

[54] PLURAL COMPONENT GUN
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[73] Assignee: **Graco Inc.**, Minneapolis, Minn.
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[51] Int. Cl. **B05b 7/04**
[58] Field of Search **239/115-118, 112, 239/113, 414, 415, 373, 379, 527, 528, 583, 239/123**

[56] **References Cited**

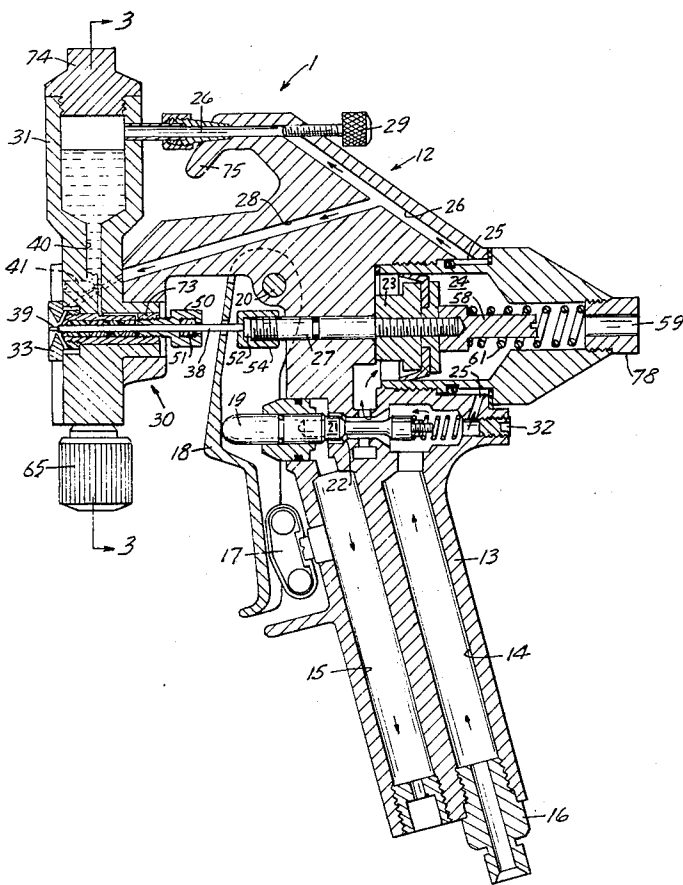
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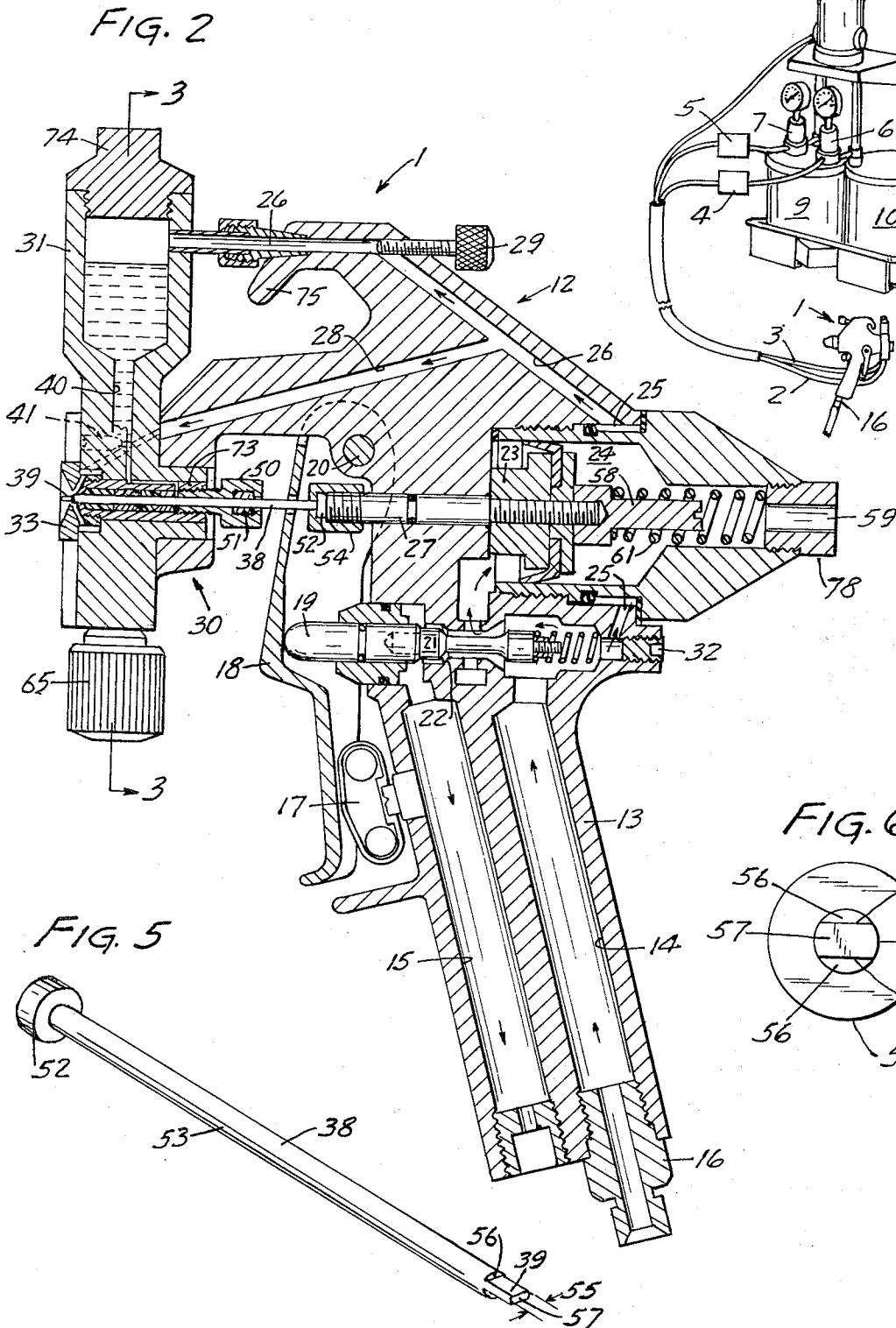
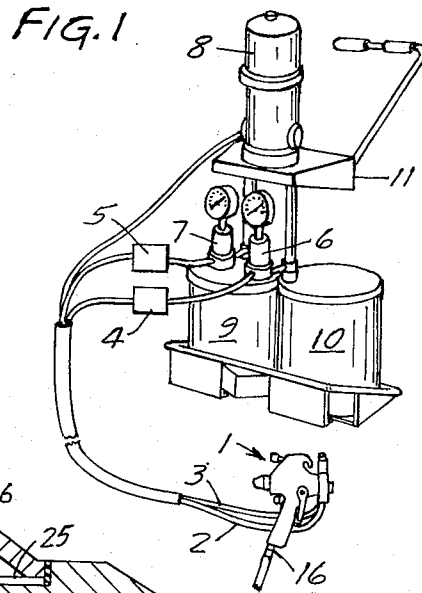
Primary Examiner—Allen N. Knowles
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[57] **ABSTRACT**
An improved internal mix plural component spray

