

July 29, 1969

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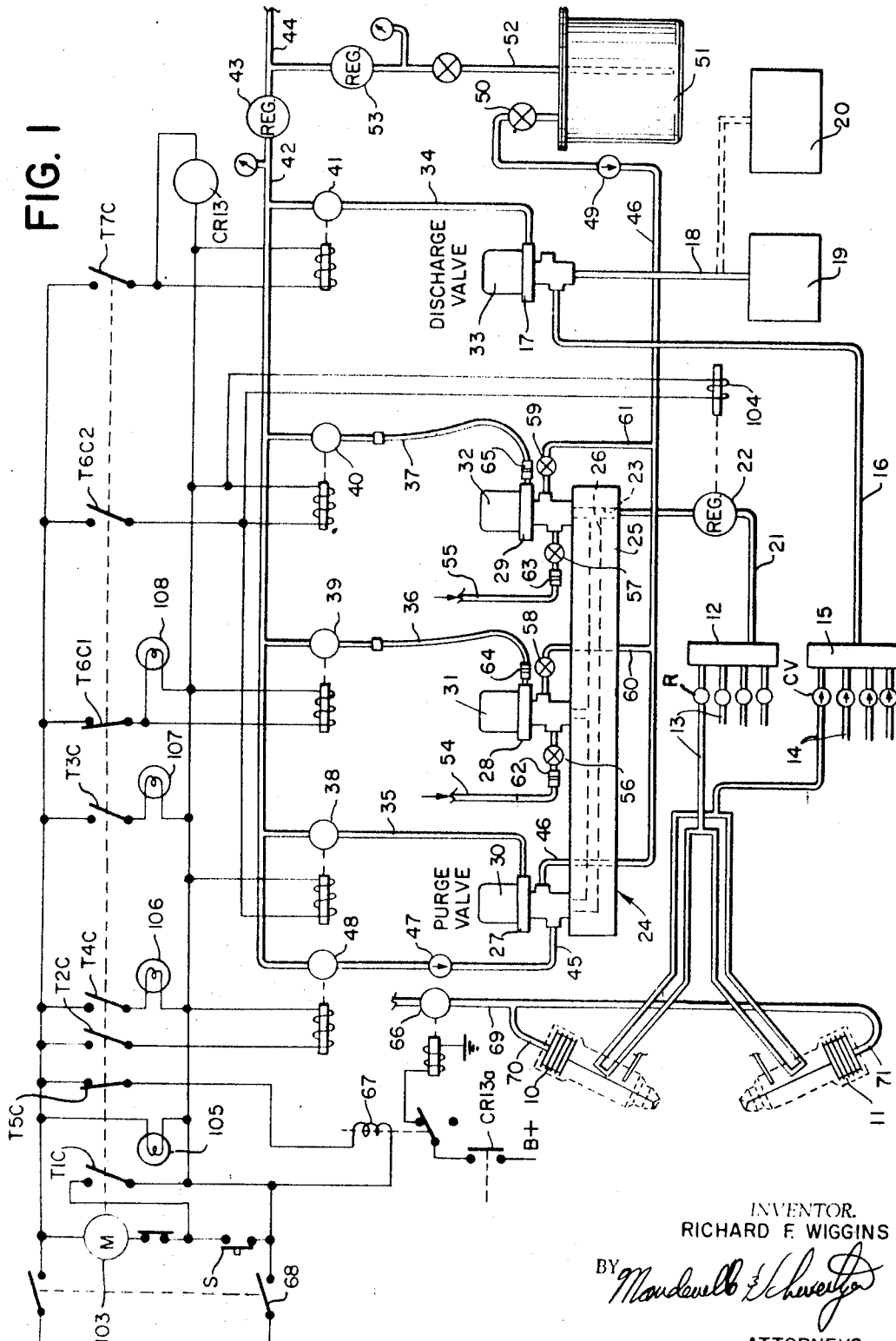
3,458,133

