 49 and bellows 82 are completely expanded such that second body section 102 has returned to the normal position, as shown in FIGS. 9 and 13, body 103 having been stopped by ring 111 of adjusting nut 110, withdrawal of unit 100 from pipe fitting 160 will cause a frictional drag on guide and seal 135 by means of the contact between fingers 138 thereof and the inner surface of pipe fitting 160. As explained previously, a sufficient frictional drag will be created to force guide and seal 135 forward with pipe fitting 160, against the hydraulic restriction of the fluid material between it and lip 117 of spacer and seal 115. This frictional drag will force the fluid material, at a controlled rate, through serrations 118 in lip 117 as lip 117 is now forced, by friction, to lay against flange 128. This action is shown in FIG. 13. Continued withdrawal of unit 100 from pipe fitting 160 while slowly rotating same will cause the distribution of the fluid material on the inside surface of pipe fitting 160 in parallel strips 164 of uniform thickness, as shown in FIG. 14.

As the end of pipe fitting 160 finally reaches lip 117, guide and seal 135 will contact spacer and seal 115. This position of the apparatus corresponds to the starting position and is shown in FIG. 9. At this time, the matching tapers of annulus 119 and tapered portion 136 of guide and seal 135 will be in contact, holding annulus 119 against the outer surface of grooves 121, causing an effective sealing of grooves 121 against evaporation and leaking by residual pressure.

It would be desirable to maintain a minimum weight for both units 10 and 100 for reasons of worker fatigue. Thus, aluminum is preferred for all metal parts except for the bellows assembly and the springs, which are preferably stainless steel. The character of the solvents involved will compromise most elastomers, therefore all seals are preferably Teflon of various compounds such as glass fiber and mineral filled as well as virgin resin. All the surfaces in normal contact with the solvent cement are either made of Teflon or Teflon-coated metal. This surface has low adhesion and very low surface tension effects with preferred solvent cements. Therefore, during continuous use, there will be a minimum buildup of excess cement and when cement has dried in places critical to proper function of the units, it may be easily stripped off in one continuous web.

The cement supply is furnished in standardized metal cans 13 which may be designed so that the entire top may be removed. This can 13 may be an aluminum can with a “tear-off” top or a standard steel can opened with a standard opener. When a can is exhausted, it may be readily replaced by unscreeing can housing 14 and withdrawing can 13. The top of the new can is removed and proboscis 25 is inserted thereinto, the fluid material therein forcing membrane 5 upwardly to its starting position shown in FIGS. 2 and 9. Can housing 14 may then be replaced and tightened into can cap 15.

The consistency of the solvent cement should be of a highly thixotropic nature with a very low viscosity. This characteristic will serve to function better by use of this application system and further it will prevent uneven flow and running after application, during assembly of the pipe and fittings.

It can therefore be seen that in accordance with the present invention there is provided a pair of fluid material applicators 10 and 100 which solve the problems discussed heretofore. Fluid material applicator 10 is designed for coating the outside surface of a pipe whereas fluid material applicator 100 is designed for coating the inside surface of a fitting. Both applicators 10 and 100 are operative to apply a predetermined quantity of fluid material, for a predetermined distance
from the end of the pipe and the fitting, quickly and efficiently so as to avoid the effect of the variables of time, temperature, discontinuities, workmanship, and the like. With applicators 10 and 100, the great bulk of the solvent cement is entirely enclosed within chamber 19, at all times, and only that portion being used is exposed to the air so that fewer fumes are released and so that the solvent is not subject to contamination or loss of effectiveness by exposure to the air. Regardless of the difficulty of installation, applicators 10 and 100 permit the application of the solvent cement to pipe 92 and fitting 160 rapidly and efficiently so that a consistent joint is achieved under all circumstances. With applicators 10 and 100, the job of solvent cementing plastic pipe is indeed so simplified that it may be relegated to an unskilled workman. The complex requirements of solvent cementing are all but eliminated and reduced to a single routine that may be readily followed with a minimum amount of training. The majority of the parts of applicators 10 and 100 are common to both, as are the basic functions. Both units are designed to be readily disassemblable for replacement of those parts subject to the greatest amount of wear, such as the guides, spreaders, and seals.

While the invention has been described with respect to the preferred physical embodiments constructed in accordance therewith, it will be apparent to those skilled in the art that various modifications and improvements may be made without departing from the scope and spirit of the invention. For example, it will be apparent to those skilled in the art that units 10 and 100 may be used to apply any flowable product to the surface of a pipe or fitting and that the two units can be used either together or independently of each other. More specifically, units 10 and 100 may be used to apply different types of coatings to different types of cylindrical objects such as fluxes to pipes and fittings for welding purposes, glazing grit to ceramic tubes, and paints to a wide variety of objects. Accordingly, it is to be understood that the invention is not to be limited by the specific illustrative embodiments, but only by the scope of the appended claims.