gun. This gun is of the solventless type that has as its major method of purging the barrel bore that acts as a mixing chamber, a movable valve rod. The rod may have a spray pattern and mixing device on its front end. A lubricating device for the rod may be added to this specific rod feature in combination or may be used by itself for any rod. The front end of the rod is rotated near the chemically-reactive plural component inlets to the mixing chamber to adjust the degree of change for the spray pattern and/or component mixing. Specially designed flatten deflecting rod surfaces accomplish this result. The rod may be made to reciprocate in its barrel bore to purge the mixed components and control the flow from the component inlets. This movement is aided by a lubricant supplied to the rod usually rearward of the component inlets. Such a lubricant substantially eliminates sticking of the movable rod in any of its positions and also acts to keep the rod clean. Fluid jets near the barrel front outlet also aid in cleaning the front end of the rod and preventing the mixed reactive plural components from fully reacting while on the valve rod. The lubricant may be gravity-fed or force-fed from a pressurized fluid source. If a pressurized fluid source is used, the same fluid may be used to simultaneously act as the mentioned rod-cleaning jets by actuating a single trigger valve.

10 Claims, 7 Drawing Figures





SHEET 2 OF 2

FIG. 3

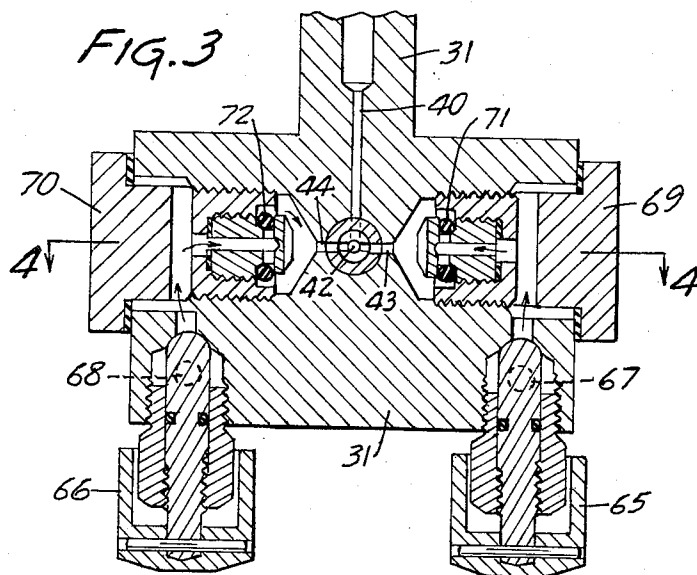


FIG. 4

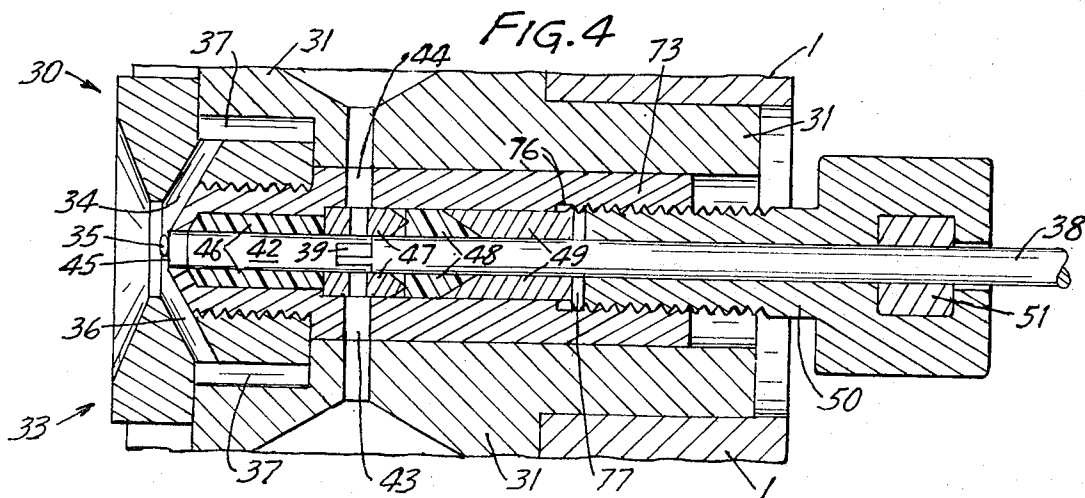
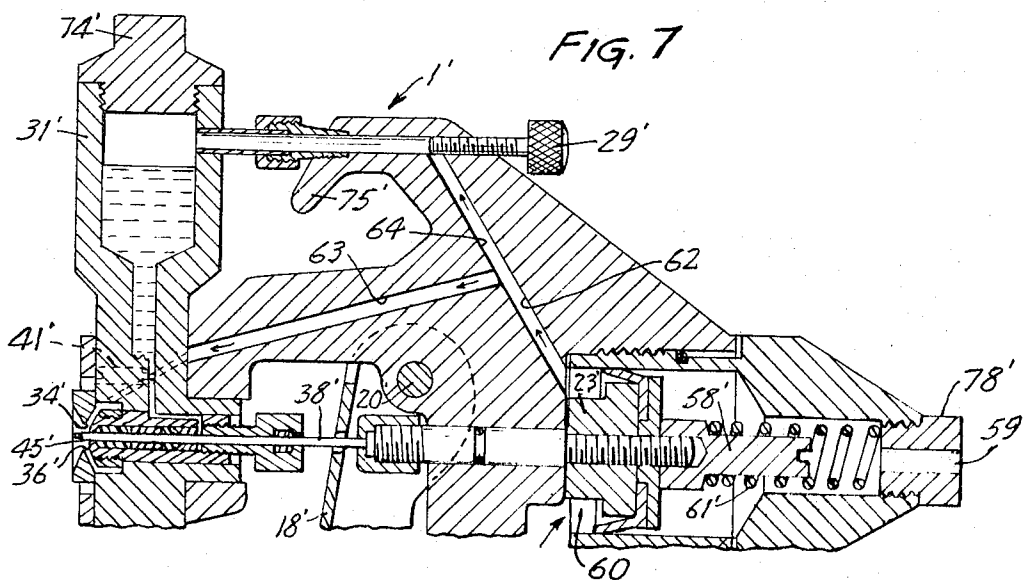


FIG. 7



PLURAL COMPONENT GUN

BACKGROUND OF THE INVENTION

1. Field of the Invention

Broadly, this invention relates to what has been termed a "solventless" plural component spray gun in which the components are mixed internally of the gun. more specifically, it is concerned with such a gun with a lubricant supply and/or an internal spray pattern forming and mixing device for the components.

