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SPRAY PAINTING APPARATUS WITH SEPARATE SOLVENT
MATERIAL CLEANING MEANS

3,403,695

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2 Sheets-Sheet 1

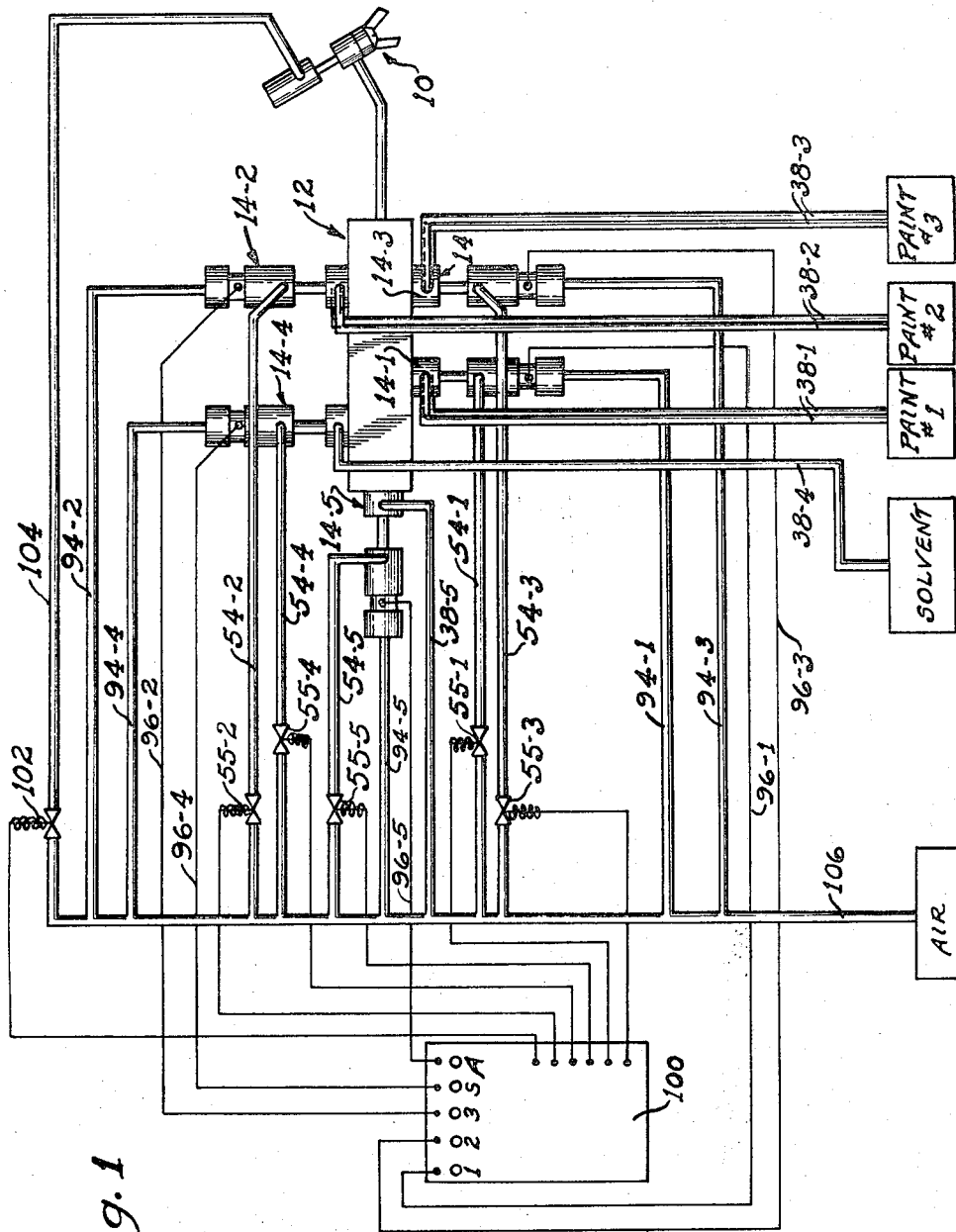


Fig. 1

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Fig. 4

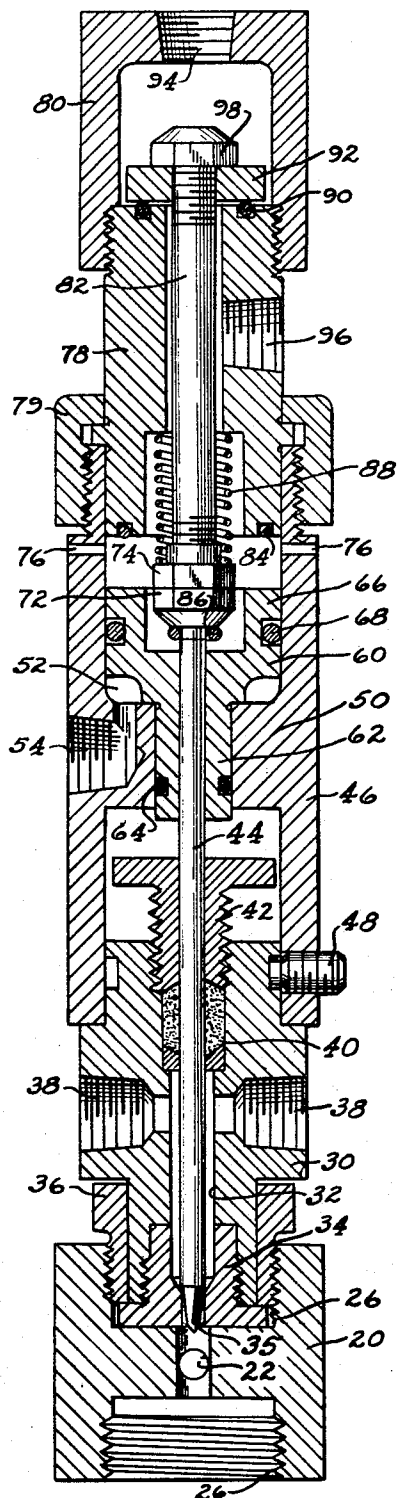


Fig. 2

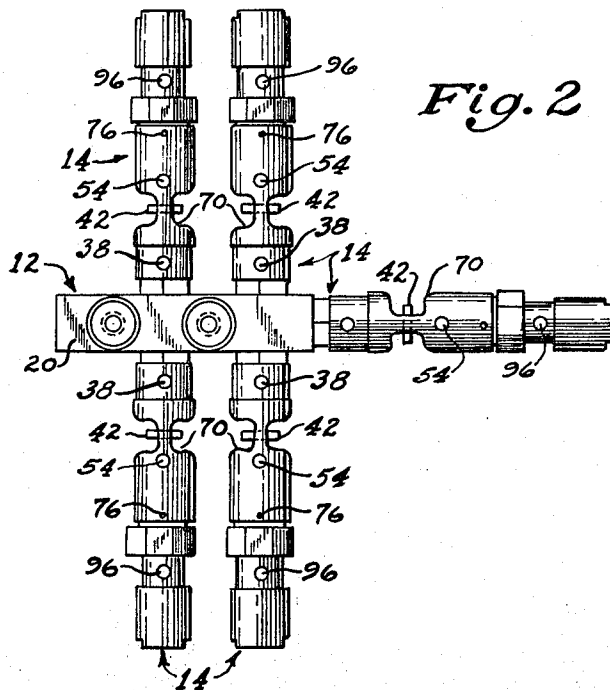
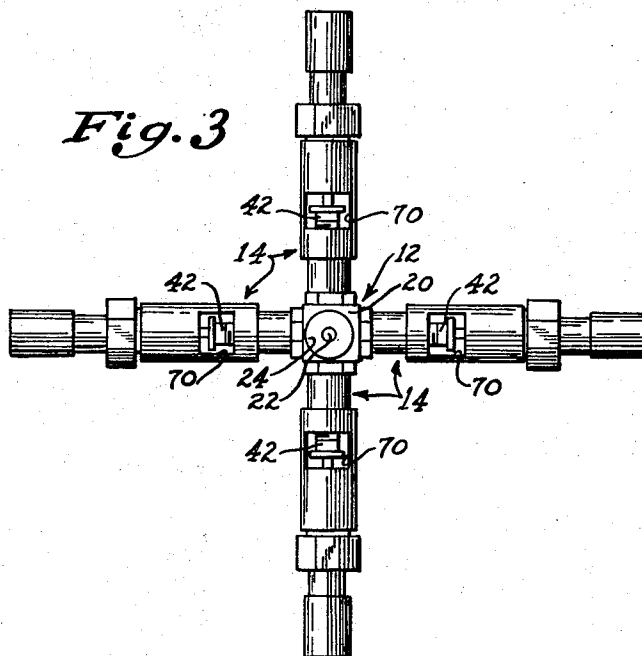