PURGING SYSTEM FOR A SPRAY PAINTING INSTALLATION

Original Filed March 18, 1965

2 Sheets-Sheet 1

FIG. 1



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2 Sheets-Sheet 2

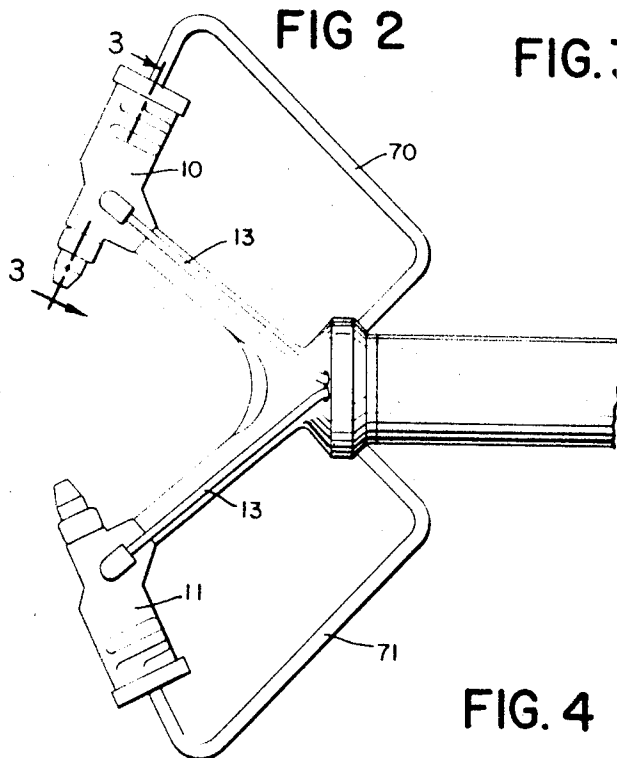


FIG.3

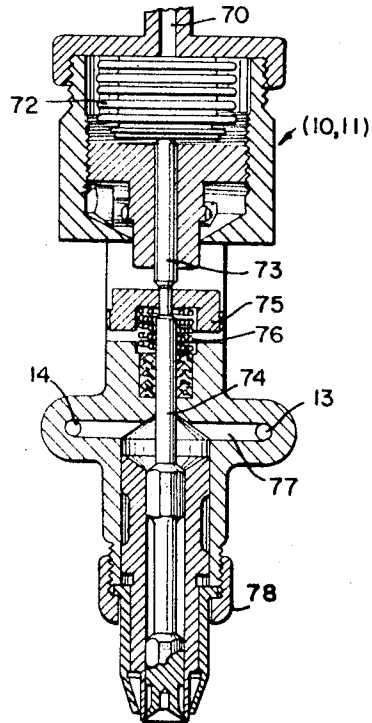
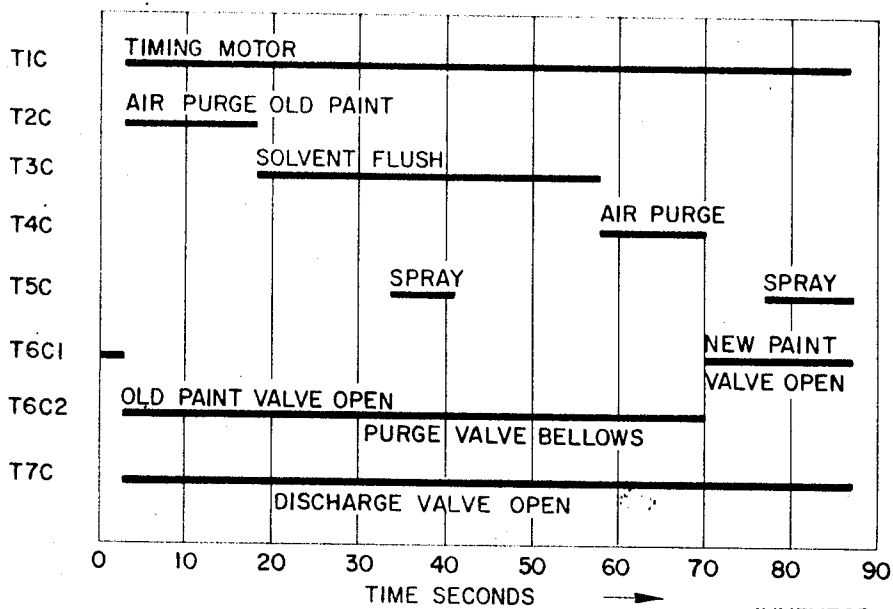