2. Description of the Prior Art

Plural component spray guns that use a minimum of solvent to purge and internally mix the components are known in the spray gun art. Many of these guns are termed "solventless" since they employ as the main residual mixture-purging device a movable rod in the mixing chamber bore. Usually no solvent flush pump system is connected to the gun to purge the wetted parts with a solvent solution, although even in a solventless system, some solvent may be intermittently used to flush thin films of mixed reactants not cleaned out by the valve rod. Examples of guns that could be termed "solventless" are disclosed in the C. J. Herman et al. U. S. Pat. No. 3,117,696, issued Jan. 14, 1964; the U. S. Pat. No. 3,263,928, issued Aug. 2, 1966 to F. E. Gusmer; the U. S. Pat. No. 2,890,836, issued June 16, 1959 to F. E. Gusmer et al.; and the U. S. Pat. No. 2,724,615, issued Nov. 22, 1955 to G. Ariotti. None of these patents or any other known prior art disclose a lubricant reservoir connected to the gun to supply the valve rod with a metered amount of lubricant to prevent sticking and assist in cleaning. Neither does the art show a valve rod fitted with frontal flatten surfaces to act as a pattern-forming and mixing device.

No matter how tight the fit between the valve rod and barrel bore inserts, the chemically-reactive materials making up the two or more plural components were never completely purged by the valve rod as it reciprocated in the gun barrel mixing bore. The residual mixture formed a thin film on the wetted parts of the gun which within a short time built up until it prevented movement of the valve rod and operation of the gun. Normally, the spraying operation was stopped to use a solvent flush to clean away the crusted film layer and also to lubricate the valve rod and the other wetted parts. My invention, by connecting a lubricant source directly to the valve rod, preferably rearwardly of the plural component inlets into the barrel bore, provides a readily available lubricant that is constantly being supplied to the rod. This substantially eliminates the shut down time and frequent clean-up procedure previously employed.

As the reactive components enter the bore of the gun barrel through their inlets, they were, in the prior art, mixed as their streams impinged because of their pressures and chemical components. Variations in the spray pattern were limited to variations caused by changing the spray tip, changing the characteristics of the reactive components, like their flow rates, temperatures, and viscosity, or by changing the pressure of the components as they were mixed. In my invention, a new variation is added by a deflecting frontal end on the valve rod to be utilized to not only control the flow of the components, to change the spray pattern, but also to aid in mixing the components within the bore.

SUMMARY OF THE INVENTION

The plural component spray gun of this invention utilizes a rotatable deflecting front end portion of the valve rod of a uniform cross-sectional reduced flatten surface dimensions, as compared to the cross-sectional dimension of the rest of the rod, to change the spray pattern and aid in mixing the components. A lubricant reservoir may be used in combination with this feature or by itself to lubricate the valve rod preferably rearward of the bore inlets for the plural components.

a primary object of this invention is an improved internal mix plural component spray gun.

An additional object is an improved plural component spray gun with an internal spray pattern forming and mixing device.

Still another object is to provide such a gun with its own lubricant supply to prevent sticking of the valve rod.

FIG. 1 shows a typical spraying system with the preferred embodiment of my improved gun as a part thereof.

FIG. 2 illustrates a lengthwise cross-sectional view of the gun with a lubricant reservoir.

FIG. 3 is a partial widthwise cross-sectional view along line 3—3 of FIG. 2 showing the nozzle assembly at the plural component inlets.

FIG. 4 is an enlarged cross-sectional view along line 4—4 of FIG. 3 of the barrel assembly and nozzle.

FIG. 5 is an enlarged isometric view of the valve rod.

FIG. 6 is an enlarged front view of the rod of FIG. 5.

FIG. 7 is another embodiment of the spray gun of FIG. 2.