Fig. 3



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SPRAY PAINTING APPARATUS WITH SEPARATE SOLVENT MATERIAL CLEANING MEANS

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ABSTRACT OF THE DISCLOSURE

Apparatus for supplying any one of a plurality of differently colored paints or the like to an automotive production line or a comparable industrial installation is hereby improved by providing for efficient, effective and high speed flushing of the supply system between color changes, even though the color change must be made in a fraction of a second; the apparatus comprising a manifold having a common bore, an outlet at one end of the common bore, a plurality of valve controlled supply ports along the length of the common bore, a solvent port and a gas port adjacent the end of the common bore opposite the outlet, and means operative upon each change of supply from a first fluid to a second fluid for sequentially closing the supply valve of the first fluid, momentarily opening the solvent valve, momentarily opening the gas valve and then opening the supply valve of the second fluid.

The present invention relates to the art of spray painting, and particularly, to an improved spray painting system including means for spraying any one of a plurality of fluids, e.g., different colored paints, and for rapidly changing from one fluid to another.

The invention has particular, though not exclusive application to the automotive industry wherein car bodies and parts are automatically spray painted at high speed as the bodies or parts move through production and assembly operations. The bodies and parts are required to be painted a wide variety of colors, e.g., forty-six different colors, and it is not practical to establish separate production lines for each color or even to paint a long sequence of parts one color, then another long sequence of parts a second color, etc. Consequently, the color changes are made practically from part to part in the small space provided between parts on the continuously moving parts conveyors.

Due to the foregoing considerations, only a fraction of a second is available within which to make a color change, and it should be a complete change from one color to the other; that is, the spray gun must spray one part the first color and then a second part the second color, not a mixture of the two colors.

The object of the present invention is the provision of an improved process of and improved apparatus for the spray painting of a plurality of different colored paints and/or different materials to be sprayed, and for rapidly and completely changing from one color or material to another almost instantaneously.

To acquaint those skilled in the art with the manner of making and using the improved spray painting and materials changing apparatus of the invention, there is described hereinafter, in connection with the accompanying drawings, the best mode presently contemplated for carrying out the invention.

In the drawings:

FIGURE 1 is a schematic diagram of a preferred embodiment of the spray painting and materials changing system provided according to the invention, the view depicting for illustrative purposes a single spray gun asso-

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ciated with a supply manifold and means for selectively supplying to the gun via the manifold each of three paints or materials;

FIGURE 2 is a side elevation and FIGURE 3 is an end elevation, both on an enlarged scale, of a supply manifold provided in accordance with the present invention for handling seven different materials to be sprayed; and

FIGURE 4 is a vertical longitudinal section, on a further enlarged scale, of the preferred embodiment of the means provided in accordance with the invention for controlling the supply of each material to the manifold and the gun.

Referring to FIGURE 1, there is shown an automatic spray gun 10, with is representative of one or many spray guns in an automatic spray painting installation, the gun being adapted to be supplied with and to spray any one of a plurality of materials. In FIGURE 1 there is shown means for supplying three materials, namely paints #1, #2 and #3 to the gun, and again these are merely representative of a number of materials (up to fifty or more) that can be supplied to the gun or guns in an automatic spray painting system. The paints are supplied to the gun or guns via a manifold 12 equipped with a plurality of individually operable valves 14 which are selectively operable to supply the paints one at a time to the guns.