FIG. 4



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3,458,133

PURGING SYSTEM FOR A SPRAY PAINTING INSTALLATION

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Original application Mar. 18, 1965, Ser. No. 440,736, now Patent No. 3,348,774, dated Oct. 24, 1967. Divided and this application Oct. 20, 1967, Ser. No. 676,822

Int. Cl. B05b 7/26, 15/02

U.S. Cl. 239—112

6 Claims

ABSTRACT OF THE DISCLOSURE

The invention concerns a color change system for industrial spray painting installations having a number of spray guns operating at varied pressures. The system includes an arrangement of check valves in each of a number of individual purge lines running from each spray gun to a common purge or discharge valve, through a manifold. The provision of the check valves, upstream of the manifold and discharge valve, permits the spray guns to operate at different pressures without causing higher pressure spray material to back up in lower pressure lines through the discharge manifold.

Reference to related applications

This application is a division of my copending application Ser. No. 440,736, filed Mar. 18, 1965, now United States Patent No. 3,348,774, granted Oct. 24, 1967.

Background and summary of the invention

The present invention relates generally to industrial spray painting installations having an automated color change cycle and a plurality of spray guns operating at different pressures.

Industrial paint spray lines commonly are called upon to supply paint in a variety of colors in regular, day-to-day production. Theoretically, it would be possible to provide a completely separate paint spray system for each color used in regular production, but this would be impractical in most instances, because of the high cost of the initial installation and the undue complication of the controls and other facilities. Accordingly, it is customary to provide arrangements for purging out the paint spray system to remove all residue of a first-used paint color, after which the system is filled with paint of a second color and readied for further production.

In accordance with the teachings of our beforementioned patent, purging of the system can be accomplished in a particularly expeditious manner by providing separate supply lines and discharge or purge lines, leading to and from each spray nozzle. This enables the residual supplies of the just-used paints to be flushed past the nozzles, collected and reused, rather than being sprayed out of the gun and wasted. The patented system enables the color change cycle to be completed in a practical minimum of time, which is of substantial, practical significance in an automated production line, and also substantially avoids fouling of the spray booth with purged paint.

The present invention provides an economical and advantageous system for purging and discharging the residue of first-used paint, and of purging fluid in an automatic or semi-automatic color change system incorporating a plurality of spray guns. The new system permits the use of a single primary discharge valve, in conjunction with a plurality of spray guns operating at different pressures, which substantially simplifies and reduces the cost of the installation. This is accomplished by including a check valve in the purge lines leading from each of the spray

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guns to the discharge valve, through a discharge manifold. These check valves are located upstream of the discharge manifold and permit fluid flow only from the spray guns to the manifold (and ultimately to the discharge valve).

During the operation of the spray painting installation, the several purge lines are filled with purging solvent and spray material and are under pressure, since these lines are in communication with the spray material supply lines to the spray guns. The individual purge lines thus may be under different pressures, during painting operations, because of the fact that different spray guns of the system may be set to operate at different pressures.

A specific aspect of the present invention is the provision of a novel color change system of the type described, which includes a common discharge valve for all purge lines and which includes means for the prevention of higher pressure spray materials from backing up into lower pressure lines through a common discharge manifold where high pressure and low pressure lines communicate with the discharge valve. This is accomplished, in accordance with the invention, by providing check valves in all purge lines running from the spray guns to the discharge manifold. These check valves are positioned upstream of the manifold and are oriented to permit the flow of material only from the spray guns to the discharge manifold and not in the reverse direction. The use of these individual check valves avoids the need for separate discharge valves in each purge line. Since the discharge valves are quite expensive, relative to the cost of check valves, the system of the invention results in a simple, relatively foolproof, and highly economical purging system for use with spray painting installations falling into the general class mentioned above and with the specific system to be described in detail hereinafter.