FIG. 1 illustrates the preferred embodiment of my improved spray gun combined with elements that make up a typical plural component spraying system. Two separate thermal insulated hoses 2 and 3 with internal heating elements enter the front end of the plural component spray gun 1. Each hose carries one of the two chemically-reactive components from a separate system source. Fluid heaters 4 and 5 may be placed in line with each of the hoses to aid in reducing the viscosity of the reactive components after each has passed through its respective in-line filter 6 or 7. The filters, in turn, are connected by conduits to the fluid outlets from a single common pump 8. The particular type of pump used is unimportant as long as it can maintain the desired component ratio accuracy and develop sufficient pressure in the hoses 2 and 3 to atomize the chemical components after they are mixed in the spray gun. Normally, like in a conventional airless system, pressures of several hundred psi are present. The particular pressure the materials are subjected to varies, depending on many factors, especially the inherent characteristics of the material involved.

The reactive chemical components may be stored in containers such as the covered receptacles 9 and 10. Pump 8 has its lower fluid inlets separately immersed in each of these receptacles to pump the fluids therefrom. A suitable support structure, similar to support 11 with a handle, bracing to support the pump and containers, and, if desired, wheels may be employed to hold and transport the system from place to place.

A cross-sectional center-line view of the hand-held gun 1 is shown in detail in FIG. 2. Broadly, the gun is

comprised of four main assemblies, namely: the body 12, the handle 13, the nozzle assembly 30, and the lubricant reservoir 31. If an automatically-triggered gun incorporated the principles of my invention, the handle 13 could be eliminated. The body in the preferred embodiment is cast in one metallic piece integral with the handle. To reduce the weight of the body and handle while still maintaining the strength required for high internal pressures, the casting for the body and handle can be made of aluminum or other suitable material.

The handle 13 has two internal fluid passages 14 and 15 extending its entire length. Compressed air, or some other suitable pressurized fluid from a source, enters the lower end of handle passage 14 when coupling 16 is connected to a hose from the pressurized fluid source (not shown). If the pump 8 is an air powered positive displacement type, the air compressor it utilizes may serve the function of also supplying the fluid to the handle. Parallel passage 15 acts as a return for the fluid which enters passage 14 depending upon the actuation of the fluid control valve hereinafter described in more detail. A rotatable safety nut 17, shown in its off position in FIG. 2, may also be attached to the handle to prevent the pivoting of trigger 18 around its pivot pin 20. U. S. Pat. No. 3,327,949 issued June 27, 1967, to Marvin J. Eull describes how the rotation of a safety nut like member 17 operates to lock the trigger from being actuated.

The fluid control valve 19 is actuated by trigger 18 as it is pivoted around pin 20 in a counter-clockwise direction as shown in FIG. 2. As valve 19 is moved to the right, part of its external shoulder surface 21 is forced against the reduced internal chamber surface 22 to block the fluid return passage 15. When valve 19 is moved to the right, fluid pressure builds up against movable gun body piston 23 and also in the normally opened annular fluid passage 25 that encircles chamber 24 and is directly connected to upper fluid conduit 26. The pressure on piston 23 aids in moving attached valve rod extension 27 rearwardly to the right to thereby open the outlet to the gun barrel as hereinafter detailed.

Whether trigger 18 is actuated or not, some fluid would, in the FIG. 2 preferred embodiment, normally continuously pass to the fluid conduit 26 and its branch passage 28. When the trigger is actuated, the fluid pressure in these two conduits would remain substantially the same. Passage 26 supplies lubricant reservoir 31 with a source of pressurized fluid via inlet 14 and annular passage 25. The external screw-operated knob 29 may be used to block passage 26 and the set screw 32 may be used to block fluid to passage 25.

Passageway 28 serves to supply pressurized fluid to the nozzle cap 33 of the nozzle assembly 30 as best shown in FIG. 4. At the cap, the pressurized fluid exits from four orifices set about 90° apart from each other when viewed from the front of the gun. FIG. 4 shows three (34, 35, and 36) of these four orifices (the fourth being opposite orifice 35) that are supplied fluid from the annular chamber 37 that internally encircles the nozzle 33 and is directly connected to passage 28. The fluid jets from the nozzle cap orifices serve to keep the valve rod 38 (FIGS. 4 and 5) free from accumulated deposits of reactant mixed materials at the valve rod front end portion.