I claim:

1. Apparatus for coating the outside surface of a pipe or other cylindrical object or the inside surface of a fitting or other hollow cylindrical object with a predetermined quantity of fluid material for a predetermined distance from the end thereof comprising:
   a first body section having a first, enclosed chamber therein for containment and storage of said fluid material and a second, open-ended chamber at one end thereof;
   means in said first body section forming a first passageway interconnecting said first and second chambers to permit fluid communication therebetween;
   first one-way valve means positioned in said first passageway between said first and second chambers for permitting passage of said fluid material only from said first chamber to said second chamber;
   a second body section connected to and movable relative to said first body section, said second body section having a third, open-ended chamber at one end thereof positioned facing said second open-ended chamber in said first body section, said second and third open-ended chambers cooperating to define an enclosed, compressible, metering chamber in selective fluid communication with said first chamber via said first passageway, said second body section further including means defining an annular area adapted to surround the end of a pipe or lie within the end of a fitting;
   means in said second body section forming a second passageway interconnecting said metering chamber and said annular area to permit fluid communication therebetween;
   said one-way valve means positioned in said second passageway between said metering chamber and said annular area for permitting passage of said fluid material only from said metering chamber to said annular area, said end of said pipe or said end of said fitting being adapted to engage said second body section and to move said second body section toward said first body section by a predetermined maximum amount, movement of said second body section toward said first body section by said predetermined amount comprising said metering chamber and pumping said predetermined quantity of fluid material through said second passageway, past said second one-way valve means, to said annular area;
   means positioned between said first and second body sections for urging said second body section away from said first body section whereby movement of said pipe or fitting out of engagement with said second body section causes movement of said second body section away from said first body section, expanding said metering chamber, and pumping said fluid material from said first chamber, through said first passageway, past said first one-way valve means, into said metering chamber to refill same; and
   means in said second body section responsive to movement of said pipe or fitting out of engagement with said second body section for uniformly distributing said pumped predetermined quantity of fluid material across said outside surface of said pipe or said inside surface of said fitting.

2. Apparatus according to claim 1 further comprising:
   a bellows, said bellows defining said metering chamber, opposite ends of said bellows being connected to said first and second body sections, respectively.

3. Apparatus according to claim 1 further comprising:
   means for adjusting said predetermined maximum amount that said second body section is movable toward said first body section.

4. Apparatus according to claim 1 for coating the outside surface of a pipe or other cylindrical object wherein said second body section has a fourth, open-ended chamber wherein for receipt of said end of said pipe, said end of said pipe being insertable into said fourth chamber for said predetermined distance, said annular area surrounding said end of said pipe.

5. Apparatus according to claim 4 wherein said second body section has an annular opening therein facing inwardly into the open end of said fourth chamber so as to face said outside surface of said end of said pipe positioned therein; and wherein said fluid distributing means comprises:
   first and second sealing means positioned within said fourth chamber in said second body section, on opposite sides of said annular opening, said first and
second sealing means extending between said second body section and said outside surface of said pipe, said pipe, said second body section, and said first and second sealing means defining said annular area surrounding said end of said pipe.

6. Apparatus according to claim 5 further comprising:

third sealing means positioned within said fourth chamber in said second body section for selectively sealing said annular opening, said third sealing means readily passing said predetermined amount of pumped fluid into said annular area between said first and second sealing means.

7. Apparatus according to claim 4 further comprising:

means for adjusting said predetermined distance that said end of said pipe is insertable into said fourth chamber.

8. Apparatus according to claim 1 for coating the inside surface of a fitting or other hollow cylindrical object wherein said second body section is insertable into the open end of said fitting for said predetermined distance, said annular area surrounding said second body section, within said end of said fitting.

9. Apparatus according to claim 8 wherein said second body section has an annular opening therein facing outwardly so as to face said inside surface of said end of said fitting positioned therearound; and wherein said fluid distributing means comprises:

first and second sealing means positioned around said second body section, on opposite sides of said annular opening, said first and second sealing means extending between said second body section and said inside surface of said fitting, said fitting, said second body section, and said first and second sealing means defining said annular area within said end of said fitting.

10. Apparatus according to claim 8 further comprising:

means for adjusting said predetermined distance that said second body section is insertable into said open end of said fitting.

11. Apparatus according to claim 5 wherein said first sealing means comprises:

a flexible distributor ring connected adjacent said open end of said second chamber, said distributor ring having an inwardly extending serrated lip adapted to contact said outside surface of said pipe, said fluid material passing through said serrations onto said outside surface of said pipe as said pipe is withdrawn from said second body section.

12. Apparatus according to claim 11 wherein said second sealing means comprises:

a flexible sealing ring, the outer surface of which contacts said second body section, the inner surface of which contacts said outside surface of said pipe, said sealing ring being movable in said second chamber under the control of said pipe, insertion of said pipe into said second chamber pushing said sealing ring away from said distributor ring, withdrawal of said pipe from said second chamber pulling said sealing ring toward said distributor ring, expelling said fluid material through said serrations therein.

13. Apparatus according to claim 12 wherein said sealing ring has a plurality of inwardly extending fingers contacting said outside surface of said pipe, said sealing ring fingers permitting controlled slipping of said pipe relative to said sealing ring.

14. Apparatus according to claim 9 wherein said first sealing means comprises:

a flexible distributor ring connected adjacent the end of said second body section farthest from said first body section, said distributor ring having an outwardly extending serrated lip adapted to contact said inside surface of said fitting, said fluid material passing through said serrations onto said inside surface of said fitting as said second body section is withdrawn from said fitting.

15. Apparatus according to claim 14 wherein said second sealing means comprises:

a flexible sealing ring, the inner surface of which contacts said second body section, the outer surface of which contacts said inside surface of said fitting, said sealing ring being movable along the outside of said second body section under the control of said fitting, insertion of said second body section into said fitting pushing said sealing ring away from said distributor ring, withdrawal of said second body section from said fitting pulling said sealing ring toward said distributor ring, expelling said fluid material through said serrations therein.

16. Apparatus according to claim 15 wherein said sealing ring has a plurality of outwardly extending fingers contacting said inside surface of said fitting, said sealing ring fingers permitting controlled slipping of said fitting relative to said sealing ring.