Brief description of the drawings

For a better understanding of the invention, reference should be made to the following detailed description and to the accompanying drawing, in which:

FIG. 1 is a simplified, schematic representation of an industrial paint spray installation incorporating the color change system of the invention;

FIG. 2 is a fragmentary plan view showing details of a paint spray head adapted for utilization in the system of FIG. 1;

FIG. 3 is an enlarged, fragmentary, cross-sectional view taken generally on line 3—3 of FIG. 2; and

FIG. 4 is a time-function chart reflecting the sequence of events which occurs in a typical color change cycle in the system of the invention.

Description of preferred embodiment

Referring now to the drawing, and initially to FIG. 1, the reference numerals 10, 11 designate paint spray nozzles of a typical industrial paint spray installation. Advantageously, the paint spray head of which the nozzles 10, 11 form a part, are Gyromat ULPE electrostatic heads, made available by The Gyromat Corporation, Stratford, Conn., although the invention is not limited to paint spray heads of this specific design.

In a typical installation, there may be a number of spray heads simultaneously spraying the same paint color, and these would be fed with paint from a manifold 12 supplying individual paint supply lines 13. In the system of the invention, each of the spray guns 10, 11 also has a discharge, leading to purge lines 14 and, where there are a number of guns, into a discharge manifold 15. The discharge manifold leads through a discharge line 16 through a normally closed, controllable discharge valve 17 to a discharge outlet 18. As will appear, the discharge outlet may be associated with a reclaim receptacle 19 or a disposal receptacle 20, as may be expedient.

The supply header 12 is connected through a supply line 21 and a pressure regulating valve 22 to the outlet port 23 of a control valve assemblage generally designated by the numeral 24, which is described in greater detail in my copending application Ser. No. 676,824, filed on or about of even date. In general, the control valve assemblage includes a housing assembly 25, providing an internal flow passage 26 of smooth and substantially uniform cross-section. The flow passage 26 communicates at its upstream end with the outlet of a purge fluid control valve 27 and at selected downstream points with individual paint control valves 28, 29. For the purpose of the present illustration and description, only two individual paint control valves are illustrated, as all of the relevant principles of the invention may be incorporated in a two-color system. However, it will be understood that more extensive, high production systems may be assembled utilizing a greater number of individual paint control valves where desired. Each of the paint control valves has its valve outlet communicating with the main flow passage 26 of the housing assembly 25 for controllably directing paint of a selected color into the system.

When more than one spray gun is served by the same delivery system, as in installation illustrated in FIG. 1, it is customary to operate the spray guns at different pressures. This is accomplished by providing each gun with a separate pressure regulator R, which may be independently adjusted. In such cases, in accordance with the invention, provision is made for preventing higher pressure spray materials from backing up into lower pressure purge lines 14 through the discharge manifold 15 where high and low pressure lines communicate. As will be observed in the drawing, corresponding supply lines 13 and purge lines 14 communicate at each spray gun, and all of the purge lines 14 communicate at the discharge manifold 15. Consequently, higher pressure purge lines 14 normally would communicate with lower pressure purge lines 14 in the discharge manifold 15. This is voided, however, in accordance with the invention, by providing a check valve CV in each of the purge lines 14. The check valves are located upstream of the manifold and prevent the flow of material from discharge manifold 15 toward the spray guns 10, 11, even though the pressure in discharge manifold 15 is greater than the pressure in a particular purge line 14. This advantageous arrangement enables the system to be utilized with a single discharge valve 17, rather than requiring a separate discharge valve for each purge line.

Each of the principal control valves 27-29 and 17 of the illustrated system is pneumatically or electrically actuated and, for this purpose, includes an actuating bellows 30-33, connected by means of control lines 34-37 and individual solenoid operated actuating valves 38-41 to an air supply line 42. The supply line 42 is, in turn, connected through a pressure regulator 43 to the main source 44 of compressed air. By controlled, timed actuation of the actuating valves 38-41 control is established over the opening and closing of the control valves 17, 27-29, as will be understood.