A manifold and valve assembly for handling up to seven different fluids to be sprayed is shown in FIGURES 2, 3 and 4 as comprising a manifold body 20 in the form of a square bar having an axial bore 22 therethrough, the bore opening at one end of the body (the left end as viewed in FIGURE 2) and being counterbored and tapped to define an outlet 24 (FIG. 3). At spaced points along the length thereof, the bar 20 is provided with aligned pairs of radial bores 26, the pairs of bores being set alternately at right angles to one another to define eight radial bores that are close together and form a compact structure, but that nevertheless are spaced sufficiently longitudinally and circumferentially to accommodate eight of the valves 14 in a very short block or bar 20. Each radial bore 26 is preferably counterbored and tapped like the outlet 24 to facilitate removable assembly therein of a respective valve 14. Likewise, the axial bore 22 at the end of the body opposite the outlet is counterbored and tapped for detachable reception of a ninth one of the valves 14.

In a preferred embodiment, the manifold body 20 is formed of one-and-one-quarter inch square bar stock and the spacing of the bores 26 is such that seven colors may be accommodated in an axial length of four inches, eleven colors in an axial length of six inches, etc. In other words, one pair of bores 26 per inch of bar length. Manifold bodies may thus be fabricated to any length desired or required for any number of fluids. Alternatively, standard bodies having eight radial ports and ten radial ports, for example, may be utilized with port plugs (not shown) and body connectors (not shown) to facilitate assembly from standard components of a manifold body for any number of materials. For example, the eight radial port body would accommodate seven different fluids to be sprayed and the ten port body would accommodate nine different fluids. By plugging off ports in either body, any number of fluids up to the stated maximum could be accommodated. By connecting two eight port bodies by a coupler extended between the end port 27 of one body and the outlet port 24 of the other body, any number of materials to be sprayed up to fifteen could be accommodated; an eight port body coupled to a ten port would accommodate up to seventeen materials to be sprayed; two eight port bodies and a ten port body would accommodate up to twenty-five materials, etc. Thus, it is apparent that any desired number of materials can be accommodated by the apparatus of the invention with each material controlled by an individual valve 14.

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Referring to FIGURE 4, each valve 14 comprises a valve body 30 having an axial bore 32 therethrough and a valve seat 34 threadedly inserted in said bore at the free end of the body. The seat 34 is provided therethrough with a valve port 35, and the seat is preferably replaceable to accommodate substitution of seats having different sized ports, whereby to meter the flow of the material through the valve. Journalled on the body 30, and retained thereon by a flange on the seat 34, is a threaded connector 36 adapted to be threaded into the respective bore 26 in the manifold 12 to detachably mount the valve on the manifold with the outlet end of the seat 34 closely adjacent the axial bore 22 of the manifold. Above said seat, the body 30 is provided with pair of radial ports 38 accommodating supply to the valve port 35 of a material to be controlled, and above these ports the body is provided with a packing gland 40 and a gland adjusting nut 42.

A needle valve 44 is slidably extended through the nut 42, the gland 40 and the body 30 for movement into and out of engagement with the valve seat 34 to control the flow of material through the valve port 35, i.e., to accommodate or discontinue flow.

Surrounding the needle 44 is the generally tubular housing 46 which is telescopically mounted atop the body 30 and attached thereto by a set screw 48 extending through the housing 46 into a circumferential groove in the body. At a location spaced above the nut 42, the housing 46 includes therein an annular portion or boss 50 which constitutes the lower wall of an air cylinder 52 defined within the housing. An operating fluid under pressure, such as compressed air, is adapted to be fed to the cylinder via a port 54 formed in the side wall of the housing and in the boss 50 thereof.

Slidably mounted in the housing 46 and the boss 50 is a fluid pressure operated piston 60 which includes a stem 62 extending through the boss and sealed relative thereto by an O-ring 64, and a piston head 66 slidably mounted in the cylinder 52 and sealed relative to the wall thereof by an O-ring 68. The piston is centrally bored to a diameter larger than that of the needle valve 44, whereby the piston moves freely relative to the valve.