FIG. 2 shows how lubricant reservoir 31 supplies a lubricant to valve rod 38. In this figure, the rod is

shown in its forward position. Pressurized fluid from a fluid source, as already mentioned, may be used to force the fluid from the reservoir 31 or the fluid could simply be gravity-fed without such a source. Lubricant conduit 40 has a set screw 41 or other appropriate device along its length to control the flow of lubricant from the reservoir to the rod 38. As shown in FIG. 2 and 3, conduit 40 preferably enters the valve rod bore 42 rearward of the inlets 43 and 44 for the reactive chemical components. The exact route the conduit takes to reach the valve rod is unimportant. My preferred embodiment shows part of the conduit being formed by a horizontal slot in the hardened steel housing 73 which joins an annular surface groove 76 in the internal bore of the same housing. This annular groove is, in turn, connected to radial slots 77 in steel nut 50. The conduit 40 ends where the radial slots exit to bore 42.

FIGS. 3 and 4 best show how the plural components enter the barrel bore 42 which also serves as a mixing chamber. In FIG. 4, the rod front end is positioned at the component inlets. Housing 73 encircles bore 42 and its inserts along its length while rod 38 is slideably and rotatably mounted in the same bore. The rod serves to act as a fluid valve when it forwardly slides past plural component inlets 43 and 44 to close them and as a purging device when it slides forwardly to protrude out of bore outlet 45. A Teflon cylinder 46 (see FIG. 4) is mounted in the bore 42 and is tightly fitted around the rod when in contact therewith. Rearward of this cylinder at the component inlets a bronze cylindrical bushing 47 with lateral holes that are aligned with and form the continuation of the inlets 43 and 44 may be inserted. Another Teflon packing 48 further back acting as a liquid seal, as well as a bronze bushing 49 still further back in the bore 42, may also be used. The steel packaging nut 50 is the farthest back (or rearward) casing for the valve rod 38 that is part of the nozzle assembly 30. As previously indicated, lubricant conduit 40 is partly formed by radial slots 77 formed in the front face of steel nut 50. This occurs where the front surface of nut 50 contacts the rear surface of bronze bushing 49. These slots may intersect the bore 42 at the same general location which is rearward of the intersection of the two passages 43 and 44 as shown in FIG. 3. A felt liner 51 (FIG. 4) or other suitable material is surrounded by the end of nut 50 to absorb lubricant that flows rearwardly. While it is not necessary, preferably, the lubricant is supplied to the rod 38 rearward of the inlets for the reactive components. The lubricant is slowly deposited on the rod at a metered rate and works itself forward and backward, as well as around, as the rod reciprocates and rotates. Were the lubricant deposited forward of the plural component inlets, there would be a greater tendency for it to enter and lodge itself in the plural component inlets as the valve rod would not always serve to block its rearward flow. Because the valve rod 38 is restrained in its reciprocating sliding movement in bore 42 and would not move rearward of the entrance of conduit 40, there is always some resistance formed by the rod itself to the lubricant entering the plural component inlets when placed rearward of them.

An enlarged view of the preferred valve rod 38 is shown in FIGS. 5 and 6. It consists of two basic parts and an optional rear end. At the front end portion are two identical flattened surfaces 39. Extending substan-

tially the rest of the entire length or major portion of the rod is a cylindrical section 53 that may have the same uniform cross-sectional diameter throughout its length. This section has also substantially the same diameter as the effective internal diameter of the barrel bore (bore 42 with its inserts). Near the end opposite the flattened surfaces 39 is an optional enlarged rod-retaining portion. As shown, this end portion is a circular portion 52 which is used to allow threaded retaining nut 54 to rigidly hold the rod to the valve rod extension 27 (see FIG. 2). The front end portion with the flattened surfaces 39 is uniform throughout its length and of the same or less cross-sectional diameter as rod section 53 when measuring the distance between arrows 55 (FIG. 5). For the rod front end, the cross-sectional dimension measured in the direction of arrows 55 is the greatest dimension, while the distance between surfaces 39 is the shortest cross-sectional dimension. The distance between the two parallel flattened surfaces 39 (i.e., the thickness perpendicular to distance 55) may be slightly less than half the distance of the diameter of rod section 53. Lengthwise, surfaces 39 may extend about two-thirds the diameter of section 53. When viewed from the front, as shown in FIG. 6, the rod 38 would thus appear as a large circular section representing retaining portion 52 with a concentric smaller circular section, representing 53, spaced forward thereof with the centered nearest section, representing the rod front end. From a frontal view facing head on, the rod front would look like two identical symmetrically-disposed upper and lower arched surfaces, shown as 56 in FIG. 6, with a generally rectangular surface 57 with curved edges being between surfaces 56. Surface 57 would be the most forward surface of the rod front end.