Advantageously, each of the primary control valves has two inlets controlled by the valve elements and arranged to discharge fluid into the main flow passage 26 when the associated primary control valve is open. Thus, the purge valve 27 has its inlets connected to a purging air supply line 45 and a purging solvent supply line 46. The air supply line 45 is connected through a check valve 47 and a solenoid operated control valve 48 to the air supply line 42. The arrangement is such that, when the control valve 48 is open, air under pressure is supplied to the purge valve 27, for discharge into the system upon opening of the purge valve. The solvent supply line 46 is connected through a check valve 49 and shut-off valve 50 to a solvent supply container 51. The solvent supply is maintained under pressure by an air supply line 52 lead-

ing through a shut-off valve and a pressure regulator 53 back to the main air supply source 44. For reasons which will become apparent, the output side of the pressure regulator 53 is significantly lower than the output side of the regulator 43, such that, in a typical installation, the air supply line 42 is under about 60 pounds pressure (p.s.i.), while the solvent system is maintained under about 40 pounds pressure.

The paint control valves 28, 29 have their inlets connected to individual paint supply lines 54, 55 through shut-off cocks 56, 57. Second inlets of the paint control valves are connected through shut-off cocks 58, 59 with solvent supply lines 60, 61. In the illustrated system, in which the paint supply valves 28, 29 are intended to accommodate a larger number of paint colors, the paint supply lines 54, 55 are provided with quick disconnect couplings 62, 63, by means of which the valves may be quickly connected with additional paint supply lines (not shown). The control lines 36, 37, which may be referred to for convenience as paint control and purge control lines, respectively, are connected to selected paint control valves by means of quick disconnect couplings 64, 65. In this respect, it is contemplated that, regardless of the number of paint control valves utilized in the system, all would be serviced by a single paint control line 36 and a single purge control line 37.

Control over the opening and closing of the spray heads 10, 11 is effected by means of a master solenoid valve 66 which is energized from an independent, separately controlled source indicated by the B+ and "ground" designations at the left in FIG. 1. Assuming that the B+ supply has not been switched out by the other control facilities (not shown), it can energize the solenoid of the master valve 66 through normally open contacts CR13a of a control relay CR13 and normally closed contacts of an energized control relay 67. The relay 67 is kept energized through a normally closed switch T5C when the system power is on through switches 68 and the equipment has not been energized to carry out a color change cycle. When the master control valve 66 is in its de-energized condition, air under pressure is supplied through lines 69 to individual control conduits 70, 71 (see FIGS. 2 and 3) leading to the respective spray heads 10, 11.

As shown particularly in FIG. 3, each of the spray heads has an actuating bellows 72 which, when acted upon by the control air, advances a plunger rod 73 to project a valve stem 74 through a predetermined valve opening stroke determined by the setting of an adjustment nut 78. A return spring 76 acts upon a nut 75 to reclose the valve when control air pressure is removed.

While specific details of the spray heads do not form a part of the present invention, the spray heads, for the purpose of incorporation into the overall system of the invention, include paint supply chambers 77 communicating with the paint supply lines 13 and purge lines 14. Additionally, the spray heads are supplied with atomizing air facilities (not shown) in accordance with known practices.

Operation of equipment

The operation of the system is best described with reference to a description of the sequencing timer arrangement illustrated in FIG. 1 and to the time-function chart illustrated in FIG. 4. Advantageously, the sequence timer is a conventional, electromechanical timer including a timing motor 103 arranged to operate through a timing cycle and actuate a plurality of timer switch contacts T1C-T7C by means of a plurality of preset cams (not shown) which may be individually adjusted with respect to the several switch contacts to achieve a desired timing sequence, in accordance with conventional techniques.

When the system is operating and in readiness for color change, the timing power supply switch 68 will be closed and typically, although not necessarily, the spray

heads 10, 11 will be in operation. Under assumed initial conditions, the actuating valve 39 is open and the paint control valve 28 previously has been actuated to an open condition supplying a paint to the system. The paint stop cock 56 is open and the solvent cock 58 is closed so that a first color paint is being supplied through the line 54 and valve 28 and into the main flow passage 26 of the valve assemblage. The actuating valve 40 and therefore its associated paint control valve 29 is de-energized and closed, as are the actuating and control valves 38, 27 for controlling purge fluids. The stop cocks 57, 59 associated with the paint control valve 29 are closed. The air control valve 48 is de-energized and open, so that air under pressure is supplied to the closed purge valve 27, as is solvent under pressure through the unvalved line 46. The actuating valve 41 is de-energized and closed, as is its associated discharge valve 17.