In the space between the needle sealing gland 40 and the boss 50, the housing 46 is provided with radial openings or slots 70 which serve to vent to atmosphere any material leaking from the materials body 30 past the gland 40 and any air leaking from the cylinder 52 past the annulus 50. Thus, air and the material cannot become mixed in any part of the valve. Also, access is thereby accommodated to the nut 42 of the sealing gland 40 for adjustment of the same.

At a location normally spaced above the piston 60, the needle valve 44 is provided with a head or collar 72 in the form preferably of a nut threadedly assembled to the needle for adjustment therealong, and adapted to be locked in adjusted position thereon by a complementary lock nut 74. The nut 72 is adjusted on the valve to be moved upwardly by the piston 60 when fluid under pressure is admitted to the cylinder 52 to drive the piston upwardly, thereby to open the valve to the extent determined by adjustment of the nut 72. To facilitate movement of the piston 60, the space thereabove is vented to atmosphere by radial vent ports 76 in the housing 46.

Telescopically assembled to the top of the housing 46 is a secondary valve assembly comprising a valve body 78, a collar 79 threadedly connected to the housing 46 and connecting the body 78 thereto, and a top cap or cylinder 80 threadedly mounted atop the body 78. The body is centrally apertured and an extension 82 of the needle valve extends therethrough into the cap. At its lower face, the body 78 mounts an O-ring seal 84 adapted to be engaged by the piston 60 to seal the piston to said body when the piston is driven upwardly to valve opening position. Also, an O-ring 86 encircles the needle valve 44 below the nut 72 to completely seal the piston against

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leakage therepast when the piston is raised and the valve is opened. A compression spring 88 confined between the body 78 and the nut 72 serves normally to bias the needle valve onto the seat 34 to close the valve, except when fluid under pressure is admitted to the cylinder 52.

At the upper face thereof, the body 78 is provided with a further O-ring seal 90 adapted to be engaged by secondary valve member 92 when the needle valve is moved to closed position by the spring 88. When the valve 44 is opened by the piston 60, the valve 92 is also moved away from its seat (the seal 90) to admit fluid under pressure into the aperture or bore through the body 78. The fluid under pressure, usually compressed air, is admitted to the secondary valve structure through a port 94 in the cap 80. Consequently, when the valves 44 and 92 are opened by upward movement of the piston 60, and the piston is sealed by engagement with the seals 84 and 86, fluid under pressure enters the bore through the body 78 from the cap 80 and is fed to an alarm or indicating system via a radial port 96 in said body. When the pressure is relieved from the cylinder 52, the spring 88 will return both the needle valve and the piston 60 to normal position substantially as shown in FIGURE 4, whereupon the needle valve 44 and the secondary valve 92 are closed, and the alarm part 96 is vented to atmosphere via the central bore in the body 78 and the vent ports 76 in the sleeve or housing 46. To accommodate proper adjustment of the secondary valve 92, the same is threadedly mounted on the needle extension 82 and is adjustably locked thereby to by a locknut 98.

In use of the valves 14 in a paint spraying installation such as that of FIGURE 1, compressed air is fed directly to the port 94, an indicator and alarm switch is inserted in the port 96, compressed air is controllably supplied via a shut-off valve to the port 54 and the material to be controlled by the valve 14 is circulated through the body 30 of the valve via the two ports 38. Upon admission of compressed air to the cylinder 52 via the port 54, the piston 60 is driven upwardly, whereupon the same engages the nut 72 and raises the needle valve off the seat 34, opening movement continuing until the piston is seated on the seal 84 therefor whereby the valve is opened fully (to the extent predetermined by adjustment of the nut 72). Material is thereupon supplied via the fluid metering valve port 35 to the axial bore 22 and outlet 24 of the manifold 12.

At the same time, upward movement of the needle valve away from the seat moves the secondary valve 92 upwardly off its seat whereupon air under pressure is admitted to the port 96 to provide an indication that this valve is open. The vent ports 76 are sufficiently small relative to the ports 94 and 96, that the alarm will always be triggered if the needle valve is open at all, thereby affording positive indication of a source of trouble should the needle valve stick in open position or fail to close fully. The seal 84 is provided to avoid waste of air and needless creation of the noise of escaping air when the valve is fully open and operating properly.