Surface sector 53 need not necessarily be of the same uniform dimension (diameter) throughout its cross-sectional measurement, although such is preferred, as long as it is complementary in shape with the internal diameter shape of the barrel bore. Hence, if bore 42 were a tapered bore that converged to its smallest dimension at outlet 45, rod section 53 could assume a complementary tapered shape.

As the plural components exit from their respective inlets (43 and 44) into mixing bore 42, the opposite flattened surfaces 39 of the valve rod can be positioned to deflect the components as illustrated in FIG. 4. This aids in mixing and forming a spray pattern. By first sliding the rod 38 until the inlets are longitudinally aligned with the rod-deflecting surfaces 39 and then rotating the rod, the spray pattern emitted may be changed to a wide variety of shapes. The rearward movement of the valve rod 38 is stopped when the rear surface of attached screw 58 contacts the forward surface of detent nut 78. At this position, the forward rod surfaces 39 would usually be aligned with inlets 43 and 44. Rotation of the valve rod 38 is accomplished by inserting a screw driver through the rear gun aperture 59 in adjustable piston detent nut 78 (FIG. 2) and turning adjustment screw 58 which, in turn, rotates the rigidly interconnected piston 23, extension 27, retaining nut 54, and rod 38. Once the desired optimum spray pattern is determined for a particular mixture of components under a given fixed set of operating conditions, no further rotational adjustment is usually necessary. Thus, the spray pattern of the resultant emitted mixture can be changed by rotating the detent nut 78 to vary the lo-

cation on surfaces 39 where the components impinge and also by rotating the valve rod itself.

Normally, the spray gun shown in FIG. 2 will be emitting a stream of fluid to the four nozzle orifices to aid in keeping the flattened surfaces clean from residual reactive mixtures when the rod protrudes through the outlet 45. Unless set screw 32 is turned to shut off the fluid to annular fluid chamber 25, the fluid stream will constantly spray through the nozzle orifices. The FIG. 7 embodiment slightly changes this feature by providing for cleaning streams of fluid only when the trigger is actuated and then to simultaneously pressurize the lubricant reservoir.

The partial cut-away gun shown in FIG. 7 is basically the same gun shown in FIG. 2 except that the fluid passageways have been reoriented. The same numbers with a prime have been used to identify the same parts. The annular chamber 25 of FIG. 2 has been eliminated and all the air or fluid is forced into chamber 60 when trigger 18' is actuated. As piston 23' moves to the right against the biasing action of spring 61', the fluid enters passage 62 and then moves into the two branches 63 and 64. The fluid in branch 64 pressurizes the lubricant supply while the branch 63 fluid simultaneously sprays the rod through the nozzle orifices when the front end of the rod protrudes through the outlet 45'. Further, actuation of trigger 18' will move rod 38' more to the right (FIG. 7) so that its front end will eventually no longer be exposed to the outlet fluid spray. On returning to its protruding position out of outlet 45', the rod front end 39' is momentarily again exposed to a jet of fluid from the nozzle orifices because of a slight delay in the system.

FIG. 3 indicates a vertical cross-sectional view through the nozzle assembly 30 at the plural component inlets to the mixing barrel bore 42. Each half of the illustrated assembly is symmetrically disposed about a vertical line drawn through conduit 40 of housing 73. The on-off valves 65 and 66 act to control the flow of their respective reactive components as they enter by way of orifices 67 and 68. By rotating either of these on-off valves from the closed position illustrated in FIG. 3, reactive components from the separate hoses 2 and 3 can be allowed to enter the nozzle assembly 30. After entering, each component will next flow through its respective check valve 69 or 70. The function of these latter valves is to prevent material cross-over flow from the opposite component source when fluid in its valve side ceases to flow. This one-way valving function is accomplished by an expandable O-ring 71 (or 72) in an annular groove in each of the check valves. Fluid flows by way of a center passage, then under and around each O-ring until it exits to the inlet passages 43 or 44. As long as the ring is under pressure, it is expanded to allow fluid flow; however, when the fluid ceases to flow, the ring collapses to a contracted position to seat itself firmly in its annular groove. Should fluid from the opposite inlet, for example, inlet 43, reach the collapsed O-ring 72 of check valve 70, it would be stopped from proceeding further.