To commence a color change cycle, a start button S is depressed momentarily to energize the timing motor 103. The start button is held closed until the motor advances slightly, enough to close holding contacts T1C which are connected in parallel with the start switch. In a typical 90 second color change cycle, it is contemplated that the holding contacts T1C will close in about 3 seconds. They will thereafter remain closed until reopened by the cam to stop the motor and terminate the timing cycle.

Simultaneously with the closing of the holding contacts T1C, timer contacts T2C, T6C2 and T7C are closed and contacts T6C1 are opened.

The closing of timer contacts T7C causes the energization of the control relay CR13 which closes contacts CR13a in the B+ energizing circuit of the master solenoid valve 66, such that the valve is energized and closed to shut off the spray heads. The closed contacts T7C also energize the actuating valve 41, admitting pressure fluid to the line 34 to the bellows of the discharge valve 17, so that the purge lines 14 and discharge line 16 are placed in communication with the reclaim or disposal containers 19, 20, as the case may be. Typically, in order to conserve paint for reuse, the discharge lines are connected to the reclaim container 19, at least during the initial stages of the color change cycle, when reusable paint is being purged from the system.

Opening of the timer contact T6C1 effects de-energization of the actuator valve 39, closing off the air supply to the then-active paint control valve 28 to close this valve and block off any further flow of paint to the system. The companion timer contact T6C2, when closed at the start of the cycle, simultaneously energizes actuating valves 38, 40 to admit pressure fluid through the lines 35 and 37 to open the purge fluid valve 27 and the inactive paint valve 29. With the stop cocks 57 and 59 closed, however, opening of the inactive paint valve is without consequence. Closure of contacts T6C2 also brings about the energization of a solenoid control 104 of the pressure regulator 22, which has the effect of decreasing the pressure drop across the regulator, enabling the purging and recharging of the system to take place with greater rapidity. Typically, the outlet side of the regulator 22 will have an operating pressure of about 5 p.s.i., and this will be increased to about 20 p.s.i. when the solenoid 104 is energized but returns to its original setting at the end of the color change cycle.

Along with the closure of timer contacts T6C2 and T7C, contacts T2C are closed to actuate the air control valve 48 to an open condition. This immediately admits purging air into the now-open purge control valve 27, and this air, at a typical pressure of about 60 p.s.i., advances through the flow passage of the valve assemblage, through the supply lines 21, 13, and out through the purge lines 14 and discharge line 16, through the discharge valve and discharge line 18, forcing the main body of paint through the system ahead of it and expelling it into the

reclaim container 19. This initial air purge advantageously continues for a period of about 15 seconds.

During the air purge interval, the operator of the system carries out a sequence of manual operations comprising closure of the paint stop cock 56, switching the controlled pressure fluid lines 36, 37, so that the active control line 37 is connected to the just-used paint valve 28, while the inactive control line 36 is connected to the paint valve 29. Thereafter, the stop cocks 57 and 58 are opened to admit a second color paint up to the closed valve 29 and to admit solvent and purge air to the just-used paint valve 28, which is now open by admission of pressure fluid through the line 37. This sequence of manual operations may be carried out quickly and conveniently by reason of the quick disconnect couplings 64, 65 and the convenient grouping of the various stop cocks, so that the operations are completed well within the 15 second period during which air purging of the system is being carried out.

It will be understood that, during the initial air purge interval, an open solvent line is connected to the purge valve 27 and, after opening of the stop cock 58, also to the just-used paint valve 28. Nevertheless, solvent does not at this time enter the system because the purging air is at a substantially higher pressure than the purging solvent in the line 46, causing the solvent to be held back by the air. Solvent is not backed up in the line 46 by the higher air pressure, however, because of the interposition of the check valve 49 in the solvent supply line.

At the end of the air purging interval, the timer contact T2C is reopened, de-energizing and closing the purging air control valve 48. The purge control valve 27 remains open, however, and the solvent, with the restraining back pressure removed, advances through the purge valve and also through the just-used paint valve 28. The solvent travels through the paint supply lines and the discharge lines in the same manner as just described with respect to the purging air, cleansing residual paint from the system. Advantageously, the discharge line 18 is re-directed at this time into the disposal container 20, or perhaps into a second reclaim container, so as not to contaminate the paint previously discharged into the reclaim container 19.