Upon relief of air pressure in the cylinder 52, the spring 88 returns the valve to closed position substantially as illustrated in FIGURE 4, wherein both the valves 44 and 92 are fully closed.

Referring again to FIGURE 1, wherein a manifold 12 mounting five of the valves 14 is shown by way of illustration, the three forwardmost (i.e., closest to the outlet of the manifold) valves 14-1, 14-2 and 14-3 have connected to the ports 38 thereof, via circulating lines 38-1, 38-2 and 38-3 respectively, the respective sources of supply of paints #1, #2 and #3. The sources of supply may take the form of any conventional pressurized paint circulating system. A valve 14-4 adjacent the rear of the manifold, i.e., the end thereof opposite the outlet, has connected to the ports 38 thereof, via supply line 38-4, a source of pressurized supply of a solvent for the paints, and the fifth one of the valves 14-5, i.e., the valve in the rear end of the manifold, has connected to the ports 38

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thereof, via line 38-5, a source of compressed air. The valves 14-4 and 14-5 may have one port 38 thereof plugged and the other connected to the respective line 38-4 and 38-5 since there is no need to circulate the solvent or the compressed air. This would also apply in respect of paints or other coating materials that do not have to be circulated.

Air under pressure is supplied to the port 54 of each of the valves 14 via a respective airline 54-1, 54-2, 54-3, 54-4 and 54-5, and each such line is controlled by a respective solenoid operated valve 55-1, 55-2, 55-3, 55-4 and 55-5, each of which is under the control of a conventional timer or sequence programmer indicated generally at 100.

The controller 100 also governs operation of the spray gun 10 via a solenoid valve 102 which controls the supply of gun operating air to the gun 10 through the supply line 104.

The ports 94 in the outer ends of the valves 14-1, 14-2, 14-3, 14-4 and 14-5 are directly connected to the source of compressed air by respective supply lines 94-1, 94-2, 94-3, 94-4 and 94-5, and air is suitably supplied to all of the described airlines by a common header 106.

The indicator and alarm port 96 of each valve preferably has mounted therein an air operated device (known per se in the art and therefore not shown) which includes a visually observable flag and a control switch. These switches are shown in FIGURE 1 as connected via respective conductors 96-1, 96-2, 96-3, 96-4 and 96-5 to respective appropriately designated signal lights or the like on the control panel 100.

In use and operation of the disclosed system, the programmer 100 is correlated to the conveyor carrying the articles to be spray painted and adjusted so that the spray gun 10 will be operated as each article is about to enter the area of spray pattern and will be shut off when each article leaves said area. The programmer is also adjusted to determine the number and sequence of articles to be painted with each of the three (or more) colors of paint and to operate the respective valve 14-1, 14-2 or 14-3 (by operation of the respective control valve 55-1, 55-2 or 55-3) so as to supply the gun via the manifold 12 with the proper paint upon each operation of the gun. The programmer is further set to operate, upon the occurrence of each change from one paint to another, the solvent valve 14-4 for a predetermined interval of time, and the air valve 14-5 for an additional interval of time. These two intervals of time will depend in part upon the size of the system to, first, supply an amount of solvent adequate to rinse from the manifold, the gun or guns and the material lines therebetween the previously used paint, and second, supply air for a sufficient period of time to drive the solvent and the previously used paint through and out of the manifold, guns and lines and to air flush the same. Such adjustment of the programmer will be obvious to those of reasonable skill in this art.

In use then, a given paint, say paint #1, may be supplied via the respective valve 14-1 to the manifold 12 and thus to the gun 10. Each time the gun is operated, via valve 102, paint #1 is sprayed on the articles to be painted. When the programmer dictates that another paint is to be used, the gun continues to operate to finish the article then being sprayed, the gun is stopped by closing valve 102 and the supply of paint #1 is discontinued by closing valve 55-1 and thus valve 14-1. Valve 55-4 is then operated for a short interval of time to insert a slug of solvent into the rear end of the manifold bore 22 via valve 14-4. Valves 55-5 and 102 are then operated for a further short interval of time to operate the spray gun and to introduce compressed air into the bore 22 behind the solvent, whereupon the paint previously sprayed (paint #1) and the slug of solvent are driven out of the manifold, through the line or lines connecting the manifold to the gun or guns and through the gun or guns to (a) clear the system of paint #1, (b) solvent flush the manifold,