Several other illustrated minor features not essential or necessary to my invention are also shown in the drawings. These include the threaded cap 74 to open and close the gun-mounted lubricant reservoir 31 and the hook 75 to hang the spray gun when not in use. Neither is the exact type or amount of lubricant used im-

portant. TCP (tricresyl phosphate) and butylcellosolve lubricants, metered at about one cubic centimeter in a two-hour period, have been found satisfactory. A mixture of a solvent with an oily base could also be used. As for the specific ratio of the reactive chemical components, this, too, is not critical and could vary with the particular component used. In the illustrated gun, a 1:1 ratio was used; but it is expected different ratios, like 2:1 or even higher ratios, will most likely be used in the future.

The plural component spray gun of my invention is not limited in its use to any specific chemical composition or components. It could be used with adhesives, foams, thermosetting resins, epoxies, polyesters, or any other sprayable rapidly-reacting chemical materials. Nevertheless, sprayable foams probably present one of the greatest potential uses because of their ability to add to sprayed surfaces both thermal and sound insulation; to strengthen the shell of the structure sprayed on; to provide both decorative and protective coatings; to provide a moisture barrier; and to act as a fire-resistant barrier.

In retrospect, this invention recognizes that solvents have long been used to flush residual mixtures from the internal wetted surfaces of plural component spray guns. For example, my U.S. Pat. No. 3,437,273, issued on Apr. 8, 1969, discloses a novel solvent flush spray gun. Not only do such guns use more polluting solvents to be disposed of, but they also require additional equipment, such as the solvent pumping system with its pump, hoses, couplings, meters, etc. Further, internally of the spray gun, a more complex valve structure and conduit system is needed that may result in a heavier and more costly gun. My current invention seeks to not only overcome the defects of a solvent flush system but to improve on the prior solventless guns to achieve a more versatile, efficient, and improved gun which requires less maintenance. Because the volume of lubricant supplied is very small as compared to the reactive components used and is also compatible therewith, less solvent is needed to clean the very small amount of residual mixed film that may remain.

None of the details illustrated, disclosed, or suggested should be used in any way to limit the scope of my invention which is defined only by the terms of the attached claims.

I claim:

1. A plural component gun comprising:

- a barrel having a bore extending therethrough with the front end of the barrel bore constituting a liquid outlet;
- a plurality of spaced inlets into said bore for introducing different liquids thereto to mix said liquids;
- an elongated rod slidably mounted in said bore, said rod having a major portion with a complementary shaped cross-sectional dimension as compared to said internal bore shape along substantially its entire length when mounted in the bore, said rod also

having a front end portion; and the front end portion of said rod having at least two substantially flatten surfaces with their greatest cross-sectional dimension being uniform throughout the length of the front end and equal to or less than that of the cross-sectional dimension of the major portion of the rod.

2. The gun of claim 1 wherein said front end of the rod also has a shorter cross-sectional dimension between the two flatten surfaces.

3. The gun of claim 2 wherein said flatten surfaces of the rod front end portion are two oppositely-directed parallel flatten surfaces that can be rotatably aligned with said liquid inlets to deflect different liquids emitted therefrom.

4. The gun of claim 1 including means for supplying a lubricant to said rod rearwardly from said liquid outlet and spaced liquid bore inlets.

5. The gun of claim 1 wherein said bore has substantially the same uniform diameter throughout its length, and said bore inlets comprise at least two oppositely-directed inlets.

6. The gun of claim 1 including means for rotating said rod front end portion with respect to said spaced liquid inlets.

7. The gun of claim 1 including means for rotating said rod in the bore and additional means for reciprocating said rod in the bore.

8. The gun of claim 1 including means for supplying a liquid lubricant to said rod rearward of said bore liquid inlets including a pressurized liquid lubricant reservoir connected to said gun to force lubricant on to said rod.

9. A plural component spray gun comprising:

- a barrel assembly having a barrel with a bore extending through said barrel, the front end of said barrel constituting a liquid outlet;
- at least two spaced inlets into said bore for introducing different liquids thereto to mix said liquids;
- an elongated rod slidably mounted in said bore with said rod having a complementary shaped uniform cross-sectional dimension as compared to the cross-sectional dimension of said bore along substantially its entire length;
- a lubricant reservoir connected to said barrel assembly, and a conduit to supply the lubricant from the lubricant reservoir to the rod at a section spaced rearward of the liquid inlets;
- means connected to said lubricant reservoir for controllably applying a source of pressurized air to force the lubricant from said reservoir to said rod;
- means for supplying a source of pressurized air to said liquid outlet to clean the front portion of said elongated rod when it protrudes through said liquid outlet.

10. The gun of claim 9 further comprising valve means for simultaneously allowing the applying of pressurized air to said lubricant reservoir and the supplying of pressurized air to said liquid outlet.

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