Advantageously, the solvent purge interval continues for about 40 seconds and, at some time during this interval, the timer contact T5C opens for a brief period, say 10 seconds, to de-energize the control relay 67 and momentarily de-energize and open the master control valve 66. This opens the spray heads 10, 11 for a brief interval, causing solvent to be discharged therefrom to cleanse the nozzle areas of residual paint which cannot be removed during the normal flow of solvent and air through the supply and discharge lines 13, 14. If desired, during this interval, the paint supply line 54 for the just-used color may be disconnected at the fitting 62, and a new supply line carrying a third color may be substituted therefor to supply new color paint up to the closed stop cock 56.

After a predetermined solvent flush period, timer contacts T4C are closed, and this re-energizes the purging air control valve 48, such that the flow of purging air is re-established, and further solvent flow is stopped by reason of the higher back pressure of the purging air. The second air purge interval is continued for a period of about 15 seconds, during which the solvent, with which the system is at that time charged, is purged forward out of the system and discharged into the disposal container 20. During this interval, the operator may close the solvent cock 58 associated with the just-cleansed paint valve 28.

At the end of the second air purge interval, timer contacts T6C are reactivated so that contacts T6C1 are re-closed and contacts T6C2 are reopened. Actuating valve 39 is thereupon energized and opened, actuating the paint valve 29 to an open condition and causing paint of a second color to be discharged into the system. The actuating valve 40 is at the same time de-energized and closed,

to deactivate and close the previously used paint valve 28. Simultaneously, the regulator solenoid 104 is de-energized so that the output of the regulator is re-established at the normal, low pressure desired.

In order to fully charge the system with paint of the new color, an interval is provided during which the new color paint valve 29 is open and discharging paint into the system and the discharge valve 17 is open and discharging air.

The nozzle regions of the spray heads 10, 11 are, at this stage, filled with solvent, and it is desirable to reopen the spray head valves momentarily during the charging of the system with new paint, so that the residual solvent is discharged and the nozzles are "primed" with the new paint. This is brought about by reclosure of the timer contacts T5C during the paint charging interval.

After a paint charging interval of about 18 seconds, the timer contact T1C is opened, along with timer contacts T7C. This de-energizes the motor 103 to end the color change cycle and simultaneously de-energizes the actuating valve 41 to close the discharge valve 17 and energizes the control relay CR13 to reactivate the spray heads 10, 11.

Advantageously, a series of indicator lights 105-108 is provided in connection with the sequence timer, to keep the operator apprised of the progress of the color change cycle. Thus, the indicator light 105 is arranged to be energized upon closure of the main switch 68, to indicate a "ready" condition. The indicator light 106 is energized by closure of either contacts T2C or T4C and indicate the carrying out of the air purge intervals, before and after the intervening solvent cleansing interval. An indicator light 107 is energized by timer contacts T3C, arranged to be closed simultaneously with the opening of the contacts T2C and to be opened simultaneously with the closure of contacts T4C. Thus, energization of the signal light 107 reflects the carrying out of the solvent cleansing interval. The signal lamp 108 is energized by closure of timer contacts T6C1 and reflects the actuated condition of whichever one of the paint control valves 28 or 29 is connected to the pressure fluid line 36 on the outlet side of the actuating valve 39.

In the just-described color change cycle, it has been assumed that the two paint control valves 28, 29 were being utilized to service a system supplying paint of a larger number of colors. In such cases, it is appropriate to supply solvent to the paint control valves, upstream of the paint inlets to the valves, in addition to supplying solvent to the purge valve 27, in order to cleanse the valves themselves of previously used paint. However, in installations where a separate paint control valve is provided for each color, internal solvent cleansing of a just-used paint valve would not be required, and it would not be necessary to provide the actuating valve 40 and its associated control line 37. In a combined system, there may be a plurality of paint control valves continuously serving an equal number of regularly used paint colors, advantageously combined with a pair of control valves arranged in the manner of the valves 28, 29 of FIG. 1, to handle a larger variety of relatively less frequently used colors. Where a control valve is assigned permanently to a given paint color, the valve itself need not, of course, be purged out during color change. Accordingly, the valve port which otherwise would serve as a purging solvent inlet can be utilized as a paint outlet and connected to the main paint supply for the assigned color. This enables the paint to be kept in continuous circulation, even when not in use.