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lines and guns, and (c) air flush the manifold, lines and guns. Valves 102 and 55-5 are then closed, and the valve controlling the next paint to be sprayed, say valve 14-2 for paint #2 is then opened, so that on the next operation of the gun paint #2 and only paint #2 is sprayed on the next article to be painted. In operation, the complete cycle of changing from paint #1 to paint #2, including the intermediate solvent and air flush of the system, takes only a fraction of a second and is readily effected in the period of time intervening between successive articles on the conveyor leaving and entering the spray area of the gun or guns.

The invention is thus shown to provide an improved process of and apparatus for changing the coating materials in a spray painting operation in a convenient, practical, economical and high speed manner.

While a preferred embodiment of the invention has been shown and described herein, it is to be appreciated that various changes, rearrangements and modifications may be made in the same without departing from the scope of the invention as defined by the appended claims.

What is claimed is:

1. Apparatus for the selective supply of each of a plurality of different fluids comprising:

a manifold having a common bore therethrough including an outlet at one end, a plurality of supply bores communicating with said common bore along the length thereof, and a pair of flush bores communicating with said common bore adjacent the end thereof opposite said outlet;

means for supplying a respective fluid to each of said supply bores each including a valve accommodating selective supply of the respective fluid to the respective supply bore;

means for supplying a solvent for said fluids to one of said flush bores including a valve accommodating selective supply of the solvent to said bore;

means for supplying a gas to the other of said flush bores including a valve accommodating selective supply of the gas to said bore;

and means operative upon each change of supply from a first fluid to a second fluid for sequentially closing the supply valve of the first fluid, momentarily opening the solvent valve, momentarily opening the gas valve and then opening the supply valve of the second fluid.

2. Apparatus as set forth in claim 1, including means for timing the opening of each of said solvent valve and said gas valve.

3. Apparatus as set forth in claim 1, each valve being mounted on said manifold and having the valve seat thereof disposed closely adjacent said common bore.

4. Apparatus as set forth in claim 1, each of said means for supplying a respective fluid including means for indicating when fluid is being supplied thereby to said common bore.

5. Apparatus as set forth in claim 1, said manifold comprising a block having an axial bore therethrough and forming said outlet at one end thereof, a plurality of spaced radial bores in said block each communicating with said axial bore, a valve removably mounted in each of said radial bores and having the outlet thereof communicating with said axial bore, one of said valves spaced furthest from said outlet including an inlet connected to the solvent supply means, the remainder of said valves each including an inlet connected to a respective one of the fluid supply means, and a valve removably mounted in the opposite end of said axial bore and having an outlet communicating with said axial bore and an inlet connected to said gas supply means.

6. Apparatus as set forth in claim 5, each of said valves including a valve member and pressure operated means for actuating said valve member, a source of fluid under pressure common to said pressure operated means, and means for supplying fluid under pressure from said source

selectively to the pressure operated means of each of said valves.

7. Apparatus as set forth in claim 6, including means associated with each valve for indicating the supply to the pressure operated means thereof of the fluid under pressure. 5

8. Apparatus as set forth in claim 1, each valve comprising an inlet, an outlet communicating with the respective supply bore, a valve seat between said inlet and said outlet, a valve member movable toward and away 10 from said valve seat, fluid pressure operated means for moving said valve member away from its seat, and means actuated by said valve member when it is moved away from its seat for indicating that the valve is open.

9. Apparatus as set forth in claim 8, the valve seat of each valve comprising a removable plug having a valve port therethrough, the plug being removable to accom- 15 modate replacement of the same with a plug having a different sized port therethrough whereby the flow rate of each valve may be varied by appropriate selection of the valve port size. 20

10. Apparatus as set forth in claim 8, said indicating means of each valve comprising a separate chamber to which fluid under pressure is supplied, an outlet from said chamber, a secondary valve member coupled to the first 25

named valve member and controlling the outlet from said chamber, and an indicator connected to the outlet from said chamber.

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