The system of the present invention represents an advantageous combination of manual and automatic control facilities to provide an effective and relatively sophisticated color change cycle, which is economical of time and supplies and yet which can be installed without undue cost and complication.

From the preceding description of this invention, it should be apparent that the applicant has made a signifi-

cant contribution to this art by providing a discharging system for a multi-gun, multi-color paint spray installation requiring the use of only one discharge or purge valve. Prior art spray paint systems of this general type require a separate discharge or purge valve for each spray gun or discharge line, which not only means a higher initial cost for the system but requires a more complex control cycle and increases the possibility of operational failure. The applicant's invention provides a foolproof, and economical discharging system for paint spray installations in this general class by providing a check valve in each discharge line upstream of the single discharge valve and discharge manifold, thereby eliminating the necessity of a separate discharge valve for each discharge line.

It should be understood that the purging system of the invention has been described in conjunction with a specific color change cycle for illustrative purposes only and can be advantageously used with other installations. Accordingly, reference should be made to the appended claims in determining the full scope of the invention.

I claim:

1. A discharge system for a multi-spray gun spray paint installation, comprising:

- (a) a discharge manifold;
- (b) purge lines connecting each spray gun to the discharge manifold;
- (c) a check valve located in each purge line;
- (d) each of the check valves being oriented in the purge lines to permit fluid flow only from said spray guns to said discharge manifold;
- (e) a discharge line leaving the discharge manifold; and
- (f) a controllable discharge valve in said discharge line;
- (g) the controllable discharge valve being in a fully closed position during normal spray painting operations;
- (h) the controllable discharge valve being in an open position during purging operations.

2. The discharge system of claim 1, wherein

- (a) at least one of said spray guns operates at a lower pressure than the other spray guns.

3. A color change system for paint spray installations having a spraying and purging cycle which comprises

- (a) a plurality of valve spray guns;
- (b) supply means for supplying paint to the spray guns at varied pressures during the spraying cycle;
- (c) said supply means adapted to supply purging fluid to said spray guns during the purging cycle;
- (d) a discharge manifold;
- (e) purging lines entering the discharge manifold and connecting said spray guns to said discharge manifold;
- (f) a check valve located in each of said purging lines;
- (g) a discharge line leaving said discharge manifold; and
- (h) a controllable discharge valve in said discharge line;
- (i) said discharge valve being in a fully closed position during the spraying cycle and in an open position during the purging cycle.

4. A discharge system for a multi-spray gun spray paint installation comprising

- (a) discharge means;
- (b) purge lines connecting each spray gun to said discharge means; and
- (c) a check valve located in each purge line;
- (d) each of the check valves being oriented in the purge lines to permit fluid flow only from said spray guns to said discharge means;
- (e) said discharge means including a controllable discharge valve means and connecting means connecting said purge lines to said controllable discharge valve means;

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(f) the controllable discharge valve means being fully closed during normal spray painting operations;	2,022,481	11/1935	Schellenger	239—127 X
(g) the controllable discharge valve means being in an open condition during purging operations.	2,244,686	6/1941	Garrison et al.	239—126 X
5. The discharge system of claim 4, wherein	2,290,350	7/1942	Olches	239—124 X
(a) said connecting means includes a discharge manifold and a discharge line leaving said discharge manifold.	2,608,247	8/1952	Carey	239—127 X
5. The discharge system of claim 4, wherein	3,023,968	3/1962	Mitchell	239—126 X
(a) said connecting means includes a discharge manifold and a discharge line leaving said discharge manifold.	3,219,273	11/1965	Killen	137—240 X
6. The color change system of claim 3, wherein said supply means includes	3,240,225	3/1966	Barrows	239—112 X
(a) a supply valve; and				
(b) a supply line feeding each spray gun.				

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EVERETT W. KIRBY, Primary Examiner

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